United States Patent [19]

Gerbracht

[11] **3,877,693**

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[54] **DISTRIBUTOR ASSEMBLY FOR SHEET SORTING DEVICE**

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[73] Assignee: **Norfin, Inc.**, Seattle, Wash.

[22] Filed: **Sept. 13, 1972**

[21] Appl. No.: **288,674**

[52] **U.S. Cl.** **270/58**; 271/173

[51] **Int. Cl.** **B65h 39/02**

[58] **Field of Search** 270/58; 271/64, 173; 209/74

[56] **References Cited**

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Primary Examiner—Wm. H. Grieb

Attorney, Agent, or Firm—Dowrey & Cross

[57] **ABSTRACT**

A sheet sorting device is disclosed which is particularly useful in direct or "in line" cooperation with a copier or duplicator. The sheet sorting device includes a distributor for distributing the sheets one at a time or as signatures into multiple individual bins or receiver trays ready for binding or other handling. The distributor includes multiple deflector mechanisms which are individually and sequentially triggered from a first position in the path of a moving sheet being conveyed such that, on deflection of the sheets into the bin, the momentum of the moving sheet striking the deflector mechanism initiates movement thereof which, aided by a positive assist force carries it to a second position permitting a subsequent moving sheet to by-pass the bin and strike the deflector mechanism of the successive index position. Means are provided for resetting the deflector mechanisms either automatically or manually and for sensing when the last deflector mechanism has been triggered, the sensing means being operatively connected to the reset means.

13 Claims, 8 Drawing Figures

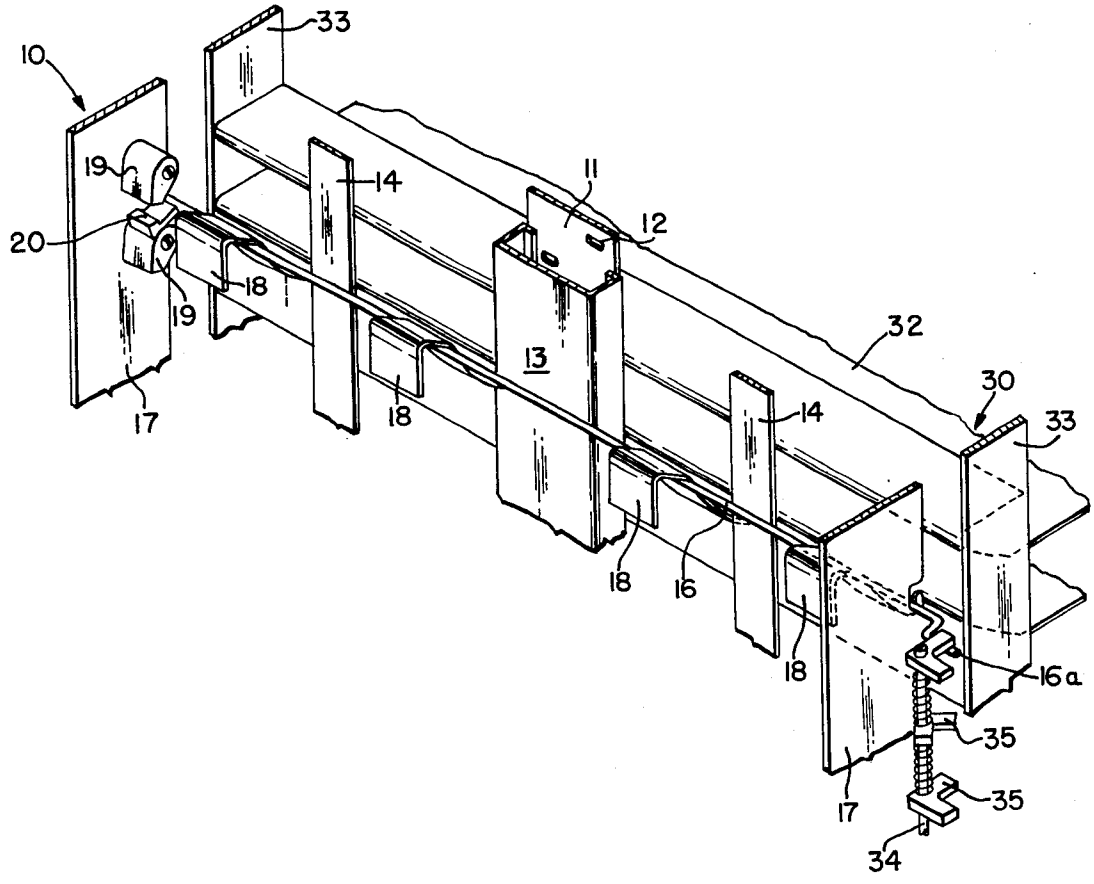


FIG. 3

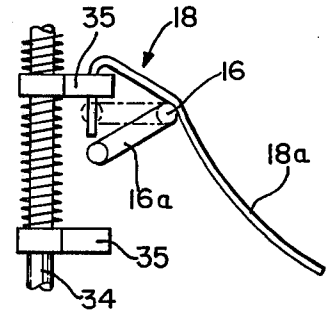
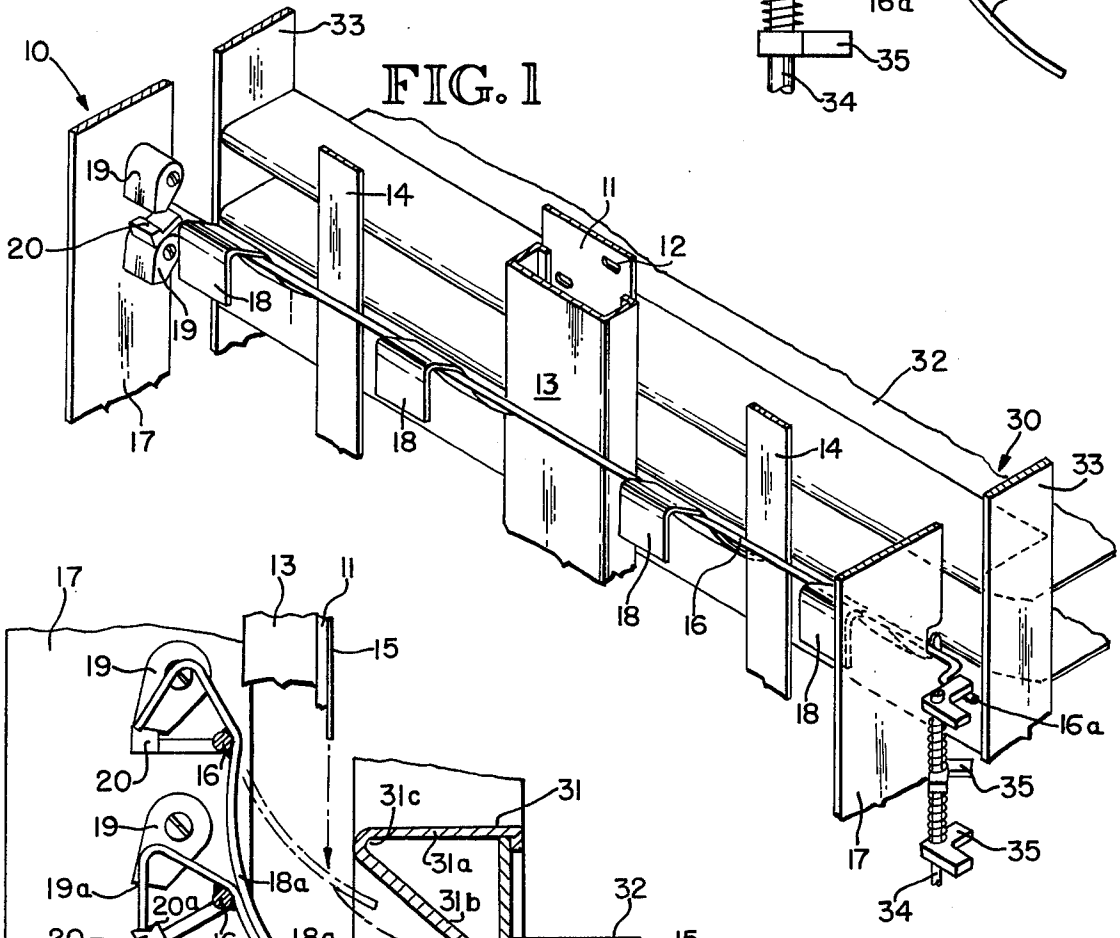


FIG. 1



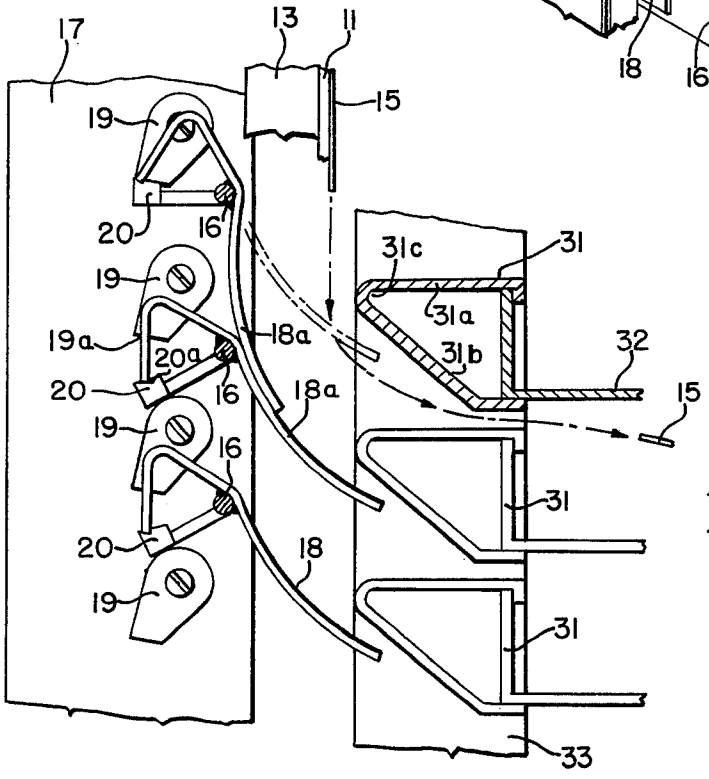


FIG. 2

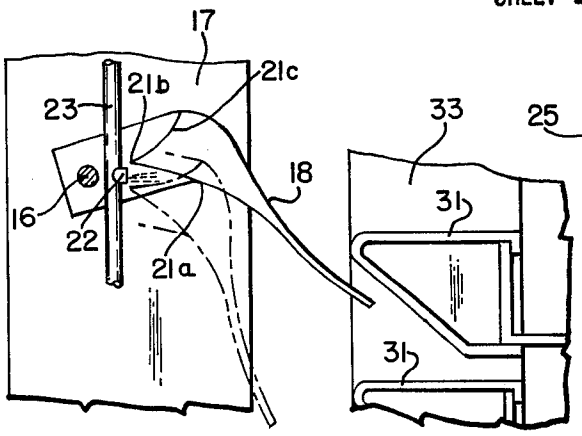


FIG. 4

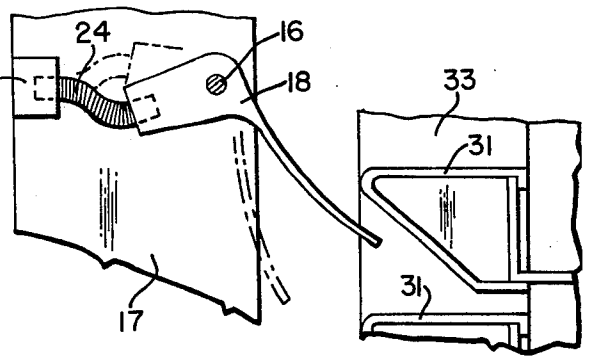


FIG. 5

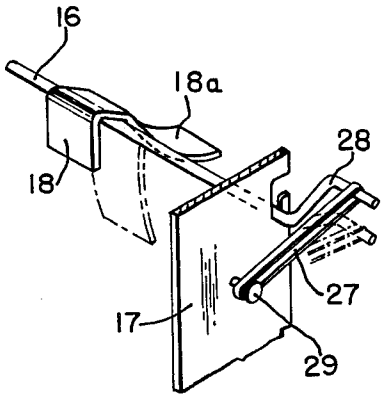


FIG. 6

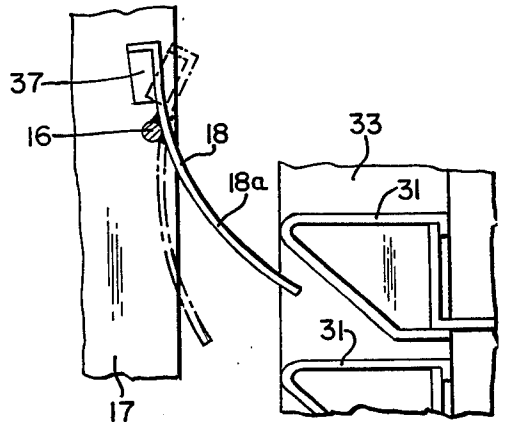


FIG. 7

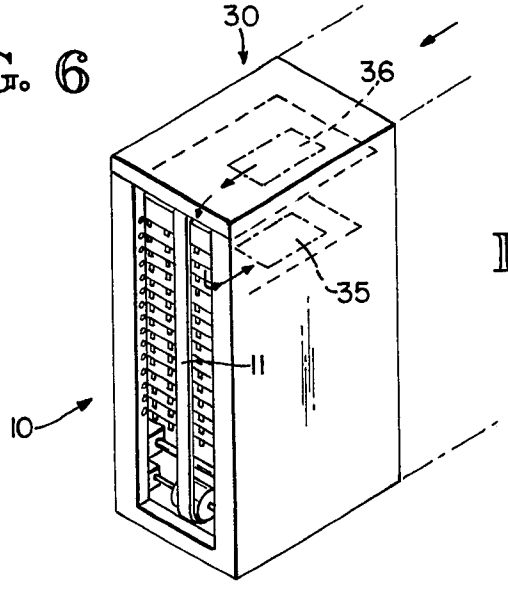


FIG. 8

DISTRIBUTOR ASSEMBLY FOR SHEET SORTING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a sheet sorting device having a distributor assembly employed therewith for delivering sheets one at a time into a plurality of individual bins or receiver trays.

2. Prior Art Relating to the Disclosure

Sorting and collating devices such as disclosed in U.S. Pat. No. 3,356,362 are relatively large in size and dependent upon complex mechanical and electrical components capable of high speed operation. These units generally employ a large number of deflecting stations or receiver bins. Sorter devices are also known which have multiple deflector finger mechanisms to deflect sheets during their course through the machine onto respective shelves or bins. These deflector finger mechanisms are individually and sequentially triggered by solenoid devices or by a tripping bar which progresses from one finger to the next responsive to the passage of each deflected sheet through a control mechanism as disclosed in the U.S. Pat No. 3,273,882. These units necessarily must include a relatively complex control mechanism and are expensive to manufacture. A sheet sorting device employing a traveling single deflector mechanism has been developed as disclosed in U.S. Pat. No. 3,561,753. This deflector mechanism is still dependent, however, on a complex control and indexing system to channel the incoming sheets on the conveyor to the proper receiver bins. It still remains a problem to provide a sheet sorter of relatively small capacity for use with available copiers and duplicators which can be manufactured economically and which furnishes substantially maintenance free operation.

SUMMARY OF THE INVENTION

This invention relates to a sheet sorting device, particularly useful in direct or "in line" cooperation with copiers and duplicators, which accepts sheets from a printer, processing machine, feeder, copier, duplicator, or by hand, one sheet at a time or as signatures in multiples of the book or document in a plurality of individual bins or receiver trays ready for binding or other handling.

The primary object of this invention is to provide a sheet sorting device of the vertical conveyor type wherein the deflector finger mechanism of the distributor assembly is greatly simplified, essentially maintenance free, economical to manufacture and operate and does not require a complex control system for satisfactory operation.

Another object of this invention is to provide a sheet sorting device employing a deflector finger mechanism adjacent each receiver shelf or bin which is sequentially triggered on impact of a moving sheet deflected into the bin associated with the finger mechanism to permit passage of the next sheet to the subsequent receiver bins.

Another object of this invention is to provide a sheet sorting device which can handle a fairly wide range of sizes of sheets and weights of paper.

A further object of this invention is to provide a sheet sorting device having a manually or automatically controlled reset means for the deflector mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partial perspective view of the sorting device illustrating a partial view of the distributor incorporating the deflector finger mechanism of this invention and a partial view of the upright receiver having one or more vertical columns, shelves or bins for storage of sorted sheets of paper or other suitable material delivered thereinto in proper order by the distributor;

FIG. **2** is a vertical cross-sectional view of FIG. **1**;

FIG. **3** is a partial side view of a reset mechanism for the deflector finger mechanisms of FIG. **1**;

FIG. **4** is a partial side view of a deflector finger mechanism employing an over-center air cam;

FIG. **5** is a partial side view of a deflector finger mechanism employing an over-center spring;

FIG. **6** is a partial perspective view of a deflector mechanism incorporating an over-center elastomeric band;

FIG. **7** is a partial side view of a deflector finger mechanism incorporating an over-center weight; and

FIG. **8** is a perspective view of a sheet sorting device having a distributor incorporating the deflector finger mechanism of this invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. **8**, the sorting device in general comprises a distributor **10** operating in repeating cycles and an upright receiver **30** mounted at the rear of the distributor and having one or more vertical columns or shelves or bins for storage of sorted sheets of paper **35** or other suitable material delivered thereinto in proper order by the distributor. These shelves are arranged to be fed from the front by the distributor and manually emptied when sorting of the document is complete. The various sheets sorted or fed in reverse order by a printer or duplicator (not shown) are delivered one sheet at a time or as signatures onto a table (not shown) at the rear of the distributor. From there they are conveyed rearwardly as indicated by the arrows in FIG. **8** and then run a downward course fronting a selected column of the receiver shelves. During their downward course the sheets are deflected onto respective of the shelves by respective deflector units. Contrary to the deflector mechanisms of the prior art these deflector units are sequentially triggered during each cycle by the impact of the downwardly coursing sheets against the deflector finger or fingers of the unit, the momentum of the moving sheet striking the deflector fingers imparting sufficient momentum which, together with a positive assist, carries them to a second position permitting a subsequent moving sheet to strike the deflector unit of the successive index position.

Referring to FIG. **1** the distributor section **10** includes generally a single tape conveyor **11** for conveying sheets and a series of deflector finger mechanisms positioned adjacent each one of the shelves **32** of the receiver **30.** The conveyor tape **11** (partially illustrated in FIG. **1**) is trained about upper and lower drums as disclosed in U.S. Pat. No. 3,561,753 the disclosure of which is hereby incorporated by reference. The lower drum is suitably driven by an electric motor or other suitable power means with the upper drum driven by the conveyor belt **11.** The belt **11** may be a rubber or plastic impregnated fabric belt or other suitable conventional belting provided with longitudinally staggered or offset perforations **12** along each lateral edge.

The belt, on its vertical course adjacent to bins **32**, passes over a vacuum plenum in the form of a hollow rectangular channel **13** closed at its top and back side but open at its front to the underside of the belt **11**. The chamber **13** is supported as described in U.S. Pat. No. 3,561,753 and is connected to a vacuum hose leading from a vacuum pump. Rather than the arrangement shown, the conveying assembly may include two parallel tape converyors or a single wide conveyor.

The sheets **36** entering the infeed section of the sheet sorting device (see FIG. **8**) are directed downwardly as disclosed in U.S. Pat. No. 3,561,753 onto the vertical course of the conveyor tape **11**. Flexible bands **14** having one end connected at the upper end of the frame of the sorter and the other at the lower end are provided for holding the downwardly moving sheets against the conveyor tape **11**. Two of these tapes **14** are provided in the present embodiment.

The receiver **30** includes a number of shelves **32** supported in a frame **33**. Nose pieces **31** at the front and an integral lip (not shown) at the rear are attached to the frame. The nose pieces **31** may be of extruded aluminum and are generally V-shaped in cross-sections with the apex **31***c* at the front, one horizontal end **31***a* and one flange **31***b* sloping downwardly and rearwardly.

Adjacent the entrance of each of the receiver shelves are mounted deflector units. Each of the deflector units includes a transverse shaft **16** extending the width of and journalled in the respective ends of the distributor frame **17** for rotation about its axis. On each shaft are secured spaced fingers **18**. Each of the fingers has a forwardly extending surface **18***a* depicting a partial circumference of a circle which, in the deflecting position deflects sheets **15** moving downwardly along the conveyor tape **11** into the shelf associated with and adjacent to the deflector unit. The deflector fingers are mounted so as to rock between a deflecting position shown in solid lines in FIGS. **4** to **7**. In the non-deflecting position the sheets moving down the conveyor tape **11** by-pass the deflector unit. The deflector fingers are mounted on shaft **16** such that, on impact of the moving sheet against the upper surface **18***a* of the deflector fingers in the deflecting position the momentum imparted by the sheets striking the upper surface **18***a* overcomes the inertia of the finger unit and sets it in clockwise motion. Once initial motion of the deflector finger unit toward the non-deflecting position occurs, the deflector finger unit is assisted in its movement to the non-deflecting position by a positive force acting on the unit. This may be accomplished in a number of ways as shown in FIGS. **1, 2** and **4** to **7**, including magnetic catch means (FIGS. **1** and **2**), an over-center air cam (FIG. **4**), an over-center spring (FIG. **5**), an over-center elastomeric band (FIG. **6**), or over-center weight. The deflector fingers of each unit are adjusted so that the moving sheets striking them are diverted into the bin or shelf associated therewith before the deflector unit moves to the non-deflecting position.

FIGS. **1** and **2** illustrate the use of magnetic catch means to provide a positive force assisting movement by the deflector unit to the non-deflecting position. In the embodiment shown a magnet **19** is mounted above and forward of the shaft **16** of each deflector unit. A paired magnet **20** is secured to the shaft **16** as shown in FIGS. **1** and **2** so that, in the deflecting position, the opposite poles **19***a* and **20***a* of the magnets **19** and **20** are sufficiently far apart that there is minimal attraction. On impact of the moving sheet against the deflector fingers of the deflector unit the deflecting fingers move clockwise bringing the pole **20***a* of magnet **20** closer to pole **19***a* of magnet **19** so that the force of attraction between the magnets provides a positive assist to continue the movement of the deflector unit to the non-deflecting position as illustrated by FIG. **2**. The units are held in the non-deflecting position by magnetic attraction of magnets **19** and **20**.

An over-center air cam is illustrated in FIG. **4**. An air conduit **23** provided with spaced nozzles **22** directs pressurized air or other gas against the undersurface of one or more of the deflecting fingers **18** of each deflector unit. The undersurface of the deflecting finger **18** is provided with a surface **21***a* which, relative to the upper surface of the finger slopes downwardly from a point about midway from the leading edge and joins at apex **21***b* an upwardly and rearwardly sloping surface **21***c*. In the deflecting position shown in solid lines in FIG. **4** pressurized gas exiting through nozzle **22** impinges against surface **21***a* with sufficient force to hold the deflector unit in the deflecting position. The force exerted against surface **21***a* is adjusted so that, on impingement of a moving sheet against the upper surface of the deflecting fingers of the unit the momentum imparted to the unit is sufficient to move the apex **21***b* of the deflecting finger or fingers past the stream of pressurized gas so that the gas then impinges against surface **21***b* and provides a positive force to continue movement of the deflecting fingers of the unit to the non-deflecting position as illustrated by the dotted lines in FIG. **4**.

In FIG. **5** one or more of the deflector fingers of each deflector unit has a spring **24** secured between a transverse member **25** and the rear surface of a deflector finger **18**. The spring is mounted such that, when the deflector finger unit is in the deflecting position shown in FIG. **5** in solid lines the spring aids in retaining the unit. However, on impact of a moving sheet of paper against the upper surface **18**a of the deflector fingers of the unit the deflector fingers and shaft move clockwise an amount such that the spring **24** provides a positive force continuing movement of the deflector finger unit to the non-deflecting position shown in dotted lines. The size of the spring for the size and weight of paper to be used can be determined by one skilled in the art.

In FIG. **6** an elastomeric band **27** is secured between a crank **28** on the end of shaft **16** and a pin **29** secured to the frame **17** to provide a positive assist to continue movement of the unit to the non-deflecting position. Once movement of the deflector finger unit is started by impact of a moving sheet thereagainst the elastomeric band exerts a positive force on shaft **16** to rotate it to the position shown in dotted lines.

In FIG. **7** a weight **37** is secured to the rear of one or more of the deflector fingers of each deflector unit in a position such that, on initial movement of the deflector finger unit toward the non-deflecting position the center of gravity of the deflector unit is sufficiently changed to provide a positive force to continue movement of the deflector finger unit to the non-deflecting position shown in dotted lines.

The deflector finger units are reset from the non-deflecting position to the deflecting position by a reset mechanism, one embodiment of which is illustrated in FIGS. **1** and **3**. The reset mechanism illustrated com-

prises a vertical shaft **34** to which are secured at right angles L-shaped members **35.** These members are secured at spaced intervals to the shaft such that when the shaft **16** of each of the deflector units is rotated clockwise to rotate the deflector fingers to the non-deflecting position, the crank end of the shaft **16***a* as illustrated in FIG. **1** contacts the underside of the L-shaped member as shown in FIG. **3** in dotted lines. When the vertical shaft is pulled down the respective shafts **16** of each of the deflector finger units is rotated counterclockwise to reposition the deflector fingers of each unit in the deflecting position. Resetting the deflector finger units may be accomplished manually or automatically. If automatic operation is desired a sensing mechanism is disposed near the lower one of the shelves in the path of the sheet moving into the last shelf to sense when the last of the deflector finger units has been moved to the non-deflecting position. Once this is sensed the sensor operates a solenoid mechanism or other mechanical or electrical mechanism to reset the deflecting finger units to their deflecting position for the next cycle. As shown in FIG. **1** the L-shaped members are rotatable in a horizontal plane about the axis of shaft **34** so that predetermined ones of the receiver trays may be by-passed.

The embodiments of the invention in which a particular property or privilege is claimed are defined as follows:

1. A sheet sorting device for delivering sheets in succession to a plurality of spaced receiver stations comprising;

a conveyor for moving sheets in succession along a course opposite the receiver stations,

deflector units opposite each receiver station and adjacent the conveyor, each deflector unit having at least one deflector finger carried thereby,

means mounting each deflector unit for movement of its deflector finger between a first deflecting position in the path of the moving sheets being conveyed along the conveyor to deflect a moving sheet into the receiver station associated therewith and a second non-deflecting position permitting a subsequent moving sheet to bypass the receiver station and strike the deflector finger of the deflector unit of the successive station, said mounting means mounting the deflector units such that, upon impact of a moving sheet against the associated deflector fingers, sufficient momentum is imparted thereto to initiate movement thereof to the second position,

assist means associated with each of the deflector units providing a positive force to assist movement of the associated deflector finger from the deflecting to the non-deflecting position only after initial impact and movement of the deflector unit caused by impact of the moving sheet and

reset means to reset selected ones of said deflector units from the non-deflecting position to the deflecting position.

2. The sheet sorting device of claim **1** wherein the assist means includes means directing a pressurized gas to the underside of one or more deflector fingers of the deflector unit, the undersurface of the finger against which the gas is impinged having a configuration such that, in the deflecting position the gas provides a positive force against the finger to retain it in the deflecting position and on impact of a moving sheet causing rotation of the deflector unit, the air provides a positive force to continue movement of the unit to the non-deflecting position.

3. The sheet sorting device of claim **1** wherein the assist means includes a weight mounted on one or more deflector fingers providing a positive force against the deflector finger to retain it in the deflecting position and, on impact of a moving sheet causing movement of the deflector unit toward the non-deflecting position providing a positive force to continue movement of the deflector unit to the non-deflecting position.

4. The sheet sorting device of claim **1** including; control means for operating said reset means, said control means including sensing means for sensing the passage of a sheet into a selected one of the stations and operatively connected to activate the reset means.

5. The sheet sorting device of claim **1** wherein said mounting means includes a frame and said deflector unit comprises a shaft rotatably mounted on the frame and extending essentially transverse to its associated receiver station, and a plurality of deflector fingers mounted at spaced intervals on the shaft.

6. The sheet sorting device of claim **5** wherein the assist means includes bias means connected between one or more of the deflector fingers of the deflector unit and the frame providing a positive force against the deflector finger to retain it in the deflecting position and, on impact of a moving sheet causing movement of the deflector unit toward the non-deflecting position, providing a positive force to continue movement of the deflector unit to the non-deflecting position.

7. The sheet sorting device of claim **5** wherein the assist means includes an elastomeric band extending between the frame and the shaft of the deflector unit providing a positive force against the deflector finger to retain it in the deflecting position and, on impact of a moving sheet causing movement of the deflector unit toward the non-deflecting position, providing a positive force to continue movement of the deflector unit to the non-deflecting position.

8. A sheet sorting device for deliverying sheets in succession to a plurality of spaced receiver stations comprising;

sheet conveyor means for moving sheets along a course of travel opposite said receiver station,

deflector units located in said course of travel associated with each receiver station,

mounting means mounting each deflector unit for movement between a deflecting position in the path of the moving sheets along the course of travel to deflect the sheets into the receiver station associated therewith and a second position away from the path of the moving sheets to permit passage thereof to a subsequent receiver station, means associated with said deflector units to provide a positive force assisting movement of the deflector unit from the deflecting position to the non-deflecting position only after the momentum of a moving sheet striking the deflector unit overcomes the inertia of the unit to start it moving to the non-deflecting position, and

means to reset selected ones of the deflector units from the non-deflecting position to the deflecting position.

9. A sheet sorting device for delivering sheets in succession to a plurality of spaced receiver stations comprising;

a conveyor for moving sheets in succession along a course opposite the receiver stations,

deflector units opposite each receiver station and adjacent the conveyor, each deflector unit comprising a rotatably mounted shaft extending essentially transverse to its associated receiver station, and a plurality of deflector fingers mounted at spaced intervals on the shaft,

mounting means including a frame rotatably mounting each said deflector units for movement of its deflector fingers between a first deflecting position in the path of the moving sheets being conveyed along the conveyor to deflect a moving sheet into the receiver station associated therewith and a second non-deflecting position permitting a subsequent moving sheet to bypass the receiver station and strike the deflector finger of the deflector unit of the successive station, said mounting means mounting the deflector units such that, upon impact of a moving sheet against the associated deflector fingers, sufficient momentum is imparted thereto to initiate movement thereof to the second position,

assist means comprising a first magnet mounted on the shaft and a second magnet mounted on said frame, said first and second magnets being located closely adjacent to each other with their poles of attraction a sufficient distance apart so as to be inoperative when the deflector fingers are in the deflecting position and spaced such that, on rotation of the deflector finger from the deflecting position toward the non-deflecting position caused by impact of the moving sheet against the deflector fingers, magnetic attraction provides a positive force to assist continued movement of the deflector fingers to the non-deflecting position,

reset means to reset selected ones of said deflector units from the non-deflecting position to the deflecting position, and

control means for operating said reset means, said control means including sensing means for sensing the passage of a sheet into a selected one of the stations and operatively connected to activate the reset means.

10. A sheet sorting device for delivering sheets in succession to a plurality of spaced receiver stations comprising;

a sheet conveyor means for moving sheets along a course of travel opposite said receiver sations,

deflector units located in said course of travel associated with each receiver station,

mounting means mounting each deflector unit for movement between a deflecting position in the path of the moving sheets along the course of travel to deflect the sheets into the receiver station associated therewith and a position away from the path of the moving sheets to permit passage thereof to a subsequent receiver station, said mounting means including magnetic means associated with each deflector unit and providing an attractive force sufficient to move the deflector unit to the non-deflecting position only after the momentum of a moving sheet striking the deflector unit overcomes the inertia of the unit, and means to reset selected ones of the deflector units from the non-deflecting position to the deflecting position.

11. The sheet sorting device of claim **10** including; control means for operating said reset means, said control means including sensing means for sensing the passage of a sheet into a selected one of the stations and operatively connected to activate the reset means.

12. In a sheet sorting device having conveyor means for moving sheets along a course of travel and delivering said sheets to a receiver station, sheet deflection means comprising;

a deflector unit located in said course of travel associated with said receiver station,

mounting means mounting said deflector unit for movement between a deflecting position in the path of the moving sheets to deflect a sheet into the receiver station associated therewith,

and a position away from the path of the moving sheets to permit passage thereof, magnetic means associated with said mounting means and said deflector unit and providing an attractive force sufficient to move the deflector unit to the nondeflecting position only after the momentum of a moving sheet overcomes the inertia of the unit.

13. In a sheet sorting device having conveyor means for moving sheets along a course of travel and delivering said sheets to a receiver station, sheet deflection means comprising;

a deflector unit located in said course of travel associated with said receiver station,

mounting means mounting said deflector unit for movement between a deflecting position in the path of the moving sheets to deflect a sheet into the receiver station associated therewith and a position away from the path of the moving sheets to permit passage thereof, means associated with said deflector unit to provide a positive force assisting movement to the deflector unit from the deflecting position to the non-deflecting position only after the momentum of a moving sheet striking the deflector unit overcomes the inertia of the unit to start it moving to the non-deflecting position.

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