United States Patent

Kummerer

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[54] **APPARATUS FOR PRODUCING AN ORDERLY STACK OF FLAT ITEMS**

[72] Inventor: **Karl-Heinz Kummerer,** Konstanz, Germany

[73] Assignee: **Telefunken Patentverwertungsgesellschaft m.b.H.,** Ulm/Danube, Germany

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[52] **U.S. Cl.** .....**271/5,** 271/26 ES, 271/87

[51] **Int. Cl.** **B65h 3/12,** B65h 31/06

[58] **Field of Search** .....271/11, 12, 13, 8 A, 26 E, 271/74, 5, 87

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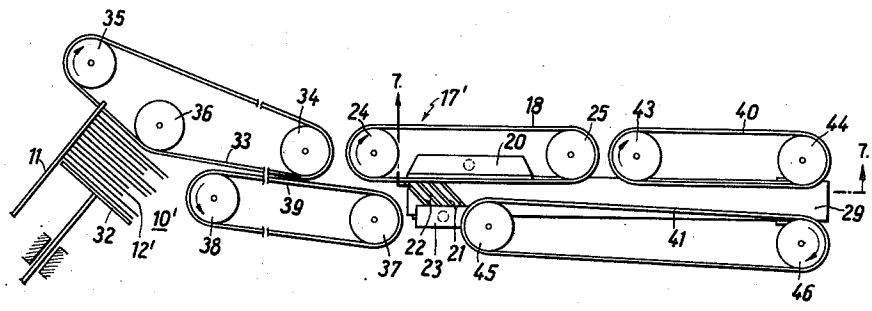
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Primary Examiner—Evon C. Blunk
Assistant Examiner—Bruce H. Stoner, Jr.
Attorney—Spencer & Kaye

[57] **ABSTRACT**

An arrangement for producing an orderly stack of items from a conveyed flow of flat items arriving in irregular amounts and overlapping one another, such as mail shipments, the arrangement including a pass-through separator and a stacker disposed in the conveying path behind the separator, the pass-through separator and the stacker being disposed with respect to one another in such a manner that the suction trough of the separator and the stack formed in the stacker are disposed on respectively opposite sides of the conveying path defined by the items passing from the separator to the stacker.

6 Claims, 10 Drawing Figures



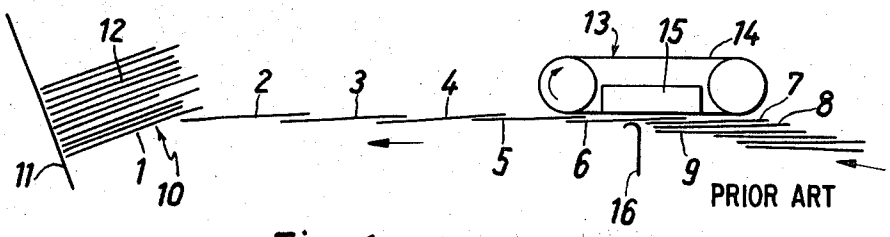


Fig. 1a

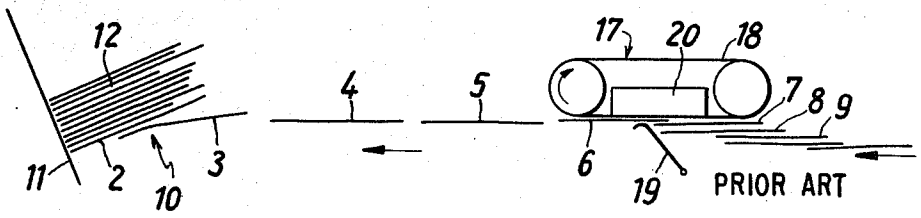


Fig. 2a

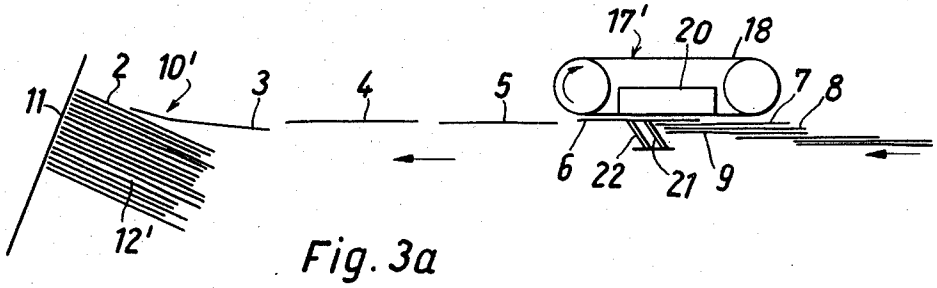


Fig. 3a

Inventor:
Karl-Heinz Kummerer

BY Spencer & Kaye
ATTORNEYS.

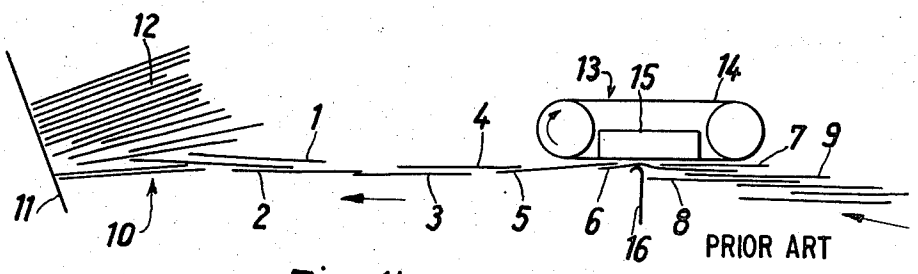


Fig. 1b

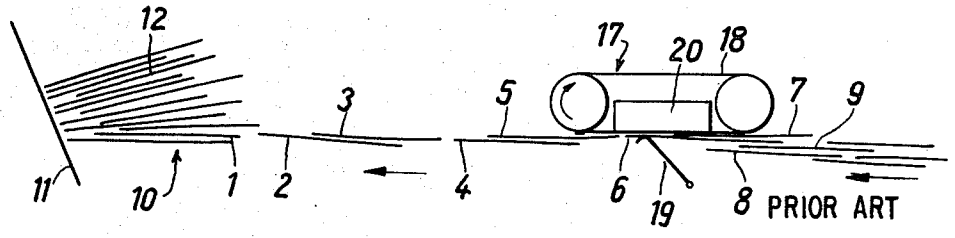


Fig. 2b

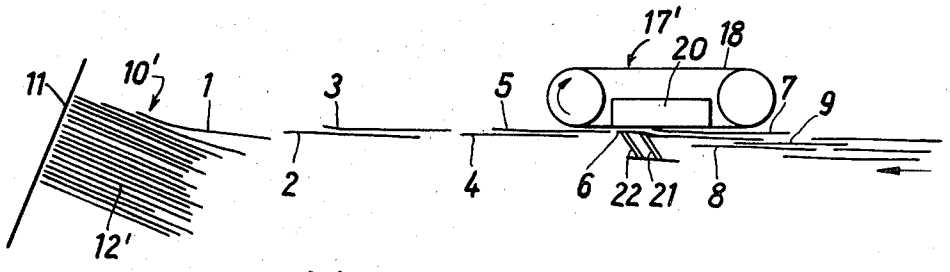


Fig. 3b

Inventor:
Karl-Heinz Kummerer

BY Spencer & Kaye
ATTORNEYS.

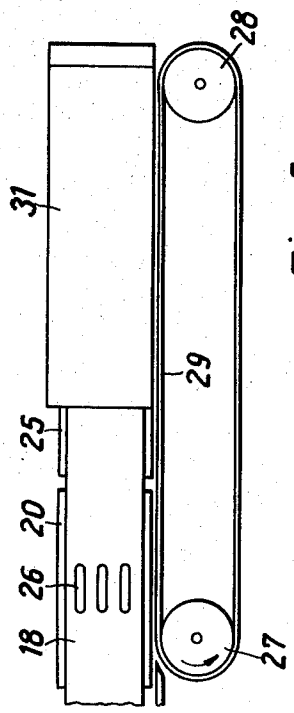


Fig. 5

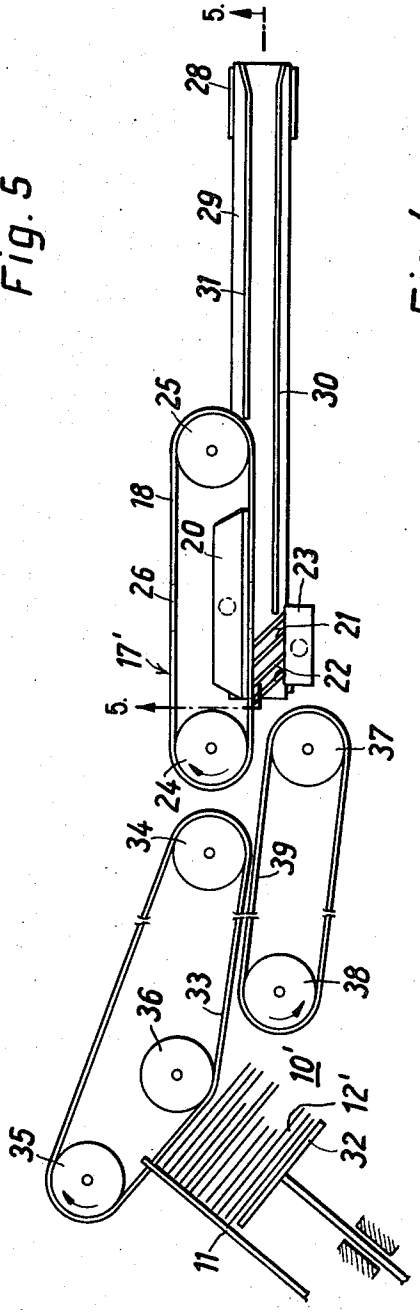


Fig. 4

Inventor:
Karl-Heinz Kummerer

BY *Spencer & Kaye*
ATTORNEYS.

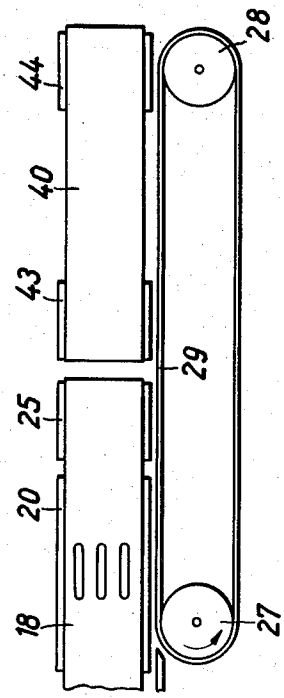


Fig. 7

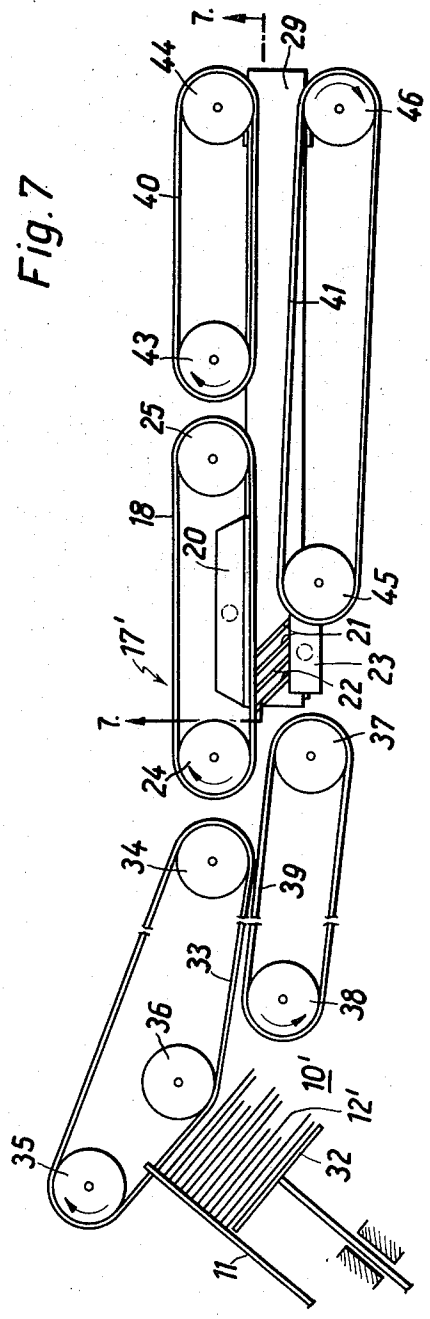


Fig. 6

Inventor:
Karl-Heinz Kummerer

BY Spencer & Kaye
ATTORNEYS.

APPARATUS FOR PRODUCING AN ORDERLY STACK OF FLAT ITEMS

BACKGROUND OF THE INVENTION

The present invention relates to an arrangement for producing an orderly stack of flat items from a conveyed stream of such items arriving in irregular amounts and with arbitrary overlapping, such as mail shipments in particular. Such a conveyed stream is produced, for example, by the format separator machine (culler) of an automatic mail distribution system in which the arriving mail shipments are prepared for further automatic processing.

In preparation for this further processing, which processing may involve, for example, arranging the pieces of mail in reading position, applying a code imprint, and distributing the pieces to individual destination cubicles, it is necessary that the pieces be separated with a high degree of reliability, i.e., without the simultaneous passage of two pieces.

So-called pass-through separators have been devised for producing a regular flow of separated items directly from an irregular conveyed stream. Due to the unfavorable operating conditions experienced by such separators, when they are incorporated into the conveying path, with respect to the relative positions of the items in the conveyed stream, this arrangement, even when strippers are used, is unable to produce sufficient separation quality. In order to achieve a high separation quality, i.e., a low error factor, the items must be brought to the separator after being aligned with respect to their front edges, from a substantially stationary stack.

This requirement creates the need for producing an orderly stack from a conveyed stream of items arriving in irregular amounts and with arbitrary relative overlappings.

U.S. Pat. No. 2,905,309 discloses, particularly with reference to FIG. 3 thereof, an arrangement for this purpose in which the stacker — here a so-called intermediate stacker — is connected behind a pass-through overlapper (shingler). This overlapper is a device provided with a suction trough and a rotating suction conveyor belt which is to produce, from an irregular stream, a succession of items which overlap one another by a given amount and always in the same sense. A stripper is provided to assure that not more than one item overlaps another. The pass-through overlapper is disposed with respect to the stacker in such a manner that the suction trough and the stack formed in the stacker are disposed on the same side of the conveying path defined by the items. Only then does the overlapping sense resulting from the position of the suction trough make possible faultfree stack formation. Such an arrangement and its intended operation are illustrated in FIG. **1***a* of the drawings.

A further arrangement for the same purpose is known from the publication "SEL-Nachrichten" 1959, and is shown in FIG. 6 on page 64 thereof. Here a pass-through separator is inserted in the conveying path leading to the stacker and includes a suction trough with a rotating intermittently perforated suction conveyor belt and a resilient retention device on the side of the conveying path opposite the suction trough. This retention device is intended to prevent arriving items from passing directly into the conveying path. Here,

too, the pass-through separator and the stacker are so arranged with respect to one another that the suction trough and the stack formed in the stacker are disposed on the same side of the conveying path, as is illustrated in FIG. **2***a* of the present drawings.

Experience has shown, however, that in the known arrangements, unexpected operating conditions occur from time to time in which the quality and the operational dependability of the stack formation leave something to be desired. The front edges of some items in the stack are offset rearwardly and this may cause errors in the subsequent separation process. Moreover, the entrance to the stack may become clogged and would then have to be cleared manually.

The known arrangement illustrated in FIG. **1***a* includes a stacker **10**, of which only the stacking wall **11** is shown, against which the front edges of the arriving items **1, 2, 3 . . . 9** come to rest to form a stack **12**, as well as a pass-through overlapper **13** having a rotating suction belt **14**, a suction trough **15** and a friction stripper **16**. The suction trough **15** and the suction belt **14** are so constructed that, despite the use of stripper **16**, a succession of overlapping items is intentionally delivered. As can be seen in FIG. **1***a*, the stacker **10** is disposed on the same side of the conveying path as the suction trough **15** so that the items, e.g., **1** and **2** furnished by the pass-through overlapper **13** with an overlapping sense determined by the position of the suction trough are stacked smoothly without jamming. The stacker **10** is actually part of an intermediate stacker to which is connected a separator on the side of stack **12** away from its input point. This separator is not shown, however, since it has no influence on the problem of stack formation which is of interest here.

The second known arrangement illustrated in FIG. **2***a* differs from that of FIG. **1***a* in that a pass-through separator **17** having a suction belt **18**, a resilient detention device **19** and a suction trough **20** is connected ahead of the stacker in place of the pass-through overlapper. This pass-through separator is so constructed that the items arriving in an unorderly stream, e.g., **7, 8** and **9**, are individually conveyed to the stacker **10** with spacing between them as shown for items **2, 3, 4, 5** and **6**. The relative positions of stacker **10** and pass-through separator **17** correspond to that of the arrangement of FIG. **1***a*.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to eliminate the shortcomings of the prior art devices.

A more specific object of the present invention is to provide an arrangement for producing an orderly stack of flat items from a conveyed stream of flat items arriving in irregular amounts and with arbitrary overlapping, such as mail shipments in particular, in which the quality and the operational dependability of the stack formation are maintained even under unfavorable operating conditions.

The invention is based on an arrangement which comprises a pass-through separator containing a suction trough and a rotating, periodically effective, suction conveyor belt and which is provided on the side of the conveying path opposite the suction trough with one or a plurality of strippers as well as a stacker following in the conveying path.

The improvement according to the present invention is achieved by having the pass-through separator and the stacker so arranged with respect to one another that the suction trough and the stack formed in the stacker are disposed on respectively opposite sides of the conveying path defined by the stream of items.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1*a* is a simplified plan view of one of the above-mentioned prior art arrangements illustrating its intended mode of operation.

FIG. 1*b* is a view similar to that of FIG. 1*a* illustrating the operation of the arrangement under unfavorable conditions.

FIG. 2*a* is a view similar to that of FIG. 1*a* of another prior art arrangement.

FIG. 2*b* is a view similar to that of FIG. 1*b* illustrating the operation of the arrangement of FIG. 2*a* under unfavorable conditions.

FIG. 3*a* is a view similar to that of FIG. 1*a* illustrating one arrangement according to the present invention operating under favorable conditions.

FIG. 3*b* is a view similar to that of FIG. 1*b* illustrating the arrangement of FIG. 3*a* operating under unfavorable conditions.

FIG. 4 is a plan view of one specific embodiment of the present invention.

FIG. 5 is a cross-sectional view taken along the line 5—5 of FIG. 4.

FIG. 6 is a plan view of a second specific embodiment of the present invention.

FIG. 7 is a cross-sectional view taken along the line 7—7 of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1*a* and 2*a* already having been described in detail, the arrangement according to the present invention illustrated in FIG. 3*a* is composed of a stacker **10'** and a pass-through separator **17'** which is disposed in the conveying path for the items. However, the separator **17'** and stacker **10'** are so arranged with respect to one another that the suction trough **20** and the stack **12'** formed in the stacker **10'** are disposed on respectively opposite sides of the conveying path defined by the items passing through the separator and moving to the stacker. The strippers are preferably composed of groups of resiliently mounted pneumatic strippers **21** and **22** which are known per se and one embodiment of which is disclosed, for example, in the German Published Patent Application No. 1,274,391, which corresponds to U.S. Pat. No. 3,258,262 issued to Karl Rehm on June 28, 1966. In a known manner, the stacker **10'** may be part of an intermediate stacker.

The present invention is based on the realization that irregularities in the formation of stacks by the known arrangements of the type previously discussed result primarily from the fact that the strippers associated with the separator are effective only for correcting one of the two possible types of overlapping in an irregular conveyed stream. With the known relative arrangement of the suction trough and stacker, the strippers are effective only with respect to that sense of overlapping which actually does not interfere with the formation of an orderly stack. The schematic representations of FIGS. 1*b* to 3*b* illustrate this in comparison with the operating conditions assumed to exist in FIGS. 1*a* to 3*a*.

Let the items **8** and **9** shown in FIGS. 2*a* and 2*b* be considered first. In FIG. 2*a* the sense of overlapping of these two items arriving at the pass-through separator **17** in an irregular conveying stream is such that item **8** has its front edge disposed ahead of the front edge of item **9** and is closer to suction trough **20** than is item **9**. If, in the further course of separation, item **8** is gripped by suction belt **18**, item **9** will also be held back and the two items **8** and **9** will assume the same relative position as the illustrated items **6** and **7**, i.e., the subsequent item **9** is held back by stripper **19** (as shown for item **7**) so that the two items will finally leave the separator in a separated state, as did the illustrated items **4** and **5**.

Under the conditions illustrated in FIG. 2*b*, however, the items arriving in the conveyed stream are so overlapped that the rearwardly positioned item **9** is closer to the suction trough than is the more forwardly located item **8**. At a later point in the separation process, the two items will inevitably assume the illustrated position of items **6** and **7**. This means that both items will be directly gripped by the suction openings of suction belt **18** while so positioned that neither item **9**, which is facing the suction trough (corresponding to **7**), nor the other item **8** (corresponding to **6**), can be held back by the stripper. The items are thus brought into the stacker **10** with an overlapping such as that of illustrated for items **4** and **5**, as well as **2** and **3**. Such an improper overlapping, however, prevents the formation of an orderly stack. There is rather formed, as indicated in the stack **12** of FIG. 2*b*, an "untidy" stack in which the front edges of the items are not aligned. If the stacking operation is permitted to continue the system will become clogged. Moreover, errors will occur during the subsequent removal of items from the stack.

Similarly, in the operation illustrated in FIG. 1*b*, in which there is an "intentional" overlapping, as for items **2**, **3** and **5**, **6**, the "wrong" overlapping sense of, for example, items **8** and **9** about to pass overlapper **13** has its effect on the stack being formed. Here, too, this overlapping, as of items **6** and **7**, can not be eliminated by stripper **16** since that item, e.g., **7**, which is offset rearwardly with respect to the front edge of the other item, e.g., **6**, is insulated from the action of stripper **16** by the latter item when its leading edge passes the stripper and thus can not be influenced thereby. Here, too, the "wrong" overlapping sense, e.g., of items **3** and **4**, results in the formation of an untidy stack and subsequent jamming, or clogging of the conveying path.

The situation illustrated in FIG. 1*b* could not be prevented by creating vibrations to bring the leading edges of items **8** and **9** into alignment before they reach suction belt **14** because open spaces appear in a conveying stream of items arriving in irregular amounts so that it occurs repeatedly that items enter the empty pass-through overlapper **13** with the "wrong" overlapping such as items **8** and **9** and then leave the overlapper with the same overlapping which prevents the formation of an orderly stack.

In the arrangement according to the present invention items having the "wrong" sense of overlapping, such as items **8** and **9** in FIG. 3*b*, will also not definitely be separated by strippers **21** and **22**. In FIG. 3*b* it is

even assumed, for reasons of illustration, that all items are fed into the stacker 10' as wrongly overlapped pairs 2, 3; 4, 5; 6, 7; etc. Since, however, the stacker 12' is here disposed on the other side of the conveying path from suction belt 18, this sense of overlapping is the one which will not have any adverse effect on the proper formation of a stack. Overlappings in the other sense, however, such as 4, 5 in FIGS. 1*a* and 1*b*, are eliminated by strippers 21 and 22.

FIGS. 4 and 5 illustrate one operative embodiment of the invention in which corresponding elements are given the same reference numerals as those used in FIGS. 3*a* and 3*b*. The arrangement further includes a suction box 23 disposed at the pass-through separator 17' in communication with flexible pneumatic stripper pairs 21 and 22. The rotating suction belt 18 is brought around two rollers 24 and 25. In a known manner the belt is provided with two opposing groups of perforations 26 which cooperate with corresponding slits (not shown) in the suction trough 20.

The conveying path for feeding in the irregular stream of mail is provided with a below-the-floor belt 29 as well as with two guide walls 30 and 31.

The stacker 10' includes a supporting wall 32 which can be moved in dependence on the size of stack 12'. The stacker input belt 33 is brought around rollers 34 and 35 and supported by a third roller 36. A conveyor belt 39 rotating around rollers 37 and 38 cooperates therewith to positively feed items to stack 12'. The belts advance in the sense of the arrows shown on their associated drive rollers. The second embodiment shown in FIGS. 6 and 7 differs from that of FIGS. 4 and 5 in that the conveying path leading to the pass-through separator 17' is provided with two conveying belts 40 and 41 in place of the guide walls 30 and 31, which belts are brought around rollers 43, 44, and 45, 46 respectively, and are advanced in the sense indicated by the arrows on respective drive rollers 43 and 46. In a particularly advantageous manner, the conveying belt 41 is here driven counter to the conveying direction and its guide roller 45 is positioned forwardly into the vicinity of suction belt 18. Conveying belts 40 and 41 are so disposed that the conveying channel formed by them narrows in the conveying direction to have the form of a wedge. This configuration of the input conveying path results in an equalization, i.e., increase in the regularity, of the conveyed stream arriving at the pass-through separator 17' and, in cooperation with the other features of the arrangement according to the present invention, results in a particularly high operational dependability.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

I claim:

1. In a device for producing an orderly stack of items from a conveyed flow of flat items defining a conveying path and arriving in irregular amounts and with irregular overlapping, which arrangement comprises a pass-through separator composed of a suction trough, a rotating periodically effective suction conveyor belt passing adjacent the trough, and stripper means disposed on the side of the conveying path which is opposite that of the suction trough and suction belt, a stacker disposed downstream of the separator in the conveying path for stacking items which pass through the separator, and conveying means operatively disposed between the pass-through separator and the stacker and transporting the items to reach the stacker in essentially the same relative arrangement they had when leaving the separator, the improvement wherein said pass-through separator and said stacker are physically disposed with respect to one another in such a manner that said suction trough and the stack of items formed in said stacker are disposed to respectively opposite sides of said conveying path.

2. An arrangement as defined in claim 1 wherein said suction belt is provided with suction openings spaced from one another by a distance sufficient to prevent any overlapping of successively conveyed items.

3. An arrangement as defined in claim 1 wherein said stripper means comprise at least one pair of suction strippers and said strippers cooperate with said suction belt to eliminate that sense of overlapping in which the leading overlapping item is closer to said suction belt than is the trailing overlapping item.

4. A device for producing an orderly stack of items from a conveyed flow of flat items defining a conveying path and arriving in irregular amounts and with irregular overlapping, which arrangement comprises a pass-through separator, item conveying means, at least one stripper means disposed on the side of the conveying path which is opposite a portion of the item conveying means, a stacker disposed downstream of the separator in the conveying path for stacking items which pass through the separator, and second item conveying means operatively disposed between the pass-through separator and the stacker and transporting the items to reach the stacker in essentially the same relative arrangement they had when leaving the separator, the improvement wherein said arrangement further comprises two upright conveyor belts disposed upstream of said separator for conveying items to said separator, each of said belts being disposed to a respectively opposite side of said conveying path, said belts being arranged obliquely to one another to define a conveying channel which narrows toward said separator, that one of said belts which is on the same side of said conveying path as said item conveying means being driven in a sense to urge items in the conveying direction, and the other one of said belts being driven in a sense to urge items in a direction counter to the conveying direction to render more uniform the distribution of items along said conveying path and wherein said separator and said stacker are physically disposed with respect to one another in such a manner that said stripper means and the stack of items formed in said stacker are disposed on the same side of said conveying path.

5. An arrangement as defined in claim 4 further comprising guide rollers around which each of said further belts passes, and wherein that guide roller at the downstream end of said other one of said further belts is disposed opposite a portion of said item conveying means.

6. A device for producing an orderly stack of items from a conveyed flow of flat items defining a conveying path and arriving in irregular amounts and with irregular overlapping, which arrangement comprises a pass-

through separator, item conveying means, at least one stripper means disposed on the side of the conveying path which is opposite a portion of the item conveying means, a stacker disposed downstream of the separator in the conveying path for stacking items which pass through the separator, and second item conveying means operatively disposed between the pass-through separator and the stacker and transporting the items to reach the stacker in essentially the same relative arrangement they had when leaving the separator, the improvement wherein said pass-through separator and said stacker are physically disposed with respect to one another in such a manner that said stripper means and the stack of items formed in said stacker are disposed on the same side of said conveying path.

* * * * *