

June 21, 1960

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2,941,653

MAIL HANDLING APPARATUS

Filed Dec. 2, 1957

4 Sheets-Sheet 1

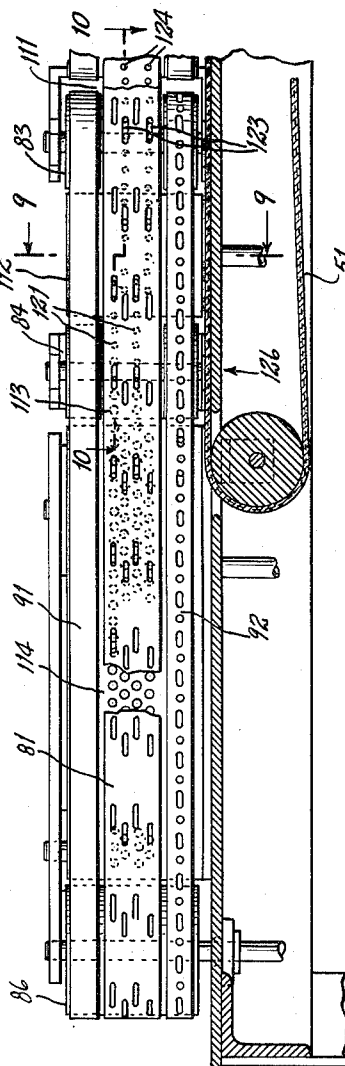
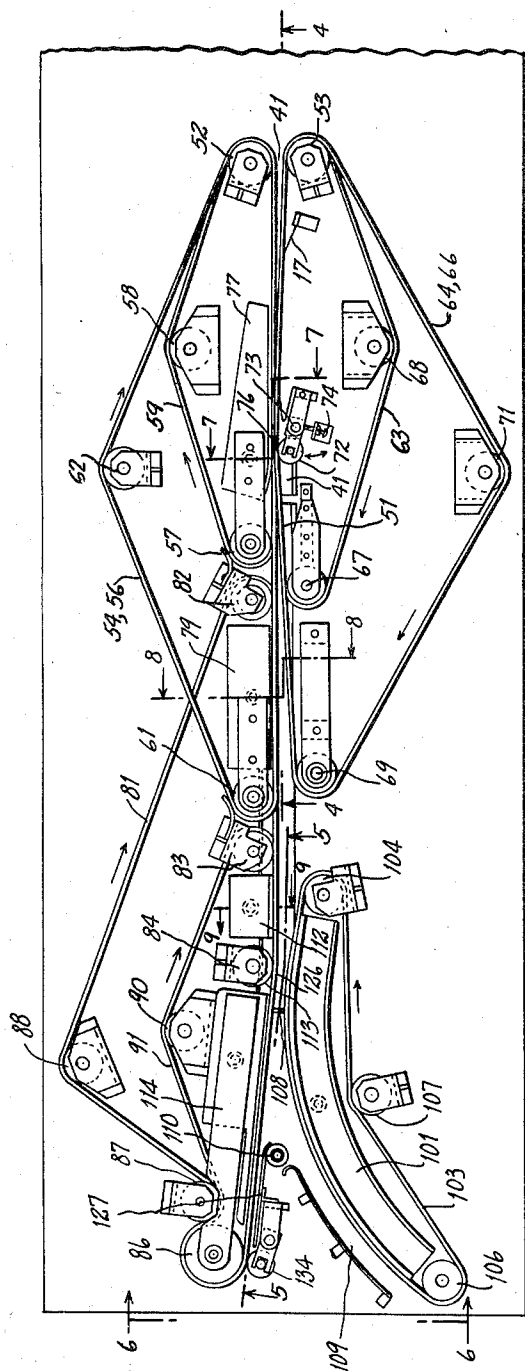


Fig. 1.

Fig. 5.

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Fig. 2.

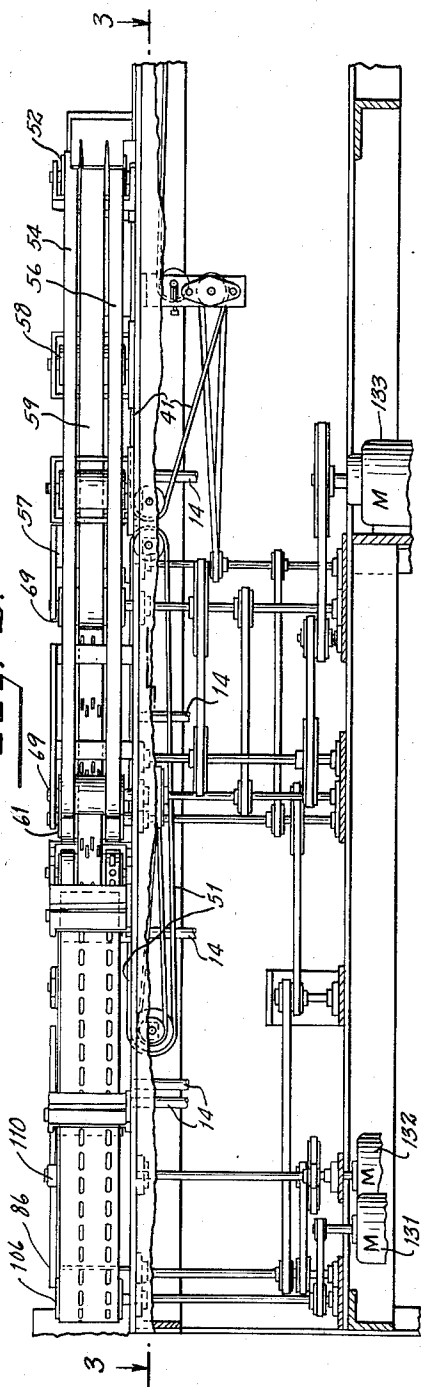
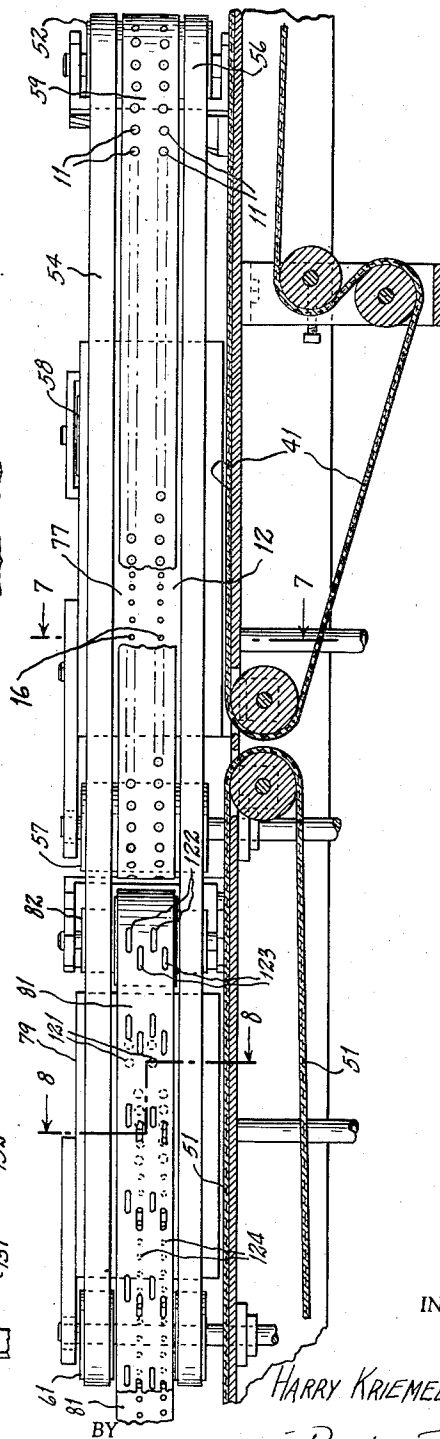


Fig. 4.



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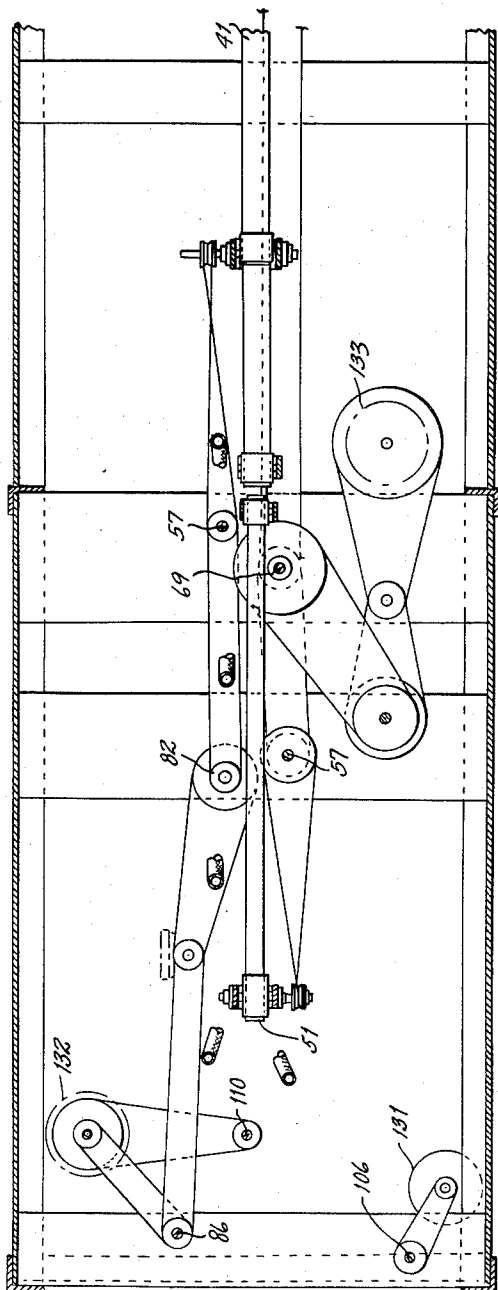


Fig. 3.

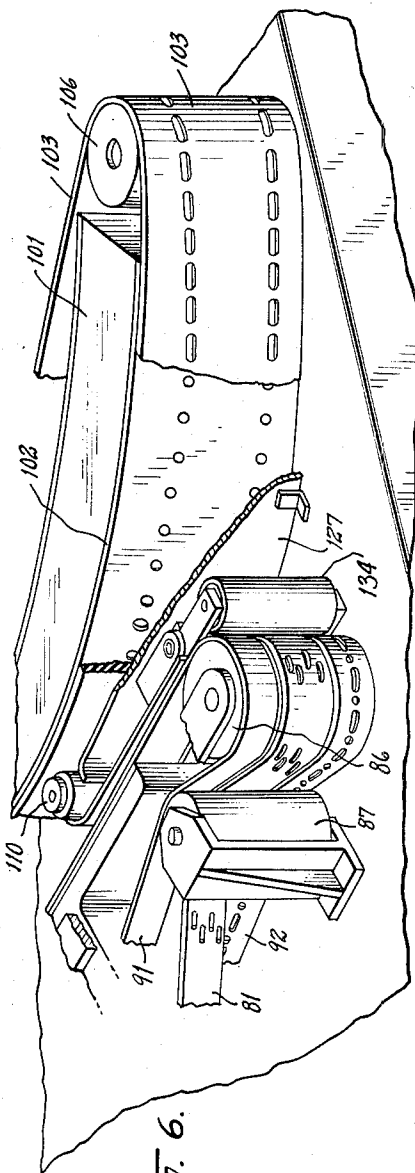


Fig. 6.

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Fig. 7.

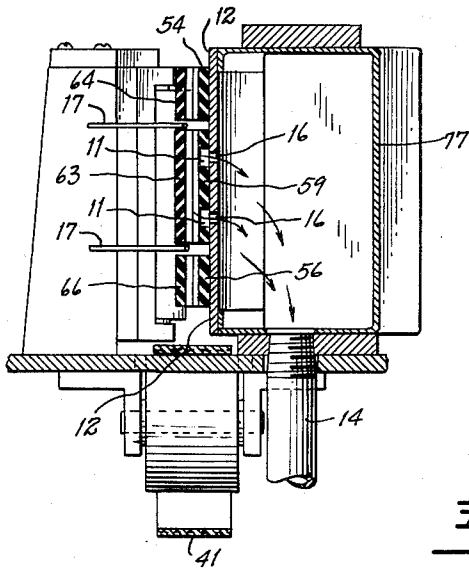


Fig. 9.

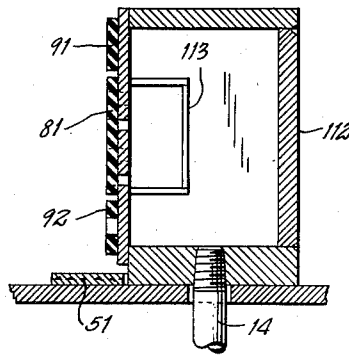


Fig. 8.

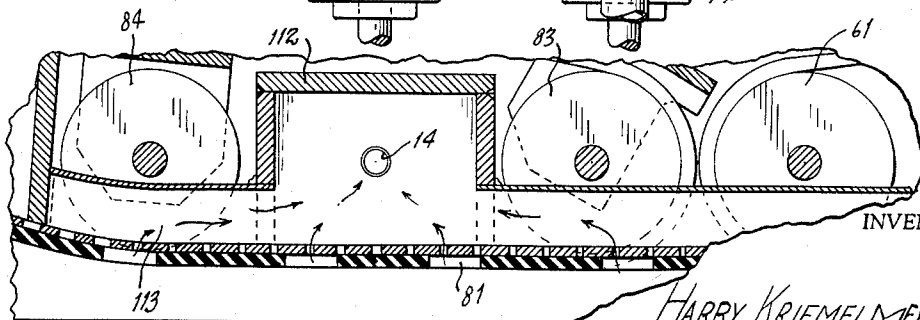
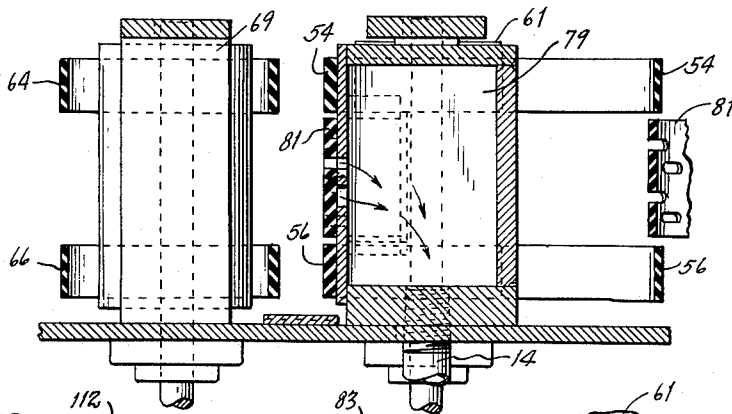


Fig. 10.

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MAIL HANDLING APPARATUS

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8 Claims. (Cl. 198—31)

The present invention is directed to the art concerning conveying and processing of very large volumes of single, light-weight, flat articles, such as letter mail, and is more particularly concerned with providing improved apparatus for the handling and conveying of letter mail pieces preliminary to automatic operations thereon.

In our current economy, the expeditious handling and processing of mail has become vital to the efficient conduct of business and communication. The volume of mail pieces has become so large as to encumber and literally swamp the postal facilities at the larger metropolitan post offices, handling many millions of pieces of mail daily. Problems of conveying and processing this great volume of mail pieces, having various shapes and sizes, have not heretofore been efficiently solved, resulting in delay in delivery of mail and uneconomical utilization of space, equipment and manpower.

In solving this problem of mail handling, the first step is to provide a rapid flow of mail pieces preferably in a stream of single units to permit subsequent individual operation on such pieces, such as cancelling, sorting, stacking and the like. Copending application Serial No. 683,284, filed September 11, 1957, in the name of Milton A. Stovall for Mail Handling Apparatus, and assigned to the same assignee as the present application, describes and claims apparatus useful in converting bulk mail of irregular quantity and size into a flowing stream having a generally uniform average flow but with specific irregularities and overlappings. Copending application Serial No. 696,393, filed November 14, 1957, now Patent No. 2,905,309, in the name of C. G. Makrides for Mail Handling Apparatus and assigned to the same assignee as the present application, now Patent 2,905,309, issued September 22, 1959, describes and claims apparatus useful in transporting individual pieces of letter mail by means of vacuum belts and for stacking and feeding such pieces. Copending application Serial No. 684,800, filed September 18, 1957 in the name of David G. Falconer for Mail Handling Apparatus and assigned to the same assignee as the present application, describes and claims apparatus useful in converting an irregular quantity and volume of mail pieces flowing in a stream into a more uniform and regular flow, and in particular describes and claims apparatus for thinning out an irregular stream of letter pieces and simultaneously speeding it up, while at the same time inhibiting clumping or doubling up of the letter pieces.

The present invention is particularly intended to be used at the output of the Falconer thinning sections where it will receive a rapid flow of letter mail which has been thinned and strung out but which may not necessarily be in the form of single isolated pieces following one another in spaced arrangements as is desirable for subsequent operations upon such letter pieces. The present apparatus is adapted to provide a further thinning function and thereafter to feed the letter pieces one at a time to subsequent apparatus while eliminating any doubling or overlapping that may have occurred.

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Further objects and advantages of the present invention will become more fully apparent from consideration of the following description of a preferred embodiment thereof taken in conjunction with the appended drawings, in which

Fig. 1 is a top plan view of the apparatus of the present invention;

Fig. 2 is a side elevation view of the apparatus of Fig. 1;

Fig. 3 is a plan cross-sectional view of said apparatus viewed along line 3—3 of Fig. 2;

Fig. 4 is a partial elevational cross-sectional view viewed along line 4—4 of Fig. 1;

Fig. 5 is a further partial elevational cross-sectional view taken along line 5—5 of Fig. 1;

Fig. 6 is a fragmentary perspective view of the exit portion of the apparatus, viewed from line 6—6 of Fig. 1;

Fig. 7 is a fragmentary vertical cross-section along line 7—7 of Figs. 1 and 4;

Fig. 8 is another fragmentary vertical cross-section along line 8—8 of Figs. 1 and 4;

Fig. 9 is still another fragmentary vertical cross-section along line 9—9 of Figs. 1 and 5; and

Fig. 10 is a fragmentary horizontal cross-section along line 10—10 of Fig. 5.

A general plan view of the apparatus is shown in Fig. 1 where the first stage at the right hand end forms essentially a final thinning section generally of the type described and claimed in the above-mentioned Falconer application.

Referring first to the Figs. 1 and 4, a horizontal conveyor belt 41 which may also form a part of a preceding thinning unit, conveys letters standing on edge into the unit from the right hand side as seen in Fig. 1. This horizontal conveyor belt 41 may illustratively have a linear speed of the order of 65 inches per second. At the entrance to this final thinning section is a pair of idler rollers 52 and 53, about each of which pass three separate belts. The center belt 59 passing around idler roller 52 also passes around a drive roller 57 and a tensioning idler roller 58. Drive roller 57 maintains belt 59 rotating at a constant speed faster than that of horizontal belt 41 and illustratively of the order of magnitude of 80 inches per second. The top and bottom belts 54 and 56 passing around the entrance idler roller 52 also pass over a further drive roller 61 downstream of drive roller 57 and over a separate tensioning idler 62 by which belts 54 and 56 are rotated in the same direction and at the same speed as belt 59. Belt 59 is provided with a plurality of rows of apertures 11, two rows being illustrated, and passes in sliding contact over the outer face 12 of a vacuum manifold 77 connected by pipe 14 to a suitable source of vacuum pressure. Manifold 77 has a corresponding plurality of rows of ports 16 adapted to register with the belt apertures 11 as the belt 59 passes along manifold surface 12. Apertures 11 are larger than ports 16, and desirably may overlap two ports.

In a generally similar way, the other input idler roller 53 has three belts passing around it, namely a central belt 63 and a pair of outer belts 64, 66 above and below belt 63. The outer belts 64, 66 are driven by a drive roller 69 around a tensioning idler roller 71 and in a backward direction at a lower speed than belts 54, 56 and 59, illustratively of the order of 30 inches per second. The center belt 63 is driven by a drive roller 67 about a tensioning idler roller 68 at the same speed as belts 64, 66, and in the same direction. A roller 72 pivotally mounted at 73 is urged against the belts 63, 64, 66 by suitable spring means, not shown, and a stop is provided at 74 for setting the spacing of the gap at 76 between the forward rotating belts 54, 56, 59 and the rearward belts 63, 64, 66. Roller 72 is set to maintain a nearly zero gap 76 (say up to .015 inch) between the two sets

of counter-rotating belts so that any duplicates or overlaps are wiped back by the counter-rotating belts 63, 64, 66.

In the horizontal gaps between adjoining backward-moving belts 64, 63, 66 are spring bows 17 (Figs. 1, 7) which hold letters away from the belts 64, 63, 66 (unless a thick clump of letters occurs) and urge the letters up against the forward belts 54, 59, 56. As a clump moves leftward in Fig. 1, by means of horizontal belt 41 and forward belts 54, 59, 56, it enters the influence of manifold 77, which causes the closest letter to be positively sucked up against belt 59 and to be moved with the belt. As the clump approaches the gap 76, the two sets of belts converge. While one letter is held against belt 59 by vacuum pressure, the others are swept back by the rearward belts 64, 63, 66 which preferably have friction surfaces. In this way, the one positively held letter passes through gap 76 while the others are delayed at the gap. This causes a final thinning action on the stream of mail to help form the desired flow of single pieces with no overlapping.

As the letters leave the final thinning gap 76, they are supplied to the feeder section, and pass from horizontal belt 41 to the subsequent horizontal belt 51, traveling faster than belt 41, with a speed representatively 110 inches per second. At the same time the letter positively transported through gap 76 continues to be positively transported by a further vacuum belt 81 passing over an idler roller 82, drive roller 86, and tensioning rollers 87 and 88. Belt 81 again is a center belt with a pair of outer belts 91, 92 cooperating therewith and driven at the same speed. These latter belts are also driven by drive roller 86, over tensioning roller 87, tensioning roller 90 and idler rollers 83 and 84. The belts 81, 91, 92 operate at considerably higher speed than the preceding belts and illustratively may have a speed of the order of 130 inches per second.

Belt 81 passes over a vacuum manifold having sections 79, 111, 112, 113, 114. Each of these manifold sections is coupled to the vacuum line 14, either directly or by way of an adjoining section. Sections 111 and 113 are generally thinner in a direction normal to belt 81 than are sections 79, 112 and 114, so as to allow room for rollers 61, 83 and 84, which in general cooperate only with the upper and lower belts 91, 92, and 54, 56 as the case may be.

Manifold section 79 for an initial region has rows of ports 121 substantially aligned with the ports 16 of manifold 77, and belt 81 has corresponding rows 122 of apertures in the form of short slots each spanning at least two ports 121. Belt 81 also has two further rows of apertures or slots 123 staggered both vertically and longitudinally with respect to rows 122. The manifold ports 121 terminate after a short distance and are replaced by rows of ports 124 in alignment with belt slots 123 which continue to transport the letters. Manifold sections 111 and the first part of section 112 are similar to 79 and continue the letter transport. However, manifold section 113 has a slight bend at 126 adjacent roller 84, and just before that point, the manifold port rows 124 end, and port rows 121 pick up again, in registry with belt slots 122. By this combination of bend 126 and shift in the port rows, accidental doubling can be eliminated. Thus, if two letters arrive at bend 126 in partly overlapped condition, the one away from the belt 81 is at least partly released and can be removed. For example, if the two letters are exactly even or if the outer one lags slightly, then its leading edge is not held by vacuum, being blocked off by the inner letter. If the outer letter leads the inner one slightly, then as ports 124 release the leading outer letter, ports 121 attract only the inner letter, again releasing the edge of the outer letter. By virtue of the bend 126, this released edge of the outer letter will not follow the belt 81 around the bend, but will instead be directed against the doubles-

removing belt 103 and the outer letter is then removed as is described below.

The inner letters and all single letters follow belt 81 about bend 126 under the attraction of manifold sections 113 and 114. To provide further attraction and avoid any harmful effects from belt 103, manifold 114 may have ports 124 as well as 121 to increase the attractive force on the letters, which then pass between guide 127 and belt 81 to a pressure idler 134 opposite drive roller 36 and are ejected to the subsequent letter processing apparatus to the left, such as automatic cancelling and/or sorting devices.

The pick-off belt arrangement for eliminating doubles or overlapping letters is illustrated in Figs. 1 and 6, the latter being a view from the output end. This pick-off arrangement comprises a vacuum manifold 101 having a curved outer edge 102 of low friction surface over which passes the pick-off belt 103 driven by a drive roller 104 about an idler roller 106 and a tensioning roller 107. The curved manifold 101 extends close to the belt 81 at the gap 108 which is near the bend 126 where the belt 81 has a slight change in direction. In effect the pick-off belt 103 is a continuation of the original path of the letters. Pick-off belt 103 runs at a far greater speed in the forward direction than does the vacuum belt 81. Illustratively this speed may be of the order of 200 inches per second. If a letter is being transported by vacuum belt 81 by itself, it will be held tightly against belt 81 and will pass the bend 126 spaced sufficiently from the pick-off belt 103 so that the latter will have no influence. However, if two letters arrive at this bend overlapped, as shown above the outer one has a loose front edge. In such case the inner letter would proceed normally through the apparatus as previously indicated. The second letter however would proceed along a straight path and its leading edge would not turn the corner but would be picked up by the pick-off belt 103. In view of the greater speed of the pick-off belt and of its greater attracting force provided by larger ports than used on the drive belt 81, the pick-off belt 103 would therefore snatch off the second letter and carry it around the curved manifold 102 to an exit channel 109 whereby such a letter may be rejected from the main stream of flow. A roller 110 driven preferably at the same speed as the pick-off belt 103 assists in diverting letters to the reject channel 109 if any letters are not held fully against the drive belt 81.

In overall operation, it will now be clear that the stream of mail entering at the left is further thinned by the final thinning section whose gap 76 is of the order of the thickness of a single post card, so that all doubles are swept back and the stream is strung out more uniformly. In passing from the thinning section to the final feeder section, the abrupt speed-up between belts 41 and 51 and belts 59 and 81 snatches each letter from the thinning section output to put a gap between it and the following letter. However, there is no fixed spacing between leading edges of successive letters, so that the rate of flow is variable with letter length, with more shorter letters or fewer longer letters per unit time, as the case may be. Any further overlapping which may occur is removed by the pick-off arrangement.

It will be understood that the various drive rollers, belts and the like may be supplied with motive power from any suitable source, such as one or more motors through suitable belts, gears, chains, or the like, to derive the various speed relationships indicated above. Figs. 2 and 3 illustrate but one example of such motive power, from motors 131, 132, 133 through various pulley and belt arrangements whose design is readily within the skill of the art and need not be described further here.

It will be understood that the above description is illustrative only, since many apparently widely differing arrangements may be readily devised within the spirit of the invention, whose scope is defined solely by the appended claims.

What is claimed is:

1. A letter-conveying system comprising a stationary elongated vacuum manifold having a series of ports extending along one surface thereof, a flexible belt in contact with said manifold surface, means for continuously moving said belt in the direction of said series of ports, said belt having a series of apertures adapted to a register successively with said ports so as to retain a letter continuously against said belt to be transported therewith, said manifold surface having a bend at a point along said series of ports whereby said belt-retained letters are caused to divert from an original direction of motion to a new direction, while the leading edges of overlapped letters momentarily continue along said original direction, and means adjacent said bend for engaging said overlapped letter-leading edges and disengaging said overlapped letters from said belt, said last means comprising a pick-off vacuum manifold having a surface along said original direction adjacent said letter-leading edges, said surface having a series of ports therealong, and a pick-off belt moving along said pick-off manifold surface and having a series of apertures adapted successively to register with said pick-off manifold ports, whereby said overlapped letter-leading edges are attracted to said pick-off belt and manifold and are separated thereby from said retained letters, said pick-off belt having a speed substantially greater than said first belt speed.

2. A letter-conveying system comprising a stationary elongated vacuum manifold having a series of ports extending along one surface thereof, a flexible belt in contact with said manifold surface, means for continuously moving said belt in the direction of said series of ports, said belt having a series of apertures adapted to register successively with said ports so as to retain a letter continuously against said belt to be transported therewith, said manifold surface having a bend at a point along said series of ports whereby said belt-retained letters are caused to divert from an original direction of motion to a new direction, while the leading edges of overlapped letters momentarily continue along said original direction, and means adjacent said bend for engaging said overlapped letter-leading edges and disengaging said overlapped letters from said belt, said last means comprising a pick-off vacuum manifold having a surface along said original direction adjacent said letter-leading edges, said surface having a series of ports therealong, and a pick-off belt moving along said pick-off manifold surface and having a series of apertures adapted successively to register with said pick-off manifold ports, whereby said overlapped letter-leading edges are attracted to said pick-off belt and manifold and are separated thereby from said retained letters.

3. A letter-conveying system comprising a stationary elongated vacuum manifold having a series of ports extending along one surface thereof, a flexible belt in contact with said manifold surface, means for continuously moving said belt in the direction of said series of ports, said belt having a series of apertures adapted to register successively with said ports so as to retain a letter continuously against said belt to be transported therewith, said manifold surface having a bend at a point along said series of ports whereby said belt-retained letters are caused to divert from an original direction of motion to a new direction, while the leading edges of overlapped letters momentarily continue along said original direction, a curved pick-off vacuum manifold having a surface with a portion adjacent the intersection of said original and new directions, said surface having a series of pick-off ports therealong, and a moving pick-off belt juxtaposed to said latter surface and having a series of apertures therealong adapted successively to register with said pick-off ports.

4. A letter-conveying system comprising a stationary elongated vacuum manifold having a series of ports extending along one surface thereof, a flexible belt in con-

tact with said manifold surface, means for continuously moving said belt in the direction of said series of ports, said belt having a series of apertures adapted to register successively with said ports so as to retain a letter continuously against said belt to be transported therewith, said manifold surface having a bend at a point along said series of ports whereby said belt-retained letters are caused to divert from an original direction of motion to a new direction, while the leading edges of overlapped letters momentarily continue along said original direction, a curved pick-off vacuum manifold having a surface with a portion adjacent the intersection of said original and new directions, said surface having a series of pick-off ports therealong, and a moving pick-off belt juxtaposed to said latter surface and having a series of apertures therealong adapted successively to register with said pick-off ports, said pick-off belt having a speed substantially greater than said first belt speed.

5. A letter-conveying system comprising a stationary elongated vacuum manifold having a series of ports extending along one surface thereof, a flexible belt in contact with said manifold surface, means for continuously moving said belt in the direction of said series of ports, said belt having a series of apertures adapted to register successively with said ports so as to retain a letter continuously against said belt to be transported therewith, means at a point along the path of said retained letters for releasing an edge of overlapped letters, and means adjacent said point for removing said overlapped letters, said last means comprising a pick-off vacuum manifold having a surface along said original direction adjacent said letter-leading edges, said surface having a series of ports therealong, and a pick-off belt moving along said pick-off manifold surface and having a series of apertures adapted successively to register with said pick-off manifold ports, whereby said overlapped letter-leading edges are attracted to said pick-off belt and manifold and are separated thereby from said retained letters, said pick-off belt having a speed substantially greater than said first belt speed.

6. A letter-conveying system comprising a stationary elongated vacuum manifold having a series of ports extending along one surface thereof, a flexible belt in contact with said manifold surface, means for continuously moving said belt in the direction of said series of ports, said belt having a series of apertures adapted to register successively with said ports so as to retain a letter continuously against said belt to be transported therewith, means at a point along the path of said retained letters for releasing an edge of overlapped letters, and means adjacent said point for removing said overlapped letters, said last means comprising a pick-off vacuum manifold having a surface along said original direction adjacent said letter-leading edges, said surface having a series of ports therealong, and a pick-off belt moving along said pick-off manifold surface and having a series of apertures adapted successively to register with said pick-off manifold ports, whereby said overlapped letter-leading edges are attracted to said pick-off belt and manifold and are separated thereby from said retained letters.

7. A letter-conveying system comprising a stationary elongated vacuum manifold having a series of ports extending along one surface thereof, a flexible belt in contact with said manifold surface, means for continuously moving said belt in the direction of said series of ports, said belt having a series of apertures adapted to register successively with said ports so as to retain a letter continuously against said belt to be transported therewith, means at a point along the path of said retained letters for releasing an edge of overlapped letters, said last means comprising termination of said series of ports adjacent said point, a second series of ports in said manifold surface parallel to and displaced from said first port series and extending onward from adjacent said point, said belt having a second series of apertures registering

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with said second series of ports, and in staggered relation therewith to cause said first series of manifold ports and belt apertures to release the leading edge of each letter prior to its engagement with said second series of manifold ports and belt apertures, and means adjacent said point for removing said overlapped letters.

8. A letter-conveying system comprising a stationary elongated vacuum manifold having a series of ports extending along one surface thereof, a flexible belt in contact with said manifold surface, means for continuously moving said belt in the direction of said series of ports, said belt having a series of apertures adapted to register successively with said ports so as to retain a letter continuously against said belt to be transported therewith, said manifold port series terminating at a predetermined point of said surface, said surface having a second series of ports parallel to and laterally displaced from said first

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series and partially overlapping said first series and extending beyond said predetermined point, said belt having a second series of apertures adapted successively to register with ports of said second series, said second belt apertures being staggered in relation to said first series, whereby certain overlapped letters are at least partially released from said belt as they pass said predetermined point, and means adjacent said point for engaging and removing said partially released letters.

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