

[54] **SENSING SHEETS ON A SUPPORT SURFACE**

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3,499,645	3/1970	Noda et al.	271/162
3,525,517	8/1970	Toby	271/117
3,563,535	2/1971	Vitu et al.	271/164
3,743,275	7/1973	Miller et al.	271/114 X

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[51] Int. Cl.²..... **B65H 7/04**

[58] **Field of Search** 271/145, 164, 162, 167, 271/110, 111, 126, 117, 171, 170, 256, 258, 259, 114

[56] **References Cited**

UNITED STATES PATENTS

3,408,064 10/1968 Johnson et al..... 271/162

[57] **ABSTRACT**

To indicate when the sheets of a stack are exhausted, the receptacle for supporting the stack has an opening in the bottom thereof, and a sensing member is biased upwardly through the opening from beneath the receptacle to engage the bottom sheet. A feeding device also acts to press the stack downwardly into contact with the sensing member. When the last sheet is used, the sensing member activates a switch to indicate that the stack is exhausted.

4 Claims, 5 Drawing Figures

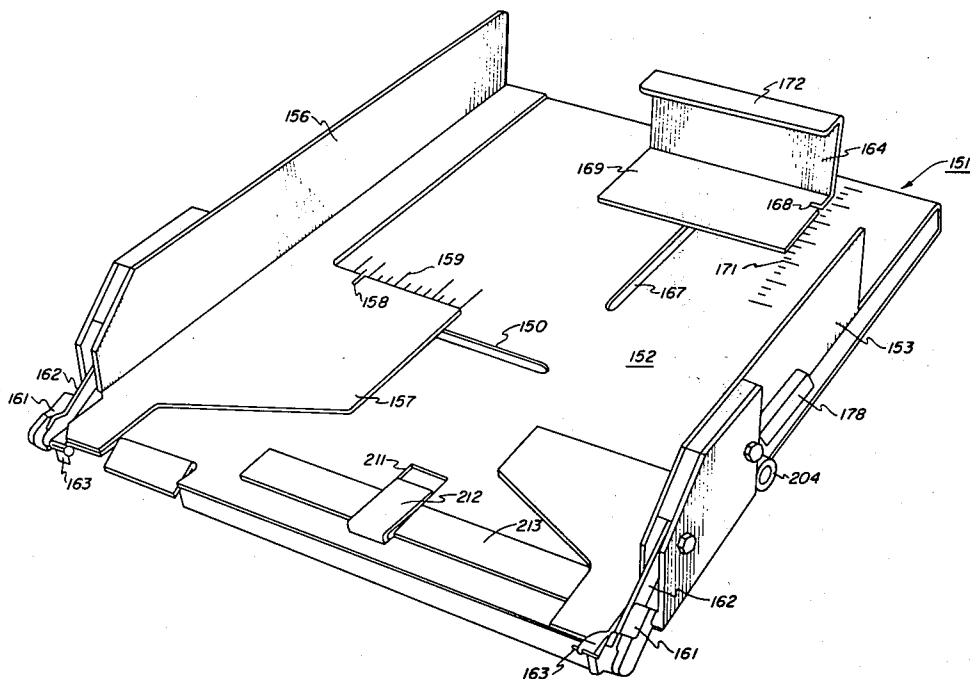


FIG. 1

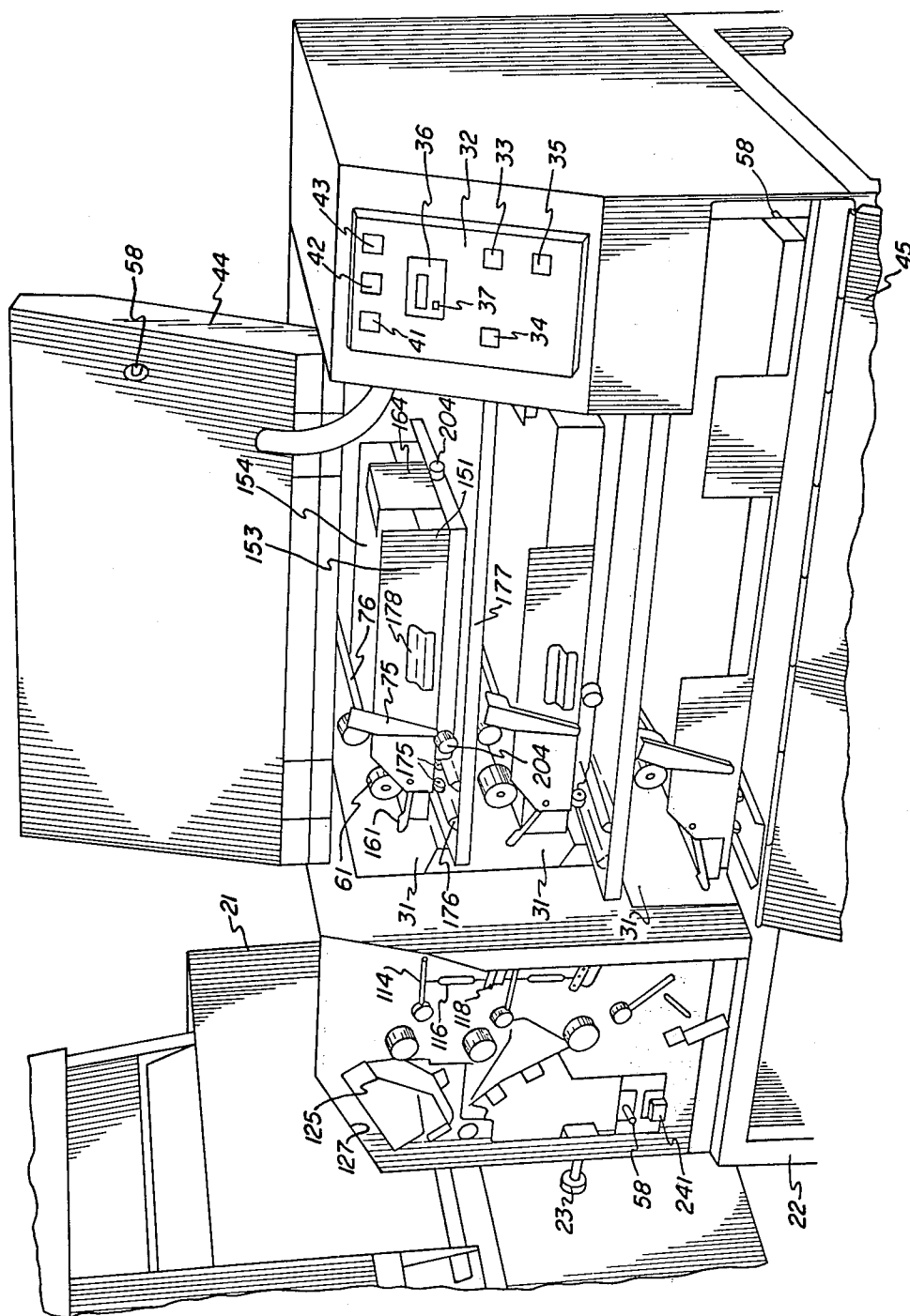
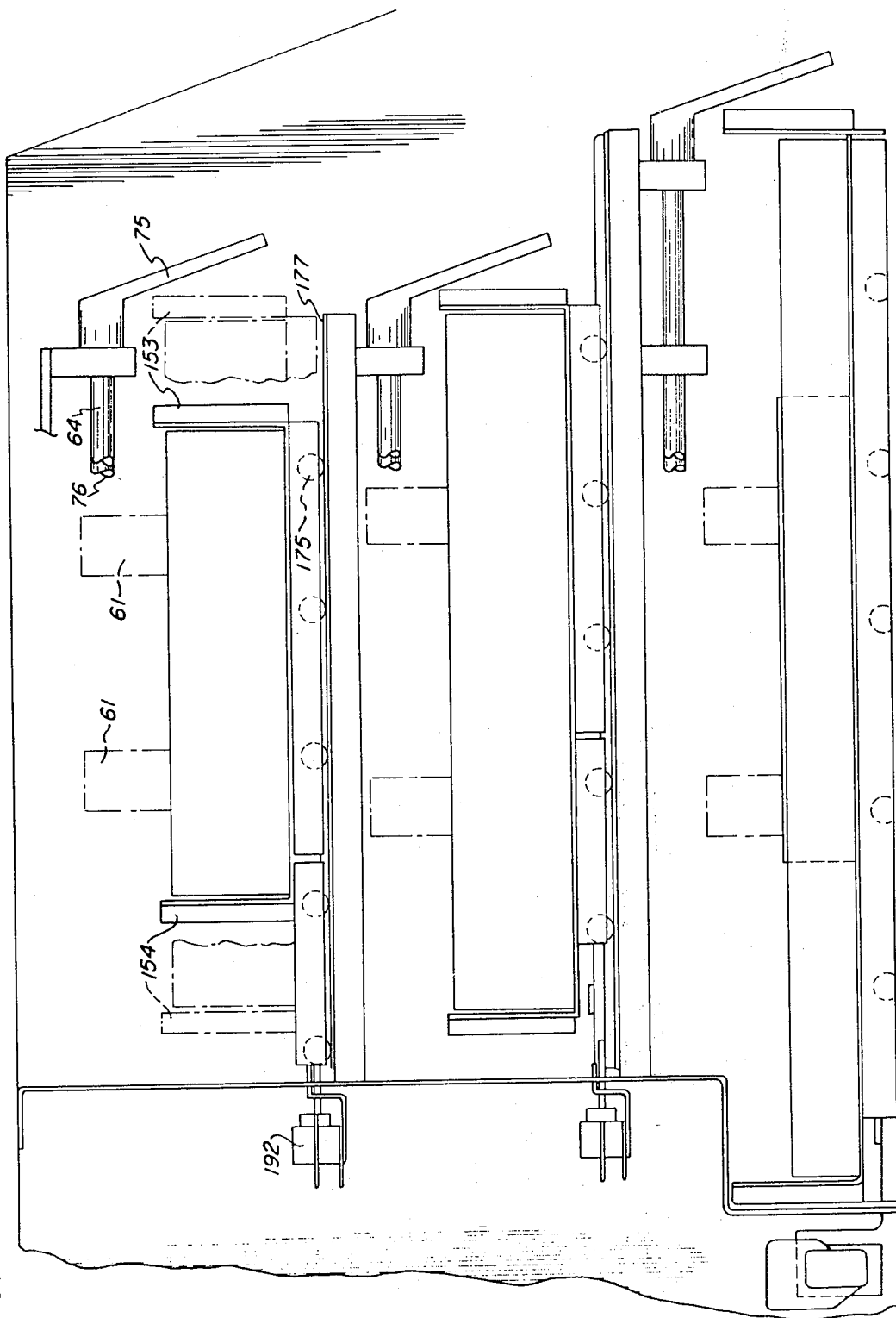


FIG. 3



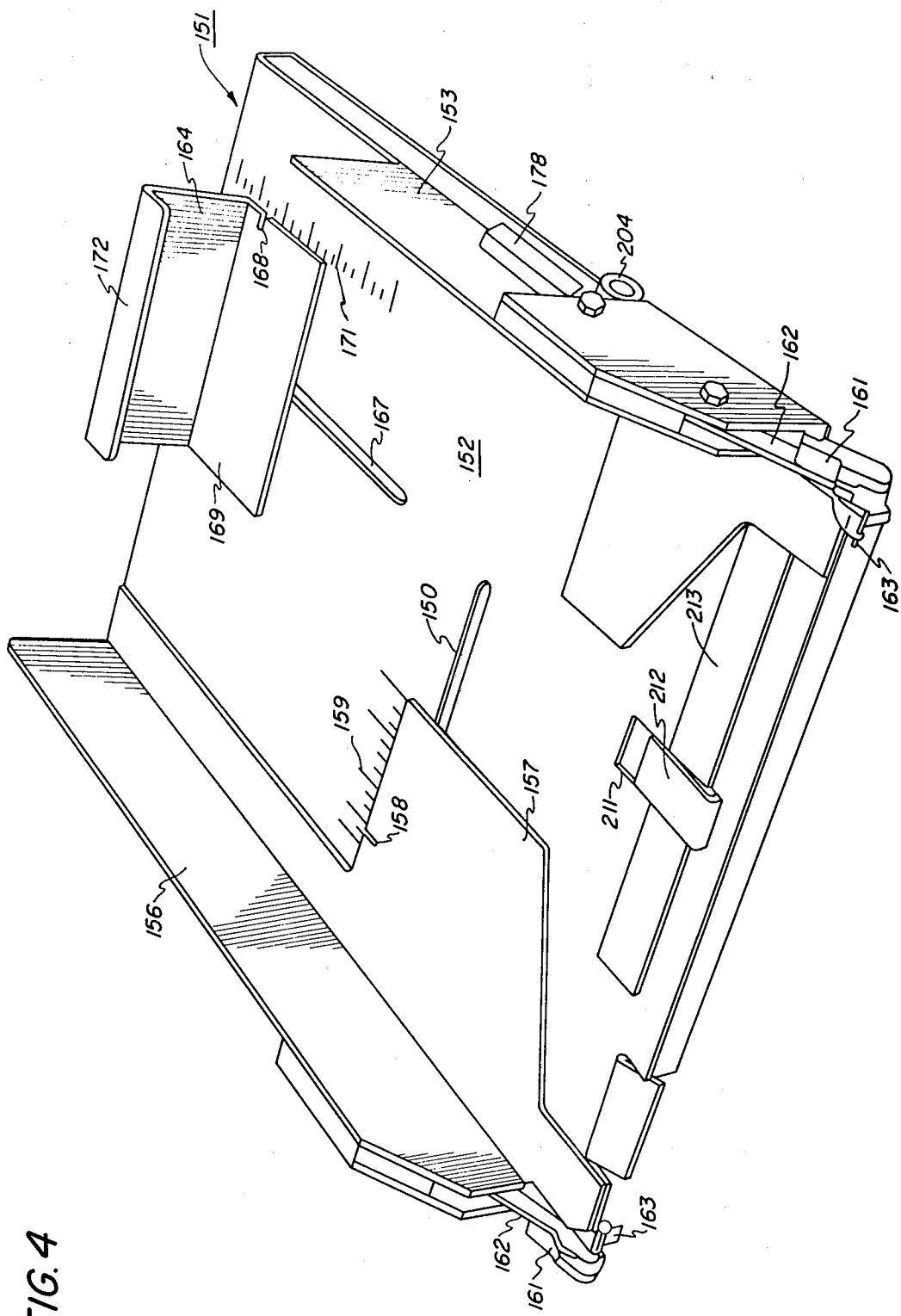
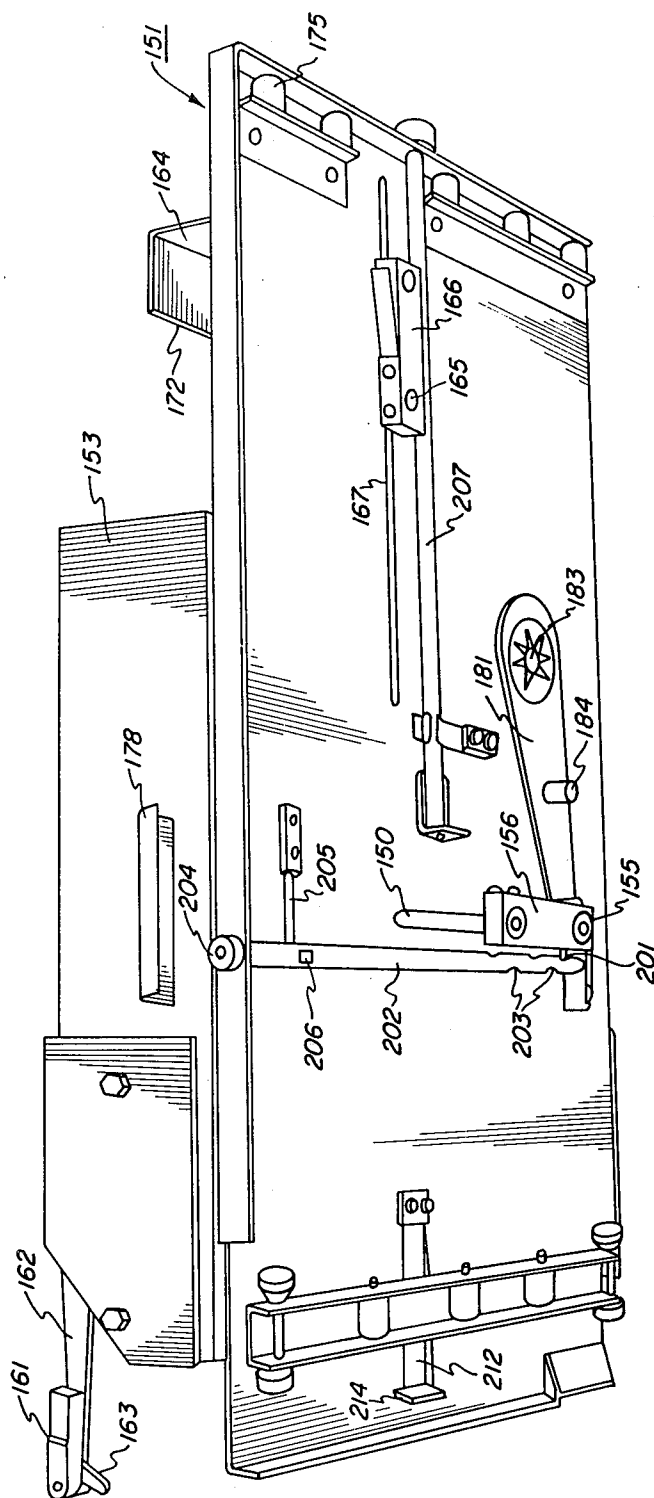


FIG. 4

FIG. 5



SENSING SHEETS ON A SUPPORT SURFACE

This invention relates to a device for sensing sheets on a support surface.

In British Patent Specification No. 1,296,763, there is disclosed copying apparatus in which cut sheets are fed from a stack through the copying machine for the formation of an image of an original on one side of each sheet in the stack, the sheets being fed back to a tray from which they are fed a second time through the machine for the formation of an image of an original document on the other side of each of the sheets of the stack. It is clearly important that the machine should be stopped or at least an alarm actuated when the sheets in the second tray are exhausted, and also that every sheet in the stack of sheets formed on the second tray should be fed again through the copying machine. A sheet sensing device which stopped the machine while a few sheets were left on the second tray would not be satisfactory.

Sheet sensing devices to sense when the stack on the tray is becoming or has become exhausted include sensing members which contact the top sheet in the stack, and cause a microswitch to be actuated when the member descends to the level of the support surface below the stack, thus indicating that no further sheets are present. It is difficult to ensure that the microswitch is sensitive to the difference in position of the sensing member corresponding to only a few sheets on the tray and the position in which no sheets are on the tray, so that the microswitch will often be actuated when several sheets remain on the tray. Increased sensitivity can be obtained by a lever system which causes the microswitch actuating finger to move a greater distance than the end of the sensing member contacting the paper stack, but such increased sensitivity is still often not sufficient to resolve the difference between one sheet on the tray and no sheet on the tray.

In an alternative arrangement, the support for the stack of sheets has a hole in its base, and a microswitch actuating plunger rests on the stack of sheets above the hole. While there is paper on the support surface, the actuator is prevented from dropping through the hole by the paper. When the last sheet of paper has been fed off the support, the microswitch actuator drops through the hole in the support base and actuates the microswitch, which causes the machine to stop feeding and to actuate an alarm signal. This arrangement has the advantage that the microswitch does not have to be sensitive to positions of the microswitch actuator differing only by the thickness of a sheet, since the actuator is allowed to drop by a large distance when the last sheet has been fed, and this large distance can be converted into a large movement of the microswitch contacts.

Such arrangements also have the disadvantage that the microswitch and sensing member are located on top of the paper stack, and can easily be put out of adjustment by an operator who is adding paper to the support tray.

The present invention incorporates a sheet sensing device which is adapted to engage the bottom sheet of the stack, so that it will not be accessible to the operator from the top of the tray except when there are no sheets on the tray. The present invention has the same advantage that the microswitch does not have to be sensitive to the movement of an actuating member

equal only to the thickness of a sheet, and it has the additional advantage that the microswitch and the associated actuating members can be located below the stacked sheets on the support rather than above it in the previously described arrangement. In machines where the support surface is in the form of a removable paper tray, the microswitch and its associated actuating members are accessible on removal of the paper tray from the remainder of the machine, either by location on the underside of the paper tray, or in the machine to be exposed by the removal of the paper tray from the machine.

According to the invention there is provided a sheet feeding and sensing device comprising a support surface for supporting a stack of sheets, a feeding device for engaging the top sheet of the stack on the surface and for pressing said sheet downwardly towards the surface at two spaced locations, a sheet sensing member biased upwardly from the surface to engage the bottom sheet said two locations and a switch movable from one position when the sensing member is depressed to another position when the sensing member moves upwardly under its bias.

An example of the invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a perspective view of sheet feed apparatus with some parts of its cabinet removed and some cabinet doors opened,

FIG. 2 is an end elevation of the apparatus on the right hand side of FIG. 1,

FIG. 3 is a schematic end elevation from the same position as FIG. 2, but showing paper trays in position, and

FIGS. 4 and 5 are perspective views of a paper tray for use in the apparatus illustrated.

The sheet feeding apparatus shown in the drawings is intended for feeding cut sheets of different sizes into a main copying machine 21, which forms xerographic images of an original on the sheets. The central portion of the apparatus as seen in FIG. 1 contains three compartments 31, supporting paper trays 151 for three sizes of sheet.

FIGS. 4 and 5 show end elevations of the three compartments, the front of the machine as seen in FIG. 1 being shown on the right hand side of the FIGS. 2 and 3. FIG. 2 shows the sheet feeding devices in detail with the paper trays removed, and FIG. 3 shows the sheet feeding devices schematically with the paper trays in position.

Referring to FIG. 2, the sheet feeding devices comprise a pair of rollers 61 covered with a high friction material mounted by means of overrunning clutches 74 on a shaft 62. The shaft 62 is supported by a hollow arm 63 mounted on a torque tube 65. A lever 66 is mounted on the torque tube 65 for rotating that tube and hence lifting the feed rollers 61 from the sheets on the paper tray. The torque tube 65 encircles a shaft 64 which drives the shaft 62 through a belt and pulley drive within the hollow arm 63. The drive is applied through the shafts 64 and 62 to the rollers 61 when the sheets are to be fed forward from the stack. A further description of the sheet feeding devices can be found in the specification of co-pending application U.S. Ser. No. 417,016, filed 19 Nov., 1973.

Referring now to FIGS. 4 and 5, each paper tray 151 is provided with a fixed front margin guide 153, a movable rear margin guide 154, and a movable right hand

edge margin guide 164. The sheets are fed from the left hand edge of the tray, at which there is no edge margin guide so that sheets supported on the base plate 152 of the tray can be fed freely from the left hand edge.

At the left hand edge of the tray, approximately in the centre, there is provided an elongated slot 211 at the inner end of which is mounted a leaf spring 212 on the underside of the tray. A pad 213 of high friction material is provided on either side of the slot 211 on the upper surface of the base plate 152. The normal position of the leaf spring 212 is extending through the slot 211 slightly above the upper surface of the base plate 152. However, when sheets are present on the base plate 152, the leaf spring 212 is depressed below the surface, being prevented from rising to its normal position by the weight of the sheet and the tension in the sheets which are pressed on to the floor of the tray by means of the two spaced feed rollers 61 and prevented by the friction between the rollers, the sheets, and the pad 213 from slipping under the feed rollers.

The free end of the leaf spring 212 is provided with a shoe 214 which engages, in the depressed position of the spring 212, a spring plunger 215 mounted on the floor of the compartment adjacent the left hand rail 176. The rear end of the plunger 215 is provided with an elongated portion 216 which is adapted to engage the actuating arm 217 of a microswitch 218 connected to the machine logic. When any sheets remain on the paper tray with the feed rollers resting on them, the leaf spring 212 is depressed so that the spring loaded plunger 215 is retained in a position to the left of its fully extended position as shown in FIG. 2. As the last sheet is fed from the tray, the leaf spring 212 rises to its normal position and the shoe 214 releases the spring loaded plunger 215 so that its elongated portion 216 releases the actuating finger 217 of the microswitch.

The microswitch 218 is connected into the machine logic so that actuation of the microswitch causes an alarm to be actuated to indicate that further paper must be added to the machine, and it also causes the machine to be shut down.

The paper tray 151 is then removed from its compartment 31 after the feed rollers 61 have been lifted from the paper tray. When the paper tray has been filled with paper, it is returned to the compartment. The leaf spring 212 in the tray will be depressed by the weight of the paper in the tray, so that the shoe 214 will engage the plunger 215 and depress it so that the enlarged portion 216 will engage the arm 217 of the microswitch 218 which will send an electrical signal to the machine logic to cause the alarm to be de-actuated and allow the continued operation of the apparatus. The tray 151 is removed from its compartment by running on rollers 175 mounted on rails 176 and the floor 177 of the compartment 31. The rails 176 extend parallel to the plunger 215.

The plunger 215 and the microswitch 218 which are normally concealed from tampering by the paper tray 151 are accessible to the service engineer when the tray 151 is removed from the compartment 31.

FIG. 3 shows a paper tray with the rear margin guide positioned as shown in full lines to accommodate a narrow stack of sheets and in chain dotted lines positioned to accommodate a wider stack of sheets. In order that the centre line of the stack should coincide with the centre line between the two feed rollers 61, and because the front margin guide 153 is fixed relative to the

base plate 152, it is necessary to locate the paper tray 151 at different positions in the compartment 31 dependent upon the position of the rear margin guide 154 relative to the base plate 152. These different positions of the paper tray 151 mean that the shoe 214 will be located at different positions relative the compartment 31. In order that the microswitch 218 should be actuated when the plunger 215 has engaged the shoe 214 in all positions of the tray 151 when the centre line of the stacks are aligned with the centre line of the feed rollers 61, the elongated portion 216 is provided so that the microswitch arm 217 will be depressed while the shoe 214 engages the plunger 215. If the tray is withdrawn from the compartment before the paper stack has become exhausted, the plunger 215 will spring out to its furthest position, actuating the microswitch 218 and causing the machine logic to actuate the same alarm which indicates that further paper should be added. It will not be possible to carry out this procedure while the machine is still running as the doors 44 and 45 of the machine must be open to withdraw the paper tray 151, and microswitches 58 (see FIG. 1) are connected in the machine energisation circuit to stop the machine when the doors are opened.

It is not necessary for the sheet feeding device, here shown as a pair of rollers, to press the top sheet of the stack downwardly towards the surface at two isolated locations. For example, the feeding device could take the form of a ring, which presses the sheet downwardly towards the support surface not only at two spaced locations at opposite ends of a diameter of the ring, but also at all other points of the ring, the sheet sensing member engaging the bottom sheet below the central aperture of the ring.

What I claim is:

1. A sheet feeding and sensing device comprising a support surface for supporting a stack of sheets, the support surface being mounted for movement between an operative position and an inoperative position, feeding means for engaging the top sheet of the stack on the support surface and for pressing downwardly at two spaced locations, the support surface having a slot formed between the two spaced locations, a leaf spring biased upwardly through the slot from below the support surface, the leaf spring being adapted to be depressed downwardly when a sheet is on the support surface, a switch movable between a first and a second position, a plunger operatively associated with the leaf spring and switch, means biasing the plunger toward the leaf spring, the plunger being mounted so as to contact the leaf spring and move the switch to the first position when the support surface is located in its operative position and the leaf spring is depressed downwardly by a sheet, and to move out of contact with the leaf spring and move the switch to the second position when the support surface is in its inoperative position and the leaf spring is moved upwardly through the slot under its bias, the plunger also being mounted so as to move out of contact with the leaf spring and move the switch to the second position when the support surface is moved to its inoperative position.

2. A sheet feeding and sensing device as set forth in claim 1, wherein the support surface is mounted for movement to any one of a plurality of operative positions, and wherein the plunger includes means for engaging the switch so as to keep the latter in its first posi-

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tion when the support surface is in any one of its operative positions.

3. A sheet feeding and sensing device as set forth in claim 2, wherein the support surface includes high friction material adjacent to the spaced locations.

4. A sheet feeding and sensing mechanism comprising a frame, a support surface for supporting a stack of sheets, means for mounting the support surface for movement between an operative position within the frame and an inoperative position out of the frame, means for engaging the top sheet of the stack and for pressing downwardly toward the support surface, the support surface having an opening formed therein,

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means for sensing the bottom sheet of the stack through the opening, the sensing means being mounted for movement through the opening, means responsive to upward movement of the sensing means through the opening for indicating when the stack of sheets is depleted, the indicating means being mounted to contact the sensing means when the support surface is in its operative position and has at least one sheet thereon, and to move out of contact with the sensing means whenever the support surface is moved to its inoperative position, to thereby indicate the position of the support surface.

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