United States Patent

[11] **3,599,972**

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[54] **PAPER TRAY FOR PHOTOCOPY MACHINE**
9 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **271/39**
[51] **Int. Cl.** **B65h 1/12**
[50] **Field of Search** 271/39, 61, 22, 24

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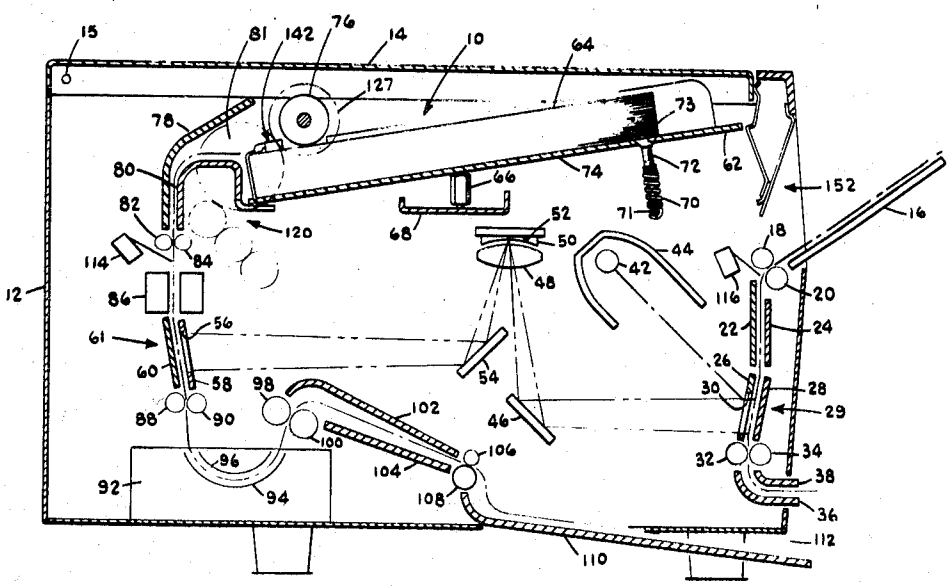
ABSTRACT: In a photocopy machine, a floating feed tray accommodates a stack of copy sheets from which individual sheets are fed successively into the machine. A pair of feed rollers are stationed above the forward end portion of the tray and are mounted on a drive shaft whose axis is fixedly positioned. The rearward end of the tray is biased downwardly to pivot the tray about a fulcrum, urging the forward end upwardly to maintain the uppermost sheet of the stack in feeding engagement with the feed rollers. A latch releasably retains the tray with its forward end spaced from the feed rollers and sheet separator-edge alignment elements elevated to facilitate loading.



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SHEET 1 OF 3

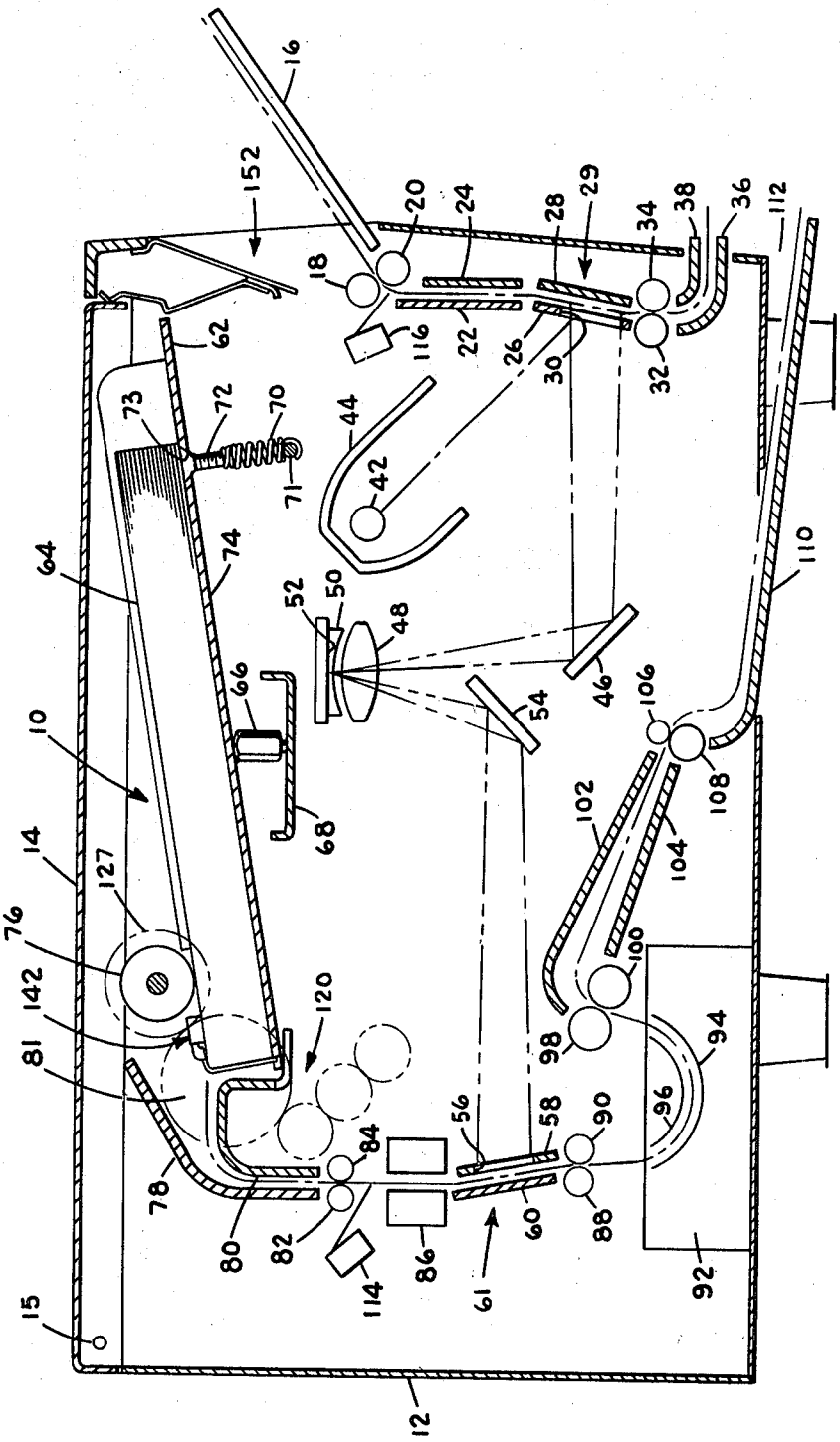

FIG. 1

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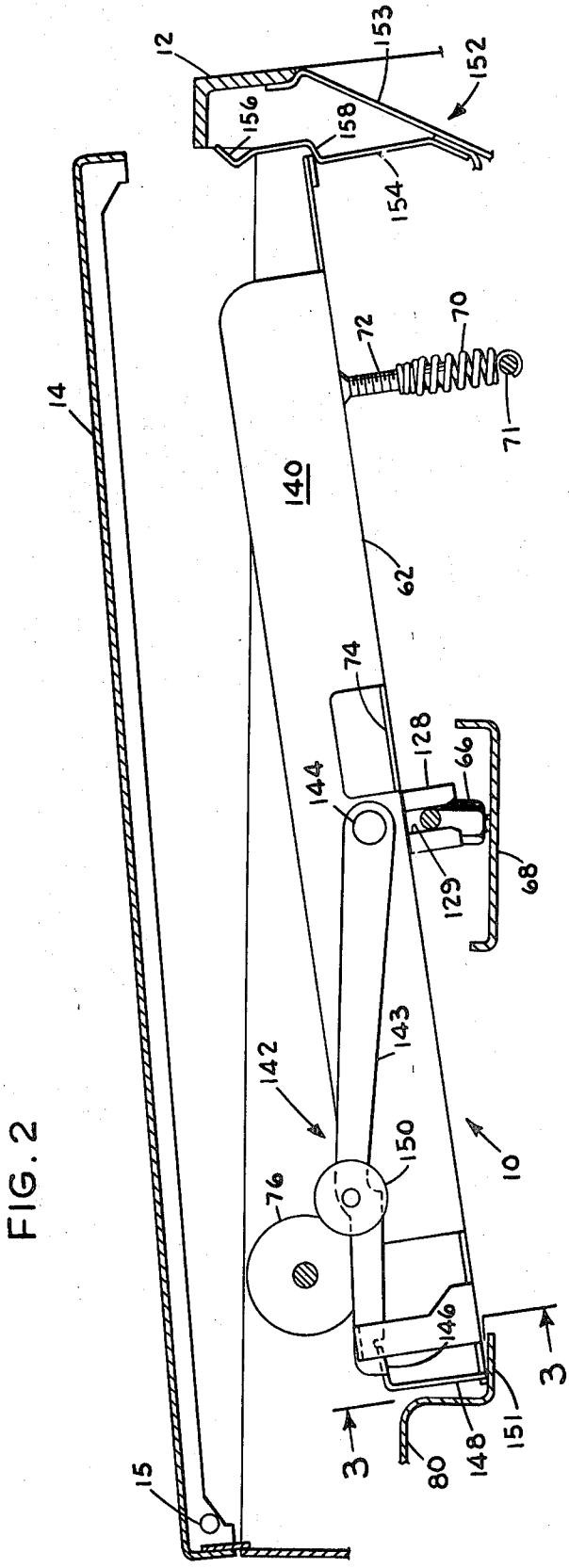

FIG. 2

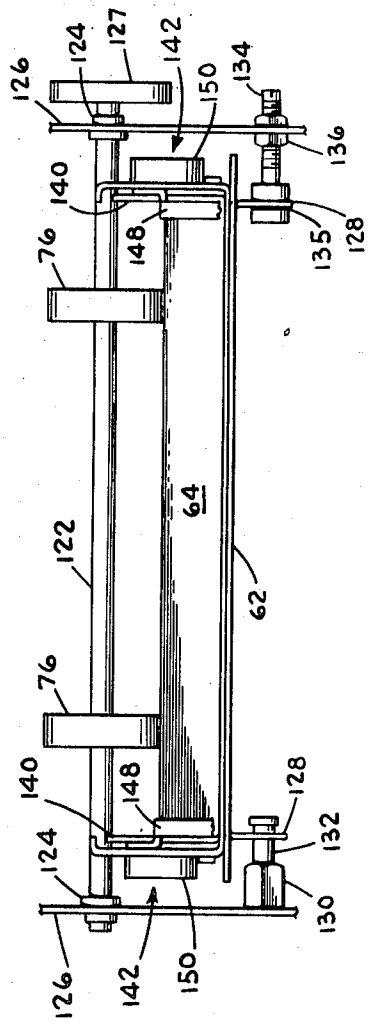

FIG. 3

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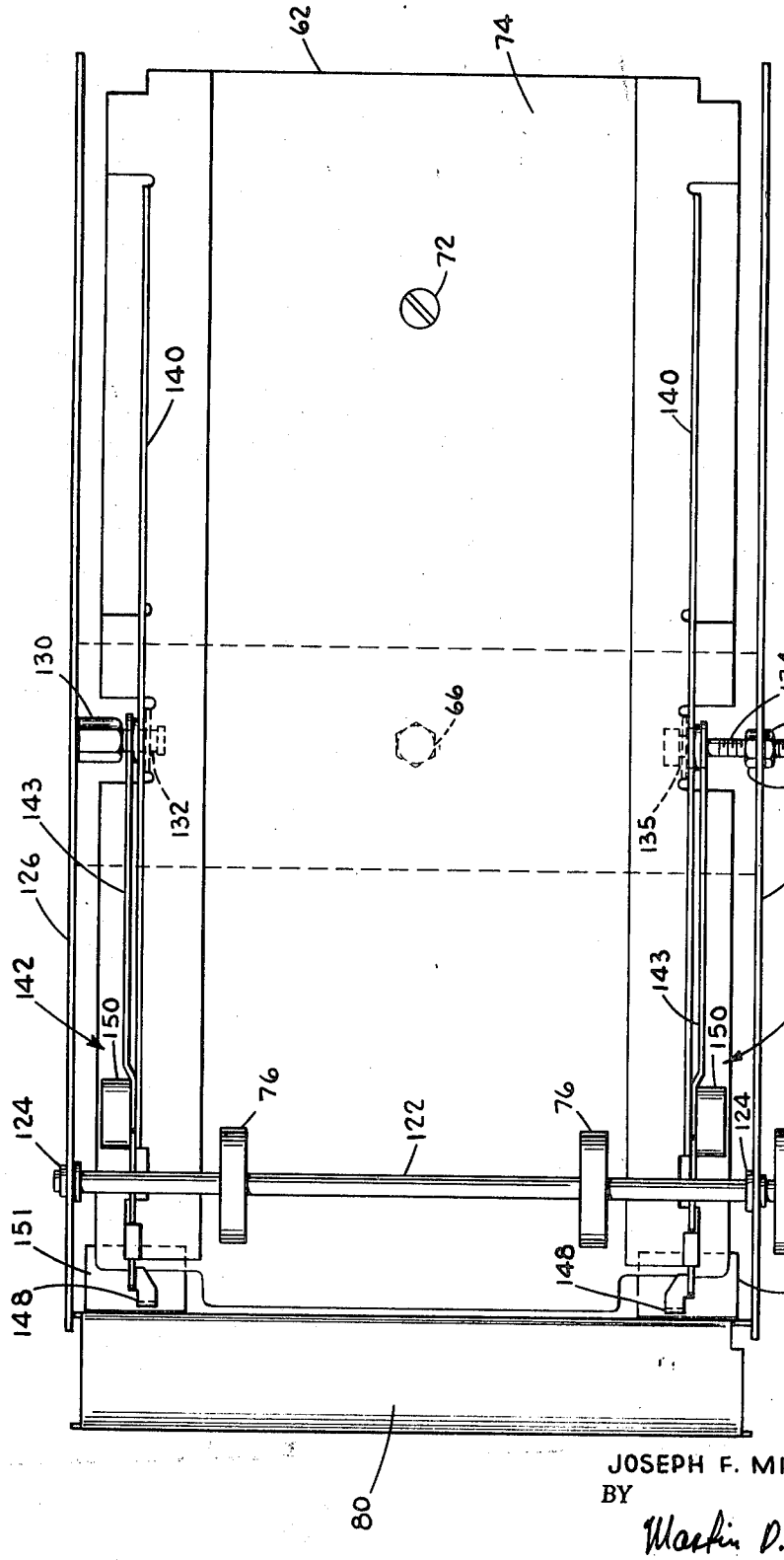

FIG. 4

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PAPER TRAY FOR PHOTOCOPY MACHINE

BACKGROUND OF THE INVENTION

successive feeding of paper from a supply or storage stack presents manifold problems and considerations. This is particularly so in photocopy machines where proper sheet feeding is of particular importance. Registration of each sheet relative to the entrance of the feed it is to follow through the photocopy machine is complicated by the fact that the stack height is constantly being diminished. This situation also complicates the means for separating each sheet from the stack and initially feeding it into the feed path entrance. Thus appropriate provisions are required to continuously adjust the physical relationship between the stack the feed path entrance and the sheet feeding means.

Heretofore, these problems have been solved by providing floating feed rollers which are biased downwardly to frictionally engage the uppermost sheet on the stack, regardless of the stack height. The feed rollers must be driven in order to advance the topmost sheet forwardly into the feed path entrance of the machine. The floating characteristic of the feed roller mounting complicates the drive system for imparting rotation thereto.

Further more, since the feed path of the machine and entrance thereto are invariably fixed, the distance between the top of the sheet stack and the feed path entrance varies with the height of the stack. However, the increment of rotation of the feed rollers calculated to advance the leading edge of each sheet through the feed path entrance and into the nip of feed rollers stationed therebeyond is also invariably constant, regardless of the stack height. If the sheet feeding rollers in the feed path itself are not rotating at the time of arrival of the sheet, considerable sheet buckling occurs for certain conditions of stack height. If the sheet buckling becomes excessive, the sheets may be wrinkled or creased, and jams may result.

The floating character of the feed rollers also tends to prevent skewing of the individual sheets as they are separated from the stack and fed successively through the feed path entrance. Typically, a pair of laterally spaced feed rollers are biased downwardly against the uppermost sheet of the stack, and the two rollers are commonly driven so as to provide nonskewed feeding of the individual sheets. But for the floating character of the feed rollers slight differences in the stack height beneath the feed rollers would result in differential feeding engagement therewith and, in all likelihood, skewing.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided sheet storage and feeding apparatus including a storage tray for accommodating sheets in stacked relation, which tray is mounted in a substantially free-floating manner relative to fixedly positioned sheet feeding means.

More specifically, the present invention provides a stack storage tray whose sole means of vertical support is provided by a fulcrum about which the tray is pivoted to bias the uppermost sheet of the stack thereon into feeding engagement with one or more feed rollers, whose axes of rotation are fixedly positioned. As a consequence, the top of the stack is always referenced against the feed rollers, and the starting point for each sheet is uniformly the same regardless of the height of the stack.

In order to insure uniform feeding engagement with the uppermost sheet of the stack in those situations where a pair of laterally spaced feed rollers are used, means are provided to permit a limited amount of rolling motion of the storage tray on the fulcrum. By maintaining the uniform feeding engagement, even despite differences in the stack height beneath the feed rollers, the sheets are fed from the stack without skew.

The assembly of the invention further includes sheet separator-stack alignment elements which serve the dual function of insuring that only the topmost sheet is fed from the stack for each cycle and aligning the forward or leading edge of the stack when loaded on the storage tray. The sheet-separator-edge alignment elements are further adapted to be elevated from the floor of the storage tray when the storage tray is pivoted about the fulcrum to a loading position. In the loading position, the feed rollers are spaced from the tray so as to afford unencumbered loading of a stack on the tray. In addition, latch means is provided for releasably retaining the tray in its loading position, thus relieving both hands of the operator for the loading operation.

Having generally described the present invention, a principal object thereof is to provide new and improved sheet storage and feeding apparatus particularly suited for use in photocopier machines.

An additional object is to provide apparatus of the above character for accommodating a supply stack of paper sheets from which sheets are successively fed to and through the entrance of a feed path through the photocopier and wherein the apparatus automatically compensates for variations in the stack height.

A further object of the present invention is to provide apparatus of the above character wherein a storage tray accommodating the stacked sheets floats relative to one or more feed rollers driven about a fixed axis.

Still another object of the invention is to provide apparatus of the above character which is reliable in operation, simplified in design, inexpensive to manufacture and convenient to use.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a generalized overall diagrammatic view of a photocopier employing sheet storage and feeding apparatus constructed according to one embodiment of the invention;

FIG. 2 is an enlarged side elevational view, partially in section, of the sheet storage and feeding apparatus of the invention;

FIG. 3 is a sectional view taken along line 3–3 of FIG. 2; and

FIG. 4 is a top plan view of the apparatus of the invention.

Similar reference characters refer to similar parts throughout the several view of the drawings.

DETAILED DESCRIPTION

Referring now to the drawings and particularly to FIG. 1, the sheet storage and feeding apparatus of the invention, indicated at 10, is shown incorporated in a photocopier machine of the type disclosed in the commonly assigned, copending application of Joseph F. Miciukiewicz, Ser. No. 730,765, filed May 21, 1968. It will be appreciated however that the apparatus of the invention may be incorporated in other types and varieties of photocopiers, as well as sheet processing apparatus generally. Moreover, while the disclosed embodiment of the invention is adapted for handling copy paper sheets on which an electrostatic image is formed and then developed, it will be appreciated that the apparatus 10 may also be adapted to accommodate stacks of original document sheets which are to be copied.

It will be also appreciated that a considerable amount of construction detail of the copier itself has been omitted from FIG. 1 for the sake of clarity. Such detail forms no part of the present invention. However, FIG. 1 includes at least a diagrammatic showing of all the major working components of a photocopier machine.

The various components shown in FIG. 1, including the sheet storage and feeding apparatus 10 are ultimately mounted from a generally rectangular frame (not shown) and enclosed by a housing 12 having various access openings for the ingress and egress of documents to be copied and the egress of copies. Access to the apparatus 10 is provided at the top of the housing 12 through a cover 14 which is hinged at one end, as indicated at 15.

A plate 16 defines an inlet guideway for original documents to be copied, and directs the leading edge of the document to the nip of a pair of feed rollers 18 and 20. A pair of substantially vertical guide plates 22 and 24 define a portion of document feed path which extends downwardly along the front edge of the photocopier. Another pair of guide plates 26 and 28 defines a continuation of the document feed path which includes an illuminating station or zone 29 defined by an elongated slit 30 in guide plate 26. Adjacent to the lower end of the guide plates 16 and 28 is another pair of feed rollers 32 and 34 which directs the document between the curved guide plates 36 and 38 and out of the photocopier.

It will be appreciated that the feed rollers 18, 20, 32, and 34 are synchronously driven from the main drive of the photocopier pursuant to translating successive original documents along the document feed path through the photocopier.

In order to project an image of the indicia borne by the original document onto a sheet of photocopy paper, an optical system comprising a source of illumination in the form of a lamp 42 and a projecting shield 44 concentrates a beam of light on the illuminating station 29 during the time the original document is fed therethrough. Rays of light are reflected from the indicia side of the document to a mirror 46 which directs the reflected light through a focusing lens 48 to a reflex lens 50, having a reflective surface 52. The rays of light forming an image of the indicia borne by the document are then reflected back through the focusing lens 48 to another mirror 54 and thence to an elongated slit 56 in a guide plate 58 which, together with a juxtaposed guide plate 60 defines an exposing station or zone 61 for a sheet of copy paper fed therethrough by means to be described.

Still referring to FIG. 1, the sheet storage and feeding apparatus 10 includes a storage tray 62 accommodating a stack 64 of copy paper sheets. As will be described more clearly below, the storage tray 62 is universally pivotally supported solely by the crowned upper surface of a fulcrum 66 which is in turn mounted on a stationary frame member 68. In its operational position, the storage tray 62 is pivoted on a fulcrum 66 in the clockwise direction, as seen in FIG. 1, by the resilient force of a spring 70. This biases the forward end of the tray 62 upwardly to maintain the uppermost sheet on stack 64 in feeding engagement with a pair of feed rollers 76 (FIGS. 1 and 3).

The lower end of spring 70 is hooked to a stationary rod 71 mounted by the photocopier frame while the upper end of the spring threadedly engages a screw 72 whose conical head is nested in a tapered aperture 73 formed in the floor 74 of storage tray 62. Thus, by merely turning screw 72, the tension of spring 70 may be conveniently adjusted.

Positioned adjacent to the front of storage tray 62 is a pair of guide plates 78 and 80 which are suitably shaped so as to provide a relatively wide entrance 81 into the copy paper feed path. The guide plates 78 and 80 include juxtaposed vertical segments which direct the leading edge of each copy sheet to the nip of a pair of feed rollers 82 and 84. Just below these rollers is a corona discharge unit 86 of known construction which imparts a uniform electrostatic surface charge to each sheet of copy paper passing through. The copy paper sheets then pass through the exposing station 61 where the surface charge is selectively discharged by the light image originating from the illuminating station 29 so as to form a corresponding latent electrostatic image on the copy sheet.

From the exposing station, feed rollers 88 and 90 feed the copy sheets into a developing tank 92 which contains a suitable toner for developing the latent electrostatic image thereon. Suitable guide elements 94 and 96 guide the copy paper sheets through the tank and direct the leading edge thereof to another pair of feed rollers 98 and 100 which also act as squeegee rollers to squeeze all excess toner from the copy sheets. A pair of juxtaposed guide plates 102 and 104 guide the copy sheets through a drying zone and between a final pair of feed rollers 106 and 108 which deliver the copy sheets to a receiving tray 110 where they are accessible to the operator through an opening 112 formed in the front of the housing 12.

It will be understood that the various control components, including sheet-sensing switches 114 and 116 stationed adjacent the copy sheet feed path and document feed path, respectively, coordinate the drive to the various sheet feeding elements and the operations of the lamp 42 and corona discharge unit 86. A gear train, generally indicated at 120 in FIG. 1, is controlled to selectively communicate drive to the feed rollers 76. For a more detailed description of suitable control and drive means, reference should be had to the above-noted copending application.

Having generally described the photocopier machine in which the illustrated embodiment of the invention is adapted, reference is now made to FIGS. 2 through 4 in conjunction with FIG. 1 for the structural details of the apparatus 10.

As already generally noted, the sole vertical support for the storage tray 62 is provided by the fulcrum 66 whose crowned tip bears against the bottom surface of the tray floor 74 at a point substantially on or at least in close proximity to the longitudinal centerline of the storage tray. This point of engagement is also preferably but not necessarily located substantially at the midlength of the storage tray 62, as seen in FIG. 4. The position of the spring 70 is preferably in substantial longitudinal alignment with the fulcrum 66.

By virtue of this mounting, the storage tray 62 is essentially free-floating for fore and aft, pitching motion about fulcrum 66. As will be seen, this motion is essential in order to accommodate loading of the storage tray 62 with stacks of copy paper and also for maintaining feeding engagement between the topmost sheet on the stack and the feed rollers 76. It is also essential to provide for a degree of lateral pivoting or rolling motion of the tray 62 about fulcrum 66 in order to compensate for minor variations in the stack height beneath the feed rollers 76 which would otherwise give rise to differential feeding engagement of the two rollers 76 with the topmost sheet in the stack 64.

This floating characteristic of the mounting for storage tray 62 is an important feature of the invention since it permits the feed rollers 76 to be mounted on a drive shaft 122 whose axis is fixedly positioned as seen in FIGS, 3 and 4. Thus, in accordance with one aspect of the invention, the storage tray 62 flats, rather than feed rollers 76 as in prior art devices of this type, in order to compensate for variations in the stack height. This a provides for considerable simplification of the power train for communicating drive to the feed rollers 76.

Specifically, as best seen in FIGS. 3 and 4, the ends of drive shaft 122 are journaled in bushings 124 mounted by side frame members 126, which may be constituted by the main rectangular mounting frame of the photocopier itself. One end of the drive shaft 122 extends beyond one of the side frames 126 and receives a gear 127 included in the gear train 120 (FIG. 1). The feed rollers 76 on drive shaft 122 may be shifted axially for various widths of copy paper.

While pitching motion and a certain amount of rolling motion of the tray 62 is required, yaw motion is undesirable. To prevent yaw of the storage tray 62, a pair of tabs 128 are depended from each lateral edge of the tray. Each tab 128 is formed having an elongated vertical slot at 129 (FIG. 2) adapting the tabs to embrace inwardly extending studs secured to the side frames 126. As best seen in FIG. 4, one of the studs stud 130, is formed having a wide notch 132 which is received in the slot 129 of one of the tabs 128. The other, stud 134, has a notch 135 whose width is just slightly in excess of the thickness of the other tab 128. The outer end portion of

stud 134 is threaded through a pair of nuts 136 positioned on opposite sides of one of side frames 126.

It is thus seen that by turning stud 134, the position of tray 62 may be shifted laterally to adjust its registry with the entrance 81 of the copy paper feed path. The studs are in lateral alignment with the fulcrum 66 to accommodate pitching motion of t ray 62. Since the studs are accommodated in elongated slots 129, some roll is permitted, but yaw of the tray is inhibited.

As seen in FIGS. 3 and 4, the stack 64 of copy sheet is accommodated on tray 62 between a pair of side rails 140, one or both of which may be adjustable in order to accommodate copy paper of different widths.

Referring now to FIGS. 2 through 4, a corner separator, generally indicated at 142, is mounted to each side rail 140 and is adapted in a known manner to effect separation of the successive topmost sheets from the stack 64 upon rotation of the feed rollers 76 for serial introduction through the entrance 81 into the copy paper feed path. As best seen in FIG. 2, each corner separator includes an elongated arm 143 having one end pivotally mounted on a pin 144 secured to as side rail 140. The other end of each arm 143 is turned inwardly to provide a flat surface 146 which rests on a corner of the leading edge of the uppermost sheet on the stack 64. An integral extension of each arm 143 extends downwardly to provide a elongated depending tabs 148 as best seen in FIGS. 2 and 3. The spacing between the inner edges of the tabs 148 is somewhat less than the width of the sheets of stack 64. Consequently, upon rotation of the feed rollers 76, the uppermost sheet is urged forwardly causing its leading edge to buckle in passing between tabs 148. This buckling serves to separate the topmost sheet from the stack in a manner known in the art. A weight 150 is secured to each arm 143 intermediate its ends so as to maintain the surface 146 pressed against the forward corner surfaces of the uppermost sheet on stack 64.

According to a feature of the invention the tabs 148 of the corner separators 142 are elongated so as to also function as aligning elements for the leading edges of the sheets in the stack 64. Moreover, the elongated tabs 148 insure proper loading of the tray by serving as abutments for locating the forward edge of the stack itself in proper relation to the entrance 81 of the copy paper feed path.

In addition, to facilitate loading of the tray 62 with a stack 64 of copy sheets, the lower guide plate 80, constituting the lower boundary of the copy paper feed path entrance 81, is extended downwardly just forwardly of the tabs 148 and provided with generally horizontally extended ledges 151 underlying each corner separator tab 148. As a consequence when the tray 62 is pitched forward about fulcrum 66 in order to space the tray floor 74 from the feed rollers 76 to facilitate loading of a stack thereon, the lower ends of the corner separator tabs 148 encounter the ledges 151, thereby automatically lifting the corner separator arms 143. This clears the way for placement of the forward edge of a stack up against the tabs 148.

To further facilitate loading of tray 62 by an operator, the invention includes the provision of a latch, generally indicated at 152 in FIGS. 1 and 2. The latch 152 may be mounted to the copier frame or to the housing 12, as desired, and includes a pair of resilient members 153 and 154 made, for example, from spring stock. Member 153 bears against the front of housing 12 so as to bias member 154 toward its operative position. The upper end of member 154 is deformed to provide a striker tab 156 which is engaged by the cover 14, when closed so as to deflect the member 154 to its inoperative position, as seen in FIG. 1. However, when the cover 14 is opened, member 154 is released to spring toward the rear edge of the storage tray 62. When tray 62 is rocked forwardly against the force of spring 70, the rear edge of the tray 62 is engaged in a crook 158 formed in member 154.

The latch 152 therefore serves to maintain the storage tray 62 in the loading position shown in FIG. 2, thus freeing both hands of the operator for loading of a stack 64 of copy sheets on the tray. As is seen, this loading position not only spaces the feed rollers 76 from the tray, but also automatically lifts the corner separators 142 to clear way for proper placement of the stack 64 on the storage tray 62. After loading has been accomplished, the cover 14 is closed. The member 154 of latch 152 is urged to the right by the cover as seen in FIG. 1, thereby releasing the tray 62 which is then rocked back on fulcrum 66 by the force of spring 70 bringing the uppermost sheet of the stack 64 into feeding engagement with the rollers 76.

From the foregoing detailed description, it is seen that there is provided sheet storage and feeding apparatus which is expensive to manufacture, reliable in operation and convenient to use. Due to the floating character of the storage tray 62, the provisions for mounting and driving the feed rollers 76 are greatly simplified. Moreover, if the storage tray 62 is fixed and the feed rollers 76 floating, as has been the practice heretofore, the distance between the top of the stack 64 to the feed path entrance 81 varies with changes in the stack height. This situation makes it difficult to coordinate the feeding of the overall operation of the copier, including the feeding of the original document sheets. However, by always feeding each sheet from the same point, as is provided by the present invention, this problem is largely obviated.

Furthermore, maintaining the distance travelled by each sheet from the top of the stack to the entrance 81 of the feed path provides consistency in the extent of feed of each copy sheet with a given increment of rotation of feed rollers 76. This is particularly advantageous when employing a prefeed technique, such as disclosed in the above noted copending application, wherein a copy sheet is prefed from the stack 64 at the conclusion of each copy cycle. When using this prefeed technique, the leading edge of a copy sheet must be rather precisely located at the nip of the first feed rollers in the feed path itself, i.e. feed rollers 82 and 84, which are not driven until initiation of the next copy cycle. Prefeed not only facilitates coordination of the overall copier operation, but also speeds up each copy cycle. While it is desirable to provide a certain amount of copy sheet buckle in order that the leading edge thereof is assured of reaching the nip of feed rollers 82 and 84, extensive buckling should be avoided. The apparatus of the present invention inherently facilitates the establishment of the proper degree of sheet buckling, since, due to the floating character of the tray 62, the distance travelled by each copy sheet in reaching the nip of feed rollers 82 and 84 remains the same regardless of the stack height. Thus, the increment of rotation of the feed rollers 76 required to feed the leading edge of each copy sheet to the nip of feed rollers 82 and 84 with the appropriate amount of sheet buckling remains constant regardless of the height of stack 62.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Sheet storage and feeding apparatus comprising, in combination:

A. a tray accommodating a stack of sheets;

B. at least one feed roller mounted above the forward end portion of said tray for rotation about a fixed axis;

C. means for supporting said tray for substantially free floating, universally pivotal motion relative to said feed roller, whereby said tray can shift its orientation in relation to said fixed axis to compensate for variations in the thickness of said stack of sheets; and

D. means for pivoting said tray in a first direction about said support means to an operational position wherein the uppermost sheet of the stack is resiliently maintained in feeding engagement with said feed roller.

2. The apparatus as defined in claim 1, wherein said support means comprises a stationary fulcrum located along the longitudinal centerline of said tray and providing a vertical support for said tray.

3. The apparatus defined in claim 2 wherein said pivoting means includes:

1. a spring anchored at its lower end to a fixed support and secured at its upper end to said tray at a point on the opposite side of said support means from said feed roller.

4. The apparatus defined in claim 3 wherein said pivoting means further includes:

1. a screw having a head engaging said tray and a body threadedly engaging the upper end portion of said spring,
   a) whereby rotation of said screw adjusts the tension of said spring.

5. The apparatus defined in claim 1, which further includes:

E. a corner separator-edge alignment element pivotally mounted to each side of said tray, each said element having
   1. an elongated depending tab for positioning and aligning the forward edge of a stack on said tray; and

F. a stationary ledge underlying each said tab and serving to elevate said corner separator-edge alignment elements when said tray is pivoted on said support means against the force of said spring to a stack loading position.

6. The apparatus defined in claim 5, which further includes:

G. a latch releasably retaining said tray in said loading position.

7. The apparatus defined in claim 6, which further includes:

H. a cover member providing access to said tray, said cover
   1. adapted to engage said latch, when closed, to cause release or said tray and, when open, permitting said latch to engage said tray when it is pivoted into said loading position.

8. The apparatus defined in claim 1 wherein a pair of feed rollers are mounted on a drive shaft extending laterally above the forward end portion of said tray, said apparatus further including:

E. a tab depending from each side of said tray and having a vertically elongated slot formed therein: and

F. a stationary stud received in said slot of each tab,
   1. said studs being positioned in lateral alignment with said support means whereby to guide said tray pitching motion and a degree of rolling motion of said tray, and to prevent yaw motion of said tray.

9. The apparatus defined in claim 8 wherein one of said studs is notched to accommodate the associated one of said tabs thereby prevent lateral movement of said tray,

a. said one stud being laterally adjustable to adjust the lateral positioning of said tray.