United States Patent

Gates

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[54] SHEET SENSING MECHANISM

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[73] Assignee: **Gestetner Limited**, London, England

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[52] **U.S. Cl.** **101/235**, 271/56

[51] **Int. Cl.** **B41f 13/40**

[58] **Field of Search** 101/233, 234, 235; 271/47, 271/56

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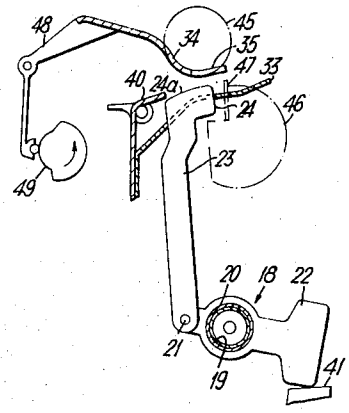
[57] **ABSTRACT**

Printing apparatus including a movable sheet sensing member cooperable with a driven slotted sheet deflector member so that a passing sheet in contact with said deflector member will cover the slot and cause the sensing member to be urged into a sheet present position to disenable the pressure roller raising mechanism. Absence of a sheet permits the sensing member to enter the slot and thereby remain in a sheet absent position.

8 Claims, 5 Drawing Figures



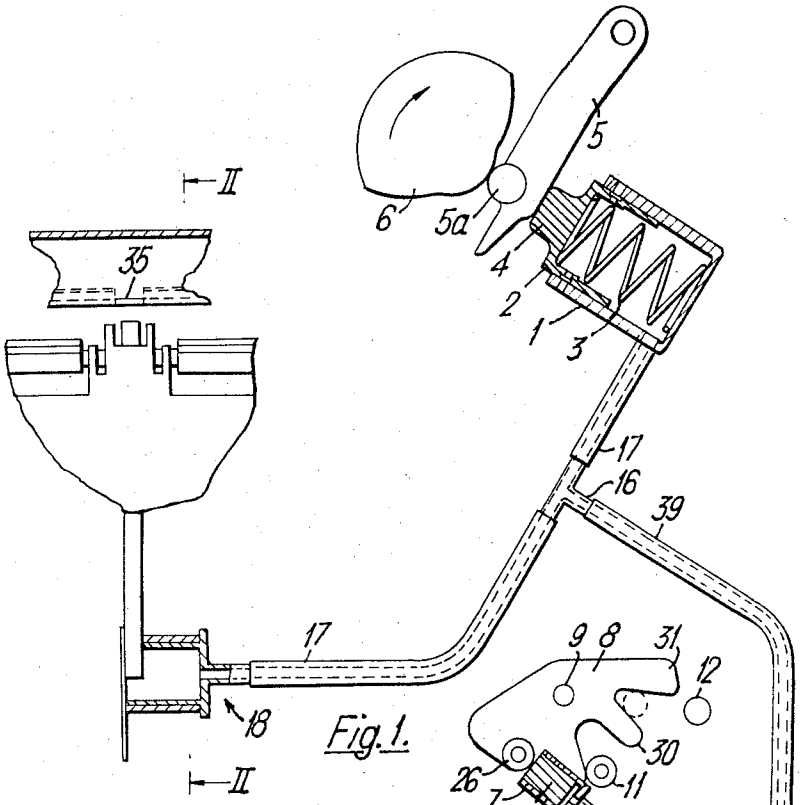


Fig. 1.

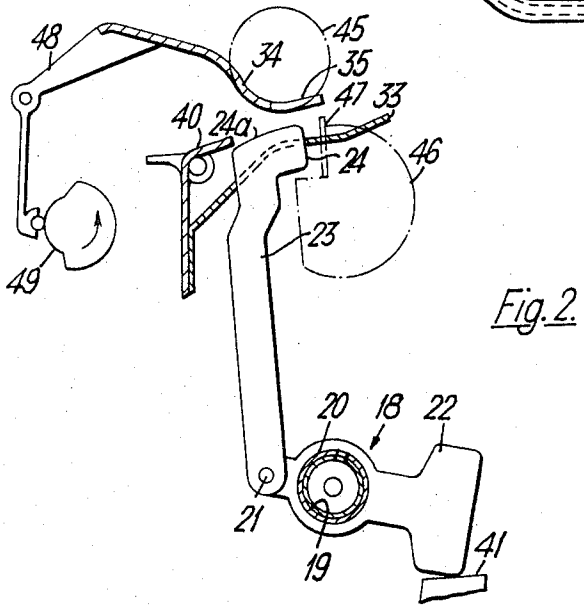


Fig. 2.

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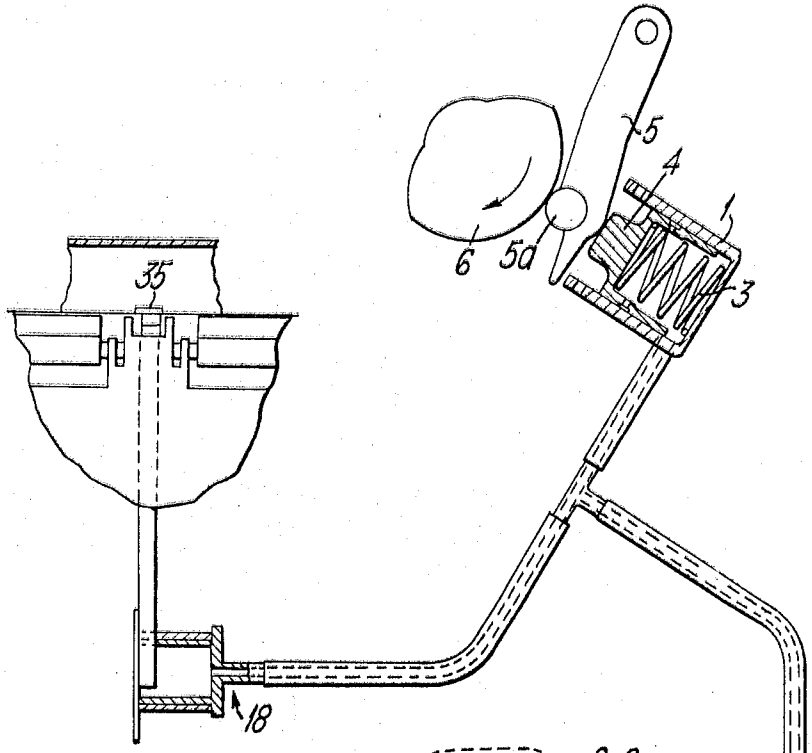

Fig.3.

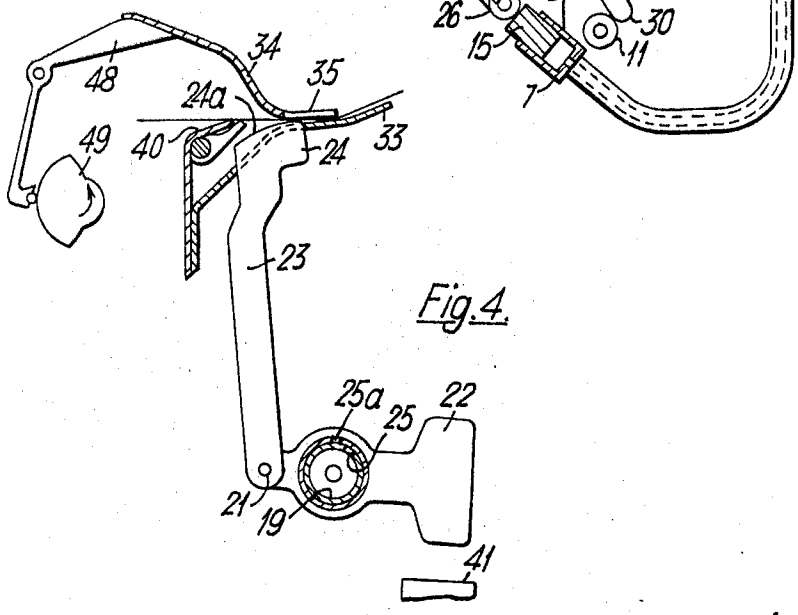

Fig.4.

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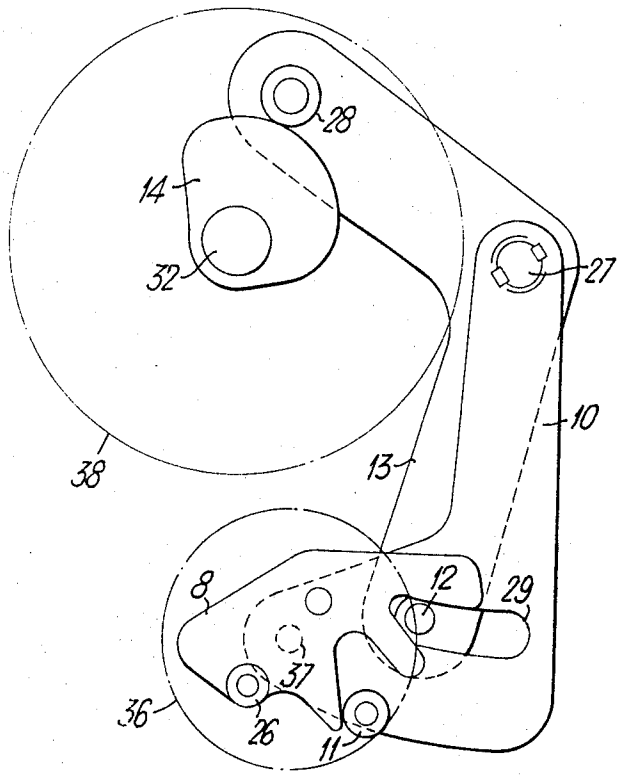

Fig. 5.

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SHEET SENSING MECHANISM

This invention relates to a sheet sensing mechanism, and more particularly to a sheet sensing mechanism for use in a sheet feeder which is intended to feed sheets one at a time to associated equipment where it is important that such equipment or part of it should be inoperative when no sheet is being fed thereto. One form of equipment in which the sheet feeder of this invention is particularly useful is a stencil duplicator. In stencil duplicators, the stencil is carried around a printing cylinder, and sheets of paper are passed one at a time between the stencil on the printing cylinder and a pressure roller which presses the paper against the stencil. It is necessary for the pressure roller to move towards and away from the printing cylinder as each sheet of paper is being fed through the duplicator and also for the pressure roller to be prevented from moving towards the printing cylinder when no sheet is being fed through the duplicator. If such movement were not prevented, the pressure roller would contact the stencil and be inked thereby and then cause soiling of the backs of the sheets subsequently passed through the duplicator.

Conventional stencil duplicators have been provided with a paper detecting device which, by means of a mechanical linkage to the pressure roller movement mechanism, ensures that the movement of the pressure roller is only effected when a sheet is being fed. In British Pat. No. 973,108 (Gestetner Limited) we have described an improved paper detecting and pressure roller control device in which control of the pressure roller is effected by pneumatic means under the control of means which senses when paper is not being fed through the machine. In the construction described in our said patent specification, the sensing device comprises a detector piston and cylinder arrangement which is positioned above the feed path of sheets to the printing cylinder and to which, while the duplicator is in operation, alternate pressure and suction pulses are supplied from a master piston and cylinder arrangement operated in synchronism with the operation of the duplicator to cause the detector piston to move downwardly and then upwardly again, once for each cycle of operation of the duplicator. The detector piston is positioned so that, in moving to its lowermost position, it crosses the feedpath of sheets fed to the printing cylinder. When no sheet of paper is being fed to the printing cylinder at the time the detector piston moves downwardly, this piston moves to its lowermost position and in such position permits a pressure pulse of air from the master cylinder to be fed to pressure roller control means. This pressure pulse acts to effect disconnection of the mechanism which normally causes the pressure roller to engage the printing cylinder of the duplicator at the appropriate time during each printing cycle. When, however, paper is being fed to the printing cylinder at the time the detector piston moves downwardly, such piston is intercepted by the paper and prevented from reaching its lowermost position. As a consequence, no pressure pulse of air can be sent to the pressure roller control means and the pressure roller operates normally.

Moreover, in British Pat. No. 1,153,617 (Gestetner Limited) there is described and claimed a pneumatic sheet sensing mechanism in which a lever is arranged in the path of sheets through the device and is deflected by contact with a sheet, the lever being connected to a rotary valve which normally vents the pneumatic system to atmosphere, but which is arranged to seal the pneumatic system when deflected by a passing sheet.

According to the present invention there is provided sheet handling apparatus including a sheet detecting control device for rendering the apparatus or a part thereof inoperative when no sheet is detected, such apparatus comprising a sheet flow path, a sheet sensing member movable between a first position in which it projects into said flow path and a second position in which it is clear of said flow path, a sheet guide member cooperable with said sensing member and movable between an out-of-the-way position and a sheet deflecting position adjacent said flow path, whereby when the sensing member is in its first position and the guide member is in its sheet deflecting position with no sheet present the sensing member is received within an aperture or recess in the guide member, and means for driving said guide member for movement from said out-of-the-way position to said deflecting position to carry out a sheet sensing operation. Preferably the sheet sensing member may be a plunger reciprocable along a direction transversely of the plane of a sheet passing along the sheet flow path. Advantageously the guide member driving means may be a linkage connected between the movable guide member and the main drive mechanism of the sheet handling apparatus, for moving the guide member at regular intervals during the operation of the apparatus.

The control device may suitably include a pneumatic transmission and the sheet sensing member may be connected to a rotary vent valve included in the pneumatic transmission so that the sensing member in its first position retains the vent valve in a venting configuration and in its second position retains the vent valve in an air tight condition. Desirably the sensing member may be counterbalanced by a counterbalance weight associated with the rotary vent valve. More desirably the rotor of the rotary vent valve may be positioned with its axis of rotation horizontal and is articulated to the sensing member and the counterbalance weight is attached to the rotor so as to be diametrically opposite the articulation connection between the sensing member and the rotor.

Conveniently the sheet guide member may be provided with a slot and the sheet sensing member has an elongated sheet sensing head arranged such that when the sensing member is in its first position and the guide member is in its deflecting position, the elongated head is received snugly within the slot in the guide member provided no sheet is present.

It will be appreciated that the sheet handling apparatus of the present invention offers considerable advantages over the prior art, in that the provision of a movable guide makes it possible to provide an entirely unobstructed sheet flow path through the apparatus, the guide member only entering the flow path when it is desired to carry out a sensing operation; and when the guide does contact a sheet the guide moves to brace the sheet against the sensing means. The preferred embodiment employing a pneumatic system has the advantage that the sensing member is moved by contact with the mechanically driven guide member rather than by the pneumatic drive employed in an earlier British Pat. No. 973,108.

In order that the present invention may more readily be understood, the following description is given, merely by way of example, reference being made to the accompanying drawings in which:

FIG. 1 is a part sectional view of the components of a sheet detecting mechanism of the present invention;

FIG. 2 is a section taken on the lines II—II of FIG. 1;

FIG. 3 is a view, similar to FIG. 1, but showing the effect of the presence of a sheet of paper on the sheet detecting mechanism;

FIG. 4 is a view, similar to that of FIG. 2, but showing the effect of a sheet being sensed; and

FIG. 5 is a side elevational view of a stencil cylinder and a pressure roller of a duplicator incorporating the device of FIGS. 1 to 4.

Referring now to FIG. 1, there is shown a sheet sensing mechanism comprising a pneumatic master cylinder 1 enclosing a slidably arranged piston 2 biased by means of a spring 3 towards an outwardly projecting position in which a head 4 of the piston bears against a cam follower lever 5 supporting a cam follower roller 5a which bears against an operating cam 6. The pneumatic system further includes a slave cylinder 7 adjacent a latch lever 8 pivotally mounted at 9 and serving to actuate some other device, in this case the pressure roller of the duplicator, when the presence of a sheet is sensed by the device. The operation of the latch lever 8 will be more fully understood from the later description with reference to FIG. 5.

The slave cylinder 7 includes a slave piston 15 which is able to be reciprocated within the cylinder by means of pressure or suction pulses communicated thereto by way of a duct 39 communicating the cylinder 7 with a T-piece 16 connected in a further duct 17 which joins the master cylinder 1 with a rotary valve 18.

The valve 18, as shown more clearly in FIG. 2, comprises a fixed inner valve core 19 and a relatively rotatable outer sleeve 20 formed as part of an actuator arm having a pivot 21 at one end and a counterbalance weight 22 at the other end.

The pivot 21 at one end of the actuator arm carries a sensing plunger 23 having a shaped head 24 over which a sheet will pass in use of the duplicator. The valve core 19 and sleeve 20 are provided with exhaust ports 25 and 25*a*, respectively, as shown in FIG. 4. When the valve is in the FIG. 2 position the ports 25 and 25*a* are in register and the space within the valve core is communicated to atmosphere. However, when the valve attains the FIG. 4 position, the ports move out of register and the space within the valve is thus sealed. The arrangement of the valve sensing plunger 23 is such that when the plunger is depressed by a passing sheet, the valve is moved to the FIG. 4 position in which the conduit 17 is sealed and any pressure pulses created in the master cylinder 1 will be communicated directly to the slave cylinder 7, and when no sheet is present the plunger 23 attains the FIG. 2 position in which the ports 25 and 25*a* are in register and any pressure pulses created by the master cylinder will be dissipated through the rotary valve 18.

The particular construction of the valve plunger is such that it has an arcuate upper sheet guiding face 24*a* on the shaped head 24 which presents little or no obstruction to the passage of a sheet thereover. As can be seen from FIG. 2, even when the plunger is in its uppermost position the majority of the arcuate face 24*a* is concealed behind and below the sheet fence 40 of the sheet feeder and thus the sheet is afforded a path clear of obstruction until it arrives at the sheet register stop plate 47 secured to the lower secondary feed roller 46 of a duplicator in which the sheet detecting system is fitted. The stop plate 47, lower secondary feed roller 46 and top secondary feed roller 45 are all shown in dot-dash line form in FIG. 2. The plunger head 24 is arranged to protrude through a slot in the sheet guide 33 and to cooperate with a sheet deflector 34 having a slot 35 which enables the plunger to remain raised in its FIG. 2 position even when the deflector 34 is in the FIG. 4 position, provided no sheet of paper is present. The deflector is driven to rise and fall when the duplicator and the sheet feeder are operating, and the slot 35 therefore ensures that, in the absence of a sheet passing across the guide 33, the plunger is able to remain up and hence ensure that the slave cylinder 7 is inoperative due to venting of the conduit 17. Deflector plates are frequently used for control of the passage of sheets from a sheet feeder and can readily be modified by having a slot 35 cut out for receiving the plunger head 24.

The counterbalance weight 22 is arranged vertically above a stop 41 which thereby defines the limit of clockwise motion of the valve sleeve 20 and accordingly the limit of upward movement of the sensing plunger 23. Since the moment exerted by the balance weight 22 about the axis of the valve 18 is greater than the moment exerted by the pivot 21 and plunger 23, the plunger 23 will be gravity biased towards a raised position in which the arcuate surface 24*a* will be contacted by a passing sheet.

FIGS. 2 and 4 also show one of a pair of bellcranks 48 driving the deflector 34 and driven by means of cams 49 which in turn are driven by a transmission from the duplicator main drive system.

The operation of the above described mechanism is as follows:

The cam 6 is driven for continuous rotation together with the stencil cylinders. The shape of the cam, as shown in FIGS. 1 and 3, is such that during rotation from the FIG. 1 position to the FIG. 3 position the cam follower lever 5 will be pivoted rapidly in the anticlockwise direction to attain a position which is then held for approximately 150° of rotation of the cam past the FIG. 3 position. Subsequently the lever 5 will return rapidly to its FIG. 1 position. During this cycle of movement, the piston 2 will first be urged into the cylinder, then be held in position for the 150° movement of the cam 6 and finally be permitted to return rapidly to the FIG. 1 condition, this having the tendency to cause the slave piston 15 to be urged rapidly outwardly, held in the extended position for a given interval of time and then permitted to retract.

Provided no sheet of paper is present on the guide 33 the plunger 23 will remain in its upper position while the sheet deflector 34 rises and falls between its FIG. 2 and FIG. 4 positions, the slot 35 of the deflector receiving the upper end of the arcuate surface 24*a*, and no resulting movement of the plunger is caused by movement of the deflector. Accordingly the two ports 25 and 25*a* will remain in register and, despite movement of the master piston 1, the slave piston 15 will remain retracted within the cylinder 7.

However, as shown in FIG. 4, once a sheet of paper is positioned on the guide 33, the slot 35 is concealed by the paper below the deflector 34 and the paper will be caused to follow the contours of the deflector underside on either side of the slit 35. In turn, the longitudinal axis of the sheet will be bowed as the sheet passes along the sheet support 33 so that the sheet will be given added rigidity. As a result, the plunger 23 will be urged downwardly by the sheet of paper reinforced by the adjacent deflector 34, and accordingly the ports 25 and 25*a* will move out of register to seal the conduit 17 and cause the slave piston 15 to be actuated by pressure pulses in the conduit.

Clearly the particular arrangement described is especially convenient in that the paper passing across the fence 40, due to the cooperation of the paper with the deflector 34, is extremely rigid and resistant to creasing by the plunger 23. Accordingly, the sheet of paper is able to exert considerable downward force on the plunger 23. This added rigidity imparted to the sheet enables the device to be used to detect successfully sheets which are of such a lightweight grade and flimsy nature that they would be damaged if subjected to a conventional mechanical sensing device.

The connection between the duplicator pressure roller and the slave cylinder 7 will now be described with reference to FIG. 5. The piston 15 engages against a roller 26 carried by the latch lever 8 which is in turn pivoted on a pin 9 carried by a pressure roller lifting lever 10. In the FIG. 5 condition the latch lever 8 rests against a stop 11 formed on the pressure roller lifting lever 10 and is therefore at its limit of anticlockwise travel. The pressure roller lifting lever 10 is pivotally mounted on a pivot 27 on which is also pivoted a two-armed lever 13 having at the end of one arm a follower 28 engaging the cam 14 and at the end of the other arm a peg 12 projecting through a slot 29 in the pressure roller lifting lever 10.

In operation of the machine, the cam 6 moves the two-armed lever 13 so that the peg 12 reciprocates along an arcuate path centered on pivot 27. With the control lever 8 in the position shown in FIG. 1, the peg 12 moves from the position shown in full lines in FIG. 1 to the position shown in dotted lines in the same Figure. It will be seen that this movement of the peg 12 is between two limbs 30 and 31 of the lever 8 and does not affect the angular movement of such lever. When, however, the slave piston 15 moves to the position shown in FIG. 3 and, by its engagement with the roller 26, pivots the lever 8 about pin 9 from the position shown in FIG. 1 to that shown in FIG. 3, the limb 30 engages the stop 11 and the limb 31 moves into a position obstructing the arcuate path of the peg 12. Reciprocation of the peg 12 then will move the lever 8 between the full and dotted line positions shown in FIG. 3. Such movement of the lever 8 would be transmitted to the pressure roller lifting lever 10 by virtue of the connection between the levers provided by the pivot 9 thereby effecting lifting of the pressure roller 36 towards the printing cylinder 38 so as to press the sheet of paper 35 against the stencil passing round the printing cylinder.

It will be appreciated that, if the above-described device fails to operate, i.e., the plunger **23** fails to be depressed but remains jammed in the FIG. **2** position, the pressure roller **36** will not be raised and there will be no question of such roller coming into contact with an inky stencil. Further, the operation of the device is still effective even when the machine is turned very slowly by hand. Additionally, the rotary valve **18**, the sensing plunger **23**, the slave piston **15** and the latch lever **8** are stationary when the machine is idling and thus unnecessary wear of such parts is avoided. Moreover, the device is quiet in operation since it does not have a detector piston constantly reciprocating into the path of the sheets fed through the duplicator. The device according to this invention therefore allows the machine to be operated by hand feeding if desired.

It is conventional for the stencils which are used with stencil duplicators to be provided with a backing sheet of stiff paper. When the stencil is initially laid on the ink screen, the operator rotates the stencil and attached backing sheet at least once so that the pressure roller may lift to press the backing sheet onto the stencil so that the stencil is properly inked, the backing sheet then being torn off by the operator. In conventional duplicating apparatus, a button is provided to override the action of the mechanical sheet detector so that the pressure roller is caused to rise even though no paper is passing through the duplicator.

In the sheet detecting and pressure roller control device of this invention, provision may also be made for enabling the pressure roller to rise when desired, e.g., when wishing to press a backing sheet against a stencil, even though no paper is passing through the duplicator. When the backing sheet button (not shown) is depressed it may engage the upper surface of the limb **31** of lever **8**, and pivots the lever to the position shown in FIG. **3**. When in this position the pressure roller is raised even when no paper is fed, and the backing sheet is pressed against the stencil.

The reason for the "tear off" backing sheet normally provided on the stencil is to enable the duplicator to be operated for one or more initial cycles of the stencil, during which cycles the ink flow through the stencil is being established, to permit one sheet of paper to absorb all the ink passed. As a result the backing sheet may subsequently be detached and the first sheet printed may then experience a uniform satisfactory inking.

Although the invention has been particularly described above in connection with a stencil duplicator, it will be appreciated that this is only given as an example. The apparatus could equally well be used in an offset lithographic printing machine or any other equipment to which sheets are fed and in which it is important that the equipment or part of it should be inoperative when no sheet is being fed thereto.

We claim:

1. A stencil duplicator having top and bottom feed rollers movable towards and away from one another during normal operation of the duplicator, a movable sheet guide member movable with and in association with the top feed rollers, a stationary sheet guide member positioned in association with the bottom feed rollers, sheet register stop plates secured to said bottom feed rollers and projecting through said stationary guide member and sheet sensing means movable between a first position projecting through said stationary sheet guide member towards said movable sheet guide member and a second position retracted behind said sheet guide member, said movable sheet guide member and said sheet sensing means being cooperable to effect displacement of the sheet sensing means from its first position to its second position only when said movable guide member descends in a sheet present condition.

2. A stencil duplicator as claimed in claim **1** and including a pressure pulse pump driven by said duplicator, a stencil cylinder, a pressure cylinder movable towards and away from said stencil cylinder in response to sheet feed to the duplicator, a control lever carrying said pressure cylinder, a pivotable latch plate carried by said control lever, an abutment surface on said latch plate, a driven reciprocating member adjacent said latch plate abutment surface, a pneumatic motor carried by said control lever and mounted in association with said latch plate, and a pneumatic transmission communicating said pressure pulse pump with said pneumatic motor whereby said latch plate may be pivoted by said pneumatic motor in response to operation of said pressure pulse creating means to urge said abutment surface for driving contact with said driven reciprocable member, said sensing means being operably connected to said pneumatic transmission for disenabling said transmission when no sheet is sensed.

3. In sheet handling apparatus including a sheet detecting control device for rendering the apparatus or a part thereof inoperative when no sheet is detected,

a. means defining a sheet flow path,

b. sheet sensing means movable between a first position in which it projects into said flow path and a second position in which it is clear of said flow path,

c. a sheet guide member co-operable with said sensing means and movable between an out-of-the-way position and a sheet deflecting position,

d. means for driving said guide member for movement from said out-of-the-way position to said deflecting position,

e. means formed on said guide member for receiving said sensing means in the absence of a sheet when the sensing means is in its first position and the guide member is in its deflecting position,

f. a control member operable in response to sheet feed through the apparatus,

g. pressure pulse creating means driven by said apparatus,

h. a pnuematic transmission connecting said control member to said pressure pulse creating means, and

i. a rotary vent valve in said transmission, said sheet sensing means being connected to said rotary vent valve such that when the sensing means is in its first position the vent valve is in a venting configuration and when the sensing means is in its second position the vent valve is in an air-tight condition.

4. Apparatus as claimed in claim **3**, and including a counterbalance weight associated with the rotary vent valve and the sensing means.

5. Apparatus as claimed in claim **4**, wherein said rotary vent valve includes a rotor and a stator, said rotor having a horizontal axis of rotation and an articulation connection with said sensing means, said counterbalance weight being attached to the rotor diametrically opposite to said articulation connection.

6. Sheet handling apparatus as claimed in claim **3**, wherein said sheet flow path has a plane of sheet movement and wherein the sheet sensing means comprises a plunger reciprocable along a direction transversely of said plane of sheet movement.

7. Apparatus as claimed in claim **6**, wherein the sheet handling apparatus includes a constantly driven member and wherein the guide member driving means comprises a linkage connected between said constantly driven member and the movable guide member for moving the movable guide member at regular intervals during the operation of the sheet handling apparatus.

8. Apparatus as claimed in claim **3**, wherein said means formed on the movable guide member comprises a slot formed in said guide member, and the sheet sensing means includes an elongated sheet sensing head arranged to extend snugly through said slot when no sheet is present.

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