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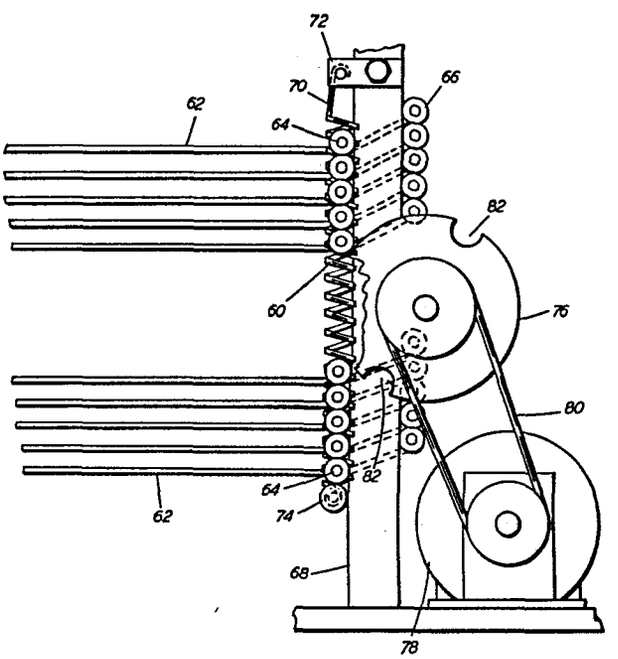
(54) Cantilever sorter.

(57) A compact sorter (12), particularly for use with an electrophotographic printing machine, in which sheets advanced to a sheet inlet region (60) are sorted in selected ones of a plurality of movable trays (62) supported in cantilever fashion. The trays have one side edge thereof supported with the sheet inlet end and the sheet outlet end opposed from the sheet inlet end of each tray being unsupported. Each tray has a pair of rollers (64, 66) on the supported side. A driven cam (76) with notches (82) is arranged so that as the cam rotates a notch meshes with roller (64) whereby successive trays are moved from one side of the sheet inlet region to the other side thereof, and shift relative to one another to provide a wide entry between adjacent trays at the sheet inlet region.



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CANTILEVER SORTER

This invention relates generally to a sorting apparatus for use with an electrophotographic printing machine.

In an electrophotographic printing machine, a photoconductive member is charged to a substantially uniform potential to sensitize the surface thereof. The charged portion of the photoconductive member is exposed to a light image of an original document being reproduced. Exposure of the charged photoconductive member selectively dissipates the charge thereon in the irradiated area. This records an electrostatic latent image on the photoconductive member corresponding to the informational areas contained within the original document being reproduced. After the electrostatic latent image is recorded on the photoconductive member, the latent image is developed by bringing a developer mixture into contact therewith. Generally, the developer mixture comprises toner particles adhering triboelectrically to carrier granules. The toner particles are attracted from the carrier granules to the latent image forming a toner powder image on the photoconductive member. The toner powder image is then transferred from the photoconductive member to a copy sheet. Finally, the copy sheet is heated to permanently affix the toner particles thereto in image configuration.

Frequently, it is highly desirable to reproduce a plurality of copies of the same original document. Moreover, if several original documents are reproduced, it is desirable to form a plurality of collated sets of copies. This may be achieved by the utilization of a sorting apparatus. Generally, the sorting apparatus comprises a plurality of bins or trays wherein each tray is designed to collect one set of copies of the original document. A variety of sorters are known in the art. One typical sorter employs tray members which are spaced apart and extend in a linear row. Another type of sorting apparatus has tray member extending radially outwardly from an axis of rotation. These are the two basic types of sorters generally used commercially, i.e. a linear type and a rotary type.

Copy sheets may be collected in the trays of the sorter in a number of ways. The most common technique is to utilize a sheet transport to advance the copy sheets past the tray openings and deflection

fingers to guide the sheets from the transport into the respective tray. Another technique comprises the use of a moving deflection finger which travels from tray to tray to deflect the copy sheet into the respective tray. Yet still another approach is to move the trays past the sheet ejecting portion of the transport. In this way, the trays collect successive sheets therein.

US-A-3 721 435 discloses a collator having sorting compartments formed by folded cardboard sheets in a zig-zag arrangement defining folders. The folders are supported by rods moved by belts. Each folder is open when receiving a copy sheet and closes before and after the sheet receiving position.

US-A-4 055 339 describes a sorter having at least two arrays of bins supported on a rotatable turntable. Each bin array has a series of vertically oriented bins with an elevator for raising or lowering all the bins. The array of bins moves vertically to position successive bins at an inlet station. Each bin opens to receive a copy sheet. After all the copy sheets are in their respective bins, the turntable rotates and the array of bins moves vertically to position successive bins at a discharge station. Each bin opens and the copy sheets are unloaded therefrom.

US-A-4 328 963 discloses a sorter having a plurality of trays which move past a sheet outlet in opposite directions. The trays are close together on opposed sides of the outlet. Adjacent trays are widely spaced at the outlet to receive the incoming sheet from the outlet. The remote ends of the trays are freely supported one on the other for longitudinal and pivotable movement. The remote end of the bottommost tray is supported on an anti-friction roller.

US-A-4 343 463 describes a sorter having a plurality of trays which move past a sheet outlet in opposite directions. The trays are close to one another on either side of the outlet. Adjacent trays are widely spaced at the outlet to receive incoming sheets from the outlet. Each tray is pivotably mounted at its remote end.

According to a first aspect of the present invention, there is provided an apparatus for sorting sheets advanced to a sheet inlet region. The apparatus includes a plurality of movable trays shiftable relative to one another. Means support one edge of the plurality of trays with the

sheet inlet end and sheet outlet end opposed from the sheet inlet end being unsupported. Means are provided for moving successive trays from one side of the sheet inlet region to the other side thereof with the plurality of trays shifting relative to one another to provide a wide entry between adjacent trays at the sheet inlet region.

In accordance with another aspect of the present invention, there is provided a printing system including means for reproducing copies of original documents on copy sheets. Means, positioned to receive the copy sheets from the reproducing means at a sheet inlet region, sort the copy sheets into sets of documents. The sorting means comprises apparatus in accordance with the first aspect of the invention.

Other aspects of the present invention will become apparent as the following description proceeds and upon reference to the drawing, in which:

Figure 1 is a schematic front elevational view depicting an electrophotographic printing machine incorporating the features of the sorting apparatus therein; and

Figure 2 is a fragmentary, schematic, side elevational view depicting the sorting apparatus used with the figure 1 printing machine.

An embodiment of the present invention will now be described with reference to the drawings. In the drawings, like reference numerals have been used to identify identical elements. Figure 1 schematically depicts the various components of an illustrative electrophotographic printing machine having the sorting apparatus of the present invention coupled thereto. It will become evident from the following discussion that the sorting apparatus of the present invention is equally well suited for use in a wide variety of printing systems, and is not necessarily limited in its application to the particular printing machine shown herein.

Inasmuch as the art of electrophotographic printing is well known, the various processing stations employed in the figure 1 printing machine will be shown hereinafter schematically and their operation described briefly with reference thereto.

As shown in figure 1, the electrophotographic printing machine 10 is coupled to sorting apparatus 12. Printing machine 10 employs a belt 16 having a photoconductive surface deposited on a conductive substrate.

Preferably, the photoconductive surface is made from a selenium alloy with the conductive substrate being made from an aluminum alloy. Other suitable photoconductive materials and conductive substrates may also be employed. Belt 16 is entrained about a pair of opposed spaced rollers 18 and 20. Roller 20 is rotated by a motor coupled thereto by suitable means, such as a drive belt. As roller 20 rotates, belt 16 advances the photoconductive surface through the various processing stations disposed about the path of movement thereof.

Initially, the photoconductive surface passes through charging station A. At charging station A, a corona generating device 22 charges the photoconductive surface to a relatively high substantially uniform potential.

Next, the charged portion of the photoconductive surface is advanced through imaging station B. At imaging station B, an original document is positioned face down upon a transparent platen 24. Imaging of a document on platen 24 is achieved by an exposure system which includes a lamp 26, mirrors 28 and a moving lens 30. The exposure system is a moving optical system wherein the lamps, mirrors, and lens move across the original document illuminating incremental widths thereof. In this way, an incremental width light image is formed. The light image is projected onto the charged portion of the photoconductive surface. The charged photoconductive surface is discharged selectively by the light image to record an electrostatic latent image of the original document thereon. Thereafter, belt 16 advances the electrostatic latent image recorded on the photoconductive surface to development station C.

With continued reference to figure 1, at development station C, a magnetic brush developer roller 32 advances developer material into contact with the electrostatic latent image. The latent image attracts toner particles from the carrier granules of the developer material to form a toner powder image on the photoconductive surface of belt 16.

Belt 16 then advances the toner powder image to transfer station D. Successive copy sheets are advanced from stack 36 by sheet feeder 38. Sheet feeder 38 advances the uppermost sheet from stack 36 into chute 40. Forwarding rollers 42 and 44 continue to advance the sheet to transfer station D. At transfer station D, a corona generator 34 sprays

ions onto the back side of the copy sheet positioned thereat. This attracts the toner powder image from the photoconductive surface of belt 16 to the sheet. After transfer of the toner powder image to the copy sheet, the copy sheet advances through fusing station E.

Fusing station E includes a heated fuser roller 46 and a back-up roller 48 with the toner particle image on the sheet contacting fuser roller 46. In this manner, the powder image is permanently affixed to the copy sheet.

After fusing, the copy sheets are advanced by forwarding rollers 50 through chutes 52 to the copy sheet outlet region. Sorter 12 is located adjacent the copy sheet outlet region to receive the copy sheets at the sorter inlet end 60. Trays 62 on opposed sides of copy sheet inlet region 60 are closely spaced to one another. The trays located on either side of inlet region 60 are shifted relative to one another to provide a wide entry region. Sorter trays 62 are supported movably and shiftably relative to one another on one side edge thereof on sorter frame 68. The inlet end and the outlet end of sorter trays 62 are unsupported. Thus, the trays are cantilevered with the inlet end, and the outlet end, the other side edge of each tray being unsupported.

Turning now to figure 2, there is shown a side, elevational view depicting the detailed structure of sorter 12. Each sorter tray 62 has a pair of rollers 64 and 66 mounted on the supported side edge thereof. The rollers ride on opposed sides of the sorter frame 68. Rollers of adjacent trays engage one another on opposed sides of sheet entry region 60 to define the spacing between adjacent tray 62. Spring 70 has one end thereof secured to bracket 72 with the other end thereof attached to bar 74. Bar 74 is also adapted to move along frame 68. Bar 74 engages roller 64 of the bottommost tray 62. Transfer cam 76 is driven by motor 78 through pulley 80. Trays 62, on opposed sides of sheet entry region 60, have their respective rollers 64 riding on the peripherial surface of cam 76. Cam 76 is cylindrical and has a pair of notches 82 on opposed sides thereof in the peripherial surface thereof. As cam 76 rotates, notch 82 engages or meshes with roller 64 of the tray 62 on one side of sheet inlet region 60. Cam 76 moves tray 62 from one side of sheet inlet region 60 to the other side thereof. When cam 76 is rotating in one direction, i.e. clockwise,

successive lowermost trays 62 are advanced in an upwardly direction from one side of sheet entry region 60 to the other side thereof. In contradistinction, when cam 76 rotates in a counterclockwise direction, successive upper trays 62 are advanced from one side of sheet inlet region 60 to the other side thereof. Thus, the sorter trays are advanced in a bi-directional manner with the regions between adjacent trays at the sheet inlet region being wider than the region adjacent trays on either side of the sheet inlet region. In this way, the sorting apparatus may be relatively compact. Since adjacent rollers contact one another, the space between adjacent trays on opposed sides of the sheet inlet region is determined by the diameter of rollers 64. The space between adjacent trays at the sheet inlet region, is determined by the diameter of cam 60 and the contact point, the space being a cord on cam 76.

In recapitulation, it is evident that the sorting apparatus of the present invention includes a plurality of cantilevered trays supported on one side edge thereof, with the other side edge, sheet inlet end and sheet outlet end being unsupported. By being unsupported at the sheet outlet end, the machine operator may readily remove stacks of copy sheets from the trays without any interference from the sorter structure. The trays are movable and shiftable relative to one another. In this way, successive trays move from one side of the sheet inlet region to the other side thereof with the trays shifting relative to one another to provide a wide entry between adjacent trays at the sheet inlet region. This type of sorting apparatus is relatively compact and inexpensive.

While this invention has been described in conjunction with a specific embodiment thereof, it will be evident to a person skilled in the art that many alternatives, modifications, and variations fall within the scope of the appended claims.

CLAIMS:

1. An apparatus for sorting sheets advanced to a sheet inlet region, including:

a plurality of movable trays shiftable relative to one another;

means for supporting one edge of said plurality of trays with the sheet inlet end and the sheet outlet end opposed from the sheet inlet end being unsupported; and

means for moving successive trays from one side of the sheet inlet region to the other side thereof with said plurality of trays shifting relative to one another to provide a wide entry between adjacent trays at the sheet inlet region.

2. An apparatus according to claim 1, wherein said moving means positions the trays located at opposite sides of the sheet inlet region closely adjacent to one another.

3. An apparatus according to claim 1 or claim 2, wherein:

each one of said plurality of trays includes at least one roller mounted on said one edge thereof; and

said moving means includes a rotatably mounted cam having at least one notch in the peripheral surface thereof adapted to engage the roller of successive trays to move the trays from one side of the sheet entry region to the other side thereof.

4. An apparatus according to claim 3, wherein said moving means includes means for resiliently urging the roller of successive trays into contact with the peripheral surface of said cam.

5. An apparatus according to claim 3 or claim 4, wherein the rollers of adjacent trays engage one another on opposed sides of the sheet entry region to define the space between adjacent trays.

6. A printing system, including:

means for reproducing copies of original documents on copy sheets; and

means, positioned to receive the copy sheets from said reproducing means at a sheet inlet region, for sorting the copy sheets into sets of documents, said sorting means comprising apparatus as claimed in any preceding claim.

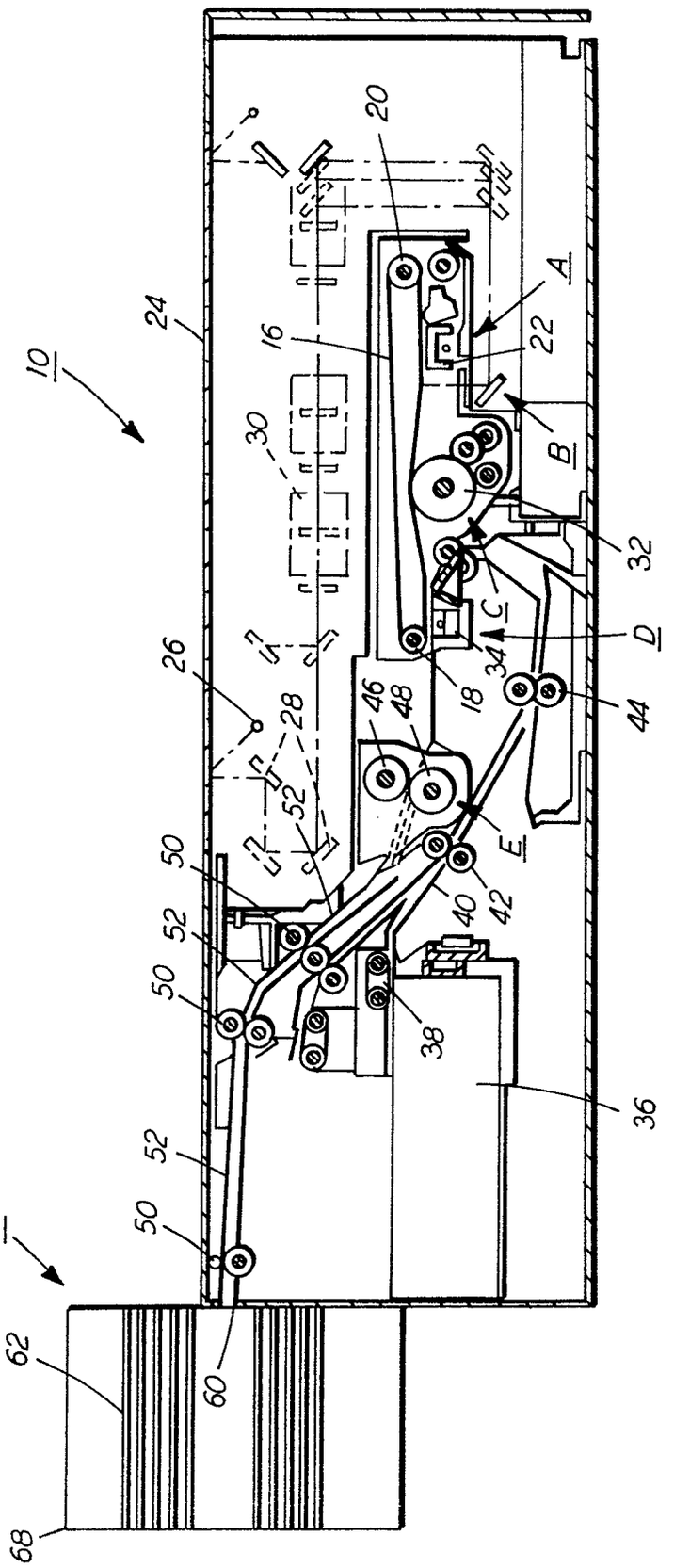
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FIG. 1

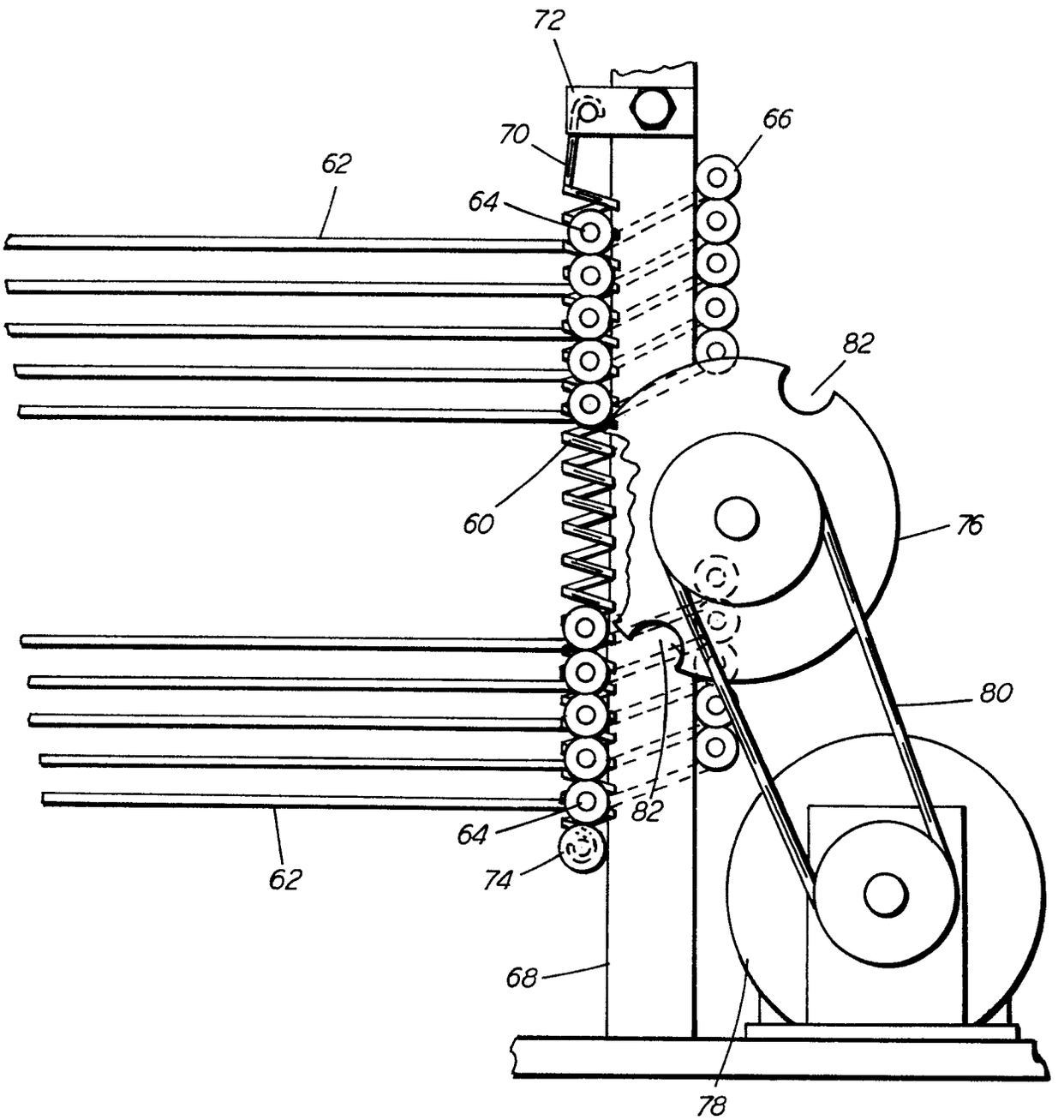

FIG. 2