

Nov. 10, 1959

K. H. GULICK

2,912,243

PILE ELEVATING MECHANISM AND CONTROL THEREFOR

Filed Dec. 16, 1955

7 Sheets-Sheet 1

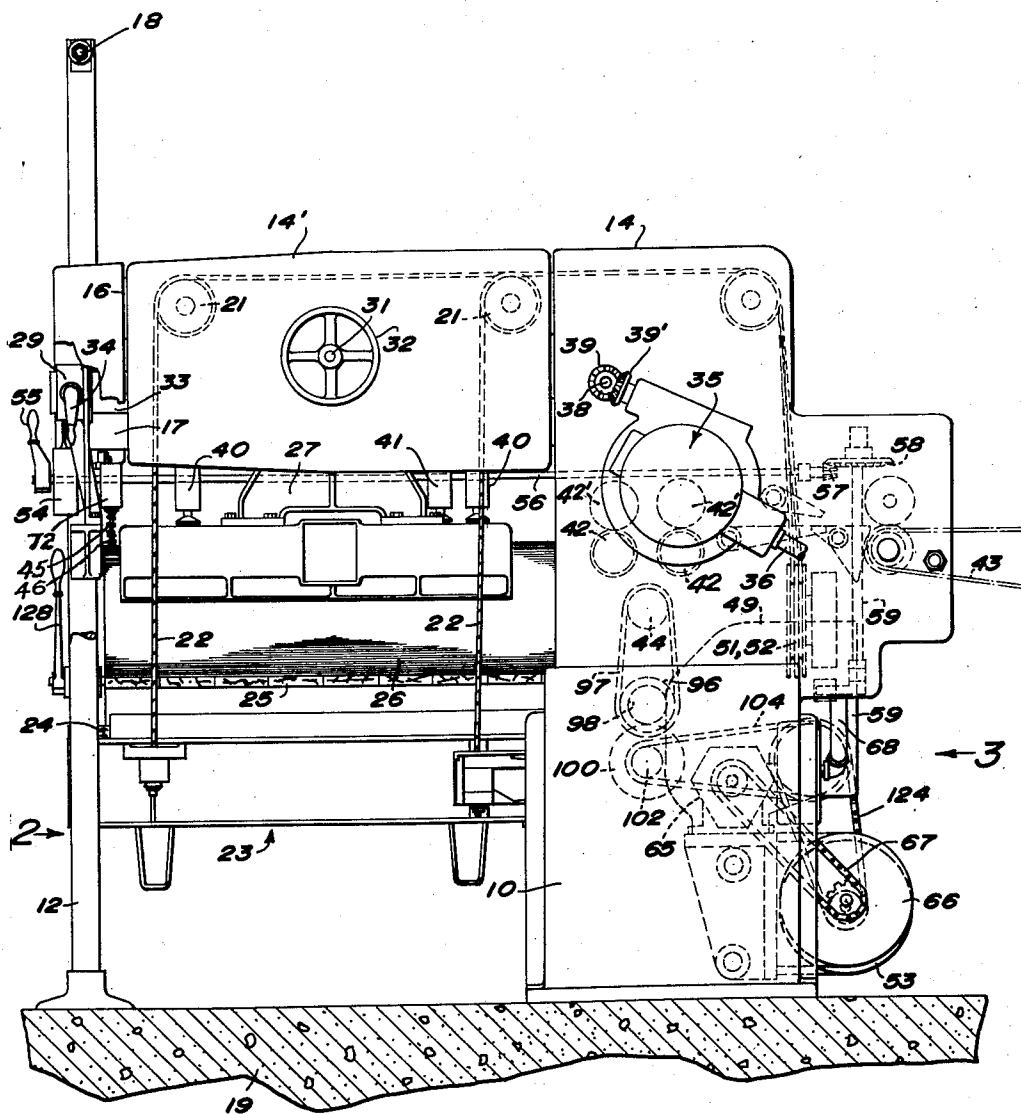


FIG. 1

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7 Sheets-Sheet 2

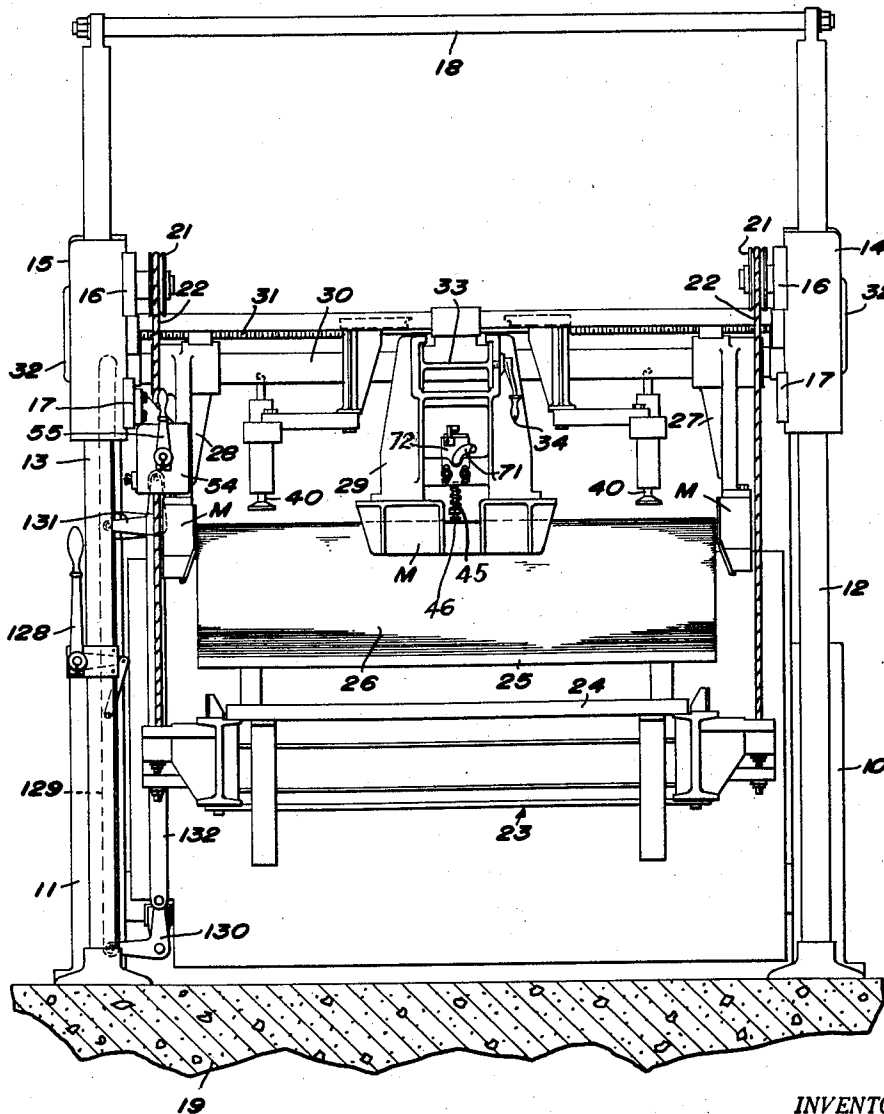


FIG. 2

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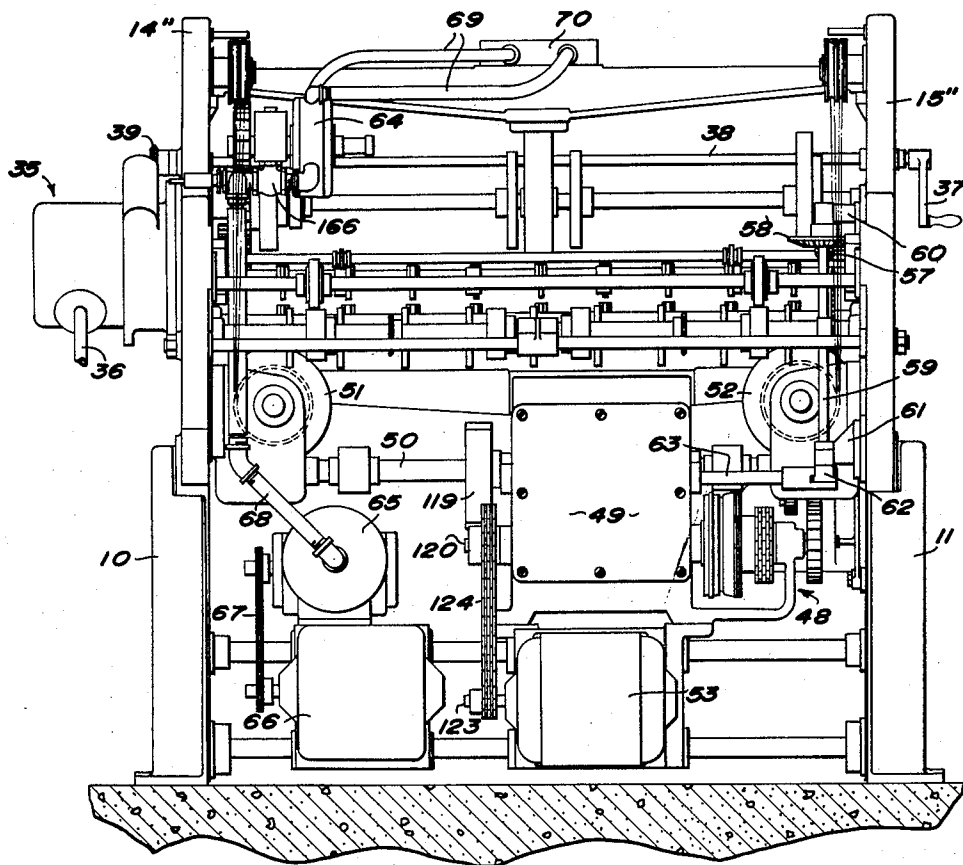
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7 Sheets-Sheet 3



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7 Sheets-Sheet 4

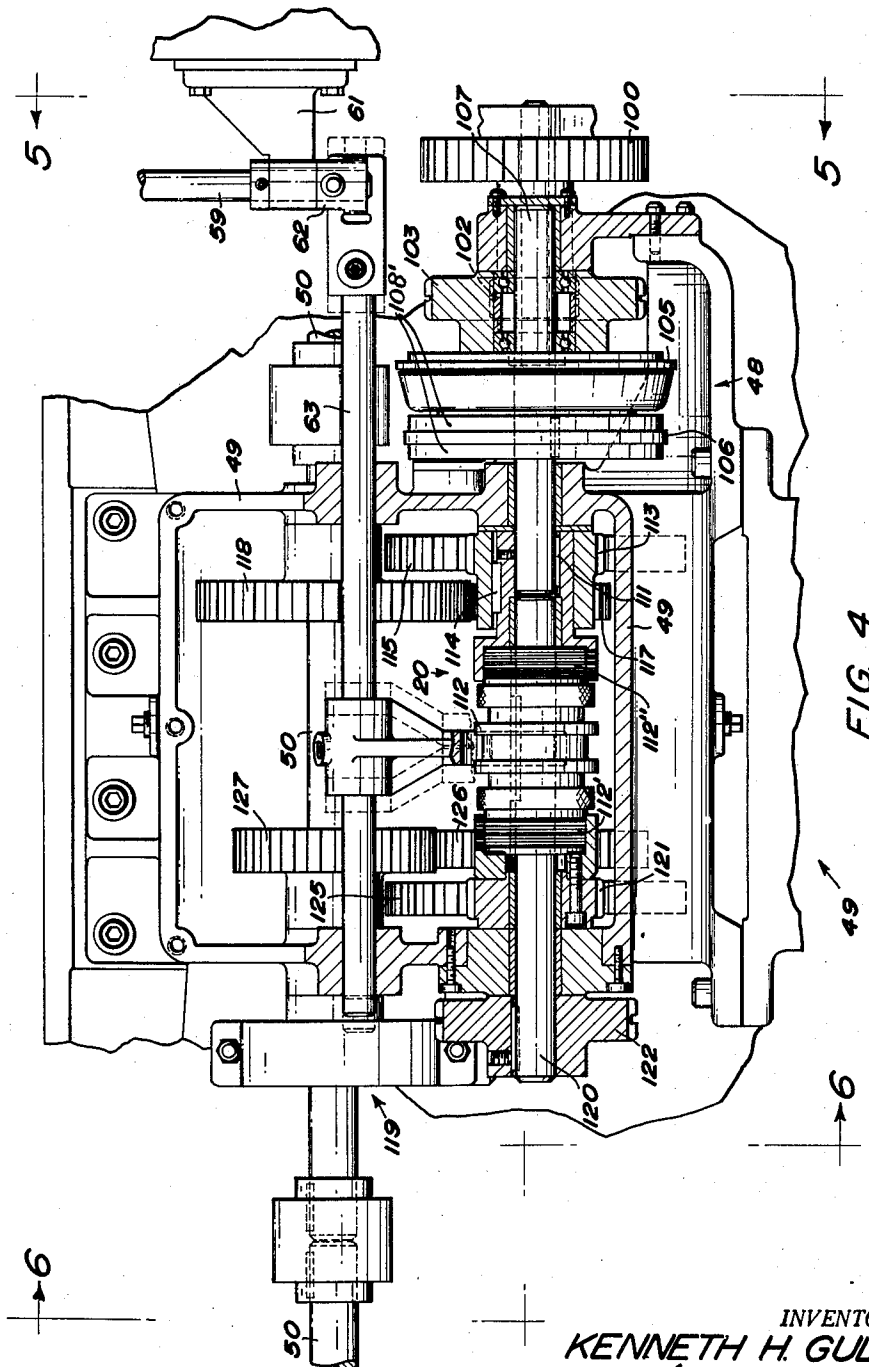


FIG. 4

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7 Sheets-Sheet 5

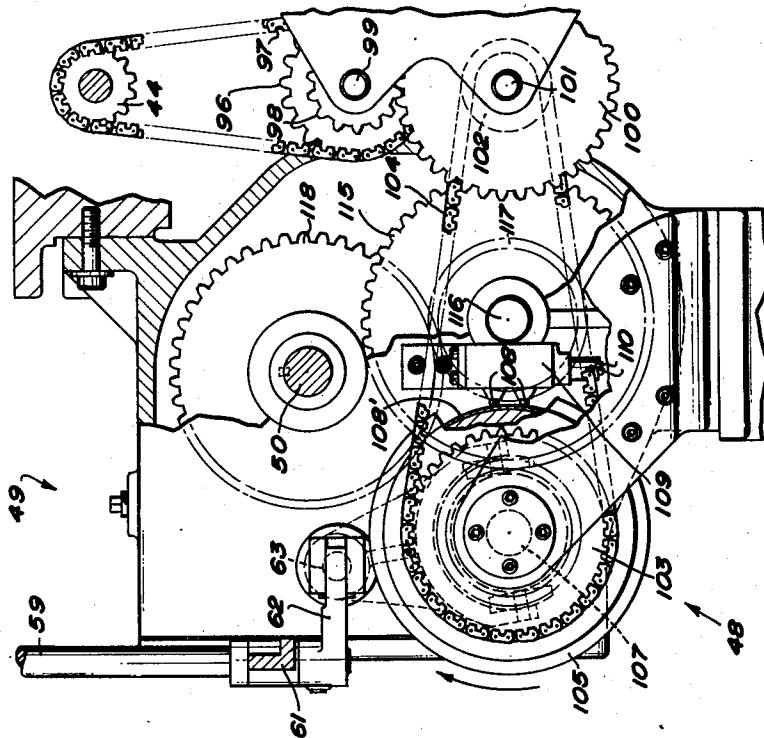


FIG. 5

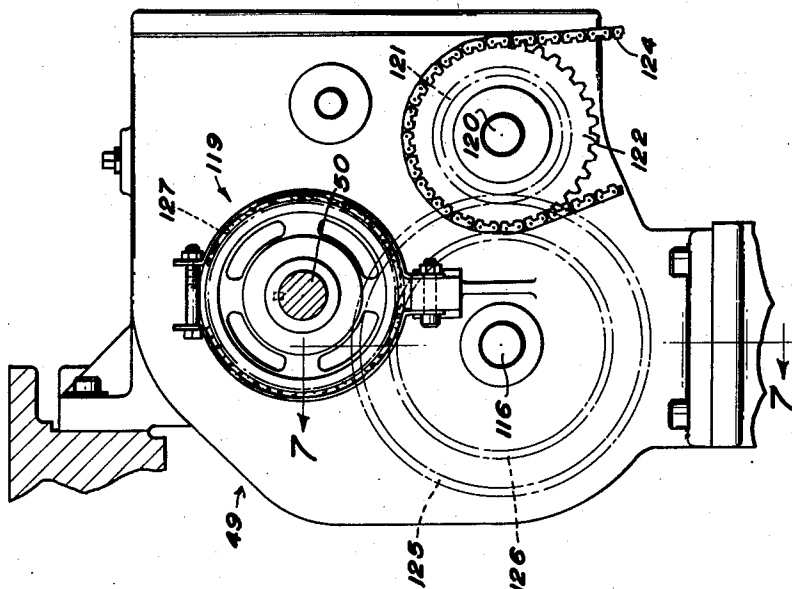


FIG. 6

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7 Sheets-Sheet 6

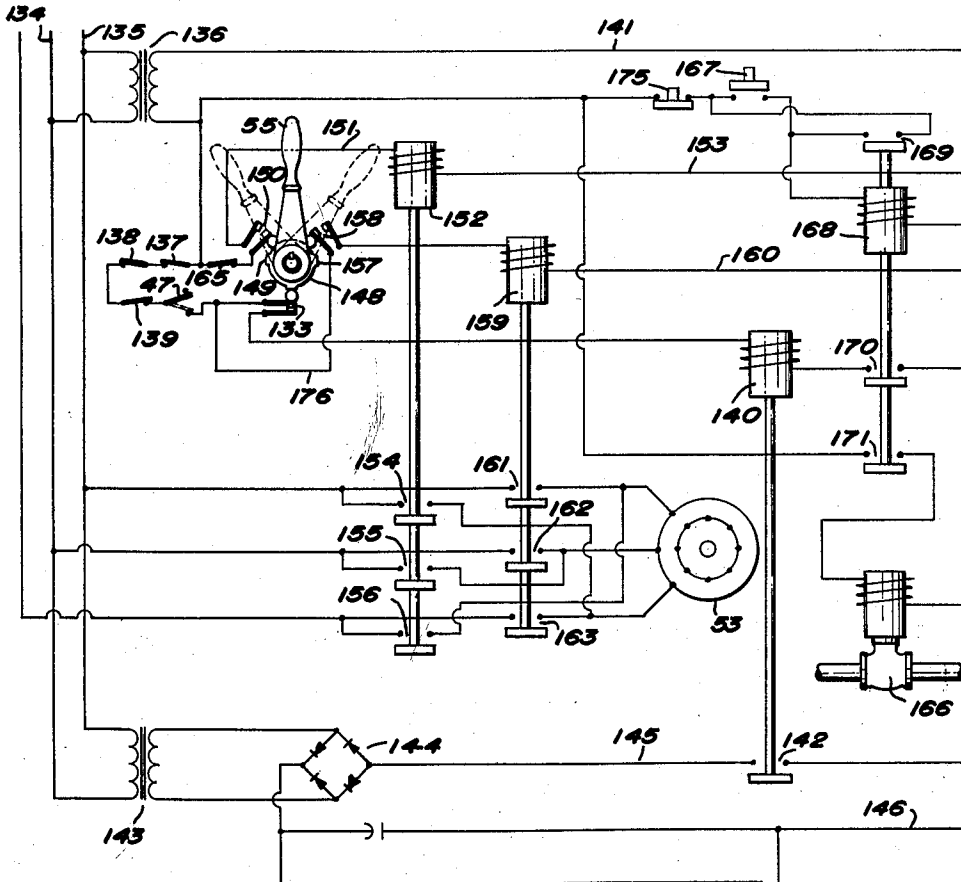


FIG. 11

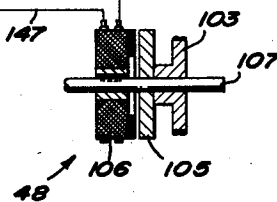
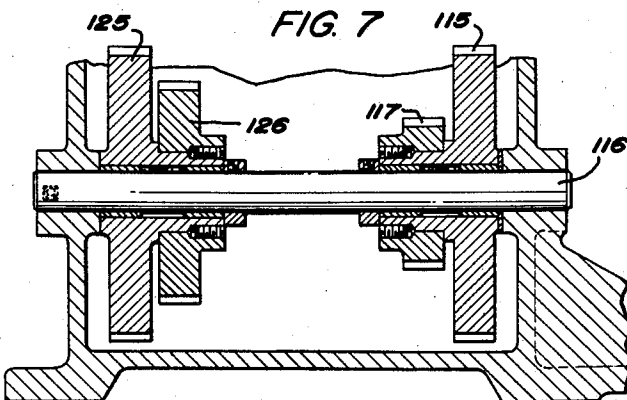


FIG. 7



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7 Sheets-Sheet 7

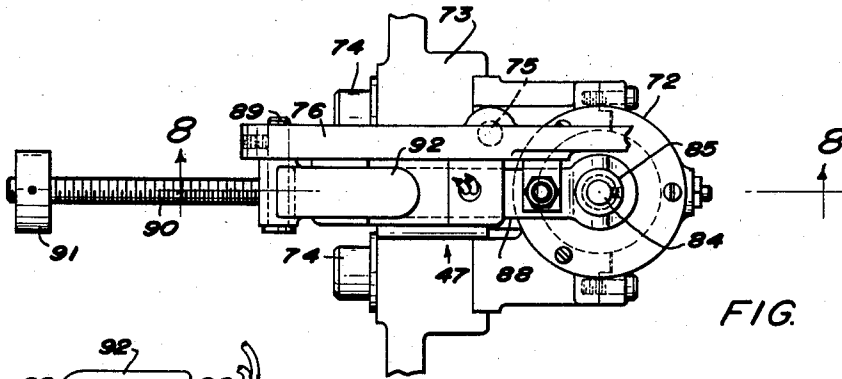


FIG. 9

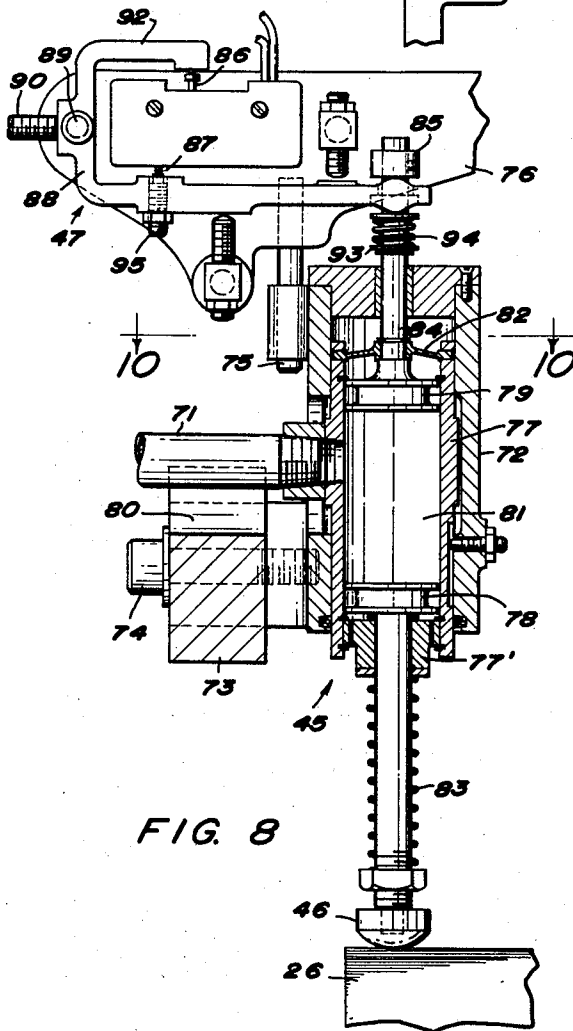


FIG. 8

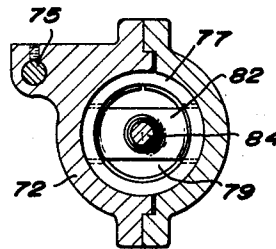


FIG. 10

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2,912,243

PILE ELEVATING MECHANISM AND CONTROL THEREFOR

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Application December 16, 1955, Serial No. 553,536

20 Claims. (Cl. 271—62)

This invention relates generally to machines for removing sheets one at a time from the top of a pile and feeding them to a sheet handling machine, and particularly a pile feeder having a novel pile height detecting means controlling pile raising means for maintaining the top level of the pile of sheets within predetermined high and low limits.

One object of the invention is to provide a pile feeder having pile height detecting means which moves out of contact with the pile just prior to the time that each sheet is raised and forwarded to a sheet handling machine, which detecting means also is adapted to actuate control means for operating pile raising means when the top level of the pile of sheets drops to the predetermined low limit.

More specifically, it is an object of the invention to provide a vacuum operated pile height detector which controls an electric switch and which is adapted to rise from the top of the pile each time a sheet is about to be fed therefrom, but which is so arranged and constructed that the electric switch is operated to start and stop raising of the pile only when the pile reaches the certain prescribed low and high limits.

Another object of the invention is to provide pile raising mechanism comprising an electric clutch controlled by said electric switch, the driving portion of said electric clutch being continuously driven from the sheet handling machine to which sheets are to be fed.

Another object of the invention is to provide a novel type of pile lifting transmission in which coaxial driving shafts, one operatively connected to the electric clutch and the other to an auxiliary motor, are adapted to raise the pile of sheets automatically and manually through the same gearing.

Still another object is the provision of novel means of mechanically controlling the transmission to the pile lifting mechanism while electrically controlling either said auxiliary motor or said electric clutch.

According to the invention a vacuum operated pile height feeler engages the top sheet of a pile and is lifted each time a sheet is about to be fed therefrom. The means through which vacuum impulses act upon the feeler, which means is movable in response to cumulative feeler movements, serves to operate electric switch means each time the level of the pile reaches a prescribed high or low limit. The mechanism is so constructed and arranged that operation of the switch means is effected only after an accumulation of up and down feeler movements causes the feeler to follow the pile downwardly as the level of the top of the pile descends to a predetermined extent amounting only to a fraction of an inch below its high maximum. At this point the switch is operated to cause the pile to rise. That movement is maintained until the level of the pile again reaches its high maximum, after which the cycle is repeated. The electric switch is

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adapted to control an electromagnetic clutch, the driving portion of which is continuously rotated through driving connections from a printing press or other sheet handling machine to which the sheets are to be fed. The driven portion of the clutch is operatively connected to a pile raising and lowering transmission which is adapted to rotate winding reels which in turn take up or let out cables running over pulleys. The ends of the cables are connected to a support for the pile of sheets. When, after a series of up and down movements the pile height feeler indicates that the level of the pile is too low, it actuates the switch to engage the clutch, thus winding the reels to raise the pile support through the cables. While the pile is being so raised, sheets continue to be fed therefrom, and the pile height feeler continues to rise from the top of the pile each time a sheet is fed off. When the pile height reaches its high limit the switch is operated to cause disengagement of the electromagnetic clutch and automatic raising of the pile is halted. In addition to the mechanism provided for automatically raising the pile while feeding sheets, there is provision also for rapidly raising or lowering the pile during pile changes. This mechanism is controlled by a handle located at the rear of the feeder at a point where an operator can easily control the rapid raising of the pile while aligning it transversely in the feeder.

The rapid operation of the pile lifting and lowering transmission is powered by a separate auxiliary motor for raising and lowering the pile independently of the pile height control. The handle at the rear of the feeder may be operated to set up the said transmission for either raising or lowering and at the same time control electric circuits for either the auxiliary motor or the electric clutch. The auxiliary motor is utilized only when rapidly raising and lowering the pile of sheets. The remainder of the time, the time during which the pile is periodically automatically raised, the drive for so raising the pile comes from the machine to which sheets are being fed.

In the drawings:

Fig. 1 is a side elevational view of a sheet feeder embodying the invention, sheets being fed off toward the right.

Fig. 2 is a rear elevational view looking in the direction of the arrow 2 of Fig. 1.

Fig. 3 is a front elevational view of the sheet feeder taken looking in the direction of the arrow 3 of Fig. 1.

Fig. 4 is an enlarged elevational view of the pile raising and lowering transmission, parts being broken away, looking in the same direction as in Fig. 3.

Fig. 5 is an elevational view, partly in section, of the automatic pile lifting portion of the transmission taken along lines 5—5 of Fig. 4.

Fig. 6 is an elevational view of the rapid action raising and lowering portion of the pile transmission taken along lines 6—6 of Fig. 4.

Fig. 7 is a fragmentary vertical sectional view taken along lines 7—7 of Fig. 6.

Fig. 8 is a detailed vertical sectional view on an enlarged scale of a novel pile height detecting and control mechanism.

Fig. 9 is a plan view of the mechanism illustrated in Fig. 8.

Fig. 10 is a detailed sectional view taken along line 10—10 of Fig. 8.

Fig. 11 is a schematic wiring diagram of the controls for the pile raising and lowering mechanism.

Referring now to Figs. 1 and 2, the machine comprises stationary side frame elements 10 and 11 and rear posts

12 and 13. The machine includes other side frame elements, comprising members 14 and 15 which are adjustable vertically to accommodate the feeder to the height of the machine to which sheets are to be fed.

Extending between member 14 and post 12 there are rails 16 and 17 which carry rear side frame member 14'. Similar parts are employed on the other side of the machine. A tie bar 18 connects posts 12 and 13 at their upper ends. At the lower ends the posts 12 and 13 are connected to a floor 19, as are also the side frame elements 10 and 11.

Rotatably journaled on the rails 16 on the opposite sides of the machine are pulleys 21 over which pass cables 22. The cables 22 support four corners of a pile supporting frame 23 of the type shown and described in my copending U.S. application Serial No. 498,068, filed March 30, 1955, now Patent No. 2,815,209, dated December 3, 1957.

The pile supporting frame 23 supports a pile board 24 upon which is carried a skid 25 supporting a pile of sheets 26. In the illustrated form of the invention the sheets are shown as being metal sheets responsive to magnetic lines of force. It is to be understood, however, that the sheets may be paper or other material.

In the embodiment shown for magnetizable metal sheets, magnet supports 27 and 28 are provided at the sides of the pile and a magnet support 29 is provided at the rear of the pile. The supports 27 and 28 are mounted on a bar 30 along which they may be guided inwardly and outwardly toward and away from the sides of the pile. Means for so guiding the supports 27 and 28 in unison comprises a threaded shaft 31 having right and left hand threads. The shaft 31 may be operated from either side of the machine by hand wheels 32. The purpose for so positioning the side magnet supports 27 and 28 is to accommodate the feeder for feeding sheets of different widths. The magnet support 29 is mounted on an I-beam 33 lying on its side and may be moved forwardly and rearwardly with respect to the rear side of the pile 26. The support 29 may be locked with respect to the I-beam 33 by means of a clamping handle 34. Each of the magnet supports 27, 28 and 29 carries a plurality of magnets "M" in the conventional manner. These magnets separate the metal sheets at the top of the pile in a manner well known in the art.

A power take-off unit 35 is operatively connected to the printing press or other sheet treating machine through a shaft 36. A crank 37 shown in Fig. 3 is connected through a shaft 38 to a bevel gearing 39, 39' which functions through other gearing, not shown, in the unit 35 for properly timing the sheet feeder to the printing press. Since the drive from the power take-off unit 35 may be of any suitable kind well known in the art only so much of the drive as is necessary to fully understand the invention is shown.

Sheets are separated one at a time from the top of the pile and fed to the printing press in the following manner. Pairs of lifting suckers 40 telescope downwardly in response to the coming on of vacuum. The suckers seal on the top sheet of the pile and then raise it to a pair of forwarding suckers 41. Timed vacuum means causes the suckers 41 to take hold of the sheet after which the suckers 40 let go. The suckers 41 then move horizontally to feed the forward edge of the sheet to pull-in rolls 42 in the customary manner. The lower rolls 42 are driven through the power take-off unit 35 and the upper rolls 42' are freely rotatable but are adapted to move up and down at predetermined times within each feeding cycle. For example, the upper rolls 42' move upwardly as a sheet is fed to the pull-in rolls and then move downwardly to grip the sheet and assist in forwarding it to a chain conveyor 43. The conveyor 43 is continuously driven and has lugs (not shown) which take the back edge of the sheet and pass it on to the printing press or other sheet handling machine. A

sprocket 44 is driven from the power take-off unit 35 for the purpose of providing automatic periodic raising of the pile supporting frame 23 as needed.

A pile height governor 45 has a feeler 46, Fig. 8, which engages the top of the pile 26 at the rear edge thereof approximately midway between its sides. Electric switch means 47 shown in Fig. 8 is adapted to control an electric or electromagnetic clutch 48 the driving portion of which rotates continuously. When the clutch 48 is engaged in response to operation of the switch means 47, a pile lifting transmission 49 enclosed in a housing, Fig. 4, is driven for a short period to cause raising of the supporting frame 23 through the cables 22. The transmission has a driving shaft 50 (see Fig. 3) extending from opposite sides thereof to drive winding drums 51 and 52 through worm and worm gear means (not shown). The cables 22 are wound around the drums 51 and 52. When the drums are rotated the cables cause the pile supporting frame 23 to be raised or lowered depending upon the direction of rotation of the drums. The pile supporting frame may only be raised automatically while under the control of the pile height governor 45.

Means is also provided to rapidly raise and lower the pile supporting frame 23. For convenience this means will be called manual means to distinguish from the automatically controlled means. The driving means for manually lowering and raising the supporting frame 23 comprises a reversible motor 53. The motor 53 is controlled by switch means in a control box 54 shown in Figs. 1 and 2. The switch means in the control box 54 will be described in detail later. As shown in Fig. 2, a handle 55 extends rearwardly of the control box 54. This handle has three positions. As shown in the figure, the position of handle 55 is vertical. When in this position, the control mechanism is set to provide for automatic raising of the pile. When the handle 55 is moved to the left as will be described later, the transmission will be so set and the control for the motor 53 will be so actuated as to cause the motor to rotate in a direction such as to raise the pile supporting frame 23. When the handle 55 is moved to the right as viewed in Fig. 2, the motor 53 will be so operated and the transmission so set as to cause the pile supporting frame 23 to be lowered rapidly to receive a new pile of sheets.

The handle 55 controls the pile lifting transmission 49 in the following manner. The handle 55 is fastened to the end of a shaft 56 shown in Fig. 1, the shaft 56 having mounted on the opposite end thereof a bevel pinion 57. Pinion 57 meshes with a bevel gear 58 and when turned operates a vertical shaft 59 journaled in brackets 60 and 61 shown in Fig. 3. The lower end of the shaft 59 has an arm 62, the end of which is pivotally connected to an end of a sliding gear-shifting rod 63 which functions to shift the drive from one set of gears to another in the pile lifting and lowering transmission. It will be seen that the transmission may be driven to raise the pile through either the electric clutch 48 or the motor 53 according to the position of the handle 55.

Rotary valve means 64, Fig. 3, is driven by the power take-off unit 35 to provide vacuum to the various parts of the feeder as needed. Valve means of this general character is well known in the art, reference being made by way of example merely to Baker et al. Patent 2,156,648 dated May 2, 1939. Detail illustration of the valve means 64 is therefore omitted. Vacuum is needed for instance in the suckers 40 and 41 at predetermined times to grip the top sheet of the pile as well as in the operation of the pile height governor 45. Vacuum is supplied by a vacuum pump 65 driven by a motor 66 through a chain 67. Piping 68 connects the vacuum pump 65 with the valve 64 and lines 69 extend from the valve 64 to a block 70 to which vacuum lines to the suckers are connected. Intermediate the pump 65 and the valve 64 is a solenoid-operated valve 166 the purpose of which is to shut off vacuum when not feeding sheets.

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The pile height governor 45 is shown in detail in Fig. 8. It comprises a stationary cylinder 72 connected to a portion 73 of the magnet supporting member 29 by means of screws 74. At its upper portion the stationary cylinder 72 carries a pin 75 on which is mounted a switch supporting member 76. Vertically movable in the stationary cylinder 72 is a second cylinder 77. Cylinder 72 merely forms a vertical track for cylinder 77, it being understood that the track may be made in any of several different ways. The cylinder 77 has reciprocable therein a piston 78 connected to the feeler 46 and a second piston 79 operatively connected to the switch means 47. A vacuum line 71 is connected to the interior of the vertically movable cylinder 77. The portion 73 of the magnet support 29 has a cut-out portion 80 to permit vertical movement of the line 71 with the cylinder 77.

As each sheet is lifted by the suckers 40 from the top of the pile 26, the feeler 46 is lifted from the pile as follows. The vacuum valve 64 controls the application of vacuum to the line 71 so as to apply vacuum to lift the piston 78 and with it the feeler 46 just before the sheet is lifted by the telescoping suckers 40. When vacuum is first applied to the chamber 81 of the cylinder 77, it pulls downwardly on the piston 79. That piston is supported in the cylinder 77 by a flexible braking member 82. When the piston 79 is urged downwardly by vacuum in the chamber 81, it causes the flexible braking member 82 to spread by toggle action to clamp the ends of the braking member against the stationary cylinder 72. Only a small amount of downward movement of the piston 79 will cause the braking portion of the member 82 to grip the cylinder wall of the stationary cylinder 72.

With the cylinder 77 locked relative to the cylinder 72 by this braking action, the vacuum pulls up on piston 78. Upward movement of the latter piston lifts the feeler 46 from the top of the pile and prevents it from restricting the action of the suckers 40 and 41 in lifting and advancing the top sheet of the pile. A spring 83 normally urges the feeler 46 downwardly. When vacuum is applied to the chamber 81 of the cylinder 77, the vacuum must overcome the force of the spring 83 in order to lift the feeler 46. The strength of the spring as compared to the flexible member 82 is the determining factor in permitting the piston 79 to move down before the piston 78 moves up.

When a sheet has been fed off by the forwarding suckers 41 and when vacuum in the chamber 81 has been discontinued the spring 83 will urge the feeler downward again and this action will be limited only by the engagement of the piston 78 with the cylinder head 77' at the lower end of the cylinder. The feeler, however, will be short of reaching the top of the pile by the thickness of the sheet which has just been fed. The vacuum being then released, the brake member 82 flexes to its upwardly bowed position and releases the brake. With the brake released, the weight of the cylinder 77 and the feeler 46 will cause the cylinder 77 to drop until the feeler 46 engages the top of the pile. The governor 45 will operate as just described for each sheet fed. At each downward movement of the cylinder 77, piston rod 84 indirectly attached to the cylinder is pulled downward a small increment, and when the cumulative effect of these movements reaches a predetermined amount the switch means 47 is actuated, as will now be described.

There is a collar 85 on piston rod 84 near its upper extremity. Switch means 47 has two control buttons, one for closing and the other for opening the circuit to the clutch 48. These buttons are shown at 86 and 87 respectively. When the feeler 46 engages the top of the pile after vacuum has been released in chamber 81, it, through the cylinder 77, rod 84 and collar 85 pulls downwardly on a counterweighted arm 88, pivoted on the switch supporting member 76 at 89 as shown in Fig. 9. The arm 88 has a screw 90 carried on which is a counterweight 91 which offsets some of the weight of the cylinder

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77 and associated parts to permit easier up and down movement thereof. The counterweighted arm 88 is bifurcated and has an upper portion 92 which engages with the button 86 when the feeler 46 detects that the pile is too low. Operation of the button 86 by the portion 92 of the arm 88 closes the circuit to the electric clutch 48 to cause the electric clutch to raise the pile supporting frame 23 through the transmission 49. As the pile supporting frame 23 is being raised, sheets continue to be fed off in their usual manner by the suckers 40, 41, and the pile height governor 45 continues to operate during the feeding of each sheet to lift the feeler 46 each time a sheet is fed. During such raising of the pile 26 when vacuum is applied to chamber 81 the piston 79 first causes the brake 82 to lock the vertically slidable cylinder 77 to the stationary cylinder 72. The feeler 46 is then lifted in response to upward movement of the piston 78. Now, when the vacuum is discontinued and the feeler is lowered to the pile, it will not go downward to its full normal extent. This is prevented because the pile was being raised while the feeler 46 was up. When the piston 79 releases the brake 82, the cylinder 77 is released with respect to the cylinder 72. When the movable cylinder 77 is so released, the spring 83 will cause the cylinder 77 to be raised until the parts are in their normal positions. This will continue to happen until the rod 84 is in such a position that a washer 93 fixed to rod 84 and a spring 94 engaged therewith causes the arm 88 to move to its upper limit. When the top level of the pile 26 reaches its upper limit, the arm 88 will have moved a set screw 95 into a position to operate the button 87, thereby opening the circuit through switch means 47 and discontinuing current flow to the electric clutch 48. With the clutch 48 disengaged, the pile raising mechanism discontinues operation and will not raise the pile again until the feeler 46 detects that the pile is again too low. At such time there will be a repeat of the operations described.

Automatic raising of the pile is effected in response to the energization of the electric clutch 48, the driving element of which is attached to the sprocket 44, the latter being driven from the power take-off unit 35. Sprocket 44 drives another sprocket 96 through a chain 97 (refer to Fig. 5). A gear 98 is fixed with respect to sprocket 96, and both are mounted on a shaft 99 journaled in brackets on the machine. Gear 98 drives a gear 100 carried by a shaft 101 also journaled in brackets on the machine. Fixed with respect to gear 100 is a sprocket 102 which drives a sprocket 103 through a chain 104.

Referring now to Fig. 4, the electric clutch comprises a driving element 105 and a driven element 106. Element 105 is fixed with respect to sprocket 103 and both are freely rotatable on a shaft 107. Driven element 106 is fixed with respect to shaft 107 for purposes which will be described. When the clutch 48 is to be engaged to impart rotation of the driving element 105 to the driven element 106, the switch 47 through brushes 108 and rings 108' shown in Fig. 5 provides current flow to the electric clutch thereby causing the driving and driven elements to be engaged. The brushes 108 are mounted in a box 109 from which leads 110 extend to the switch 47. A key 111 fixes a portion of a disc clutch 20 to the shaft 107. A gear 113 is keyed to the portion of the disc clutch fixed to the shaft 107 by means of a key 114. Gear 113 meshes with a gear 115 shown best in Fig. 7. Gear 115 is mounted on a shaft 116. Fixed to the gear 115 is a smaller gear 117 which meshes with a gear 118 mounted on the driving shaft 50 for the worm and worm gears which operate the winding drums 51 and 52 for the cables 22. It will be seen that each time the switch means 47 is closed to cause engagement of the driving and driven elements of the electric clutch 48, rotation of the sprocket 103 will be imparted through the clutch to the shaft 107 and then through gears 113, 115, 117, and 118 to the

shaft 50. When the circuit to the electric clutch 48 is opened, the elements 105 and 106 will become disengaged. Sprocket 103 and driving element 105 of the electric clutch 48 will continue to be rotated by the power take-off unit 35. A brake 119 shown best in Figs. 4 and 6 is provided for shaft 50 to prevent unwanted rotation of the shaft.

When the stack of sheets in the pile 26 on the skid 25 has been depleted, it is necessary to lower the pile elevating frame to the floor 19 to remove the pile board 24 and skid 25 and replace them with a newly loaded pile of sheets. The pile is then raised back into position between the magnets "M" so that the second pile can be fed into the machine.

The pile supporting frame 23 is lowered to the floor to remove the skid and pile board therefrom as follows. The handle 55 is moved to the right as viewed in Fig. 2 to cause contacts to close the circuit to the motor 53 to drive shaft 50 in a direction to cause the drums 51 and 52 to lower the frame 23. At the same time, shaft 56 is rotated to cause bevel gears 57 and 58 to rotate shaft 59 to cause the slidable gear-shifting rod 63 to move to the left as shown in dotted lines in Fig. 4. Leftward movement of rod 63 causes a shifting spool 112, slidably keyed to a shaft 120, to put discs 112' of clutch 20 into clutching engagement for driving a gear 121. The shaft 120 has mounted on the end thereof a sprocket 122 which is driven from the motor shaft 123 through a chain 124. Gear 121 meshes with a gear 125 mounted on shaft 116 as shown in Fig. 7. Fixed with respect to gear 125 is another smaller gear 126. Gear 126 meshes with a gear 127 mounted on the driving shaft 50. Rotation of the motor is of course in such a direction as to cause the winding drums 51 and 52 driven by the shaft 50 to lower the pile supporting frame 23.

After the pile supporting frame 23 has reached the floor, the pile board 24 and the skid 25 may be removed and a new pile board and skid with a new pile of sheets may be positioned on the pile supporting frame 23 to be raised into position. At this time, the handle 55 is moved to the left as viewed in Fig. 2 whereupon the motor 53 is caused to drive the pile raising mechanism in the opposite direction. Simultaneously with the reversing of the motor 53, the rod 63 is shifted to the right as shown in dotted lines in Fig. 4. This causes disengagement of the discs 112' and causes engagement of a second set of discs 112'' on the right side. When the latter discs engage, the shaft 120 and gear 113 become relatively fixed. The gear 113 is now rotated through the shaft 120 to drive gears 115, 117 and 118 to operate the winding drums 51 and 52 to raise the pile rapidly into position between the magnets M. Just before the pile is brought into position between the magnets, a handle 128 (shown in Fig. 2) is operated to shift the pile supporting frame 23 laterally to assist in properly aligning the new pile of sheets between the magnets M. Such shifting mechanism is shown and described in my previously mentioned copending application. It will suffice to say in this instance that the handle 128 when pivoted counterclockwise raises a bar 129 to operate bell cranks 130 and 131 pivoted on the machine frame to cause lateral movement of a guide bar 132 which engages with the pile supporting frame 23 to guide it while the frame 23 is moving vertically. When the pile is near its proper height and in position between the magnets M the handle 55 will be returned to its vertical position to set up control of the transmission for automatic raising.

Referring now to Fig. 11, which is the wiring diagram for controlling the motor 53 and the electric clutch 48, such control is effected as follows. The full line position of the handle 55 is that in which automatic control of the pile raising mechanism is obtained. At this time contacts 133 are closed and switch 47 is open. This indicates that the height of the pile is at the proper level between its high and low limits. Once the handle 55 is in position for automatic operation, a switch 167 is depressed by

the operator to energize the coil of a relay 168 having contacts 169, 170 and 171. The contacts 171 when closed permit current to flow to the solenoid operated valve 166 shown in Fig. 3 to open the line 68 between the vacuum pump 65 and the valve 64. Contacts 169 maintain the circuit to relay 168. Contacts 170 ready the automatic raising circuit for action in response to control by pile height governor 45. When the pile height governor 45 detects that the pile is too low, the switch means 47 closes and current flows through a lead 134 and a lead 135 to a transformer 136 and then across closed switches 137, 138 and 139, across the now closed switch 47 through closed contacts 133 to the coil of a relay 140, across now closed contacts 170 and then through a lead 141 to energize the relay 140 and close a set of contacts 142. Current flow will now go to the electric clutch 48 through the leads 134 and 135, through a transformer 143 and then through a rectifier 144 through a lead 145, across the now-closed contacts 142 and then through a lead 146 to the coil of the electric clutch 48 and then through a lead 147, energizing the coil of the electric clutch and engaging the driving and driven elements 105 and 106. Rotation of the driving element 105 is thus imparted to the driven element 106 and to the shaft 107. The pile is thus raised as described earlier until switch means 47 is opened, at which time current to the coil of the relay 140 is discontinued and contacts 142 opened. Opening of contacts 142 discontinues current flow to the coil of the electric clutch 48 thus deenergizing the electric clutch and interrupting the raising movement of the pile supporting frame 23.

When the pile has been depleted and the supporting frame 23 is to be lowered and a new pile of sheets is to be received the operator depresses switch 175, which opens the holding circuit for relay 168 and thus breaks the contacts 170 and 171. Breaking contacts 170 prevents further energization of the relay 140 thereby preventing operation of the electric clutch. The breaking of contacts 171 deenergizes the solenoid for valve 166 which closes, stopping vacuum to the lifting and forwarding suckers and also to the feeler cylinder 77. The operator then throws handle 55 to the right as shown in dotted lines in this figure. At that time contacts 133 will be open because of a low spot on cam 148, permitting disengagement of the contacts. A high spot 149 on cam 148 will cause contacts 150 to close. These contacts permit current to flow through a lead 151 to the coil of a relay 152 and then through a lead 153 and the lead 141. Energization of the relay 152 will cause closing of contacts 154, 155 and 156 thus causing the motor 53 to be operated to rotate in a direction such as will lower the pile supporting frame 23. The handle 55 may lock in its right and left positions, or may be such as to require holding the handle in position to cause the high spot 149 to keep contacts 150 closed. Release of the handle in the latter case when lowering or raising the pile supporting frame rapidly will cause the corresponding contacts to open.

After a new pile of sheets has been brought into position on the pile supporting frame 23, the handle 55 is thrown to the left as shown in Fig. 11 to cause the pile support to rise and at that time, a high spot 157 will close contacts 158 to cause current to flow to the coil of a relay 159 and then through a lead 160 and through the lead 141. Current will be supplied to contacts 158 through a conductor 176 inasmuch as switch 47 will have closed due to the lowering of the pile away from feeler 46, thereby permitting cylinder 77 to descend and tilt arm 88 to operate button 86. Energization of the relay 159 closes contacts 161, 162 and 163 to cause the motor 53 to be operated in that direction which raises the pile supporting frame 23. It is to be understood that the contacts 154, 155 and 156 were opened when the handle 55 was moved away from its right hand position, thereby opening contacts 150 and deenergizing the relay 152.

Switches 137, 138 and 139 have not been shown in de-

tail in the mechanism but are merely normally closed microswitches adapted to prevent operation of either the motor 53 or the electric clutch 48 when the pile supporting frame 23 is too high. A normally-closed switch 165 is adapted to be opened when the frame reaches the ground level to deenergize the relay 152 and stop motor 53.

While feeler 46 is shown as being connected to piston 78, which is movable in the cylinder 77, it should be understood that numerous other types of feeler carriers may be employed. It is essential only that the carrier remain approximately the same distance from the pile during the feeding of sheets, and that some means be provided for holding the carrier stationary in each feed cycle during movement of the feeler away from the pile.

It should further be understood that while the pile height detecting means illustrated operates raising mechanism through an electric switch and electrical clutch mechanism, any type of conventional raising mechanism may be used, and mechanical or other control mechanism may be used in place of the electric switch.

Having thus described my invention, I claim:

1. In combination with a pile of sheets, pile height detecting means comprising a pneumatic cylinder vertically mounted above the pile to move up and down with corresponding variations in the top level of the pile therebeneath, means mounting the cylinder for said up and down movement, a piston slidable in said cylinder, a stop on said cylinder to limit the downward movement of said piston relative to the cylinder, means for maintaining said piston in engagement with said stop, a feeler depending from said piston and adapted to contact the top of the pile and space said cylinder therefrom, a vacuum connection to said cylinder, control means for exerting a vacuum through said connection each time a sheet is to be fed from the top of the pile whereby said piston and feeler are raised relative to said cylinder to clear the pile and for breaking the vacuum after the sheet has been fed from under said feeler and before the next sheet is to be fed from said pile whereupon said piston descends and strikes said stop and said cylinder and piston descend as a unit sufficiently to permit said feeler to contact the next sheet of the pile, and means for locking the cylinder momentarily against downward movement when vacuum to move the feeler clear of the pile is established in said cylinder.

2. Pile height detecting means substantially as defined in claim 1, wherein the means for locking said cylinder against movement momentarily comprises a pneumatically operated member actuated by the vacuum in said cylinder.

3. Mechanism substantially as defined in claim 1, comprising also an electric switch and a mechanical connection between said cylinder and switch for actuating said switch when said cylinder descends to a predetermined extent, and means set in motion by the actuation of said switch for effecting a control operation in accordance with the detected low level of the pile.

4. In combination with the mechanism defined in claim 1, means for supporting the pile of sheets for upward movement, an electric switch, a mechanical connection between said cylinder and switch for actuating the latter when said cylinder descends to a predetermined extent, and means set in motion by the closing of said switch for raising said pile a small increment.

5. In combination with the mechanism defined in claim 1, means for supporting the pile of sheets for upward movement, a switch adapted to be actuated to open and closed positions, switch operating means for actuating said switch alternately to its two positions, a mechanical connection between said cylinder and said switch operating means, and means set in motion by the closing of said switch for raising said pile and by the opening of said switch for stopping the pile raising means, whereby the pile is raised a small increment when said feeler de-

scends to a predetermined extent, and whereby the raising of the pile is interrupted when the feeler is raised to a predetermined extent by the rising pile.

6. In a pile feeder for periodically feeding sheets one at a time from the top of a sheet pile to a sheet handling machine, means for periodically separating and feeding the top sheet of the pile, pile height detecting means comprising a cylinder vertically mounted above the pile for movement up and down, a lower piston movable in said cylinder, an upper piston mounted in said cylinder for limited movement only, a stop on said cylinder to limit downward movement of said lower piston, a feeler depending from said lower piston adapted to contact the top sheet of the pile, resilient means bearing against said cylinder for holding said feeler extending downwardly, a vacuum connection to said cylinder between said pistons, means actuated by a slight downward movement of said upper piston for locking said cylinder against downward movement, control means for exerting vacuum through said connection each time a sheet is to be fed from the top of the pile, whereby said upper piston is actuated to lock said cylinder against movement and said lower piston is raised to lift said feeler off the pile, and for breaking the vacuum after the sheet being fed has moved clear of its position under said feeler and prior to the feeding of the next sheet, whereupon said cylinder is unlocked and said lower piston descends and strikes said stop and said cylinder moves downwardly with said lower piston permitting said feeler to contact the next sheet on the pile.

7. In combination with the mechanism defined in claim 6, an electric switch, a mechanical connection between said cylinder and switch for actuating the latter when said cylinder descends to a predetermined extent, and means set in motion by the closing of said switch for raising said pile a small increment.

8. In combination with the mechanism defined in claim 6, a switch adapted to be actuated to open and closed positions, switch operating means for actuating said switch alternately to its two positions, a mechanical connection between said cylinder and said switch operating means, and means set in motion by the closing of said switch for raising said pile a small increment and by the opening of said switch for stopping the operation of said pile raising means.

9. In a pile feeder for feeding sheets one at a time from the top of a sheet pile to a sheet handling machine, means supporting said sheet pile for upward movement, a pile height detecting means comprising a vertical cylinder, means mounting the cylinder for up and down movement, vacuum means for controlling the downward movements of said cylinder gradually as sheets are fed from the top of the pile to maintain a predetermined distance of the cylinder above the pile, said means comprising a piston movable in said cylinder and carrying a depending feeler normally spacing said cylinder from the top of said pile, said feeler rising independently of the cylinder each time a sheet is to be fed to clear the top sheet as it is fed off the pile and then descending to contact the next succeeding sheet prior to the time the latter is to be fed, and means for raising the pile set in motion by the movement of the cylinder downward to a predetermined extent.

10. A pile feeder substantially as defined in claim 9, comprising also spring means between said cylinder and feeler urging the feeler toward the top of the pile, said spring means being yieldable in response to raising the feeler to permit the piston to rise relatively to the cylinder, and said spring means comprising an actuator for imparting upward movement to the cylinder when the feeler descends while the pile supporting means is being raised.

11. In a pile feeder, means for supporting a pile of sheets for up and down movement, two aligned shafts, a train of gears operatively connected to the pile support-

ing means for raising the pile, the driving gear of said train surrounding a first one of said shafts and being locked thereto, pile height detecting means, clutch means periodically operated by said pile height detecting means when the top of the pile is at a predetermined low limit for rotating said first shaft through short intervals to raise the pile a small increment at a time, a second train of gears for lowering the pile, the driving gear of said second train surrounding the second shaft but loose thereon, shifting clutch means having a neutral position when said first shaft is adapted for rotation by said releasable means, having a position for locking said second gear train to said second shaft and a third position for locking said shafts together to turn in unison, means for operating said shifting means and rendering said releasable means inoperative when said shifting means is in said second or third positions, and an electric motor operatively connected with said second shaft for rotating the latter to lower the pile when the shifting means is in its second position and to raise the pile independently of said releasable means when the shifting means is in the third position.

12. A pile feeder substantially as defined in claim 11, wherein said motor is reversible, comprising an operating device for said shifting means and electrical connections associated with said operating device functioning to drive said motor in one direction when said shafts are locked together for rapid traverse of the pile raising means and in the opposite direction for rapid traverse of the pile lowering means.

13. In a pile feeder, means for supporting a pile of sheets for up and down movement, gearing operatively connected to the pile supporting means for raising the pile, pile height detecting means, means for driving the gearing intermittently comprising an electric clutch periodically operated by the pile height detecting means when the top of the pile is at a predetermined low limit, a motor for driving said gearing, and common control means for operatively connecting said clutch to the pile height detecting means to drive said gearing or for disabling said detecting means and clutch and energizing the motor to drive the gearing and raise the pile supporting means.

14. A pile feeder substantially as defined in claim 13, comprising first and second aligned shafts, a sprocket wheel loosely mounted on said first shaft, means driven from the machine to be fed for continuously revolving said sprocket wheel, said electric clutch comprising one element rigid with the sprocket wheel and loosely mounted on the shaft, the other clutch element being keyed to the shaft, the driving gear of said gearing being rigid with said first shaft, said motor driving said second shaft, and shifting clutch means operated by said common control means for coupling said shafts together to drive the gearing from the motor when the electric clutch is disabled.

15. In a pile feeder for a sheet handling machine, pile supporting means for a pile of sheets, pile height detecting means comprising a feeler engageable with the top of said pile and a feeler carrier movable up and down with the pile and maintained approximately the same distance from said pile at all times during the feeding of sheets, means for lifting the feeler from the pile as each sheet is removed therefrom, means restraining the carrier against movement while said feeler is out of engagement with said pile, gearing for raising said pile supporting means, gearing for lowering said pile supporting means, an electric clutch the driving element of which is continuously driven from said sheet handling machine and the driven element of which is connected to said raising gears, switch means for operating said electric clutch which switch means is closed by said feeler carrier when the pile reaches its low limit and opened when the pile reaches its high limit, a reversible electric motor, and means manually controlled by the operator for electrical-

ly and mechanically connecting either said raising or lowering gears with said motor or for electrically and mechanically connecting said electric clutch with said raising gears in order that the clutch may be engaged when said switch is closed to cause automatic raising of said pile in response to detection by said pile height detecting means that the pile is too low.

16. In a pile feeder having supporting means for a pile of sheets and means operated in response to detection of the position of the top level of the pile for raising said supporting means to maintain the top level between predetermined high and low limits, a feeler engageable with the top of said pile, a feeler carrier movable up and down with the pile and maintained approximately the same distance from said pile at all times during the feeding of sheets, means mounting the carrier for up and down movement, said carrier and feeler being normally maintained in a predetermined relative position wherein said feeler is adapted to space said carrier from said pile, means for lifting said feeler from the pile independently of said carrier as each sheet is removed therefrom, means restraining the carrier against vertical movement during the time said feeler is out of engagement with said pile, and control means for said raising means, said feeler carrier operating said control means upon detection that the pile has reached its low limit to cause said raising means to raise the pile.

17. A pile feeder according to claim 16 including means engaged by said carrier for operating said control means to discontinue raising of the pile when the pile reaches its high limit.

18. A pile feeder according to claim 16 wherein said control means comprises an electric switch operated by said feeler carrier when the pile reaches its low limit, and wherein said pile raising means comprises electrically operated clutch mechanism controlled by the switch.

19. A pile feeder according to claim 18 wherein said electric clutch mechanism comprises a freely rotating member continuously driven from the machine to which sheets are to be fed and a second member operatively connected to said pile raising means, said members being engaged when said electric switch is operated by said feeler carrier to cause the drive from said machine to be imparted to said pile raising means.

20. In combination with a pile of sheets which is moved up vertically as the top sheets are fed therefrom, pile height detecting means comprising a support member disposed above said pile, a feeler engageable with the top of the pile to sense the height thereof, means for actuating said feeler to and from engagement with the top of said pile comprising an extendible and contractible actuator including a cylinder element and a piston element slidable relatively to and in said cylinder element, said elements being extendible and contractible in response to fluid pressure in said cylinder, means connecting said feeler to one of said elements to reciprocate the latter toward and from said pile upon the extension and contraction of said elements respectively, means normally biasing said piston and cylinder elements to an extended position, means mounting the other of said elements on said support member for vertical movement relative thereto whereby the actuator may move up and down with said pile, the engagement of said feeler with said pile limiting the downward movement of said actuator, control means for controlling the pressure in said cylinder to effect a contraction of said actuator and a raising of said feeler when a sheet is to be fed from said pile and to extend said actuator to lower said feeler after said sheet is clear of said feeler and prior to the feeding of the next sheet, and means for locking said other element against movement with respect to said support member when said actuator is contracted to raise said feeler and for releasing said other element for vertical movement when said actuator is extended whereby said feeler may again move into engagement with the top of said pile.

and the position of said other element relative to said support member indicates the height of said pile.

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