

Description

This invention relates generally to printers and, more particularly, to an apparatus for controlling the movement of selected paper-holding trays to feed an electrophotographic printer, according to the preamble of claim 1.

A paper handling apparatus of the type as set forth in the preamble of claim 1 is disclosed in US-A-4 770 403 wherein the horizontal movement of the selected tray may be implemented with a cam which is so arranged as to push the rear end of the selected tray or, alternatively, with the vertical movement of the paper feeding means. There is no disclosure as to the way in which the cams for the trays are operated.

EP-A-0 239 871 discloses a device for loading and unloading X-ray film cassettes comprising a plurality of vertically arranged compartments accommodating film dispensing magazines containing film stacks of different formats. Each magazine is horizontally moveable between a selected and an unselected position by means of a rack-and-gear. Each magazine has its own electromotor coupled with the gear associated to the particular magazine for horizontal movement thereof.

Printers, such as electrophotographic and laser printers, are typically used in an office environment where they are connected to personal computers, personal computer networks or dedicated word processing computers. Most laser printers used in offices share common advantageous characteristics: small size, high quality print, quiet operation, and adequate speed for most applications.

Laser printers include paper handling mechanisms that usually employ separate trays for holding different types or different sizes of paper. These trays are typically configured to hold approximately 250 sheets of paper. If the paper handling mechanism of a laser printer includes only one tray, then the laser printer is capable of withdrawing paper from only the one tray during a requested printing operation. When the printer receives instructions to print on different types of paper during a print request, the single tray must be removed and replaced with a tray containing the proper paper.

To obviate this problem, laser printers have been adapted to include multiple trays from which different types or different sizes of paper may be withdrawn. When a multiple-tray printer receives instructions to print on different type of paper during a print request, the paper handling mechanism associated with the printer simply withdraws paper from the appropriate tray.

A paper feeding mechanism is used to withdraw paper from a tray, and typically includes at least one rubber-like roller that rotatably engages the paper within the tray and draws the paper into the printing mechanism. When a laser printer includes a paper

handling mechanism that includes more than one tray, each tray ordinarily has a dedicated paper feeding mechanism associated therewith. Further, the trays and their associated paper feeding mechanisms are normally stacked in a vertical arrangement, and, therefore, consume vertical space equal to the vertical height of each 250 sheet tray and the vertical height of each paper feeding mechanism. Accordingly, the combined vertical height of each tray and paper feeding mechanism limits the maximum number of trays that can be associated with a paper handling mechanism of a laser printer.

Since commonly used paper trays include a spring which forces the paper within the tray into contact with the rubber-like roller of its associated paper feeding mechanism, the pressure between the paper picker and the stack of paper varies with the thickness of the stack of paper remaining in the tray. The paper feeding mechanism is stationary, so that the spring force applied to the stack of paper constantly maintains the top sheet of paper in contact with the paper feeding mechanism. Thus, when it is desired that additional paper be loaded into a particular tray, the printing process from that tray must cease while the tray is removed and the paper supply replenished. This is particularly important where the user wishes to print a short run of unique paper that differs from the paper currently loaded in the tray.

Previous laser printers have employed a single sheet feeding mechanism whereby an operator desiring to print a small number of copies on a paper style unique from that currently loaded in the trays may singularly and consecutively feed the number of sheets required for the printing process. This, of course, is a time intensive process that does not free the user to accomplish other tasks, but requires that the user remain at the printing station, consecutively feeding each sheet of paper into the printer, until the entire printing process is complete.

Alternatively, the user may remove the tray from the paper handling mechanism, insert the desired number of pieces of paper into the tray and replace the tray in the paper handling cassette. While this method does free the user to leave the area of the printer during the printing process, the procedure of removing the tray and loading the tray with a precise preselected number of unique sheets of paper causes the printer to discontinue printing until the tray has been replaced.

The present invention is directed to overcoming or at least minimizing one or more of the problems as set forth above.

The invention provides a paper handling apparatus as defined in claim 1.

Embodiments of the invention are defined in the dependent claims.

The present invention and/or embodiments thereof provide :

a paper handling mechanism, particularly for use with an electrophotographic printer, that is compact in size and which delivers a large capacity and variety of paper;

an electrophotographic printer that includes a greater number of paper trays and which occupies approximately the same space as conventional electrophotographic printers;

a paper handling mechanism for an electrophotographic printer that is readily loaded with limited supplies of unique paper to permit the electrophotographic printer to access unique paper styles for short runs;

a paper handling mechanism that automatically selects the tray containing paper requested during a printing operation;

a paper handling mechanism that is simple in construction and operation;

an apparatus, associated with the paper handling mechanism of the present invention, that controls the movement of a plurality of trays;

a paper handling mechanism that includes a series of vertically stacked trays, which are manually and automatically horizontally movable to a readily accessible loading position.

Other objects and advantages will become apparent upon reading the following detailed description of embodiments of the invention and upon reference to the drawings in which:

Fig. 1 generally illustrates a paper handling mechanism in accordance with the present invention;

Fig. 2 is a partial cross-sectional side view of an apparatus for controlling the movement of a plurality of trays in accordance with the present invention;

Fig. 3 is a partial cross-sectional top view of Fig. 2;

Fig. 4 is a partial cross-sectional view of a paper tray and its corresponding drive mechanism taken along section line 4-4 in Fig. 2;

Fig. 5 is a partial cross-sectional view of the drive mechanism taken along section line 5-5 in Fig. 2;

Fig. 6 is a partial cross-sectional view of the drive mechanism taken along section line 6-6 in Fig. 5;

Fig. 7 is a partial cross-sectional view of gear teeth taken along section line 7-7 in Fig. 4; and

Fig. 8 is a partial cross-sectional view of gear teeth taken along section line 8-8 in Fig. 7.

While the invention is susceptible to various modifications and alternative forms, a specific embodiment thereof has been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that it is not intended to limit the invention to the particular form disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the

appended claims.

Turning to the drawings and referring first to Fig. 1, a side view of a conceptual schematic of a paper handling apparatus 10 for a printer (not shown) is shown. While the discussion of the apparatus 10 herein is confined to being combined with an electrophotographic printer, it is readily envisioned that the apparatus 10 may be combined with various types and styles of printers without departing from the scope of the instant invention.

The apparatus 10 includes a plurality of paper containing trays 12, 14, 16, 18, which are configured to receive a variety of different styles and sizes of sheets of paper 19. Preferably, each tray 12, 14, 16, 18 contains a different style of paper so that a user of the electrophotographic printer simply designates which tray to use in order to select the proper style of paper. For example, it might be desirable to load each of the trays 12, 14, 16, 18 respectively with letterhead, white bond, yellow bond, A4, legal, etc. Thus, the user could be relieved of the time consuming task of loading the printer with additional paper each time a different style of paper is desired.

In order to conserve space and reduce the overall cost of the paper handling apparatus 10, the trays 12, 14, 16, 18 are arranged vertically in close proximity to one another with a single paper feeding mechanism 20 provided to operate with all of the trays 12, 14, 16, 18. The paper feeding mechanism 20 moves vertically to selectively engage each of the plurality of trays 12, 14, 16, 18. This vertical movement is effected by an electric motor 22 that is connected to and possibly travels with the paper feeding mechanism 20 along a vertical frame assembly 24.

The vertical frame assembly 24 is constructed from any of a variety of devices, including a rack and pinion and a rolamite. One embodiment of such a vertical frame assembly 24 and paper feeding mechanism 20 is discussed in copending patent application Serial No. 360,395 by Mark Ruch et al, filed June 2, 1989 (= EP-A-0 400 673).

It should be noted that the motor 22 also provides power to a rotating rubber wheel 26 that contacts the stacks of paper located in each of the trays. Contact between the rotating wheel 26 and the top sheet in any of the stacks of paper urges the top sheet from the stack and into the electrophotographic printer where the actual printing process is performed.

The paper feeding mechanism 20 is generally limited to vertical movement, and the trays 12, 14, 16, 18 are also vertically arranged. Therefore, in order for the paper feeding mechanism 20 to contact a selected one of the stacks of paper, the trays 12, 14, 16, 18 are preferably horizontally moveable between a first selected position and a second unselected paper-feeding position where the tray intersects the vertical path of the paper feeding mechanism 20.

A single electric motor 28 provides the mechani-

cal power to selectively drive the trays 12, 14, 16, 18 between these first and second positions. The motor 28 is connected to a shaft 30, which extends vertically along one side of the trays 12, 14, 16, 18. A plurality of gears 32, 34, 36, 38 are fixed to the shaft 30 at various vertical locations to respectively coincide with racks 40, 42, 44, 46 extending horizontally along the side of each of the trays 12, 14, 16, 18. Thus, rotation of the motor 28 in a first direction produces similar rotation in the shaft 30 and the gears 32, 34, 36, 38.

The gears 32, 34, 36, 38 interact with their corresponding rack 40, 42, 44, 46 and convert the rotational movement into horizontal linear movement of each of the trays 12, 14, 16, 18. Rotation of the motor 28 in a first direction produces horizontal movement of the trays 12, 14, 16, 18 from the first to the second position, while rotation of the motor 28 in a second direction moves the trays 12, 14, 16, 18 from the second to the first position.

For the paper feeding mechanism 20 to properly intersect with the trays 12, 14, 16, 18, the selected tray is preferably horizontally moved between the unselected and selected position without corresponding movement of the unselected trays. For example, if the user desires to print on paper contained in the lowest tray 18, then not only must tray 18 move to the selected position, but the unselected trays 12, 14, 16 must remain in the unselected position. Otherwise, the trays 12, 14, 16 interfere with vertical movement of the paper feeding mechanism 20 and prevent the paper feeding mechanism 20 from descending to and contacting with the paper contained in the lowest tray 18. It should be appreciated that similar problems arise when operation of any one of the other trays 12, 14, 16 is desired.

Accordingly, the motor 28 and shaft 30 employ a transmission 48 to selectively engage only one of the desired gears 32, 34, 36, 38.

Fig. 2 illustrates an apparatus, generally designated by the reference numeral 50, that controls the movement of a plurality of trays 52, 54, 56. The apparatus 50 is conceptually quite similar to the apparatus 10 previously described; however, Fig. 2 illustrates an embodiment of the transmission 48 in conjunction with a paper handling mechanism which includes three paper-holding trays 52, 54, 56. Note that whereas the illustration in Fig. 2 of the apparatus 50 does not include side portions of a frame for ease of illustration, preferably a frame similar to the frame 24 is used to support various elements of the apparatus 50.

The trays 52, 54, 56 are sized to accommodate a selected geometry of paper, and, therefore, may be roughly 8.5 by 11 inches or 8.5 by 14 inches (about 22 cm by 28 cm or 22 cm by 36 cm). However, for ease of illustration, the trays 52, 54, 56 are shown in Fig. 2 to be substantially equal in length.

The trays 52, 54, 56 are adapted to slide in the

horizontal direction as designated by a double-headed arrow 58. Each of the trays 52, 54, 56 is slidably mounted on its respective rails 60, 62, 64. A roller 66, 68, 70 is rotatably mounted one end of each of the rails 60, 62, 64 so that each roller 66, 68, 70 engages a corresponding upper, outwardly extending lip 72, 74, 76 provided on each of the respective trays 52, 54, 56. To support the end of each tray 52, 54, 56 that is opposite the rollers 66, 68, 70, rollers 78, 80, 82 are rotatably mounted at one end of each tray 52, 54, 56 so that the rollers 78, 80, 82 ride on a lower flange portion of the rails 60, 62, 64.

Preferably, each tray is supported on two sides. As illustrated in the cross-section of tray 54 in Fig. 4, each tray includes two opposing lips 74A, 74B and two opposing rollers 80A, 80B, so that each tray is supported by two rails 62A, 62B. The rails 60, 62, 64 on each side of the trays 52, 54, 56 are preferably mounted, e.g., by brackets (not shown), directly to the frame 84.

As shown in Figs. 2 and 3, an electronic controller 85 controls the vertical movement of a paper feeding mechanism 87, which includes a rotatable, paper-contacting wheel 89 driven by a motor 91. The electronic controller 85 also controls the transmission 48. A transmission motor 86, which is mounted on an upper portion 88 of the frame 84, powers the transmission 48 and is conventionally connected to a gear 90 by means of an output shaft 92.

The transmission 48 includes a tubular shaft 94 that is mounted between the upper portion 88 of the frame 84 and a lower portion 96 of the frame 84. The lower portion of the tubular shaft 94 resides within a coupling 98 that is mounted on the lower portion 96 of the frame 84. The coupling 98 permits the shaft 94 both to slide axially and to rotate about its axis.

Three gears 100, 102, 104 are mounted to the shaft 94 in spaced apart relation and may be secured thereto by means of respective set screws 106, 108, 110. The gears 100, 102, 104 are adapted to mesh with associated racks 112, 114, 116 that are mounted on one side of the respective trays 52, 54, 56. A selected gear 100, 102, 104 engages its respective rack 112, 114, 116 to move a selected tray 52, 54, 56 between the first and second positions, as previously described.

Preferably, the teeth of the gears 100, 102, 104 and of the racks 112, 114, 116 are self-aligning so that each gear always meshes with its associated rack. As shown in Figs. 7 and 8 with respect to the rack 114, the teeth 93 include upper and lower tapering portions 95, 97 that facilitate the teeth of the vertically moving gears to slide in between the teeth of the stationary racks. Each rack and each gear carry similar teeth.

The shaft 94 positions the selected one of the gears 100, 102, 104 to engage with its associated rack 112, 114, 116 before the selected tray 52, 54, 56 is moved between the first and second positions.

Therefore, the shaft 94 can move axially to any one of three different preselected locations to mesh the appropriate one of the three gears 100, 102, 104 with its associated rack 112, 114, 116.

The vertical spacing between the gears 100, 102, 104 is such that, in any of the three preselected locations, only one gear engages with a rack at any given time. As shown in Fig. 2, the gear 104 is in a preselected location and engaged with the rack 116 on the tray 56.

To axially move the gears, the shaft 94 includes an inner threaded portion 118 (see Fig. 4) that engages with one end of a screw 120. The other end of the screw 120 is rotatably mounted to a gear 122 on the upper portion 88 of the frame 84. The gear 90 on the output shaft 92 of the motor 86 drives an idler gear 124 that drives the gear 122 in the same direction as the gear 90. If the shaft 94 is fixed so that it cannot rotate, rotation of the screw 120 in a first direction drives the shaft 94 upwardly, and rotation of the screw 120 in a second direction drives the shaft 94 downwardly.

While it is desirable for the shaft 94 to remain rotatably fixed during the positioning of the gears, the shaft 94 is adapted to rotate when the selected gear is in position to drive the selected tray horizontally. Therefore, a means is provided for preventing rotation of the shaft 94 during the gear positioning operation, and for facilitating rotation of the shaft 94 during the tray moving operation.

As shown with further reference to Figs. 5 and 6, the screw 120 has an inner bore 126, and a bar 128 having a T-shaped lower end 130. Further, a polygonally-shaped upper end 132 extends completely through the bore 126. Preferably, a plate 134 is affixed to the upper end of the bar 128 to form the polygonally-shaped upper end 132, the purpose of which is described below.

A spring 136 is coiled around the bar 128 between the plate 134 and a bearing washer 138, and biases the plate 134, and thus the bar 128, upwardly. The T-shaped lower end 130 of the bar 128 extends radially outwardly from the shaft 94 through a pair of axial slots 142, 144 diametrically opposed on the tubular shaft 94.

The bar 128 is axially moveable between a rotation-preventing position and a rotation-allowing position. In its upwardly biased position, i.e., the rotation allowing position, the T-shaped end 130 of the bar 128 rests within a transversely extending notch 140 in the lower end of the screw 120. Since the bar 128 cannot rotate by virtue of its T-shaped lower end 130 extending through the slots 142, 144, the screw 120 cannot rotate without rotating the shaft 94 as well.

Therefore, rotation of the screw 120 does not move the shaft 94 axially, because the screw 120 and the shaft 94 cannot move relative to one another. Conversely, if the bar 128 is moved downwardly

against the force of the spring 136, the T-shaped lower end 130 of the bar does not rest within the notch 140, as illustrated by the phantom lines in Figs. 2, 5 and 6. If the bar 128 is prevented from rotating, the shaft 94 cannot rotate since the T-shaped lower end 130 of the bar 128 extends through the slots 142, 144. Therefore, rotation of the screw 120 causes the shaft 94 to move linearly upwardly or downwardly so that the gears can be positioned properly.

To prevent the bar 128 from rotating during the gear positioning operation, the control 85 moves the paper feeding mechanism 87 upwardly to a gear positioning location. In the gear positioning location, a bumper 146 on the paper feeding mechanism 87 pushes a first end 150 of a lever 148 upwardly, as shown by the phantom lines in Fig. 2. This causes a second end 152 of the lever 148 to push downwardly onto the polygonally-shaped plate 134 of the bar 128, thus compressing the spring 136 and moving the T-shaped lower end 130 of the bar 128 out of the notch 140.

The second end 152 of the lever 148 includes a polygonally-shaped recess 154, which is similar in shape to the polygonally-shaped plate 134 and which accepts the polygonally-shaped plate 134. Since the plate 134 resides within the recess 154, the bar 128 cannot rotate. For ease of construction, the lever 148 is shown in Fig. 3 to extend through an aperture 155 in the upper portion 88 of the frame 84 and to be pivotally connected thereto by a bar 156.

During the gear positioning operation, the trays 52, 54, 56 are in the first unselected position, as shown in Fig. 2. Once the selected gear has been properly engaged with its associated rack, the control 85 moves the paper feeding mechanism downwardly to a tray positioning location.

In the tray positioning location, the paper feeding mechanism 87 remains higher than the tray 52, but the bumper 146 no longer engages the first end 150 of the lever 148. Therefore, a spring 158, mounted between the lever 148 and the upper portion 88 of the frame 84, biases the second end 152 of the lever 148 upwardly so that it no longer engages the plate 134. Since the bar 128 is free to rotate in response to rotation of the screw 120, rotation of the screw 120 in a first direction causes the shaft 94 to rotate and slide one of the trays into its first preselected paper-feeding position.

If at any time during the printing operation, the controller 85 receives a signal to withdraw paper from a different tray, the shaft 94 is rotated in a second direction, causing the tray to return to its first unselected rest position. The controller 85 then moves the paper feeding mechanism 87 into its gear positioning location so that the gears may be repositioned into contact with the rack of the newly selected tray. The controller 85 delivers a signal to the motor 86 that causes the motor 86 to rotate a predetermined amount, and,

thus, move the shaft 94 in the appropriate vertical direction to bring the selected gear into engagement with the proper rack.

The controller 85 then moves the paper feeding mechanism 87 into its tray positioning location so that the selected tray may be slid into its second paper-feeding position. This is accomplished by again rotating the motor 86 by a predetermined amount in the appropriate direction. Once the newly selected tray is in position, the paper feeding mechanism 87 moves downwardly until the rotatable wheel 89 contacts the paper in the selected tray.

Preferably, the motor 86 is a stepper motor, and the number of teeth per inch on the screw 120 are selected so that the shaft 94 is controllably moved in either vertical direction. The controller 85 contains a memory that stores a correspondence curve relating the number of turns of the motor 86 to the corresponding vertical distance traveled by the shaft 94 in response to the number of turns of the motor 86. With this information, the control 85 applies a predetermined voltage signal via line 99 to the motor 86 that causes the motor 86 to turn a selected number of "steps," which corresponds to a selected amount of rotation.

The controller 85 also stores the present position of each of the gears 100, 102, 104, and the position of each of the racks 112, 114, 116. Therefore, when the controller 85 receives a request to withdraw paper from a selected tray 52, 54, 56, the controller 85 determines the distance between the proper gear and its associated rack and the direction of shaft movement needed to bring the gear into engagement with the rack. An appropriate voltage is applied to the stepper motor, rotating the stepper motor by a selected amount that corresponds to the vertical distance between the gear and the rack, and in a selected direction that brings the gear into engagement with the rack.

It should be appreciated that when the printer is between print requests, all of the trays 52, 54, 56 are readily available for receiving paper. The added paper can either be additional paper of the same type, or small quantities of special paper specifically loaded for a special print request (e.g., transparencies for overheads, special size paper, special color paper, etc.). Loading the trays 52, 54, 56 is particularly simple because, unlike prior art devices, the paper feeding mechanism 20 is not in contact with the stack of paper. Thus, because of a lack of mechanical obstructions, the paper is directly loadable into the trays 52, 54, 56 from the rear of the apparatus.

Moreover, referring again to Fig. 1, the motor 28 also drives the trays 12, 14, 16, 18 in the reverse direction to enhance user accessibility. A series of slides 130, 132, 134, 136, similar to furniture drawer slides, respectively support the trays 12, 14, 16, 18 and permit the trays to be fully extended to the right

in Fig. 1.

Further, each of the trays 12, 14, 16, 18 are also manually movable to the right when the transmission 48 is not engaging the motor 28 with the respective racks 40, 42, 44, 46. The user is free to grasp each of the trays 12, 14, 16, 18 and slide them to the right, thereby exposing the top of the tray for easy loading of the desired paper.

An additional feature of the apparatus 10 involves the trays 12, 14, 16, 18 being user configurable. For example, in some instances it is desirable that rather than have four independently accessible trays 12, 14, 16, 18 that are each capable of holding, for example, five-hundred sheets of paper, that only a single tray be available that has a capacity of, for example, two-thousand sheets of paper.

The user readily adapts the apparatus 10 for such use by physically removing the upper trays 14, 16, 18 and then reprogramming the controller to indicate that only the single lower tray is available for use. Since the upper trays 14, 16, 18 are removed, paper is stacked into the lower tray 12 to a maximum height that permits the tray 12 and paper to move horizontally under the sheet feeding mechanism 20.

Claims

1. A paper handling apparatus, comprising:
 - a plurality of trays (12, 14, 16, 18; 72, 74, 76) being adapted for holding a respective stack of sheets of paper, said plurality of trays (12, 14, 16, 18; 72, 74, 76) being generally vertically disposed relative to one another and being adapted for generally horizontal movement between a first position and a second position;
 - means for moving a selected one of said plurality of trays (12, 14, 16, 18; 72, 74, 76) between said first position and said second position;
 - paper feeding means (20; 87) for removing a selected one of said sheets of paper from the respective stack of sheets of paper in said selected tray (12, 14, 16, 18; 72, 74, 76), said paper feeding means being controllably moveable along a preselected substantially vertical path that intersects said selected tray (12, 14, 16, 18; 72, 74, 76) at its first position; and
 - a motor (22; 86);
 - characterized by
 - a transmission means (48) for selectively engaging said motor (22; 86) with said selected tray (12, 14, 16, 18; 72, 74, 76), whereby rotation of said motor (22; 86) moves said selected tray (12, 14, 16, 18; 72, 74, 76) between said first position and said second position;
 - further characterized in that said transmission means (48) includes a combination of a gear



thus, move the shaft 94 in the appropriate vertical direction to bring the selected gear into engagement with the proper rack.

The controller 85 then moves the paper feeding mechanism 87 into its tray positioning location so that the selected tray may be slid into its second paper-feeding position. This is accomplished by again rotating the motor 86 by a predetermined amount in the appropriate direction. Once the newly selected tray is in position, the paper feeding mechanism 87 moves downwardly until the rotatable wheel 89 contacts the paper in the selected tray.

Preferably, the motor 86 is a stepper motor, and the number of teeth per inch on the screw 120 are selected so that the shaft 94 is controllably moved in either vertical direction. The controller 85 contains a memory that stores a correspondence curve relating the number of turns of the motor 86 to the corresponding vertical distance traveled by the shaft 94 in response to the number of turns of the motor 86. With this information, the control 85 applies a predetermined voltage signal via line 99 to the motor 86 that causes the motor 86 to turn a selected number of "steps," which corresponds to a selected amount of rotation.

The controller 85 also stores the present position of each of the gears 100, 102, 104, and the position of each of the racks 112, 114, 116. Therefore, when the controller 85 receives a request to withdraw paper from a selected tray 52, 54, 56, the controller 85 determines the distance between the proper gear and its associated rack and the direction of shaft movement needed to bring the gear into engagement with the rack. An appropriate voltage is applied to the stepper motor, rotating the stepper motor by a selected amount that corresponds to the vertical distance between the gear and the rack, and in a selected direction that brings the gear into engagement with the rack.

It should be appreciated that when the printer is between print requests, all of the trays 52, 54, 56 are readily available for receiving paper. The added paper can either be additional paper of the same type, or small quantities of special paper specifically loaded for a special print request (e.g., transparencies for overheads, special size paper, special color paper, etc.). Loading the trays 52, 54, 56 is particularly simple because, unlike prior art devices, the paper feeding mechanism 20 is not in contact with the stack of paper. Thus, because of a lack of mechanical obstructions, the paper is directly loadable into the trays 52, 54, 56 from the rear of the apparatus.

Moreover, referring again to Fig. 1, the motor 28 also drives the trays 12, 14, 16, 18 in the reverse direction to enhance user accessibility. A series of slides 130, 132, 134, 136, similar to furniture drawer slides, respectively support the trays 12, 14, 16, 18 and permit the trays to be fully extended to the right

in Fig. 1.

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An additional feature of the apparatus 10 involves the trays 12, 14, 16, 18 being user configurable. For example, in some instances it is desirable that rather than have four independently accessible trays 12, 14, 16, 18 that are each capable of holding, for example, five-hundred sheets of paper, that only a single tray be available that has a capacity of, for example, two-thousand sheets of paper.

The user readily adapts the apparatus 10 for such use by physically removing the upper trays 14, 16, 18 and then reprogramming the controller to indicate that only the single lower tray is available for use. Since the upper trays 14, 16, 18 are removed, paper is stacked into the lower tray 12 to a maximum height that permits the tray 12 and paper to move horizontally under the sheet feeding mechanism 20.

Claims

1. A paper handling apparatus, comprising:
 - a plurality of trays (12, 14, 16, 18 ; 72, 74, 76) being adapted for holding a respective stack of sheets of paper, said plurality of trays (12, 14, 16, 18; 72, 74, 76) being generally vertically disposed relative to one another and being adapted for generally horizontal movement between a first position and a second position;
 - means for moving a selected one of said plurality of trays (12, 14, 16, 18; 72, 74, 76) between said first position and said second position;
 - paper feeding means (20; 87) for removing a selected one of said sheets of paper from the respective stack of sheets of paper in said selected tray (12, 14, 16, 18; 72, 74, 76), said paper feeding means being controllably moveable along a preselected substantially vertical path that intersects said selected tray (12, 14, 16, 18; 72, 74, 76) at its first position; and
 - a motor (22; 86);
 - characterized by
 - a transmission means (48) for selectively engaging said motor (22; 86) with said selected tray (12, 14, 16, 18; 72, 74, 76), whereby rotation of said motor (22; 86) moves said selected tray (12, 14, 16, 18; 72, 74, 76) between said first position and said second position;
 - further characterized in that said transmission means (48) includes a combination of a gear



- (32, 34, 36; 100, 102, 104) and a rack (40, 42, 44, 46; 112, 114, 116) for each tray (12, 14, 16, 18; 72, 74, 76); and in that the rack-and-gear combination for the selected tray (12, 14, 16, 18; 72, 74, 76) is engaged to move the selected tray (12, 14, 16, 18; 72, 74, 76) while the rack-and-gear combinations for the unselected trays (12, 14, 16, 18; 72, 74, 76) are not engaged.
2. An apparatus, as set forth in claim 1, characterized in that said transmission means (48) includes a shaft (94) having an upper end portion and a lower end portion and being vertically positioned adjacent said trays (12, 14, 16, 18; 72, 74, 76) and rotatably connected to said motor (22; 86), said gears (32, 34, 36; 100, 102, 104) being connected to said shaft (94) and disposed at preselected vertical heights relative to each of said vertically disposed trays (12, 14, 16, 18; 72, 74, 76), said racks (40, 42, 44, 46; 112, 114, 116) being respectively connected to each of said trays (12, 14, 16, 18; 72, 74, 76) and associated with said corresponding gears (32, 34, 36; 100, 102, 104), whereby said gears (32, 34, 36; 100, 102, 104) selectively engage said corresponding rack (40, 42, 44, 46; 112, 114, 116) and rotation of said motor (22; 86) in a first and second direction produces linear movement of said trays (12, 14, 16, 18; 72, 74, 76) between said first and second position.
 3. An apparatus, as set forth in claim 2, characterized in that said gears (32, 34, 36; 100, 102, 104) are spaced a vertical distance apart less than the vertical distance between the corresponding racks (40, 42, 44, 46; 112, 114, 116) and the transmission means (48) includes means (94, 118, 120) for altering the vertical position of said shaft (94) whereby only one of said gears (32, 34, 36; 100, 102, 104) is engaged with its corresponding rack (40, 42, 44, 46; 112, 114, 116).
 4. An apparatus, as set forth in claim 3, characterized in that said vertical position altering means (94, 118, 120) includes said shaft (94) having an axial, threaded bore (118) extending into the upper end portion of said shaft (94), a threaded screw (120) having a first end extending into said bore (118) and a second end being connected to said motor (28; 86), and means for selectively fixing said threaded screw (120) relative to said shaft (94) to prevent rotation therebetween.
 5. An apparatus, as set forth in claim 4, characterized in that said selective fixing means includes said shaft (94) having a diametric, longitudinal slot (140) intersecting said threaded bore (118), said threaded screw (120) having a longitudinal bore (126) extending coaxially therethrough and a diametric notch (140) extending across the first end of said threaded screw (120), a bar (128) disposed in said longitudinal bore (126) of said threaded screw (120) and having a T-shaped end portion (130) extending through said diametric longitudinal slot (140), and means for selectively engaging said T-shaped end portion (130) with said diametric notch (140) and displacing said T-shaped end portion (130) from said diametric notch (140) whereby said threaded screw (120) and said shaft (94) are respectively fixed against relative rotation therebetween and free for relative rotation therebetween.
 6. An apparatus, as set forth in claim 5, characterized in that said selective engaging means includes means for preventing rotation of said shaft (94) in response to said T-shaped end portion (130) being displaced from said diametric slot (140) whereby said shaft (94) is held stationary and said threaded screw (120) is rotated.
 7. An apparatus, as set forth in claim 5 or 6, characterized in that said selective engaging means includes means (146, 148) for displacing said T-shaped end portion (130) from said diametric slot (140) in response to movement of said paper feeding mechanism (20; 87) to a preselected position.
 8. An apparatus, as set forth in claim 3, characterized in that said vertical position altering means includes a sliding coupling connected to the vertically lower end portion of said shaft.

Patentansprüche

1. Papierhandhabungsvorrichtung, umfassend:
 - mehrere Laden (12, 14, 16, 18; 72, 74, 76) zum Aufnehmen jeweils eines Stapels Papierbögen, wobei die Laden (12, 14, 16, 18; 72, 74, 76) etwa vertikal zueinander angeordnet und zur etwa horizontalen Bewegung zwischen einer ersten Position und einer zweiten Position ausgebildet sind;
 - eine Einrichtung zum Bewegen einer ausgewählten von den mehreren Laden (12, 14, 16, 18; 72, 74, 76) zwischen der ersten Position und der zweiten Position;
 - eine Papiertransporteinrichtung (20; 87) zum Entfernen eines ausgewählten Papierbogens aus dem jeweiligen Stapel von Papierbögen in der ausgewählten Lade (12, 14, 16, 18; 72, 74, 76), wobei die Papiertransporteinrichtung gesteuert entlang einem vorbestimmten etwa vertikalen Weg bewegbar ist, welcher die ausge-



- wählte Lade (12, 14, 16, 18; 72, 74, 76) in ihrer ersten Position schneidet; und
einen Motor (22; 86);
gekennzeichnet durch
eine Übertragungseinrichtung (48), die
5 selektiv den Motor (22; 86) mit der ausgewählten Lade (12, 14, 16, 18; 72, 74, 76) in Eingriff bringt, so daß die Drehung des Motors (72; 86) die ausgewählte Lade (12, 14, 16, 18; 72, 74, 76) zwischen der ersten Position und der zweiten Position bewegt;
10 weiterhin dadurch gekennzeichnet, daß die Übertragungseinrichtung (48) eine Kombination aus einem Zahnrad (32, 34, 36; 100, 102, 104) und einer Zahnstange (40, 42, 44, 46; 112, 114, 116) für jede Lade (12, 14, 16, 18; 72, 74, 76) aufweist, und daß die Kombination aus Zahnstange und Zahnrad für die ausgewählte Lade (12, 14, 16, 18; 72, 74, 76) in Eingriff gebracht wird, um die ausgewählte Lade (12, 14, 16, 18; 72, 74, 76) zu bewegen, während Zahnstangen-Zahnrad-Kombinationen für die nicht-
15 ausgewählten Läden (12, 14, 16, 18; 72, 74, 76) nicht in Eingriff stehen.
2. Vorrichtung nach Anspruch 1,
dadurch gekennzeichnet,
daß die Übertragungseinrichtung (48) eine Welle (94) mit einem oberen Endabschnitt und einem unteren Endabschnitt aufweist, welche
20 vertikal in der Nachbarschaft der Läden (12, 14, 16, 18; 72, 74, 76) angeordnet und drehbar mit dem Motor (22; 86) gekoppelt ist, wobei die Zahnräder (32, 34, 36; 100, 102, 104) mit der Welle (74) verbunden sind und in vorbestimmten vertikalen Höhenlagen relativ zu jeder der vertikal angeordneten Läden (12, 14, 16, 18; 72, 74, 76) angeordnet sind, die Zahnstangen (40, 42, 44, 46; 112, 114, 116) mit jeder der Läden (12, 14, 16, 18; 72, 74, 76) verbunden und dem entsprechenden Zahnrad (32, 34, 36; 100, 102, 104) zugeordnet sind, wodurch die Zahnräder (32, 34, 36; 100, 102, 104) selektiv mit der entsprechenden Zahnstange (40, 42, 44, 46; 112, 114, 116) in Eingriff gelangen und die Drehung des Motors (22; 86) in einer ersten und einer zweiten Richtung eine Linienbewegung der Läden (12, 14, 16, 18; 72, 74, 76) zwischen der ersten und der zweiten Position hervorruft.
3. Vorrichtung nach Anspruch 2,
dadurch gekennzeichnet,
daß die Zahnräder (32, 34, 36; 100, 102, 104) vertikal um eine Strecke beabstandet sind, die kleiner ist als der vertikale Abstand zwischen den entsprechenden Zahnstangen (40, 42, 44, 46; 112, 114, 116), und die Übertragungseinrichtung (48) Mittel (94, 118, 120) aufweist, um die
25 vertikale Lage der Welle (94) zu ändern, wodurch nur eines der Zahnräder (32, 34, 36; 100, 102, 104) mit seiner entsprechenden Zahnstange (40, 42, 44, 46; 112, 114, 116) in Eingriff gelangt.
4. Vorrichtung nach Anspruch 3,
dadurch gekennzeichnet,
daß die Mittel zum vertikalen Ändern der Position (94, 118, 120) aufweisen: die Welle (94), die eine axiale Gewindebohrung (118) aufweist, die sich in den oberen Endabschnitt der Welle (94) hinein erstreckt, eine mit Gewinde versehene Schraube (120), die sich mit einem ersten Ende in die Bohrung (118) hinein erstreckt, und von der ein zweites Ende mit dem Motor (28; 86) verbunden ist, und eine Einrichtung zum selektiven Fixieren der mit Gewinde versehenen Schraube (120) relativ zu der Welle (34), um deren Relativdrehung zu unterbinden.
5. Vorrichtung nach Anspruch 4,
dadurch gekennzeichnet,
daß die Einrichtung zum selektiven Fixieren dadurch gebildet wird, daß die Welle (94) einen diametralen Längsschlitz (140) aufweist, der die Gewindebohrung (118) schneidet, wobei die mit Gewinde versehene Schraube (120) eine Längsbohrung (126) besitzt, die sich koaxial durch sie hindurch erstreckt, und eine diametrale Kerbe (140), die sich quer durch das erste Ende der mit Gewinde versehenen Schraube (120) erstreckt, einen Stab (128), der in der Längsbohrung (126) der mit Gewinde versehenen Schraube (120) angeordnet ist und einen T-förmigen Endabschnitt (130) besitzt, der sich durch den diametralen Längsschlitz (140) hindurch erstreckt, und eine Einrichtung zum selektiven In-Eingriff-Bringen des T-förmigen Endabschnitts (130) mit der diametralen Kerbe (140) und durch Versetzen des T-förmigen Endabschnitts (130) aus der diametralen Kerbe (140) heraus, wodurch die mit Gewinde versehene Schraube (120) und die Welle (94) gegenüber einer Relativbewegung zueinander fixiert bzw. für eine Relativbewegung frei sind.
6. Vorrichtung nach Anspruch 5,
dadurch gekennzeichnet,
daß die Einrichtung zum selektiven In-Eingriff-Bringen eine Einrichtung aufweist, um eine Drehung der Welle (94) ansprechend auf die Versetzung des T-förmigen Endabschnitts (130) aus dem diametralen Schlitz (140) zu verhindern, wodurch die Welle (94) ortsfest gehalten und die mit Gewinde versehene Schraube (120) gedreht wird.
7. Vorrichtung nach Anspruch 5 oder 6,



dadurch gekennzeichnet,
daß die Einrichtung zum selektiven In-Ein-
griff-Bringen eine Einrichtung (146, 148) auf-
weist, um den T-förmigen Endabschnitt (130) aus
dem diametralen Schlitz (140) ansprechend auf
eine Bewegung des Papiertransportmechanis-
mus (20; 87) in eine vorgewählte Position zu ver-
setzen.

8. Vorrichtung nach Anspruch 3,
dadurch gekennzeichnet,
daß die Einrichtung zum Ändern der ver-
tikal Position eine Gleitkupplung aufweist, die
mit dem vertikal unteren Endabschnitt der Welle
verbunden ist.

Revendications

1. Appareil de manipulation de papier, comprenant:
une pluralité de cassettes (12, 14, 16, 18,
72, 74, 76) adaptées à contenir une pile corres-
pondante de feuilles de papier, ladite pluralité de
cassettes (12, 14, 16, 18; 72, 74, 76) étant dispo-
sée de manière globalement verticale les unes
par rapport aux autres, et les cassettes étant
adaptées à effectuer un mouvement globalement
horizontal entre une première position et une se-
conde position;
des moyens pour déplacer une cassette
sélectionnée de ladite pluralité de cassettes (12,
14, 16, 18; 72, 74, 76) entre ladite première po-
sition et ladite seconde position;
des moyens (20; 87) d'acheminement du
papier destinés à retirer l'une, sélectionnée, des-
dites feuilles de papier de la pile correspondante
de feuilles de papier contenue dans ladite casset-
te sélectionnée (12, 14, 16, 18; 72, 74, 76), lesdits
moyens d'acheminement du papier étant mobiles
de façon contrôlée le long d'un chemin présélec-
tionné sensiblement vertical qui croise ladite cas-
sette sélectionnée (12, 14, 16, 18; 72, 74, 76)
dans sa première position; et
un moteur (22; 86);
caractérisé par
un moyen de transmission (48) destiné à
mettre en engagement, de façon sélective, ledit
moteur (22; 86) avec ladite cassette sélectionnée
(12, 14, 16, 18; 72, 74, 76), de manière que la ro-
tation dudit moteur (22; 86) déplace ladite casset-
te sélectionnée (12, 14, 16, 18; 72, 74, 76) entre
ladite première position et ladite seconde po-
sition;
caractérisé de plus en ce que ledit moyen de
transmission (48) comprend une combinaison de
roues dentées (32, 34, 36; 100, 102, 104) et une
crémaillère (40, 42, 44, 46; 112, 114, 116) pour
chacune des cassettes (12, 14, 16, 18; 72, 74,

76); et en ce que la combinaison crémaillère-roue
dentée propre à la cassette sélectionnée (12, 14,
16, 18; 72, 74, 76) est embrayée en vue de dé-
placer la cassette sélectionnée (12, 14, 16, 18;
72, 74, 76) tandis que les combinaisons crémail-
lère-roue dentée propres aux cassettes non sé-
lectionnées (12, 14, 16, 18; 72, 74, 76) ne sont
pas embrayées.

2. Appareil selon la revendication 1, caractérisé en
ce que ledit moyen de transmission (48)
comprend un arbre (94) ayant une partie extrême
supérieure et une partie extrême inférieure et
étant positionné verticalement de façon adjacen-
te auxdites cassettes (12, 14, 16, 18; 72, 74, 76),
et relié de façon rotative audit moteur (22; 86),
lesdites roues dentées (32, 34, 36; 100, 102, 104)
étant reliées audit arbre (94) et disposées à des
hauteurs verticales présélectionnées par rapport
à chacune desdites cassettes (12, 14, 16, 18; 72,
74, 76) agencées verticalement, lesdites crémail-
lères (40, 42, 44, 46; 112, 114, 116) étant respec-
tivement reliées à chacune desdites cassettes
(12, 14, 16, 18; 72, 74, 76) et associées auxdites
roues dentées correspondantes (32, 34, 36; 100,
102, 104), de façon que lesdites roues dentées
(32, 34, 36; 100, 102, 104) entrent sélectivement
en engagement avec ladite crémaillère corres-
pondante (40, 42, 44, 46; 112, 114, 116), et que
la rotation dudit moteur (22; 86) dans un premier
et dans un deuxième sens produise un mouve-
ment linéaire desdites cassettes (12, 14, 16, 18;
72, 74, 76) entre lesdites première et seconde po-
sitions.
3. Appareil selon la revendication 2, caractérisé en
ce que lesdites roues dentées (32, 34, 36; 100,
102, 104) sont espacées les unes des autres
d'une distance verticale, qui est inférieure à la
distance verticale entre les crémaillères corres-
pondantes (40, 42, 44, 46; 112, 114, 116), et en
ce que le moyen de transmission (48) comprend
des moyens (94, 118, 120) destinés à modifier la
position verticale dudit arbre (94), de manière
que respectivement une seule desdites roues
dentées (32, 34, 36; 100, 102, 104) soit amenée
en engagement avec sa crémaillère correspon-
dante (40, 42, 44, 46; 112, 114, 116).
4. Appareil selon la revendication 3, caractérisé en
ce que les moyens (94, 118, 120) de modification
de la position verticale comportent un arbre (94)
ayant un alésage axial fileté (118) s'étendant jus-
que dans la partie d'extrémité supérieure dudit
arbre (94), une vis filetée (120) comprenant une
première extrémité s'étendant jusque dans ledit
alésage (118) et une seconde extrémité reliée au-
dit moteur (28; 86), et des moyens permettant de



fixer de façon sélective ladite vis filetée (120) par rapport audit arbre (94) de manière à empêcher la rotation entre ces deux éléments.

5. Appareil selon la revendication 4, caractérisé en ce que lesdits moyens de fixation sélective comprennent ledit arbre (94) muni d'une fente diamétrale longitudinale (140) coupant ledit alésage fileté (118), ladite vis filetée (120) comportant un alésage longitudinal (126) s'étendant coaxialement à travers celle-ci, et une encoche diamétrale (140) s'étendant à travers la première extrémité de ladite vis filetée (120), une barre (128) disposée dans ledit alésage longitudinal (126) de ladite vis filetée (120) et présentant une partie d'extrémité en forme de T (130) s'étendant à travers ladite fente diamétrale longitudinale (140), et des moyens destinés à amener en engagement, de façon sélective, ladite partie d'extrémité en forme de T (130) avec ladite encoche diamétrale (140) et à déplacer ladite partie d'extrémité en forme de T (130) hors de ladite encoche diamétrale (140), de manière que ladite vis filetée (120) et ledit arbre (94) soient respectivement solidaires, de manière à interdire une rotation relative entre ceux-ci, et libres de manière à autoriser une rotation relative entre ceux-ci.

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6. Appareil selon la revendication 5, caractérisé en ce que lesdits moyens d'embrayage sélectif comportent des moyens destinés à empêcher la rotation dudit arbre (94) en réponse au fait que ladite partie d'extrémité en forme de T (130) est déplacée hors de ladite encoche diamétrale (140), de manière que ledit arbre (94) soit maintenu de façon stationnaire et que ladite vis filetée (120) soit mise en rotation.

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7. Appareil selon l'une des revendications 5 ou 6, caractérisé en ce que lesdits moyens d'embrayage sélectif comportent des moyens (146, 148) destinés à déplacer ladite partie d'extrémité en forme de T (130) hors de ladite encoche diamétrale (140) en réponse au déplacement dudit mécanisme (20; 87) d'acheminement du papier vers une position présélectionnée.

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8. Appareil selon la revendication 3, caractérisé en ce que lesdits moyens de modification de la position verticale comprennent un accouplement à glissement relié à la partie d'extrémité verticalement inférieure dudit arbre.

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