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SHEET FEEDING MECHANISM

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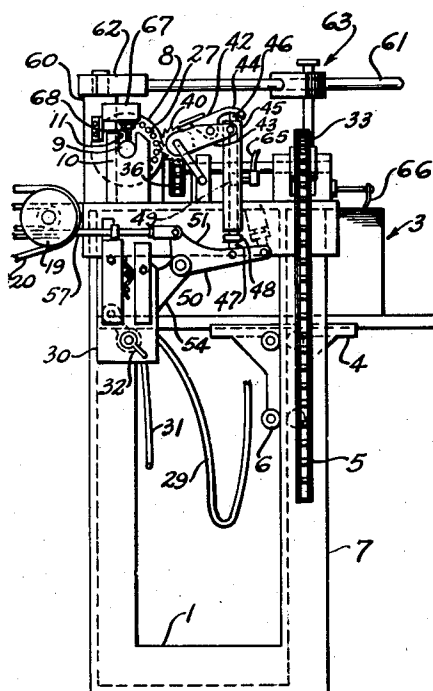


Fig. 1

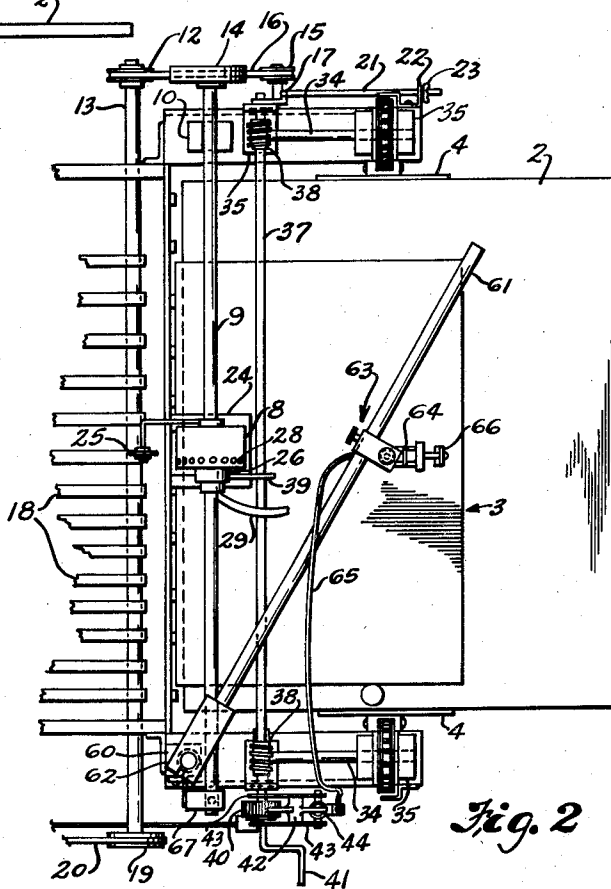


Fig. 2

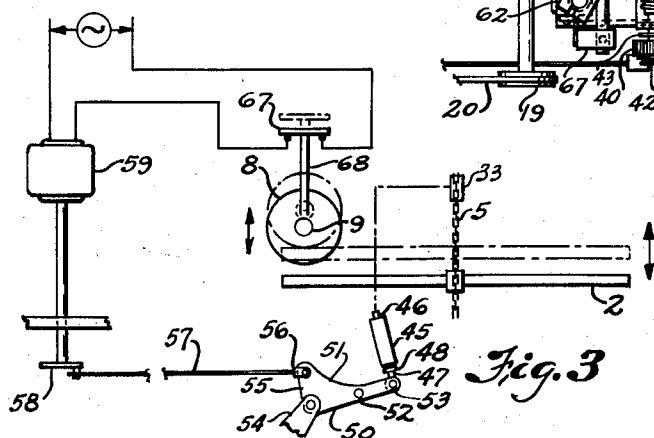


Fig. 3

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SHEET FEEDING MECHANISM

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11 Claims. (Cl. 271—62)

This application is a continuation-in-part of my co-pending application Serial No. 482,493, filed January 18, 1955, now Patent No. 2,739,810, dated March 27, 1956.

In such prior application, I have disclosed apparatus intended principally for use in the automatic feeding of paper sheets to a work-performing device, such as a perforator. The feed mechanism includes an elevator for supporting and raising a stack of the sheets, a transfer device at a predetermined elevation above the elevator and operative to remove the sheets successively from the top of the stack, and feeler mechanism for controlling the rise of the elevator in response to the top level of the stack. The elevator drive is taken from the drive of the perforator, so as to be in synchronized relation therewith, and the connection includes a coupling which is under control of the feeler mechanism.

The present invention is concerned with improvements in such feed mechanism which afford more flexible operation and enhance control of the same.

It is a primary object of the invention to provide a modified drive connection for the elevator which will permit the same to be operated at varying rates, thereby enabling the apparatus to handle sheets of varying thicknesses, for example, thin paper sheets as well as sheets of cardboard, at optimum rates of feed.

Another object is to incorporate a safety feature which will protect the structure in the event of improper operation or failure of the feeler mechanism, whether this is due to a mechanical failure or to negligence on the part of the operator.

The transfer operation, or the removal of the sheets from the elevator, requires the suction or other unit employed for the purpose to be located above the elevator, and the feeler mechanism should function to bring the sheets successively into such proximity that they may be stripped from the top of the stack. Since the drive must be synchronized with the work-performing device, there is a drive connection between the latter and the elevator, as indicated above. Accordingly, if the feeler is ineffective for any reason, the elevator would be continuously raised and either the stack or the platform itself forced against the transfer device with damage to the structure.

In accordance with the present disclosure, an additional safety control is provided and the transfer device so modified that the presence of such improper force is immediately detected and applied to shut off the entire apparatus.

Other objects and advantages will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but

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a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

Fig. 1 is a side elevational view of sheet feeding mechanism incorporating the present improvements;

Fig. 2 is a top plan view thereof; and

Fig. 3 illustrates diagrammatically the components and actions involved in the new safety control.

Referring now to the drawings in detail, I have illustrated here only the sheet feeding mechanism proper of the perforator apparatus described in detail in my application Serial No. 482,493, now Patent No. 2,739,810, to which reference may be had for the structure not included herein and not essential to a full and complete understanding of the present improvements. Such mechanism comprises a frame 1 within which a horizontal platform or elevator 2 is arranged for supporting a stack of the sheets indicated at 3. At each side, the platform is supported by a bracket 4 attached to a section of chain 5, the brackets being guided by rollers 6 in engagement with the vertical frame posts 7.

The device for removing the sheets from the top of the stack supported on the platform is in the form of a suction wheel or drum 8 secured centrally to a shaft 9 for rotation. The shaft is mounted in posts 10 located at the respective sides of the frame and having vertical slots 11 within which the shaft is received and, accordingly, vertically movable.

Shaft 9 is adapted to be driven so as to rotate the suction drum in a clockwise direction as viewed in Fig. 1. This drive comprises a split-cone variable-speed pulley 12 of commercially available type on a shaft 13, a flat face pulley 14 on the shaft 9, an idler pulley 15, and a V-belt 16 arranged about the variable speed and idler pulleys. The belt is arranged so that its flat surface engages the pulley 14 at the lower portion of the latter, thereby reversely to drive the shaft 9, and by mounting the idler pulley 15 on a support 17 pivotally secured to the frame, the latter may be shifted to vary the belt tension with a resultant change in speed due to radial movement of the belt on the split-cone pulley 12 in well known manner.

Shaft 13 extends parallel to the suction drum shaft 9 at the inner side of the feed mechanism and has arranged thereabout in longitudinally spaced relation a number of tapes 18 which deliver the sheets to the perforator unit, not shown. At its other end, the shaft 13 is driven by such device by means of a pulley 19 and a belt 20, as fully discussed in my earlier application, and in such manner both the delivery tapes and the suction drum are driven in response to operation of the perforator.

The shiftable support of idler pulley 15 provides regulation of the suction drum speed of rotation relative to the speed at which the conveyor tapes move, and this affords variable overlap of the sheets in stream feeding. Such adjustment is facilitated by an operating rod 21 secured to one end of the idler support and having its other end threaded and passed through a bracket 22 on the frame. A thumb nut 23 is threaded on the outer end of the rod for convenient manual positioning of the support about its pivotal connection.

Small substantially horizontal guides 24 are positioned just beneath the suction drum to provide for sliding movement of the paper sheets toward the conveyor tapes as a result of the lifting and carrying action of the drum. A friction roll 25 is provided to grip the leading edge of each sheet as thus transferred cooperably with one of the tapes to ensure that the transfer is accomplished without slippage.

Suction is applied to the drum 8 by means of a shoe 26 overlying and held stationary at one end of the drum. As customary, the adjacent end face of the drum is pro-

vided with a series of circumferentially spaced apertures 27, and a further communicating series of spaced apertures 28 is provided in the cylindrical wall thereof. The shoe applies suction at the lower peripheral portion of the rotating drum effective to pick up and carry a sheet from the top of the stack a predetermined distance sufficient to transfer the same to the conveyor. A hose 29, which has been shown partially broken for convenience of illustration, extends from the lower region of the shoe 26 to a valve assembly 30 having a hose connection 31 leading to a suitable source of suction, for example, a motor-driven blower, not shown. This valve assembly is of a known type adapted to provide for either strike or stream feeding of the sheets by operation of a handle 32 controlling a barrel valve in the main suction line.

It will be clear that the top of the stack of sheets has a proper operating level relative to the suction drum for the desired transfer action of the latter, and that, as sheets are successively removed, the stack should be elevated to maintain the top at such level. I provide, for this purpose, an automatically controlled drive and lift means operating on the platform support chains 5. The chains are engaged respectively about drive sprockets 33 affixed to shafts 34, the shafts being supported for rotation in bearing assemblies 35. At the inner end of each shaft 34 is a worm gear 36 and a transverse shaft 37 is provided with worms 38 at the sides of the mechanism respectively in driving engagement with the worm gears. The gearing is such that rotation of the shaft in one direction, counter-clockwise in the illustrated structure, causes both chains to be actuated in a direction lifting the platform 2.

A latch bar 39 secured at one end of the suction shoe 26 has its other end slotted and engaged about shaft 37, thereby to hold the shoe stationary as the suction drum shaft 9 passing therethrough rotates. At one side of the frame of the feeding mechanism, shaft 37 projects outwardly, has a ratchet wheel 40 secured thereon, and terminates in a crank handle 41. A pawl 42 is pivotally mounted on a pin held by spaced support blades 43 which are, in turn, rotatably mounted on shaft 37, the pawl being disposed for engagement with the ratchet wheel. Pawl 42 has a lever 44 extending to the rear or oppositely from the ratchet-engaging end for rocking of the pawl about its pivotal connection with the support blades or ears 43.

Outwardly of such pivotal connection of the pawl, the upper end of a cylinder 45 is attached between the ears 43 and reciprocally received in the upper end portion of this cylinder is a first plunger 46. The upper end of this plunger is positioned beneath and in engagement with the lever 44 of the pawl, so that reciprocation of the plunger causes the pawl to oscillate between positions engaged with and disengaged from the ratchet wheel. In the normal depressed condition of plunger 46, the pawl is disengaged. A second plunger 47 is mounted likewise for reciprocation in the lower end portion of the cylinder 45 and is provided with an adjustable collar 48 limiting upward movement of the same or penetration of this plunger into the cylinder.

There is accordingly, defined within the cylinder and between the opposed ends of the two plungers a chamber 49 adapted to contain air and dimensioned so that air sealed therewithin is effective to transmit the motion of one plunger to the other. Accordingly, when the chamber is exhausted of air, there will be no effective coupling between the plungers, but when filled and sealed with air, the same forms a fluid connection therebetween.

The lifting thus imparted to the upper plunger, or the absence of the same, is utilized to control engagement of the pawl with the ratchet wheel in the manner of a triggering action to complete or leave disabled the driving connection of the shaft 37, as the case may be. Assuming chamber 49 to be sealed, initial upward movement of plunger 47 causes plunger 46 to raise, thereby to rock

pawl 42 from its normal disengaged condition into engagement with the teeth of the ratchet wheel. This locks together the ears 43 and the ratchet wheel with respect to movement in the direction of desired rotation of shaft 37. As plunger 47 continues its upward travel, collar 48 thereon engages the lower end of cylinder 45, and with further elevation raises the cylinder and hence the outer ends of ears 43. The latter swing upwardly about the axis of shaft 37, and since the ears are locked by the pawl relative to the ratchet wheel, the shaft is rotatively advanced.

However, should air be permitted to escape from chamber 49, initial raising of the lower plunger will not result in rocking of the pawl from its normal condition disengaged from the ratchet wheel, so that subsequent raising of the cylinder and swinging of the ears 43 will not turn the shaft. In such case, the ears are free to rotate relative to the drum and shaft 37. Thus, the lower plunger 47 of the assembly may be continuously reciprocated with transmission of the drive force to shaft 37 under control of conditions in the cylinder air chamber. It is to be noted that a direct mechanical connection of structural elements results in the drive condition of the assembly, thereby making it possible to lift heavy loads on the platform.

The protruding lower end of plunger 47 is pivotally attached to one arm 50 of a crank member 51. Such arm has two possible points of connection of the plunger indicated respectively at 52 and 53, these being in the form of openings through which a pin is passed to secure the plunger to the arm.

The crank is pivotally connected to a support projection 54 of the housing of the suction valve assembly 30 with the other arm 55 of the crank extending upwardly. Arm 55 has a connection by means of a yoke and pivot pin fitting 56 to one end of a rod 57 which is connected at its other end eccentrically to an element 58 also driven by the electric motor 59 of the perforator. Accordingly, operation of the perforator causes the rod to reciprocate substantially horizontally and this motion is transmitted through the crank to reciprocate the plunger vertically. Rod 57 also actuates the valve assembly 30 to apply suction to the drum 8 likewise in synchronism with the perforator operation in a manner set forth specifically in my prior application.

A vertical support post 60 projects above the frame 1 at the corner of the same adjacent the pawl and ratchet drive assembly, and a rod 61 is attached thereto by a fitting 62 for swinging movement in a plane parallel to that of the elevator. A sensing assembly indicated at 63 is slidably mounted on the arm and supports a depending valve and feeler unit 64. A small flexible conduit 65 leads from the valve of such unit to the cylinder 45 at the central chamber 49 of the same, while the feeler arm 66 extends downwardly into engagement with the top of the stack on the elevator.

The feeler arm is adapted to be rocked upon raising and lowering of the top of the stack relative thereto and, by virtue of such action, to control the opening and closing of the associated valve. When the top of the stack is at a predetermined level, the valve is operative to vent the cylinder chamber 49 to the atmosphere, whereby the cylinder and plunger drive is ineffective to rotate shaft 37 and raise the elevator. However, when the stack top is below such level, the feeler swings downwardly and closes the valve which thereby seals air in the cylinder and results in the drive force being transmitted to the elevator lifting mechanism. The detailed construction and a more elaborate description of the operation of this feeler mechanism will be found in my application, Serial No. 482,493, now Patent No. 2,739,810, and further discussion is believed unnecessary here.

As stated in the foregoing, the shaft 9 and hence

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the suction drum 8 may be lifted from the normal support position thereof and this would occur as a result of the stack, or the elevator itself, being improperly raised and forced against the suction drum. This might occur, for example, as a result of some mechanical failure of the feeler causing the valve for venting the cylinder to remain closed, although the feeler detection indicates the stack top to be at the proper level. Likewise, if the feeler is accidentally moved away from the stack and platform by an operator, so that it would remain in its downwardly extending position in which it closes the valve, the rise of the elevator would not be interrupted.

To protect against damage resulting from improper force against the suction drum, I provide a safety feature which will immediately and automatically shut off the entire apparatus upon the occurrence of such force. This safety comprises a limit switch 67 mounted by the post 60 above the projecting end of shaft 9 at such side and having a plunger 68 which extends downwardly into contact with the shaft. Accordingly, should the shaft be lifted, for any reason, the limit switch is actuated.

As shown in Fig. 3, switch 67 is connected and normally closed in the energization circuit of the perforator drum motor 59. Shifting of the shaft and suction drum upwardly from the full to the dashed line conditions thereof illustrated opens the switch, whereupon the motor is de-energized and the drive of the elevator, and of the entire apparatus, is stopped.

It is further to be noted that the variable attachment of the cylinder coupling assembly to the crank 51 in the drive connection between the perforator and the elevator affords different rates of feed or rise of the elevator. That is, the two points of attachment 52 and 53 on the crank arm 50 are unequally spaced from the axis of oscillation of the crank and thereby afford different moment arms. Thus, when the lower plunger 47 is attached to the point 52, as illustrated in Fig. 1, the shaft 37 is rotated in increments smaller than those resulting when the attachment is at the point 53 as indicated in Fig. 3. The first arrangement thus corresponds to a slow feed position and the second to a fast feed position, the operator being able to select between the two depending upon the material being handled.

It will accordingly be seen that the feeding operation of the prior mechanism has been made more flexible by the present improvements and, moreover, better protected against the possibility of serious and expensive damage due to malfunctioning of the feeler device and its control. It is now possible to handle efficiently in the same apparatus relatively thick cardboard sheets as well as thin paper sheets, the drive being set in the fast feed condition for the former in the slow feed condition for the latter. While I have shown only two such feed conditions, an even greater number of different rates may readily be had by providing added points of possible attachment for the cylinder-plunger unit on the drive crank, each affording a different stroke of the unit. Within limits, a maximum degree of adjustment could be realized by the use of a slot in the particular crank arm along which the attachment could be made as desired.

Other modes of applying the principle of the invention may be employed, changes being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In apparatus for the feeding of sheet material to a work-performing device having an electric drive motor, an elevator for supporting and raising a stack of the sheets to be fed, a drive connection between such motor and the elevator including a pneumatically controlled coupling and an oscillatable member to which the coupling is adjustably attached, adjustment of such attach-

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ment affording different rates of feed of the elevator, a transfer device for removing the sheets from the top of the stack on the elevator, said transfer device comprising a suction drum and a shaft on which the drum is mounted for rotation, supports holding such shaft with the drum positioned above the elevator, the shaft and hence the drum being movable upwardly relative to such supports, feeler mechanism for conditioning such drive coupling of the elevator in accordance with the level of the stack top in relation to the suction drum, and a normally closed limit switch mounted adjacent the drum shaft for actuation thereby upon lifting of the shaft, said switch being connected in the energization circuit of the electric drive motor, whereby such actuation of the same de-energizes the motor to stop operation of the work-performing device and of the elevator.

2. In apparatus for the feeding of sheet material to a work-performing device having an electric drive motor, an elevator for supporting and raising a stack of the sheets to be fed, an adjustable drive connection between such motor and the elevator capable of adjustment to vary the rate of feed of the latter, a transfer device for removing the sheets from the top of the stack on the elevator, said transfer device comprising a suction drum and a shaft on which the drum is mounted for rotation, supports holding such shaft with the drum positioned above the elevator, the shaft and hence the drum being movable upwardly relative to such supports, feeler mechanism for controlling the drive of the elevator at its adjusted rate of feed in accordance with the level of the stack top, and a normally closed limit switch mounted adjacent the drum shaft for actuation thereby upon lifting of the shaft, said switch being connected in the energization circuit of the electric drive motor, whereby such actuation of the same de-energizes the motor to stop operation of the work-performing device and of the elevator.

3. In apparatus for the feeding of sheet material to a work-performing device having an electric drive motor, an elevator for supporting and raising a stack of the sheets to be fed, a drive connection between such motor and the elevator including a pneumatically controlled coupling and an oscillatable member to which the coupling is adjustably attached, adjustment of such attachment affording different rates of feed of the elevator, a transfer device for removing the sheets from the top of the stack on the elevator, said transfer device being supported above the elevator and capable of being lifted from its normal operative position, feeler mechanism for conditioning such drive coupling of the elevator in accordance with the level of the stack top in relation to the transfer device, and a normally closed switch located to be actuated by the transfer device upon lifting thereof from its normal position, said switch being connected in the energization circuit of the electric drive motor, whereby such actuation of the same deenergizes the motor to stop operation of the work-performing device and of the elevator.

4. In apparatus for the feeding of sheet material to a work-performing device having an electric drive motor, an elevator for supporting and raising a stack of the sheets to be fed, an adjustable drive connection between such motor and the elevator capable of adjustment to vary the rate of feed of the latter, a transfer device for removing the sheets from the top of the stack on the elevator, said transfer device being supported above the elevator and capable of being lifted from its normal operative position, feeler mechanism for controlling the drive of the elevator at its adjusted rate of feed in accordance with the level of the stack top, and a normally closed switch located to be actuated by the transfer device upon lifting thereof from its normal position, said switch being connected in the energization circuit of the electric drive motor, whereby such actuation of the same deenergizes the motor to stop operation of the work-performing device and of the elevator.

5. In apparatus for the feeding of sheet material to a work-performing device having an electric drive motor, an elevator for supporting and raising a stack of the sheets to be fed, a drive connection between such motor and the elevator including a pneumatically controlled coupling, a transfer device for removing the sheets from the top of the stack on the elevator, said transfer device comprising a suction drum and a shaft on which the drum is mounted for rotation, supports holding such shaft with the drum positioned above the elevator, the shaft and hence the drum being movable upwardly relative to such supports, feeler mechanism for conditioning such drive coupling of the elevator in accordance with the level of the stack top in relation to the suction drum, and a normally closed limit switch mounted adjacent the drum shaft for actuation thereby upon lifting of the shaft, said switch being connected in the energization circuit of the electric drive motor, whereby such actuation of the same de-energizes the motor to stop operation of the work-performing device and of the elevator.

6. In apparatus for the feeding of sheet material to a work-performing device having an electric drive motor, an elevator for supporting and raising a stack of the sheets to be fed, a drive connection between such motor and the elevator, a transfer device for removing the sheets from the top of the stack on the elevator, said transfer device comprising a suction drum and a shaft on which the drum is mounted for rotation, supports holding such shaft with the drum positioned above the elevator, the shaft and hence the drum being movable upwardly relative to such supports, feeler mechanism for controlling the drive of the elevator in accordance with the level of the stack top, and a normally closed limit switch mounted adjacent the drum shaft for actuation thereby upon lifting of the shaft, said switch being connected in the energization circuit of the electric drive motor, whereby such actuation of the same de-energizes the motor to stop operation of the work-performing device and of the elevator.

7. In apparatus for the feeding of sheet material to a work-performing device having an electric drive motor, an elevator for supporting and raising a stack of the sheets to be fed, a drive connection between such motor and the the elevator, a transfer device for removing the sheets from the top of the stack on the elevator, said transfer device being supported above the elevator and capable of being lifted from its normal operative position, feeler mechanism for controlling the drive of the elevator in accordance with the level of the stack top, and a normally closed switch located to be actuated by the transfer device upon lifting thereof from its normal position, said switch being connected in the energization circuit of the electric drive motor, whereby such actuation of the same de-energizes the motor to stop operation of the work-performing device and of the elevator.

8. Sheet feeding mechanism comprising a stack platform, drive means including an electric motor and transmission means connecting said motor to said platform for raising the latter, a sheet removing device positioned

normally above the platform and mounted for vertical movement, control means for regulating operation of said drive means in response to the elevation of the platform, and a control circuit for said drive motor including a switch actuated in response to lifting of the sheet removing device to de-energize the motor.

9. Sheet feeding mechanism comprising a stack platform, drive means having a connection with said platform for raising the same, sheet removal and transfer means positioned normally above the platform and capable of being moved upwardly from its normal position, control means for regulating said drive means in accordance with the elevation of the platform, and further control means operative to disable said drive means in response to lifting of the sheet removal and transfer means from its normal operative position.

10. Sheet feeding mechanism comprising a stack platform, drive means for raising the same including an electric motor and transmission means connecting the same to the platform, a sheet removing device mounted on a shaft above the platform, hanger supports for said shaft permitting the same and hence the sheet removing device to be moved upwardly, control means for regulating operation of said drive means in response to the elevation of a stack of sheets on the platform, a normally closed limit switch located above said shaft for actuation by the same when lifted, and a control circuit for said motor including such switch, such actuation of the switch being effective to stop the motor drive of the platform.

11. In sheet feeding mechanism, an elevator for supporting and raising a stack of the sheets to be fed, drive means for the elevator comprising a shaft, a cylinder, latch means for interconnecting one end of the cylinder and the shaft, a first plunger in the cylinder operative to actuate the latch means, a second plunger opposed to the first and having a lost-motion connection with the cylinder, valve means for selectively venting and sealing the cylinder region between the two plungers, control means for conditioning the valve means in accordance with the elevation of a stack of sheets on the platform, the cylinder being sealed when the stack is below a predetermined level whereby initial movement of the second plunger causes the first to latch the cylinder to the shaft, a continuously driven crank, and an adjustable connection between the second plunger and the crank, the lower plunger being driven by the crank to drive the cylinder, adjustment of such plunger attachment varying the resultant stroke of the cylinder and hence the rate of feed of the elevator.

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