This invention concerns an apparatus for handling sheets of flexible resilient material and more particularly concerns an apparatus for transferring a sheet of flexible resilient material being moved in a path of travel to a receiving compartment at the end of the path of travel.

In a document handling apparatus of the type described, for example, in United States Patent Number 3,108,694, "System for Collating Documents in Response to Indicia Appearing Thereon," issued October 29, 1963, by N. R. Crain et al. and assigned to the present assignee, flexible resilient documents, such as bank drafts, bearing indicia are transported in a path of travel past an indicia reading device and subsequently past a number of transferring stations. Normally the transferring stations operate to effect transfer of each document from this path of travel into a respective receiving compartment in accordance with the indicia on such document. However, occasionally a document may contain defective indicia or no indicia. This document is merely transported past all of the transferring stations to the end of the path of travel. Additionally, a transferring station may occasionally fail to transfer a document into its associated receiving compartment due to reasons such as the document not being properly located in the path of travel as the transferring station is operated. The document that was intended, but failed to be transferred, usually continues to be moved in the path of travel past the remainder of the transferring stations to the end of the path of travel. The time of arrival of the document at the end of the path of travel is generally unpredictable. Therefore, it is necessary that a means be provided for transferring into a last receiving compartment all documents that arrive at any time at the end of the path of travel.

Documents handled by apparatuses of the type described in the aforementioned patent are sheets of paper which are flexible and resilient.

The documents are advanced edgewise in the path of travel by being firmly supported and gripped along their length between a series of moving, opposed belts. However, at the end of the path of travel the document must be ejected directly from between the opposed belts and fully into the last receiving compartment. Thus as the document is driven into the last receiving compartment an increasing area of the moving document emerges from between the opposed supporting belts.

A serious problem is encountered when attempting to rapidly move a sheet of flexible resilient material edgewise if the forward edge is not supported. The forward edge of the moving sheet is deflected to one side or another by the force of the encountered air stream. The deflected side of the forward edge presents to the air stream additional sheet surface. The force of the air stream acting upon the additionally exposed surface of the moving sheet causes further deflecting aside of the sheet's forward edge. The overall effect may be a buckling or rolling up of the unsupported sheet as it moves in the path of travel. Therefore, in order to reliably transfer a document rapidly egressing from between opposed moving belts or other supporting devices into a receiving compartment, a means for resisting the forces of an air stream acting on the forward edge of the document must be provided.

When a document completely emerges from between opposed moving belts it generally has a short distance yet to travel before being firmly entered into the receiving compartment. The document must also be free to be urged laterally aside in order that the next succeeding document may be entered into the receiving compartment. Therefore a means must be provided for aiding complete depositing of a document into a receiving compartment as it emerges from between supporting moving belts and yet not interfere with stacking of succeeding documents entering into the receiving compartment.

Accordingly it is a principal object of the present invention to provide for an improved apparatus for transferring a document from a path of travel into a receiving compartment.

Another object of the present invention is to provide novel apparatus for moving edgewise a sheet of flexible resilient material in a path of travel.

Still another object of the present invention is to provide apparatus for resisting air stream forces acting on the forward area of a moving sheet of flexible resilient material.

It is yet another object of the present invention to provide an apparatus for moving an unsupported sheet of flexible resilient material across a space without difficulty.

The present invention in which the stated objects are realized comprises a deflecting device which curves or deflects each moving document to a configuration infusing longitudinal and lateral stiffness to the document as it emerges from between the opposed belts. Curving of the document, as previously described, causes resilient forces of the document to react with the deflecting device to urge the document into the receiving movement with the moving belt portion to further guide and aid movement of the document into the compartment.

The features of novelty that are considered characteristics of the invention are set forth with particularity in the appended claims. The organization and method of operation of the invention itself will best be understood from the following description when read in connection with the accompanying drawings in which:

FIGURE 1 is a simplified diagrammatic illustration of a document handling apparatus which utilizes the present invention.

FIGURE 2 is a perspective view of the present invention.

FIGURE 3 is a top elevational view of the present invention.

FIGURE 4 is a sectional view taken along line 4-4 of FIG. 5.

The apparatus of FIG. 1 is divided, for purposes of explanation, into several distinct sections; namely, from right to left in the figure, a document feeding section indicated generally by the reference numeral 10, a document reading section indicated generally by the reference numeral 11, a series of identical document transferring stations indicated generally by reference numerals 12a, 12b, and 12c and a terminal receiving section indicated generally by numeral 13.

Individual documents 14 contained in a supply hopper 15 are held in an upright position between a pusher plate 16 and a document feeding device 17. Upon receipt of a document feeding control signal from an external source (not shown) the feeding device accelerates the foremost document from the supply hopper toward the reading section 11 by a system of moving belts.

At the reading section 11 the accelerated document is transported at a constant speed past a symbol reading device 18 by being gripped by a system of moving belts. As the document moves past the reading device 18 the information contained thereon is sensed and converted to a corresponding series of electrical symbol signals. Symbol signals are transmitted to an external device (not shown) such as an electronic data processor or a
system shown in the previously mentioned N. R. Crain et al. patent. The external device interprets the symbol signals and in turn may transmit a decision signal to a temporary memory 19. The decision signal denotes the one of a plurality of receiving compartments 20a, 20b and 20c into which the document just read is to be deposited. The temporary memory 19 stores the decision signal until such time that it is to be utilized to operate one of the transferring stations 12a, 12b, or 12c.

After reading of the document it is advanced toward the one of the transferring stations 12a, 12b, and 12c, by being gripped between opposed moving belts 22a, 22b, and 22c, and 23a, 23b, 23c, and 23d.

The terminal receiving section 13, which includes the present invention, is provided with a special receiving compartment 26 into which all documents arriving at the receiving section 13 at any time are automatically and reliably transferred or deposited without control by memory 19.

Reference to FIGS. 2 and 3 illustrate that as a document advances into the section 13 it is supported by being gripped between a portion of a belt 22c and a portion of a belt 27. Belt 27 is wrapped around an approximately 180° of a cylindrical surfaced drum 28 which is rotatably supported on a base 34 of the section 13. The belt 27 is additionally held in position by pulleys 38, 51, 52, and 53. A tensioning pulley 54 is supported on a pivot support arm 55 that is biased by a spring 56 to urge pulley 54 to ride against a portion of belt 27. The biased pulley 54 thus takes up any slack in belt 27 and imparts a tension in the entire length of belt 27. Drum 28 is rotated at a constant angular speed (by means not shown) in a counterclockwise direction in order to drive belt 27 at a constant linear speed.

The special receiving compartment 26 into which the documents are to be deposited is located generally at the region outwardly of that portion of belt 27 contained between drum 28 and pulley 53.

A belt 29 is positioned around a series of rotatably supported pulleys 60, 61, 62, and 63 such that a portion of belt 29 is held against that portion of belt 27 that conforms to drum 28. Pulley 63 is positioned on a spring biased tensioning arm 68 so that pulley 63 imparts a tension in belt 29 and thereby firmly urges a portion of belt 29 against the opposed portion of belt 27. As a document emerges from between belts 27 and 29 the forward area of the document is gripped between belts 27 and 29. The document then follows the opposed portions of belts 27 and 29. Thus the movement of the document is changed from a right-to-left direction to a left-to-right direction. A change in direction of the moving document is not important to the present invention, but is provided in order to move the documents into the compartment 26, which is located on the same side of the document handling apparatus as are the receiving compartments 20a, 20b, and 20c.

The document emerges from between belts 27 and 29 at the point where belt 29 passes around pulley 60. As the forward area of the document emerges from between belts 27 and 29 the document moves or is advanced into the beginning of compartment 26. The forward or leading edge of the document must travel across compartment 26 to a point slightly to the right of pulley 53 before it is completely deposited in compartment 26. This distance or path of travel is greater than the length of the longest document that is to be deposited in the compartment 26. The distance separate pulley 60 from pulley 52, is however, slightly less than the length of the shortest document that is to be deposited in compartment 26. However, the distance of the path of travel of a document from pulley 60 to pulley 52 is considerably greater than the space that can be traversed by a rapidly moving unsupported document before air stream forces deflect the forward area of the unsupported document.

The present invention enables the document to cross this space without difficulty. Air stream forces are prevented from uncontrollably deflecting the forward area of the document in the present invention by providing means for controllably deflecting or curving the document as it travels between the support of the document so that the document is longitudinally stiffened. The deflecting means includes an upstanding support column 33 rigidly attached to base 34 at a point between pulleys 60 and 61. A guide or deflecting member 35 is attached to the column 33 and extends at an acute angle toward belt 27. The upper right hand corner of the guide 35 is bent inwardly across the top of belt 27 as illustrated more fully in FIG. 4. A second guide or deflecting member 36 is attached to the column 33 and extends at an acute angle toward belt 27. The lower right hand corner of the guide 36 is bent inwardly across the bottom of belt 27.

As the forward area of a document 39 emerges from between belts 27 and 29 an upper portion of the document's leading edge makes contact with the bent portion of guide 35 and at the same time a lower portion of the document's leading edge makes contact with the bent portion of guide 36. As the document continues its forward movement the upper and lower portion of the leading edge of the document 39 are deflected or curved to one side across respectively the top and bottom of belt 27. Since the flexible document is also resilient, the mid portion of the document's leading edge also tends to move to one side across the lower portion of belt 27. However, since belt 27 is directly adjacent the mid portion of the document's leading edge, the mid portion is restrained from being deflected.

The deflecting or curving of the top and bottom and restraining of the mid portion of the document's leading edge results in the leading edge being curved as clearly illustrated in FIG. 4. Curving of the document at its leading edge induces a similar curvature everywhere in the document rearwardly of the leading edge. However, the document is less curved rearwardly of the points where guides 35 and 36 directly contact the document. This is due to the fact that the resilient forces in the curved documents are increasingly able to straighten or flatten out the document.

As more of the document emerges from between belts 27 and 29 and moves forward in the path of travel toward the receiving compartment 26 an upper longitudinal area of the document and a lower longitudinal area of the document are thus moved past the respective guides 35 and 36. There will be a curvature induced in that area of the document forward of the guides 35 and 36. This curvature will depend upon the extent of curvature produced directly by the guides 35 and 36 plus the flattening effect of the natural resiliency of the document.

Deflecting devices other than bent guides 35 and 36 may be used to induce curvature of the document 39. For example, rods or wires extending from column 33 to a short distance across the top and bottom of belt 27 could be used equally as well, or for example, streams of air flowing transversely against the top and bottom portions of a document as it emerges from between belts 27 and 29 could be used.

Since substantially the entire document length that is forward of the receiving compartment 26 and is curved, the document is thus shaped to a configuration that stiffens it longitudinally and infuses resistance to forces acting substantially transversely to its surfaces tending to crumple or buckle the document. Hence the document is stiffened while traversing the space from guides 35 and 36 to, essentially, pulley 52 such that air stream forces acting on the forward edge of the document intending to force the document out of the path of travel are resisted.

The curvature induced in the document 39 by guides 35 and 36 sets up potential energy in the form of resilient forces tending to straighten or flatten the document. This potential energy is utilized in the present invention.
for aiding continued driving of the document into the receiving compartment 26. Since the resilient force in the document acting to straighten the document are acting against the stationary guides 35 and 36, a force concentrated along a longitudinal center line of the document and normal to the surface of the document will act in a direction forcing the document into firm frictional contact with moving belt 27. Thus resilient forces of the curved document considerably aid frictional engagement of the document with the moving belt 27. Engagement of the moving belt 27 with the document aids driving of the document forward. When the document is acted upon by the resilient forces acting in a portion of the right-hand area of backup plate 47 to be urged against that portion of belt 27 is thus lengthened and the path of travel of the belt is made slightly curved rather than straight. The extra length is obtained by a corresponding shortening of that portion of belt 27 contained between pulley 51 and 53. Shortening of the length of the belt 27 between pulleys 51 and 53 makes less curved that portion of the belt and causes tensioning pulley 54 to move with its pivot arm a short distance in the clockwise direction and against the biasing force of spring 56. Resilient forces of the curved document are thus balanced by additional biasing energy now stored by spring 56.

As the rearward edge of the moving document 39 passes completely past the guides 35 and 36 the biasing energy stored by spring 56 and the resilient forces of the curved document are now effective to cause the rearward area of the document to be flung away from contact with the moving belt 27. The resilient forces in the curved document are now effective to straighten or flatten the document. As the document flattens the upper and lower longitudinal areas, which were previously curved, move in a direction away from belt 27. In addition, the tension in the belt 27 causes its portion contained between drum 28 and pulleys 52 and 53 to elongate and move outward from its loop. Thus the tension in belt 27 acts against the longitudinal mid area of the document and aids movement of the document in a direction away from the belt 27.

Lateral document momentum continues to carry the document a short distance laterally away from belt 27.

The previously described features aid in straightening an unsupported document, moving in a path of travel, to be stiffened by lateral forces tending to deflect its leading edge in a direction lateral to the path of travel, a device for frictionally engaging only one surface of the document so stiffened with a moving driving belt, and a device for causing a document to be moved away from the frictionally engaging belt when the document has been substantially entered into the receiving compartment.

The special receiving compartment 26 includes several other features aiding efficient and firm depositing of documents therein. As illustrated in FIGS. 2 and 3 a guide plate support frame 49 is positioned at the right-hand side of the compartment 26 and extends from a point adjacent pulley 53 to the rear end of compartment 26. A guide plate support bushing 41 is slideably positioned over a bushing support rod 42 which is rigidly held in a horizontal position in the support frame 43 and extends from a point adjacent support rod 42 and positioned between the rearward end of frame 40 and bushing 41 biases the bushing in the forward direction. A guide plate support arm 44 is attached to bushing 41 and extends leftward across most of the width of compartment 26. A flat surfaced backup plate 47 is attached to arm 44 and is parallel with that portion of belt 27 that runs between pulleys 52 and pulley 53. With no documents deposited within compartment 26 the force of biasing spring 43 causes a portion of the right-hand area of backup plate 47 to be urged against that portion of belt 27 between pulleys 52 and 53 with a very small force. As a document is transferred into the receiving compartment 26 as previously described, the leading edge of that document is gripped between belt 27 and the surface of guide plate 47, and is transported toward the extreme right end of the receiving compartment 26. Thus the document is actively engaged with belt 27 even though the rearward edge of that document has been transported past guides 35 and 36. The leading edge of the document continues to be transported toward the right until the leading edge emerges from between pulley 53 and plate 47 and makes contact with frame 40. The distance separating that emergent point just mentioned and frame 40 is short enough that the natural resiliency of the document prevents its crumbling or buckling. The document thereupon halts in the compartment 26. The frictional engagement between belt 27 and the deposited document is low enough that the moving belt 27 morely slides over the surface of the deposited document without causing buckling or crumbling of the document.

Directly below the left hand end of support arm 44 is located a document edge support trough 45. The trough 45 is a groove in the base 34 that extends from the rearward end of compartment 26 to a considerable distance forward of the compartment 26. A document edge support band 46 which is generally of a thickness slightly greater than the depth of trough 45 is attached to the left hand end of support arm 44 and rests within trough 45. As the document enters the receiving compartment 26 the backup plate 47 is urged rearwardly to make room for that document. Since the forward area of the document is in contact with and conforms to the right-hand surface of backup plate 47 the natural resiliency of the document tends to flatten the entire document such that the rearward area of the document conforms to the left-hand area of backup plate 47. Thus the bottom edge of the left-hand portion of the document now deposited within the compartment 26 rests upon support band 46. As another document is deposited in receiving compartment 26 it merely slides against the previously deposited document in a manner as described above when depositing the first document in the receiving compartment 26. When a succeeding document is deposited in the compartment 26 thereby causing further rearward movement of backup plate 47, the left-hand edge of those documents already deposited in the compartment are actively urged rearwardly thereby losing contact with the rearwardly moved band 46. Thus band 46 prevents dragging of the rearward ends of deposited documents on the stationary base 34.

While the principles of the invention have been made clear in the illustrative embodiments, there will be obvious to those skilled in the art, many modifications in structure, arrangement, proportions, the elements, materials, and components, used in the practice of the invention, and otherwise, which are adapted for specific environments and operating requirements, without departing from these principles. The appended claims are therefore intended to cover and embrace any such modifications within the limits only of the true spirit and scope of the invention.

What is claimed is:

1. An apparatus for handling sheets of flexible resilient material, said apparatus comprising: a sheet receiving and storing compartment; a moving endless belt; a supply means; a portion of said endless belt, extending from said supply means to said compartment, for transporting ones of said sheets into said compartment; said supply means sequentially delivering said sheets to said portion of said endless belt; deflecting members for curving said sheets about said endless belt to a configuration infusing transverse stiffness to said sheets; said deflecting members acting with resilient forces in said sheets thereby curved to urge one surface of said sheets into operative contact with said portion of said endless belt,
2. An apparatus for handling sheets of flexible resilient material, said apparatus comprising: a sheet receiving and storing compartment; a sheet supply means; a continuously driven endless belt; a portion of said endless belt extending from said supply means into said compartment, said portion engageable with a longitudinal area of one surface of said sheets for driving said sheets into said compartment when engaged therewith, said supply means furnishing single ones of said sheets to said portion of said endless belt; guide means for curving a first longitudinal area of said sheets over said belt and for curving a second longitudinal area under said belt; said guide means urging said sheets into operative engagement with said portion of said belt.

3. An apparatus for handling sheets of flexible resilient material, said apparatus comprising: a sheet receiving and storing compartment; a sheet supply means, a portion of a moving endless belt frictionally engageable with one surface of said sheets, said portion extending from said supply means to said compartment, said portion moving a sheet engaged therewith into said compartment; said supply means moving ones of said sheets in a path of travel adjacent said portion of said endless belt; stationary guides positioned across said path of travel for curving portions of said one sheet about said portion of said endless belt as said supply means moves said one sheet adjacent said portion of said endless belt.

4. An apparatus for handling sheets of flexible resilient material, said apparatus comprising: a receiving compartment; a supply means; a moving endless belt extending from said supply means substantially into said receiving compartment; sheet guiding means positioned between said supply means and said compartment, said guiding means and said belt defining a path of travel between said supply means and said compartment; said belt moving ones of said sheets in said path of travel; sheet curving means positioned between said supply means and said compartment, said curving means including members extending across said guiding means, said members contacting and curving said ones of said sheets about said endless belt as said ones of said sheets are moved in said path of travel.

5. An apparatus for handling sheets of flexible resilient material, said apparatus comprising: a receiving compartment; a supply means; a moving endless belt, a portion of said endless belt extending from said supply means to said compartment; said portion of said endless belt defining a path of travel between said portion of said belt and said compartment; said supply means moving ones of said sheets in said path of travel; sheet flexing members extending across said portion of said endless belt; said members contacting and flexing longitudinal areas of said ones of said sheets about said endless belt as said ones of said sheets are moved in said path of travel.

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