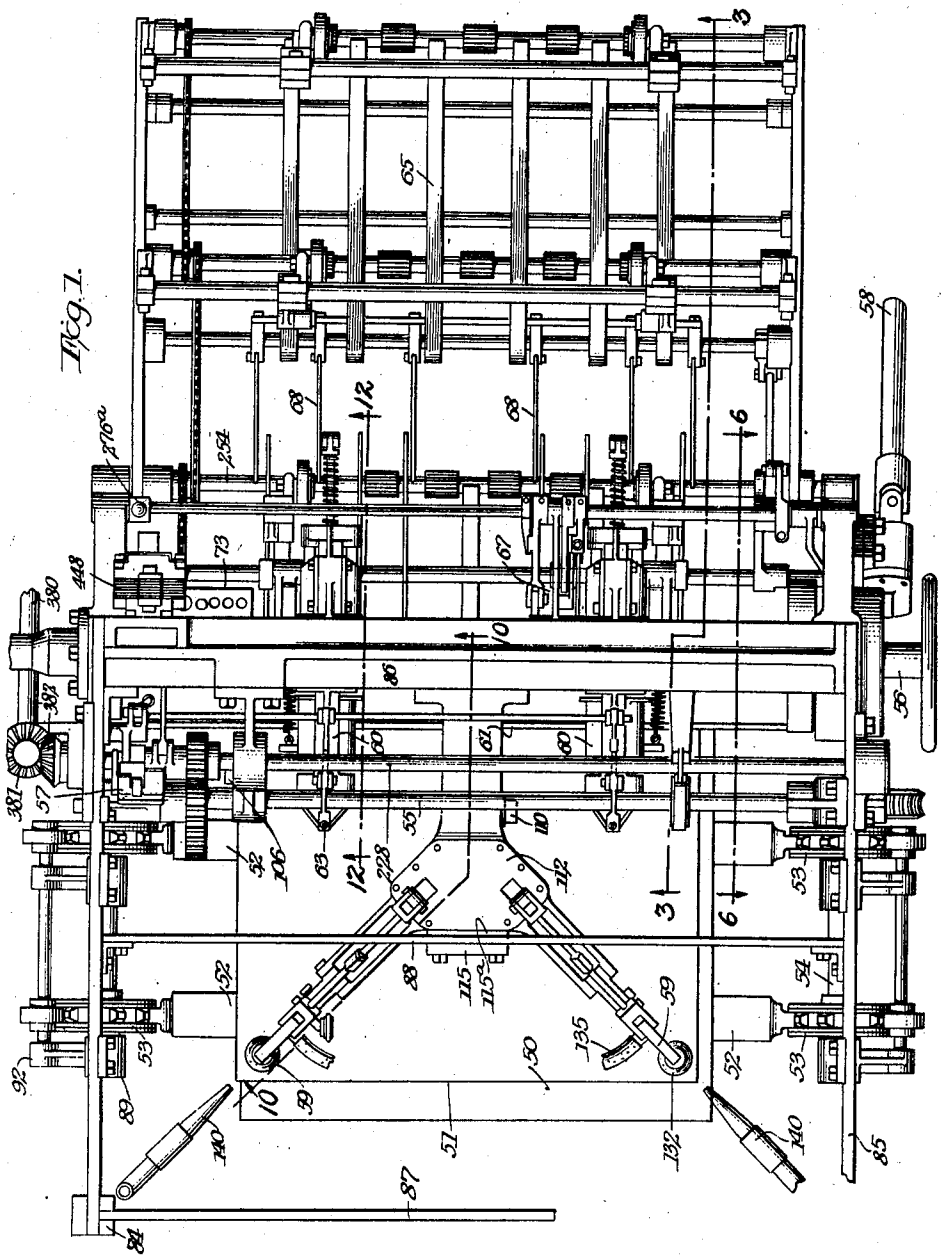
April 30, 1940. G. GOEBEL ET AL 2,199,170

SHEET HANDLING MECHANISM FOR SHEET FEEDERS

Original Filed June 10, 1935 10 Sheets-Sheet 1

Fig. 1.



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SHEET HANDLING MECHANISM FOR SHEET FEEDERS

Original Filed June 10, 1935 10 Sheets-Sheet 2

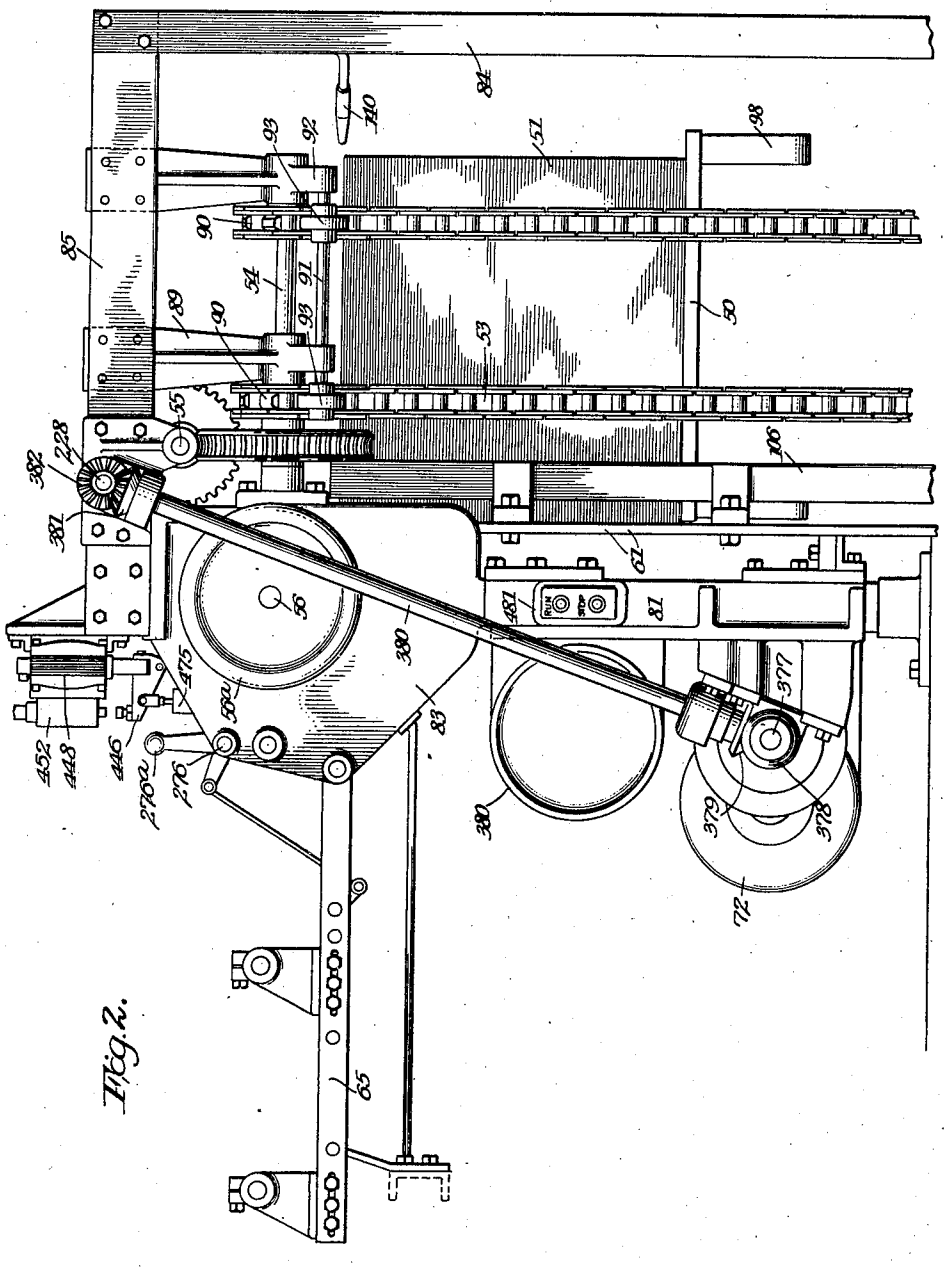


Fig. 2.

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SHEET HANDLING MECHANISM FOR SHEET FEEDERS

Original Filed June 10, 1935 10 Sheets-Sheet 3

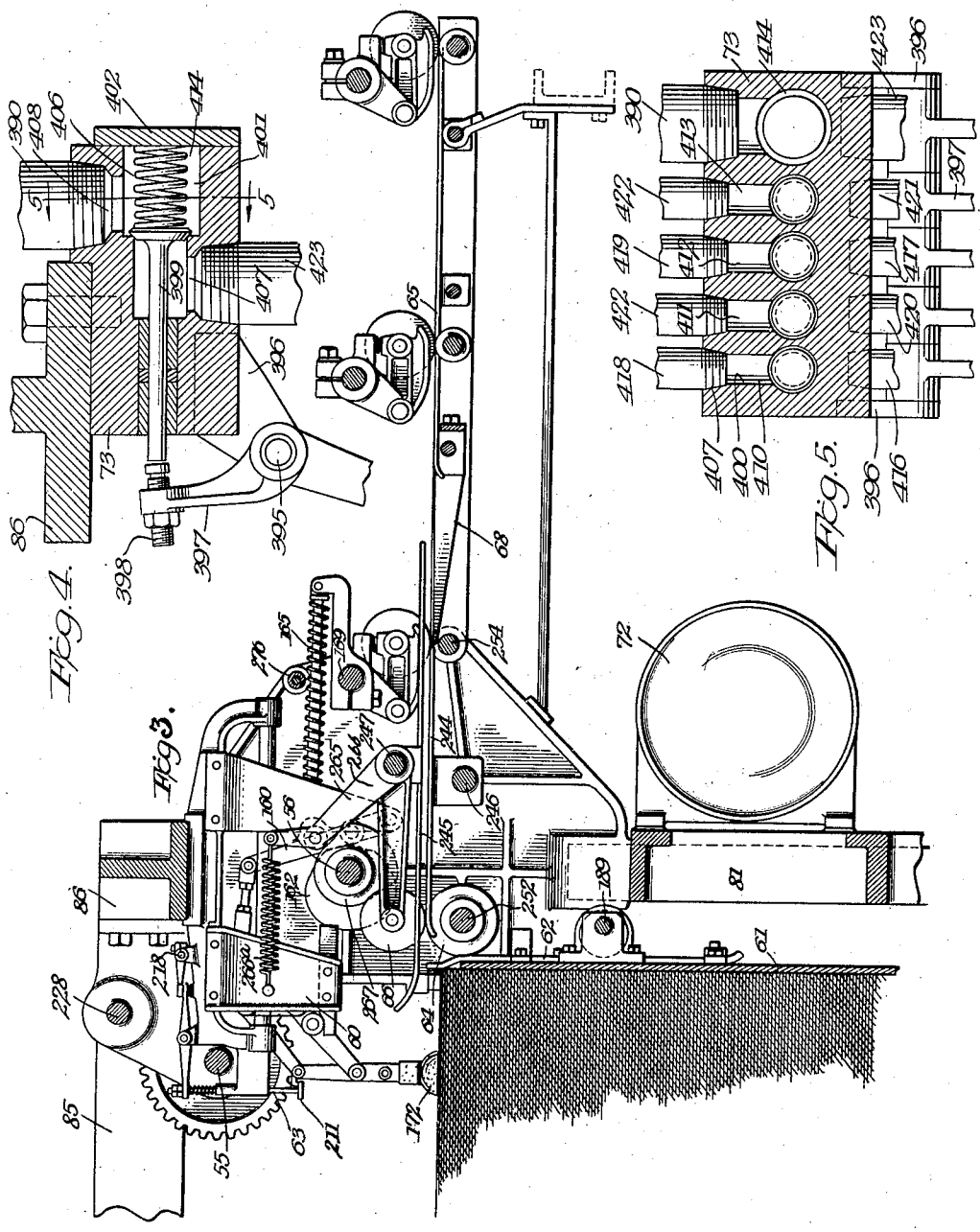


Fig. 4.

Fig. 5.

Fig. 3.

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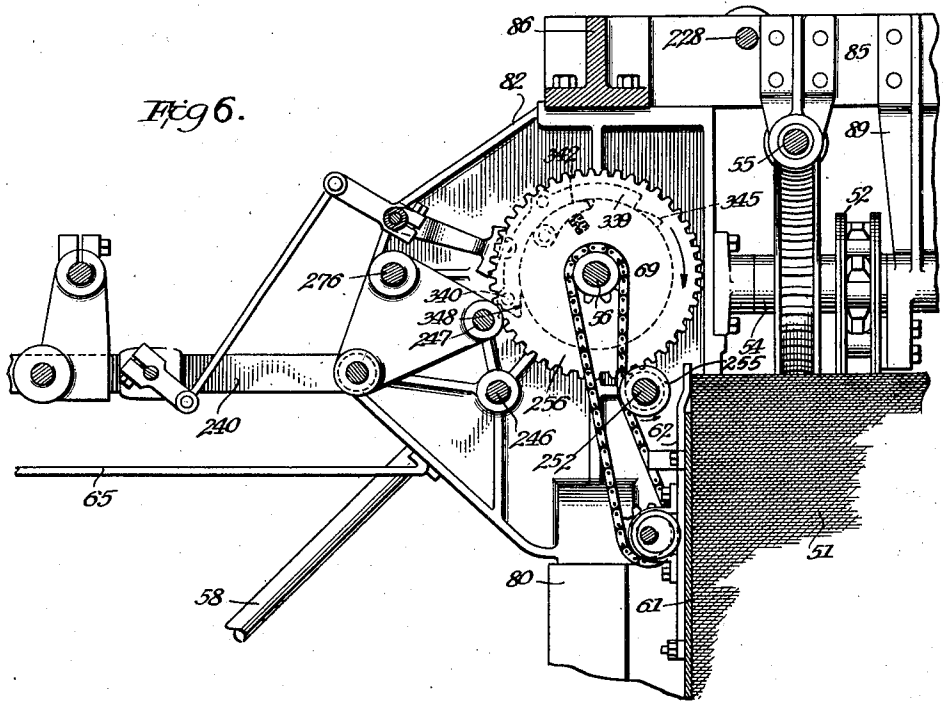
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SHEET HANDLING MECHANISM FOR SHEET FEEDERS

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Fig 6.



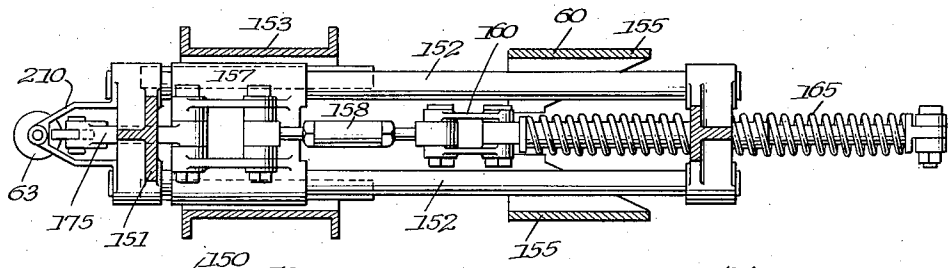


Fig. 7.

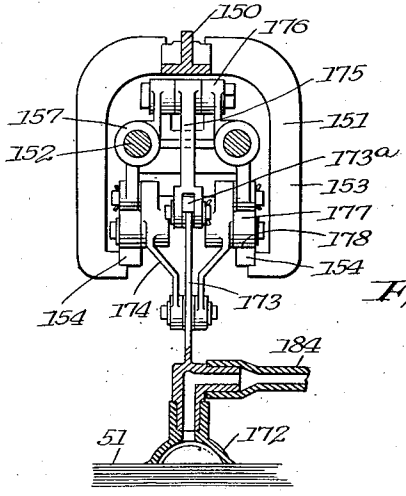


Fig. 8.

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SHEET HANDLING MECHANISM FOR SHEET FEEDERS

Original Filed June 10, 1935 10 Sheets-Sheet 5

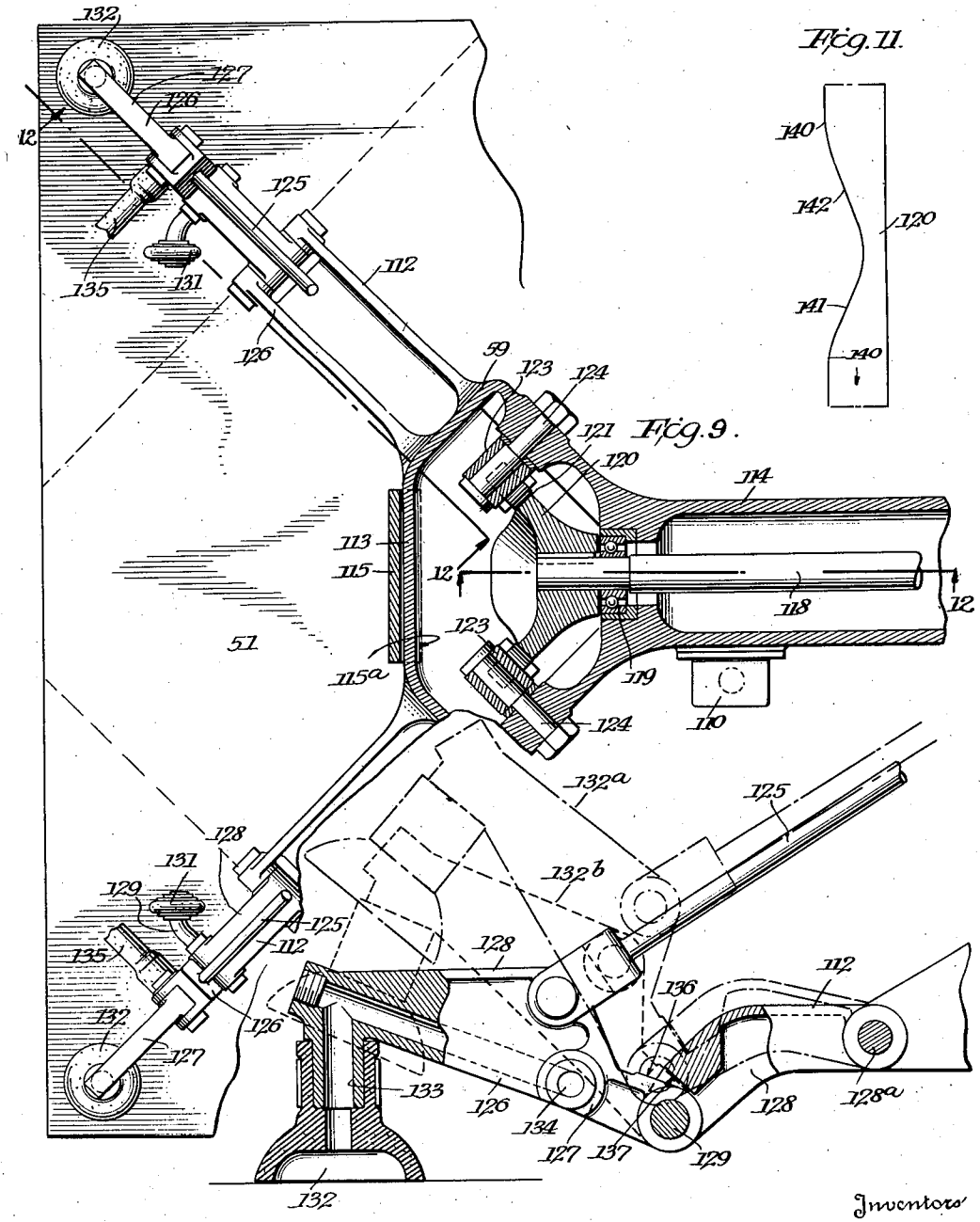


Fig. 10.

Fig. 11.

Fig. 9.

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SHEET HANDLING MECHANISM FOR SHEET FEEDERS

Original Filed June 10, 1935 10 Sheets-Sheet 6

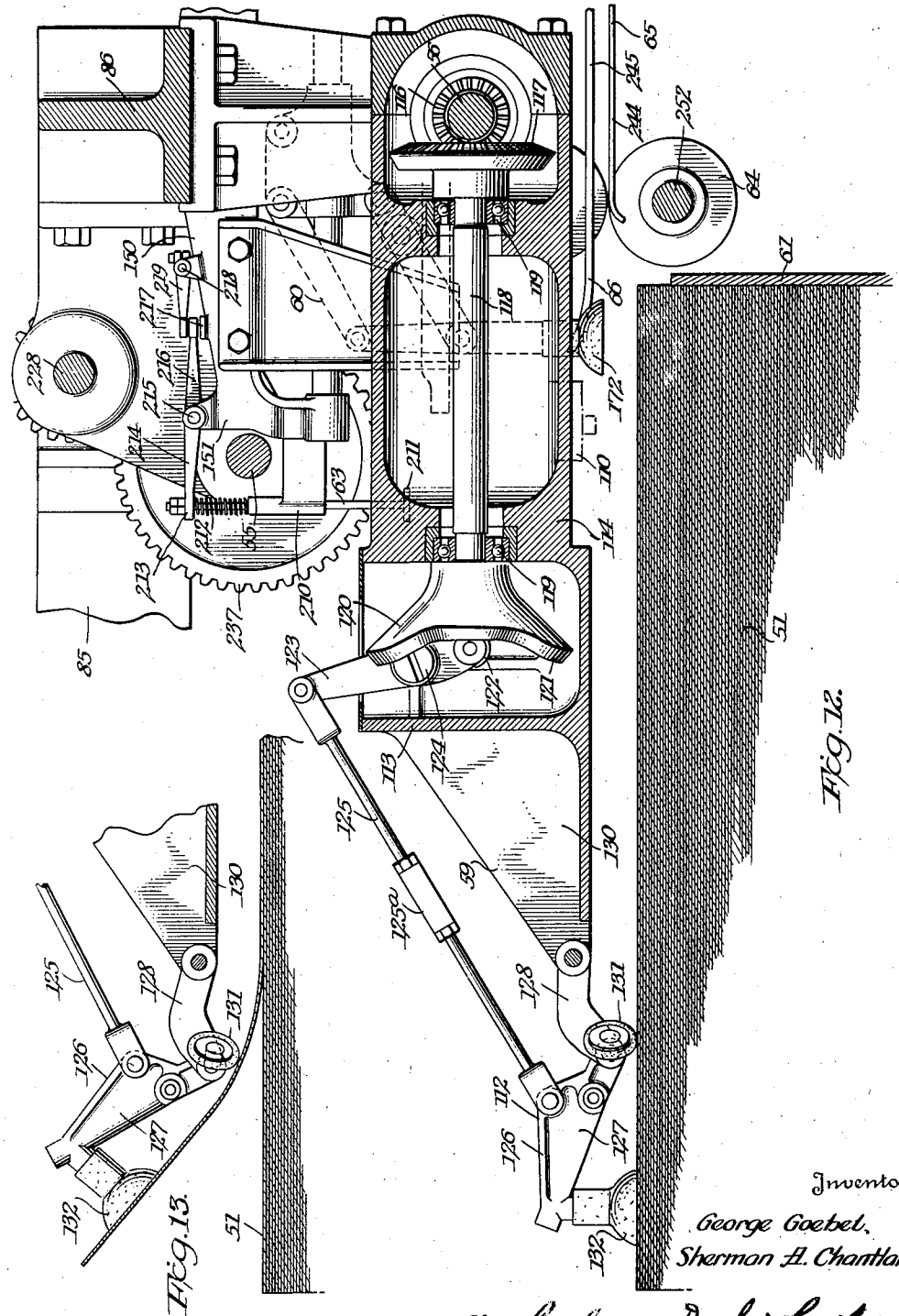


Fig. 12.

Fig. 13.

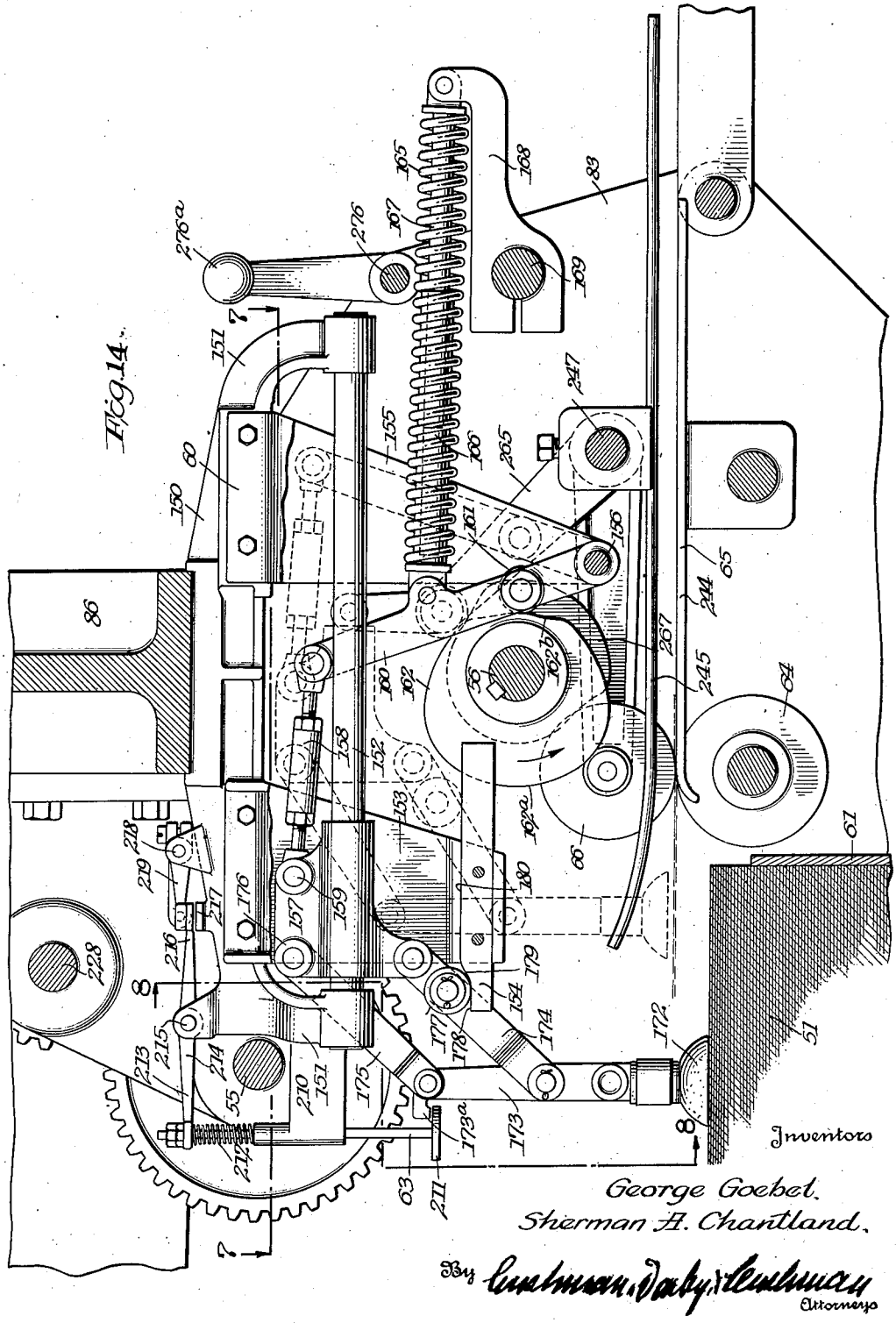
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SHEET HANDLING MECHANISM FOR SHEET FEEDERS

Original Filed June 10, 1935 10 Sheets-Sheet 7

Fig. 14.



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SHEET HANDLING MECHANISM FOR SHEET FEEDERS

Original Filed June 10, 1935 10 Sheets-Sheet 8

Fig. 15.

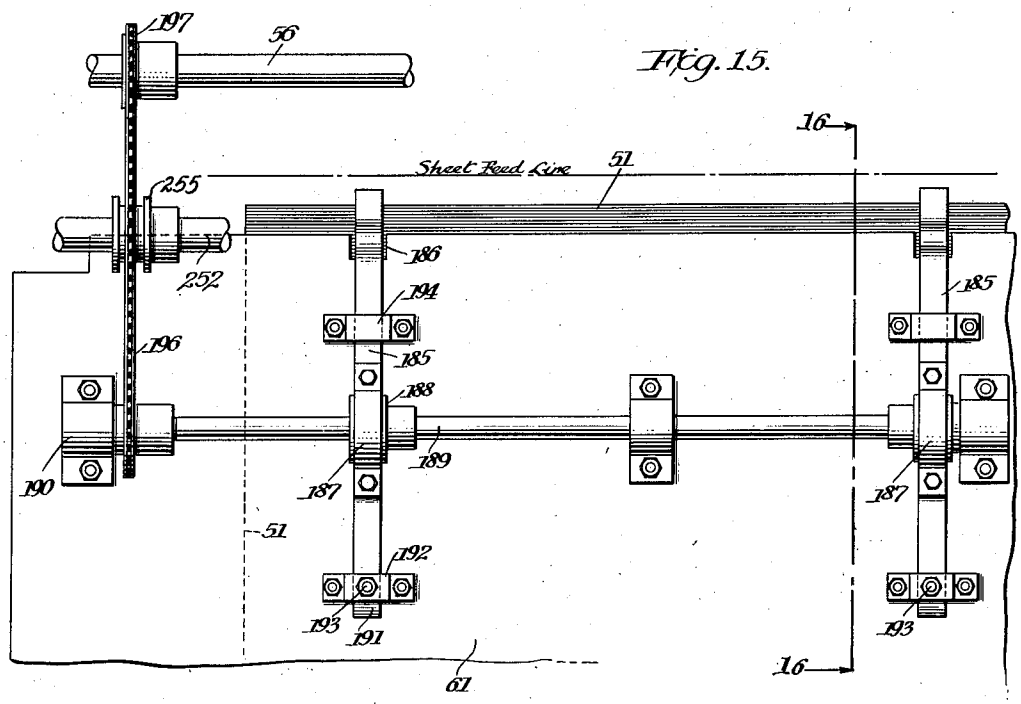


Fig. 16.

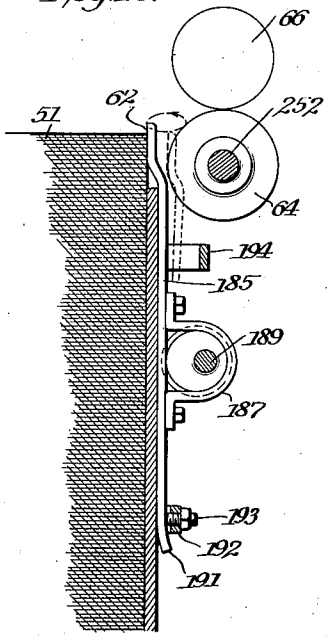


Fig. 17.

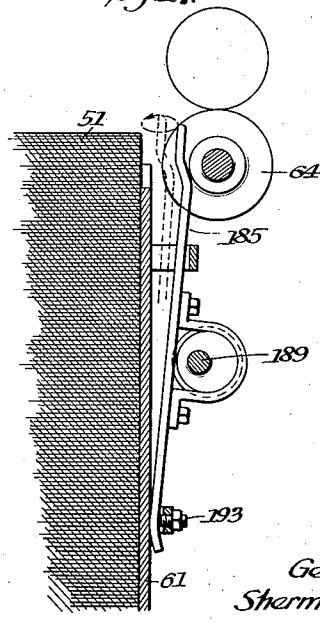
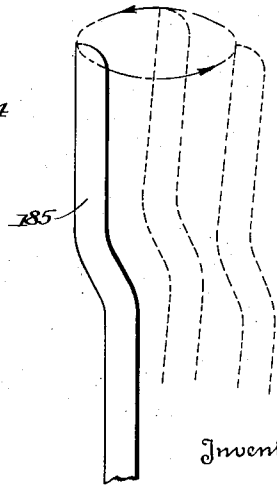


Fig. 18.



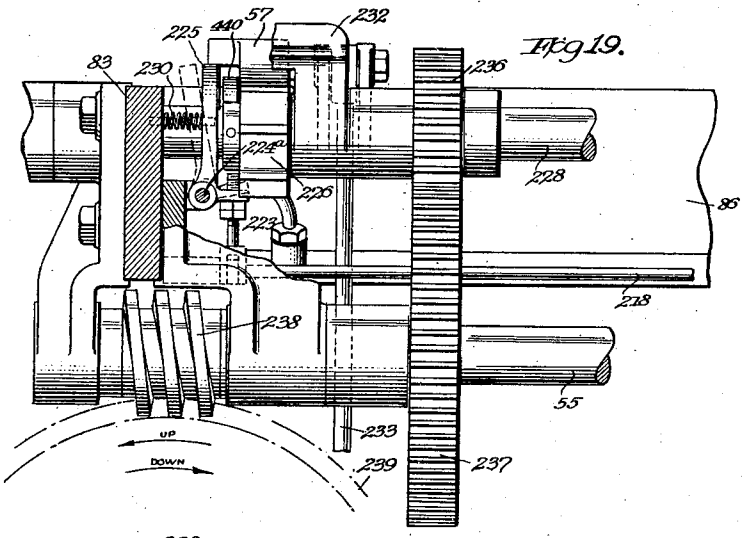
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SHEET HANDLING MECHANISM FOR SHEET FEEDERS

Original Filed June 10, 1935 10 Sheets-Sheet 9

Fig. 19.



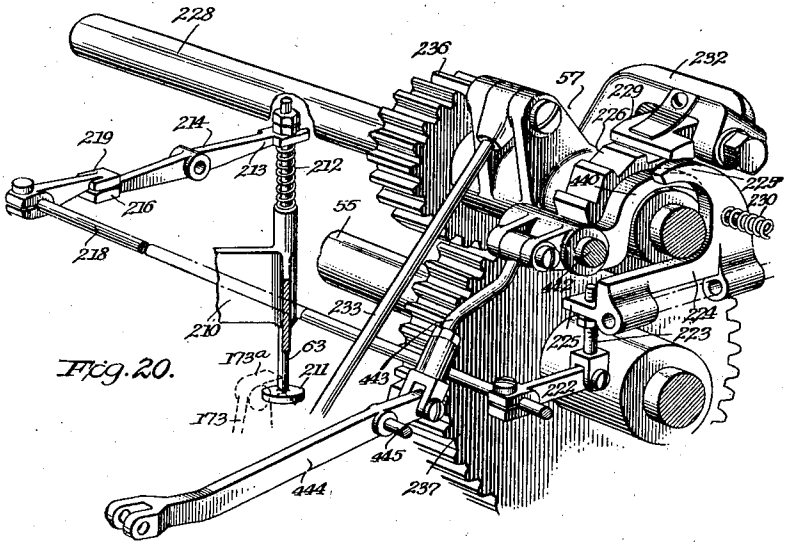


Fig. 20.

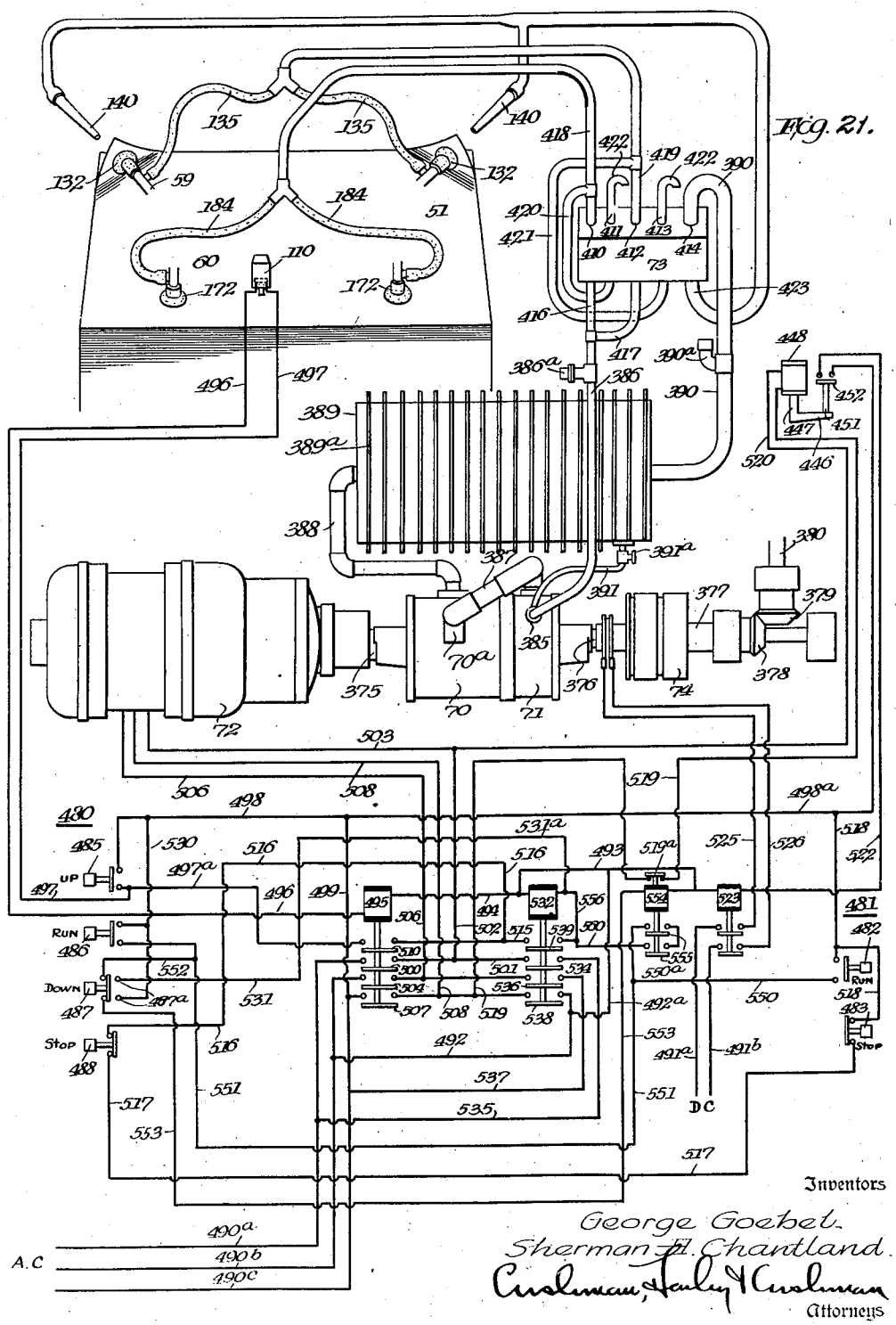
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SHEET HANDLING MECHANISM FOR SHEET FEEDERS

Original Filed June 10, 1935 10 Sheets-Sheet 10



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UNITED STATES PATENT OFFICE

2,199,170

SHEET HANDLING MECHANISM FOR SHEET FEEDERS

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Original application June 10, 1935, Serial No. 25,908. Divided and this application January 20, 1939, Serial No. 252,052

19 Claims. (Cl. 271—27)

The present invention relates to sheet moving mechanisms for sheet feeders, this application being a division of our application for Sheet feeders, Serial No. 25,908, filed June 10, 1935.

The principal object of the invention is to provide a sheet feeder of maximum efficiency in delivering but one sheet at a time to the press or other apparatus to which the sheets are to be fed, and which will successfully handle a wide range of types of materials.

Another object of the invention is to provide a sheet separating or rear suction cup mechanism which is arranged to readily separate the upper sheet of material from the next lowest sheet so that but one sheet of material at a time will be moved through the feeder.

In the handling of a stack of sheets, in order to separate the uppermost sheet from the next lowest sheet, it is desirable to bend the rear portion of the uppermost sheet upwardly and suction cups are ordinarily used for this purpose. By the action of the separators used in most types of sheet feeders, the rear portion of the sheet is bent upwardly along a line extending crosswise of the sheet. In handling some materials, particularly thin sheets of metal, when the rear suction cups tend to bend the sheet on a line extending transversely thereof, the sheet frequently has a tendency to buckle along a line at right angles to its rear edge, resisting the efforts of the suction cups to bend its rear portion.

The rear cup or separator mechanism of the present invention is designed to bend the rear corners of the top sheet upwardly on a diagonal bending line, instead of bending the entire rear portion on a transverse line. Obviously, the corners can be bent much more readily than the entire rear portion, since the buckling tendency of the sheet referred to above will not be encountered. Aside from their function of bending or upturning the corners of the sheet, the separators of the present invention are also designed to exert a bending action within the area of the upturned portion. That is to say, each rear corner of the sheet is double bent on diagonal lines, i. e., bent upward from the sheet and also bent around a projecting member. By this arrangement, should the corners of the next lowest sheet tend to adhere to the upper sheet, they will be forced or snapped away from the upper sheet by reason of their own resiliency.

Another object of the invention is to provide a front suction cup or forwarding mechanism which will be positive in action toward moving the sheet from the pile when its rear corners are released from the suction of the rear suction cups or separators, and which front cup or forwarding mechanism is extremely simple in construction and operation.

The forwarding mechanism of a sheet feeder must lift the uppermost sheet from the stack and then carry it forward to position it upon the feed table, the forwarder necessarily moving upwardly and then horizontally or forwardly to accomplish this movement. Heretofore, it has been necessary to provide complicated cam and trip devices to obtain these movements of the forwarder.

The front cup or forwarding mechanism of the present invention is of extreme simplicity but nevertheless insures that as the uppermost sheets of the stack are successively presented thereto, they will be lifted and moved forward in the proper manner.

Another object of the invention is to provide a mechanism which will move adjacent the underside of each sheet as the sheet is passed over the stack gauge plate, tending to remove from the under surface of the sheet any lower sheet which may tend to adhere thereto, and return the adhering sheet to proper position on the stack.

It has heretofore been proposed to provide spring fingers upon the upper edge of the stack gauge plate, which fingers are intended to engage the lower surface of a sheet to remove adhering sheets therefrom. However, these devices are not of the desired efficiency, particularly because, being stationary, they merely tend to rub or scrape against the lower surface of the sheet and therefore do not exert sufficient force to remove a closely adhering lower sheet.

The stripper mechanism of the present invention comprises one or more members positioned adjacent the upper edge of the stack gauge plate and which are so arranged that their upper or sheet engaging edges move in a substantially elliptical path, their movement during a portion of this path being opposed to the forward movement of the sheets. More particularly, the strippers move downwardly and forwardly as the top sheet leaves the stack, then move upwardly and rearwardly adjacent the under surface of the top sheet, and, finally, back against the front edge of the stack so that if the position of the sheets immediately beneath the top sheet has been disturbed by removal of the latter sheet, they will be restored to properly aligned position upon the stack.

Another object of the invention is to provide a

fluid flow circuit which is so arranged that oil cannot come in contact with the sheets.

The oil used to lubricate the suction pumps and blowers which respectively supply the suction and the air blasts necessary to lift and separate the sheets frequently works through the flow lines to the suction or blast nozzles which contact with or direct air upon the sheets, resulting in the sheets becoming soiled.

By the structure of the present invention, the pressure tank in which the pressure pump compresses the air used in the blast directed against the edges of the sheets is positioned above both this pump and the suction pump of the apparatus, and the remainder of the flow circuit is arranged so that any oil in the circuit will remain in or drain to the tank and thence to the suction pump, which has its outlet connected to the inlet of the pressure pump, thereby obviating all possibility of oil reaching the elements of the circuit which are in proximity to or contact with the sheets.

Another object of the invention is to provide a novel form of drive for the various mechanisms of a sheet feeder.

Other objects and advantages of the invention will be apparent from the following specification and drawings wherein:

Figure 1 is a plan view of the feeder.

Figure 2 shows the left hand side of the feeder in elevation.

Figure 3 is a longitudinal vertical section through a portion of the machine taken on the line 3—3 of Figure 1.

Figure 4 is a detail view showing the valve casing of the feeder in vertical transverse section.

Figure 5 is a horizontal sectional view taken on the line 5—5 of Figure 4.

Figure 6 is a longitudinal vertical sectional view of a portion of the machine taken on the line 6—6 of Figure 1.

Figure 7 is a view taken on the line 7—7 of Figure 14 and showing the front suction cup or feeder operating mechanism.

Figure 8 is a transverse sectional view taken on the line 8—8 of Figure 14.

Figure 9 is a view partly in plan and partly in horizontal section showing the mechanism for operating the rear suction cups or separator mechanism.

Figure 10 shows one of the rear suction cups or separators partially in longitudinal vertical section, and also shows in dotted lines the various positions of the separators.

Figure 11 is a diagrammatic showing of the operating cam for the rear suction cups.

Figure 12 is a vertical sectional view of the rear suction cup operating mechanism taken on the line 12—12 of Figure 9 or the line 12—12 of Figure 1.

Figure 13 is a detail view showing one of the rear suction cups or separators in extreme raised position.

Figure 14 is a longitudinal vertical sectional view of a portion of the apparatus taken on the line 14—14 of Figure 1 showing one of the front cups or feeders and its operating mechanism in side elevation.

Figure 15 is a transverse vertical sectional view of the apparatus showing the stripper mechanism.

Figure 16 is a vertical sectional view of the stripper mechanism on the line 16—16 of Figure 15.

Figure 17 is a view similar to Figure 16, but showing the stripper mechanism in another position.

Figure 18 diagrammatically shows, in side elevation, the movement of the stripper bar illustrated in Figures 15 to 17.

Figure 19 is a view showing the stack lift control mechanism, with parts broken away.

Figure 20 is a perspective view of the stack lift control mechanism as viewed from left of Figure 19, and

Figure 21 diagrammatically shows the pumps, the motor for driving the same, and the flow circuit and wiring of the machine.

In the following description of the apparatus of the invention, the front of the sheet feeder shown herein is regarded as the end which would be positioned adjacent the press or other apparatus to which sheets are delivered by the feeder, the rear would be the end at which the stack of sheets is positioned for separation by the feeder, and the left and right sides of the apparatus would be these sides as viewed by a person standing at the rear of the feeder and facing the same.

In order that the relation of the mechanisms of the present invention may be more readily understood, the principal elements of a sheet feeder and their related operations are broadly described below:

A stack platform 50 (Figures 1 and 2) is provided at the rear of the machine and on this is carried the pile of sheets, designated by the numeral 51, the platform 50 being supported on cross bars 52 having their ends removably engaged in the inner runs of pairs of endless chains 53 passing about sprocket wheels on chain driving shafts 54 as described in our said original application. The chain driving shafts 54 are driven from a shaft 55 extending transversely of the feeder and rotated step by step during the normal operation of the machine from a main cam shaft 56 by means of a pawl and ratchet mechanism 57. The main cam shaft 56, upon which are mounted or from which are driven all of the timing elements or cams of the machine, is preferably driven from a main drive shaft 58 (Figure 9) extending from the press or other apparatus to which the sheets are delivered by the present feeder.

The lifting of the platform 50 causes the uppermost sheet of the stack 51 to be presented to rear suction cups or sheet separators 59 and front suction cups or forwarders 60. The rear suction cups 59 are positioned above the rear corners of the uppermost sheet on the stack (Figure 8) and will descend to lift and bend these corners, the line of bending being diagonally of the sheet. A blast of air is simultaneously directed beneath each lifted corner to separate or float the upper sheet from the next lowest sheet. Just before the suction of the rear cups is released and while the sheet is floating, the front suction cups or forwarders 60 move downwardly (Figure 7) and engage the front portion of the sheet, lifting it and then moving it forwardly over a stack gauge plate 61 against which the front edges of the sheets in the stack contact.

As the sheet moves over the upper edge of the stack gauge plate 61, a moving stripper 62 (Figures 16 and 17) engages the undersurface of the forward portion of the sheet to remove therefrom any sheet which might otherwise adhere to the uppermost sheet and to return the adhering sheet to the stack 51.

The sheet stack 51 is kept at a height to permit the uppermost sheet to be engaged by the separators 59 and forwarders 60 by means of a lift control mechanism including trip members 63, one positioned adjacent each forwarder 60, and either of which is arranged to be operated by a forwarder in its downward movement if the portion of the uppermost sheet beneath the forwarder is not at the proper height as described in our said original application Serial No. 25,908.

The forwarders 60 position the sheet upon driven outfeed rolls 64 included in the feed table 65, hold-down rolls 66 press downwardly upon it to hold it in contact with the rolls 64 so that it will be moved along the feed table, and during the initial portion of this movement it passes through a calipering or gauging mechanism 67. As described in our divisional application Serial No. 252,051 for Calipering mechanism filed of even date herewith, the calipering mechanism is so designed that if but one sheet passes through the same, it will be permitted to move forwardly along the feed table 65 to the press or other apparatus to which the feeder delivers. If two sheets simultaneously pass through the calipering mechanism, this mechanism will operate to raise a reject member 68, thereby diverting the sheets to a point beneath the feed table 65. Should three sheets pass simultaneously through the calipering mechanism, the reject member will be raised and the main clutch 69 of the machine, provided on the main cam shaft 56, will be disengaged to stop the operation of the feeder.

The suction and compressed air required in the operation of the machine is provided by pumps 70 and 71, respectively, (Figure 20) driven by a motor 72 mounted on the feeder and beneath the feed table 65, the flow of fluid being controlled by a valve mechanism 73. As described in our said original application Serial No. 25,908, the motor 72 may also be connected through a clutch 74, preferably of the magnetic type, to raise or lower the stack platform 50 when it is necessary to change stack platforms, that is, to insert a full platform in place of one from which the sheets have been entirely removed by the forwarders 60. During such operation, the lift control pawl and ratchet mechanism 57 is disconnected.

The machine frame and stack supporting structure

The frame of the feeder of the present invention comprises front standards 80 and 81, respectively positioned on the right and left sides of the machine. A side plate 82 is fixed to the standard 80 and a side plate 83 extends upwardly from the left-hand standard 81. Rear standards or uprights 84 are spaced from the standards 80 and 81 and are connected to the side plates 82 and 83, respectively, by horizontal beams 85. The uppermost portions of the side plates 82 and 83 are connected by a transverse beam 86 beneath which is positioned the main cam shaft 56. The upper ends of the rear uprights 84 are similarly connected by a horizontal beam 87. A horizontal beam 88 is fixed to the side beams 85 intermediate their ends.

The chain driving shafts 54 are supported beneath the side beams 85 in depending brackets 89, best shown in Figure 2, and a pair of spaced sprocket gears 90 is fixed to each of these shafts, the lift chains 53 moving about these sprockets. The lift chains 53 are of endless form and their lower ends hang free. In order to hold the outer runs of the chains in proper engagement with the sprocket gears 90, a fixed rod 91 is supported in downward and outward extensions 92 of the brackets 89, rod 91 carrying a roller 93 in alignment with each of the chains 53, which rollers force the links of the chains 53 to remain in intermeshed relationship with the teeth of the sprocket gears 90, as shown in Figure 2.

The stack supporting platform 50 is preferably in the form of a runner of the type used on industrial trucks, that is, it has skids or feet 98 upon its side edges, the runner being positioned in the machine in such a manner by the operator that the skids 98 will be arranged transversely of the machine. The platform 50 is supported, during the operation of the machine, upon the cross bars 52 as best shown in Figure 2. These cross bars are provided with hook members at each end thereof, as described in our said original application, to engage the chains 53.

The rear suction cups or separators

The rear suction cup or separator mechanism 59 is shown in plan in Figure 1 and is shown in detail in Figures 7 to 13. The mechanism comprises two separator elements 112, each supported from a casing comprising a body portion 113 and a forwardly extending portion 114 which at its forward end is journalled for vertical upward swinging movement upon the cam shaft 56. A vertical plate 115 extending downwardly from the intermediate beam 88 of the main frame is provided at its lower end with a shelf or hook 115a upon which the lower surface of the rear end or face of the body 113 of the casing normally rests. The main cam shaft 56 has a bevel gear 116 fixed thereto within the forwardly extending casing 114, which gear meshes with a bevel gear 117 fixed to the end of a shaft 118 extending longitudinally of the casing 114, the shaft 118 being mounted in bearings 119 as shown in Figure 12.

A dished cam 120 is secured to the rear end of shaft 118, the effective cam surface of cam 120 being its periphery 121. Cam 120 is arranged to engage rollers 122 mounted on the lower ends of levers 123 journalled on pins 124 fixed in the side walls of the casing body 113, with the result that the levers 123 will be swung. The upper ends of the levers 123 extend through the upper wall of the casing body 113 and rods 125 are pivotally connected thereto. The opposite ends of the rods 125 are connected to jointed suction cup supporting elements 126, which elements include outer arms 127 and inner arms 128, these two arms being pivotally connected by a pin 129 and the inner arm 128 being pivotally supported at 128a upon an extension 130 rigid with and extending diagonally from the casing body 113. The rods 125 are preferably formed in two sections, with a threaded sleeve 125a joining the adjacent ends of the sections to permit the length of the rods to be adjusted.

As is best shown in Figure 9, the pin or stud 129 is angled exteriorly of each jointed supporting member 126, the free end of the stud extending parallel with the rear edge of the stack 51 and having a roller 131, preferably with a rubber tread, mounted thereon. The outer arms 127 each carry a suction cup or sheet engaging element 132 on the underside of their outer ends and a bore 133 extends from the interior of the suction cup and through the arm to a transversely arranged outlet bore 134 to which is connected a suction line 135 leading to the valve mechanism 73 of the machine. The outer arm 127 is pro-

vided with an abutment face 136 on its upper side at its inner end, which abutment is adapted to contact with a shoulder 137 on the inner arm 128 when the outer arm is raised.

The gearing connecting the main cam shaft 56 with the shaft 118 is such that the cam shaft 56 will make one revolution to each half revolution of shaft 118, that is, the separator actuating cam 120 will operate the separators through a complete cycle by a 180° rotation. Figure 11 diagrammatically illustrates the contour of 180° of the periphery 121 of cam 120 and shows how the cam roller 122 of one member 112 would be actuated thereby, it being understood that the remainder of the cam is a duplication of that shown in this figure so that the other member 112 would be actuated in synchronism.

In the operation of the rear suction cup or separator mechanism, when the diametrically opposite high portions 140 are opposite the rollers 122 on levers 123, the suction cups will be in the extreme upper position indicated in dotted lines at 132*a* of Figure 10. As the cam 120 rotates in the direction of the arrow of Figure 11 to position the inclines 141 of the cam 120 opposite the cam rollers 122, the upper ends of the levers 123 will move rearwardly to permit the suction cups 132 to drop by gravity upon the surface of the uppermost sheet of the stack 51, closely adjacent the rear corners of this sheet. At this moment the valve mechanism 73 will cause suction to be exerted in the cups 132, causing the corners of the sheets to adhere thereto. The rotation of the cam will subsequently cause the oppositely inclined surface 142 of cam 120 to come opposite the rollers 122, forcing the upper ends of the levers 123 forwardly and raising the outer arms 127 of the suction cup supporting members 126 to a position corresponding to that indicated in dotted lines at 132*b* of Figure 10, the outer arm 127 turning on the stud 129 of inner arm 128 during its movement. When the position indicated at 132*b* has been reached, the abutment surface 136 on the outer arm 127 will contact with the shoulder 137 on inner arm 128 and during the subsequent rearward movement of the upper ends of levers 123, the arms 127 and 126 will move together, the entire jointed member 126 thereby swinging on the pivot 128*a* at the inner end of inner arm 128.

The movement of outer arm 127 with respect to inner arm 128 will cause the upwardly bent corners of the sheets to be bent about the rollers 131 as indicated in Figure 13. By this action, the rear corners of the sheets will be bent on arcuate lines, that is, the corners of the sheet will be bent upwardly from the surface of the stack 51 and will be pressed outwardly intermediate this line of bending and the extreme outer corner of the sheet by the rollers 131. Such bending of the corners of the sheet will insure that any lower sheet or sheets which might tend to adhere to and bend upwardly with the uppermost sheet will be snapped away from the latter sheet.

It will be observed that the bending of the uppermost sheet is accomplished along diagonal lines. This method is considerably more effective than the bending of the sheet along a line extending transversely thereof, i. e., parallel with its rear edge, particularly in the handling of sheets of relatively heavy material, such as thin metal. Metal sheets, in particular, frequently resist bending on a line parallel to their rear edge because such sheets are not always perfectly flat but may be curved from edge to edge. If a sheet is even imperceptibly curved or bent from edge to edge, it will tend to resist any bending of the sheet across this curvature with such effect that the rear suction cups cannot lift the rear portion of the sheet. The bending of the sheets on diagonal lines at their corners entirely eliminates the possibility of the bending being resisted by any curvature of the sheet.

By the valve mechanism 73, as hereinafter described under the heading "The motor and pump assembly," suction is maintained at the cups 132 until the corners of the sheet are lifted to the extreme raised position, when the suction is released. During the time that the corners are being lifted, a blast of air will be directed beneath them from blast nozzles 140, one of which is supported rearwardly of each rear corner of the stack as shown in Figure 1 and each of which receives compressed air through the valve mechanism 73. The blasts of air directed beneath the upturned corners of the sheet tend to slightly raise the uppermost sheet from the next lowest sheet so that the uppermost sheet will, in effect, float above the stack upon a cushion of air.

The angle in the pins 129 which support the rollers 131 positions these rollers in planes parallel to the path of movement of the sheet from the stack when it is subsequently lifted by the forwarder mechanisms 60.

It will be observed that the casing elements 113 and 114 entirely enclose the operating shafting of the separator mechanism, obviating all possibility of oil or dirt falling upon the sheets.

It will be noted that by the construction described, the casing 113 may swing vertically upwardly upon the main cam shaft 56 as a pivot. During stack changing operations, an over-travel limit switch 110 (Figures 1 and 21) may be relied upon to stop the upward movement of the stack and should the stack lifting mechanism overrun after the switch has been actuated, the stack will merely swing the casing 114 upwardly without damage to the machine.

The front suction cup or forwarder mechanism

The positioning of the front suction cups or forwarder mechanisms 60 is indicated in Figures 1, 3 and 12, and one of the mechanisms is shown in detail in Figures 7, 8 and 14.

Two of the forwarders are provided upon the machine, one adjacent each side edge of the stack 51. Since the construction of the two forwarders is identical, the following description of the detailed construction of one will apply to both.

Each forwarder is supported from the transverse beam 86 as best shown in Figure 14, the supporting frame 150 of the forwarder being rigid with the beam. The supporting frame or casting 150 is in the form of a bar or beam extending in a direction lengthwise of the machine and having its ends curved downwardly as indicated at 151. The ends of rods 152 are supported in bores provided in the downwardly extending ends 151 of the bars 150, the rods 152 being horizontally spaced as shown in Figure 7 to provide a trackway. A plate 153 is bolted to each side of the bar 150 adjacent the rear end thereof, the left-hand end as viewed in Figures 7 and 14, these two plates being curved outwardly from the bar as shown in Figure 8 and thence extending downwardly past the rods 152. The lower ends of the plates 153 are angled toward each other and each plate has fixed thereto an

upwardly facing cam track 154, best shown in Figure 14. A plate 155 is fixed to each side of the bar or beam 150 adjacent its forward end (right-hand end in Figures 7 and 14), these plates extending downwardly to a point somewhat below the rear plate 153 and serving to support between them a pin 156 for a purpose hereinafter set forth.

A carriage 157 is slidable upon the trackway formed by the rods 152, the carriage 157 having bores extending therethrough to receive the rods. From the forward end of the carriage 157, the right-hand end of Figures 7 and 14, there extends a link 158 which is pivotally connected to the upper portion of the carriage 157 by means of a pin 159 journalled in the carriage. The link 158 is preferably provided with means such as a threaded sleeve as shown, to permit its length and thereby the movement of the carriage 157 to be adjusted, and its forward end (right-hand end of Figures 7 and 14) is pivotally connected to a lever 160 mounted to swing on the pin 156 extending between the lower ends of the front plates 155. At a point adjacent its lower end, the lever 160 carries a roller 161 arranged opposite a cam 162 on the main cam shaft 56. The roller 161 of lever 160 is held in contact with the cam 162 by means of a spring 165 bearing upon the forward side of lever 160 and above the roller 161. The spring 165 is mounted upon the telescoping members 166 and 167, member 166 being pivotally connected to the forward side of the lever 160 and member 167 being similarly connected to a bracket 168 secured to a bar 169 extending transversely of the apparatus.

By the above arrangement, it will be obvious that the carriage 157 will be tended to the position shown in solid lines in Figures 7 and 14 by the spring 165 and that the movement of the high portion of cam 162 against the roller 161 on lever 160 will draw the carriage forwardly or to the right in Figure 14 against the action of the spring.

A suction cup or sheet engaging element 172 fixed to the lower end of a rod 173 is supported upon links 174 and 175 pivotally connected to the rear end of the carriage 157. Link 175 is pivoted on a pin extending between trunnions 176 on the extreme upper portion of the rear end of the carriage and is pivotally connected to the upper end of the cup carrying rod 173. Two links 174 are pivotally connected to the lower rear portion of the carriage, one on either side thereof and both extending inwardly to be pivotally connected to the cup supporting rod 173 intermediate the length of the latter. Links 174 and 175 are of equal length and the distances between the axes of their pivots upon both the carriage and the cup supporting rod 173 are the same, with the result that the links will always be parallel. The lower links 174 have rollers 177 journalled on their outer sides and these rollers are adapted to move along the members of cam track 154 when the carriage reciprocates. As shown in Figure 14, the rear end of each of the members forming cam track 154 is cut away to form a low portion 178, which low portion has an incline 179 extending upwardly therefrom to the high portion 180 of the track, the high portion 180 being of substantial length. The suction cup 172 is connected by tubing 184 with the valve mechanism 173. As is hereinafter described under the heading "The motor and pump assembly," the valve mechanism is so operated that suction will be exerted by the cup 172 when it contacts with the surface of the uppermost sheet of the stack, this suction becoming effective immediately prior to the release of the suction in the rear suction cups of separate mechanism 59.

The operation of each forwarder mechanism 60 is as follows: As the high portion 162*a* on the cam 162 on main cam shaft 56 moves from a position opposite the roller 161 on operating lever 160, the spring 165 will force the carriage 157 from the position indicated in dotted lines on Figure 14 to the rear, or left as viewed in Figure 14. The carriage will move along the trackway 154 with the rollers 177 of lower links 174 bearing on the high portion of each cam track 154, thereby holding the suction cup at the height indicated in dotted lines. However, as the carriage reaches the rear end of the trackway, the rollers 177 will move down the inclines 179 of the cam tracks, permitting the suction cup to move almost straight downwardly to a position in engagement with the top sheet as indicated in solid lines in Figure 14 as the low portion 162*b* of the cam comes opposite roller 161. The valve mechanism 73 will cause the suction to be effective at this moment, and the continued rotation of the cam 162 to turn the high portion 162*a* again opposite the roller 161 will cause the operating lever 160 to be moved forwardly toward the dotted line position indicated in Figure 14. The resulting movement of carriage 157 to the right (Figure 14) will cause the rollers 177 to move up the inclines 179 on the cam tracks, causing the suction cup to be sharply lifted to raise the leading edge of the sheet in an almost vertical line. When the rollers 177 reach the high portion 180 of the cam tracks, the suction cups will be raised to the height indicated by the dotted line showing thereof in Figure 14, thereby raising the leading edge of the sheet above the upper edge of the stack gauge plate 61 and the stripper bars 62. The forward movement of the cups 172 at this height will position the leading edge of the sheet slightly above the upper surface of the driven outfeed rolls 64 included in the feed table 65. After a short length of the sheet has passed over the rolls 64, the suction in the cups 172 will be released and the hold-down rolls 66 will be moved downwardly upon the upper surface of the sheet to hold it in engagement with the driven rolls 64 so that the sheet will be advanced through the calipering mechanism 67 by the rotation of the latter rolls.

The arrangement of the above mechanism whereby the cups are moved into engagement with the uppermost sheet by the action of a spring such as 165 enables the cups to be properly positioned upon the stack despite a certain variation of the height of the stack such as might result from the fact that one side of the stack is slightly higher than the other.

The stripper mechanism

The stripper mechanism 62 is shown in relation to the other elements of the apparatus in Figures 3 and 6, and is illustrated in detail in Figures 15 to 18. As is indicated in Figure 15, the stripper mechanism comprises two vertically arranged bars 185 mounted on the forward side of the stack gauge plate 61.

Figures 16 and 17 illustrate the detail construction of the bars 185, which are offset adja-

cent their upper ends with the offset portions adapted to move into and out of notches 186 in the upper edge of the gauge plate 61. The upper ends of the bars 185 extend slightly above the upper edge of the gauge plate, the offset portions, in normal position, thereby serving to gauge the front edges of the uppermost sheets in the stack. Two stripper bars 185 are preferably provided, one adjacent each side of the gauge plate 61, but the number may of course be varied.

Intermediate their length, each stripper bar has fixed thereto a forwardly extending strap or trunnion 187 positioned about an eccentric 188 fixed to a shaft 189, which shaft is journalled in bearings 190 secured to the forward side of the gauge plate. The lower end of each stripper bar 185 is curved outwardly from gauge plate 61 as indicated at 191 and is positioned in a bracket 192 fixed to the gauge plate. A set screw 193 is provided in each bracket to limit the movement of the lower end of the bar toward and from the gauge plate, the screw 193 being positioned to permit the bar to slide beneath the same as is hereinafter described and also, in effect, serving as a pivot point for the bar. A bracket 194 is fixed to the gauge plate above the shaft 189 to guide the outward swinging movement of the bar with respect to the gauge plate. The shaft 189 is rotated by a sprocket chain 196 or the like driven by a sprocket 197 on the main cam shaft 56. One run of the chain may pass about a guide roller 255 on the shaft 252 carrying the driven outfeed rolls 64 as shown in Figure 15.

The operation of the stripper mechanism is as follows: The rotation of the eccentric 188 exerts pressure upon the trunnion 187 and the adjacent surface of the stripper bar 185 to cause the upper end of the bar to move through the following orbital path indicated by the arrowed line in Figure 18 and from the normal position shown in Figure 16. The upper edge of the stripper bar 185 first moves downwardly and forwardly as the leading edge of the sheet leaves the stack 51 by the action of the forwarders 60, the set screw 193 and curved lower end 191 of the bar permitting this movement. As the sheet continues to move forward, the upper end of the stripper bar continues its movement in an orbital path, now moving upwardly and still further forwardly to a point beneath the periphery of the outfeed rolls 64. At the time that the leading edge of the sheet is well past the center line of the rolls 64, the stripper bar will move upwardly and rearwardly as shown by the arrowed line in Figure 18 adjacent the under surface of the forwarder supported sheet so that its upper end will engage the leading edge of any sheet which might have been dragged forward out of proper position on the stack 51. The stripper bar will then move rearwardly and downwardly to complete its orbital movement and to return any displaced sheet to its normal position on the stack. As is indicated by the dotted line in Figures 16 and 17, the upper ends of the stripper bars move in an elliptical orbit which is of particular effectiveness in returning displaced sheets to proper position on the stack.

The platform lift control mechanism

The lift controlling mechanism, in relation to the other elements of the apparatus, is illustrated in Figures 1, 3 and 14, and is shown in detail in Figures 19 and 20.

The platform lift mechanism is arranged to hold the stack at such height that the uppermost sheet thereof can be engaged by the front suction cups 172 of the forwarder mechanisms 60 to enable these cups to properly engage the surface of the uppermost sheet; the power for raising the platform under such conditions, that is, during the operation of the feeder, being furnished from the main cam shaft 56.

The main cam shaft 56 of the machine is driven from a shaft 58 (Figures 1 and 6) extending from the apparatus to which the feeder delivers sheets.

The construction of the lift control mechanism is described in detail in our original application Serial No. 25,908. Its operation is as follows: As the front suction cups 172 are lowered to contact with the uppermost sheet on the stack 51, a projection 173*a* at the upper end of each of the cup supporting rods 173 will move toward the flange 211 on the trip member 63. Should the portion of the stack beneath that front suction cup be at such height that it is not necessary to lift the stack before the cups descend again, the downward movement of the suction cup will be so limited by the stack that the shoulder 173*a* of the cup rod will not come into contact with the flange 211 of trip 63. Immediately subsequent to this downward movement of the suction cup, the lift drive eccentric 235 on the main cam shaft 56 will move to a position to impart a downward movement to pawl operating rod 233, moving the pawl 229 to the left as viewed in Figure 20. However, since lift control trip 63 has not been moved by the downward movement of the suction cup, the pawl hold-out member 224 will be in inward position shown in Figure 20 and therefore in the path of movement of pawl 229, preventing the pawl from engaging the teeth of the ratchet wheel 226, so that shaft 228 will not be rotated, and the stack platform will remain in its former position.

In the event that the stack is at such height that either front suction cup 172 must move downwardly to a position approximating its extreme limit of downward movement to contact with the uppermost sheet of the stack, it would, of course, be necessary that the stack be raised before the suction cups again descend. This action will be accomplished due to the fact that when either suction cup moves downwardly a greater than predetermined distance, the shoulder 173*a* thereon will come into contact with the flange 211 of trip 63, moving this trip downwardly against the action of spring 212 so that the far end 216 of corresponding lever 214 will be raised, thereby rocking the rod 218. The above described turning movement of rod 218 will be transmitted through its arm 222 and the link 223 to move the flange 225 of pawl hold-out member 224 upwardly, thereby moving the latter member outwardly (to the right in Figure 20) and away from the ratchet wheel 226 to the dotted line position shown in Figure 19. As a result, when the bell crank 232 and the pawl 229 carried thereby are swung to the left (Figure 20), the shaft 228 will be turned and the pinion 236 thereon will rotate to permit the larger pinion 237 on the lifting drive shaft 55 to turn the latter shaft. Such rotation of shaft 55 will rotate the chain drive shafts 54 to raise the platform 50 before the suction cups 172 again descend.

The distance which the platform 50 is raised by each movement of the lifting pawl 229 is preferably slightly greater than the thickness of a sheet of the material which is being handled by the feeder. With such a setting of the lift con-

trol mechanism, the suction cups will contact with the flange 211 of lift trip 63 on approximately four successive downward strokes out of each five such strokes and the uppermost sheet of the stack will thereby be maintained at a height at which it can be readily engaged by the front suction cups.

As is stated in our original application Serial No. 25,908, in the handling of relatively thick sheets of stock, for example metal sheets, it is found that the thickness of the individual sheets may vary over the area of one sheet and when such variances are totaled in a stack from three to five feet high, one side of the stack may be lower than the other. By the present arrangement of having a lift control trip 63 positioned adjacent each of the front suction cups, should the stack adjacent that cup be low because of variances in the thickness of the sheets, the trip 63 actuated by that cup will be continuously responsive to this condition and will keep that portion of the stack sufficiently high to permit the cup to engage that side of the uppermost sheet. This may, of course, result in the portion of the stack at the other side being at more than normal height, but this will not affect the operation of the machine since the suction cup at the high side of the stack will merely move down a smaller distance than normal, the shortness of its stroke being accommodated by the spring 165 which moves the suction cups of the forwarding mechanisms 60 to downward position.

The construction of the calipering mechanism 67 and its operation are described in our divisional application for Calipering mechanism, filed of even date herewith. The feed table 65 is described in our said original application Serial No. 25,908.

The motor and pump assembly

The motor 72 and the pressure and suction pumps 70 and 71, respectively, are best shown in Figures 2 and 21. The motor and pumps are mounted on bases secured to the forward sides of the standards 80 and 81. As best shown in Figure 21, the drive shaft 375 of the motor 72 is operatively connected to the driving shaft 376 of the pumps 70 and 71. The magnetic clutch 74 is adapted to connect shaft 376 with a shaft 377 having a bevelled gear 378 fixed thereto arranged to mesh with a bevelled gear 379 on a shaft 380 carrying a bevelled gear 381 which meshes with a bevelled gear 382 on shaft 228. As will be hereinafter described, when the clutch 74 is in engaged position, the motor 72, through shaft 380, will drive shaft 228 to lift or lower the stack platform 50.

The inlet 385 of suction pump 71 is connected by a lead 386 to the valve mechanism 73. The outlet of the suction pump is connected by piping 387 to the inlet pipe 70*a* of the pressure pump 70, remaining air required by the pressure pump being drawn through the mouth of inlet pipe 70*a*. The outlet from the pressure pump is connected by a line 388 to the pressure tank 389, from which extends a pressure line 390 leading to the valve mechanism 73. The lines 386 and 390 may be provided with pressure regulating valves 386*a* and 390*a*, respectively, as shown.

It will be observed that the pressure tank 389 is mounted above the pumps 70 and 71 and that the valve mechanism 73 is arranged above the pressure tank. By this arrangement, any oil which might be forced into the pressure tank with the compressed air from pump 70 will settle in the bottom of the pressure tank 389, instead of moving upwardly through the pressure line 390 to the valve casing. A bleed line 391 extends from the lower portion of pressure tank 389 to a point of connection with the inlet 385 of suction pump 70 and line 391 is provided with a valve 391*a* which will be maintained in almost closed position. This permits oil to settle in the pressure tank so that the latter, in effect, forms an oil reservoir from which oil flows into the suction pump and thence to the pressure pump, keeping both pumps lubricated, but with no possibility of oil flowing upwardly to the valve mechanism and the suction cups 132 and 172 or blast nozzles 140.

The pressure tank 389 may be provided with cooling fins 389*a* to hold the same at a low temperature and thereby prevent oil in the tank from becoming vaporized. So long as the oil does not vaporize, there is little possibility of it being moved from the tank and through the pressure line.

As best shown in Figures 4 and 5, the casing of the valve mechanism 73 is secured to the underside of the cross beam 86, and a rod 395 secured in arms 396 extending downwardly from each end of the valve casing has a plurality of valve operating rocker arms 397 journalled thereon. Each rocker arm is provided on its uppermost end with an adjustable tappet 398 arranged to contact with the outer end of one of a plurality of poppet valves 399 positioned in bores 400 extending horizontally through the valve casing, the rear ends of the bores being sealed by suitable packing. A spring 401 is provided in each valve chamber, one end of the spring bearing upon the face of the valve and the opposite end of the spring bearing upon a closure plate 402 at the forward end of the valve casing. Both the valve ends and the plate 402 may be provided with studs to center the springs thereon.

The lower ends of the rocker arms 397 are provided with rollers 403, each roller being adapted to engage one of a series of five cams, generally indicated by the numeral 404 fixed on cam shaft 56. It will be obvious from Figure 4 that when the low portion of one of the cams 404 is opposite the corresponding rocker arm roller 403, the corresponding valve 399 will be permitted to seat while when the high portion of the cam is opposite the rocker arm roller, the corresponding valve 399 will be moved to be unseated. As indicated in Figure 4, the valve chamber 406 of each valve is divided into two separate chambers when the valve is in seated position, one chamber opening from the valve casing through a port 407 and the other chamber opening from the valve casing through an outlet port 408.

Reading from left to right in Figures 5 and 21, the five valves and chambers are designated by the numerals 410, 411, 412, 413 and 414, respectively. As is shown in these two figures, the left-hand valve chamber 410 in the valve casing and the third valve chamber 412 from the left have their ports 407 connected by branches 416 and 417, respectively, with the suction lead 386. The other port 408 of the left-hand valve 410 is connected to a pipe 418 which terminates in a three-way coupling through which the pipe is respectively connected through branches 184 with the respective suction cups 172 of the forwarder mechanisms 60. The valve chamber 412 has a pipe 419 extending therefrom to a three-way coupling through which the pipe communicates with the branches 135 respectively communicat-

ing with the suction cups 132 of the separator mechanisms 59. Each of the pipes 418 and 419 has a return lead, numbered 420 and 421, respectively, connected thereto. Lead 420 of pipe 418 extends to the port 407 of the second valve chamber from the left (411) in the valve casing while the lead 421 from pipe 419 extends to the port 407 of the fourth valve chamber from the left (413). The ports 408 of the valve chambers 411 and 413 have fitted thereto short ends of tubing 422 having their outer ends turned downwardly to prevent any dirt from falling into the valve chambers with which they are connected. The right-hand valve chamber 414 has its upper port 408 connected to the pressure line 390 leading from pressure tank 389 while its lower port 407 has a pipe 423 connected thereto which pipe extends across the rear of the machine and has the blast nozzles 140 fixed thereto.

The operation of the suction controlling valves described above is as follows:

When the high portion of the cam 404 which controls the rocker arm of the valve chamber 410 is opposite the roller 408 on the rocker arm 397 controlling this valve, the valve will be in opened position and suction will be exerted through the line 418 at the suction cups 172 of the forwarder mechanism. At the same time, the low portion of the cam controlling the valve in valve chamber 411 will be opposite the rocker arm of that valve so that the latter will be in closed position. However, when the positions of these two cams are reversed, the valve in chamber 410 will be closed so that line 418 will be closed from suction main 386. At this time, the valve in chamber 411 will be held in open position by its cam so that air may flow inwardly through the tube 422, past the valve in chamber 411, through return lead 420 and thence through pipe 418 to the suction cups 172, thereby permitting the sheet which has heretofore been supported by these cups to drop.

The same method of operation will occur with the valve in chambers 412 and 413 which control the suction flow to the rear suction cups 132.

The control of the compressed air flowing through lines 390 and 423 is as follows: When the low portion of the pressure valve cam is opposite the roller 403 controlling the valve in valve chamber 414, the valve will be closed and there will be no flow of air to the blast nozzles 140. When the high portion of the cam moves opposite the roller 403, the valve will be opened and compressed air will flow inwardly through upper port 408, past the valve 399, and out through lower port 407 to line 423. At the proper moment, the cam will permit the valve to again close, thereby shutting off the blast of air.

It will be observed that the valves of the apparatus are thus located in a position convenient for adjustment and, furthermore, the mechanism is very compactly arranged.

The drive mechanism used in changing stacks

The drive mechanism used in changing stacks is shown in Figures 19 to 21. As is illustrated in Figure 21, and as has been described above, the motor 72 which ordinarily drives only the suction and pressure pumps 70 and 71 has upon its shaft a magnetic clutch 74 which magnetic clutch is ordinarily disengaged. The driven element of the clutch 74 is carried by a shaft 377 which acts through bevelled gears 378 and 379 to drive a shaft 380 extending upwardly on the left-hand side of the machine as indicated in Figures 1 and 2, the upper end of shaft 380 carrying a bevelled gear 381 which meshes with the bevelled gear 382 on the horizontally arranged cross shaft 228.

As has been heretofore explained, shaft 228 is ordinarily rotated with a step by step rotation by the engagement of pawl 229 with ratchet wheel 226 fixed to shaft 228. Therefore, in order to enable shaft 228 to be continuously rotated to drive shaft 55 and, therethrough, the chain drive shafts 54, it is necessary to hold pawl 229 out of engagement with the ratchet wheel 226. To accomplish this purpose, a pawl hold-out member 440, best shown in Figure 20, is pivoted upon a stud 442 carried in the side plate 83. The hub of the pawl hold-out member 440 is pivotally connected to a link 443, the lower end of the link being pivotally connected to a lever 444 which is mounted for swinging movement on a stud 445, also fixed in the side plate 83. The opposite end of lever 444 is pivotally connected to a small cross head 446 (Figure 2) mounted on the armature 447 of a solenoid 448 fixed to the cross beam 86. By this arrangement when the solenoid 448 is energized through suitable circuits hereinafter described and which are actuated when the feeder is operated for stack changing, its armature 447 will be drawn upwardly, moving the left-hand end of lever 444 (Figure 20) upwardly and thereby raising the pawl hold-out member 440 to lift pawl 229 and hold it out of engagement with the teeth of ratchet wheel 226.

The cross head 446 carries an adjustably mounted stud 450 at its outer end which stud, when the cross head moves upwardly as described above, is arranged to strike the actuating member 451 of a switch 452 mounted adjacent the solenoid 448. Switch 452 controls the flow of current to the magnetic clutch 74 and, by the above arrangement, after the pawl hold-out member 440 has been raised to lift the pawl 229 out of engagement with ratchet wheel 226, the magnetic clutch 74 will be energized so that motor 72 may continuously drive shafts 377, 380, 228, 55 and 54 to thereby either raise or lower the stack supporting platform 50, according to the direction in which the motor is rotated under the control of suitable switch elements, such as are illustrated in Figure 2 and acting through suitable circuits, hereinafter described.

Should the pawl 229 drop into engagement with the ratchet wheel 226 on shaft 228 before the ratchet wheel has ceased to rotate, particularly during the downward movement of the stack platform, either the pawl 229 or teeth of the ratchet wheel 226 may be broken or chipped. In order to prevent the pawl from dropping too suddenly, a dashpot 475 is provided beneath the cross head 446, the plunger 476 of the dashpot being connected to the cross head 446 to prevent the latter from moving downwardly too suddenly and thereby permitting the pawl 229 from dropping too quickly after the current to solenoid 448 has been cut off.

As is indicated in Figure 21, the motor 72 will be connected to a suitable source of power to enable it to drive the pumps 70 and 71 during the ordinary operation of the feeder. During such operation the remaining mechanisms of the feeder are driven through clutch 69 by the shaft 58 operated from the press or other mechanism to which the sheets are delivered and the clutch 74 on shaft 376 is disengaged. For stack changing operations, by operation of the proper switch button on the control in Figure 21, the motor

72 may be run (with clutch 74 engaged), in one direction for lifting the stack table, or rotated in the reverse direction to enable the stack table to be moved downwardly.

Should the stack be moved too high during stack changing operation, the over-travel limit switch 110 will open the circuit to stop the lifting operation of motor 72.

The electrical circuits and the operation of the apparatus controls

The feeder is ordinarily controlled from the left-hand side thereof (Figure 2), since the control of the press or other apparatus to which the feeder delivers sheets can be reached from this point. Also, the clutch operating lever 276*a* of the feeder is within reach of the operator standing on the left-hand side of the feeder. In order to permit the operator to control the feeder during its ordinary operation, a control panel 481 including a "Run" switch 482 (Figure 21) and a "Stop" switch 483 is mounted on the standard 81. During preparation of the feeder for running, or for stack changing operations, the operator would control the feeder from the right-hand side (Figure 3) and a control panel 480 is provided at this point, which panel includes an "Up" switch 485 (Figure 21), "Run" switch 486, "Down" switch 487 and "Stop" switch 488.

As shown in Figure 21, alternating current to operate the motor 72 may be furnished through a three-wire main comprising lines 490*a*, 490*b*, and 490*c*. Direct current to operate the magnetic clutch 74 may be supplied through a main including lines 491*a* and 491*b*.

When a stack 51 has been positioned between the chains 53, in order to move the stack upwardly to position the uppermost sheet thereof within reach of the separators 59 and forwarders 60, the operator would press "Up" switch 485. This would result in a flow of current from main line 490*b* through leads 492, 492*a*, 493 and 494, relay 495, lead 496, through overtravel limit switch 110, lead 497, switch 485 and then through leads 498 and 499 to main line 490*c*. The armature of relay 495 would thus be moved to close the circuits through the four contactors carried thereby. Current would thus flow from main line 490*a* through relay contactor 500 to leads 502 and 503 to motor 72. Current would also flow to the motor from line 490*b* through relay contactor 504, lead 506 to motor 72. A third circuit would be established through contactor 507 as follows: from main line 490*c*, through contactor 507 to lead 508 and to the motor, these three circuits causing the motor to be rotated. The pumps would thereby be driven but since the main clutch 69 is not engaged to drive the main cam shaft 56, the various sheet handling mechanisms would not be operated and the fluid from the pumps would be ineffective.

Current would also flow through the fourth contactor 510 to keep the relay closed, as follows, from main 490*b* through leads 492, 492*a*, 493 and 494, relay 495, lead 496, overtravel limit switch 110, leads 497 and 497*a*, through contactor 510, leads 515 and 516, normally closed stop switch 488 lead 517 through normally closed stop switch 483 and leads 518, 498*a* and 499 to main line 490*c*, thereby holding the relay 495 closed. In order to actuate the pawl hold-out member 404, a shunt circuit is provided from contactors 507 and 500 as follows: contactor 507, lead 519 through cut-out 519*a*, pawl hold-out actuating solenoid 448, leads 520 and 502 and contactor 500. Solenoid 448 will therefore be actuated to lift the cross head 446 to raise pawl hold-out member 440 so that the pawl 229 (Figure 20) will be disengaged from ratchet wheel 226 to permit shaft 228 to turn freely. The lifting of cross head 451 will also close switch 452 so that current may flow from line 490*c* through leads 499 and 498*a*, switch 452, lead 522, relay 523, leads 493, 492*a* and 492 tend to main line 490*b*, thus closing relay 523 which controls the current to magnetic clutch 74 from the D. C. lines 491*a* and 491*b* through the contactors of relay 523 and leads 525 and 526, respectively.

The stack platform 50 will move upwardly immediately magnetic clutch 74 is engaged since the motor is already running and the shaft 380 will now be rotated to drive shaft 228 continuously, pawl hold-out member 440 already having been placed in position to maintain pawl 229 lifted.

The stack 51 will move upwardly until it contacts with overtravel limit switch 110 to break the circuit through relay 495, thereby opening all of the above described circuits, or its upward movement may be stopped by operation of either of "Stop" buttons 483 or 488 to opened position, thereby breaking the circuit through relay 495 to open the closed circuits described above.

In the use of the apparatus, a "Run" switch would next be actuated to set the machine in normal operation. The circuits closed by the operation of the "Run" switches will be subsequently described but in order to make the relative arrangement of the circuits more readily apparent, the "Down" circuit is next described.

In order to move a platform downwardly to enable it to be removed from between the lifting chains 53, "Down" switch 487 would be pressed inwardly against its inner set of contacts 487*a*, thereby causing current to flow through main line 490*c*, leads 499, 498 and 530, across bridged contacts 487*a* through leads 531 and 531*a*, relay 532, and leads 493, 492*a* and 492 to main line 490*b*. Relay 532 being energized would cause the four contactors thereof to complete the respective circuits in which they are included. More specifically, contactor 534 would close the following circuit: 490*a*, lead 535, contactor 534, and leads 501, 502 and 503 to motor 72. Contactor 536 would close the following circuit: main line 490*c*, lead 537, contactor 536, and lead 506 to motor 72. Contactor 538 would close a circuit from 490*b*, lead 492, contactor 538, and lead 508 to motor 72, thereby causing the motor to be operated. The fourth contactor 539 of relay 532 will close a circuit to hold the relay energized, as follows: From main line 490*c* through lead 499, 498*a*, 518, closed stop switch 483, lead 517, closed stop switch 488, leads 516 and 515, contactor 539, relay 532, leads 494, 493, 492*a* and 492 to main line 490*b*. A shunt circuit will be formed from contactor 538 through lead 519 by cut-out 519*a* and pawl hold-out member actuating solenoid 448 and then through leads 520 and 502 to contactor 534. This circuit will actuate solenoid 448 to raise cross head 446, thereby closing switch 452 and resulting in a circuit through solenoid 523 which controls the direct current circuit to the magnetic clutch 74 as set forth above. Actuation of the clutch will cause the shaft 380 to be operated in the manner already described, but to cause the platform 50 to be moved downwardly, the flow of current to motor 72 having been reversed.

Since the circuit which is holding the contactors of relay **532** in closed position passes through the stop switches **483** and **488**, the above operation may be stopped by actuation of either of these stop switches.

The apparatus may be placed in normal running operation by actuating clutch operating lever **276***a* to move the main clutch **69** to engaged position, thereby causing the main cam shaft **56** to be driven, and by closing either "Run" switch **482** or **486** to operate the motor **72** which drives the pumps **70** and **71** so that the separator and forwarder mechanisms will be effective.

Movement of "Run" switch **482** to closed position will result in the following circuit: From main A. C. line **490***c*, leads **499**, **498***a* and **518**, through switch **482**, leads **550**, **551** and **552** to closed "Down" switch **487**, lead **553**, relay **554**, and leads **493**, **492***a* and **492** to main line **490***b*. The actuation of relay **554** will cause the cut-out **519***a*, carried by the armature of the relay, to move out of line **519** so that no current can flow to pawl hold-out solenoid **448** and the latter can not cause the direct current line to magnetic clutch **74** to be closed, as occurs when the "Up" or "Down" switches are operated. The closing of the contactors **555** of relay **554** will result in a shunt circuit from lead **550** to lead **493**, as follows: through lead **550***a*, (including contactors **555**) leads **560** and **556**, relay **532** and to lead **493**. Relay **532** being thus energized, will move its four contactors to set up circuits to drive the motor **72** and also to hold both it and the relay **554** energized. The circuits closed through contactors **534** and **536** to motor **72** will be the same as closed thereby during the "Down" operation described above and the same will be true of the contactor **538** except that the shunt circuit to solenoid **448** which is closed during "Down" operation cannot now be closed since the relay **554** holds cut-out **519***a* open, thereby preventing flow of current to pawl hold-out member actuating relay **448**. The fourth contactor, **539**, of relay **532** will close the following circuit: Main line **490***c*, leads **499**, **498***a* and **518**, closed stop switch **483**, lead **517**, closed stop switch **488**, leads **516** and **515**, contactor **539**, lead **556**, relay **532**, and leads **493**, **492***a* and **492** to line **490***b*. Relay **554** will be on a shunt from contactors **539** and **538**, as follows: contactor **539**, lead **560**, contactors **555**, leads **550***a*, **551** and **552**, the bridged contacts of "Down" switch **487**, lead **553**, relay **554**, and leads **493** and **492***a* to contactor **538**.

Obviously, the above circuits just described may be broken and the operation of motor **72** stopped upon actuation of either "Stop" switch **483** or **488**, since both of these switches are in the holding circuit.

If "Run" switch **486** is actuated, current will flow from line **490***c* through leads **499**, **498** and **530**, "Run" switch **486**, the bridged contacts of "Down" switch **487**, lead **553**, relay **554**, and leads **493**, **492***a* and **492** to line **490***b*, thus energizing relay **554**. The closing of the contactors **555** of relay **554** will result in a shunt circuit from lead **552** to lead **493**, as follows:—through leads **551**, **550***a*, contactors **555**, leads **560** and **556** and relay **532** to lead **493**. Relay **532** thus being energized, the motor and holding circuits described in connection with the actuation of "Run" switch **482** will be set up and actuation of either "Stop" switch **483** or **488** will cause the circuits to be opened and motor **72** stopped.

The operation of the separator mechanism **59**, stripper mechanism **62**, forwarder mechanism **60** and the operation of the compressed air pump **70** and valves **73**, as well as the drive for the entire apparatus, has been set forth in connection with the construction of each of these mechanisms.

Subject-matter disclosed but not claimed herein is claimed in our original application Serial No. 25,908, filed June 10, 1935, or in our other divisional application for Calipering mechanism, filed of even date herewith.

It will be understood that the invention is not limited to the details of construction shown in the drawings and that the examples of the use of the machine and mechanisms which have been given do not include all of the uses of which they are capable, and that the phraseology employed in the specification is for the purpose of description and not of limitation.

We claim:

1. The combination in a sheet feeder arranged to deliver sheets to a second apparatus, of sheet stack supporting means, sheet handling means, fluid pump means to provide a desired pressure of fluid at said handling means, means driven from said second apparatus to move said supporting and handling means, and a second driving means to operate said pump means.

2. The combination in a sheet feeder arranged to deliver sheets to a second apparatus, of sheet stack supporting means, sheet handling means, fluid pump means to provide a desired pressure of fluid at said handling means, means driven from said second apparatus to move said supporting and handling means, and a second driving means to operate said pump means, said second driving means being alternatively operative to move said supporting means.

3. The combination in a sheet feeder including sheet stack supporting means, of a pivoted sheet separator arranged to bend a portion of the adjacent sheet of the stack, and means associated and moving with said separator intermediate the latter and its pivot and about which the separator will bend the sheet.

4. The combination in a sheet feeder including sheet stack supporting means, of a pivoted sheet separator arranged to bend upwardly a rear corner of the uppermost sheet of the stack, and means carried by and moving with said separator intermediate the latter and its pivot and about which the separator will bend the sheet.

5. The combination in a sheet feeder including sheet stack supporting means, of a sheet separator arranged to bend upwardly a rear corner of the uppermost sheet of the stack, said separator being pivotally mounted, and means carried by said separator adjacent its pivot and about which the separator will bend the sheet.

6. The combination in a sheet feeder including sheet stack supporting means, of a sheet separating mechanism pivotally connected at its inner end to the frame of the feeder, said mechanism comprising arms pivotally connected to form a jointed lever, sheet engaging means carried by the outer end of said lever, means to move said end of said lever upwardly to bend a portion of the engaged sheet, the adjacent ends of the arms of said lever being arranged to project toward the upturned portion of the sheet during upward movement of the lever so that the sheet will be bent about said ends of said arms.

7. The combination in a sheet feeder including sheet stack supporting means, of a sheet separating mechanism pivotally connected at its inner end to the frame of the feeder, said mech-

anism comprising arms pivotally connected to form a jointed lever, sheet engaging means carried by the outer end of said lever, means to move said end of said lever upwardly to bend a portion of the engaged sheet, the adjacent ends of the arms of said lever being arranged to project toward the upturned portion of the sheet during upward movement of said lever, and a roller carried at the joint between said arms and about which the sheet will be bent.

8. A sheet separator mechanism for a sheet feeder including sheet stack supporting means, comprising a supporting frame mounted on the body of the feeder, sheet separating elements extending from said frame diagonally toward the rear corners of the sheet stack, and means to move said elements upwardly to lift the rear corners of the uppermost sheet of the stack and bend such corners on diagonal lines, said separator elements comprising jointed lever devices formed of pivotally connected arms, the adjacent ends of the arms being arranged to project toward the upturned portion of the sheet so that the latter will be bent intermediate its area.

9. A sheet separator mechanism for a sheet feeder including sheet stack supporting means, comprising a supporting frame mounted on the body of the feeder, sheet separating elements extending from said frame diagonally toward the rear corners of the sheet stack, and means to move said elements upwardly to lift the rear corners of the uppermost sheet of the stack and bend such corners on diagonal lines, said separator elements comprising jointed lever devices formed of pivotally connected arms, the adjacent ends of the arms being arranged to project toward the upturned portion of the sheet, and a roller mounted at the point of pivotal connection of the arms and about which the sheet will be bent.

10. A sheet separator for a sheet feeder including sheet stack supporting means, comprising a supporting frame mounted on the body of the feeder, an inner arm pivotally connected to said frame, an outer arm pivotally connected to the outer end of said inner arm, a sheet engaging element carried by said outer arm, means connected to said outer arm to initially raise said arm with respect to said inner arm, the adjacent ends of said arms being provided with faces adapted to abut during continued raising of said outer arm to cause said inner arm to subsequently swing upwardly.

11. A sheet separator for a sheet feeder including sheet stack supporting means, comprising a supporting frame mounted on the body of the feeder, an inner arm pivotally connected to said frame, an outer arm pivotally connected to the outer end of said inner arm, a sheet engaging element carried by said outer arm, means connected to said outer arm to initially raise said arm with respect to said inner arm, the adjacent ends of said arms being provided with faces adapted to abut during continued raising of said outer arm to cause said inner arm to subsequently swing upwardly, and means carried at a point adjacent the joint of said arms to contact with the upturned portion of the sheet and about which such upturned portion will be bent.

12. The combination in a sheet feeder including a stack gauge plate, of means to support a sheet stack adjacent said plate, means to engage and move sheets from the stack and over the upper edge of said stack gauge plate, and a vertically moving element to engage the under surface of a sheet moved over said stack gauge plate to remove a sheet adhering to the under surface of the engaged sheet.

13. The combination in a sheet feeder including a stack gauge plate, of means to support a sheet stack adjacent said plate, means to engage and move sheets from the stack and over the upper edge of said stack gauge plate, a vertically arranged bar, and means to move at least the upper end of said stripper bar in an orbital path to engage the under surface of a sheet moved over said stack gauge plate and remove a sheet adhering to the under surface of the engaged sheet.

14. The combination in a sheet feeder including a stack gauge plate, of means to support a sheet stack adjacent said plate, means to engage and move sheets from the stack and over the upper edge of said stack gauge plate, stripper means, and means to move said stripper means bodily upwardly and in an orbital path to engage the under surface of a sheet moved over said stack gauge plate and remove a sheet adhering to the under surface of the engaged sheet.

15. The combination in a sheet feeder including a stack gauge plate, of means to support a sheet stack adjacent said plate, means to engage and move sheets from the stack and over the upper edge of said stack gauge plate, stripper means, and means to move said stripper means upwardly against the under surface of the engaged sheet and thence counter to the movement of such sheet.

16. A sheet stripper for sheet feeders comprising a vertically arranged bar mounted on the frame of the feeder, a cam, a member carried by said bar encircling said cam, means to guide said bar for movement with respect to said frame, and means to rotate said cam to impart simultaneous vertical and swinging movement to said bar.

17. The combination in a sheet feeder including sheet stack supporting means, comprising a trackway fixed to the frame of the feeder, a carriage movable on said trackway, a sheet engaging member operatively connected to said carriage, a lever extending between the frame of the feeder and said carriage, resilient means engaging said lever to move said carriage to position said sheet engaging member upon the sheet stack and positive actuating means engaging said lever to move said carriage in the opposite direction to raise said member and the sheet engaged thereby from the sheet stack.

18. The combination in a sheet feeder, of means to direct air against sheets, a pressure pump, a storage tank, the outlet of said pump being connected to said tank and the outlet of said tank being connected to said means, said storage tank being below said means and above said pump, and a bleed line connecting said tank and the intake of said pump so that liquid will drain from said tank to said pump.

19. The combination in a sheet feeder, of means to direct air against sheets, a pump and a storage tank connected to said means, said storage tank being provided with cooling means to prevent liquid within the same from being vaporized.

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