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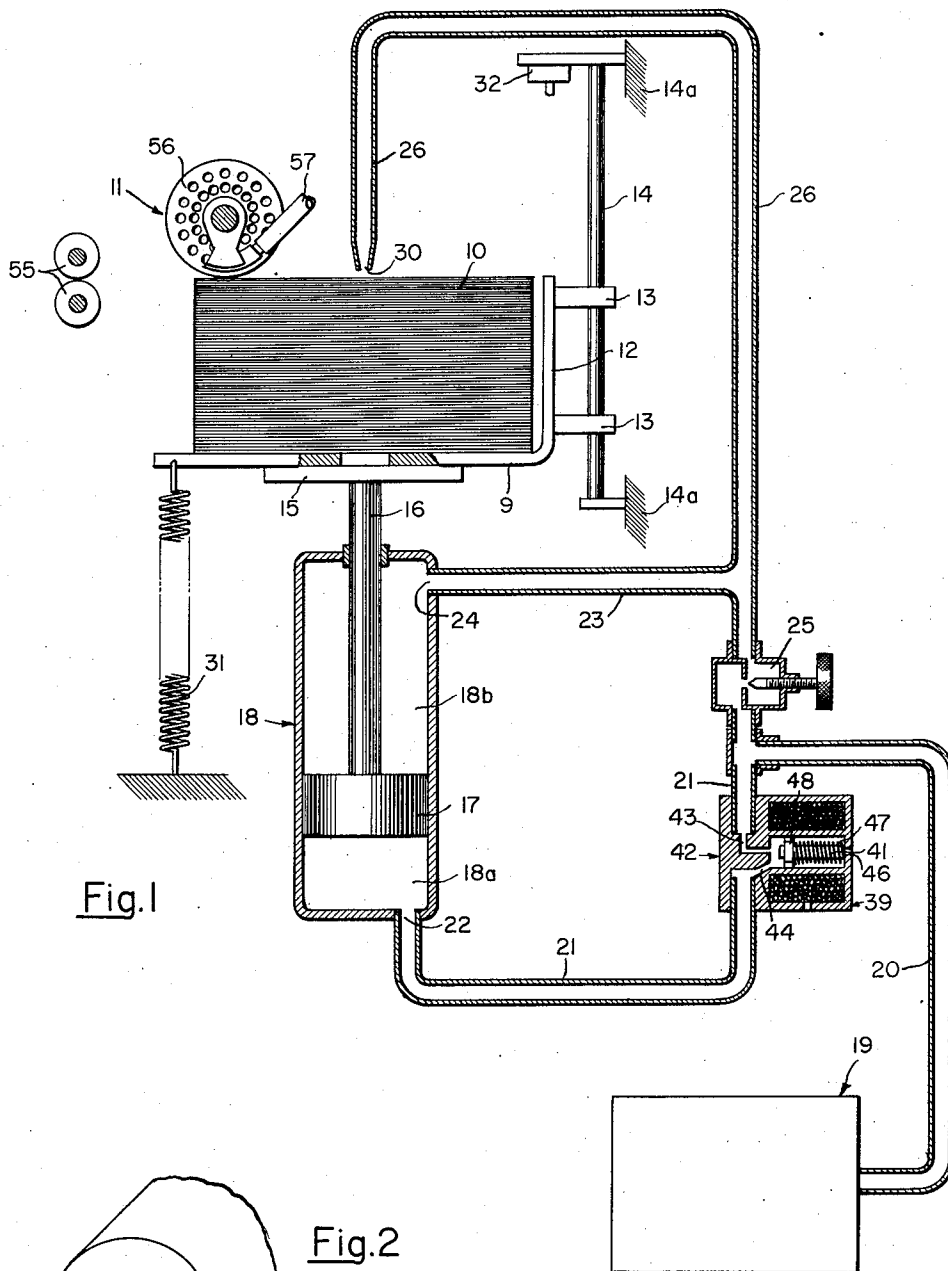
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2,902,278

PNEUMATIC CONTROLLED SHEET FEEDER

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3 Sheets-Sheet 1



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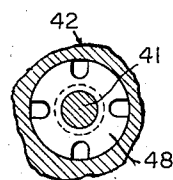
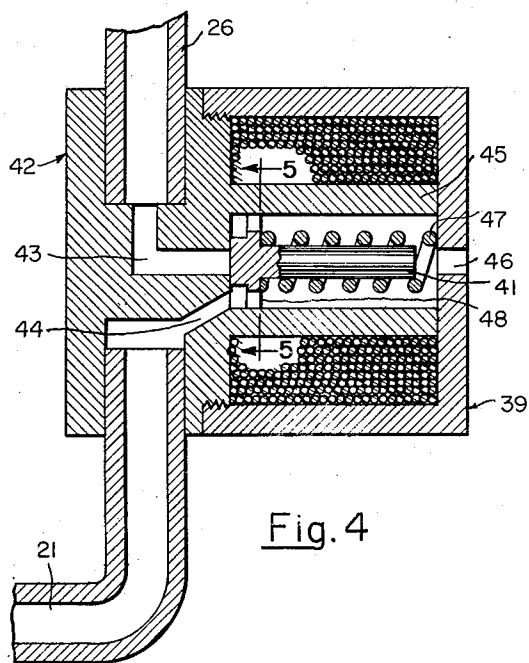
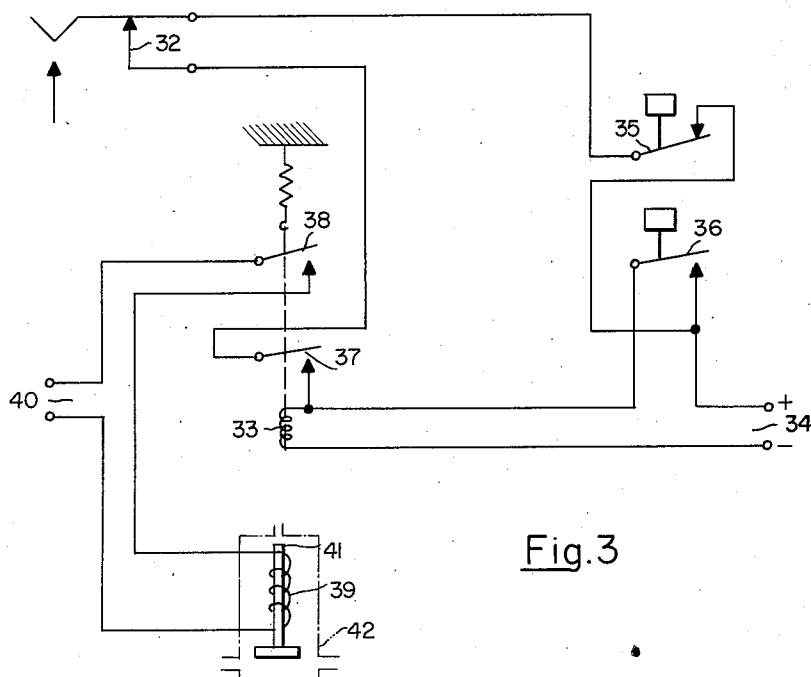
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PNEUMATIC CONTROLLED SHEET FEEDER

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3 Sheets-Sheet 2



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PNEUMATIC CONTROLLED SHEET FEEDER

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19 Claims. (Cl. 271—30)

The present invention relates to the feeding of stacked sheets of material and more particularly to apparatus for maintaining the successive top sheet of a stack of sheets at a substantially constant level whereby sheet feeding devices can remove successively presented top sheets of the stack as it diminishes by such removal.

There are many types of sheet feeding devices, one of the most common of which advances the stack of paper or like sheets to a picker or feeder by means of a pawl and ratchet arrangement wherein a lead screw advances the stack by means of a reciprocating pawl which is under the control of a sensing arm arranged at the height of the top sheet of the stack. To carry out its proper function the sensing arm or finger is required to be in contact with the top sheet being sensed and has to be removed from such contact on every feed cycle to prevent interference with the stripping of the sheet from the stack. Of course, other means have been provided for the purpose of maintaining the top sheet of a stack of sheets at a substantially constant level for feeding purposes but in applicant's knowledge all require some contact with the top sheet of the stack. If not removed from such contact as indicated above they offer a disadvantageous resistance to the removal of the successive sheets.

It is an object of the invention to provide a sheet stack positioning or levelling device wherein the foregoing disadvantages are overcome.

Another object is to provide a system of sheet stack control wherein the level of successive sheets to be fed is maintained substantially constant.

Another object is to provide stack levelling apparatus pneumatically controlled whereby the top sheet of a stack is automatically moved to an accurate level sheet feeding position.

Generally stated, the invention provides pneumatically controlled means for moving a stack of sheets relative to a feeding position in a manner locating the successive top sheets thereof always at the same level or plane for removal by a suitable picker for transfer to a feeding device which delivers it to some mechanism for processing. A novel feature resides in the provision of a pneumatic sensing device positioned relative to the sheet stack so as to effect balanced pressures in the system when the top sheet reaches the feeding level and thereby provide continuous operation moving successive sheets into the same position for removal from the stack.

In the accompanying drawings:

Fig. 1 is a schematic sectional view of a stack control mechanism embodying one form of the invention;

Fig. 2 is a fragmentary perspective view of the sensing head;

Fig. 3 is a view showing one form of electrical control circuit for the mechanism;

Fig. 4 is a detail sectional view of a solenoid control valve used in the assembly;

Fig. 5 is a section on line 5—5 of Fig. 4;

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Fig. 6 is a side elevation view of an assembled machine embodying the invention; and

Fig. 7 is a section view on line 7—7 of Fig. 6.

Referring to the drawings illustrating a preferred embodiment of the present invention and first with reference to Fig. 1, the numeral 9 designates a platform forming a support or holder for a stack 10 of sheets such as paper from which the top sheet is to be removed by a suitable feeder 11 whereupon the next succeeding sheet will be brought into position for like removal. In this figure the platform 9 is horizontally disposed and has a side wall 12 rising at one end from which guide lugs 13 extend into slidable engagement with a rod 14, the ends of which are fixed in framing members 14a, thus to guide and stabilize the platform during movement thereof to position the top sheet of the stack 10 properly positioned in registration with the removal point and during its return movement for placement of another stack on the platform.

The platform 9 is mounted upon a plate 15 secured to and carried by the projecting end of a piston rod 16 of a piston 17 which is reciprocable in a cylinder 18 suitably supported in operative position beneath the platform. Operation of piston 17 is effected by compressed air from a suitable source 19 and through a pipe 20. A pipe 21 as a branch of pipe 20 communicates by way of a port 22 with the lower chamber 18a of cylinder 18, and a second branch pipe 23 communicates by way of a port 24 with the upper chamber 18b of the cylinder. Pipe 20 is provided with an adjustable needle valve 25 positioned between the inlets to the two branch pipes 21 and 23 for a purpose to be presently described.

In order to sense the position of successive top sheets of the stack for proper delivery to the paper feeder 11, a fixed sensing tube 26 extending from pipe 20 beyond branch pipe 23 has its end spaced above the stack 10 to terminate in a downwardly disposed air exhaust outlet located to direct a stream of air toward the top sheet of the stack, preferably at the center thereof.

The discharge end 30, may, if desired, be provided with one or more orifices 30a therein, see Fig. 2, juxtaposed to the stack sheet which is to be sensed for removal. Preferably five such orifices are provided in the present showing but the number is not critical since the desideratum is to provide an air outlet over the top sheet as the stack approaches. The adjustment of needle valve 25 forms a means to proportion the air to the branches 21 and 23 according to the desired rate of air flow at the orifices 30 in order to balance the pressure between the upper and lower ends of the cylinder as is required for stopping the movement of the piston and thus the stack when the top sheet reaches the feeding position.

A tension spring 31 is connected at one end to a fixed point and at the other end to the platform 9 thereby producing a force counter to that operating to elevate the loaded platform. When the spring 31 is stretched to its maximum by the removal of all of the sheets, namely when the stack is exhausted, the force applied by the stretched spring is approximately equal to the weight of a full stack. On the other hand the spring rate is such that it exerts little force with a full stack in place on the platform. Thus in all rising positions of a stack of sheets the changing force applied by the spring compensates for the decreasing weight of the stack as the sheets are removed so that the piston is under a relatively constant force.

In operation the full pressure of the air supply from the source 19 is admitted through pipe 20 to the lower chamber 18a of the cylinder and is of sufficient force to overcome the weight of the stack and thus cause the platform 10 to move upwardly. The needle valve 25 is adjusted so as to bleed the air supply to both the upper chamber 18b of the cylinder and to the sensing tube 26 and its

orifices 30 and so maintain a proportioned control. Thus as the top of the stack approaches the orifices the free flow of exhaust air is restricted and the pressure consequently increases in the sensing tube creating a back pressure in the upper chamber 18b of the cylinder counter to the lifting pressure in the opposite end of the cylinder. This back pressure continues to build up until the force produced by the pressure on top of the piston plus the weight of the paper stack and the force of spring 31 is equal to the full air pressure acting on the bottom of the piston. When this occurs the advance of the paper is stopped by the balanced pressures and the top sheet is so positioned with respect to the orifice exhaust that sufficient air is still escaping to maintain this balanced condition. Thus as each sheet of paper is removed from the stack the piston advances thereby to keep successive top sheets at the same level. Preferably when the top sheet is so positioned for removal the orifice sensing unit 30 is spaced minutely from the sheet so there is no contact between them to cause friction during the feed cycle.

In order to stop the support when the last sheet of the stack has been removed and also release the lifting pressure, a trip microswitch 32 is mounted in the path of stack wall 12 at the precise level to be tripped when the support has been emptied of sheets. Switch 32 is normally closed and, as seen in Fig. 3, is included in a holding circuit for a relay 33 which received voltage from a source 34. This holding circuit also includes a normally closed push button switch 35. Relay 33 is also included in a starting circuit having a normally open push button switch 36 to be manually closed, thereby to energize relay 33 closing the holding circuit at contactor 37 while also closing a circuit at contactor 38, thus to energize a solenoid 39 from voltage source 40. The solenoid 39 and its plunger 41 are a part of an air control unit 42 mounted in pipe 21, see Figs. 1 and 4. The unit 42 has an upper port 43 and a lower port 44 both communicating with a cylinder 45 in which plunger 41 rides to function as a valve for closing port 43 as required to cut off the supply of air to chamber 18a, while leaving port 44 open to exhaust air from chamber 18a around plunger 41 to escape through an outlet 46 in the end of the cylinder. When the solenoid is energized plunger 41 is retracted against an encircling compression spring 47 to close the outlet 46. Spring 47 bears at one end against a ported collar 48 (Fig. 5), carried by plunger 41, and at the other end seats against the end of the solenoid cylinder 45.

When the sheet stack is in place switch 36 is manually closed to energize relay 33 which closes two contactors 37 and 38 for the respective holding and solenoid circuits, whereupon plunger 41 is retracted to open ports 43 and 44 and close the relief exhaust outlet 46. The compressed air is now directed into the lower chamber 18a of cylinder 18, as the lifting means for the stack, and the weight balancing spring 31 is exerting practically no counter pressure. Needle valve 25 has been adjusted to permit a proportionately controlled amount of air to flow through sensing tube 26 and branch pipe 23 to upper chamber 18b as well as to the sensing exhaust outlet 30 so that the air escaping therefrom maintains a lesser degree of pressure above piston 17 than below. When the top sheet of the stack reaches its removal position the discharge from outlet 30 is diminished to the point where there is sufficient back pressure in tube 26 and branch 23 when combined with the stack weight and spring pressure to balance the lifting pressure in cylinder 18a and thus stop the stack with the top sheet positioned for feeding by unit 11. This balanced condition is maintained during the upward movement of the stack as successive sheets are fed therefrom. The final sheet is fed substantially coincident with the impact of stack wall 12 with switch 32, thus to open the holding circuit. When this circuit opens, relay 33 is deenergized and both contactors 37

and 38 open, the former safeguarding the open holding circuit and the latter deenergizing the solenoid 39. As a result the solenoid plunger 41 is projected to cause its valve to close port 43 and open port 46 thus to exhaust air from chamber 18a through pipe 21 to the atmosphere removing the pressure from chamber 18a whereupon spring 31 assisted by the air pressure in chamber 18b lowers the platform assembly ready to receive a fresh stack of sheets.

While the above description of the invention has been with reference to a schematic showing thereof in Figs. 1-5, it will be seen in Figs. 6 and 7 that the principles of the invention are readily adapted for incorporation in a practical embodiment thereof. In these views like reference characters have been applied to like parts in the above description.

Certain minor differences are apparent. For example, as seen in Fig. 7 two rods 14 and two springs 31 are shown, thus to stabilize the movements of platform 9. It will be seen that the sheet stack is carried by a tray 50 having two sides 51 and 52 and a bottom 53. The tray is easily slid into position on platform 9 from the side thus to position the stack beneath sensing element 30. Still further in this embodiment the air tubes for the most part are of flexible material such as rubber. Sensing element 30 however, preferably is formed of a rigid pipe section. The stack carrier or platform 9 is mounted to slide on the rods 14 which are angularly disposed to feed the sheets angularly upwardly and outwardly from tray 50 first between feed roller 55 and thence to processing equipment, not shown.

While various types of strippers, such as indicated at 11 in Fig. 1, can be used to draw off the top sheet for delivery to the pair of rotating feed rolls 55, it is preferred to employ a conventional type sheet picker comprising a ported driven drum 56 operatively assembly with a suction pipe 57 leading to a source of vacuum. For details of such a mechanism reference may be had to Patent 939,260 to J. Hren.

It is to be understood that the electrical controls shown in Figs. 3, 4 and 5 while described more particularly with respect to Fig. 1, are used also with the modified assembly shown in Figs. 6 and 7.

It will now be apparent that a novel mechanism has been devised for effectively positioning the top sheet of a sheet stack in register with a removal point.

What is claimed is:

1. A sheet feeding mechanism comprising means for positioning successive top sheets of a stack of sheets at a sheet feeding position as the sheets are fed from the stack, and means for removing said successive top sheets, said positioning means comprising, means for supporting a stack of sheets, means having an outlet at said sheet feeding position for directing a stream of air toward the top sheet of said stack, means for moving said stack supporting means toward said air outlet, means responsive to the free flow of air through said air outlet to effect the movement of said stack supporting means toward said sheet feeding position, and means responsive to the restriction of said air flow from said air outlet by the successive top sheets of said stack as they are removed from the stack to stop said stack moving means with the top sheet of said stack in said feeding position.

2. A sheet feeding mechanism comprising means for successively presenting sheets of a stack of sheets at a sheet feeding position, and means for removing the top sheet of the stack as they are presented, said presenting means comprising, means for supporting a stack of sheets, means having an outlet at said sheet feeding position for directing a stream of air toward the top sheet of said stack, means for moving said stack supporting means in a linear direction, means responsive to the free flow of air through said air outlet to effect the linear movement of said stack toward said sheet feeding position, and means responsive to the restriction of said air flow from said air outlet by

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the top sheet of said stack to stop said stack moving means with the successive top sheets of said stack in said feeding position whereby said top sheets can be removed by said sheet removing means.

3. A sheet feeding mechanism comprising means for successively presenting sheets of a stack of sheets at a sheet feeding position, and means for removing said top sheets as they are presented, said presenting means comprising, means for supporting a stack of sheets, means having an outlet at said sheet feeding position for directing a stream of air toward the top sheet of said stack, means for moving said stack supporting means in a linear direction, pneumatic means responsive to the free flow of air through said air outlet to effect said linear movement of said stack toward said sheet feeding position, and means responsive to the restriction of said air flow from said air outlet by the successively presented top sheet of said stack to stop said stack moving means with the successive top sheets in said feeding position.

4. A mechanism for positioning the top sheet of a sheet stack at a removal point, comprising a support for such stack, means including a cylinder and a piston for lifting said support, a source of compressed air, a pipe connecting said source between one end of said cylinder and said piston, a sensing tube connecting said source between the other end of said cylinder and said piston, an extension on said tube terminating in an exhaust outlet juxtaposed to but spaced from said top sheet, and pressure control means for proportioning the air flow between said tube extension and said cylinder in response to restricted air discharge from said outlet due to the approach of said top sheet whereby at the predetermined level of said top sheet the air pressure at opposite sides of said piston are balanced and said top sheet is stopped in register with said removal point.

5. A mechanism according to claim 4 wherein said proportioning means is a needle valve.

6. A mechanism according to claim 4 wherein means is provided to compensate for stack weight variations to maintain a constant weight on said lifting means.

7. A mechanism according to claim 6 wherein said compensating means is a tension spring stretched between said support and a fixed point.

8. A mechanism for positioning the top sheet of a sheet stack, comprising a support for such stack, means for lifting said support to bring the top sheet to a removal point, pneumatic pressure sensing means juxtaposed to but spaced from the top sheet for controlling said lifting means, and means responsive to the variation of said spacing by the rising stack to stop said lifting means when the top sheet is positioned at said removal point.

9. A mechanism according to claim 8 including means operable to withdraw successive top sheets.

10. A mechanism according to claim 8 wherein said sensing means includes an orifice for exhausting air towards the rising top sheet.

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11. A mechanism for positioning the top sheet of a sheet stack, comprising a support for such stack, means including a piston and a cylinder for lifting said support, a supply pipe connected to a source of compressed air, branch pipes from said supply pipes communication with said cylinder at opposite sides of said piston, a sensing tube forming an extension of said supply pipe having an exhaust outlet juxtaposed to said top sheet, and means responsive to a restriction of said orifice by the rising top sheet to balance the pressure in said branch pipes whereby said stack is stopped with the top sheet positioned in register with a removal point.

12. A mechanism according to claim 11 wherein means operates to proportion the pressure between said branches and said sensing tube.

13. A mechanism according to claim 12 wherein a tension spring is stretched by the moving support to rebalance the weight of said stack as sheets are removed.

14. A mechanism according to claim 12 wherein a supplemental means is operated by the rising support to exhaust air from the lift end of said cylinder whereby said support is retracted by unbalanced pressure in said cylinder.

15. A mechanism according to claim 14 wherein said supplemental means is an electrical controlled valve unit in said air supply pipe.

16. A mechanism according to claim 15 wherein said valve unit is in a solenoid circuit including a limit switch in the path of said support for closing said solenoid circuit to exhaust the said lift end of said cylinder, whereby said support is restored to a loading position.

17. A mechanism for positioning the top sheet of a sheet stack at a removal point, a support for said stack, pneumatic means for lifting said support, a limit switch position in the path of the rising support, a source of compressed air, means controlling air from said source for actuating said lifting means, and circuit means operated by said limit switch when engaged by said support for rendering said controlling means ineffective.

18. A mechanism according to claim 17 wherein said limit switch is normally closed but is opened by said support at a predetermined level to cause said circuit means to operate.

19. A mechanism according to claim 18 wherein said circuit means includes a relay controlled solenoid for exhausting said pneumatic lifting means whereby said support is restored to a loading position.

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