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(54) SHEET LATERAL OFFSETTING APPARATUS AND METHOD

(71) We, INTERNATIONAL BUSINESS MACHINES CORPORATION, a Corporation organized and existing under the laws of the State of New York in the United States of America, of Armonk, New York 10504, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to sheet lateral offsetting apparatus and method for laterally offsetting sheets during transport in a predetermined direction along a path. Such sheet offsetting apparatus and method find a particular, but not exclusive application to copier/duplicator/printer systems.

In copier/duplicator systems and in duplicator/printer systems, there may be need for providing job-separation of the sheets fed to the collection station as the output of the equipment. For example, in a duplicator/printer system, there are two collection stations, one for use when the system is operating as a duplicator and another for use when the system is operating as a printer. Typically, the equipment, when functioning in the duplicator mode, either collates the output by collecting the copy sheets in separate bins with a single collated set or job in each bin; or the copy sheets are simply collected in a single stack, uncollated, but with the desired number of copies of each sheet grouped together one on top of the other as separate jobs.

When such equipment is operated in the printer mode, copy sheets may be produced from electronic information such as magnetic cards or computers. In this mode, the entire information is printed onto the required number of successive sheets to form an individual print job, with the sheets of the job properly collated. This process is then repeated the required number of times to make the desired number of copies of the job. With the present construction of duplicator/printer systems, the successive jobs are fed to a print exit pocket where they are collected in a single stack.

Where the copy sheets are finally collected in a single stack, uncollated or collated, it is desirable to form the stack in such a way that the successive jobs are visually identifiable. For this purpose, it is generally known to offset each job with respect to the next job in the stack. Typical arrangements have included separate sheet feeding mechanisms alternately operable on the sheets of each succesive job. With this type of construction, each alternate job is fed into the stack by one or the other of the feeding mechanisms which are arranged to effect the offset relation. Other devices for offsetting successive jobs in a single stack involve oscillating the collecting bin in which the stack is collected. In particular, the bin is moved to one position for receiving every other job while it is moved to the second position for receiving the remaining jobs. The successive jobs therefore become offset laterally in the formed stack. Still another arrangement for offsetting jobs collected in a single stack includes the use of a stop device for controlling the extent to which each job is fed into the collecting bin. With this construction, individual jobs are offset longitudinally of their path of movement into the bin.

According to the present invention, a method of laterally offsetting sheets comprises the steps of feeding the sheets in the predetermined direction along an initial path, and directing the sheets along a second downstream path at least partly curved about an axis or axes, the angle of which relative to an axis perpendicular to the predetermined direction is selectively adjustable, to a third downstream path in the predetermined direction.

Sheet lateral offsetting apparatus according to the invention comprises feeding means for feeding sheets in the predetermined direction along an initial path, and means for directing sheets through a second downstream path at least partly curved about an axis or axes and mounted for selec-

tive adjustment of angle relative to an axis perpendicular to the predetermined direction, to a third downstream path in the predetermined direction.

In a particular application of the present invention, job separation is produced by laterally offsetting the sheets of each job with respect to their direction of travel toward a collecting bin in which they are to be stacked. For producing this lateral offset, the sheets are directed from their original path of travel into a curved path formed about an axis which is selectively adjusted relative to an axis perpendicular to the direction of travel of the sheets in their initial path. After this skewed travel, the sheets are fed back into a third path in the predetermined direction. At this point, the sheets are moving along the path in laterally offset relation to their original positioning on the path.

To effect job separation of each successive copying or printing job, the sheets of each alternate job may, for example, be directed along a differently skewed path while the remaining jobs are directed along an unskewed path. The successive jobs may then be collected in a single stack and each will be visually identifiable by their relative lateral offsetting. It is also possible to offset just the first or last sheet of each successive job as it travels toward the collecting bin. It will be apparent that this procedure will provide the same type of visual indication of the separated jobs when collected in a single stack.

In construction, the curved path for offsetting the sheets is provided by curved guide structure extending across the initial path of travel of the sheets toward the collecting bin. The guide structure is formed into a curved shape about an axis and is in the form of a trough. Positive drive means is advantageously provided both before and after the trough for positively feeding the sheets in their original predetermined direction. The spacing of these drive means is such that the sheets will remain under their control as they are directed through the guide structure. This is significant in that the sheets will thereby always remain under positive control.

The scope of the invention is defined by the appended claims; and how it can be carried into effect is hereinafter particularly described with reference to the accompanying drawings, in which:—

Figure 1 is a schematic view of part of a copier/duplicator/printer system, in which offsetting apparatus according to the present invention may be incorporated;

Figure 2 is a schematic plan view of a variable skew trough-shaped guide structure in an embodiment of apparatus according to the present invention; and

Figure 3 is a sectional side view taken on a line parallel to the line III—III of Figure 2.

A copier/duplicator/printer system (Figure 1) may have a sheet lateral offsetting apparatus 4, as described in our co-pending application for Letters Patent No. 37507/77 (Serial No. 1572143). Such apparatus provides alternative paths for sheets fed from the system. Along a first path, sheets enter in a direction of travel and emerge in the same direction in a common plane. Along a second path, at least partly curved about an axis or axes skewed to an axis perpendicular to the direction of travel, sheets enter in the direction of travel, are diverted into a re-entrant trough set at the skew angle, and emerge in the direction of travel but offset due to the skewed nature of the trough.

Sheets are fed by a feeding mechanism 1 from a copying or printing station 2 to a bin type collection station 3 along a guide path which includes the offsetting apparatus 4 at the entrance to the collection station 3. A control panel 5 contains switches to control operation so the system, for example to set it in a duplicating mode or printing mode, to select numbers of copies and for setting other operating functions. A switch is included to operate a solenoid 15 to control the offsetting apparatus. The feeding mechanism includes pairs of rollers along the sheet guide path. One of each pair of rollers, the drive roller, is positively driven against a sheet between the drive roller and the other roller, which is an idler roller.

According to the present invention, such offsetting apparatus is replaced by that illustrated in Figures 2 and 3, and in which there is a single, at least partly curved, path for sheets and the path is formed about an axis or axes whose angle, relative to an axis perpendicular to the direction of travel of the sheets, is selectively adjustable.

Sheets enter in a direction of travel 9 (Fig. 2) on a sheet support surface section 7^{1} and emerge in the same direction 9 on a sheet support surface section 7^{11}, both lying in a common plane. Between these sections 7^{1} and 7^{11} is a re-entrant trough structure 20. The structure 20 is mounted on a platform 25 (Fig. 3) which is supported on a rotatable shaft 26. Depending upon the angle of the axis or axes about which the curved surface of the trough structure is set in relation to the direction of travel 9, the sheets emerge on the sheet support surface section 7^{11}, in the direction 9 without offset or offset according to the skew angle of the trough.

A sheet fed into the trough, is guided around the trough and back onto the surface section 7^{11}. During its passage through the offsetting apparatus, the sheet is given a lateral component of motion by the shape

and angle of the trough, in addition to the forward component of motion in the direction 9.

In order to maintain positive control of the sheet throughout its path of travel through the trough, a pair of sheet feeding rollers 6 and 6^1 is positioned closely adjacent to the trough both on the input and output sides thereof. The trough is dimensioned so that the distance between the two pairs of rollers is less than the length of the paper as measured along its path of travel through the trough.

Thus, when the leading end of a sheet has passed completely through the trough and has been directed back into its original direction of travel on the surface section 7^{11}, the trailing end of the sheet has not yet been diverted from the surface section 7^1 into the trough.

Sheets which pass through the trough, when the latter is skewed, become offset laterally with respect to the direction of travel 9. The amount of sheet offset depends on the angle of skew. The offsetting of each sheet is effected without changing the ultimate direction of travel 9. This is advantageous in that all sheets passing through the trough, whatever its angle, will have the same direction of travel and will thus be parallel.

The trough (Figure 3) comprises a pair of wall members which closely overlie each other to contain the paper as it is fed through the trough. A double wall construction is used because the sheets must traverse a path which includes reverse turns. The outer wall guides the sheets for making turns in the counterclockwise direction (Figure 3) and the inner wall guides the sheets as they are turning in the clockwise direction (Figure 3). Although a continuous double wall construction is shown, it is possible to use other constructions for guiding the sheets through their curved path. For example, the wall members may have interrupted surfaces and strategically placed guide surfaces at the proper orientation with respect to the curved portions of the trough may be used to hold the sheets against the surfaces of the wall members, where necessary.

The angle of the trough is adjustable so that the amount of skewing of the trough relative to the predetermined direction 9 can be varied. For this purpose, the entire trough is made as an integral unti separate from the sheet feed rollers and support surface sections 7^1 and 7^{11}, and mounted on the platform 25 supported on the shaft 26. Rotation of the trough guide structure by the platform 25 about the axis of the shaft 26 will change the angle of skew of the trough relative to the direction 9. To permit rotative movement of the trough construction without interfering with the sheet travel, the portion 27 of the outer wall of the guide structure at the entrance underlies the surface section 7^1 and the portion 28 at the exit overlies the surface section 7^{11}.

With the construction shown, all the sheets can be fed through the trough with offsetting of one job relative to another being effected by control of the rotative position of the trough.

It is preferred to have all the sheets collected in one stack with their front edges aligned with each other.

WHAT WE CLAIM IS:—

1. A method of laterally offsetting sheets with respect to their path of travel in a predetermined direction, comprising the steps of feeding the sheets in the predetermined direction along an initial path, and directing the sheets along a second downstream path at least partly curved about an axis or axes, the angle of which relative to an axis perpendicular to the predetermined direction is selectively adjustable, to a third downstream path in the predetermined direction.

2. A method according to claim 1, in which the third path is in a common plane with the initial path.

3. A method according to claim 1 or 2, in which the angle of skew of the second path axis or axes is selectively adjusted to determine the amount of lateral offset of the sheets.

4. A method of laterally offsetting sheets with respect to their path of travel in a predetermined direction, substantially as hereinbefore particularly described with reference to Figures 2 and 3 of the accompanying drawings.

5. Sheet lateral offsetting apparatus for laterally offsetting sheets with respect to their path of travel in a predetermined direction, comprising feeding means for feeding sheets in the predetermined direction along an initial path, and means for directing sheets through a second downstream path at least partly curved about an axis or axes and mounted for selective adjustment of angle relative to an axis perpendicular to the predetermined direction, to a third downstream path in the predetermined direction.

6. Apparatus according to claim 5, in which the third path is in a common plane with the initial path.

7. Apparatus according to claim 5 or 6, in which the second path includes a trough structure.

8. Apparatus according to claim 7, in which the trough structure includes a reentrant trough.

9. Apparatus according to any of claims 5 to 8, in which the second path is

mounted for pivotation about a central axis normal to the predetermined direction, through which at least one of the axes of curvature of the second path passes.

10. Sheet lateral offsetting apparatus for laterally offsetting sheets with respect to their path of travel in a predetermined direction, substantially as hereinbefore particularly described with reference to Figures 2 and 3 of the accompanying drawings.

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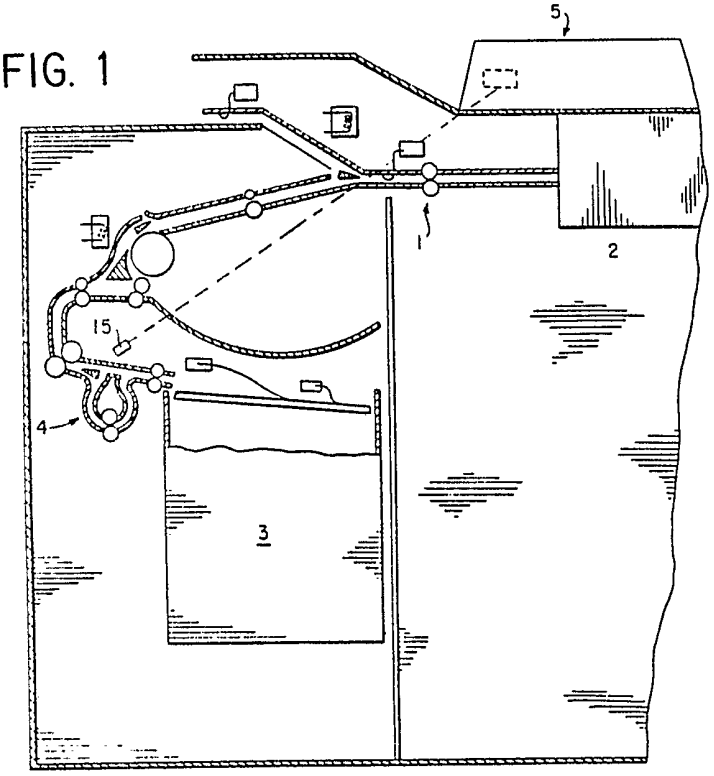
1572144 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1



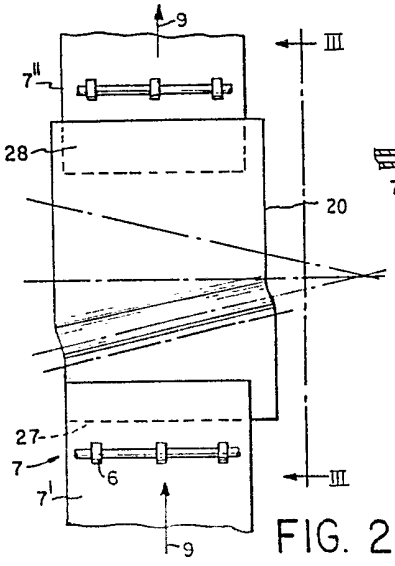


FIG. 2

FIG. 3