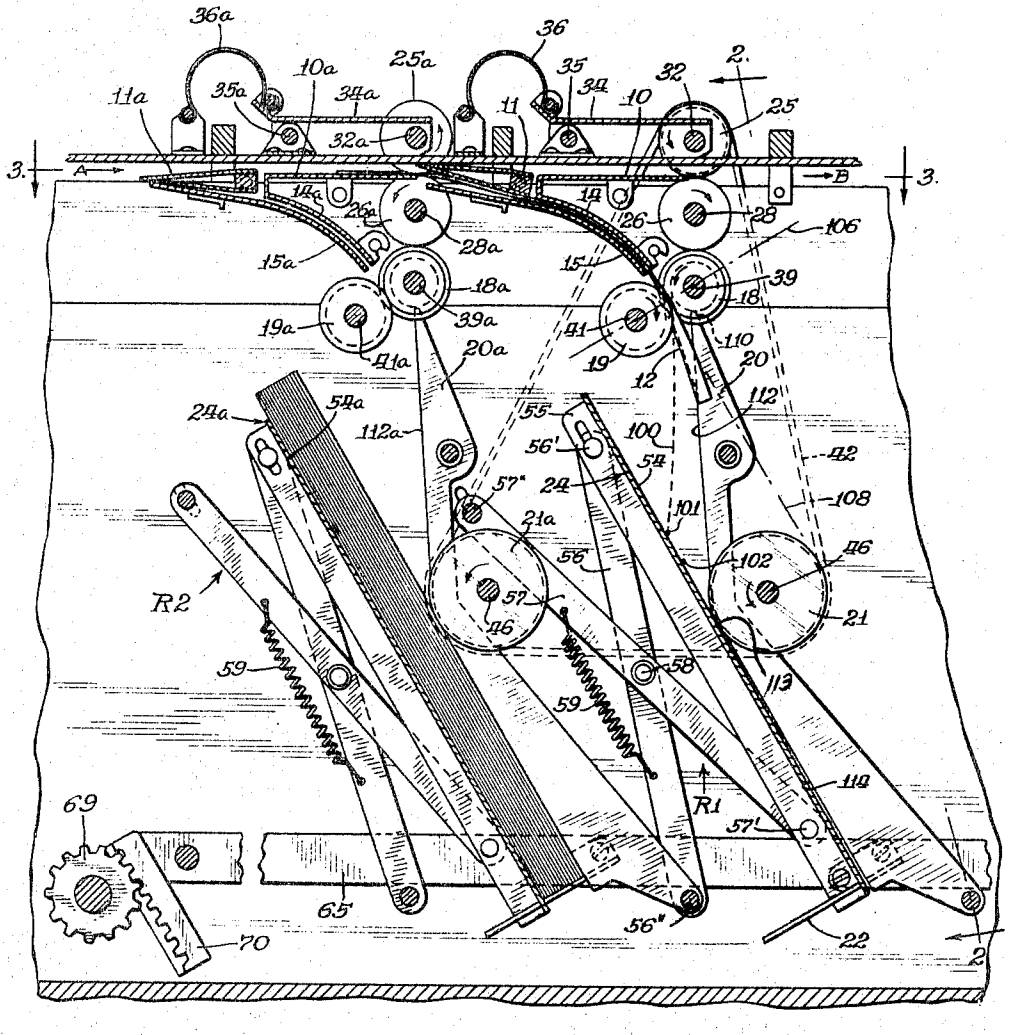
April 30, 1963 D. R. SNOWDON ETAL 3,087,724

DOCUMENT DELIVERY AND STACKING APPARATUS

Filed Sept. 15, 1960 3 Sheets-Sheet 1

Fig. 1.

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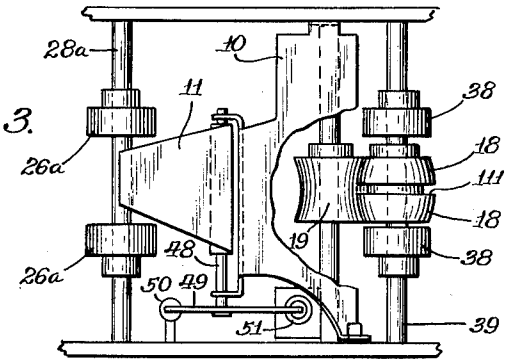
DOCUMENT DELIVERY AND STACKING APPARATUS

Filed Sept. 15, 1960 3 Sheets-Sheet 2

Fig. 3.



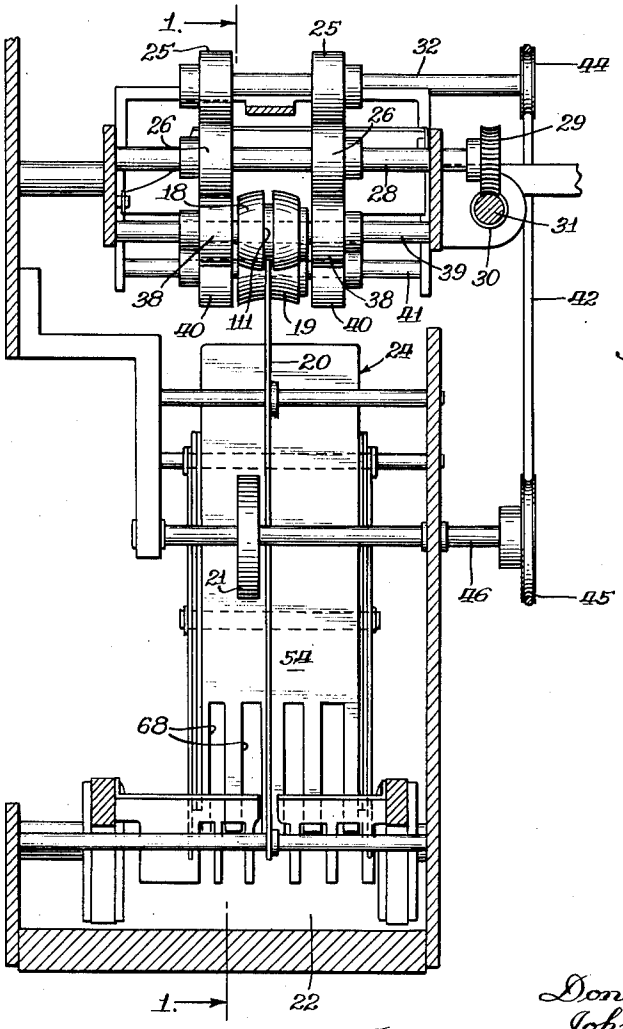




Fig. 2.

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Filed Sept. 15, 1960 3 Sheets-Sheet 3

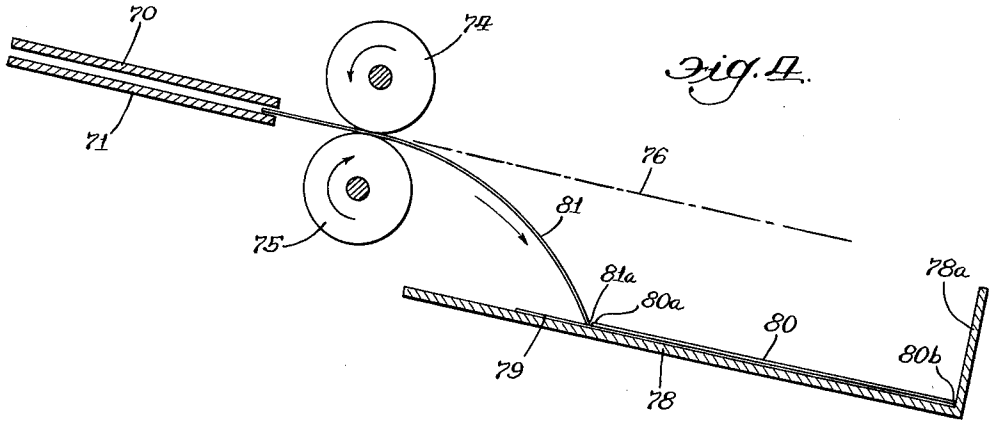


Fig. 4.

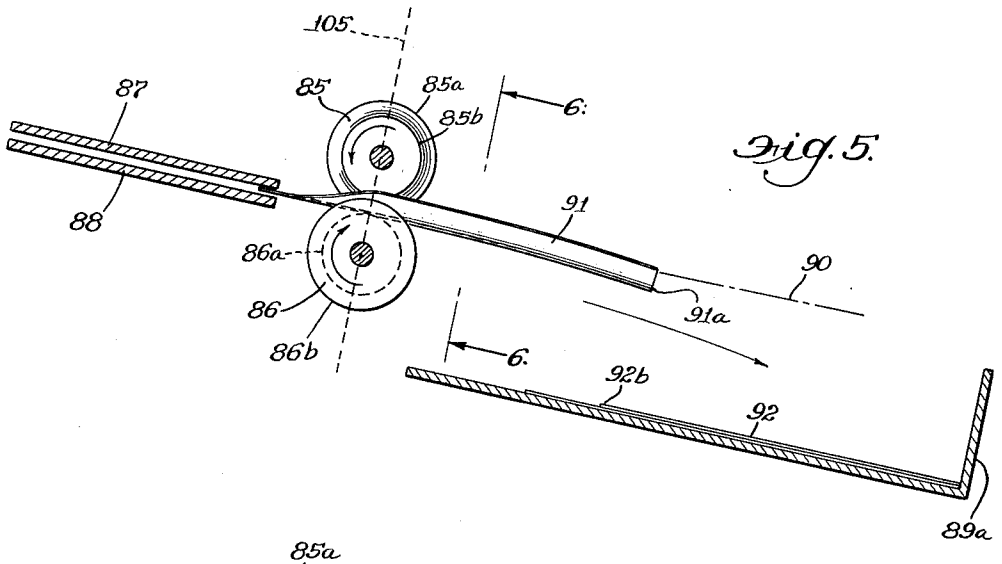


Fig. 5.

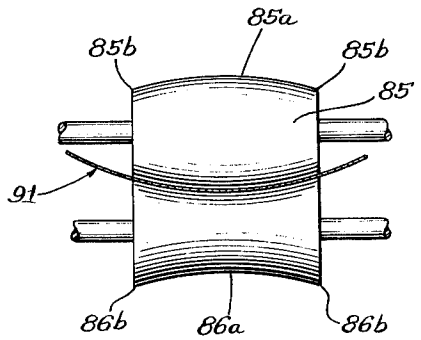


Fig. 6.

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United States Patent Office 3,087,724 Patented Apr. 30, 1963



3,087,724

# DOCUMENT DELIVERY AND STACKING APPARATUS

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7 Claims. (Cl. 271—71)

This invention relates in general to business machines such as sorters, collators, readers, and the like through which documents are successively fed. Such business machines are widely used in the handling of various commercial documents, e.g., bank checks, payment coupons, money orders and punched cards. The present invention is concerned more particularly with the delivery apparatus in which commercial documents are successively received and stacked after passing serially through a business machine of the type indicated.

The majority of business machines have in the past been constructed to operate on relatively stiff punched cards especially made for that purpose. These punched cards are purposely manufactured from materials and given such thickness that they are fairly stiff and inflexible. They can be fed and handled in business machines as if they were rigid, plate-like elements, thereby avoiding serious problems which have largely thwarted the automatic feeding and processing of more flexible paper documents. Yet, there has been a more recent demand that business machines accept standard commercial documents such as bank checks, charge slips, and the like to read and process printed, perforated, or magnetic ink indicia thereon. Such commercial documents, although made of a high quality paper, are, nevertheless, thin and very flexible, at least in comparison with the standard, well-known punched cards.

It is the general aim of the present invention to provide delivery apparatus for receiving and stacking relatively flexible paper documents, and characterized by the elimination of difficulties previously encountered due to the limpness or flexibility of such documents.

Another object of the invention is to assure that relatively flexible documents are stacked one on top of another in the order received by a relatively simple structural arrangement, and despite the fact that the documents may be of various lengths.

It is a further object of the invention to prevent "drooping" of flexible documents as they are fed into a delivery tray or hopper.

Still another object is to positively feed documents to a stacking roller in a delivery receiver by stiffening them with a transverse bow or curvature so as to eliminate drooping, and to affirmatively deflect such documents so that their leading edges engage the stacking roller.

Other objects and advantages will become apparent as the following description proceeds, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a vertical section, taken substantially along the line 1—1 in FIG. 2, showing a portion of a document sorter which employs improved delivery and stacking apparatus embodying the features of the present invention;

FIG. 2 is a front elevation, looking substantially along the line 2—2 in FIG. 1, and showing one delivery tray and the components associated therewith;

FIG. 3 is a detail view, taken substantially along the line 3—3 in FIG. 1, and showing a document diverter with feed rollers associated therewith.

FIG. 4 is a diagrammatic illustration which makes clear the problem of document drooping which exists when cylindrical feed rollers are employed in delivery apparatus;

FIG. 5 is a diagrammatic illustration, similar to FIG. 4, but showing the manner in which document drooping is inhibited by the present delivery apparatus; and

FIG. 6 is a detail view taken substantially along the line 6—6 in FIG. 5, and showing a particular shape or configuration of feed rollers.



While the invention has been shown and described in some detail with reference to a particular embodiment thereof, there is no intention that it thus be limited to such detail. On the contrary, it is intended here to cover all modifications, alternatives, and equivalents falling within the spirit and scope of the invention as defined by the appended claims.

To make clear the background environment of the invention, a preferred embodiment has been shown by way of example as employed in a document sorter, two of the receptacles or receivers R1 and R2 for sorted documents being illustrated in FIG. 1. Generally stated, a plurality of documents, such as bank checks, enter at point A and are transported lengthwise and in spaced succession along a horizontal path to the point B. This path is defined by spaced support plates **10**, **10***a* and diverters **11**, **11***a* the upper surfaces of the latter being normally coplanar with the upper surfaces of the plates **10**. Those documents which are to be sorted into the receivers R1 or R2 are turned downwardly from the normal path of travel by actuation or lifting of the appropriate diverter **11** or **11***a*. The diverter **11** is shown in FIG. 1 as raised to its actuated position.

Because the components associated with the two receivers R1 and R2 are identical, the description of the components associated with the receiver R1 will suffice for both, and the corresponding parts cooperating with the receiver R2 will be identified by the same reference characters to which the distinguishing suffix *a* is added.

The leading edge of a document **12** which strikes the raised diverter **11** is turned downwardly between two curved, spaced guide plates **14**, **15** which direct it into the bite of counter-rotating feed rollers **18**, **19**. These rollers transport the documents downwardly and to the right so that its leading edge strikes a deflector **20** and then moves into engagement with the periphery of a rotating stacking roller **21** which pulls the document downwardly until its leading edge hits a stop or floor **22**. The document is then held between the stacking roller and an inclined tray **24** which is mounted for yielding, retreating movement so that it shifts as the thickness of the received documents increases (compare the positions of trays **24** and **24***a*).

In somewhat greater detail, the documents which enter the sorting apparatus at point A are transported over the plates **10**, **10***a* and the lowered diverter **11**, **11***a* by upper and lower transport rolls **25** and **26** which are respectively rotated in counter-clockwise and clockwise directions. The lower transport rolls **26** are carried on a journaled shaft **28** (FIG. 2) which is driven by a worm wheel **29** meshed with a worm gear **30** formed on a shaft **31** powered from a motor (not shown). The upper transport rolls **25** are spaced apart on a shaft **32** journaled at one end of a bracket **34** which is pivoted at **35** and biased in a clockwise direction by a spring **36**. Thus, the upper transport rolls **25** are yieldably biased into running contact with the lower rolls **28**, and the latter thus drive the upper rolls in a counter-clockwise direction.

The upper and lower feed rollers **18** and **19** are respectively driven in counter-clockwise and clockwise directions. For this purpose, friction wheels **38** (FIG. 2) are mounted on a journaled shaft **39** which supports the upper feed roller **18**, and located to have driving contact with the lower transport rolls **26**. Thus the transport rolls **26** drive the upper feed roller **18** in a counter-clockwise direction as viewed in FIG. 1. Friction wheels **40** (FIG. 1), carried by a journaled shaft **41** which sup-

ports the lower feed roller **19**, have peripheral contact with the friction wheels **38**, so that the lower feed roller **19** is, in turn, driven in a clockwise direction as viewed in FIG. 1.

To drive the stacking rollers **21**, **21***a*, a belt **42** is trained over a pulley **44** on the shaft **32** (FIG. 2), and also over pulleys **45** mounted at the ends of shafts **46** which support the stacking rollers. Thus, as the lower transport roll **26** is driven clockwise, and in turn drives the upper roll **25** counter-clockwise, the latter causes the belt **42** to drive the stacking rollers **21**, **21***a* in a counter-clockwise direction.

The diverter **11** is triangular in cross-section (FIG. 1) and tapered (FIG. 3) so that its tip lies between the upstream transport rolls **26***a*. The diverter is rigidly mounted on a rock shaft **48** which carries a lever **49** engaged at its left end by a tension spring **50** and connected at its right end with the armature of a solenoid **51**. The spring **50** normally biases the diverter **11** to its lowered position so that documents may pass over as they come from the upstream transport rolls **26***a*. However, when the solenoid **51** is energized, it pulls the right end of the lever **49** downwardly (FIG. 3) and thus raises the diverter **11** to the actuated position shown in FIG. 1. The leading edges of documents moving to the right through transport rolls **25***a*, **26***a* will strike the underside of the raised diverter **11** so as to be deflected into the channel defined by the curved guide plates **14**, **15**. The solenoid **50** is energized at the proper instants to divert documents which are to be sorted into the receiver R1. Since the control means for energizing and deenergizing the solenoid **51** at the proper instants form no part of the present invention, they will not be further described. However, for a better understanding of the entire sorter and its operation, reference may be made to the copending application of James K. Duncan et al., Serial No. 56,293, filed September 15, 1960.

While the specific configuration and mounting of the receiving tray **24** may take a variety of forms, the tray here illustrated comprises simply a flat platform **54** having a flange **55** projecting from its underside. Crossed "scissors" links **56**, **57** which are pivoted together at **58** have their opposite extremities pivotally joined at **56'**, **57'** to the flange **55** and at **56''**, **57''** to the machine frame. The connections at **56'** and **57''** are made through elongated slots, so that as the links rock relative to one another about the center pivot **58** the tray **24** moves toward or away from the associated stacking roller **21** while remaining parallel to the plane in which it is originally disposed (compare the positions of the trays **24** and **24***a*). To yieldably bias the platform **54** toward the stacking rollers **21**, suitable spring means are employed, being here shown as a tension spring **59** connected between the left portions of the links **56**, **57**.

To form a stop or floor for documents which are moved successively onto the tray **24** and even though the latter shifts as the thickness of the received document stack increases, the floor piece **22** is rigidly fixed to a cross bar **65** in an inclined position such that it is at right angles to the platform **54**. The floor piece **22**, as shown in FIG. 2, is comb-like in configuration, having fingers or teeth which are slidably received in notches **68** formed in the lower portion of the platform **54**. This permits the platform **54** to shift away from the stacking roller **21**, so that the effective area of the floor **22** is increased as the thickness of the document stack increases. Moreover, the longitudinal bar **65** may be bodily moved in a direction paralleling the platform **54** by rotation of a pinion **69** engaged with the rack **70** fixed to the bar **65** so that the effective length of the receptacle is adjusted to receive documents of different lengths.

As successive documents are received from the feed rollers their leading edges are caught between the platform **54** and the rotating roller **21**, the latter urging the documents downwardly until their leading edges are



against the floor **22**. The tray **24** shifts rearwardly as successive documents are received while the stacking roller continues to have light rubbing contact, under the bias of the spring **59**, with the uppermost document. Thus, the documents are always fed into the stacking roller **21** and disposed in a plane substantially tangent to the roller **21**, despite the fact that the tray progressively shifts as the number of documents is increased.

The sorter and delivery apparatus as thus far described are intended to accommodate relatively flexible documents such as bank checks. It will be helpful at this point briefly to treat a problem which arises in the handling of such flexible documents. Referring to FIG. 4, document delivery apparatus is there diagrammatically shown as including guide means in the form of spaced plates **70**, **71** for feeding successive documents into the bite of counter-rotating feed rollers **74**, **75**. These feed rollers are assumed to have cylindrical surfaces which have running engagement or tangency in a plane **76**. A receiving tray **78** is disposed beneath and to the right of the rollers **74**, **75** so as to receive documents which are passed through the latter. The tray **78** has stop means in the form of an end flange **78***a* (corresponding to the floor **22**) to engage and aline the leading edges of documents which are received therein.

The flexible documents passed successively through the rollers **74**, **75** may have various lengths. For example, a first document **79** shown in the tray **78** is considerably longer than a second document **80**, the trailing edge **80***a* of the latter being spaced a relatively great distance from the feed rollers **74**, **75** when its leading edge **80***b* is abutted against the stop flange **78***a*. The leading portion of a flexible document **81** which has partially passed through the cylindrical feed rollers **74**, **75** tends to droop or curve longitudinally downward due to the influence of gravity and the flexible nature of the document. Its leading edge **81***a* thus might well strike the upper surface of the lower document **79**, i.e., to the left of the leading edge **80***a* of the short document **80**, so that further movement of the document **81** would result in its being shifted under, rather than on top of the short document **80**. As a result of this drooping, therefore, it is quite possible that the successive documents would not be stacked in the order received and, indeed, that they foul or jam in the tray **78**.

Simply to move the stop **78***a* closer to the feed rollers **74**, **75** does not obviate the problem even though this would result in the trailing edge **80***a* of a short document **80** being located much closer to the feed rollers. If that were done, the stop **78***a* would be so close to the feed rollers **74**, **75** that a relatively long document, such as shown at **79**, would not fall freely into the tray. Therefore, the drooping of flexible documents, illustrated by the downward curvature of the document **81** in FIG. 4 constitutes a serious problem where both long and short documents are to be received by delivery apparatus.

In accordance with the present invention, the difficulty discussed above is overcome by stiffening flexible documents while they are passing through feed rollers, so that they are inhibited from downward drooping and thus from catching under the edges of documents previously received in a tray. For this purpose, means are provided for imparting a transverse curvature or bow to documents while they are passing through feed rollers. As shown in FIGS. 5 and 6, the upper and lower feed rollers **85**, **86**, which receive successive documents passed through guide plates **87**, **88**, are formed with mating surfaces which are respectively curved to be convex and concave in a lengthwise or axial direction. That is, the upper feed roller **85** at a central point **85***a* on its surface has a larger diameter than its edges **85***b*, the surface of the roller being smoothly curved convex in an axial direction. Correspondingly, the lower feed roller **86** has lengthwise edges **86***b* which are greater in diameter than its central portion **86***a*, the roller surface being smoothly curved or concave

in an axial direction, and generally complemental to the convex surface of the roller **85**.

A receiver or tray **89** disposed on the output side of the feed rollers **85, 86** has a stop flange **89***a* to engage and aline the leading edges of documents. Although the mating rollers **85** and **86** are convex and concave, they may be considered for purposes of discussion to have a plane of tangency **90** defined by the point running contact at their lengthwise midpoints **85***a*, **86***a*, this being the path traveled by the lengthwise centerline of documents passing through the rollers. The tray **89** is disposed below the plane of tangency **90** and on the output side of the feed rollers **85, 86**.

As illustrated in FIGS. 5 and 6 a document **91** passing through the feed rollers **85, 86** is given a transverse curvature or bow so that its longitudinal edges are curved upwardly relative to its longitudinal centerline. Because of this curvature imparted to the document **91**, it is stiffened against bending in a lengthwise direction, i.e., it is inhibited against downward drooping such as is illustrated by the document **81** in FIG. 4. Thus, the leading edge **91***a* of the transversely bowed document **91** drops only slightly below the plane of tangency **90** as the document is passed almost completely through the convex, concave feed rollers **85, 86**. By this provision, therefore, the leading edge **91***a* of the document **91** will always fall on the upper surface of a previously received short document **92** having a trailing edge **92***b* which is spaced considerably from the feed rollers. There is no problem of the stiffened document **91** drooping to such a degree that its leading edge **91***a* would strike to the left of the trailing edge **92***b*, and thus slide under and perhaps foul the document **92**.

It will be apparent, therefore, that with the arrangement diagrammatically illustrated in FIG. 5 the stop means **89***a* may be considerably spaced from the feed rollers **85, 86** to receive documents which are relatively long. Yet, even if relatively short documents such as that shown at **92** are delivered to the tray **89**, the following documents cannot slide under such short documents because they are stiffened to eliminate the drooping characteristic which they would otherwise have.

The upper and lower feed rollers **18, 19** shown in FIGS. 1–3 are formed with mating surfaces which are curved in an axial direction, substantially as described in connection with the feed rollers **85** and **86** shown in FIGS. 5 and 6. That is, the feed roller **18** is convex in its surface configuration and the roller **19** is concave, as will be apparent from FIGS. 2 and 3. Since these feed rollers transversely bow and stiffen documents passing therethrough, there is little tendency for a document to droop downwardly into the position represented by the dashed line **100** in FIG. 1, and thus engage the platform **54** (or the uppermost document thereon) at a point **101** which is spaced considerably above the stacking roller **21**. If a document previously received on the platform **54** has its leading edge disposed at a point **102** when its trailing edge is seated on the floor **22**, then a flexible document which took the path represented by the line **100** would perhaps slip under the previously received document. As noted above, this difficulty is here obviated by the convex-concave curvature given to the surfaces of the mating, counter-rotating feed rollers **18, 19**.

The tendency of flexible documents to droop is, of course, caused by gravity acting on the unsupported leading portion thereof which has passed through mating feed rollers. If the feed rollers were spaced apart horizontally, i.e., their axes of rotation disposed on the horizontal line so that their plane of tangency were vertical, there would be no drooping tendency. However, it is impractical in most applications to receive and stack a plurality of documents in a vertical position. In practical designs of delivery and stacking apparatus, therefore, the delivery tray is inclined substantially from the vertical, and the feed rollers cooperating with that tray are disposed for rotation about axes which lie in a line which is inclined substantially from the horizontal.

As shown in FIG. 5, a line **105** joining the axes of the feed rollers **85, 86** is displaced from the horizontal by an angle of almost ninety degrees, so that the plane of tangency **90** is inclined downwardly only slightly from the horizontal, and the tray **89** is similarly inclined. In FIG. 1, the orientation of the corresponding parts is somewhat different than shown in FIG. 5, but the feed rollers **18** and **19** have their centers or rotational axes disposed on a line **106** which is inclined approximately forty-five degrees from the horizontal. Thus, the plane of tangency defined by the mating contact of the rollers **18, 19** and represented by the dashed line **108** in FIG. 1 is inclined from the vertical by about forty-five degrees, and the platform **54** of the tray **24** is similarly inclined. In either arrangement, i.e., FIG. 1 or FIG. 5, the tendency for flexible documents to droop downwardly because of gravity is present. But in both the arrangement of FIG. 1 and FIG. 5, this tendency is inhibited by the convex-concave mating rollers **18, 19** or **85, 86**. Although, as indicated, the particular angular disposition of the feed rollers is not critical, it can be stated as a general relationship that one of the feed rollers will always be higher than the other so that they can be characterized as upper and lower feed rollers.

In accordance with another feature of the present invention, means are provided not only to stiffen documents against drooping as they are fed into a receiving tray, but also to affirmatively deflect or artificially droop the documents so that their leading edges always strike the stacking plane at the same location. For this purpose, a document-directing element such as the deflector **20** is disposed between the plane of tangency **108** adjacent the feed rollers **18, 19** and the stacking plane which is defined by the platform **54** or the uppermost document thereon. Because the documents are transversely bowed as they pass through the rollers **18, 19** the deflector **20** is preferably thin (see FIG. 2) and disposed so that it makes contact generally along the longitudinal centerline of documents coming from the feed rollers. It is the left edge **112** of the deflector **20** which by its shape and orientation affirmatively deflects the documents in the desired manner.

It will be noted that the upper end of the deflector **20** angularly intersects the plane of tangency **108**, the tip **110** of the deflector being disposed in a radial groove **111** formed in the mid-portion of the upper roller **18** to assure that documents issuing from the feed rollers must strike the deflecting edge **112**. The edge **112** extends downwardly at an angle to the platform **54** and reaches the stacking plane just at the point **113** where the roller **21** is tangent thereto.

If the deflector **20**, or more properly its edge **112**, were not present, a document passing through the feed rollers **18, 19** would, due to the stiffening by transverse curvature, tend to continue along the plane of tangency **108** until its trailing edge was ejected from the rollers. It would thus not be engaged with the left side of the stacking roller **21**, nor urged by the latter against the floor **22**. While it is desired to prevent the leading edges of documents from drooping to the stacking plane at a point **101** displaced considerably above the stacking roll, it is nevertheless desirable to make the leading edges engage the stacking plane at or just above the point **113**.

Despite the fact that the transversely bowed and stiffened documents coming from the feed rollers **18, 19** tend to continue along the plane of tangency **108**, the deflector element **20** affirmatively bends those documents downwardly, that is, creates "artificial droop" or longitudinal curvature in the documents, so that their leading edges are always caught between the rotating stacking roller **21** and the platform **54** substantially at the point **113**. The documents cannot engage the platform **54** (or the uppermost document thereon) at a point appreciably

above the periphery of stacking roller **21**, and thus cannot slide under the trailing edges of previously received short documents. Yet, they always engage the stacking roller **54** so that it can urge them downwardly against the floor **22**. The combination of means for preventing droop by gravity forces and deflector means to simultaneously create the necessary degree of artificial droop for proper entry into the receiving tray thus assures that all of the documents will be affirmatively moved into the tray and yet stacked one on top of the other in the order in which they are received.

The deflectors **20** as shown in FIG. 1 serve still another function. Their lower portions include an edge **114** which is parallel to the associated platform **54** and substantially engage it with the latter when no documents have been received by that platform. This straight edge **114** formed on the deflectors **20**, therefore, serves as a retaining element which prevents the uppermost stacked document on the tray **54** from being buckled under the rubbing influence of the stacking roller **21**. The roller **21** continuously engages and frictionally biases the uppermost document downwardly against the floor of stop **22**, yet it cannot buckle that document because flexing of the latter is prevented by the edge **114** on the element **20**.

In the foregoing description reference has been made to feed rollers having running, mating contact, i.e., running tangent to one another. It will be understood by those skilled in the art that at least one of such tangent feed rollers is made or resilient, yieldable material so that it will deform sufficiently to let a document be pulled through. Alternatively, the shaft supporting at least one of a pair of feed rollers may be resiliently supported so that it can shift. Or, the two feed rollers can be spaced apart, so that they are not in actual running contact, by a distance slightly less than the thickness of the documents, thereby slightly but non-destructively compressing and gripping documents being passed therethrough. Any of these arrangements can be considered as involving rotating feed rollers which have substantially mating, tangent surfaces.

We claim as our invention:

1. In paper document delivery apparatus, the combination comprising a pair of mating feed rollers counter-rotating about spaced horizontal axes disposed on a line inclined from the horizontal, means for guiding documents successively between said rollers so that they are transported therethrough, a tray disposed on the ouput side of and below said feed rollers to receive documents passed through the latter, said feed rollers having mating surfaces which are curved respectively convexly and concavely in an axial direction to impart a transverse curvature to documents passing therethrough, thereby to stiffen the documents against downward drooping, and deflector means disposed on the output side of said rollers for engaging said transversely curved documents and imparting thereto a longitudinal curvature so that the leading edges of said transversely curved documents are deflected downwardly to a predetermined point on said tray.

2. In paper document delivery apparatus, the combination comprising a pair of counter-rotating feed rollers having running peripheral contact and turning about respective spaced horizontal axes which are spaced apart on a line inclined substantially from the horizontal, the input and output sides of said rollers being respectively those sides at which their mating surfaces turn inwardly and outwardly, means for guiding documents lengthwise so that their leading edges engage between said rollers at the input side, a tray disposed below and on the output side of said rollers, the uppermost and lowermost of said rollers respectively having longitudinally convex and concave surfaces so that documents passing therethrough are transversely bowed, whereby the leading edges of documents coming from said roller are inhibited from drooping onto said tray, and means adjacent the output side of said rollers for engaging the leading edge of each transversely bowed document and imparting to the document a longitudinal curvature so that the document is simultaneously bowed in both a transverse and longitudinal direction to insure that the leading edge thereof is affirmatively directed toward a predetermined point on said tray.

3. In delivery apparatus for receiving flexible documents, the combination comprising means for feeding documents successively and lengthwise with that portion of a document engaged with the feed means traveling along a plane inclined substantially from the vertical, means for imparting a transverse bow to documents passing through said feed means so that the leading portions of documents passed therethrough are inhibited from downward drooping, a receiving tray disposed on the output side of said feed means and below said plane, and means for intercepting the leading edges of documents coming from said feed means and deflecting them downwardly so that said documents are simultaneously bowed in both a transverse and a longitudinal direction to insure that the leading edges thereof are delivered to a predetermined point on said tray.

4. In delivery apparatus for receiving flexible documents, the combination comprising means including a delivery tray refining a stacking plane inclined from the vertical to which documents are to be successively delivered for stacking, stop means for engaging and alining the leading edges of documents delivered to said stacking plane, means spaced from said stop means and above said stacking plane for feeding documents successively therethrough, said feeding means including means for imparting a transverse bow to the documents while the latter are passing through the feed means, and means for intercepting the leading edges of documents coming from said feed means to impart to said documents a longitudinal curvature so that said documents are simultaneously bowed in both a transverse and longitudinal direction to insure that the leading edges thereof are deflected down to a predetermined point on said stacking plane.

5. In paper document delivery apparatus, the combination comprising upper and lower counter-rotating feed rollers having running peripheral contact defining a plane of tangency, means for guiding successive documents lengthwise along said plane and between said rollers so that they are transported therethrough, a tray disposed on the output side of said feed rollers and spaced below said plane of tangency, a stop for engaging and alining the leading edges of documents received in said tray, a rotating stacking roller spaced between said stop and said feed rollers with its edge adjacent a point on said tray to engage and urge documents against said stop, said upper and lower feed rollers respectively having concave and convex surfaces curved in the lengthwise direction thereof to transversely bow documents passing therethrough so that their leading edges are inhibited from drooping away from said plane of tangency, and means disposed in the path of transversely bowed documents coming from said feed rollers to intercept and deflect the leading edges downwardly so that said documents are simultaneously bowed in both a transverse and a longitudinal direction to insure that the leading edges thereof engage said tray substantially at said point adjacent the edge of said stacking roller.

6. In paper document delivery apparatus, the combination comprising upper and lower counter-rotating feed rollers having mating longitudinally concave and convex surfaces with running contact in a plane of tangency inclined from the vertical, means for feeding documents lengthwise successively between said rollers for transport therebetween so that said documents are transversely bowed, a tray disposed on the output side of said feed rollers and below said plane of tangency, means for engaging and stopping the leading edges of documents fed from said feed rollers into said tray, a stacking roller rotating in the same direction as said upper roller and spaced intermediate said feed rollers and said stopping means, said stacking roller normally having yieldable rubbing contact

with said tray to urge documents engaged therewith against said stopping means, means mounting said tray to resiliently shift away from said stacking roller as the thickness of documents interposed therebetween increases so that each document is received in a stacking plane, and a deflector disposed in the path of documents coming from said feed rolls and inclined relative to said plane of tangency to impart to said documents a longitudinal curvature so that said documents are simultaneously bowed in both a transverse and a longitudinal direction to insure that the leading edges of the documents are deflected downwardly to said stacking plane at a point adjacent said stacking roller.

7. Document delivery apparatus comprising, in combination, a pair of counter-rotating mating feed rollers having spaced horizontal axes disposed on a line inclined from the horizontal, the uppermost and lowermost of said rollers respectively having bowing surfaces which are convex and concave in a longitudinal direction, means for guiding documents lengthwise into the bite of said feed rollers, a tray disposed on the output side of said feed rollers and spaced below and substantially parallel to the plane of tangency defined by the axial midportions of such rollers, a rotating stacking roller normally having rubbing



contact with said tray at a predetermined point spaced from said feed rollers, means mounting said tray for movement away from said stacking roller, means for yieldably biasing said tray toward said stacking roller, and a thin, plate-like deflector having one edge extending between said plane of tangency at a point adjacent the output side of said feed rollers to said platform at said predetermined point, said deflector being located substantially opposite the axial midpoints of said feed rollers to intercept documents fed therethrough substantially along their longitudinal centerlines for imparting a longitudinal curvature thereto so that said documents are simultaneously bowed in both a transverse and longitudinal direction to insure that the leading edges thereof are delivered to a predetermined point on said tray.

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