United States Patent

Drexler et al.

[54] DUPLEX REPRODUCTION SYSTEM

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[57] ABSTRACT

An improved duplex reproduction system which produces duplex copy sets in collated separated stacks from a stack of precollated documents. The system includes a document feeding apparatus which feeds a stack of documents one by one onto the platen of a copy processor for producing copies of each document. The copy sheets are transported to a receiving tray in a sorting apparatus which does not sort the copy sheets when producing the first side of the duplex copies. The documents are reloaded into the document feeding apparatus for feeding the documents with the second side onto the platen of the processor. On the simplex or first pass a circuit disables the sorting function of the sorting apparatus. The copy sheets are removed from a single receiving tray of the sorter for a second or duplex run. On the second pass the copies are distributed sequentially to the different trays of the sorting apparatus which is now energized to produce duplex copy sets in separated collated bundles without rearranging or reshuffling of the documents or copy sheets.

4 Claims, 2 Drawing Figures
FIG. 2
DUPLEX REPRODUCTION SYSTEM

This invention relates in general to a duplexing system and in particular to an improved apparatus combining copier, document feeder and sorter cooperating to produce duplex copies in collated order from precollated documents without rearranging of documents or copies. The instant application incorporates by reference U.S. Pat. No. 3,567,214 issued on Mar. 2, 1971 on a document feeder and U.S. Pat. No. 3,460,824 issued on Aug. 12, 1969 on a sheet sorter each being commonly assigned herewith.

Since the disclosure of the basic concept of xerography, as disclosed in U.S. Pat. No. 2,297,691 to Carlson, a variety of machines and devices have been proposed to incorporate such teaching in a manner to create copy xerographically on a commercial basis. For the most part, such machines in present commercial use are limited to making a limited number of reproductions from an original on one side. It is also known to produce two sided or duplex copies as described for example in U.S. Pat. No. 3,615,129. However, there is no document feeder or sorter apparatus to collate copies in accordance with a precollated document order. Recently, there has been a demand to produce duplex copies which can be sorted in collated stacks from a precollated order of documents fed to a platen in a minimum of time without rearranging or reshuffling of documents or copies by the machine operator.

It is an object of this invention to improve copier/duplicator systems.

It is a further object of this invention to produce duplex copies in collated order from precollated documents in a reliable manner.

It is another object of this invention to print duplex copy sheets in collated stacks in a minimum of time and without the need for a rearranging of documents or copies by a machine operator.

These and other objects of the instant invention are achieved generally speaking by a control circuit for feeding documents from a precollated stack to the platen of the copier to produce a stack of copies and then on a second pass separating the duplex copies into separate collated bundles corresponding to the document order.

For a better understanding of the invention as well as other objects and further features thereof, reference is had to the following detailed description of the invention which is to be read in conjunction with the accompanying drawings wherein:

FIG. 1 illustrates schematically a duplex xerographic reproducing system including document feeder and sorter in accordance with the instant invention; and

FIG. 2 is a schematic electrical diagram of the control circuit according to the invention.

As shown schematically in FIG. 1 the duplex xerographic reproducing system comprises a document feeding apparatus 22, positioned on a xerographic processor 25 which transports copy sheets to a sorting apparatus 28. A control panel 32 includes the usual counters and buttons as well as switch buttons S1 for START PRINT, S2 for sorter ON and S3 for document feeder ON. The processor includes a drum shaped surface 40 including a photoconductive backing. This surface is mounted on a shaft journaled in a frame to rotate in the direction of the arrow to cause the drum surface sequentially to pass a plurality of xerographic processing stations.

For the purpose of the present disclosure, the several xerographic processing stations in the path of movement of the drum surface may be described functionally as follows:

A charging station A, at which a uniform electrostatic charge is deposited on the photoconductive layer of the xerographic drum;

An exposure station B, at which a light or radiation pattern of copies to be reproduced is projected onto the drum surface to dissipate the drum charge in the exposed areas thereof and thereby form a latent electrostatic image of the copy to be reproduced;

A developing station C, at which a xerographic developing material including toner particles having an electrostatic charge opposite to that of the electrostatic latent image are cascaded over the drum surface, whereby the toner particles adhere to the latent electrostatic image for a xerographic powdered image in the configuration of the copy being reproduced;

A transfer station D, at which the xerographic powder image is electrostatically transferred from the drum surface to a transport sheet material or drum surface;

A drum cleaning and discharge station E, at which the drum surface is brushed to remove residual toner particles remaining thereon after image transfer, and at which the drum surface is exposed to a relatively bright light source to effect substantially complete discharge of any residual electrostatic charge remaining thereon;

And

A fusing station F, at which the powder image is permanently affixed to the sheet material which is transported to sorting apparatus 28.

For a more detailed description of the copy processing stations reference is had to U.S. Pat. No. 3,301,126 to Osborne et al which is commonly assigned.

In accordance with the present invention a stack of documents is placed in a document feeding apparatus 22 in such a manner as to feed documents to the platen 50 of the processor. The operation of the document feeding apparatus is such that one document is fed to the platen to produce the desired number of copies and then advanced from the platen to enable the next document to be positioned in overlaying relationship to the platen as described in the commonly assigned aforementioned patent. The sorter apparatus 28 comprises trays 60 each having a gate 62. In the first pass the copy sheets are collected in the top tray only as will be described more fully hereinafter. After the first side of each document has been copied the documents are reinserted in the document feeding apparatus and the second side copied. Prior to starting the system for the duplex pass, the copy sheets are returned to the copy sheet feeder section 65 and turned over for receiving copy print on the blank side. It will be appreciated that neither the documents or the copy sheets are rearranged or reversed to resuffle the order of the sheets. On the second or duplex pass the copy sheets are distributed sequentially to the trays of the sorting apparatus to produce the desired number of collated and separated duplex sets in a minimum of time.

A better understanding of the invention can be had with a detailed description of the operation and reference to the control circuit in FIG. 2. In operation when the system is turned on in the standby condition a
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switch S4 is closed to initiate the desired duplexing operation. When this occurs a relay KX is energized. Upon energizing relay KX a normally opened contact KX-1 is closed and a normally closed contact KX-2 is opened. Contact KX-1 is closed to maintain relay KX energized and lamp L1 energized indicating the duplex system is on. Contact KX-2 is opened to prevent motor B3 from being energized. Motor B3 is an indexing motor which serves to actuate gates 62 associated with each of the trays 60 of the sorting apparatus 28. Start print button S1 (FIG. 1) is pressed to energize document on the platen of the processor. Document feeding button S2 and the sorting apparatus button S3 are also pressed. The processor begins the print cycle and causes a relay KY to be energized. When the relay KY is energized contact KY-1B opens isolating relay KX from wire 10. It will be noted that relay KX is not de-energized immediately due to an RC circuit delay comprised of a capacitor C1 and a resistor R1. At the same time a contact KY-1A is closed connecting relays KX to a wire 47 thereby maintaining relay KX energized and preventing motor B3 from indexing.

The document feeding apparatus 22 continues to feed documents one at a time onto the platen to produce the desired number of copies which are transported to the top tray 60 of the sorting apparatus 28. After the last copy of the last document has been produced, wire 47 is de-energized thereby removing power from both relays KX and KY. Relay KY is coupled with an RC circuit comprised of a capacitor C2 and resistor R2 and a longer delay than does the RC circuit, comprised of capacitor C1 and resistor R1. As a result relay KX has a shorter delay or dwell for de-energizing than does relay KY which serves to reset the system.

To produce duplex copies the documents are restacked in the document feeding apparatus. At the same time the copy sheets are removed from tray 60 and placed in copy feeding section 65 of the processor with the second or blank side turned for receiving the xerographic print. The start print button S1 is pressed initiating a normal operation for the sorting apparatus 28 with motor B3 operating in the usual manner to index the gates. Since switch S4 is not closed motor B3 remain energized and normal sorting of the copy sheets into the trays of the sorting apparatus occurs. By this structure duplex copy sheets in book form are produced in collated separated bundles. It will be further appreciated that it is not necessary to rearrange or re-shuffle the order of documents and/or copy sheets after the first pass or side one copies are produced and at the end of the duplex reproduction cycle.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:
1. An improved duplex reproduction system producing collated duplex copy sets comprising:
document feeding means for feeding a stack of documents in seriatim to the platen of a copy processor,

copy processor means for copying each document a predetermined number of times,

sorter means including a plurality of trays each having an associated gate at the inlet thereof for opening the tray to receive copy sheets from said processor means,

and circuit means for disabling said gates on the first pass of copy sheets through said copy processor means to said sorter means and then energizing said gates on the second pass to distribute copy sets without rearranging documents or copy sheets.

2. A system according to claim 1 wherein said circuit means includes first relay means for de-energizing motor means normally operating said gates and second relay means for resetting said motor means to operate said gates sequentially.

3. A system according to claim 2 wherein said first and second relay means include RC circuit means, said second relay means having RC circuit means with a longer dwell time than RC circuit means of said first relay means.

4. A method of producing separated collated duplex copy sets without rearranging documents or copy sheets comprising the steps of:
feeding documents in seriatim to the platen of a copy processor to expose one side thereof a predetermined number of times,
xerographically copying the documents on one side of copy sheets synchronously advanced through copy processing stations,
advancing the copy sheets to a single receiving tray of a sorter including a plurality of trays, refeeding the documents on the other side to the platen of the copy processor for producing a predetermined number of copies thereof, simultaneously refeeding the copy sheets through the copy processor stations with the blank side turned to receive xerographically copied images of the other side of the documents, and sorting the copy sheets into said plurality of trays sequentially to produce collated duplex copy sets on the second pass.

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