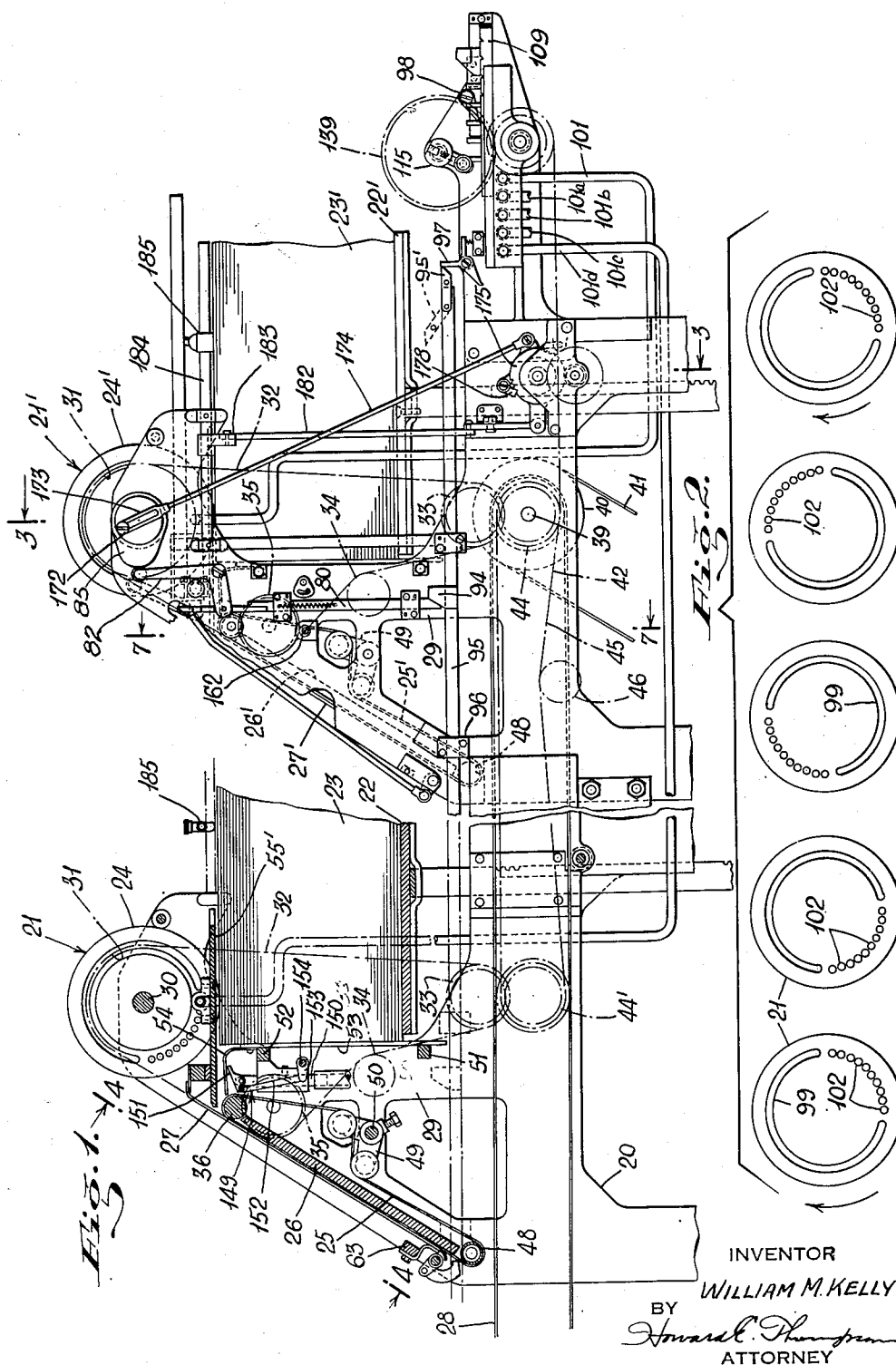


Filed Nov. 10, 1947

SHEET COLLATING MACHINE

6 Sheets-Sheet 1



April 14, 1953

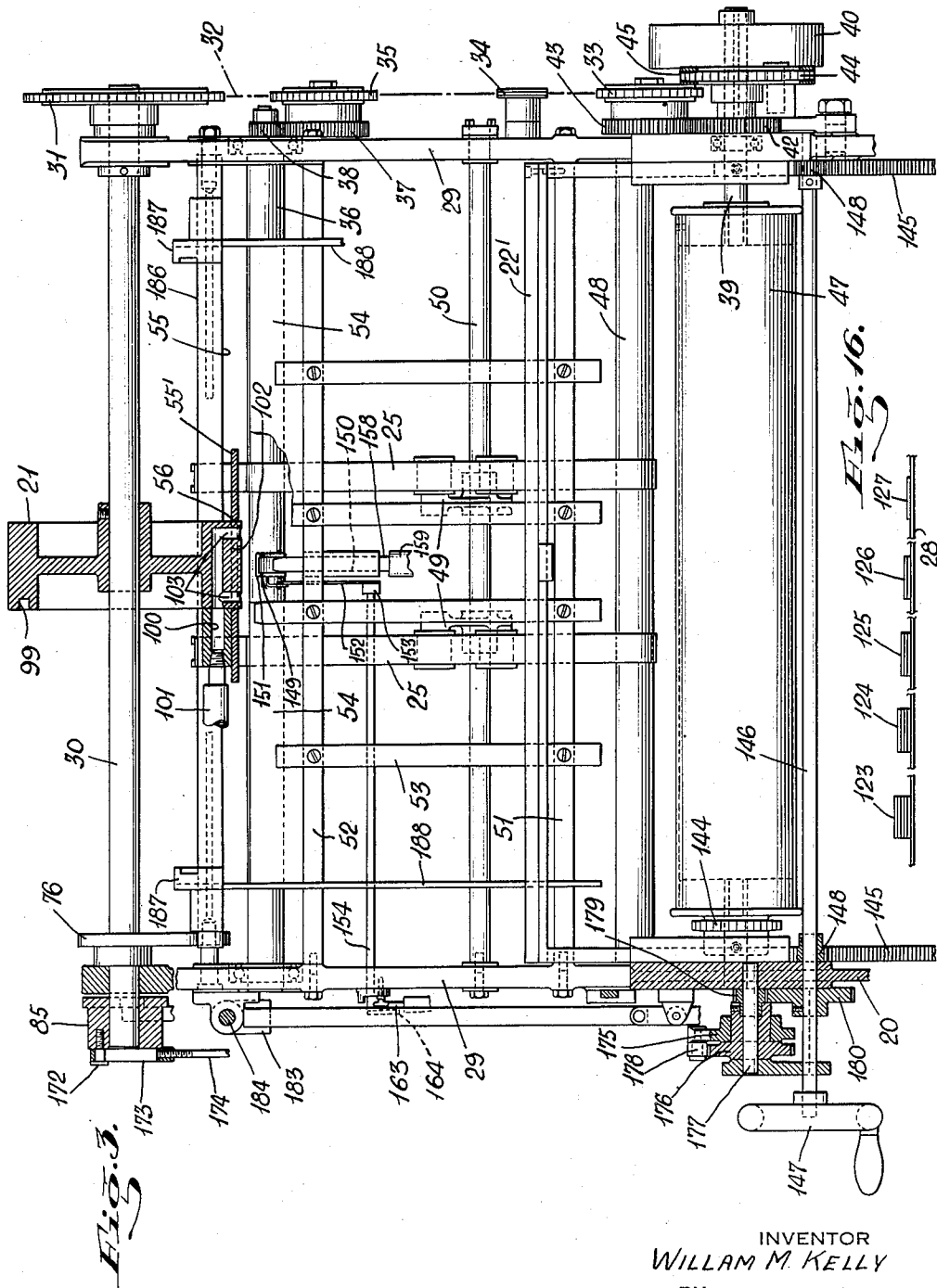
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2,634,972

SHEET COLLATING MACHINE

Filed Nov. 10, 1947

6 Sheets-Sheet 2



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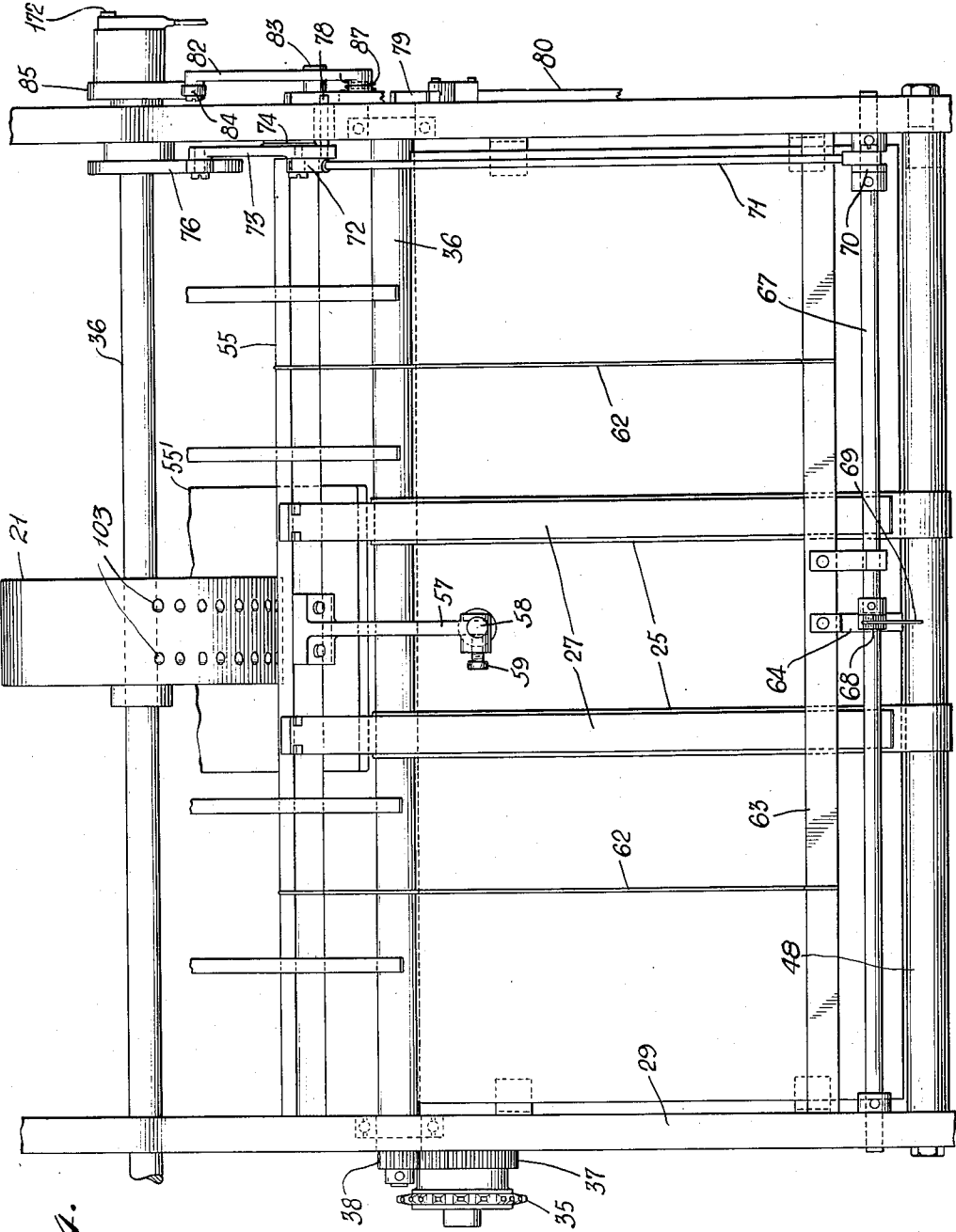
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6 Sheets-Sheet 3



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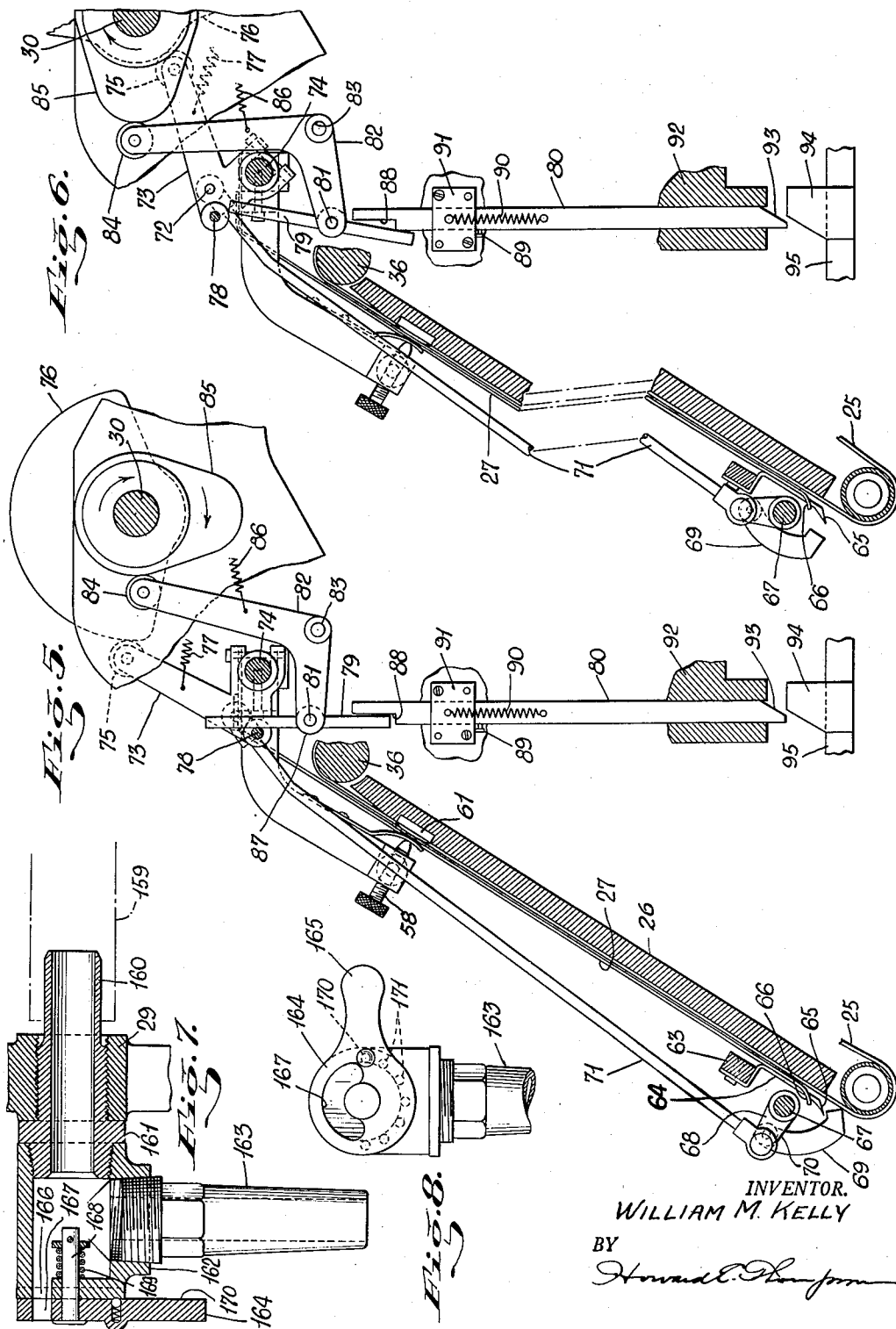
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2,634,972

SHEET COLLATING MACHINE

Filed Nov. 10, 1947

6 Sheets-Sheet 4



April 14, 1953

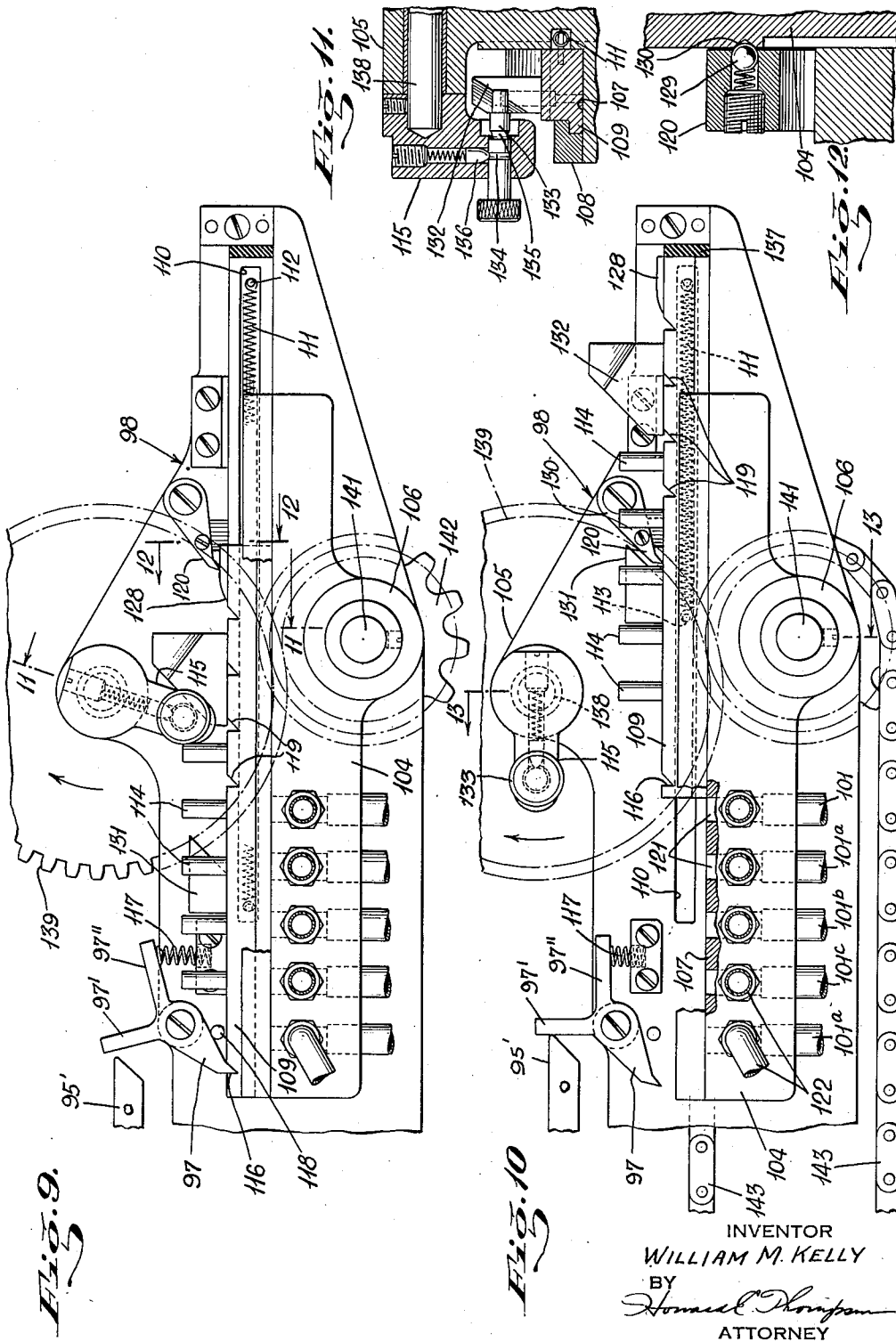
W. M. KELLY

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SHEET COLLATING MACHINE

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6 Sheets-Sheet 5



April 14, 1953

W. M. KELLY

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SHEET COLLATING MACHINE

Filed Nov. 10, 1947

6 Sheets-Sheet 6

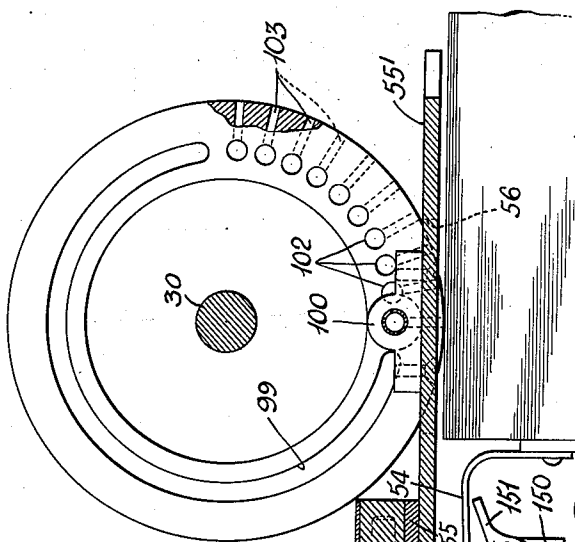


Fig. 15.

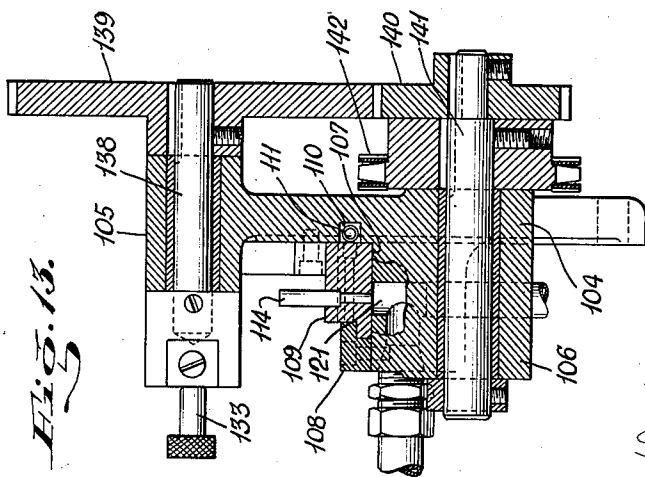


Fig. 16.

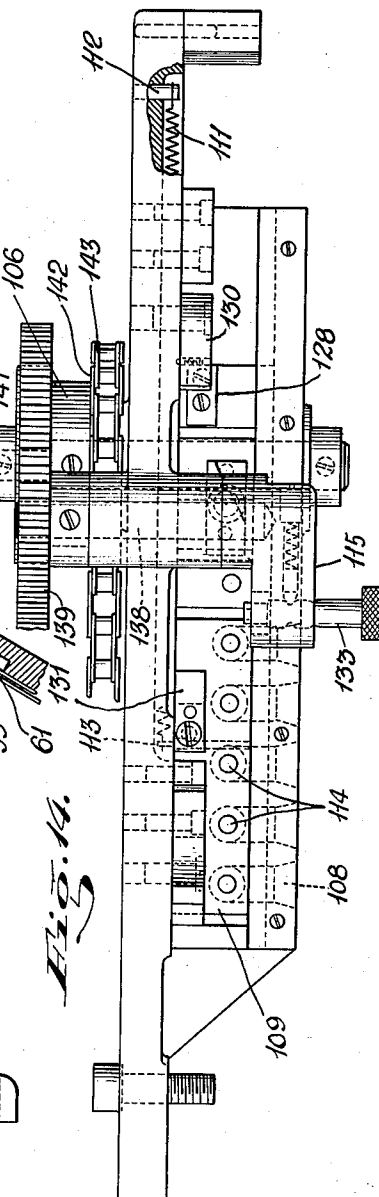


Fig. 17.

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UNITED STATES PATENT OFFICE

2,634,972

SHEET COLLATING MACHINE

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Application November 10, 1947, Serial No. 785,020

17 Claims. (Cl. 270—58)

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This invention relates to collating machines employing a plurality of substantially similar units arranged in a predetermined alinement, with conveyor means arranged beneath all of the units, with means in each unit for picking-up and delivering to the conveyor a predetermined sheet so that the deposit of the sheet from one unit will be upon a sheet delivered to the conveyor by a preceding unit. Still more particularly, the invention deals with a collating machine in which each unit has a pick-up and feed suction wheel, with means controlling operation of the wheel so that the failure of delivery to a sheet to the conveyor from any unit will cause all units to be rendered inoperative insofar as the sheet pick-up mechanism is concerned.

The novel features of the invention will be best understood from the following description when taken together with the accompanying drawing, in which certain embodiments of the invention are disclosed, and in which the separate parts are designated by suitable reference characters in each of the views; and in which:

Fig. 1 is a side and sectional view showing end portions of a multiple unit collating machine, with mechanisms of the machine in what might be termed a starting position.

Fig. 2 is a diagrammatic view showing the various positions of a suction wheel in a cycle of operation.

Fig. 3 is a section on the broken line 3—3 of Fig. 1 on an enlarged scale, with parts of the construction broken away.

Fig. 4 is a view looking in the direction of the arrows 4—4 of Fig. 1, on an enlarged scale.

Fig. 5 is a view similar to Fig. 1 showing only parts of the construction and with parts in section.

Fig. 6 is a view similar to Fig. 5 showing parts in a different position.

Fig. 7 is a partial section on the line 7—7 of Fig. 1, on an enlarged scale.

Fig. 8 is a face view of the structure as seen in Fig. 7, with parts broken away and omitted.

Fig. 9 is a view similar to Fig. 1 on an enlarged scale, showing only a part of the construction and with parts in a different position.

Fig. 10 is a view similar to Fig. 9, showing the parts in a different position.

Fig. 11 is a section on the line 11—11 of Fig. 9, showing the crank and pin in a different position.

Fig. 12 is a section on the line 12—12 of Fig. 9.

Fig. 13 is a section on the line 13—13 of Fig. 10.

Fig. 14 is a plan view of the structure as shown in Fig. 9, with parts in a different position.

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Fig. 15 is a view similar to Fig. 1, showing only a part of the construction on an enlarged scale with parts in a different position and with parts broken away; and

Fig. 16 is a diagrammatic view indicating the method of collating sheets by the units on the conveyor.

It is the purpose of my invention to provide a simple, economical and relatively foolproof machine for collating sheets of any type or kind. In carrying out my invention, I provide a plurality of substantially similar units, any number of which may be employed, depending upon the requirements of the user. For illustrative purposes, I will refer in the present case to a "Five Unit Machine" by means of which five sheets may be piled one directly upon the other and delivered at one end of the machine.

According to the present invention, I provide five sheet pick-up and delivery units arranged longitudinally over a constantly rotating conveyor unit. All of the units are simultaneously operated to deliver a sheet, or other elements, to be collated, onto the conveyor and in so timing the operation of the conveyor that the sheet of one delivery unit is delivered directly upon a sheet previously delivered to the conveyor by the preceding unit. Further, the invention comprises the use of suction wheels at each unit with automatically actuated means controlling supply of suction to the wheel whereby in the event of the failure of any unit to operate, or deliver a sheet to the conveyor, suction is automatically shut-off to all of the units, thus rendering the machine inoperative to the extent of sheet delivery.

Considering Fig. 1 of the drawing, I have shown at 20, the framework of the machine, which may be constructed in units attached one to the other, or may comprise a single frame in which a predetermined number of units are arranged. In said figure, 21—21' generally identify two end units of the machine, the machine being broken away centrally, and between these units will be disposed three other units in a five unit machine. Each unit comprises a vertically movable bed or table 22—22' upon which the sheets 23—23' to be collated are adapted to rest. The beds 22—22' are intermittently raised, as later described, to maintain the uppermost sheets in close proximity to suction delivery wheels 24—24' adapted to deliver the sheets to feed belts 25—25' travelling over an inclined plate 26—26' and beneath one of a number of retaining fingers or rods 27—27' in delivery of the sheets to an endless conveyor 28 arranged within the frame of the

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machine and extending from one end unit to a point beyond the other end unit to deliver collated sheets onto a receiving table, not shown, as it forms no part of the present invention.

As each unit is of the same construction, the brief description of one unit will apply to the other and common references will be applied to both, except to the extent indicated above, in distinguishing the two units of Fig. 1, one from the other.

Each unit has upright frame members, as at 29, note Figs. 3 and 4 and in the upper portion of the frame members is supported a shaft 30 to the central portion of which the suction wheel 21 is secured. The shaft 30 extends through the frame and secured to one end is a sprocket 31 over which passes a chain, indicated by dot and dash lines at 32, the chain 32 passing around a sprocket 33 at the lower portion of the unit around an idler, as at 34 and then around another sprocket 35, note in this connection Figs. 1 and 3 of the drawing.

Mounted between the frames 29 is a roller 36, which is rotated by the sprocket 35 through a gear 37 and a pinion 38 in driving the belts 25 of each unit. Mounted in the frame 20, adjacent the end unit 21' is a driven shaft 39 having at one end a pulley 40, over which a drive belt 41 passes, the belt being driven from a motor, not shown. On the shaft 39 is a gear 42 meshing with a gear 43, constituting part of the sprocket 33 and by means of which the chain 32 is driven. On the shaft 39 is a sprocket 44 over which passes a drive chain 45 which passes around other and similar sprockets beneath each of the units in alignment with the sprockets 33 and the sprocket of the end unit 21 is shown at 44'. Suitable idlers engage the lower portion of the chain 45, one of which is seen at 46 to maintain the chain taut at all times. By reason of this construction, all units of the machine or the mechanisms thereof are driven in synchronism.

On the shaft 39 is secured a drum 47 over which the conveyor 28 passes, suitable means commonly known in the art for maintaining the belt taut will be provided, but is not shown in the accompanying drawing.

The delivery belts 25 also pass over a roller 48 at the lower part of each unit, the belts also passing over belt crank idlers, as at 49, adjustable to maintain the belts taut at all times. The belt crank idlers 49 are adjustable on a shaft or rod 50 mounted in the frames 29. Mounted in the frames 29 is an open or lattice-work frame comprising two horizontal rods 51—52 and vertical rods 53, the latter having upwardly and forwardly extending platform portions 54 which guide and direct sheets from the pile 23 onto the delivery belts 25 above the roller 36 to insure feed downwardly between the belts and the rods 27, note in this connection Fig. 15 of the drawing.

Arranged above the forward end of each pile 23 between the frames 29 is a strip 55 supporting a plate or platform 55' cutout, as indicated at 56, note Fig. 3, to receive the lower portion of the wheel 21 so that the lower portion of the wheel 21 extends below the lower surface of the plate or platform 55' to engage the uppermost sheet of the pile 24, as will clearly appear from a consideration of Fig. 15 of the drawing. As a matter of fact, the lower surface of the wheel is at all times slightly spaced from the uppermost sheet of the pile, the sheet being picked-up to engage the surface of the wheel, by suction, as later described. Secured to the strip 55 centrally, is a forwardly

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and downwardly extending bracket 57, note Figs. 4 and 15, supporting at its lower end an adjustable screw 58 set in different positions of adjustment by a set screw 59 in controlling spacing of a curved spring 60 with respect to a button 61 mounted in the plate 26. This controls the feed of sheets by the belts 25 so that a single sheet only can pass through the adjustable control, adjustment being provided to compensate for sheets of different thicknesses. If for any reason two sheets should be delivered to the control point defined by the spring 60 and button 61 and be jammed at this point, no sheet will be delivered to the conveyor or to a stop control mechanism, later defined, thus automatically stopping the operation of the respective units, in a manner later clarified.

Considering Fig. 4 of the drawing, it will be apparent that the guide strips or fingers 27 are disposed in alignment with the belts 25 in maintaining the sheets in position for delivery and other sheet supporting rods 62 may also be employed, particularly in support of wide sheets.

Supported between the frames 29 is a transverse rod 63 to which is secured, centrally thereof, a spring finger 64 having a bevelled end 65, note Figs. 5 and 6, the finger being disposed slightly beyond the lower outwardly curved ends 66 of the strip guides 27. Also mounted in the frames 29 is a transverse rod 67 to which is secured a lever 68 in which is pivoted a trip or control element 69, note in this connection Figs. 4, 5 and 6. The element 69 is in the form of a very thin and lightweight finger which normally extends to the surface of the sheet as it passes over the belts 25, the finger 69 being swung outwardly by the sheet, sufficiently to move the finger to a position out of engagement with the end 65 of the spring finger catch 64. Secured to the rod 67, at one side of the machine, is another lever 70 with which a long link 71 is coupled. The link 71 is pivoted at its upper end, as seen at 72, note Fig. 6, to a crank lever 73 pivoted in the frame, as seen at 74. The crank 73 carries at its free end a roller 75 operating upon a cam 76 on the shaft 30. A spring 77 supports the crank 73 in constant engagement with the cam. The crank 73 carries a pin 78 which extends through the frame 29, note Fig. 4, to operatively engage an actuating dog 79 in controlling engagement and disengagement with a trip rod actuating plunger 80. Note in this connection Figs. 5 and 6.

The dog 79 has a pivotal mounting, as at 81, on one end of a L-shaped lever 82, pivoted in the frame, as seen at 83. The other end of the lever carries a roller 84 operating upon a cam 85, also on the shaft 30. A spring 86 maintains the lever 82 in constant engagement with the cam and a spring 87, note Fig. 4, is mounted on the pivot 81 and engages the dog 79 to normally urge the same in the direction of the plunger 80 to seat in a notch 88 in the upper end of the plunger 80. The dog 79 fits freely in the notch 88, the plunger 80 having stop means, as at 89, limiting upward movement thereof by the spring 90. The plunger operates in two guides 91 and 92, the lower end of the plunger having a bevelled wall 93 adapted to engage a bevelled block 94 on a longitudinal trip rod 95. It will here be understood that the rod 95 extends longitudinally of the machine, being slidably mounted in suitable guides, as for example, at 96, note Fig. 1, and one of the blocks 94 is disposed beneath or in close proximity to the plunger 80 or each unit so that any one of the plungers can actuate the trip rod 95 to trip a pawl

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97, releasing an air control mechanism 98, later described.

The respective plungers 80 are actuated as and when a sheet fails to be delivered from the lower end of the delivery belts 25 onto the conveyor 28. In other words, if at the instant a sheet is supposed to pass beneath the finger 69, a sheet does not present itself, the finger 69 maintains the position shown in Fig. 5, thus maintaining the dog 79 in the position shown in said figure, and when the cam 85 moves into the position shown in Fig. 6, the dog will be moved downwardly, actuating the plunger 80, which in turn engages the block 94 and moves the trip rod 95 to the right, tripping the pawl 97, thus allowing the mechanism 98 to automatically move from the position shown in Fig. 9 to the position shown in Fig. 10. On the other hand, if a sheet is delivered by the delivery belts 25 to the finger 69, the finger is thrown outwardly in the manner diagrammatically illustrated in Fig. 6, which operation actuates the link 71, moving the pin 78 to the position shown in Fig. 6, during which operation the pin working on the surface of the dog 79, causes the dog to be tilted sufficiently to disengage the notch 83 so that in the downward movement of the dog, the dog passes freely by the plunger and the plunger is maintained in its raised inoperative position.

Returning for a moment to the first mentioned operation of the plunger 80, it will be apparent that the lever 73 is given its normal operation through the cam 76 at all times, but when the catch or finger 69 is maintained in the position shown in Fig. 5 and the lever 73 attempts to raise and swing the pin 78, this motion is checked by engagement of the finger 69 with the spring end 65, thus holding the lever with the pin 78 substantially in the position shown in Fig. 5, leaving the dog 79 in its operative position. Whereas, if the finger 69 is raised by the sheet beyond the spring end 65, the lever 73 is permitted to perform its normal function and the pin 78 will then tilt the dog, as previously stated.

Returning now to the wheel 21 of the respective units, each wheel is of the structure more clearly seen in Figs. 3, 4 and 15. The wheel has a wide peripheral portion in one side of which is arranged a circumferential arc-shaped groove 99 adapted to register with a suction nozzle 100 having a pipe or tube connection 101 to the mechanism 98. To distinguish the pipes or tubes one from the other, in Fig. 1, the tubes will be identified as 101, 101^a, 101^b, 101^c, and 101^d, each tube leading to the respective units of the machine, the tubes 101—101^d being shown as extending to the end units, illustrated in Fig. 1.

The wheel 21 of each unit also has a series of circumferentially spaced apertures 102 which are also adapted to register with the nozzle 100, each aperture 102 having a pair of communicating apertures 103 opening through the peripheral surface of the wheel, as clearly seen in Fig. 3 and as indicated in part in Fig. 15. It will thus be apparent that if a suction prevails in the nozzle 100 and the apertures 102, this suction exposed at the surface of the wheel will cause a sheet from the pile 23 to be drawn upwardly. As the wheel 21 rotates, successive pairs of apertures 103 will be brought into registration with the sheet to provide a successive series of sheet grippings and rotation of the wheel will advance the sheet to the left or in the direction of the delivery belts 25 for delivery of the sheet thereto, as will be apparent.

In Fig. 2 of the drawing I have diagrammatically illustrated a cycle of operation of the wheel.

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The wheel as it appears at the left in said figure is in the beginning of the sheet pick-up operation, thus roughly for one-quarter revolution of the wheel, the sheet will be gripped and fed to the left, it being understood as each aperture 102 passes beyond the nozzle 100, the suction is broken and the sheet released. The sheet is further stripped from the surface of the wheel by the plate 55' which guides and directs the sheet to the belts 25, the platforms 54 also aiding in this operation. After the last of the apertures 102 have passed the nozzle 100, the elongated recess 99 is brought into engagement with the nozzle, thus exposing the suction to atmosphere and rendering the wheel inoperative until it returns to the gripping position, which is indicated at the extreme right of Fig. 2, when the above cycle of operation is repeated.

The suction mechanism 98 is shown in detail in Figs. 9 to 14 inclusive. On one side of the frame of the machine, is arranged an elongated block 104 having at its upper end a bearing portion 105 beneath and to one side of which is another bearing portion 106, note Fig. 13 of the drawing. The block has between the bearing portions a long platform, the upper surface of which is indicated at 107. To this surface is secured a slide retaining strip 108 grooved to retain a slide valve 109 against displacement from the surface 107 while permitting movement of the slide valve 109 longitudinally of the block 104. The block has an elongated recess 110 in the outer surface thereof in which is disposed a long coil spring 111 secured to the block at one end of the recess, as seen at 112, note Fig. 9, and to the slide 109, as indicated at 113. The spring 111 is adapted to normally maintain the slide 109 in its inoperative position, as seen in Fig. 10 of the drawing, whereas the slide is adapted to be intermittently advanced to the left to its fully operative position, as shown in Fig. 9, through a series of intermittent operations.

Projecting from the upper surface of the slide is a series of pins 114, the pin furthest to the left being normally disposed in position to be engaged by a crank 115 as the crank is rotated in advancing the slide step by step to the left until the slide has been fully advanced and the pawl 97 is forced into the notch 116 to check and hold the slide in its operative position, as seen in Fig. 9. In this figure is also shown the free end of the trip rod 95 which is adapted to engage a finger 97' on the pawl in moving the pawl into position disengaging the slide in the manner indicated in Fig. 10 of the drawing, the pawl 97 has another finger 97'' engaged by a spring 117, which normally urges the pawl into operative engagement or to seat upon the stop 118, which maintains the pawl in the position as shown in Fig. 9.

The upper surface of the slide 109 has a plurality of longitudinally spaced notches 119 adapted to be engaged by a gravity pawl 120 to hold the slide in its respective advanced stages and until the pawl 97 engages the notch 116, which maintains the slide in operative position during the continued operation of the collator. The block 104 has T-shaped passages with which the pipes 101—101^d communicate, which passages open through the upper surface 107 of the block and designated by the reference character 121 in Fig. 10 of the drawing and one of which is also shown in Fig. 13. The other branch of the passages opens through the outer side surface of the block and with which communicate suction pipes 122,

coupled with a suction line, and it is preferred that each pipe has its own pump for creating the suction. Thus it will be apparent that each unit of the machine is under independent control. When the slide 109 is in the inoperative position shown in Fig. 10, all of the passages 121 are open to atmosphere through the upper surface 107 of the block. However, as the slide is intermittently advanced to the left, successive passages 121 are closed by the slide valve, thus transmitting the suction to the respective pipes 161—101^d to the units, putting the respective units into operation. Here it will be apparent that in starting operation of the machine, the first unit, that is to say, the one to the right end of the machine, as shown in Fig. 1, will be operated to deliver a sheet to the conveyor, then the second unit will be put into operation and then the fourth and fifth, so that after five cycles of operation of the machine, five sheets will be delivered to the conveyor to a receiving station.

Turning to Fig. 16 of the drawing, here is diagrammatically shown the conveyor, or broken sections thereof, and at the extreme left is shown the five sheets as delivered to the conveyor in completing the full cycle above referred to, the stack of five sheets being designated by the reference character 123. At this particular moment of machine cycle, on the conveyor will be deposited to the right of the pile 123, a pile of four sheets 124, a pile of three sheets 125, two sheets as at 126 and a single sheet, as at 127. In other words, after the first complete operation, each unit of the machine is, at all times, delivering a sheet to the conveyor and stacks of five sheets are transmitted by the conveyor to the receiving station thereafter in each cycle of operation of the machine.

Considering Fig. 9 of the drawing, it will be apparent that when the slide 109 reaches the extreme end of its travel from right to left, and is retained in this position by the pawl 97, the pawl or catch 120 is moved into a raised position by a raised cam portion 128 on the slide and is held in this raised position by a spring pressed ball 129, note Fig. 12, which drops into a recess 130 in the block 104. This maintains the pawl or catch 120 in raised position when the slide 109 is moved from the position of Fig. 9, to the position of Fig. 10, maintaining the pawl 120 out of engagement with the notches or recesses 119. However, in the aforesaid movement of the slide 109, a raised cam portion 131 on the slide engages the pawl 120 and moves the same out of the held position in the recess 130 so as to rest upon the upper surface of the slide in order to again enter the various notches 119 when the slide is again moved to the left in the manner above stated.

Also arranged upon the slide 109 is another cam block 132 which is adapted to strike a blocking or control pin 133 to automatically move this pin outwardly into inoperative position. The pin is clearly shown in Fig. 11. This pin has two circumferential grooves 134 and 135 adapted to be engaged by a spring pressed rounded pin 136. The pin 133 is mounted in the crank 115 and is manually moved into the operative position shown in Fig. 11 so as to bring the pin into registering alinement with the pins 114, thus providing advancement of the slide 109 step by step in the aforesaid cycles of operation of the machine. However, upon completing full advancement of the slide valve 109, to the position shown in Fig. 9, the next turn of the crank 115 will cause the pin 133 to be thrown outwardly into inop-

erative position with the groove 135 engaged by the spring pressed pin 136. The pin 133 remains in this position until it is again manually moved inwardly to start advancement of the slide 109. The block 104 has at its right end a pad 137 of cushioning or shock absorbing material to take up the shock of the slide in movement into the position shown in Fig. 10.

The crank 115 is mounted on a shaft 138 supported in the bearing 135. Secured to the inner end of the crank shaft 138 is a gear 139 which meshes with a gear 140 on a shaft 141 mounted in the bearing 106. Also secured to the shaft 141 is a sprocket 142 over which passes a chain 143 which passes over a sprocket 144, note Fig. 3, on the shaft 39, thus providing a direct drive to the crank so that the crank is actuated in synchronism with the rest of the machine operation for advance of the slide valve, which puts all of the units of the machine into operation for the pick-up and delivery of sheets.

The table or platform 22 of each unit has a pair of downwardly extending racks 145 at side portions thereof, note Fig. 3 and mounted in the frames 29 at each unit is a shaft 146 having a crank wheel 147 at one end thereof and at one side of the machine. On the shaft 146 in registering alinement with the pair of racks 145 are pins 148. This construction provides for manual raising and lowering of the table 22, particularly in the operation of loading the sheets thereon or in setting the machine to bring uppermost sheets on the table in juxtaposition to the wheel 121.

In Figs. 1 and 3 of the drawing, I have shown a sheet fluttering device 149 which is also indicated in Fig. 7, and shown in part in Fig. 15 of the drawing. The device comprises a nozzle tube 150 having a manually adjustable hood 151 at the upper end thereof controlling direction of a blast of air to the under-surface of the plate 55' and in the direction of the edges of the sheets in the pile 23, as will be clearly apparent from the structure indicated in Fig. 15. The hood 151 is pivoted to the upper end of the nozzle and coupled therewith is a link 152 to the lower end of which is attached a crank lever 153 on a rod 154. The rod extends through one of the side frames 29, as clearly seen in Fig. 3, and secured to the protruding end of the rod is a manually adjustable plate 155 having a clamp screw 156 for retaining the hood 151 in different positions of adjustment, the clamp screw 156 operating in an elongated arc-shaped recess 157 in the plate 155. The nozzle 150 has a downwardly extending nipple portion 158 with which is connected a flexible hose 159 which extends to and is coupled with a corresponding nipple portion 160 on a sleeve 161, upon which is mounted a valve body 162. The sleeve 161 has a threaded mounting in the plate 29, as clearly indicated in Fig. 7 of the drawing. The valve body has a downwardly extending nipple 163 with which an air hose is adapted to be coupled for placing the nipple in communication with a source of air supply, under pressure, as for example from a blower, the latter not being shown, as it forms no part of the invention.

Adjustably supported on the valve body 162 is a control or regulating disc 164 having a finger grip portion 165, note Fig. 8. The valve body 162 has an arc-shaped opening 166 and the disc 164 a corresponding opening 167 and by adjusting the disc 164, the extent of the opening to atmosphere is controlled, and in this manner the pressure of air for fluttering the sheets can be sensitively regulated. The disc 164 is rotatable about an axis 168, upon which is spring means 169 ar-

ranged within the valve body for maintaining the disc in firm engagement with the surface of the body. The disc 164 carries a spring pressed ball 170 adapted to seat in one of a number of notches or recesses 171 on the valve body, note Fig. 8, in retaining the disc in different positions of adjustment. In Figs. 7 and 8 the disc 164 is shown in its fully open position with the ports 166 and 167 in complete registration. It will be apparent that the port 166 may also be fully closed by said disc.

On the hub portion of the cam 85 is a screw 172 on which is mounted an elongated loop 173 of a rod 174, the rod being pivoted to a disc 175 rotatable upon the hub portion of a ratchet 176 mounted on a stub shaft 177, note Fig. 3. The disc 175 has a pawl 178 adapted to engage the teeth of the ratchet in intermittently advancing the ratchet in control of the upward feed of the platform 22. On the shaft to which the ratchet is secured is a pin 179 meshing with a gear 180 secured to the shaft or rod 145. At 181 is a feed trip lever adapted to be actuated by a long link 182, the upper end of which is coupled with a lever 183 on a shaft 184, suitably supported at the upper end of the frame as clearly indicated in Figs. 1 and 3 of the drawing. Mounted on the shaft 184 is a transversely extending feeler arm 185 adapted to rest upon the uppermost sheets of the pile 23 so that as a predetermined number of sheets are consumed, the shaft 184 is partially rotated actuating the link 182 to in turn operate the lever 181 in moving the link 174 through the disc 175 to set the elongated loop end of the link 174 in an eccentric position, whereupon in the rotation of the screw 172, a partial rotation is transmitted to the disc 175, causing the pawl 178 to rotate the ratchet wheel 176, thus producing a predetermined upward feed of the table 22 to again bring the uppermost sheets into a feeding position.

The cam block 132 reaches a position registering with the crank and the pin 133 thereof when the slide has completed its stroke movement, as seen in Fig. 9 and as the crank continues to rotate from the position of Fig. 9, the pin will strike the cam surface, throwing the pin into inoperative position where it remains to clear the pins 114 in the automatic movement of the slide from the position of Fig. 9 to the position of Fig. 10. In Fig. 11, the pin 133 is shown in a position about to engage the cam block to be moved into the inoperative position, whereas in Fig. 9, the crank is shown with the pin 133 immediately after it has passed over the block.

On the bar 55 is a block or strip 186 supporting through the medium of brackets 187 at the ends thereof sheet guide bars 188 to guide the sheets as they are delivered onto the conveyor, note in this connection Fig. 3 of the drawing. This structure has been omitted from other figures for sake of clarity.

Pivotaly supported in connection with the right free end of the rod 95 is an extension 95' adapted to be thrown back into inoperative position, as seen in dotted lines in Fig. 1, and as and when the slide valve 109 is moved from the position shown in Fig. 10 to the position shown in Fig. 9. Upon completing this operation the extension 95' is thrown manually into the full line operative position to set the machine before going. This is essential, due to the fact that the suction is not completed to the nozzles of the successive units and the rods 80 of these successive units will be actuated due to the failure of

the passage of a sheet through the delivery mechanism of the units.

In connection with the adjustability of the air blast at the nozzle 151 through the medium of the control 164 a blast suitable for handling sheets of different thicknesses or weights can be maintained, it being understood in this connection that the machine is adaptable for use in handling sheets of various thicknesses or weights.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A collating machine comprising an endless conveyor, a plurality of similar sheet delivery units arranged above and spaced longitudinally of the conveyor, each unit comprising a work-sheet supporting table, a suction wheel arranged above and in close proximity to uppermost work-sheets on the table, a sheet delivery mechanism forwardly of said wheel for delivering sheets onto said conveyor, the path of sheet delivery and the path of conveyor travel being in the same vertical plane automatically actuated means controlling suction supply to the wheels of the respective units, each wheel having circumferentially spaced means for picking up and feeding a sheet to the delivery mechanism, means for guiding the sheet from the wheel to said delivery mechanism, the delivery mechanism of each unit comprising feed belts for picking up and feeding the sheet one at a time for deposit onto said conveyor, means in said delivery mechanism adjustably controlling the delivery of sheets one at a time to said mechanism, a single air control mechanism at one end of the machine controlling all of said units, and having means to successively actuate the several sheet delivery units for initial pack formation of the sheets, and means at the discharge end of said delivery mechanism actuated by a sheet discharged therefrom for maintaining the air control mechanism in constant operation.

2. A collating machine comprising an endless conveyor, a plurality of similar sheet delivery units arranged above and spaced longitudinally of the conveyor, each unit comprising a work-sheet supporting table, a suction wheel arranged above and in close proximity to uppermost work-sheets on the table, a sheet delivery mechanism forwardly of said wheel for delivering sheets onto said conveyor, the path of sheet delivery and the path of conveyor travel being in the same vertical plane automatically actuated means controlling suction supply to the wheels of the respective units, each wheel having circumferentially spaced means for picking up and feeding a sheet to the delivery mechanism, means for guiding the sheet from the wheel to said delivery mechanism, the delivery mechanism of each unit comprising feed belts for picking up and feeding the sheet one at a time for deposit onto said conveyor, means in said delivery mechanism adjustably controlling the delivery of sheets one at a time to said mechanism, a single air control mechanism at one end of the machine controlling all of said units, and having means to successively actuate the several sheet delivery units for initial pack formation of the sheets, means at the discharge end of said delivery mechanism actuated by a sheet discharged therefrom for maintaining the air control mechanism in constant operation, and said last named means including means whereby the failure to discharge a sheet from the delivery mechanism of any unit will automatically actu-

ate said air control mechanism to disable the same and render the suction wheels of all units inoperative.

3. A collating machine comprising an endless conveyor, a plurality of similar sheet delivery units arranged above and spaced longitudinally of the conveyor, each unit comprising a work-sheet supporting table, a suction wheel arranged above and in close proximity to uppermost work-sheets on the table, a sheet delivery mechanism forwardly of said wheel for delivering sheets onto said conveyor, the path of sheet delivery and the path of conveyor travel being in the same vertical plane automatically actuated means controlling suction supply to the wheels of the respective units, each wheel having circumferentially spaced means for picking up and feeding a sheet to the delivery mechanism, means for guiding the sheet from the wheel to said delivery mechanism, the delivery mechanism of each unit comprising feed belts for picking up and feeding the sheet one at a time for deposit onto said conveyor, means in said delivery mechanism adjustably controlling the delivery of sheets one at a time to said mechanism, and having means to successively actuate the several sheet delivery units for initial pack formation of the sheets, means at the discharge end of said mechanism actuated by a sheet discharged therefrom for maintaining the suction wheel in constant operation, a single air control mechanism at one end of the machine controlling all of said units, and said means of the air control mechanism comprising a slide valve normally controlling suction to the wheels of each unit and automatically breaking suction to said wheels upon the failure of the sheet delivery mechanism of any unit to deliver a sheet to the conveyor.

4. A collating machine comprising an endless conveyor adapted to be driven at constant predetermined speed, a plurality of similar sheet delivery units arranged above and spaced longitudinally of the conveyor, each unit being adapted to deliver a sheet onto the conveyor in such manner that delivery of sheets of successive units is upon the sheet delivered to the conveyor by the preceding unit in a preceding cycle of operation of the machine, the path of sheet delivery and the path of conveyor travel being in the same vertical plane sheet delivery of each unit comprising a suction wheel and a delivery mechanism, said wheel being adapted to pick-up the uppermost sheet of a pile in the unit and deliver the same to said delivery mechanism, a single air control mechanism on the machine controlling all of said units and said delivery mechanism having means actuated by a sheet delivered therefrom, and in operative engagement with said air control mechanism, for maintaining the wheels of all units operative.

5. A collating machine comprising an endless conveyor adapted to be driven at constant predetermined speed, a plurality of similar sheet delivery units arranged above and spaced longitudinally of the conveyor, each unit being adapted to deliver a sheet onto the conveyor in such manner that delivery of sheets of successive units is upon the sheet delivered to the conveyor by the preceding unit in a preceding cycle of operation of the machine, the path of sheet delivery and the path of conveyor travel being in the same vertical plane sheet delivery of each unit comprising a suction wheel and a delivery mechanism, said wheel being adapted to pick-up the upper most sheet of a pile in the unit and deliver the same to said delivery mech-

anism, a single air control mechanism on the machine controlling all of said units said delivery mechanism having means actuated by a sheet delivered therefrom, and in operative engagement with said air control mechanism, for maintaining the wheels of all units operative, said air control mechanism comprising a single slide valve controlling suction of the wheels of all units whereby said units can be successively actuated for controlling initial pack formation of the sheets, means for holding the valve in operative position, and the sheet actuated means of each unit automatically maintaining said valve in operative position.

6. A collating machine comprising an endless conveyor adapted to be driven at constant predetermined speed, a plurality of similar sheet delivery units arranged above and spaced longitudinally of the conveyor, each unit being adapted to deliver a sheet onto the conveyor in such manner that delivery of sheets of successive units is upon the sheet delivered to the conveyor by the preceding unit in a preceding cycle of operation of the machine, the path of sheet delivery and the path of conveyor travel being in the same vertical plane sheet delivery of each unit comprising a suction wheel and a delivery mechanism, said wheel being adapted to pick-up the uppermost sheet of a pile in the unit and deliver the same to said delivery mechanism, a single air control mechanism on the machine controlling all of said units said delivery mechanism having means actuated by a sheet delivered therefrom, and in operative engagement with said air control mechanism, for maintaining the wheels of all units operative, said air control mechanism comprising a single slide valve controlling suction of the wheels of all units whereby said units can be successively actuated for controlling initial pack formation of the sheets, means for holding the valve in operative position, the sheet actuated means of each unit automatically maintaining said valve in operative position, and each unit having means for automatically releasing the valve for movement into inoperative position upon the failure of the delivery of a sheet to the conveyor by any one of the units.

7. In a machines employing a plurality of similar sheet pick-up and delivery units spaced longitudinally of and above conveyor means actuated at a constant predetermined speed, each unit comprising means for supporting a stack of sheets, a delivery, a rotatable suction wheel arranged above the stack and adjacent an uppermost sheet of the stack for intermittently gripping the uppermost sheet of the stack and feeding the same to said delivery, the extent of intermittent gripping being synchronized with the feed requirements of the sheet for feed into the delivery, means to then check intermittent gripping of said sheet, said delivery of each unit delivering the sheet to the constantly operating conveyor means to deposit sheets of successive units one upon the other on the conveyor means, the path of sheet delivery and the path of conveyor travel being in the same vertical plane said mechanism having means to successively actuate the several sheet delivery units for initial pack formation of the sheets each delivery having means in operative engagement with said control mechanism and controlled by passage of a sheet therethrough controlling operation of said suction wheel of all units, whereby the failure of delivery of a sheet from any one unit.

onto the conveyor will automatically stop operation of the suction wheels of all units.

8. In machines employing a plurality of similar sheet pick-up and delivery units spaced longitudinally of and above conveyor means actuated at a constant predetermined speed, each unit comprising means for supporting a stack of sheets, a delivery, a rotatable suction wheel arranged above the stack and adjacent an uppermost sheet of the stack for intermittently gripping the uppermost sheet of the stack and feeding the same to said delivery, the extent of intermittent gripping being synchronized with the feed requirements of the sheet for feed into the delivery, means to then check intermittent gripping of said sheet, said delivery of each unit delivering the sheet to the constantly operating conveyor means to deposit sheets of successive units one upon the other on the conveyor means, the path of sheet delivery and the path of conveyor travel being in the same vertical plane said mechanism having means to successively actuate the several sheet delivery units for initial pack formation of the sheets a single control mechanism for the wheels of all units, each delivery having means in operative engagement with said control mechanism and controlled by passage of a sheet therethrough controlling operation of said suction wheel of all units, whereby the failure of delivery of a sheet from any one unit onto the conveyor will automatically stop operation of the suction wheels of all units, said control mechanism comprising a single control member normally maintained in operative position, and each unit having means for independently releasing said control member for movement into inoperative position.

9. A collating machine comprising a sheet conveyor, a plurality of sheet feed units spaced equally along said conveyor, sheet feeding mechanisms for the various units comprising suction picker means, each said mechanism being timed in accordance with conveyor travel to remove a sheet from the pile and deposit it upon the sheet carried forward from the preceding unit by the conveyor, a vacuum system comprising separate conductors for each of said suction picker means, a bleed port in each of said conductors, a common control means for said ports comprising a valve disposed for travel from an inoperative position step by step to successive positions covering said ports one after another to thereby energize the picker means of successive units until said valve occupies a final operative position in which all ports are covered, means for moving said valve step by step to said final operative position, and means set in motion by the failure of any one of said sheet feeding mechanisms to function for releasing said valve from said holding means and moving it in a single step to its inoperative position.

10. A collating machine comprising a sheet conveyor, a plurality of sheet feed units spaced equally along said conveyor, sheet feeding mechanisms for the various units comprising suction picker means, each said mechanism being timed in accordance with conveyor travel to remove a sheet from the pile and deposit it upon the sheet carried forward from the preceding unit by the conveyor, a vacuum system comprising separate conductors for each of said suction picker means, a bleed port in each of said conductors, a common control means for said ports comprising a slide valve biased in one direction, means for advancing said valve step by step in

the opposite direction to cover one part for each cycle of the machine until all of said ports are covered, means for latching said slide valve against movement when all of said ports have been covered, and means set in motion by the failure of any one of said sheet feeding mechanisms for disengaging said latching means.

11. In collating machines having a plurality of units, each unit having a suction actuated gripper wheel for gripping and delivering sheets of the units, a single valve member controlling suction operation of the gripper wheels of all of the units, means normally supporting the valve member in operative position to maintain suction supply to the gripper wheels of all units, each unit having automatically actuated means for releasing the valve member for movement into inoperative position to render the suction grippers of all units inoperative, said first named means comprising a crank having a constant drive, a pin on the crank, said pin being manually movable into position operatively engaging said valve member in intermittent operation thereof, and means moving said pin into inoperative position with respect to said valve member.

12. A collating machine comprising a conveyor, a plurality of sheet feed units spaced along said conveyor, sheet feeding mechanisms for the various units functioning in timed relation to each other to remove sheets from their respective piles and deposit them upon the said conveyor, a sheet detector means for each feeding mechanism, a trip rod disposed parallel to said conveyor, means controlled by any one of said detector means for shifting said trip rod, a control means adapted to be set in motion by said trip rod for disabling all of said feeding mechanisms, each said feeding mechanism comprises suction picker means, a vacuum system comprising separate conductors for each of said picker means, a bleed port in each conductor, said control means comprising a valve disposed for travel from an inoperative position step by step to successive positions covering said ports one after another to thereby energize the picker means of successive units until said valve occupies a final operative position in which all of said ports are covered, means holding said valve in operative position, and means set in motion by the shifting of said trip rod for releasing said valve from said holding means and moving it in a single step to its inoperative position.

13. A collating machine comprising a conveyor, a plurality of sheet feed units spaced along said conveyor, sheet feeding mechanisms for the various units functioning in timed relation to each other to remove sheets from their respective piles and deposit them upon the said conveyor, each of said feeding mechanisms comprising suction picker means, a vacuum system comprising separate conductors for each of said picker means, a bleed port in each conductor, a sheet detector means for each feeding mechanism, a trip rod disposed parallel to said conveyor, means controlled by any one of said detector means for shifting said trip rod, a control means adapted to be set in motion by said trip rod for disabling all of said feeding mechanisms, said control means comprising a slide valve, means for moving said valve step by step to cover said ports a latch for holding said valve at one end of its travel to cover all of said ports, and means biasing said valve toward the opposite end of its travel for uncovering said

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ports, said trip rod being adapted to release said latch, whereby all of said suction picker means may be disabled simultaneously.

14. A collating machine comprising a sheet conveyor adapted to be constantly operated, a plurality of sheet feeding units spaced equally along and above said conveyor, sheet feeding mechanisms for the various units comprising suction picker means, means for supporting a pile of sheets at each unit, each said mechanism being timed in accordance with conveyor travel to remove a sheet from the pile and deposit it upon the sheet carried forward from the preceding unit by the conveyor in forming packs delivered from the conveyor, said conveyor being of such length as to accommodate a variable number of said units, said units being equally spaced along said conveyor, the path of sheet feeding and the path of conveyor travel being in the same vertical plane, a plurality of unit drive means spaced along said conveyor consistent with spacing of said units, each of said units having a drive member engageable with its associated means, a vacuum system comprising separate conductors for each of said suction picker means, each of said conductors having a bleed port, an automatically operated sequence control mechanism for closing the ports of successive sheet feed units, and said mechanism closing step by step in the ports one after another in timed relation to conveyor travel until all ports are closed to energize the picker means of successive units one after another for initial pack formation of the sheets and the continued machine operation.

15. A collating machine, as defined in claim 14, comprising a sheet detector for each sheet feed mechanism, and means actuated by any one of said detectors for actuating the sequence control mechanism opening all of the bleed ports thus simultaneously disabling the picker means of all units.

16. In collating machines having a plurality of units, each unit having a suction actuated gripper for gripping and delivering sheets of the units onto a constantly moving conveyor in pack formation of the sheets, the path of sheet delivery and the path of conveyor travel being in the same vertical plane, a single valve member controlling suction operation of the grippers of all of said units, said valve member having a plurality of air control sections, each of which is connected to a gripper, means to initially actuate said sections successively for initial pack formation, means normally supporting the valve

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member in operative position to maintain suction supply to the grippers of all units in continuing formation of successive packs, and each unit having sheet controlled means for releasing the valve member for movement into inoperative position to render the suction grippers of all units inoperative.

17. A collating machine comprising a sheet conveyor adapted to be constantly operated, a plurality of sheet feeding units spaced equally along and above said conveyor, sheet feeding mechanisms for the various units comprising suction picker means, means for supporting a pile of sheets at each unit, each said mechanism being timed in accordance with conveyor travel to remove a sheet from the pile and deposit it upon the sheet carried forward from the preceding unit by the conveyor in forming packs delivered from the conveyor, a vacuum system comprising separate conductors for each of said suction picker means, each of said conductors having a bleed port, a common control valve for said ports, manually controlled automatic means operating said valve step by step from a position in which all ports are open to positions for closing said ports of successive sheet feed units, the ports of the units being closed one after another in timed relationship to conveyor travel until all ports are closed to energize the picker means of successive units one after another for initial pack formation of the sheets and the continued machine operation, a sheet detector for each sheet feed mechanism, and means set in motion by any one of said detectors for shifting said control valve in a single movement to its original open position and thereby bleeding all of said conductors simultaneously for disabling the picker means of all units.

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