

[54] **SWITCHING DEVICE FOR DELIVERING SHEET-LIKE ARTICLES**

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[51] Int. Cl.B07c 3/06

[58] Field of Search209/74; 271/64

[56] **References Cited**

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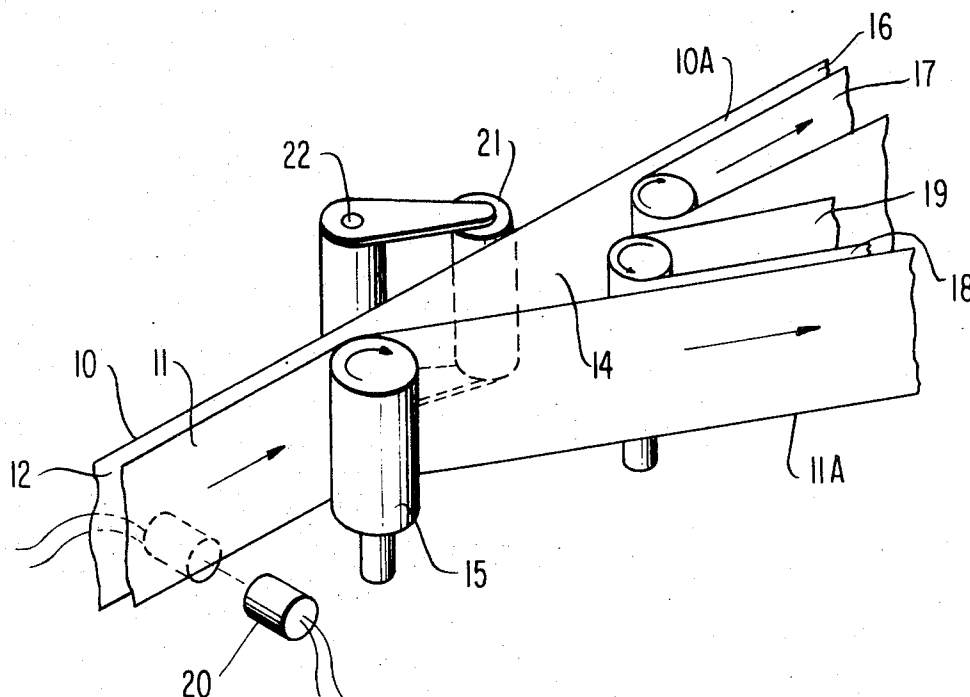
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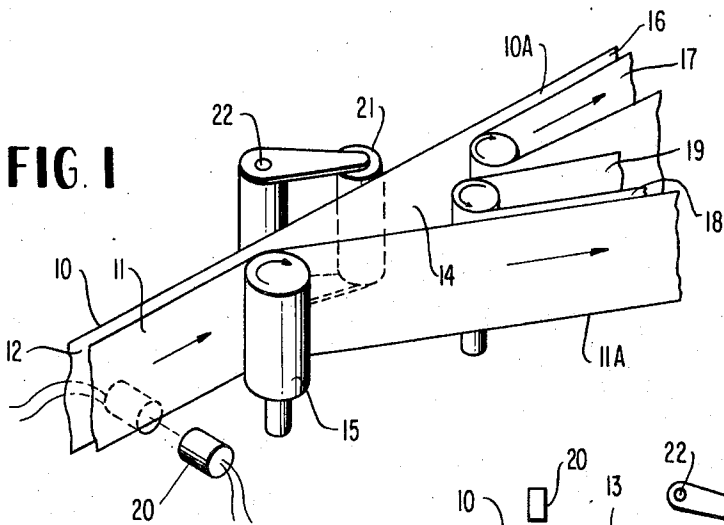
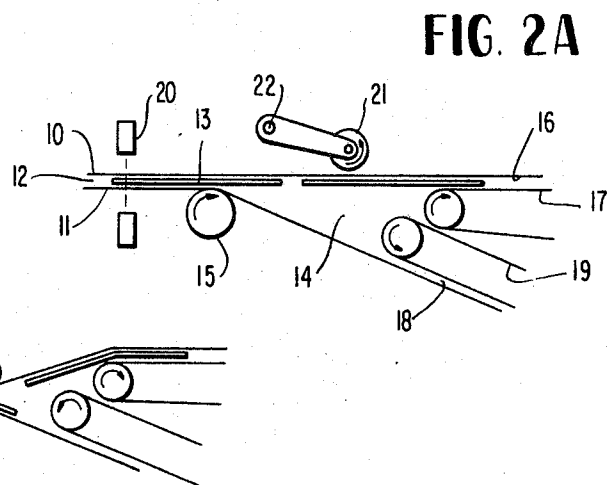
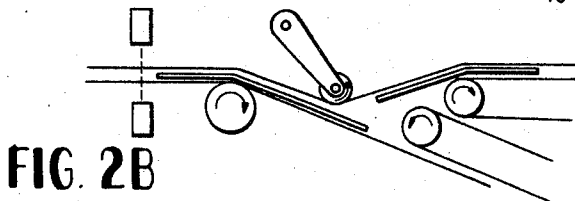
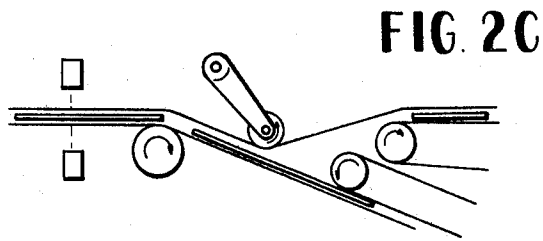
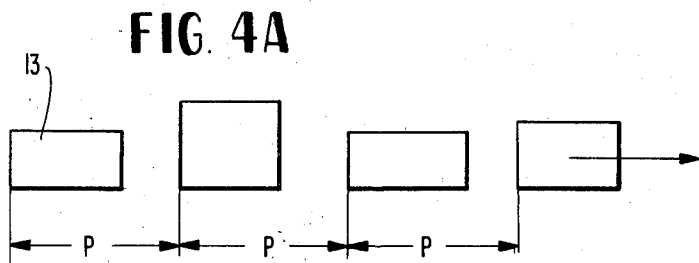
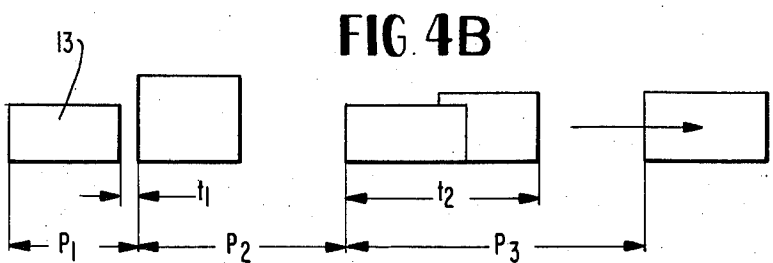
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[57] **ABSTRACT**

A switching device for interswitching the delivery of sheet-like articles conveyed to a bifurcation through a feed route, between the main and the branch routes, each route being formed of the opposing surfaces of a pair of endless belts, comprising, instead of the conventional wedge-shaped switching member disposed within the bifurcation, a switching member located outside the bifurcation. The device may be provided with means for rearranging the dislocated sheet-like matters, if any.

7 Claims, 10 Drawing Figures





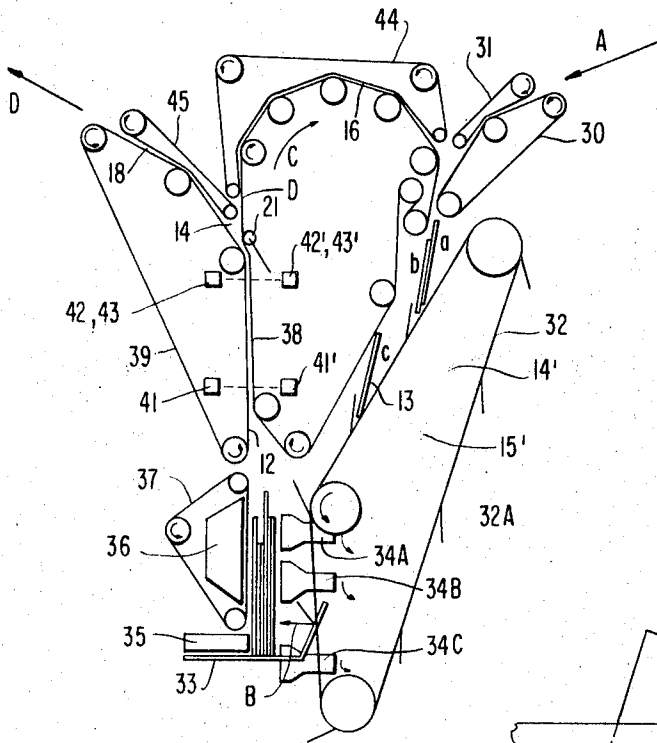


FIG. 3

FIG. 5A

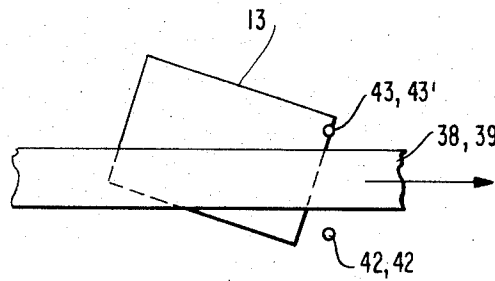


FIG. 5B

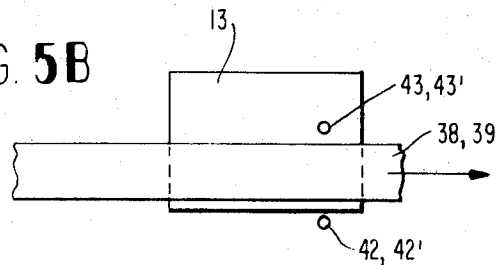
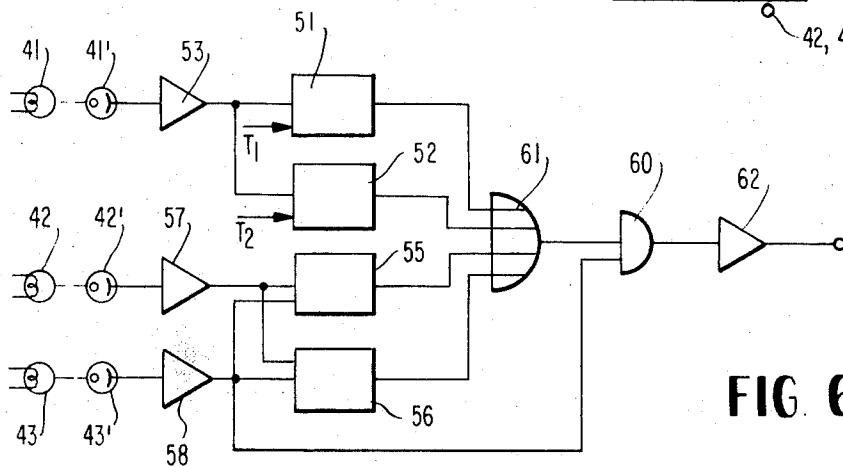


FIG. 6

SWITCHING DEVICE FOR DELIVERING SHEET-LIKE ARTICLES

BACKGROUND OF THE INVENTION

This invention relates to a switching device for inter-switching at a ramification the delivery of sheet-like articles, such as letter mail and cards, among a plurality of routes. The device is applicable to apparatus for feeding the sheet-like articles one after another.

This invention will hereafter be described, for illustrative purposes, in particular conjunction with mail handling systems.

In a mail handling system now in use, mail such as letters or the like is first subjected to sorting as to size. Letters of standard sizes and postcards to which subsequent automatic disposition is applicable are selected from the remainder which must be manually disposed of. The subsequent disposition of the selected mail involves a check of the postage by optical scan, sorting as to destination by zip codes, and the like. Before such subsequent disposition, it is necessary to feed the mail by equipment for this purpose, one by one at a predetermined pitch of feed in order to increase the efficiency of the postage check and the destination sorting. In conventional equipment of this type, an endless belt is provided with equally spaced holes or sets of holes for picking up the mail one after another from a stack thereof and successively feeding them to the output of the equipment, by suction. With this one-by-one feeding equipment, it has been experienced that nonuniformity of the thickness, the stiffness, the dimensions, the quality of paper, and the like results in dislocation of the output mail, such as irregular pitch of the feed and slant or misaligned positioning relative to the path of delivery, which impairs the efficiency of the subsequent disposition.

In such a mail handling system, devices for switching the feed of mail from the main route to the branch route at each bifurcation are necessary on sorting the mail matters as to the size, the results of postage check, the destination, and the like. Furthermore, it is desirable to relocate the dislocated mail in the one-by-one feeding equipment. Such relocation also requires a switching device of this kind.

As will become clearer from the description of the present invention hereinafter, a conventional switching device comprises a first and a second endless belt, the opposing surfaces of the belt pair forming a feed route for the mail. The second belt departs from the first belt at the bifurcation. The main route is formed of that surface portion of the first belt disposed ahead of the bifurcation and the opposing surface of a third endless belt, while the branch route is formed of the departing surface portion of the second belt and the opposing surface of a fourth endless belt. Two or more parallel-running similar endless belts may be substituted for each of the first through the fourth belts. A wedge-shaped member rockable about an axis is positioned within the bifurcation so that all mail conveyed to the bifurcation may be brought into contact with one or the other side surfaces of the wedge depending on whether the member assumes the normal position or is rocked away from the normal position. The mail is fed to the main or the branch routes as determined by the position of the wedge-shaped member.

If an article reaches the bifurcation during the rocking movement of the wedge-shaped member, it either runs against the edge or comes in contact with the edge portion of the member to come to a standstill, to hinder the movement of the member, to be damaged by the edge, or to give rise to other troubles. Likewise, the edge of the member often touches the side surface of an article to peel off the imperfectly adhering postage stamp, damage the envelope at the lap or the window, or cause other troubles. Furthermore, the edge causes troubles to mail which happens to be fed to the bifurcation in the folded state. Some of the troubles, such as jamming of the mail, sometimes results in dislocation of the belt or even into other serious damages of the switching device.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a switching device for sheet-like articles which is not subject to the troubles and disadvantages of previously used switching devices.

Another object is to provide a switching device of the type which is very simple in construction and yet highly reliable.

Still another object is to provide a switching device of the type which is operable at a high speed.

Yet another object is to provide a switching device of the type which increases the efficiency of a mail handling system or a like system.

A further object is to provide a switching device of the type for improving the spatial relation of each output sheet-like article to another and to the path of delivery prescribed therefor.

According to this invention, there is provided a switching device for delivering sheet-like articles conveyed to a ramification through a feed route, into selected one of a plurality of routes, said routes being disposed on a single plane, each route being formed of a pair of wall members having opposing portions, each portion being substantially rectilinear in the direction perpendicular to the plane, the outermost ones of the wall members of the plurality of routes being the extensions of the wall members of the feed route, and comprising no switching means positioned within the feed route, the plurality of routes or the ramification.

According to an aspect of this invention, there is provided a switching device as mentioned in the preceding paragraph, with the ramification being a bifurcation, the plurality of routes being the main route and the branch route, the main route being a substantial extension of the feed route, the opposing portions being the opposing surfaces of endless belts, wherein the switching means is a swingable roller disposed outside of the bifurcation in proximity to one of the belts which is the common belt for the feed and main routes, the roller being positioned so as not to force the one belt inwardly when the selected route is the main route, but to force the belt inwardly of the bifurcation until the branch route becomes a substantial extension of said feed route when the branch route is the selected route, thereby directing the sheet-like articles to the main and branch routes, respectively.

According to another aspect of this invention, there is provided a switching device as described in the preceding paragraph, with the sheet-like articles being

conveyed through the feed route in the prescribed state of conveyance but with possible dislocation, wherein detector means is disposed along the feed route for detecting the dislocation, the predetermined one of the main and branch routes is a feedback route for feeding the sheet-like articles delivered thereinto back to the feed route, and means is provided for positioning the roller, responsive to the discrimination made by the detector means, to direct the dislocated sheet-like articles to the feedback route.

The switching devices defined in the preceding paragraphs, although very simple in construction, have been put into commercial use in mail handling systems, after filing of the counterpart patent application in Japan, and have proved to be quite excellent.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a switching device according to this invention;

FIGS. 2(A), (B), and (C) are plan views of the switching device shown in FIG. 1, showing various steps in the operation thereof;

FIG. 3 is a schematic side elevational view of one-by-one feeding equipment according to this invention;

FIGS. 4(A), 4(B), 5(A) and 5(B) are schematic views of the mail articles being conveyed along the feed route of the equipment illustrated in FIG. 3, for describing the operation thereof; and

FIG. 6 is a schematic circuit diagram of the equipment depicted in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, a switching device according to this invention comprises first and second endless belts 10 and 11, respectively, forming a feed route 12 for articles of mail 13. The second belt 11 departs from the first belt 10 at a bifurcation 14 around a first roller 15 which rotates as the second belt 11 is driven. The main route 16 is formed by that portion 10A of the first belt 10 which extends beyond the bifurcation 14 and a third endless belt 17. Similarly, a branch route 18 is formed by the departing portion 11A of the second belt 11 and a fourth endless belt 19. A conventional detector 20 is provided ahead of the bifurcation to produce and electric signal when the front edge of a mail article 13 reaches the position of the detector 20. It is presumed that another detector (not shown) is provided ahead of the detector 20 to produce, in a manner well known in the art, a switching electric signal for indicating whether the mail article 13 fed in the feed route 12 passing by the latter detector should be directed to the main route 16 or to the branch route 18. For the purpose of describing the present invention, the detector 20 may be regarded as producing a switching signal determining the route 16 or 18 of delivery of the mail article 13 in question.

According to this invention, a switching roller 21 is provided at the bifurcation 14 outside of the first belt 10, in place of the conventional wedge-shaped member (not shown) that is positioned within the bifurcation 14. The roller 21 is swingable about a fixed axis 22 in response to the switching signal and is placed either out of contact with the outside surface of the belt 10 or in light touch therewith as shown in FIG. 2(A) when the

mail article 13 in question is to be directed to the main route 16. The roller 21 is swung to push the belt 10 inwardly of the bifurcation 14 when a mail article 13 is to be delivered to the branch route 18, as illustrated in

FIGS. 2(B) and (C).

In the switching device according to this invention, the routes 12, 16, and 18 are defined by the inside surfaces of the driven belts 10, 11, 17, and 19 and do not include any member which is disposed within the routes to cause interruptions to the delivery of the mail articles 13 as is the case with the conventional switching device having the wedge-shaped member disposed within the bifurcation. Furthermore, the swingable roller 21 does not come into direct contact with the mail articles 13. As a result, it is possible to reduce the pitch of feed of the mail articles 13 to such an extent that the roller 21 can be moved to its inner position before the preceding mail article has completely passed through the bifurcation 14 as can be seen from FIGS. 2(B) and (C).

It will now be understood that each of the routes 12, 16, and 18 need not necessarily be formed of the opposing surfaces of a pair of endless belts, but may be defined by other wall members, such as feed rollers arranged in a pair of rows, the feed rollers of one row being urged against those of the other row, provided that the row of first wall members corresponding to the first belt 10 is deformable inwardly at the bifurcation 14. Also, the number of the routes, such as 16 and 18, to which the sheet-like articles are selectively delivered may be three or more, provided that a plurality of such routes are placed on a single plane for the purpose of simplification of the device and that two stepwise swingable rollers are disposed outside the ramification at the outside proximity of the first and the second wall members, respectively, for directing the extension of the feed route at the ramification towards the selected one of the plurality of routes.

Referring to FIG. 3, one-by-one feeding equipment according to this invention comprises first and second endless belts 30 and 31, respectively, cooperating to deliver the mail articles 13 fed into the equipment as shown by an arrow A, towards a third endless belt 32 having equally spaced pawl-like portions 32A for carrying the mail articles 13. The mail articles 13 are fed on a horizontal guide table 33 in the sense illustrated by the arrow B by means of conventional helical rollers 34A, 34B, and 34C and then subjected to suction by first and second suction boxes 35 and 36 in a well known manner. The suction is effected by the second suction box 36 through equally spaced holes or sets of holes (not shown) formed in a fourth endless belt 37 to feed upwardly the mail articles 13 one by one with a pitch of feed determined by the spacing between the holes or sets of holes. The mail articles 13 are thus successively fed to a feed route 12 formed by fifth and sixth endless belts 38 and 39 to undergo inspection by detector means mentioned with reference to FIGS. 1 and 2.

By way of example, the detector means comprises a first light source 41 and an associated photoelectric transducer 41' positioned at the entrance portion of the feed route 12, and a pair of second light sources 42 and 43 cooperating photoelectric transducers 42' and 43' placed remote from the entrance on a plane substan-

tially perpendicular to the route 12. The distance between the first source 41 and the second sources 42 and 43 is substantially equal to the length of the longest one of the standard-size mail articles. The second sources 42 and 43 are so disposed that the narrowest standard-size mail article may intercept the rays from these sources so that a mail article, if fed in misaligned relation to the feed route 12, may intercept the rays from only one of these sources 42 and 43. Beyond the second sources 42 and 43, there is a bifurcation 14 from which a main route 16 extends along the extension of the feed route 12 between a fifth belt 38 and a seventh endless belt 44, and a branch route 18 extends sideways between the sixth belt 39 and an eighth endless belt 45. Outside the bifurcation 14, symbolically depicted is a swingable roller 21 for delivering the mail articles 13 to the main or the branch route 16 or 18 as shown by arrows C and D, depending on the result of inspection made by the detector means. In this illustrated embodiment, the main route 16 serves as a feedback route for feeding the mail articles 13 delivered thereto back onto the third or pawl-carrying belt 32.

Referring to FIGS. 4 and 5, the mail articles 13 should perform translation with the predetermined pitch p of feed illustrated in FIG. 4(A). In practice, however, the mail articles 13 may be fed with uneven pitches p_1, p_2 , and

or with parts overlapped as shown in FIG. 4(B), or slanted as illustrated in FIG. 5(A), or along a misaligned path depicted in FIG. 5(B).

Such dislocation of the mail articles 13 is inspected by the detector means. When the pitch of feed is small as exemplified by p_1 in FIG. 4(B), the time interval t_1 during which the light from the first source 41 is received by the associated transducer 41' is shorter than a first predetermined time interval T_1 . When two or more mail articles 13 are in overlapped relation, the time interval t_2 during which the light from the first source 41 is not received by the associated transducer 41' is longer than a second predetermined time interval T_2 . The mail article 13, if fed in slanted relation to the feed route 12, as exemplified in FIG. 5(A), intercepts the rays from the second sources 42 and 43 at different time points. The mail article 13, if fed along a misaligned path, intercepts the light emitted from only one of the second sources 42 and 43 as shown in FIG. 5(B) by way of example.

Referring finally to FIG. 6, the output signal of the first transducer 41' is supplied to a pitch detector circuit 51 and an overlap detector circuit 52 through a power amplifier 53. The pitch detector circuit 51, supplied with another input signal representative of the first predetermined time interval T_1 , produces an output signal when the time interval t_1 is shorter than the predetermined interval T_1 . The overlap detector circuit 52, supplied with another input signal representative of the second predetermined time interval T_2 , similarly produces an output signal when the time interval t_2 is longer than the predetermined interval T_2 . For comparison of the time intervals, the detector circuit 51 or 52 may comprise means, such as an integrator, for producing an output signal whose level is representative of the duration of the input signal or the duration between two successive input signals.

The output signals of the second transducers 42' and 43' are supplied together to an inclination detector circuit 55 and an alignment detector circuit 56 through power amplifiers 57 and 58, respectively. These detector circuits 55 and 56 may be differentiators. In the illustrated example, the output signal of one of the second transducers 43' is applied to the inhibit terminal of an INHIBIT gate 60 to whose other input terminal are connected the output terminals of the detector circuits 51, 52, 55 and 56 through an OR gate 61. It will be appreciated by temporary reference to FIG. 5(B) that the INHIBIT gate 60 is opened whenever the front or the leading edge of a mail article 13 reaches the path of rays from the particular one of the second sources 42 and 43. Alternatively, the output signals of the second transducers 42' and 43' may be applied to the INHIBIT gate 60 through an AND gate (not shown). The output signal of the INHIBIT gate 60, after being processed by an amplifier circuit 62, is used to swing the swingable roller 21 to direct the dislocated mail articles to the feedback route 16.

It will now be understood that the pitch detector circuit 51, for example, comprises a monostable circuit for keeping the output signal for a time interval slightly longer than the time required for a mail article 13 to travel from the position irradiated by the first source 41 to the position on which the rays from the second sources 42 and 43 are incident. The amplifier circuit 62 comprises means for timing its output signal to place the swingable roller 21 in the desired position with correct timing. Incidentally, another pitch detector circuit (not shown) may be provided to receive the output signal of the first transducer 41' and to produce a reference signal representative of the time interval for discriminating too large pitch of feed and to supply the output signal to the OR gate 61.

What is claimed is:

1. A switching device for delivering sheet-like articles conveyed to a ramification through a feed route into a selected one of a plurality of routes, all said routes being disposed on a single plane, each of said routes being formed of a pair of driving wall members having opposing portions, each of said portions being substantially rectilinear in the direction perpendicular to said plane, and the outermost wall members of said plurality of routes being the extensions of the wall members of said feed route; said device comprising switching means for effecting delivery of each of said articles into a selected one of said plurality of routes, said switching means being completely positioned outside of said feed route, said plurality of routes and said ramification.

2. A switching device as claimed in claim 1, wherein at least one of said extensions of the wall members is deformable inwardly at said ramification.

3. A switching device as claimed in claim 2, wherein said wall members are endless belts, and said opposing portions are the opposing surfaces of said endless belts.

4. A switching device as claimed in claim 3, wherein said ramification is a bifurcation, said plurality of routes is the main route and the branch route, said main route is the substantial extension of said feed route, and wherein said switching means is a swingable roller disposed outside said bifurcation in proximity to said extension of one of said belts which is the common

belt for said feed and said main routes, said roller being operable between a first position wherein said one belt is not deformed inwardly when the selected route is said main route and a second position wherein said one belt is deformed inwardly of said bifurcation until said branch route becomes the substantial extension of said feed route, thereby directing said sheet-like articles to said main or said branch routes, respectively.

5. A switching device as claimed in claim 4, wherein detector means is disposed along said feed route for detecting the dislocation of said sheet-like articles, the predetermined one of said main and said branch routes is a feedback route for feeding the sheet-like articles delivered thereinto back to said feed route, and means is provided for positioning said roller, responsive to the discrimination made by said detector means, to direct the dislocated sheet-like articles to said feedback route.

6. A switching device as claimed in claim 5, wherein said roller positioning means causes said roller to direct the sheet-like articles to said feedback route when the spatial relation of the sheet-like articles passing said de-

tector means is such that:

- a. the spacing between the corresponding edges of the last-mentioned sheet-like article and the sheet-like article conveyed adjacent thereto is not equal to a predetermined spacing,
- b. the last-mentioned sheet-like article overlaps at least at a portion the sheet-like article conveyed adjacent thereto;
- c. the last-mentioned sheet-like article is conveyed in slanted relation to said feed route, and
- d. the last-mentioned sheet-like article is conveyed along a misaligned path relative to said feed route.

7. A switching device as claimed in claim 2, wherein said switching means comprises at least one swingable roller disposed outside said ramification in proximity to said one extension of the wall members, said roller being adapted to deform said one extension of the wall members inwardly of said ramification to such an extent that the selected one of said plurality of routes becomes the substantial extension of said feed route.

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