

Sept. 3, 1946.

C. W. HARROLD

2,406,765

SHEET FEEDER

Filed June 10, 1942

9 Sheets-Sheet 1

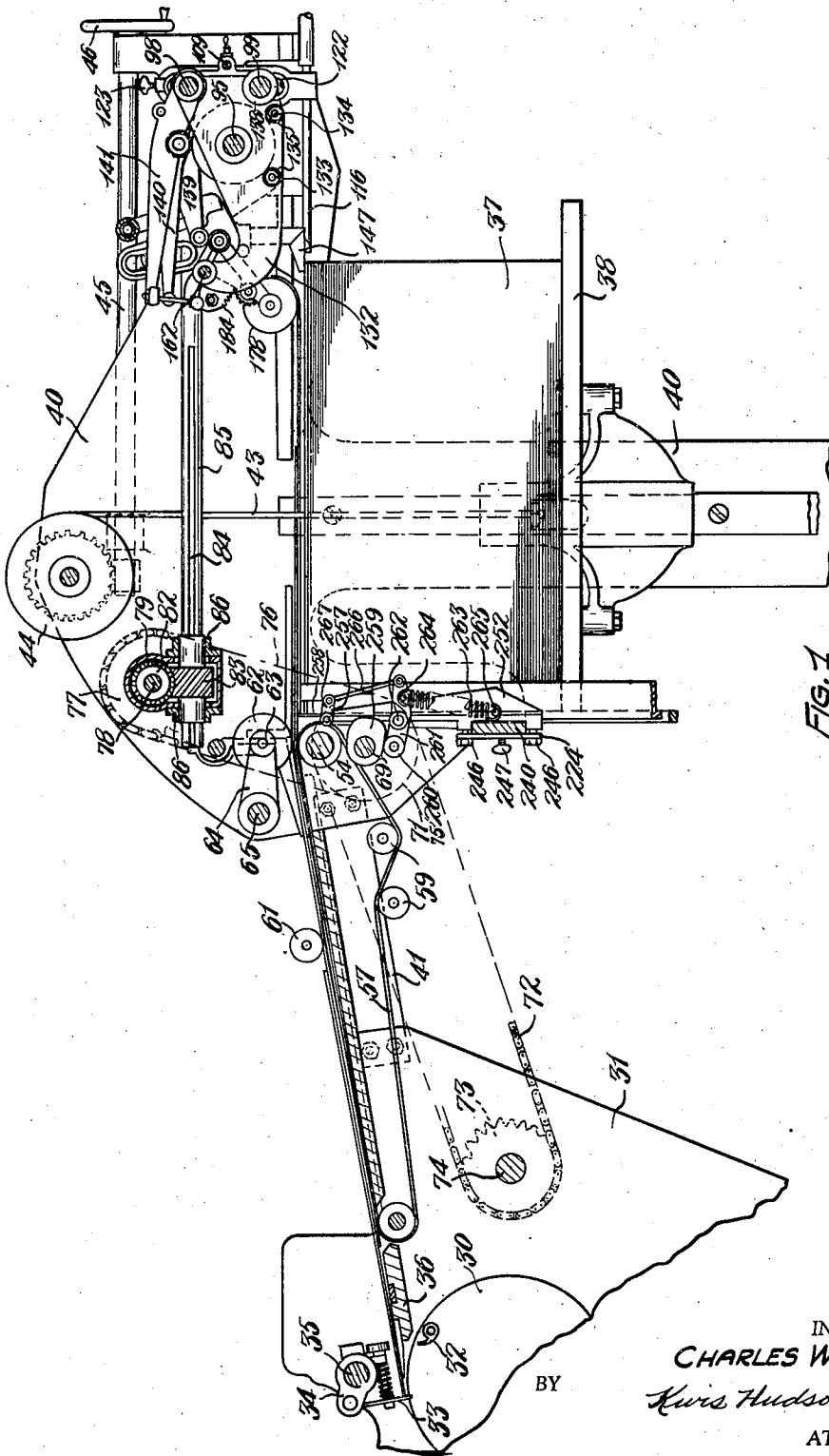


FIG. 1

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Sept. 3, 1946.

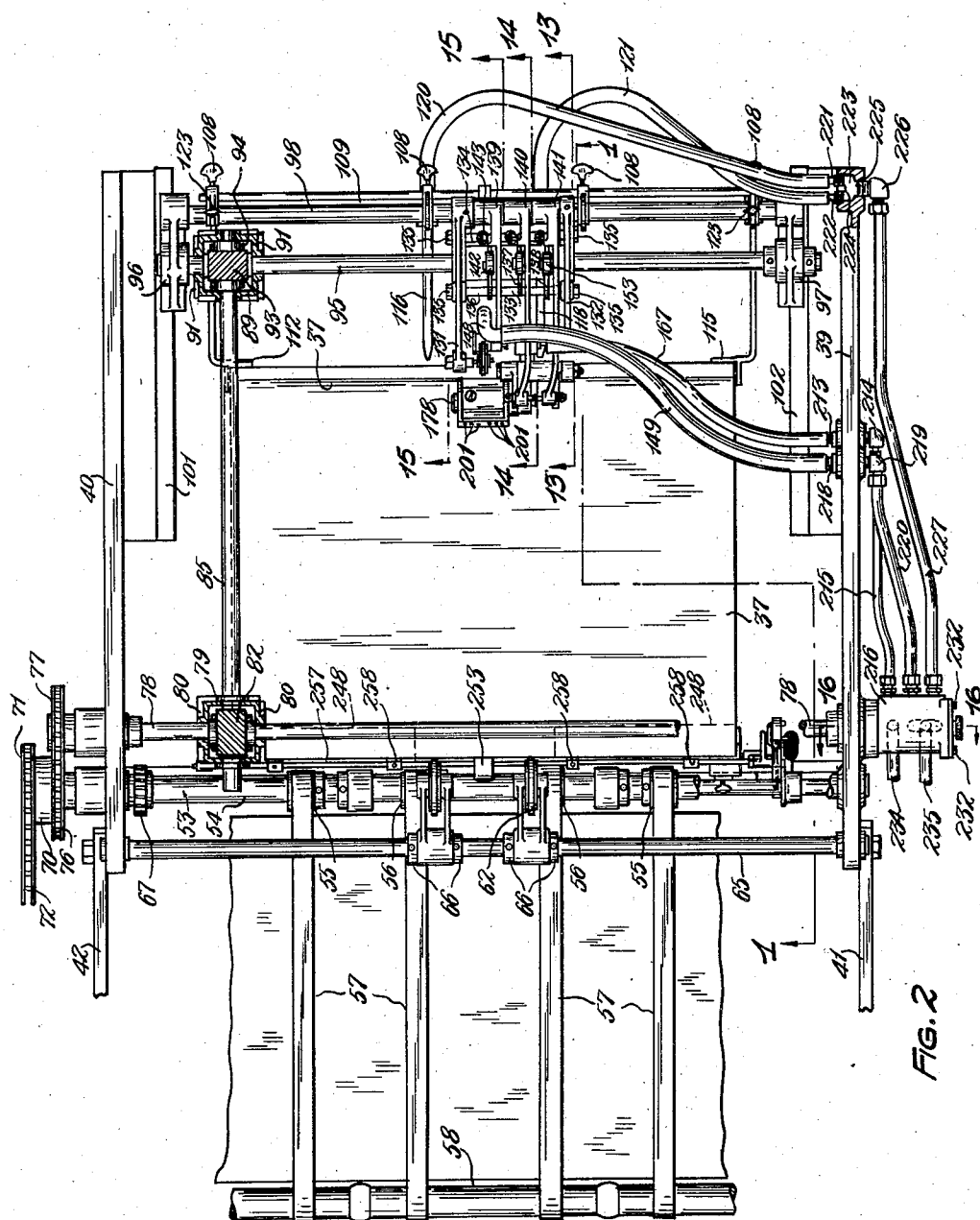
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SHEET FEEDER

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9 Sheets-Sheet 2



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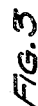
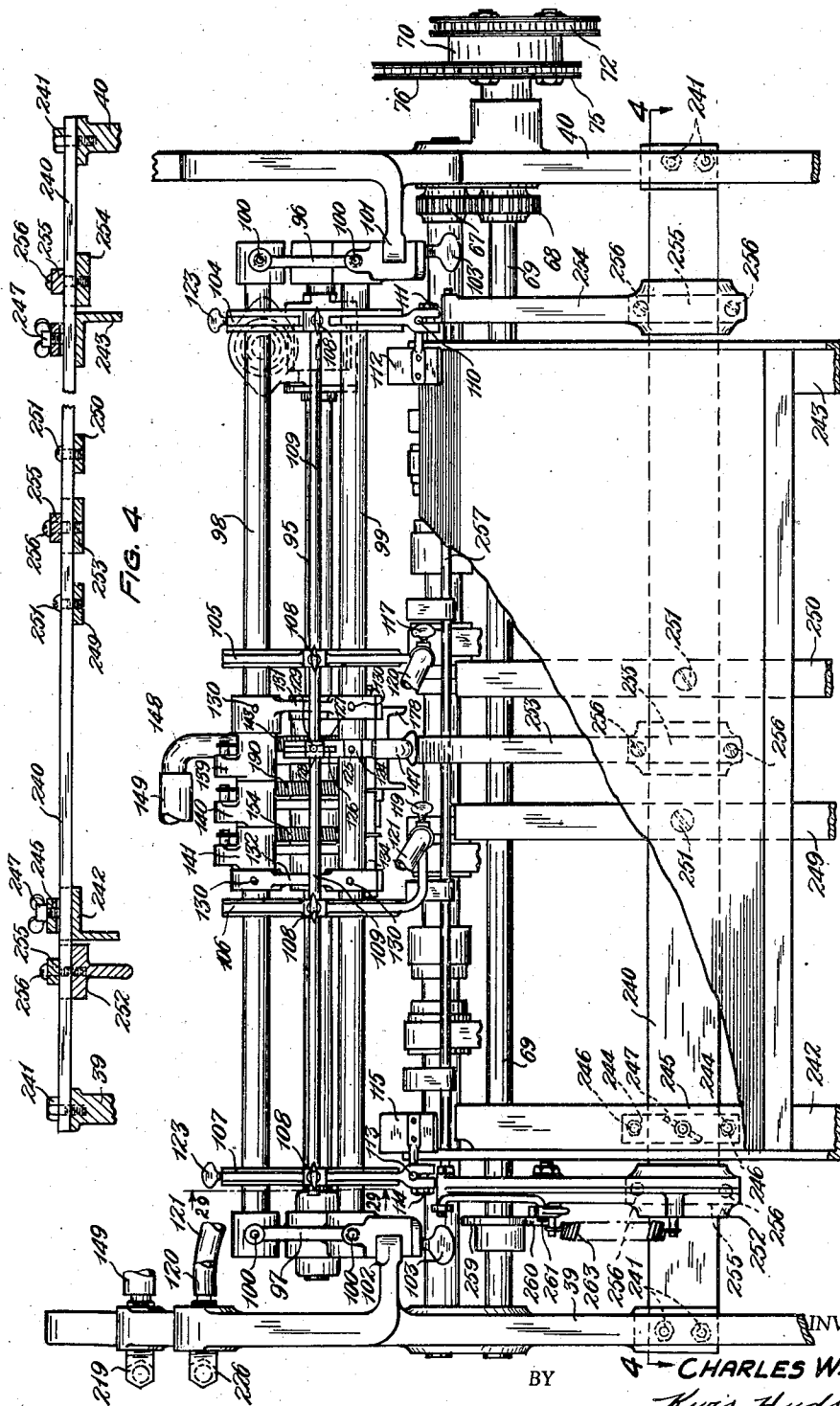
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SHEET FEEDER

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9 Sheets-Sheet 3



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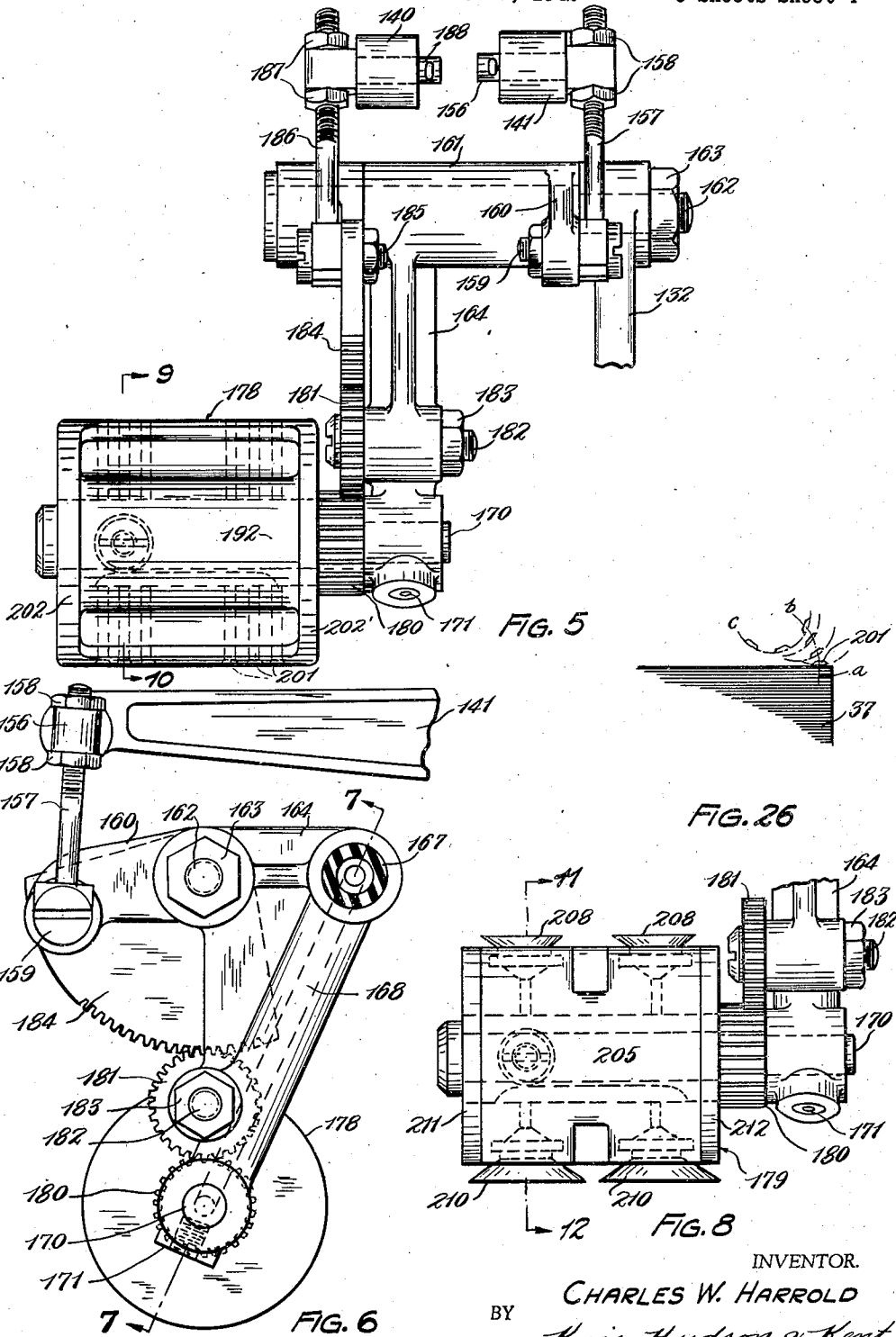
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SHEET FEEDER

Filed June 10, 1942

9 Sheets-Sheet 4



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SHEET FEEDER

Filed June 10, 1942

9 Sheets-Sheet 5

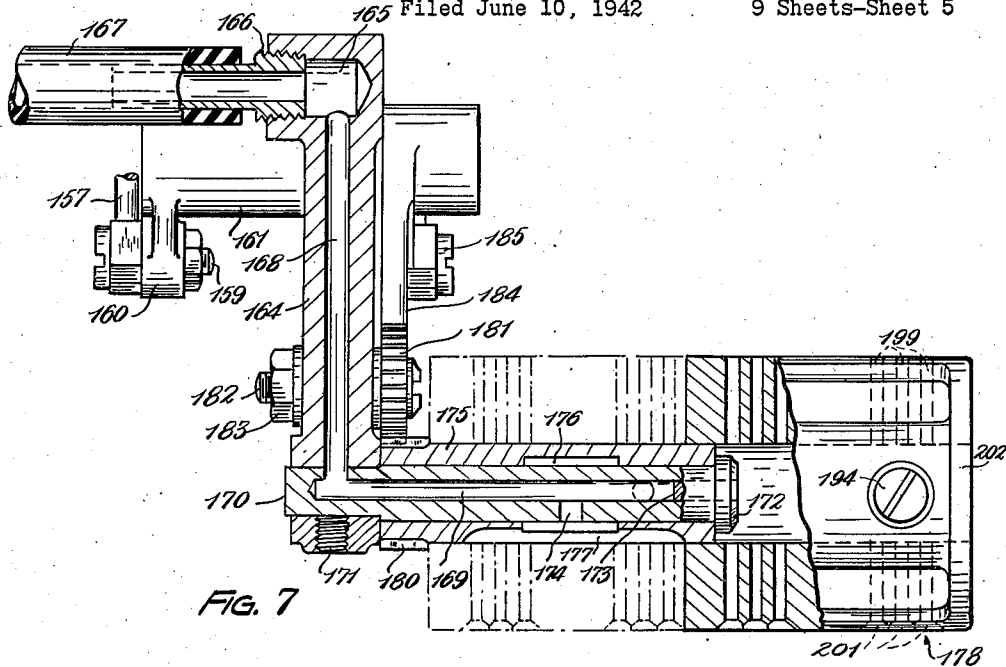


FIG. 7

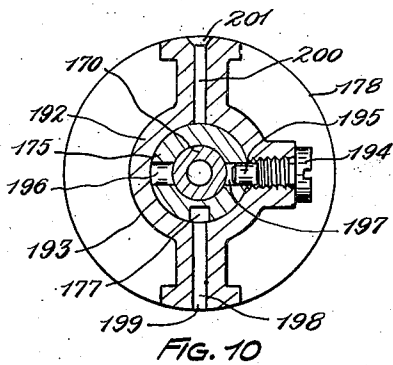


FIG. 10

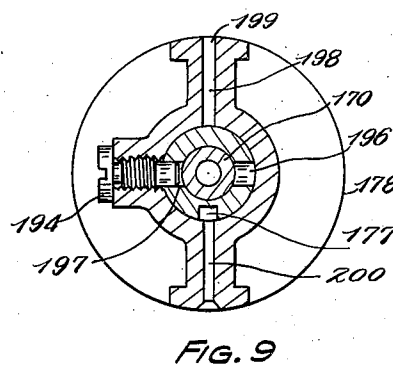


FIG. 9

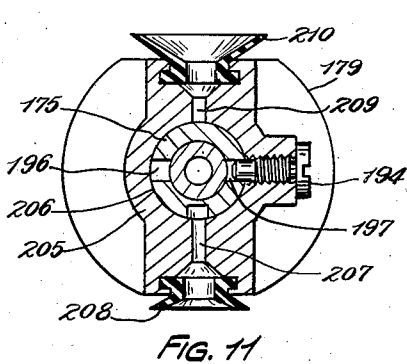


FIG. 11

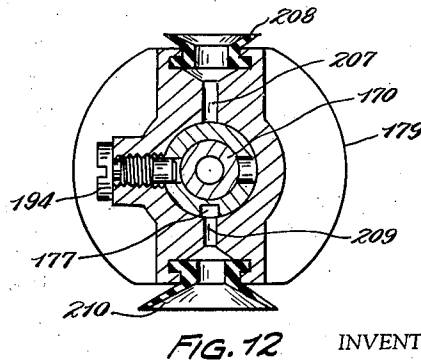


FIG. 12

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SHEET FEEDER

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9 Sheets-Sheet 6

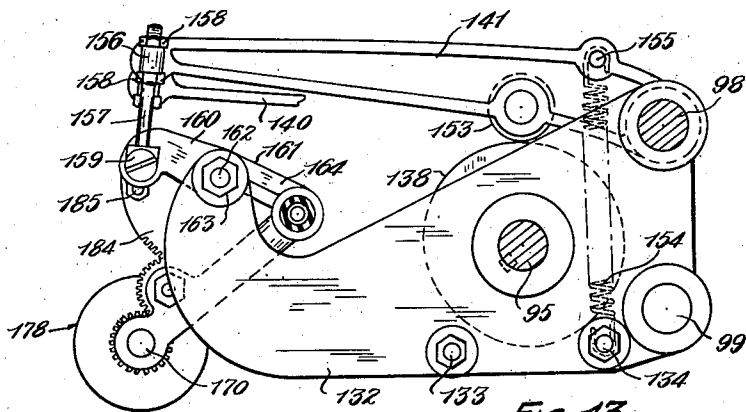


FIG. 13

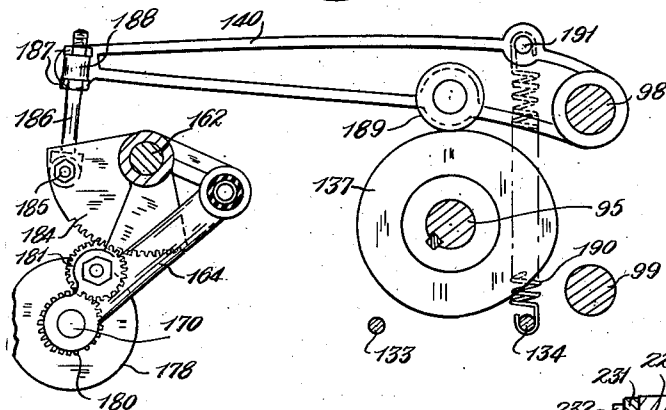
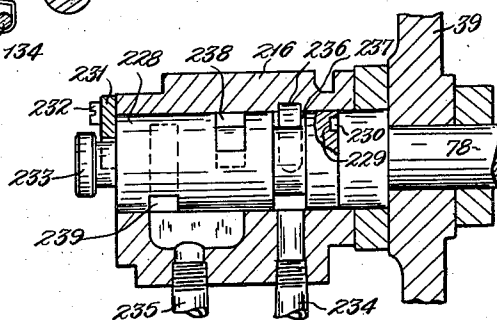


FIG. 14



Sept. 3, 1946.

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SHEET FEEDER

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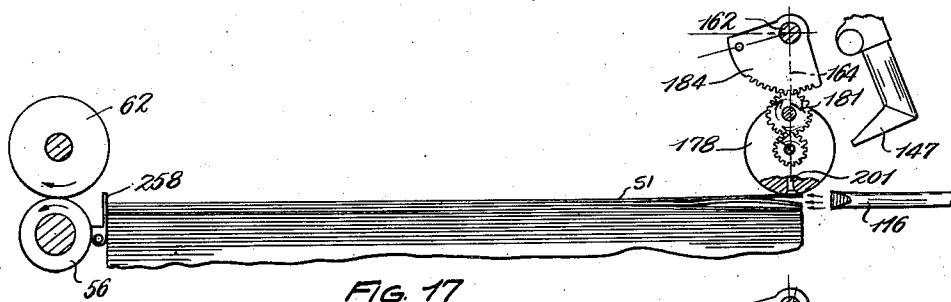


FIG. 17

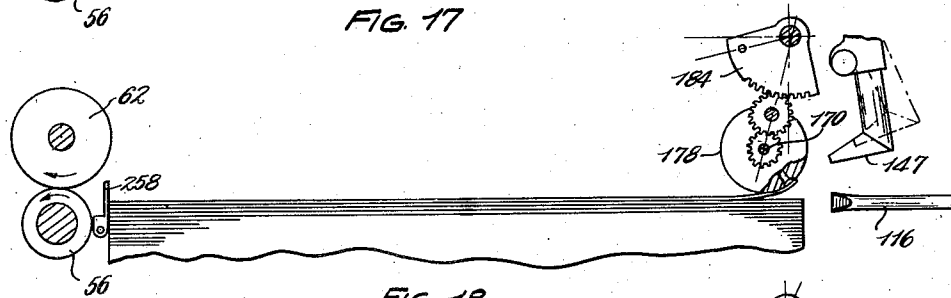


FIG. 18

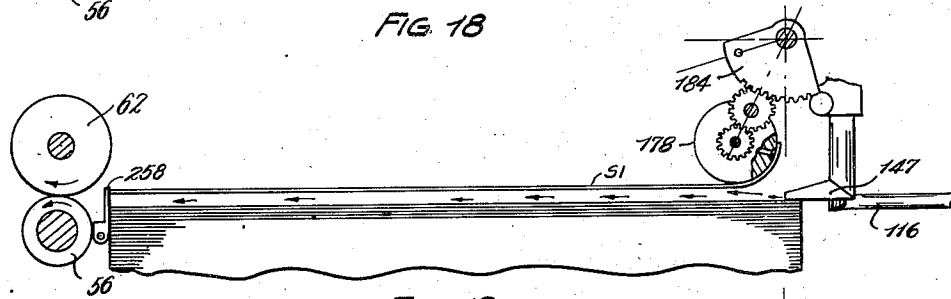


FIG. 19

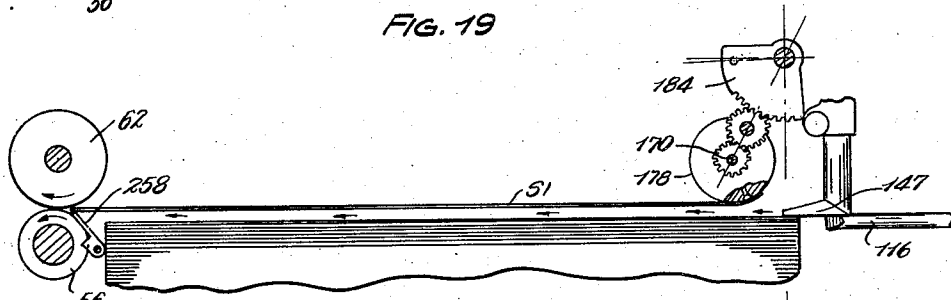


FIG. 20

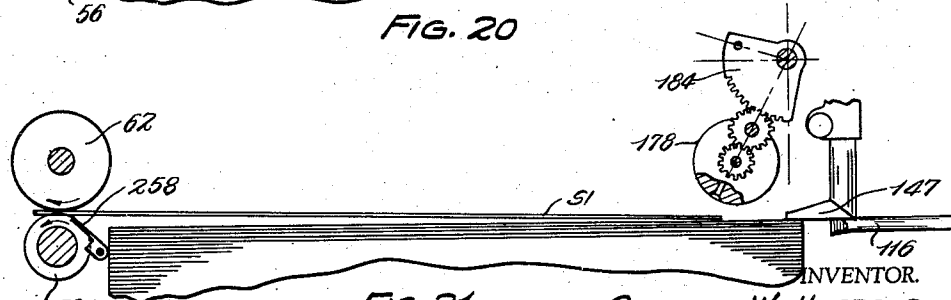


FIG. 21

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SHEET FEEDER

Filed June 10, 1942

9 Sheets-Sheet 8

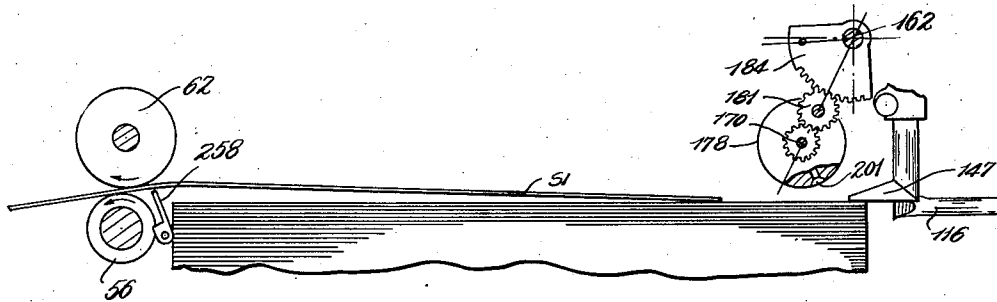


FIG. 22

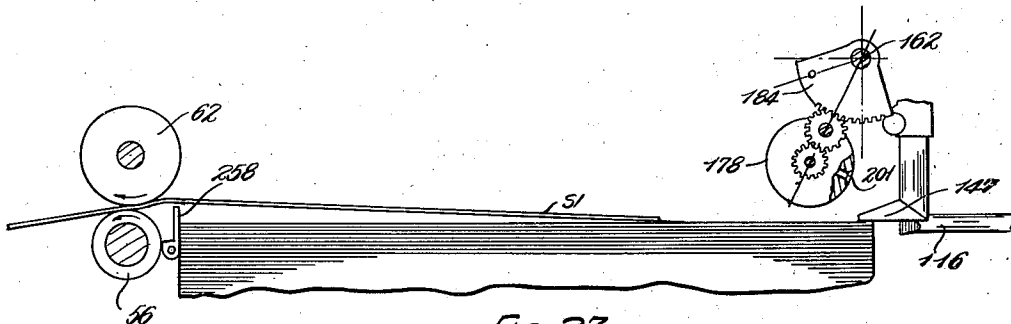


FIG. 23

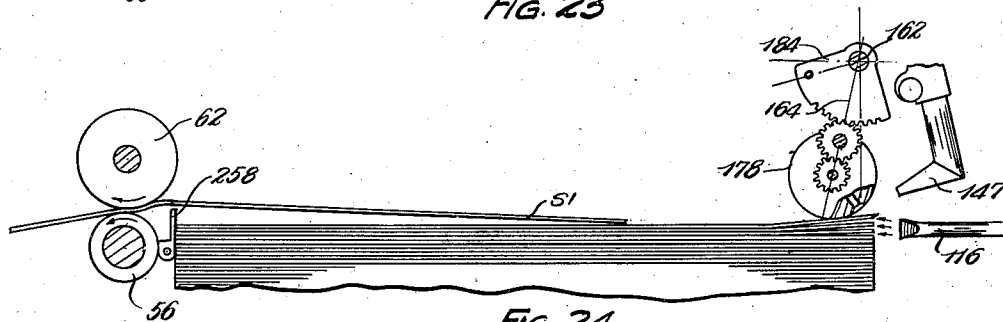


FIG. 24

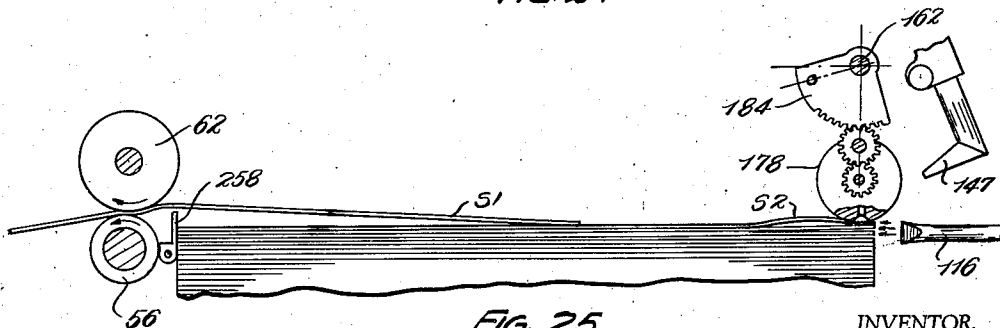


FIG. 25

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SHEET FEEDER

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9 Sheets-Sheet 9

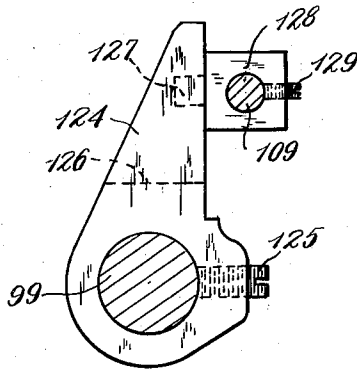


FIG. 27

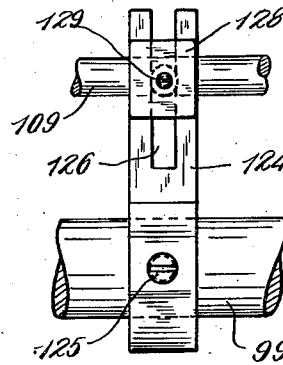


FIG. 28

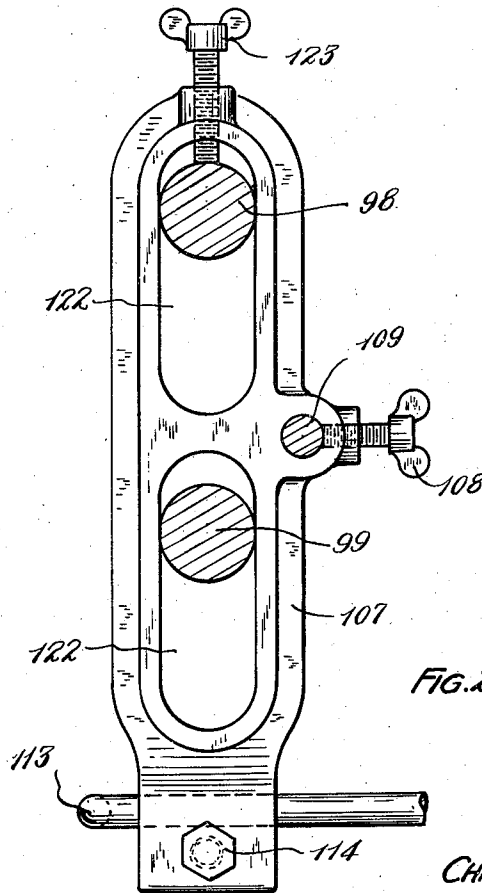


FIG. 29

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UNITED STATES PATENT OFFICE

2,406,765

SHEET FEEDER

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Application June 10, 1942, Serial No. 446,477

43 Claims. (Cl. 271—28)

1

This invention relates to sheet feeders and particularly to feeders for feeding sheets of paper, cardboard and the like to printing, folding, scoring and other machines for operating on the sheets.

A general object of the invention is to provide a sheet feeder which shall be reliable, efficient and convenient in operation and simple and economical in construction.

A further object is to provide a sheet feeder particularly well adapted for the feeding of sheets in lapped formation, commonly known in the art as stream feeding.

Another object is to provide a sheet feeder capable of feeding very small sheets in lapped formation.

Another object is to provide a sheet feeder which shall positively separate the topmost sheet of a pile of sheets and forward the same accurately toward the operating machine without disturbing the position of the remaining sheets of the pile.

Another object is to provide a novel and highly effective method and means for separating sheets individually from a pile of sheets.

Another object is to provide a reliable sheet separating means which shall avoid rubbing or abrasive action or undue pressure on the sheets.

Another object is to provide improved suction means adapted to perform separating, lifting and forwarding operations upon sheets.

Other objects lie in the construction, arrangement, and operation of the various parts of the mechanism herein disclosed and will be apparent from the description.

In the drawings,

Fig. 1 is a side elevational view of a feeder embodying the invention taken along the line 1—1 of Fig. 2 and including certain portions of a printing press to which the feeder is attached;

Fig. 2 is a plan view of the feeder shown in Fig. 1;

Fig. 3 is a rear elevational view of the same;

Fig. 4 is a horizontal detail sectional view taken substantially along the line 4—4 of Fig. 3;

Fig. 5 is a detail front elevational view on a larger scale of one form of sucker head and its operating mechanism;

Fig. 6 is a side elevational view corresponding to Fig. 5;

Fig. 7 is a sectional view taken along the line 7—7 of Fig. 6 and showing the air passages leading to the sucker head;

Fig. 8 is a view similar to a portion of Fig. 5 but showing another form of sucker head;

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Figs. 9 and 10 are sectional views of the sucker head of Fig. 5 taken along the line 9—10 of that figure and illustrating alternative positions of the head;

5 Figs. 11 and 12 are sectional views of the sucker head of Fig. 8 taken along the line 11—12 of that figure and illustrating alternative positions of the head;

Figs. 13, 14 and 15 are detail sectional views 10 taken substantially on the lines 13—13, 14—14 and 15—15, respectively, of Fig. 2, but on a larger scale;

Fig. 16 is a detail sectional view taken substantially on the line 16—16 of Fig. 2, but on a larger 15 scale;

Figs. 17 to 25 inclusive are diagrammatic side elevational views illustrating the operation of certain portions of the preferred form of the invention;

20 Fig. 26 is a diagrammatic view illustrating the paths of movement of the sheet gripping suckers;

Fig. 27 is a detail elevational view, partly in vertical section longitudinally of the machine, showing on a larger scale means for preventing 25 transverse movement of a vertically movable assembly positioned at the rear of the pile of sheets to be fed;

Fig. 28 is a rear elevational view of the parts illustrated in Fig. 27; and

30 Fig. 29 is a detail elevational view taken substantially on the line 29—29 of Fig. 3 and showing the parts on a larger scale.

In Fig. 1 a sheet feeder constructed according to the invention is shown attached to a printing 35 press whose impression cylinder 30 is journaled in a pair of side frames 31, only one of which is shown. The cylinder 30 is provided with the usual sheet grippers 32 and adjacent the cylinder are two or more front registering guides or stops 33, of known construction, adjustably carried by 40 brackets 34 which are keyed to shaft 35. The latter shaft is oscillatably journaled in frames 31 and known connections, not shown, are provided for oscillating shaft 35 to raise guides 33 out of 45 the path of the sheets as the latter are taken by the grippers 32. The usual sheet support plate 36 is also provided for supporting the forward ends of the sheets as they are fed into contact with the guides 33. Preferably mechanism of any 50 desired construction, not shown, is also provided for registering each sheet laterally during the time it is at rest in contact with the guides 33 so that each sheet may be accurately positioned in relation to the press before it is taken by the grippers 32. 55

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The pile 37 of sheets to be fed is supported upon a pile board 38 which in turn is supported by the feeder side frames 39, 40, which are joined to press frames 31 by connecting frame members 41, 42. Means of known construction, not herein shown in detail, are provided for raising pile 37 gradually as sheets are fed off to maintain the pile at proper height. This means may embody cables 43 running upon reels 44 automatically rotated small increments at intervals, the operating means being diagrammatically indicated herein as a shaft 45 with hand wheel 46, the reels being driven from shaft 45 by a worm and worm wheel connection.

At the forward end of pile 37 is located a tape driving roller, referred to generally as 53, which comprises a shaft 54 rotatably journaled in frames 39, 40 and a plurality of wheels 55, 56 pinned or otherwise secured to shaft 54. Around wheels 55, 56 are trained a plurality of endless sheet forwarding tapes 57 which extend, at the forward end of their runs, around an idler roller 58 mounted for free rotation in press frames 31. Tightening rollers 59 are arranged to engage the lower courses of the tapes to maintain the latter taut, and one or more idler wheels 61 of the usual kind are arranged above each tape 57 to rest on the sheets and press them against the tapes to assist the forwarding action. Above roller 53 and arranged to cooperate with wheels 56 are a pair of wheels 62 of usual kind which function to press the sheets against wheels 56 for conveying the sheets off the pile, the diameter of those portions of wheels 56 which cooperate with wheels 62 being such as to have a peripheral speed substantially the same as the speed of tapes 57. Wheels 62 are freely rotatable on pins 63 carried in arms 64 which are carried in any suitable manner on rod 65 fixed at its ends in frames 39, 40. Arms 64 may be arranged to resiliently press wheels 62 against the sheets but, as shown, are arranged loosely on rod 65 between collars 66 thereby causing wheels 62 to rest by gravity on the sheets.

Shaft 54 has keyed to it near frame 40 a gear 67 which meshes with gear 68 keyed to shaft 69. The latter is rotatably journaled in frames 39, 40 and has secured to one end a sprocket hub 70 carrying a sprocket 71 around which passes a drive chain 72. Chain 72 also passes around sprocket 73 keyed to shaft 74 which is rotatably mounted in press frames 31 and is driven by gearing not shown to make one revolution for each revolution of impression cylinder 30.

As illustrated, the tape roller 53 and its driving mechanism are so arranged as to cause the tapes 57 to travel at a relatively slow speed as compared with the peripheral speed of impression cylinder 30 so that the sheets fed from pile 37 are conveyed toward the press in lapped formation, thus providing so-called "stream" feeding. In some of its aspects, however, the invention is independent of the manner of conveying the sheets away from the pile and therefore the tapes 57 may, if desired, be driven with speed approximating the peripheral speed of cylinder 30 whereby the sheets may be withdrawn from the pile in entirely separated condition as in so-called "sheet-by-sheet" feeding; or the tapes 57 may be given any other suitable constant or varying speed.

Hub 70 has secured thereto a further sprocket 75 which drives a chain 76 which passes around a sprocket 77 keyed to a shaft 78. The latter shaft extends across the feeder near the forward end thereof and is rotatably journaled in side frames 39, 40 and the connections are such as to cause

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shaft 78 to make one revolution for each revolution of impression cylinder 30. Near one end shaft 78 supports a housing comprising a body portion 79 and end plates 80 secured to the body portion by screws or the like. Between plates 80, shaft 78 carries a spiral gear 82 keyed to the shaft. The latter gear meshes with another spiral gear 83 which is slidably keyed to a shaft 85 extending toward the rear of the feeder at right angles to shaft 78. Gear 83 is rotatably journaled in and held against lateral movement by end plates 86 secured to housing body 79 by screws, not shown. Shaft 85 is provided with a long keyway 84 for the purpose of permitting adjustment of the feeder for different lengths of sheets as will appear.

At the rear end of shaft 85 is another housing comprising a body portion 89 and end plates similar to the parts 79 and 86 previously described. Between the end plates of housing 89 is a spiral gear 93 keyed to shaft 85 and between end plates 91 attached to the upper part of the housing there is a spiral gear 94 keyed to a cam shaft 95 which extends across the feeder at the rear thereof. By means of the connections just described driving force is transmitted from shaft 78 through shaft 85 to shaft 95, the latter being made to turn with the same speed as shaft 78.

Shaft 95 is rotatably journaled at its ends in a pair of brackets 96, 97 which are rigidly connected by two tie rods 98, 99 secured in the brackets by set screws 100. Bracket 96 is provided with a groove which slidably engages a supporting flange 101 formed integral with side frame 40 and bracket 97 is provided with a similar groove which engages a flange 102 formed integral with side frame 39. Thumb screws 103 in each of the brackets are provided for clamping the latter in any desired position on the flanges 101, 102.

Supported upon tie rods 98, 99 are four brackets 104, 105, 106, 107 each of which is adjustably clamped by a thumb screw 108 to a transversely extending rod 109. At its lower extremity bracket 104 is bifurcated to receive one end of a rod 110 which is clamped to bracket 104 by screw 111 and which carries at its other end a pile guide 112 having two faces at right angles for guiding the corner of pile 37. Bracket 107 is likewise bifurcated at its lower extremity to receive rod 113 which is clamped in bracket 107 by screw 114 and carries a pile guide 115 for the other rear corner of the pile. Bracket 105 carries at its lower end a normally stationary air blast nozzle 116 directed toward the upper rear edge of the pile and clamped to bracket 105 by thumb screw 117. This nozzle is flattened vertically at its open end to form a relatively narrow vertically extending slot whereby the force of the blast is increased and the blast is effective through a considerable vertical distance to fluff the upper part of the pile of sheets. Bracket 106 similarly carries at its lower end a second normally stationary air blast nozzle 118 clamped to the bracket by thumb screw 119 and formed in a manner similar to nozzle 116. As shown, nozzles 116, 118 are located a short distance apart on opposite sides of the longitudinal center line of the pile, this being the preferred arrangement when the suction and movable air blast devices are located substantially in the center of the pile as shown and later described. The nozzles 116, 118 may, however, be adjusted to other desired positions as required for different kinds of stock and conditions of operation. Nozzles 116, 118 are connected by hose

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connections 120, 121 to a controlled source of air pressure as later described.

Each of the brackets 104, 105, 106, 107 is provided with vertically aligned elongated slots embracing the two tie rods 98, 99 as indicated at 122 in Fig. 1, each of these slots being of a length to permit limited vertical movement of the assembly comprising the brackets 104, 105, 106, 107, rod 109, pile guides 112, 115, and nozzles 116, 118, in order to provide for adjustment and to prevent accidental damage to the parts when the pile is first raised into operative position. Brackets 104 and 107 are provided with adjusting screws 123 which bear against rod 98 to fix the lowermost position of these brackets. For the purpose of preventing lateral movement of the assembly on rods 98, 99, a small guide block 124 is clamped by set screw 125 to rod 99. This block is provided with a vertical slot 126 into which extends a tongue 127 which is formed as part of a block 128 adjustably secured on rod 109 by a set screw 129.

Between the brackets 96, 97 and secured upon tie rods 98, 99 by set screws 130 are two brackets 131, 132 which are spaced apart by shouldered tie rods 133, 134 and clamped thereto by nuts 135 on the ends of the rods to form a rigid box-like structure to contain the operating mechanism now to be described. Shaft 95 is journaled rotatably in the brackets 131, 132 and between the latter carries three cams 136, 137, 138 each of which is keyed to the shaft 95. Between brackets 131, 132 on rod 98 are pivotally mounted three arms 139, 140, 141 which cooperate with the three cams.

Arm 139 carries a cam roller 142 which runs on cam 136 and is urged against that cam by tension spring 143 extending between pin 144 in arm 139 and rod 134. At its forward end arm 139 carries a stud 145 upon which is pivotally supported a slotted bracket 146 in the lower end of which is secured a combined presser foot and air blast nozzle 147 of known design consisting of a hollow L-shaped tube adapted to press on the pile of sheets and having a long narrow horizontally disposed mouth for directing a blast of air forwardly along the top of the pile of sheets. The nozzle 147 receives air under pressure through a chamber in bracket 146 with which it connects and which is connected by pipe 148 and flexible hose connection 149 to a controlled source of air under pressure later described. Bracket 146 at its upper end is provided with a slot 150 which slidably engages a flanged roller 151 loosely carried on a stud 152 secured in bracket 131. The arrangement of the parts is such that as cam 136 rotates to lift arm 139 the nozzle 147 is raised up off the pile of sheets and is swung about its pivot 145 to a position above and to the rear of the pile. Its initial upward movement is substantially vertical so as not to disturb the sheets and subsequently it moves backward as well as upward as illustrated in Figs. 17 to 25 inclusive. Its movement downward is of course the reverse of its upward movement, so that as it presses upon the sheets its motion is practically vertical.

Arm 141 carries a roller 153 which runs on cam 138 and is urged against that cam by tension spring 154 extending between pin 155 in arm 141 and rod 134. At its forward end arm 141 pivotally carries a noddle pin 156 through which extends one end of a link 157 adjustably fixed in the pin 156 by nuts 158. The lower end of link 157 is pivotally mounted on a stud 159 fixed in one arm 160 of a rock lever 161 pivotally sup-

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ported on a headed stud 162 which is fixedly held in bracket 132 by nut 163. The other arm 164 of rock lever 161, constituting a swinging support for the sucker head presently to be described, is provided at its upper end with a cavity 165 (Fig. 7) into which is threaded a nipple 166 to which is connected a flexible hose 167, the latter being connected to a controlled source of suction as later described. Arm 164 is further provided with a downwardly extending bore 168 which connects with the laterally extending bore 169 in a stud 170 fixedly held in the lower end of arm 164 by set screw 171. Stud 170 is provided with a head 172 carrying a plug 173 which closes the outer end of bore 169. Between head 172 and the arm 164 an opening 174 is provided in stud 170 for a purpose which will be apparent.

Upon the stud 170 there is rotatably mounted a sleeve 175 constituting a rotatable support for the suction head, said sleeve having an internal annular chamber 176 which is adapted to connect with opening 174 in all rotative positions of sleeve 175. This sleeve is also provided with a longitudinal groove 177 which connects annular chamber 176 with suction mouths of a suction head removably fixed upon sleeve 175. One form of suction head is indicated at 178 in Figs. 5, 7, 9 and 10, while an alternative form which may be used in place of head 178 is shown at 179 in Figs. 8, 11 and 12. The construction of these heads will be described in detail later.

Between suction head 178 and arm 164, and formed integrally with sleeve 175, are gear teeth 180 which mesh with a pinion 181 rotatably mounted on a stud 182 secured in arm 164 by nut 183. Pinion 181 meshes with a gear segment 184 which is pivotally carried on stud 162. This gear segment has fixed therein a stud 185 which is pivotally connected to the lower end of a link 186 whose upper end is adjustably clamped by nuts 187 to a noddle pin 188. Pin 188 is pivotally carried in the forward end of arm 140 which also carries a roller 189 which runs upon cam 137. A tension spring 190 extending between pin 191 in arm 140 and rod 134 urges roller 189 against its cam 137.

As cam 138 is rotated arm 141 moves up and down and through its connecting link 157 rocks the lever 161 about its pivot 162 thereby swinging stud 170 and suction head 178 in an arcuate path extending from a point substantially directly below stud 162 to a point forwardly and upwardly therefrom, as illustrated in Figs. 17 to 25 inclusive.

It is to be noted that the movement of lever 161 about its pivot 162 will not only effect bodily translation of suction head 178, but if gear segment 184 is caused to remain stationary or to have a different movement than lever 161, will also cause rotation of suction head 178 in a manner determined by the relation between gear teeth 180 and gear segment 184. Thus a combined motion of translation and rotation may be imparted to suction head 178 or translation alone or rotation alone may be produced. Preferably, and as later more fully described, these motions of translation and rotation are combined into a novel and highly efficient sequence of movements for separating and forwarding the sheets off the pile 37.

The suction heads 178 and 179 are interchangeable and each is preferably constructed with two differently formed sets of suction mouths, either of which may be used, thus making four sets of suction mouths of different character which may

be used optionally to secure efficient operation upon a wide variety of sheets and under many different conditions.

Suction head 178 as illustrated comprises a body portion 192 having a bore 193, which slidably accommodates sleeve 175. In the wall of body portion 192 is a threaded screw 194 having a reduced end 195 which is adapted to extend into either one of two holes 196, 197 in sleeve 175 for fixing the head 178 in either of its two operative positions as shown in Figs. 9 and 10. Body portion 192 is further provided with a plurality of passages 198 having small mouths 199 and substantially diametrically opposite thereto a plurality of passages 200 having mouths 201 substantially larger in area than the mouths 199. As shown in Figs. 5, 7 and 9, sucker mouths 201 are in operative position, that is, they are in communication with slot 177 of sleeve 175 and therefore with the source of suction. As shown in Fig. 10 sucker mouths 199 are in operative position. Each of the sets of suction mouths 199 and 201 is arranged substantially in a line extending lengthwise of the suction head 178 and transversely of the direction of travel of the sheets whereby the sheets are gripped at sufficiently widely spaced points to substantially prevent twisting of the sheets out of alignment. These mouths are also arranged in two spaced groups as shown in Fig. 5, for a similar reason, it being apparent that the further the sucker mouths are spaced from the center of suction head 178 the greater will be the effect of preventing twisting of the sheets.

At each end of the sucker head 178 there are two semi-cylindrical flanges 202, 202' formed integrally with the body portion 192, the radius of curvature of these flanges being substantially equal to the distance of the sucker mouths 199 and 201 from the center of stud 170. The purpose of the flanges 202, 202' is to enable the sucker head 178 to form a curvature in the rear portion of the sheet as the latter is lifted from the pile as more fully explained below. It is apparent that the head 178 could be made in the form of a full cylinder, but, in order to reduce weight, it is preferable to form the head as shown. It is also evident that, if desired, the suction head may be provided with one set only of sucker mouths and an arcuate flange or shoe constituting only part of a cylinder, since in any case only one set of sucker mouths is in operation at one time.

Referring to Figs. 8, 11 and 12, the suction head 179 comprises a body portion 205 having a bore 206 which slidably accommodates sleeve 175 to which the body 205 is removably secured in either of two positions by screw 194 protruding into either of the holes 196, 197 as in the case of body portion 192 of suction head 178. Two passages 207 are provided on one side of the body 205, each of which is arranged at its outer end to receive and retain a flexible sucker 208 preferably formed of rubber or like material. On the opposite side are two other passages 209 which are arranged to hold the larger flexible suckers 210. As shown in Figs. 8 and 12, suckers 210 and passages 209 are in operative position, that is, they are in communication with slot 177 and therefore with the source of suction, and as shown in Fig. 11, the head 179 has been moved through 180° to bring suckers 208 and passages 207 into operative position.

At each end of suction head 179 there are two arcuate flanges 211, 212 formed integrally with

body portion 205. The radius of these flanges is substantially equal to the distance from the center of stud 170 to the outer surface of suckers 208 or 210, as the case may be, when one or the other set of suckers is gripping a sheet. As illustrated, flanges 211 and 212 are concentric with stud 170, but they with the body 205 are cut back further on the side where the suckers 210 are mounted in order to accommodate the larger suckers. Furthermore the location of suction mouths and the radii of curvature of the flanges of the two heads 178 and 179 are substantially the same so that the heads may be interchanged without necessitating changes in the other parts of the feeder. The suction heads may be differently proportioned provided appropriate changes are made in the other parts of the feeder.

The connections by which suction effect is transmitted to the suction head 178 or 179 and air under pressure is transmitted to the movable presser foot nozzle 147 and the stationary nozzles 116 and 118 are as follows (Fig. 2): Suction hose 167 is connected to a nipple 213 threaded into a hole extending through frame 39. Into the other end of this hole is threaded an elbow 214 to which is connected a pipe 215 whose other end is joined to the stationary valve casing 216, the latter being secured to the outer surface of frame 39 by screws or other suitable means. Air pressure hose 149 is connected to nipple 218 threaded into a hole in frame 39 which is connected to casing 216 by elbow 219 and pipe 220. Air pressure hoses 120, 121 are joined to nipples 221, 222 which are threaded into holes 223, 224 in frame 39. These latter holes connect with a common hole 225 into which is threaded elbow 226 which is connected to valve casing 216 by pipe 227.

As illustrated more particularly in Fig. 16, valve casing 216 is provided with a cylindrical bore in which there is a rotor 228 having a socket 229 in one end which is adapted to engage a lug or pin 230 secured to the end of rotating shaft 78. The rotor 228 is normally held within the casing 216 by a bar 231 removably held in place by screws 232 secured in the casing. A knurled head 233 is formed upon the outer end of rotor 228 to enable the latter to be easily pulled out of the casing when the bar 231 is removed. A pipe 234 leading from a suitable source of suction (not shown) and a pipe 235 leading from a suitable source of air pressure (not shown) are connected at appropriate points to the underside of casing 216.

A chamber 236 extending part way around the cylindrical wall of casing 216 and a registering passageway 237 extending part way around rotor 228 are provided to furnish connection between inlet pipe 234 and outlet pipe 215, the arrangement being such that, as rotor 228 is turned once for each cycle of operation of the feeder, suction is induced in suction head 178 or 179 at the required times. Further passageways 238 and 239 are provided in rotor 228 for connecting inlet pipe 235 to the outlet pipes 220 and 227 so that air under pressure is delivered to the nozzles 116, 118 and 147 at the proper times.

At the forward end of the pile of sheets 37, the frames 39, 40 are joined by a bar 240 secured to the frames by bolts 241. On this bar are two upright guides 242, 243 each having two faces disposed at right angles for guiding the front corners of the pile of sheets. Each guide 242, 243 is provided with a pair of lugs 244 and a cover plate 245 secured to the lugs by screws 246 forming a rectangular opening adapted to slid-

ably receive bar 240. In plate 245 is a threaded thumb screw 247 adapted to be tightened against bar 240 for clamping the guides 242, 243 in any desired position along bar 240 to accommodate sheets of different sizes. Pile board 38 is notched out as at 248 so the guides 242, 243 may engage the corners of small sheets without interference by the board 38. Near the center of bar 240 two non-adjustable upright pile guides 249, 250 are secured by screws 251.

Bar 240 also supports three upright stationary brackets 252, 253, 254, each of which is rigidly clamped to bar 240 by a plate 255 held against the bar by two screws 256. Bracket 254 supports one end of an oscillatable shaft 257 which extends transversely across the feeder and is journaled also in brackets 253 and 252. This shaft has secured thereto a plurality of movable pile guides or joggers 258 which are adapted at times to occupy a position against the pile as shown in Fig. 1, and at other times to swing forward shaft 54 of roller 53 in spaces not occupied by collars 55 and 56 as shown in Figs. 20, 21 and 22. Oscillation of shaft 257 and guides 258 is produced by a cam 259 secured to shaft 69 upon which cam runs a roller 260 carried by lever 261 pivotally supported on a stud 262 in bracket 252. A tension spring 263 between pins 264 and 265 in lever 261 and bracket 252 respectively maintains roller 260 against cam 259. The rocking movement imparted by the cam to lever 261 is transmitted by connecting rod 266 to an arm 267 pinned or otherwise keyed to shaft 257. Shaft 69, as previously stated, turns once for each cycle of the feeder, and as a consequence the movable guides 258 make one complete movement toward and away from the pile for each sheet fed therefrom.

The operation of my feeder will in part be evident from the preceding description and the drawings, but for a more complete understanding I will now describe the preferred manner of operation with particular reference to Figs. 17 to 25 inclusive. In these figures the lower arm 164 of rock lever 161 is indicated by a broken line through the centers of stud 162, pinion 181, and suction head 178.

Fig. 17 shows the position of the parts when the topmost sheet of the pile has just been gripped by suction head 178 and its rear edge is about to be lifted from the pile. The blast in nozzles 116 and 118 has been on for a time with the result that the sheets near the top of the pile have been fluffed up, separated from each other and raised to some extent by the presence of air under pressure between the sheets. Movable front guide 258 is up against the pile so that the sheets will not move forward off the pile under the impetus of the blast from nozzles 116, 118. Presser foot nozzle 147 has been lifted up off the pile and backward out of the path of suction head 178. Segment 184 is stationary and arm 164 is momentarily in the vertical position. With the parts in these positions suction is induced in head 178 causing suction mouths 201 to grip the topmost sheet S1.

After the sheet S1 has been gripped the blast in nozzles 116, 118 is turned off, the arm 164 starts to swing forward and upward, and presser foot nozzle 147 begins to move downward and forward toward the top of the pile, as shown in Fig. 18. During the forward movement of arm 164, segment 184 remains stationary with the result that suction head 178 rotates in the anti-clockwise direction about its pivot stud 170. This

causes the suction mouths 201 to rise more rapidly than the head 178 as a whole, thereby lifting the rear portion of the sheet and wrapping the sheet partly around the suction head 178 thus forming an upwardly concave curvature in the sheet as it conforms to the shape of the suction head 178.

The forward and upward movement of arm 164 and the downward and forward movement of presser foot nozzle 147 continue until the arm reaches its foremost position and the nozzle rests upon the pile as illustrated in Fig. 19. At this point the rear portion of the sheet has been formed into a curve and has been lifted off of the pile. It is to be noted that curving the rear part of the sheet causes the rear edge thereof to be carried forward as well as upward so that it is out of the way of the descending presser foot nozzle 147. Thus only a slight spacing of the suction head 178 above the pile is sufficient to permit easy passage of air beneath the top sheet, in contrast to known feeders in which the rear part of the sheet must be raised vertically a relatively large distance in order to provide clearance for a nozzle such as nozzle 147. It is also to be noted that in the preferred form, and as illustrated, the proportions of the parts are such as to cause the rear part of the sheet to be curved and lifted without the main body of the sheet being moved either forward or backward on the pile. By this arrangement there is no tendency for the sheet to slip on the suction mouths 201 and break their grip upon the sheet. At about the time nozzle 147 descends to the pile its air blast is turned on and air is blown forwardly under the top sheet S1 to complete the separation thereof from the pile and to assist in the subsequent forwarding of the sheet off the pile.

After the completion of the forward and upward movement of arm 164, and while the blast from nozzle 147 continues to blow, the movable front guides 258 are swung forward sufficiently to permit the sheet S1 to freely move off the pile and segment gear 184 is swung upward thereby causing suction head 178 to rotate about its stud 170 in the clockwise direction, as shown in Fig. 20. This causes suction mouths 201 to move downwardly and forwardly in an arcuate path which corresponds to the curvature of the rear portion of the sheet. The movement of suction mouths 201 together with the forwarding effect of the air blast from nozzle 147 upon the separated sheet S1 imparts to the latter controlled forward movement which carries the front edge of the sheet into the bite of wheels 62 and collars 56. The speed imparted to the sheet by suction mouths 201 is preferably substantially equal to the peripheral speed of wheels 62 and collars 56 at the time the latter take the sheet in order to avoid slipping of the sheet upon the mouths 201.

At about the time the front edge of sheet S1 is taken by wheels 62 and collars 56, the blast from nozzles 147 is discontinued and suction in mouths 201 is cut off, whereupon the rear portion of the sheet is released and drops upon the pile. After suction is cut off, segment 184 continues to swing upward a short distance with decreasing speed until it comes to a stop at its uppermost position thereby bringing the rotation of head 178 to a stop as shown in Fig. 21. Meanwhile the wheels 62 and collars 56 continue to convey the sheet S1 forward and nozzle 147 continues to rest upon the pile, holding the remaining sheets against any tendency to move forward out of their proper position.

As sheet S1 is being conveyed off the pile and

while nozzle 147 still rests on the pile and arm 164 remains stationary in its foremost position, front guides 258 are swung back toward the pile and segment 184 is swung downward as shown in Fig. 22. This movement of segment 184 causes suction head 178 to rotate anti-clockwise and return suction mouths 201 toward their uppermost position.

The movements just described continue until the parts are in the positions shown in Fig. 23, that is, front guides 258 are back against the pile and segment 184 has reached its rearmost position.

Thereupon, as shown in Fig. 24, presser foot nozzle 147 begins to rise off the pile, the air blast in nozzles 116, 118 is turned on and arm 164 begins to swing backward and downward, segment 184 remaining stationary meanwhile. The movement of arm 164 while segment 184 remains stationary causes suction mouths 201 to travel in a curved path extending backwardly and downwardly toward the pile, the direction of the path being substantially vertical during the latter part of the movement although the surface of the mouths 201 is at a constantly changing angle to the plane of the top of the pile. Furthermore the combined swinging and rolling movement of suction head 178 causes each point of the periphery of the suction head to move in an epicycloidal path with stud 182 as the stationary center. For any such point which comes in contact with the sheets, this path is substantially vertical at the time of contact so that there is no wiping or rubbing effect upon the sheets as the suction head descends to sheet gripping position. As will be apparent from inspection of Fig. 24, the suction head 178 constitutes means for limiting the elevation of the uppermost sheet due to the fluffing action of nozzles 116, thereby maintaining the sheet in proper position to be taken by the sucker as the latter rolls from the position of Fig. 24 to that of Fig. 25.

The movements illustrated in Fig. 24 and just described continue until the parts reach the positions shown in Fig. 25 whereupon suction is again turned on and the next sheet S2 is seized preparatory to being separated and fed off. The previous sheet S1, having been only partly removed from the pile, will partly overlie the next sheet S2 and the same condition will exist for the succeeding sheets, so that a stream of lapped sheets will be formed and conveyed forward by the wheels 62 and collars 56 and the forwarding tapes 57.

In the preferred form of the invention the suction mouths move along a linear path comprising an epicycloidal portion and a circular portion. Referring to Fig. 26 the suction mouths rise and move somewhat forward along the path a-b, meanwhile tilting so that the surface adjacent the mouths moves from a position substantially horizontal to a position approaching the vertical. After their rising movement is completed the mouths move downward and forward in a circular arc about the center of the suction head, this movement continuing slightly past the vertical centerline through the suction head. The mouths then return over the same circular path, completing their backward arcuate movement prior to beginning their epicycloidal downward movement. It is somewhat important in the operation of the feeder that the lifting and forwarding movement be as described, but it is of less importance that the return movements be carried out in sequence, and, if desired, the re-

turn circular and epicycloidal movements may be combined. If the return movements are carried out in different sequence than the lifting and forwarding movements, the mouths will of course travel in a closed path instead of a linear path.

As previously mentioned the forwarding wheels 62 and collars 56 and the tapes 57 may be operated at such speed that each sheet is completely drawn off the pile before the next sheet is started forward, so that the sheets are not lapped. Under such conditions the contour of cam 137 would preferably be altered so that the suction mouths 201 would forward the sheets substantially at the higher speed of wheels 62 and collars 56, but in other respects the feeder would require no substantial alteration.

It will be seen that the sheets of the pile are at all times held against shifting movement. Whenever presser foot nozzle 147 is lifted off the pile, front guides 258 are up against the front edge of the pile to prevent forward movement of the sheets, backward movement, of course, being prevented by the stationary rear corner guides 112, 115. Whenever the front guides 258 are swung forward to permit the top sheet to move off the pile, presser foot nozzle 147 is on the pile holding the sheets firmly against shifting forward.

It will also be noted that in the preferred form shown there is no substantial forward or backward shifting of the main body of the sheet while the rear portion thereof is being separated and raised. Under some conditions it may be desirable to so proportion the parts that the main body of the sheet is shifted forward or backward during the separating action. If desired, this may be accomplished in one way merely by decreasing the radius of the suction head 178 for achieving a forward shift of the sheet or by increasing the radius thereof for achieving a rearward shift of the sheet. When the suction head 178 swings in a forward direction through a given arc about the shaft 162, the head 178 rotates simultaneously in an anti-clockwise direction due to the action of the gears. The machine as illustrated is so designed that the forward swing is compensated by the anti-clockwise rotation so that motion of the body of the sheet is zero. Now if the diameter of the head is decreased, the rotation is insufficient to compensate for the forward swing and the sheet moves forward. On the other hand if the diameter of the head is increased the rotation more than compensates for the forward swing and the body of the sheet moves rearward slightly.

The alternate fluffing of the pile by the air blast from nozzles 116, 118 and compression of the pile by presser foot nozzle 147 causes an effective preliminary separation of the rear edges of the several topmost sheets of the pile. Thus any sheets which may be slightly stuck together will be broken apart prior to reaching the topmost position on the pile.

The mechanism described is simple and easy to construct and adjust, and the movements involved are accomplished without undue strain or wear on the parts.

Preferably and as shown the pile is maintained in such vertical position that the topmost sheet, if not fluffed up by the blast from nozzles 116, 118 would lie a slight distance, say about $\frac{1}{8}$ " below the suction head 178 when the latter is in its lowermost position; and the fluffing of the sheets by the air blast causes them to rise up into

contact with the suction head. The vertical position of the pile may be varied, however, and may be such that the unfluffed pile would lie close enough to the suction head to be within the operative range thereof.

While as herein disclosed the preferred embodiment of the invention includes means for raising the suction head as it moves forward and rolls up the rear end of the sheet, it is within the spirit of the invention to omit the raising movement. For example, while the rear edge of the sheet is being rolled up on the suction head the latter may be moved in a rectilinear path parallel to the plane of the top of the pile and at a speed such that the rolling up of the rear edge shall not disturb the body of the sheet, the sheet being separated from the top of the pile only enough to permit introduction of the air blast beneath the topmost sheet. This could be accomplished for example by mounting in engagement with the pinion 180 a horizontal rack arranged parallel to the direction of feed, and providing mechanism to effect bodily movement of the stud 170 in a horizontal plane instead of arcuate reciprocation about the shaft 162, as shown in the drawings.

The vertical position of the pile is preferably controlled by automatic mechanism of known design connected to the presser foot nozzle 147 and to the mechanism for raising the pile rather than by the manual mechanism illustrated, but such mechanism is not shown in the drawings since it does not form a part of the present invention.

If desired, as for larger sheets, two or more separating and forwarding units of the kind described may be utilized. For example, one unit comprising a suction head 178, a presser foot nozzle 147, a pair of stationary blast nozzles 116, 118 and associated operating mechanism may be employed near each rear corner of the sheets, or any number of such units may be employed at any desired position along the rear edge of the sheets. For small sheets, however, one such unit is sufficient and it is an important advantage of the invention that one such unit placed substantially on the longitudinal centerline of the sheets is sufficient to efficiently feed rather large sheets at high speeds.

It is not necessary in the practice of some features of the invention that the curvature of the flanges 202, 202' and 211, 212 of suction heads 178 and 179 be circular or have their centers at the center of stud 170, or that the motion of each point on the periphery of these flanges be epicycloidal in character. Other curvatures may be employed to produce the desired curvature of the sheets; or the flanges may be omitted, curvature of the sheet being accomplished by the upward and forward movement of the suction mouths 199, 201, 208, or 210, as the case may be, combined with the tilting of the suction mouths and the natural stiffness of the sheet or its contact against front guides 258.

Having thus described my invention, I claim:

1. The method of separating sheets from a supply and advancing them to forwarding means, which comprises gripping the uppermost sheet near its rear edge, raising and forwarding the gripper in an epicycloidal path, swinging the gripper forwardly and downwardly in a circular arc to advance the sheet, releasing the sheet, and returning the gripper to a position above the rear portion of the next sheet.

2. The method of separating sheets from a

supply and advancing them to forwarding means, which comprises lowering a sheet gripper in an epicycloidal downward and rearward path into sheet-taking position at the rear of the pile, gripping the sheet, raising and forwarding the gripper in the reverse epicycloidal path, swinging the gripper forwardly and downwardly in a circular arc to advance the sheet, releasing the sheet, and swinging the gripper in the reverse direction through the same circular arc to complete the cycle.

3. The method of separating sheets from a supply and advancing them to forwarding means, which comprises gripping the uppermost sheet near its rear edge, swinging the gripper axis forwardly and upwardly and simultaneously rotating the gripper rearwardly about its axis to elevate the gripper, rotating the gripper forwardly and downwardly upon its axis to advance the sheet, releasing the sheet, and returning the gripper to a position above the rear portion of the next sheet.

4. The method of separating sheets from a supply and advancing them to forwarding means, which comprises lowering a sheet gripper to sheet-taking position at the rear of the supply, gripping the sheet, swinging the gripper axis forwardly and upwardly and simultaneously rotating the gripper rearwardly about its axis to elevate the gripper, rotating the gripper forwardly and downwardly upon its axis to advance the sheet, releasing the sheet, and rotating the gripper in the reverse direction through the same circular arc to complete the cycle.

5. In mechanism of the character described, an oscillatable gear sector, a sucker, a shaft upon which said sucker is mounted, an arm oscillatable through a given angle about the center of said sector, said shaft being mounted in the free end of said arm, a gear on said shaft rigid with said sucker, said gear being operatively connected with said gear sector, and means for oscillating said sector back and forth while said arm remains stationary at one end of its arc of movement.

6. In mechanism of the character described, a gear sector oscillatable through a predetermined angle, a sucker, a shaft upon which said sucker is mounted, a swing arm carrying said shaft, said arm being mounted to turn about the center of said gear sector, a gear on said shaft rigid with said sucker and operatively associated with said gear sector, and means for swinging said arm back and forth while said sector remains stationary at one end of its angle of movement.

7. In mechanism of the character described, a gear sector mounted to oscillate about its axis, an arm oscillatable about the same axis, a shaft carried by said arm, a sheet gripper on said shaft, a gear on said shaft rigid with said gripper, said gear being operatively associated with said sector, said gripper being arranged to take a position beneath said shaft when the arm extends down from said axis, and means for swinging the arm from said last named position through a given angle while the sector remains stationary, swinging the sector back and forth through a given angle while the arm remains in its raised position, and then returning the arm to its original position.

8. In mechanism of the character described, a gear sector mounted to oscillate about its axis, an arm oscillatable about the same axis, a shaft carried by said arm, a sheet gripper on said shaft, a gear on said shaft rigid with said gripper, a gear on said arm meshing with said gripper gear and said sector, said gripper being so disposed

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angularly as to take a position beneath said shaft when the arm extends downward from said axis, and means for swinging the arm from said last named position through a given angle while the sector remains stationary, thereby producing an epicycloidal movement of the gripper, swinging the sector back and forth through a given angle while the arm remains in its raised position and then returning the arm to its original position.

9. In mechanism of the character described, a gear sector mounted to oscillate about its axis, an arm oscillatable about the same axis, a shaft carried by said arm, a sheet gripper on said shaft, a gear on said shaft rigid with said gripper, said gear being operatively associated with said sector, said gripper being so disposed angularly as to take a position beneath said shaft when the arm extends downward from said axis, a cam shaft, two cams thereon, means associated with said cams for swinging the arm from said last named position through a given angle while the sector remains stationary, swinging the sector back and forth through a given angle while the arm remains in its raised position and then returning the arm to its original position, and means for rotating the cam shaft.

10. In mechanism of the character described, a gear sector mounted to oscillate about its axis, an arm oscillatable about the same axis, a shaft carried by said arm, a sucker on said shaft, a gear on said shaft rigid with said sucker, said gear being operatively associated with said sector, said sucker being arranged to take a position beneath said shaft when the arm extends downward from said axis, an air blast for fluffing the sheets at the rear of the pile, a combined presser foot and air blast nozzle for floating the uppermost sheet from the rear of the pile, said nozzle being movable back and forth between operative and inoperative positions, operating means for turning on the fluffing air blast and the suction in said sucker, turning off the fluffing air blast, swinging the arm forward and raising the sucker, lowering the presser foot to operative position upon the pile, turning on the air blast from said presser foot, rotating the sucker forwardly and downwardly to advance the sheet while floated on the blast from said presser foot, shutting off the latter blast, relieving the suction in said sucker to release the sheet, rotating the sucker backwardly and upwardly and swinging the arm rearwardly to retract and lower the sucker for the beginning of the next cycle.

11. In mechanism of the character described, a pile support, pile guides at the forward end of the pile support mounted to swing from a vertical position downwardly and forwardly, means for gripping and rolling up the rear end of the uppermost sheet of the pile, means for causing a blast of air to be blown forwardly under the rolled up end of said uppermost sheet to float the forward portion thereof, means for swinging the pile guides downwardly and forwardly, means for advancing the rear edge of the floating sheet, and feeding means adapted to engage the front edge of the advanced sheet as it moves forward over said downwardly deflected guides, said guide operating means functioning thereafter to return the guides to vertical position before the next sheet of the pile is taken by said sheet gripping means.

12. In mechanism of the character described, a pile support, pile guides at the forward end of the pile support mounted to swing from a vertical

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position downwardly and forwardly, means for gripping and rolling up the rear end of the uppermost sheet of the pile, a blower presser foot for exerting pressure upon the rear end of the pile and for causing a blast of air to be blown forwardly under the rolled up end of said uppermost sheet to float the forward portion thereof, means for swinging the pile guides downwardly and forwardly, means for advancing the rear end of the floating sheet, and feeding means adapted to engage the front edge of the advanced sheet as it moves forward over the said downwardly deflected guides, said guide operating means functioning thereafter to return the guides to vertical position before the presser foot is withdrawn and before the next sheet of the pile is taken by said sheet gripping means.

13. In mechanism of the character described, a pile support, movable pile guides at the forward end of the support, sheet separating and advancing means at the rear of the pile, front and rear transverse shafts for operating said guides and said sheet separating and advancing means respectively, and a longitudinal shaft operatively connected to both of said transverse shafts, the operative connection between said longitudinal shaft and one of said transverse shafts permitting the adjustment of one of said transverse shafts toward and away from the other transverse shaft without disturbing the longitudinal shaft.

14. In mechanism of the character described, a pile support, an air blast nozzle adapted to play upon the rear of the pile at its upper edge, a pair of pile guides for the rear corners of the pile, a framework for carrying said nozzle and guides, and means for supporting said framework, said supporting means being yieldable in an upward direction.

15. The method of separating and feeding sheets from the top of a supply of sheets, comprising preliminarily separating a rear edge portion of the upper sheets of the supply and thereby elevating the topmost sheet of the supply, gripping the topmost sheet by suction near its raised rear edge while said edge remains thus raised, further raising and tilting the gripped portion of the sheet and rolling up a portion of the sheet adjacent and in front of said gripped portion, blowing air forwardly under the rolled up sheet, holding the next sheet of the supply against forward movement, and moving said gripped portion substantially along the line of curvature of the rolled up portion of the sheet to move the sheet forwardly along the top of the supply.

16. The method of separating and feeding the topmost sheet from a supply, comprising rolling up a rear portion of the sheet to partially cylindrical form to separate the same from the next sheet of the supply and unrolling the rolled up portion of the sheet to advance the sheet forward end first in the feeding direction.

17. The method of separating and feeding sheets from the top of a supply, comprising gripping the topmost sheet near its rear edge by suction, rolling up the rear portion of the gripped sheet around a moving center to partially cylindrical form and causing said center to move forwardly, and unrolling said rear portion of said gripped sheet to advance the sheet forward end first in the feeding direction.

18. The method of separating and feeding sheets from the top of a supply, comprising gripping the topmost sheet by suction near its rear edge, simultaneously rolling up and bodily lift-

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ing the rear portion of the topmost sheet to impart a partially cylindrical form thereto, blowing air forwardly under said sheet to further separate the same and to provide sheet forwarding force, pressing on the next sheet of the supply, and unrolling the rolled up portion of the sheet to control advance of the sheet in the feeding direction.

19. The method of separating and feeding sheets from the top of a supply comprising gripping the topmost sheet by suction near its rear edge, rolling up the rear portion of the gripped sheet around a curved body to separate the same from the next sheet of the supply, blowing air in the feeding direction under the rolled up sheet, unrolling said rear portion of said gripped sheet while said air is blowing to advance the sheet forward end first in the feeding direction further conveying the sheet in the feeding direction along the top of the supply and similarly operating upon the next sheet while the latter is still partly covered by the preceding sheet to form a stream of lapped sheets.

20. The method of separating and feeding sheets from the top of a supply, comprising gripping the topmost sheet by suction near its rear edge, raising and tilting the gripped portion of the sheet to a position approximately at right angles to the plane of the top of the supply and thereby carrying the rear edge of the sheet upward and forward, rolling up a portion of the sheet adjacent and in front of said gripped portion during said raising and tilting movement, blowing air forwardly under the sheet, and moving said gripped portion substantially along the line of curvature of said rolled up portion to advance said topmost sheet forward edge first along the top of the supply.

21. The method of separating and feeding sheets from the top of a supply, comprising gripping the central portion only of the topmost sheet by suction near its rear edge, moving said gripped portion of the sheet to roll up a rear portion of the sheet and carry a central portion of said rear edge upward and forward, blowing air forwardly under the rolled up sheet to separate the same from the supply and provide sheet forwarding force, and moving said gripped portion to unroll the rolled up portion of the sheet to control advance of the sheet in the feeding direction.

22. The method of separating and feeding sheets from the top of a supply of sheets, comprising preliminarily separating the central portion of the rear edges of the upper sheets of the supply, gripping the central portion of the topmost sheet by suction near its rear edge while the sheets are in preliminarily separated condition, moving said gripped portion to roll up a portion of the sheet in the feeding direction, pressing on the central portion of the next sheet of the supply to hold the same against forward movement, blowing air forwardly between the rolled up sheet and the next sheet of the supply to further separate the topmost sheet and provide sheet forwarding force, moving said gripped portion to unroll the rolled up portion and thereby control the advance of the sheet in the feeding direction, further advancing the sheet by force applied to the forward portion thereof, releasing the gripped portion of the sheet, and similarly operating upon each succeeding sheet of the supply in turn while the same is still partly covered by the preceding sheet whereby a stream of lapped sheets is formed.

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23. In mechanism for separating and feeding sheets from the top of a pile, two air blast nozzles arranged to blow air against the rear edges of the upper sheets of the pile at adjacent spaced points to fluff the sheets, a movable presser foot arranged between said nozzles, and means for operating said presser foot to cause the same to press on the pile during a portion only of the feeding cycle once for each sheet fed.

24. In mechanism for separating sheets from the top of a pile of sheets, means for alternately fluffing and compressing a rear edge portion of the upper sheets of the pile, a pair of flexible suckers arranged closely adjacent each other in a line parallel to said rear edge, means for causing said suckers to grip the topmost sheet of the pile near its rear edge while the pile is fluffed, means for simultaneously raising and tilting said suckers while gripping a sheet to curve a rear portion of the sheet upwardly, said raising and tilting movement carrying the rear edge of the sheet upward and forward, and a curved body associated with said suckers adapted to contact the gripped sheet during the raising and tilting movement of said suckers to assist in curving said rear portion of the sheet, said body being at all times spaced above the unfluffed pile.

25. In sheet feeding mechanism, a sheet separating sucker, a pivot about which said sucker is movable, an arm carrying said pivot, a fixed support on which said arm is pivotally mounted, means effective during the active portion of the sucker movement for swinging said arm about its pivot to swing said sucker pivot forward with respect to the feeding direction and responsive to said arm movement for moving said sucker about its pivot rearwardly.

26. In mechanism for separating and feeding sheets from the top of a supply, a sheet separating sucker, a pivot about which said sucker is movable, an arm carrying said pivot, a fixed support on which said arm is pivotally mounted, means for swinging said arm about its pivot to swing said sucker pivot forward and backward with respect to the feeding direction, and means for moving said sucker about its pivot in the reverse direction, said sucker, sucker pivot and arm pivot being arranged to occupy positions substantially in a line perpendicular to the top of the supply at the time when said sucker first grips a sheet.

27. In mechanism for separating and feeding sheets from the top of a supply, a sheet separating sucker, a pivot about which said sucker is movable, an arm carrying said pivot, a fixed support on which said arm is pivotally mounted, means for swinging said arm about its pivot to swing said sucker pivot forward and backward with respect to the feeding direction, and means for moving said sucker about its pivot, said sucker, sucker pivot and arm pivot being arranged to occupy positions substantially in a line perpendicular to the top of the supply at the time when said sucker first grips a sheet, said sucker moving means functioning to move said sucker backwardly through an angle of approximately 90 degrees while said sucker pivot is being swung forward through a lesser angle.

28. A sheet separating suction device comprising a support, a suction head adjustably mounted thereon having a plurality of suction ports of different suction characteristics fixed with respect to said head adapted selectively by adjustment of said head to occupy an operative position, and means for locking said head on said support in

any of a plurality of positions corresponding to the positions of said ports.

29. In sheet separating and feeding mechanism, a support, a suction head adjustably mounted thereon, a plurality of flexible suckers of different size mounted in said head adapted selectively by adjustment of said head to occupy an operative position, and means for locking said head on said support with a selected sucker in operative position.

30. In sheet separating and feeding mechanism, a support, a suction head angularly adjustably mounted thereon having a plurality of angularly spaced suction ports of different suction characteristics adapted selectively to occupy an operative position depending upon the angular position of said head, and means for locking said head on said support in different angular positions.

31. In sheet separating and feeding mechanism, a support, a suction head angularly adjustably mounted thereon having a plurality of angularly spaced rows of suction ports therein adapted selectively to occupy an operative position depending upon the angular position of said head, the different rows of ports having different suction characteristics, and means for locking said head on said support in different angular positions.

32. A sheet separating suction device comprising a movable support, a rotatable support on said movable support, a suction head demountably mounted on said rotatable support having angularly spaced sheet gripping suction ports and means for locking said head in position on said rotatable support to hold a selected one of said suction ports in operative position.

33. A sheet separating suction device comprising a stud, a support at one end thereof, the other end thereof being unsupported, a sleeve rotatable on said stud, a suction head adapted to slidably fit over said sleeve, and means for locking said head to said sleeve.

34. In sheet separating and feeding mechanism, a bodily movable stud, a support at one end thereof, the other end thereof being unsupported, a suction head adapted to be demountably and rotatably carried on said stud, means for retaining said head on said stud operable to permit removal of said head endwise from said stud, and means for rotating said head operable during bodily movement of said stud, the suction connection to said head extending through the supported end of said stud, and said rotating means being disposed at the supported end of said stud.

35. In mechanism of the character described a support for a pile of sheets, a sheet gripper adapted to occupy a position substantially above the level of the pile for gripping a sheet and to move upwardly while gripping a sheet, forwardly directed variably operated air blast means at the rear of the pile for fluffing the sheets and thereby periodically raising the top sheet into contact with said gripper, a presser foot adapted periodically to move under a lifted sheet and press upon the rear portion of the pile at a time when said fluffing air blast means is ineffective, pile guides at the sides and rear of the pile, movable pile guides at the front of the pile, means for moving said front guides backward and forward into and out of pile guiding position in synchronism with the movements of said presser foot, said front guide moving means functioning to maintain said front guides in pile guiding position while said air blast means is blowing and said

presser foot is off the pile and to move said front guides out of pile guiding position only while said presser foot is on the pile.

36. A sheet separating suction device comprising a movable support, a suction head demountably mounted on said support, said head having sheet gripping suction ports angularly spaced and being rotatably adjustable upon said support to bring a selected one of said ports into operative position, means for retaining said suction head on said support, and means for rotating said suction head.

37. In mechanism for separating sheets from the top of a pile, air blast means for fluffing an edge portion of the upper sheets of the pile and thereby elevating the topmost sheet, a sheet gripping sucker adapted to move downwardly and angularly to a predetermined position above the level of the unfluffed pile for gripping the elevated topmost sheet and after gripping the sheet to move upwardly with the sheet, and means adapted to limit the elevation of said topmost sheet substantially to the level of said predetermined position prior to gripping of the sheet by said sucker, said elevation limiting means having substantially rolling contact with said topmost sheet.

38. In mechanism for separating and feeding sheets from the top of a supply, a sucker adapted to grip the topmost sheet of the supply near its rear edge, a curved body arranged in front of the sucker with respect to the feeding direction and adapted to engage a gripped sheet for forming a desired contour therein, means for raising and tilting the sucker while gripping a sheet to separate the rear portion of the sheet from the supply, said raising and tilting movement bringing the sheet into contact with said body, and means for further moving the sucker to move the sheet forward edge first in the feeding direction along the top of the supply.

39. In mechanism for separating and feeding sheets from the top of a supply, a pivot, a sucker mounted on the pivot arranged to grip the topmost sheet of the supply near its rear edge, a curved body mounted on said pivot in front of the sucker with respect to the feeding direction and adapted to contact a gripped sheet for forming a desired contour therein, and means for swinging said sucker and body about the pivot in one direction while gripping a sheet to separate the rear portion of the sheet from the supply and in another direction to advance the sheet forward edge first in the feeding direction.

40. The method of separating and feeding sheets from the top of a supply, comprising gripping the sheet near its rear edge, applying to the gripped portion of the sheet a combined tilting and bodily lifting movement, said combined movement raising the portion of the sheet in front of the gripped portion and carrying the rear edge of the sheet adjacent the gripped portion upward and not substantially rearward of its original position, forming an upwardly concave curvature in the sheet in the region in front of the gripped portion during said combined movement, blowing air forwardly under the curved up sheet to further separate the same and provide sheet forwarding force, and moving said gripped portion, while said air is blowing, to impart controlled forward movement to the sheet, forward edge first, from said curved up position of the sheet to a position where it may be further advanced by conveying elements at the front of the supply, said controlled forward movement

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being initiated while the sheet is curved up as aforesaid and continuing until the sheet is within the region of control of said conveying elements.

41. The method of separating the top sheet 5 from a pile of sheets, comprising pneumatically fluffing a rear edge portion of the upper sheets of the pile thereby elevating the same, gripping the top sheet near its rear edge while thus elevated, applying to the gripped portion thereof a 10 combined tilting and bodily lifting movement, said combined movement raising the portion of the sheet in front of the gripped portion and carrying the rear edge of the sheet adjacent the gripped portion upward and not substantially 15 rearward of its initial position, curving the sheet

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in the region directly in front of the gripped portion around a curved body during said combined movement, and blowing air forwardly under the curved up sheet to further separate the same.

42. The method as claimed in claim 40, wherein the sheet gripping action is applied to a relatively small transverse portion of the sheet, whereby separation of the sheet takes place progressively both forwardly and laterally.

43. The method as claimed in claim 40, wherein the sheet gripping action is applied centrally of the sheet and to a relatively small transverse portion thereof only, whereby separation of the sheet takes place progressively both forwardly and laterally.

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