Sept. 8, 1970 R. L. SWARTZ 3,527,456

ARTICLE DELIVERY AND SENSING FOR ARTICLE SORTING MACHINES

Filed May 21, 1968 2 Sheets-Sheet 1

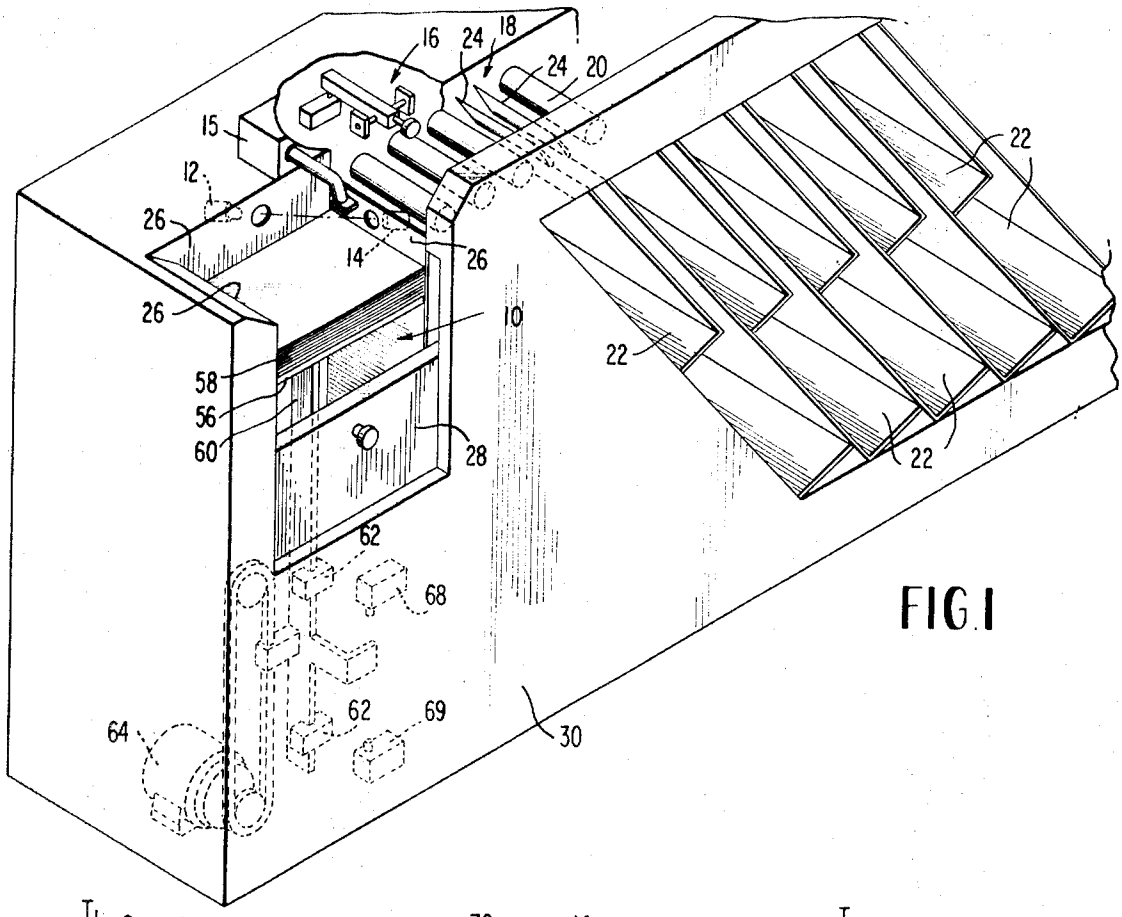


FIG. 1

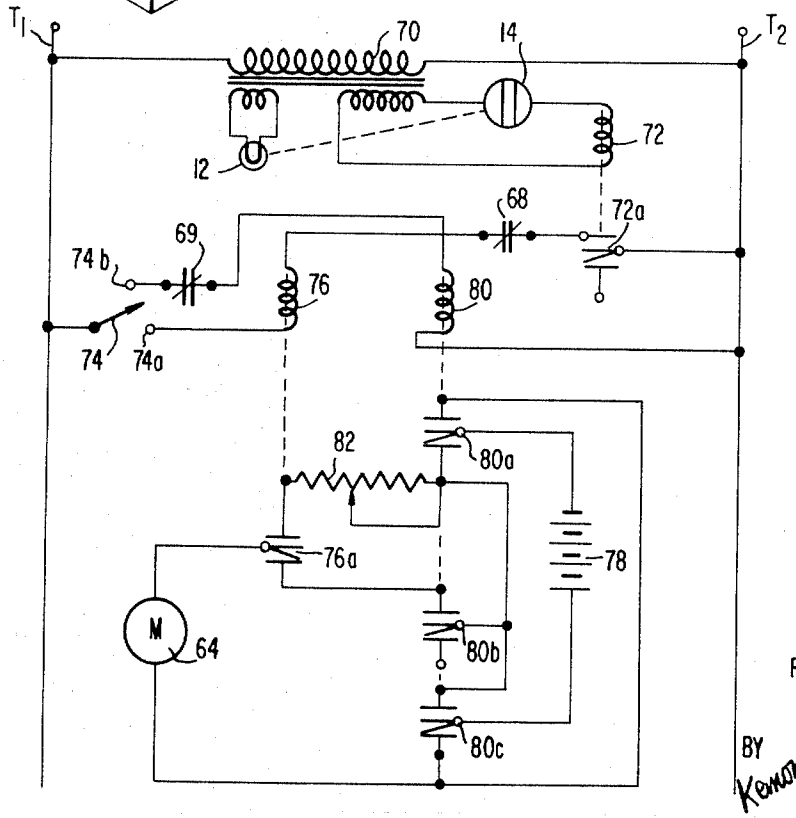


FIG. 3

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FIG. 2

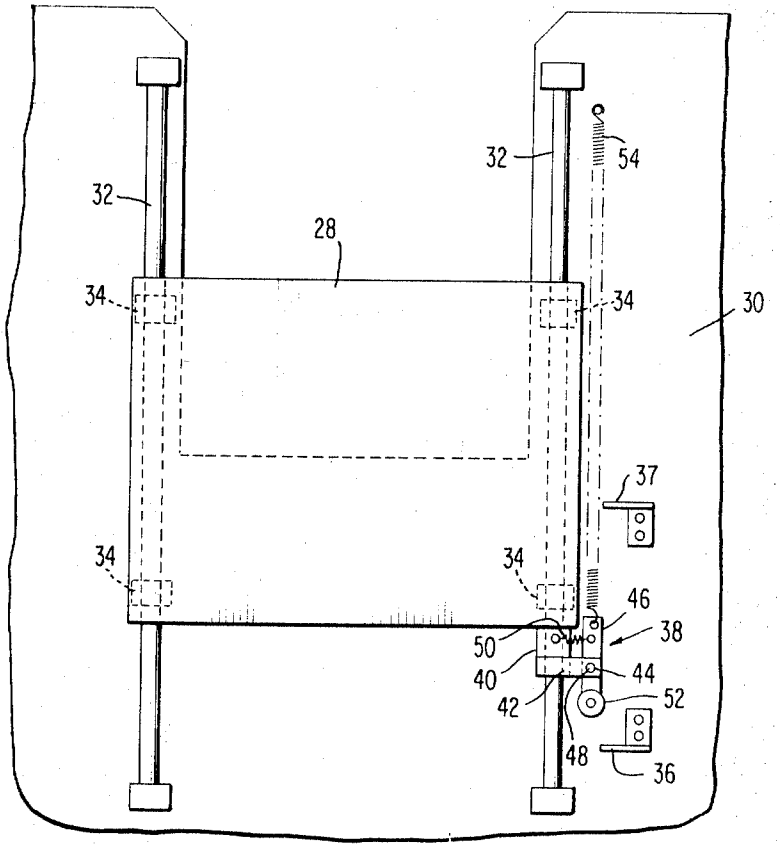
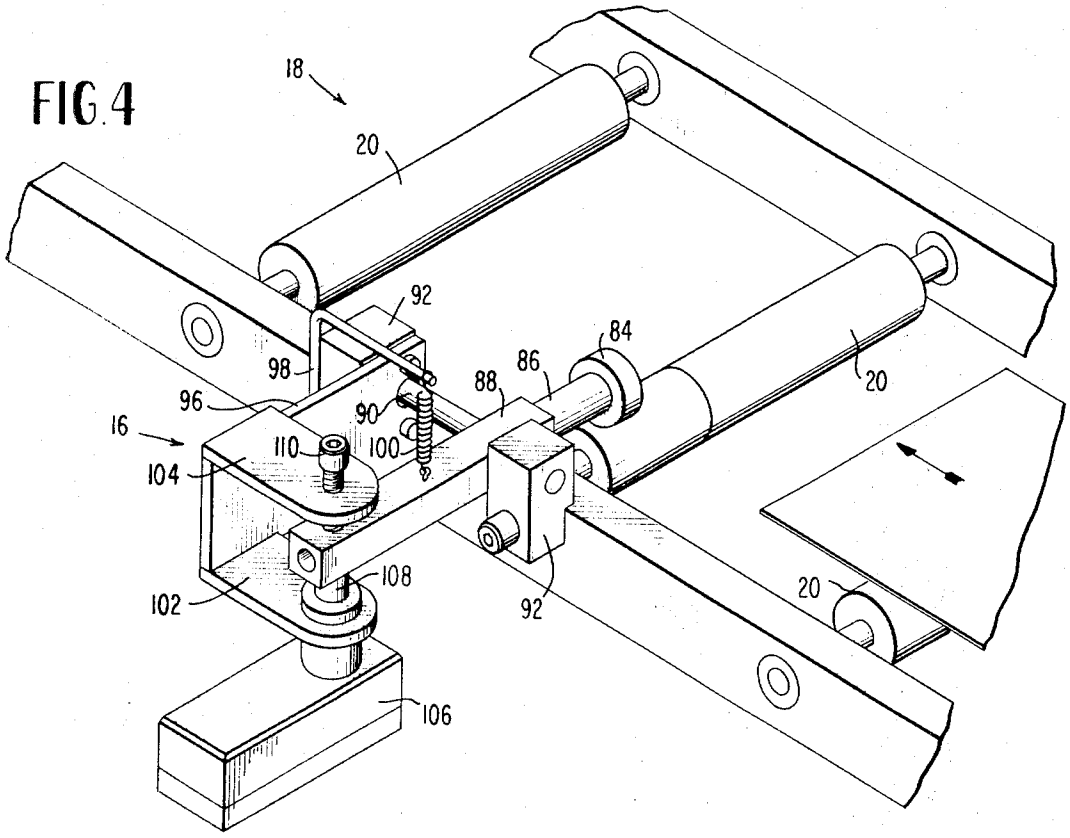


FIG. 4



United States Patent Office 3,527,456 Patented Sept. 8, 1970

3,527,456

ARTICLE DELIVERY AND SENSING FOR ARTICLE SORTING MACHINES

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U.S. Cl. 271—3 6 Claims

ABSTRACT OF THE DISCLOSURE

There is disclosed in the hereinafter specification improved means for delivering articles such as documents and the like to the conveying guideway of an article sorting machine. The said means include an improved article delivery station including an article delivery bin provided with a movable article guiding sidewall. Improved means are provided for detecting articles as they are brought to an article delivery position such that movement of an article supporting member within said bin is controlled. Finally, means are provided at or adjacent to said station for detecting articles as they are delivered such that a signal, alarm or the like is provided in the event that more than one article is delivered in a single delivery operation.

FIELD OF THE INVENTION

This invention relates to and is usable with high speed article sorting machines of the type used to sort a large volume of documents. The documents, e.g., letters, telephone toll cards, checks, and the like may be of the type bearing coded information. Coded information is used in conjunction with certain types of sorting machines for the purpose of distributing the documents to various selected receiving bins or pockets. Teachings of the general type of machine referred to may be found in U.S. Pats. No. 2,668,706, No. 2,707,569 and No. 3,288,038.

PRIOR ART

In general the type of machines referred to above are provided with a horizontal conveying guideway having a plurality of document receiving bins located therealong. In addition, a plurality of gate stations are also located along the guideway. The said gate stations include tiltable gates and are so arranged that the gates are effective to deflect documents moving on the guideway into receiving bins. In some types of machines documents are selectively placed in bins whereas in other types documents may be sequentially placed in the receiving bins.

Such machines are usually provided with means for feeding the documents to the conveying guideway, and in the usual case the document feed means is located at one end of the guideway; the said means, its associated apparatus and its general location relative to the machine will hereinafter be collectively referred to as the article delivery station of the machine. It will be understood that both the apparatus taught by the prior art and the embodiments of the present invention described below are located at the article delivery station. Further it will be understood that by referring to an article input station it is meant that the said station may either form a portion of a continuous machine structure or it can form a separate section that is attachable to and utilizable with the various types of machines referred to above.

In the prior art machines the article delivery station usually included a document delivery bin provided with four fixed sidewalls and a movable end wall. In order to load the delivery bin it was usually necessary to raise the movable end wall to a document loading position, place a stack of documents to be sorted on the end wall, and

then return the end wall to its initial position. After these preparatory operations were completed the machine operator could initiate a sorting operation.

For example, through the use of a keyboard the operator could cycle the end wall up to a document delivery position, i.e., a position wherein a suitable feed mechanism engages the documents and places them on the horizontal guideway or trackway. In the alternative, the end wall and documents supported thereon could be automatically raised to the feed position by employing a mechanical document sensor in conjunction with the feed mechanism.

Such sensors usually included a feeler arm positioned above the bin in such a manner that the stack of documents in being elevated for delivery engages the feeler to thereby cause power to be disconnected in such a manner as to stop the upward movement of the end wall. The uppermost documents were then fed to the guideway by the feeding mechanism for sorting. Tension was thereby removed from the feeler arm and power was thereby restored such that the end wall would rise in a stepping manner until the stack of documents again effected a power disconnect.

Examples of feeler arm mechanisms used with particular types of document feeding mechanisms may be found in U.S. Pats. No. 2,866,640 and No. 2,984,481.

Such sensing devices are complicated in operation in that it was necessary to move them during the document feed operation such that the feeding mechanism did not have to overcome the resistance of the sensor as the feeding mechanism removes a document from the stack. Too, because of the fixed sidewalls of the delivery bin if it became necessary for an operator to adjust the documents in the bin the operator could damage the sensor by reaching into the bin to adjust the documents. Finally, the feeler arm could and does obscure portions of the documents from the operator. If the portion of the document that is covered by the feeler carries a code the document would either be misdelivered or the operator would have to slow down the operation of the machine.

A further problem developed with prior art machines. It was found that the feed mechanism for various reasons occasionally would place more than one document at a time on the guideway. This problem might especially occur with very thin documents, i.e., documents having a thickness on the order of 7 mils. Under such circumstances documents could be and were misdelivered to the document receiving bins.

SUMMARY OF THE INVENTION

Accordingly, in order to achieve high speed processing of a wide variety of documents, it was necessary to overcome the deficiencies of the machines of the prior art by providing an improved document delivery bin for receiving and storing the documents until the start of a sorting operation which bin would also operate as a document guide during sorting; by providing an improved system for controlling the presentation of the documents to the feeding mechanism; and by providing apparatus for determining that only one document at a time is being fed onto the machine's guideway for sorting.

It is therefore a primary object of this invention to provide a novel and useful article delivery station for article sorting machines of the kind hereinbefore referred to.

It is an object of this invention to provide a new and novel article delivery station provided with improved means for delivering documents and the like to the conveying guideway of an article sorting machine to thereby improve the operating features and speed of document sorting of such a machine.

It is an additional object of this invention to provide

a novel delivery bin structure as part of an article delivery station of or usable with an article sorting machine.

It is a further object of this invention to provide an improved system for controlling the movement of articles within an article delivery bin such that they are smoothly and rapidly brought to an article delivery position for feeding to the guideway of an article sorting machine.

It is another object of this invention to provide a novel article detecting mechanism for determining whether more than one document has been placed on the conveying guideway of an article sorting machine during a single feeding operation.

These and other objects of this invention will be apparent from the following detailed description when read in conjunction with the drawings in which:

FIG. 1 is a partial perspective view of an article sorting machine provided with the novel article delivery station;

FIG. 2 is a rear view of a movable sidewall employed in an article delivery bin shown in FIG. 1;

FIG. 3 is a wiring diagram showing the control power source used in conjunction with an improved document sensor; and

FIG. 4 is a view of an article detector apparatus for determining whether more than one document has been placed on the guideway in a single feeding operation.

Referring now to FIG. 1 of the drawings, an article delivery station comprising an article delivery and guide bin **10**, document delivery sensing detector **12, 14**, a document feed mechanism **15** and a document detector **16** are shown located at one end of a horizontal conveying guideway **18**.

The guideway comprises, as in the usual case, a plurality of driven rollers **20** for conveying documents on the guideway to any of several document receiving bins **22** located along and beneath the guideway. A pair of tiltable gates **24** is shown located in the guideway, and it is their function to deflect a document moving on the guideway downwards into an appropriate receiving bin **22**. It is understood that the sorting machine per se may be any of several types as heretofore mentioned, and it is for this reason that only a schematic representation of the guideway **18**, gates **24** and receiving bins **22** has been provided.

In general a document sorting machine of the type depicted in FIG. 1 must be provided with an article delivery and guide bin at the article delivery station which provides the machine operator with complete, fast and easy access to documents placed in the bin for a sorting operation. In order for the machine to be used at an optimum sorting rate the operator should have full and complete visibility of documents in the delivery bin **10**, and he should have unrestricted access to the bin in the event of malfunctions, jams, document tilt or distortion.

In the present invention these requirements are met in part by the unique construction of the delivery bin **10**. Referring to FIGS. 1 and 2 it will be seen that the bin **10** is provided with three fixed vertical sidewalls **26** and a vertically movable sidewall **28**. As shown in FIG. 1 the sidewalls **26** may in practice be portions of a unitary machine frame **30**, or the article delivery station may be a separate unit attachable to the machine frame. In the latter event the fixed sidewalls **26** can constitute a portion of a framework for the article delivery station.

The movable sidewall **28** is shown in a rear view in FIG. 2. As shown the wall **28** is mounted for vertical movement on a pair of guide rails **32** through the use of low friction guide bearings **34**. The bearings **34** may constitute Teflon (registered trademark) rings or they may be made out of other low friction materials. The wall **28** preferably is made out of a light strong material such as lightweight aluminum. In addition, the guide rails may be mounted internally of the wall **28**, or they may be fixed externally of the wall and supported by the frame **30** in any suitable manner, e.g., they may be affixed to mounting brackets which in turn are bolted or otherwise affixed to the frame **30**.

As shown in FIG. 2, a pair of lock bars **36** and **37** are bolted or otherwise affixed in vertical displacement to each other and to the frame **30**. The bars **36, 37** are mounted so as to cooperate with a locking mechanism **38** mounted on the wall **28** so as to move with the said wall. The locking mechanism **38** comprises an angle member attached to or forming a part of the wall **30** and having a short leg **40** and a long leg **42**. The leg **42** extends generally in the direction of the bars **36, 37** and is provided with a through hole **44**. A fulcrum member **46** is shown supported by the leg **42** by means of a bearing **48** located in the hole **44**. The member **46** is attached to the short leg **40** of the angle member by a spring **50** such that the member **46** may pivot against the spring **50** around the leg **42**. A roller bearing **52** or the like is rotatably attached to an end opposite the spring end of the member **46** and is positioned so as to engage the bars **36, 37** when the wall **28** is moved to either of two positions. Finally, a spring balance **54** is supported on one end by the machine frame **30** and is attached on its other end to the member **46** such that when the wall **28** is moved vertically downwards it moves against the spring balance but such movement is aided by the weight of the wall. Conversely, when the wall is moved upward the spring balance acts to aid such movement.

In operation the machine operator may quickly and easily lower the wall **28** in order to load documents for a delivery operation or to clear and straighten tilted documents, clear jams and the like. During sorting, the operator can lift the wall **28** such that it in cooperation with the walls **26** provides guides for the documents as they are raised in the bin. It should be noted that the wall **28** when in the down or load position will also provide a partial guide surface.

Referring back to FIG. 1, it will be noticed that the bin **10** is provided with a movable end wall **56** for supporting documents **58**. The wall **56** is in turn supported by a stem **60** where the stem is moved vertically in guide members **62** through a power take-off from an electric motor **64**. As shown, the stem **60** is provided with a switch operator **66** for operating a pair of limit switches **68** and **69**. The switches **68** and **69** constitute up limit and down limit switches respectively and when operated cut power to the motor such that movement of the stem **60** and hence wall **56** is stopped. In the usual operation the walls **28** and **56** are lowered for document loading. During document feeding and sorting the end wall **56** is automatically raised by a photoelectric document sensor **12, 14** cooperating electrically with the motor **64**.

The photoelectric sensor comprises a source of light **12** arranged to transmit a beam of light to a photocell **14**. The detector is so arranged that as the stack of documents **58** is moved vertically upwards in the bin **10** the uppermost documents will, when in position for feeding to the guideway **18**, break the light beam.

Referring now to FIG. 3 it will be noticed that the light source **12** and photocell **14** are electrically connected to an A.C. source T_1, T_2 by a step down transformer **70**. The photocell is connected in series with a relay **72** having contacts **72***a*. The circuit of FIG. 3 is shown de-energized. Thus, with light impinging on the photocell **14**, the contacts **72***a* reverse. Assuming it is desired to raise the stack of documents, a switch **74** is closed on up movement contacts **74***a* to complete a circuit from T_1 through a relay **76**, the normally closed up limit switch **68**, and the now reversed contacts **72***a* to T_2 thus energizing relay **76** and causing its contacts **76***a* to reverse. Power is now applied to the motor **64** from the positive terminal of a battery **78**, through contacts **80***c* of a de-energized relay **80**, the motor **64**, the reversed contacts **76***a*, a speed control resistor **82**, contacts **80***a* and to the negative terminal of the battery **78**. It is believed that it is unnecessary to trace the current path for a down movement of the end wall of the bin **10**.

As should be readily apparent from FIG. 3, when a document in the stack **58** interrupts the light beam the

relay **72** de-energizes returning its contacts **72***a* to the position shown in FIG. 3. This action in turn causes de-energization of the relay **76** which thereby returns its contacts **76***a* to thus break the series current path to the motor **64**. In this manner the movement of the end wall is rapidly stopped such that the uppermost documents in the stack **58** are in the proper position for being fed from the stack onto the guideway **18**. It should be apparent that this system provides improved sensing and a much more accurate control over the placement of documents in a delivery bin than was provided by the prior art mechanical sensor. And, the operator's field of vision for the document is unimpaired with the improved system thus allowing the operator to fully concentrate his attention on the coded portions of the document as he operates bin selector keys on a keyboard.

As has been stated heretofore, the feed mechanism may be any one of several different types. For example, it can be a vacuum system including a cup mounted for vertical and horizontal motion as shown in U.S. Pat. No. 2,984,-481. A feed mechanism of the type described in the patent is illustrated diagrammatically in FIG. 1 as the unit **15**; the details of the mechanism may be obtained from said U.S. patent. In such a system the pick-up and feed cup is operated in conjunction with the control system utilized to select and operate guideway gates **24**. Thus at a proper point in a feed cycle the cup moves downwards into contact with the uppermost document in the stack **58**, vacuum is applied, and the cup then picks up the document and carries it to the guideway. When the document is properly positioned relative to the guideway the vacuum is removed and the document is thereafter propelled down the guideway by the powered rollers **20**.

On occasion the feed mechanism picks up more than one document at a time during a single feeding operation of the types described above. This sort of malfunction is most likely to occur when the documents are very thin, e.g., when they have a thickness of approximately 0.007 inch. For obvious reasons a malfunction of this type is highly undesirable, e.g., it can result in the placement of documents in the wrong receiving bins. Also, because of the very high speed operation of the sorting machines, because of the thinness of the documents, and because of the discontinuity in document flow, i.e., an electronic analog might be a series of pulses, it is a very difficult problem to detect a malfunction of the type here referred to. Detectors used to determine variations in continuous flow machines are generally not sensitive enough to determine whether one or two documents have been placed on the guideway in a single feeding operation, in an article sorting machine.

A novel detector system **16** for quickly determining whether such a malfunction has occurred is shown in FIG. 4. Since it is the function of the detector system to determine whether more than one document has been placed on the guideway **18** in a single feeding operation it was determined that the measurement that should be made would be one of thickness, i.e., if two similar documents were inadvertently superimposed on each other the total thickness would be equal to twice that of a single document, e.g., 14 mils.

I therefore decided to mount two rollers such that any document placed on the guideway **18** has to pass through the rollers. As shown in FIG. 4 a thickness detector roller **84** is mounted on a shaft **86** such that the roller **84** is in direct and rolling contact with a driven roller **20** in the guideway **18**. The shaft **86** is journaled in a pivotable supporting member **88**.

The member **88** is mounted on a pivot shaft **90** extending transversely through the member **88**. The pivot shaft is supported for rotation in a pair of bearing housings **92** secured to a guideway rail **94**. The guideway rail is either supported by the machine frame **30** or it may be part of the said frame. A bracket **96** is secured to a bearing housing **92** such that it extends in the direction of the member **88**. A spring support bar **98** is secured to the bracket as by being welded thereto such that it extends over the member **88**. A spring **100** is attached to the bar **98** and the member **88** and it serves to hold the bar against the bearing surfaces in the bearing housings, i.e., it eliminates any clearance space in the bearing such that the roller will be able to immediately react to a document passing between the rollers **84** and **20**.

A pair of transversely extending tongues **102** and **104** are mounted opposite each other and on the extreme end of the bracket **96**. The lower tongue **102** is provided with a hole at its outer end for supporting a switch **106** which may be an electric switch such as a microswitch. The member **88** is pressed against an operating button **108** of the switch **106** by a set screw **110** mounted in a threaded hole located in the upper tongue **104**. Thus it will be apparent that the degree of document thickness corresponding to a malfunction in feed as defined above can be regulated by adjusting the screw **110** to thereby vary the pressure exerted on the switch button **108** by the member **88**.

If the article delivery station is supplying documents having an average thickness of 7 mils. to the guideway **18** then the pressure on the switch is adjusted to detect a thickness of 10–14 mils. Accordingly, if two documents are fed onto the guideway the angle through which the roller **84** and its supporting members **86** and **88** pivots is sufficient to operate the microswitch. The microswitch can be connected to perform any of a number of functions in the sorting machine's control circuits. For example, U.S. Pat. Nos. 3,021,509 and 3,259,238 disclose control circuits usable with certain types of article sorting machines. As explained in the said patents it is desirable on some occasions to cancel selecting signals used to select particular gates **24** (FIG. 1). It will be recalled that by selecting particular gates **24** the operator has thus selected particular document receiving bins. If a cancel signal is inserted at the control keyboard then either all previously selected gates are closed or in some cases all previously selected gates in a particular section of the guideway may be closed.

In the present invention the switch **106** can be connected into the control circuitry such that when it is operated it will provide a cancel signal to thereby effect a closing of all gates **24** such that the two or more documents that were improperly fed onto the guideway proceed down the guideway and are deposited in a reject bin. Obviously, the microswitch could be wired into the circuitry to perform other functions as alternatives to that explained above. For example, it may be used to light a warning lamp or it might be used to shut down the entire machine by performing a power disconnect operation.

In summary then what is provided by this invention is a new and novel article delivery station including a novel delivery and guiding bin for an article delivery machine, a novel sensing circuit and means for controlling the positioning of documents within said bin and a novel detector system for detecting feed malfunctions.

What is claimed is:

1. Apparatus for delivering articles to be sorted to an article sorting machine, the machine comprising a conveying guideway along the length of which are disposed a plurality of article receiving bins and a plurality of article deflecting gates for diverting articles on said guideway into said receiving bins, said apparatus comprising at least one article delivery station including:

at least one article delivery bin including three fixed sidewalls and a fourth sidewall, the fourth sidewall being movable relative to the said fixed sidewalls between an article guiding position and a bin access position, said article delivery bin further including a driven movable end wall for supporting and delivering articles to said guideway;

means positioned adjacent to said guideway and responsive to articles supported by said movable end

wall for controlling the position of said end wall within said bin;

means for removing individual articles from said bin and delivering same to said guideway; and

means for detecting and responding to a physical characteristic of articles delivered to tbe guideway and to provide an indication of a malfunction in the event that said article delivery means feeds more than one article at a time in one delivery operation.

2. Apparatus according to claim 1 wherein said fourth sidewall is mounted on guide rails for low friction movement between the two said positions, said fourth sidewall also being provided with spring balance means, and wherein locking means are provided for locking the said sidewall against movement in each of the said two positions.

3. Apparatus according to claim 1 wherein said means for controlling the position of said movable end wall comprises photoelectric means mounted so as to be responsive to said articles to thereby provide signals for controlling movement of said end wall.

4. Apparatus for delivering articles to be sorted to an article sorting machine, the machine comprising a conveying guideway along the length of which are disposed a plurality of article receiving bins and a plurality of article deflecting gates for diverting articles on said guideway into said receiving bins, said apparatus comprising at least one article delivery station including:

at least one article delivery bin, said bin including a plurality of sidewalls at least one of which is movable relative to the others, and a driven movable end wall for supporting and delivering articles to said guideway;

means positioned adjacent to said guideway and responsive to articles supported by said movable end wall for controlling the position of said end wall within said bin;

means for removing individual articles from said bin and delivering same to said guideway; and

means for detecting and responding to a physical characteristic of articles delivered to the guideway to provide an indication of a malfunction whenever the article delivery means feeds more than one article at a time in a delivery operation, the said responsive means including a pair of relatively adjustable rollers supported along said guideway such that an article moving down the guideway passes between the rollers, one of said rollers being pivotally mounted to effect energization of a switch upon being pivoted through a predetermined angle by articles passing down the guideway.

5. Apparatus for delivering articles to be sorted to an article sorting machine, the machine comprising a horizontal conveying guideway along the length of which are disposed a plurality of article receiving bins and a plurality of article deflecting gates for diverting articles on said guideway into said receiving bins; said apparatus including:

at least one article delivery station positioned at an article input portion of said guideway, said station including means for delivering individual articles one by one to said guideway; and

a multiple article detector mounted at the input portion of said guideway and including a roller located in the guideway, a pivotably mounted sensor member mounted such that an article on said guideway passes between said sensor and said roller, and means positioned adjacent to said sensor and operated thereby to provide a signal for indicating the presence of multiple articles delivered by said means for delivering individual articles during a single delivery operation.

6. Apparatus according to claim 5 wherein means are provided for adjusting the position of the sensor member relative to said roller.

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