

(12) STANDARD PATENT APPLICATION (11) Application No. AU 2009200339 A1
(19) AUSTRALIAN PATENT OFFICE

(54) Title
A method and device for sorting flat objects in a number of sort passes

(51) International Patent Classification(s)
B07C 3/00 (2006.01) **B07C 3/10** (2006.01)
B07C 3/02 (2006.01)

(21) Application No: **2009200339** (22) Date of Filing: **2009.01.30**

(30) Priority Data

(31) Number (32) Date (33) Country
10 2008 006 752.0 **2008.01.30** **DE**

(43) Publication Date: **2009.08.13**
(43) Publication Journal Date: **2009.08.13**

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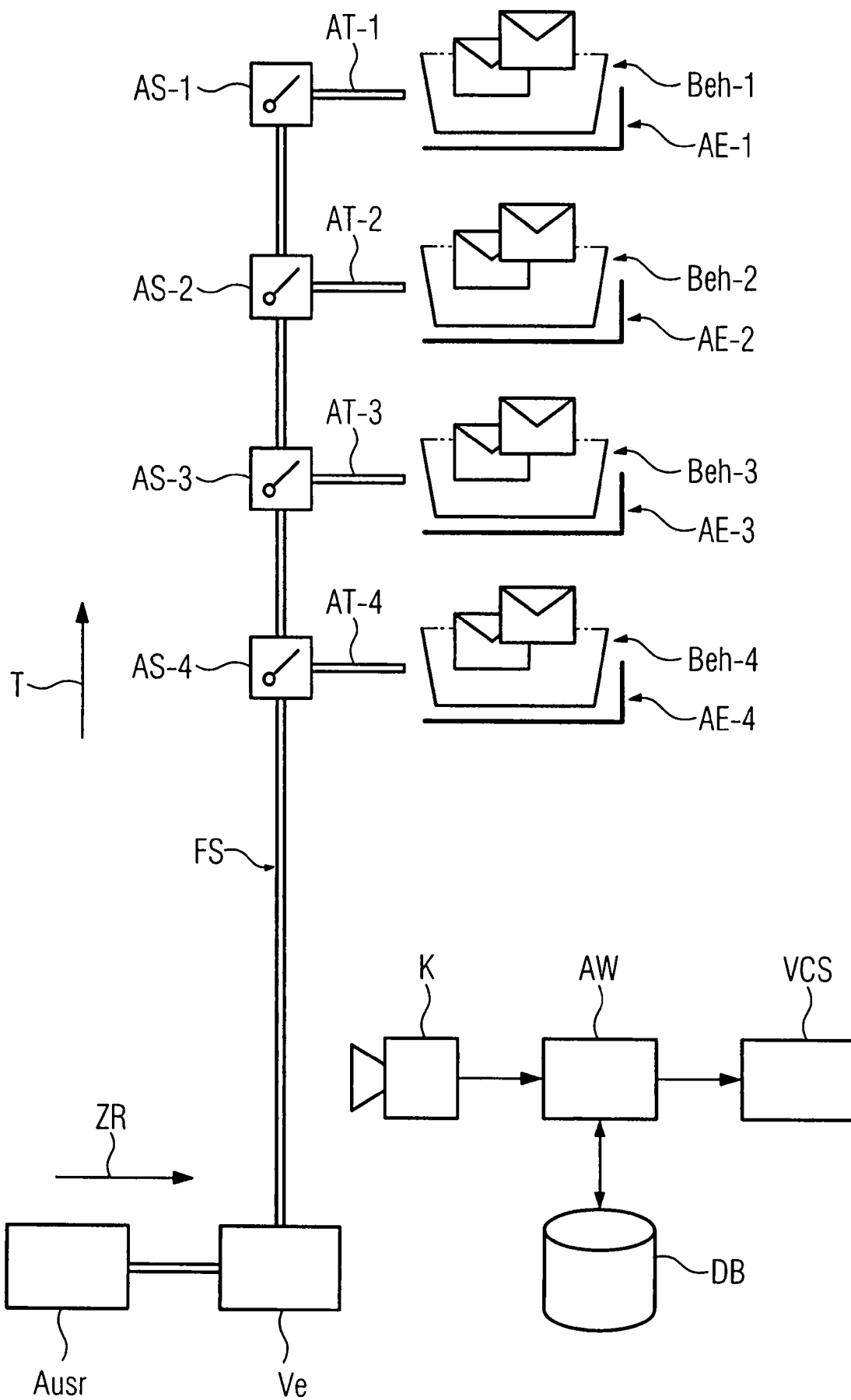
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A METHOD AND DEVICE FOR SORTING FLAT OBJECTS IN A NUMBER OF SORT PASSES

Abstract

There is disclosed herein a method and to a device for sorting a quantity of flat objects, especially of mail items. Each object passes at least twice through a sorting system with a number of output devices (AE-1, ..., AE-4, AE). In each pass of an object the sorting system determines a destination identification (ZA-1, ZA-2, ...) of the object and discharges the object depending on the destination identification determined into one of the respective output devices (AE-1, ..., AE-4, AE). In the second sort pass the sorting system groups all objects which are provided with identifications of the same destination (ZA-1, ZA-2, ...) into at least one stack such that each stack comprises a number of objects and the objects of each stack at least partly overlap each other. The sorting system transports each stack formed in this manner to one of the output devices (AE-1, ..., AE-4, AE) and discharges it into this output device (AE).

FIG 1



2009200339 30 Jan 2009

S&F Ref: 892590

AUSTRALIA

PATENTS ACT 1990

COMPLETE SPECIFICATION

FOR A STANDARD PATENT

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Invention Title:	A method and device for sorting flat objects in a number of sort passes

The following statement is a full description of this invention, including the best method of performing it known to me/us:

A METHOD AND DEVICE FOR SORTING FLAT OBJECTS IN A NUMBER OF SORT PASSES

Background of the Invention

5 The invention relates to a method and to a device for sorting a quantity of flat objects, especially of mail items but not limited thereto.

A prior art method and device is disclosed in EP 1425113 B1 and US 2004/0182759 A1 as well as in DE 10 2004 035 365 A1. The two publications describe how mail items are sorted in accordance with a predetermined order of distribution in a sorting system and each mail item in this case passes through the sorting
10 system a number of times. After each pass except for the last the mail items are fed back again to the sorting system.

In EP 1425113 B1 and US 2004/0182759 A1 it is described how a sorting plan is generated which defines which objects are discharged into which output devices.

15 US 2005/0218046 A1 proposes creating a separate sorting plan for each pass and using it for the respective pass. The first sorting plan makes a distinction between a number of delivery point groups and the mail items for these groups output into different output devices.

EP 0999902 B1 and US 6566620 B1 use one presorting plan and a number of
20 final sorting plans. Each mail item is initially sorted in accordance with the presorting plan, is fed back to the sorting system and subsequently output in accordance with one of the final sorting plans into an output device.

To save space, it is proposed in EP 0654309 B1 and DE 69326617 T2 that a sorting system for mail items groups a number of mail items into a stack in each case. The
25 mail items of a stack overlap each other at least partly, and the stack is transported as a whole. Each such stack is created by an accumulation device. Before the stack is formed a read device reads the sorting information on the mail item. Depending on the respective sorting information, a mail item is diverted to one of the accumulation devices.

Apparatuses and methods for sorting mail items in a number of sort passes are
30 also disclosed in the following publications:

DE 10 2004 033 564 B3 and US 20070090027 A1,

DE 10 2004 056 696 B4 and US 2008/0087582 A1,

2006/100598 A1,

US 2004/0261366 A1

DE 10 2005 055 B3 and 2007/057078 A1.

It is desirable to provide a method and a device in which, for the second sort pass with the same number of possible destination points, fewer output devices are needed than with known methods and yet it is still made possible for all objects to be discharged
5 in accordance with a predetermined sequence among the destination points into the at least one output device used in the second sort pass.

It is the object of the present invention to substantially overcome or at least ameliorate one or more of the prior art disadvantages or at least provide a useful alternative.

Summary of the Invention

In one aspect, the present invention provides a method for sorting a quantity of flat objects, with

each object of the quantity being provided with a respective identifier of a
15 destination point, to which the object is to be transported.

each object passing at least twice through a sorting system with a number of output devices and

the sorting system, in each pass of an object, determining the destination identification of the object and discharging the object, depending on the destination
20 identification determined, into one of the respective output devices,

with the sorting system distributing the objects in the first sort pass to a number of output devices so that it discharges each object into that output device which is assigned to the respective destination of the object,

after the first pass each object is taken out of the respective output device and fed
25 to the sorting system again,

with the objects being fed to the sorting system such that,

when they are fed, a mixture of objects from different output devices is avoided and the objects will be fed in accordance with a predetermined feed sequence among the output devices used in the first sort pass,

30 wherein,

during the second sort pass the sorting system groups

– all objects which are provided with identifications of the same destination point into at least one stack in each case, such that

each stack comprises a number of objects,

all objects of a stack are provided with identifications of the same destination point, and

the objects of each stack at least partly overlap each other, and

- transports each stack formed in this way to one of the output devices and discharges it into this output device.

In another aspect, the present invention provides a sorting system for sorting a quantity of flat objects, with

each object of the quantity being provided with a respective identifier of a destination to which the object is to be transported and

the sorting system

- featuring a number of output devices and
- being designed so that each object passes through the sorting system at least twice,

with the sorting system being designed, in each pass of an object

- to determine the destination identification of the object and
- to discharge the object depending on the destination identification determined into one of the respective output devices,
- with the sorting system during the first sort pass distributing the objects to a number of output devices so that each object is discharged into that output device which is assigned to the respective destination point of the object,

with the sorting system being further designed so that

- after the first pass each object is taken out of the respective output device and fed to the sorting system again,
 - with the objects being fed to the sorting system such that, when they are fed, a mixture of objects from different output devices is avoided and the objects will be fed in accordance with a predetermined feed sequence among the output devices used in the first sort pass,
- wherein,

the sorting system is further designed so that in the second sort pass

- all objects which are provided with identifications of the same destination point are grouped into at least one stack in each case,

each stack includes a number of objects,

all objects of a stack are provided with identifications of the same destination point, and

the objects of each stack at least partly overlap, and

- to transport each stack formed in this manner to one of the output devices and discharge it into this output device.

Advantageous embodiments of the present invention will now be described.

5 In accordance with the preferred embodiment a quantity of flat objects is sorted. Each object of this quantity is provided with an identification of a destination point to which the object is to be transported.

Each of these objects passes at least twice through a sorting system with a number of output devices.

10 When an object passes through the preferred embodiment of the sorting system in the first pass, this sorting system executes the following steps:

- It determines the destination point identification of the object.
- It discharges the object into one of the respective output devices.
- In this case the sorting system distributes the objects to a number of output devices. The sorting system does this by discharging each object into that output device 15 which is assigned to the respective destination point of the object.
- Each object is taken after the first pass from the respective output device and fed back to the sorting system again.
- When the object is fed back a mixture of objects from different output devices is avoided and the objects are fed in accordance with a predetermined feed sequence among 20 the output devices used for the first sort pass.

This preferred embodiment sorting system, when an object passes through the sorting system in the second sort pass, then executes the following steps:

- It determines the destination point identification of the object.
- 25 - It groups all objects which are provided with the identifications of the same destination point into at least one stack in each case.
- This grouping is undertaken such that each stack comprises a number of objects and the objects of each stack at least partly overlap with each other. Each stack consists exclusively of objects which are provided with identifications of the same destination 30 points. Thus no stack comprises two objects with identifications of different destination points.
- If only one object or no object at all is to be transported to a destination point, the sorting system does not form any stack for this destination point, but transports the object onwards individually.

- The sorting system transports each stack formed in this way to one of the output devices and discharges the stack into this output device.

Each flat object generally extends in one object plane. Because the objects are grouped into stacks in the second sort pass, less space is needed for the second sort pass. This is because a stack occupies less space during transport in a direction of conveyance in parallel to the object plane of the objects in the stack than if the objects were to be transported behind each other and with spaces between them.

The objects generally pass through the sorting system one after another in the second sort pass. If a stack were to contain objects for different destination points, subsequent objects for one of these destination points would have to be pushed in between already stacked objects in order to preserve a predetermined sequence among the destination points after the discharging of the second sort pass. Or objects for the same destination points would have to be buffered, so that the sequence among destination points is adhered to in the one stack, which demands space as well as additional outlay in apparatus.

There is also a saving on output devices in the second sort pass by grouping objects into stacks in the sorting system instead of only forming stacks after discharging the objects. The sorting system is able to convey objects one after the other to a first and a further stack and subsequently discharge these two stacks into the same output device. Without the invention two output devices would be needed.

With the known methods, when the sorting system discharges the objects in the first sort pass into N_1 output devices and in the second sort pass into N_2 output devices, it is able to sort to a maximum of $N_1 * N_2$ different destination points. By contrast, the preferred embodiment of the present invention enables sorting to more than $N_1 * N_2$ different destination points.

This advantage is obtained because the objects with the same destination points are grouped before discharge into at least one stack and this stack consists exclusively of objects with identifications of the same destination point. The stacks occupy less space than non-stacked objects. Instead of only collecting the objects after the second sort pass into a predetermined sequence among the output devices, the preferred embodiment allows objects for the same destination point to be grouped into stacks before being discharged and then different stacks to be discharged into the same output device, with the predetermined sequence among the destination points defining the sequence in which the stacks are discharged into the same output device.

In one embodiment the sorting system in the second pass discharges all objects one after the other into the same output device. This output device can simultaneously be that device which is first in the feed sequence which will be emptied in the first sort pass and thus is the first to become free again. This embodiment saves on output devices, because in the second sort pass only a single output device is used.

In one embodiment at least one output device is used in both sort passes. In the second pass the sorting system discharges at least one stack into one of those output devices (AE-1) into which it has discharged at least one object in the first pass.

In a development of this embodiment the output device used in both sort passes is that which was the first to be emptied after the first sort pass and thus is the first to be available again for discharging mail items. The sorting system also discharges all objects which it has discharged in the first sort pass into the first output device (AE-1) of the feed sequence into this output device (AE-1) in the second sort pass.

As already stated, a number of objects which are provided with identifications of the same destination point are grouped into at least one stack in the second sort pass. The grouping of objects with identifications of the same destination points is preferably aborted if at least one of the following two events has occurred:

- For this destination point each object with an identification of this destination point is contained in one of the stacks previously formed. In other words: Each object which is now passing through the sorting system in the second sort pass is to be transported to another destination point and thus is either to be discharged alone or into another stack.

- A parameter of a previously formed stack reaches a predetermined limit.

This limit is preferably predetermined as a function of boundary conditions which are set by the sorting system, e.g. by the transport device which discharges each stack to an output device in each case. The stack may especially not be thicker than a predetermined thickness limit.

In one embodiment the thickness of each object is measured. In another embodiment an average thickness of each object is used, and a number of limits are derived from the thickness limit. The grouping of objects into a stack is then ended at the latest when the number of objects in the stack has reached the numerical limit.

It is also possible for the objects with identifications of the same destination point to be distributed to a number of stacks, e.g. because a single stack has not been able to be discharged. Preferably these several stacks are discharged directly after one another

into the same output device, i.e. so that there is no stack with objects with other identifications between two such stacks. Different objects with identifications of the same destination point can be transported together to this common destination point.

Preferably the sorting system includes a number of accumulation devices. At least one accumulation device is assigned to each destination point. In the second sort pass the sorting system transports each object to an accumulation device which is assigned to the destination point of this object. The accumulation device groups into at least one stack all supplied objects which are provided with identifications of the same destination point and were fed to the accumulation device. It is possible for objects for the same destination point to be divided between a number of stacks. The accumulation device ends this grouping of objects to at least one stack as soon as it is evident that in the second sort pass there are no further objects with an identification of this destination point.

Preferably the first sort pass includes a count for each destination point of how many objects are provided with identifications of this destination point. This information is stored and used in the second sort pass in order to end the stack formation as just described.

Preferably a sorting plan assigns one output device to each destination point for the first sort pass. In one embodiment the accumulation devices are assigned to the destination points such that those destination points to which the same output device is assigned in the first sort pass are distributed in the second sort pass to different accumulation devices.

As already stated, the objects are fed after the first sort pass in accordance with a feed sequence among the output devices back to the sorting system. Thus the objects from a first output device are initially fed back to the sorting system. Each of these objects is transported to that accumulation device which is assigned to the destination point of this object. The accumulation devices group the objects from the first output device into stacks, provided a number of objects are to be transported to the same destination point. This stack will be discharged. Thereafter the accumulation devices are available for grouping the objects from the second output device into stacks, and so forth.

The flat objects are for example mail items or baggage from travelers or freight items or also flat objects which are to be transported within a production system to different production lines, or also flat foodstuffs.

Brief Description of the Drawings

The invention is illustrated below with reference to an exemplary preferred embodiment. The figures show:

- Fig. 1 schematic components of the sorting system during the first sort pass;
- Fig. 2 schematic components of the sorting system during the second sort pass;
- Fig. 3 a sorting plan for the sorting system of Fig. 1 and Fig. 2;
- Fig. 4 a schematic diagram of an accumulation device.

Detailed Description of the Preferred Embodiments

In the exemplary embodiment the flat objects are flat mail items, e.g. letters, postcards or newspapers. Each mail item is provided with an identification of a delivery address or of another delivery point to which this mail item is to be transported. In one embodiment this identification is attached to the mail item itself. In another embodiment the identification is stored in a database and will be assigned to the mail item. These delivery points function as the destination points of the objects.

Each mail item to be transported passes through the same sorting system at least twice – i.e. in two sort passes. Fig. 1 shows schematic components of the sorting system for the first sort pass. Fig. 2 shows schematic components of the sorting system for the second sort pass.

This sorting system possesses a number of output devices AE-1, ..., AE-4, AE for discharging mail items. An output device can for example comprise a supporting surface for a container and the mail items will be discharged into the output device so that the sorting system puts them into a container on the supporting surface. Or the output device has the form of an output compartment into which the sorting system discharges mail items. It is also possible for the output device to comprise an output location and a container, for the container to be temporarily linked to the output point and for the sorting device to fill this container. The filled container is removed and replaced by an empty container.

Fig. 1 shows four typical output devices AE-1, AE-2, AE-3 and AE-4. These will be emptied after the first sort pass with the aid of the containers Beh-1, Beh-2, Beh-3 and Beh-4.

In exceptional cases a mail item only passes through the sorting system once. Such an exceptional case occurs if the mail item is addressed to a recipient of numerous

mail items and a separate output device is reserved for this recipient. An exception case also occurs if, during the first pass of a mail item, it is determined that this mail item cannot be machine-processed, i.e. the sorting system cannot process this mail item automatically.

5 All other mail items pass through the sorting system twice since they are brought by the sorting in a predetermined sequence of distribution ("delivery point sequence") among the delivery address and because there are many more possible delivery addresses than output devices. Thus it is not possible to provide a separate output device for each delivery address in each case. In the exemplary embodiment the sorting system can only
10 discharge a mail item so that the mail item arrives behind an already discharged item but not between two previously selected mail items.

The sorting system comprises the following components:

- At least one feed device ZE (feeder) with an alignment device Ausr and a separator Ve,
- 15 – A read device with a camera K,
- The output devices already mentioned,
- A transport device with a conveyor FS and a specific transport path Tp, which leads to one of the identified output devices AE, and
- An evaluation unit AW with a database DB.

20 A stack with mail items is repeatedly placed on a conveyor belt of the feeder ZE. This stack originates for example from another sorting system or a post office or from a mailbox. The conveyor belt transports the stack in a feed direction ZR initially to the alignment device Ausr and subsequently to the separator Ve. This separator Ve extracts each mail item from the stack individually, and does so in a direction at right angles to the
25 feed direction ZR.

The transport device transports each mail item in turn to different processing devices of the sorting system. Preferably the transport device comprises a system of driven endless conveyor belts. Two conveyor belts in each case clamp an upright mail item – or also a stack of upright mail items which partly overlap – temporarily between
30 them and transport the mail item or the stack, with the two conveyor belts turning at the same speed. The transport device can have additional underfloor conveyor belts on which the mail items stand.

The camera K of the read device creates a processable image of each mail item. This image contains an image of the delivery address identification. The evaluation unit

AW of the read device initially attempts to read the delivery address automatically by using "Optical Character Recognition" to find and evaluate the delivery address identification. If it is not successful, the image of the mail item is sent to a video coding station VCS and an operator enters the delivery address – or at least a part thereof, e.g. the
 5 Zip code.

Depending on the delivery address recognized, the sorting system discharges each mail item into one of the output devices AE-1, AE-2, AE-3, AE-4, AE. This comprises the step of the transport device transporting the mail item to the respective output devices. In the example the mail item is initially transported Fig. 1 in the first
 10 sorting run onto the conveyor FS. Depending on the delivery address, one of the four discharge switches AS-1, AS-2, AS-3 and AS-4 discharges the mail item onto one of the four discharge transport paths AT-1, AT-2, AT-3, AT-4. Via the respective extraction transport path the mail item arrives at one of the output devices AE-1, AE-2, AE-3 or AE-4.

15 As already mentioned, each mail item passes at least twice through the sorting system. In the exemplary embodiment the first sort pass is fully completed before the second sort pass begins.

The sorting system evaluates a sorting plan available for processing. This sorting plan defines at least the following:

- 20 – For each possible delivery address the output device into which the mail items addressed to this delivery address are to be discharged in the first sort pass,
- A feed sequence among the output devices which defines the sequence in which the output devices are to be emptied and the mail items from these output devices are to be fed back to the sorting system,
- 25 – For each output device and for the delivery addresses which are assigned to these output devices, a discharge sequence in each case which is taken into account in the second sort pass, and
- an assignment of delivery addresses to accumulation devices

Fig. 3 which is explained below shows a sorting plan for the sorting system of
 30 Fig. 1 and Fig. 2. In this example 16 possible delivery addresses ZA-1, ..., ZA-16 are distinguished. The lines assign each of these 16 delivery addresses to a respective output device for the first sort pass. For example each of the delivery addresses ZA-5, ZA-6, ZA-7 and ZA-8 is assigned to the output device AE-2. In addition this sorting plan defines as

the feed sequence the sequence AE-1, then AE-2, then AE-3 and then AE-4 among the output devices.

For the second sort pass the sorting plan of Fig. 3 defines the following discharge sequence:

5 The mail items which are discharged in the first sort pass into AE-1 are discharged in the discharge sequence ZA-1, ZA-2, ZA-3, ZA-4.

After the two sorting runs the mail items are sorted according to their delivery addresses such that the feed sequence among the output devices and among the delivery addresses of an output device the discharge sequence of the sorting plan is adhered to.

10 The sorting plan of Fig. 3 causes the mail items to be discharged after the second sort pass in the global sequence of distribution ZA-1, ZA-2, ..., ZA-16.

In one embodiment all mail items will be discharged in the second sort pass into the same identified output device AE. This embodiment facilitates the transporting away of the discharged mail item. This is because the one identified output device AE only
15 needs to be emptied if a predetermined fill level is reached. Until this time the sorting system can conduct the second sort pass automatically without a full output device interrupting the execution. However it is also possible to empty the identified output device AE beforehand, e.g. if all mail items of the quantity addressed to a predetermined delivery area which consists of a number of delivery addresses, have been discharged into
20 the identified output device AE and the transport to this delivery area is to begin immediately.

In the first sort pass the mail items pass through the sorting system with an unpredictable sequence among the delivery addresses. The mail items originate for example from other sorting systems or from mailboxes or from reception points, e.g. post
25 offices. In both sort passes all mail items of a quantity are processed, e.g. all mail items which are supplied within a predetermined period and a predetermined district.

During the first sort pass the sorting system creates in the exemplary embodiment a data record for each mail item in each case which has passed through the sorting system in the first sort pass. After completion of the first sort pass the sorting
30 system thus "knows" for each delivery address how many mail items are to be transported to this delivery address in each case.

In one embodiment, for each delivery address, by evaluating the stored information, the sorting system counts how many mail items addressed to this delivery address pass through the sorting system in the first sort pass.

In one variation the thickness of each mail item is measured in addition or instead. For each delivery address the sorting system adds the thicknesses of the mail items addressed to this delivery address. After completion of the first sort pass the sorting system knows the overall thickness of the mail items addressed to this delivery address.

5 The sorting system uses the numbers or the total thicknesses of the stack in the second sort pass in order to avoid creating stacks which are too thick and thereby the occurrence of congestion in the conveyor device. It is also possible to measure the thickness of each stack directly.

10 In order to empty the output devices and feed the mail items to the feed unit again a transfer bridge is used in one embodiment. Such a transfer bridge is known for example from EP 0634957 B1, DE 4236507 C1 and EP 1608470 B1. It is also possible to empty each output device manually and to transport the mail items in containers to the feeder for example.

15 The mail items pass through the feeder in the second pass precisely as they do in the first pass. The mail items are separated. Subsequently the sorting system determines the respective delivery address of each mail item.

20 It would be very impractical for the read device to have to read the delivery address again for the second sort pass. The classical method of avoiding this is for the sorting system to print a delivery address code during the first sort pass onto the mail item, e.g. in the form of a bar code. In the second sort pass the sorting system reads this bar code. Each further new sorting system through which the mail item passes also reads this bar code.

25 Frequently however there is no desire to provide a mail item with a bar code. An agreement of the Universal Postal Union (UPU) makes provision for international mail items not to be provided with a bar code since as a rule different postal service providers use different systems of encoding.

30 Thus in the exemplary embodiment a method is employed which is has become known as a "fingerprint" or also "virtual ID" and is described for example in DE 4000603 C2 and EP 1222037 B1 and which enables the sorting system to determine that delivery address which was read during the first pass, without use of a bar code, without having to read it again and without printing a bar code on it.

In the exemplary embodiment different features of a mail item are predetermined, which can be measured from outside while the mail item is passing through the sorting system. Examples of such features are

- Dimensions of the mail item,
- The distribution of gray values and/or color tones on a surface of the mail item,
- The position and dimensions of the franking mark,
- The position and size of the address block and/or the sender's details as well as
- 5 - Parameters of the delivery address, e.g. the Zip code.

In the exemplary embodiment the sorting system has a database DB. As soon as a mail item passes through the sorting system for the first time, the evaluation unit AW generates a data record for this mail item and stores it in the central database. This data record includes

- 10 - A unique identifier of the mail item,
- The destination address which the first sorting system has read, as well as
- Optionally further parameters of the mail item, e.g. its weight or its franking.

The identifier distinguishes the mail item from all other mail items passing through the sorting system within a specific period. The period of time is three hours for
15 example.

During the first pass the sorting system measures for each mail item which passes through the sorting system and for each predetermined feature the value which this feature assumes for this mail item. This means that during the first pass the sorting system creates a feature vector for the mail item. For N features this feature vector consists of N
20 feature values. The data record for the mail item also includes the feature vector as well as the delivery address.

Whenever the mail item passes through a sorting system again, this sorting system once again measures for each feature the respective value which the feature assumes for this mail item. The sorting system thus likewise creates a feature vector for
25 the mail item which consists of N feature values. This second feature vector will be compared with the feature vectors of data records which are stored in the database DB. This process finds the data record which was created during the first pass of the mail item through the sorting system and originates from the same mail item. The sorting system uses the delivery address of this data record as the delivery address to which this mail
30 item is to be transported.

Each mail item is subsequently transported during the second pass through the sorting system to a specific transport path Tp. The steps of determining the read result and transporting the mail item can overlap in time. In one embodiment the sorting system activates this transport path Tp separately for the second sort pass, while it is not used for

the first sort pass. The transport path Tp leads in the exemplary embodiment to the one identified output device AE which is used in the second sort pass.

It is possible for the identified output device AE to which the transport path Tp leads to be that output device AE-1 which, in accordance with the feed sequence, will be the first to be emptied after the first sort pass. The first output device AE-1 = AE is also used in both sort passes. The emptying of the first output device AE-1 is completed before the stack with the mail items is discharged once more from this output device AE-1 in the second sort pass. Thus this output device AE-1 = AE can be used both in the first and also in the second sort pass.

A number of accumulation devices SB-1, SB-2, SB-3, SB-4 are provided in the transport path. Each accumulation device is assigned a number of delivery addresses by the sorting plan. The delivery addresses to which the same output device is assigned for the first sort pass are assigned different accumulation devices in pairs, i.e. no two of these delivery addresses to the same accumulation device. The discharge sequence which predetermines the sorting plan for the delivery addresses of the same output device and for the same sort pass is the same as the sequence among the accumulation devices for these delivery addresses. The discharge sequence thus defines the sequence among the accumulation devices.

In the second sort pass those mail items initially pass through the sorting system which are taken according to the first sort pass from that output device AE-1 which occurs as the first device in the feed sequence. As already stated, the sorting system determines the delivery address of each of these mail items from AE-1. Depending on the delivery address, the sorting system determines the accumulation device for this mail item. In the first embodiment the sorting system includes so many accumulation devices that two mail items from AE-1, which are to be transported to different destination addresses, reach two different accumulation devices because each accumulation device is only assigned a destination address such as is assigned in the first sort pass AE-1. This case is illustrated by Fig. 3. The sorting system discharges the mail item from this accumulation device into the transport path Tp.

In a second embodiment there are not sufficient accumulation devices. In this second embodiment at least two different destination addresses ZA-x, ZA-y, which are both assigned in the first sort pass AE-1, are assigned to at least one accumulation device SB-z. The accumulation device SB-z first forms one or more stacks for all mail items with the destination address ZA-x. The sorting system "knows" when all mail item with

the destination address ZA-x have passed through this accumulation device SB-z. As soon as this is the case the sorting system discharges the stack with mail items addressed to the destination address ZA-x. The accumulation device SB-z is then available for the mail items addressed to the destination address ZA-y. If a mail item addressed to the destination address ZA-y has already reached the conveyor FS before all mail items addressed to the delivery address ZA-x have passed through the accumulation devices SB-z in the second sort pass, the mail items will be buffered at the destination address ZA-y, for example by moving around a loop of the conveyor FS until the accumulation device SB-z has become free again.

10 In both cases each accumulation device first groups all mail items addressed to a destination address into one or more stacks, before this accumulation device groups mail items address to other destination addresses into a stack. The stacks with mail items addressed to the same destination address are discharged directly after each other into the transport path, i.e. without a stack with mail items being pushed to other destination addresses between two stacks with the same destination address.

As stated above, the sorting system "knows" after the first sort pass for each destination address how many mail items addressed to this destination address are to be sorted. To do this the sorting system accesses the stored information. In the second sort pass the sorting system counts for each sort pass how many mail items which are respectively assigned to this destination address have reached and passed through that accumulation device. If all mail items addressed to a destination address have reached the respective accumulation device, the accumulation device completes the grouping of the mail items for this destination address and discharges the stack or the stacks into the transport path Tp. This embodiment ensures that each stack consists exclusively of mail items which are to be transported to the same destination address.

After all mail items from the first output device AE-1 have passed through the sorting system, first of all those mail items pass through the sorting system which were removed after the first sort pass from that output device AE-2 which occurs as the second device in the feed sequence, and so forth.

30 As explained above, the sorting system "knows" after the first sort pass, for each destination address, how many mail items for this destination address are present and will pass through the sorting system in the second sort pass. Thus the sorting system "knows" in the second sort pass for each destination address, when all mail items for this destination address are fed back to the sorting system. As soon as

Fig. 4 shows schematically the accumulation device SB-1 with an accumulation device. This example shows the following conveyor devices:

- A first conveyor device FV-1 with the two driven endless conveyor belts F7 and F8,
- 5 – A second conveyor device FV-2 with the two driven endless conveyor belts F5 and F6,
- A third conveyor device FV-3 with the two driven endless conveyor belts F1 and F4 and
- A fourth conveyor device FV-4 with the two driven endless conveyor belts F2 and F3.

The first conveyor device FV-1 belongs to the incoming discharge transport path AT-1 of Fig. 2. The second conveyor device FV-2 is a component of the first accumulation device SB-1. The third conveyor device FV-3 and the fourth conveyor device FV-4 lie in the transport path Tp.

- 15 There is already a sequence of mail items in the transport path Tp, preferably in the form of further small stacks, between which a gap occurs in each case. These small stacks come from other accumulation devices, the mail items of these other small stacks were discharged via other discharge transport paths.

- 20 The small stack of the accumulation device SB-1 is to be inserted into a gap between other accumulation devices in the transport path Tp. Individual mail items are also transported in transport path Tp, because these are too thick to be collected into a small stack for example.

- 25 In the example depicted in Fig. 4 a small stack St-1 and an individual mail item Ps-3 are located in the transport path Tp. After all small stacks with mail items addressed to the respective delivery addresses have been formed, the sorting system transports

- the individual mail item Ps-3,
- the small stack with Ps-1 and Ps-2 and
- the small stack St-1.

in turn in the direction of conveyance T

- 30 The two mail items Ps-1 and Ps-2 are to be grouped beforehand into a small stack and are to be inserted between the small stack St-1 and the further mail item Ps-3. After the insertion the mail items should be transported so that there is a gap both between the mail item Ps-3 and the small stack with the mail item Ps-1 and Ps-2 and also between the small stack and the further small stack St-1.

With the aid of a light barrier in the incoming discharge transport path AT-1 the length of the first small stack to be inserted is also determined. If this length of the small stack has reached a predetermined length barrier, a further stack is preferably formed.

The operation of the accumulation device SB-1 is described below in greater
5 detail with reference to Fig. 4.

The accumulation device SB-1 which is shown in Fig. 4, comprises the conveyor belts F5 and F6 and the rollers around which these two conveyor belts F5 and F6 are guided. The incoming discharge transport path AT-1 is formed inter alia by the conveyor belts F7 and F8. This transport path opens out into a further transport path, namely the
10 transport path Tp for identified output devices AE, which comprises the conveyor belts F1, F2, F3 and F4 and in which a small stack St-1 is already located.

In one embodiment the mail items are diverted while they are passing through the accumulation device SB-1. The direction of conveyance in which they are transported is thus changed by an angle α which preferably lies between 30 degrees and 60 degrees,
15 e.g. it is equal to 45 degrees.

A preceding mail item Ps-1 is transported by a first conveyor device FV-1 (endless conveyor belt and opposing conveyor element) in the old direction of conveyance T alt, and is transported until the point at which the mail item Ps-1 is gripped by a second conveyor device FV-2. In the example depicted in Fig. 4 this first conveyor
20 device FV-1 comprises the conveyor belts F7 and F8. A second conveyor device FV-2 comprises the conveyor belts F5 and F6. The second conveyor device FV-2 diverts the mail item Ps-1 by the angle α into the new direction of conveyance and transports the mail item Ps-1 far enough for it no longer to be gripped by the first conveyor device FV-1 (with F7 and F8). Subsequently the second conveyor device FV-2 stops or slows down
25 the further transport of the preceding mail item Ps-1. This requires the mail item Ps-1 to no longer be gripped by the first conveyor device FV-1, since it would otherwise be clamped by the two conveyor devices FV-1 and FV-2.

The first conveyor device FV-1 transports a subsequent mail item Ps-2 far enough for it to strike the stopped preceding mail item Ps-1 at an angle. During the
30 stopping process the preceding mail item Ps-1 – seen in the old direction of conveyance T alt – lies before an endless conveyor belt F6 of the second conveyor device FV-2. This means that the arriving subsequent mail item Ps-2 cannot bend the stopped preceding mail item Ps-1 on arrival, but is diverted because the first conveyor device FV-1 transports the

subsequent mail item Ps-2 further in the old direction of conveyance T alt until the second conveyor device FV-2 has caught the subsequent mail item Ps-2.

The second conveyor device FV-2 grips the preceding and the subsequent mail item. These now overlap at least partly. This forms a small stack consisting of the preceding mail item Ps-1 and the subsequent mail item Ps-2. The accumulation device
5 SB-1 later transports this small stack away in the new direction of conveyance T, with the second conveyor device FV-2 transporting the small stack with Ps-1 and Ps-2 onwards.

The mail items are as a rule rectangular and thus each have a front edge – seen in the direction of conveyance T alt and T. By means of a light barrier Li in the incoming transport path AT-1 the point in time at which the front edge of the preceding mail item
10 Ps-1 and the point in time at which the subsequent mail item Ps-2 passes the light barrier Li are measured. The transport speeds of the two conveyor devices FV-1, FV-2 are controlled and are thus also known. The second conveyor device FV-2 transports the preceding mail item Ps-1 far enough in the new direction of conveyance for its front edge
15 to be located in a defined position when the rear edge is no longer gripped by the first conveyor device FV-1. The point at which the front edge of the subsequent mail item hits the stopped preceding mail item Ps-1 thus has a known and adjustable minimum gap from the front edge of the preceding mail item Ps-1. This gap is preferably as small as possible, so that the overall length of the small stack is as small as possible.

Preferably the light barrier Li in the incoming transport path AT-1 also measures
20 the point in time at which the rear edge of the two mail items Ps-1 and Ps-2 pass the light barrier Li. From this information and the speed of transport of the first conveyor device Fv-1 and the above-mentioned distance between the front edge of the preceding mail item Ps-1 of the arrival point, the overall length of the small stack now formed with Ps-1 and
25 Ps-2 is computed.

The sorting system initially undertakes the already described formation of stacks for all mail items, which after the first sort pass were taken out of the first output devices AT-1. The sorting system determines when this stack formation for the mail item is completed for the first output device AE-1. All these mail items are now distributed to the
30 stacks at the accumulation devices SB-1, ..., SB-4. It is naturally possible for a stack to consist of only a single mail item, because namely only a single mail item of the quantity is to be transported to this delivery address. It is also possible for there to be no mail items at all at an accumulation device, because no mail item is to be transported to the assigned delivery address.

After the sorting system has finished forming the stack for the mail items from the first output device AE-1, the sorting system transports the stack along the transport path Tp. This transport path Tp is also preferably formed by a system of driven conveyor belts. Each stack is clamped at times between two conveyor belts in each case which are
5 turning at the same speed and is transported by this movement. The output conveyor devices FV-3 and FV-4 of transport path Tp can be seen in the example of Fig. 4.

Preferably the gap between two opposite rollers around which the two conveyor belts are fed can be changed, by a roller normally being able to be moved in a direction perpendicular to the direction of conveyance. This adapts the gap to stack thicknesses
10 which vary from small stack to small stack.

The sequence in which the sorting system transports the stack along the transport path Tp is the same as the discharge sequence predetermined by the sorting plan for the delivery addresses of this stack. In this sequence the stacks arrive at the identified output device AE and are discharged in this sequence into this output device AE. After the
15 discharge the stacks are located in the discharge sequence in the output device AE.

Preferably the sorting system inserts a divider element between two stacks addressed to different delivery addresses, e.g. a divider card. This divider element differs optically and/or by its dimensions from the mail items and in the identified output device AE marks the limits between the two stacks.

20 Fig. 2 shows a store Tk for divider cards. The divider cards are inserted directly into the store Tk or are inserted via the feed device ZE and via the conveyor path FS and via a specific discharge switch and a specific discharge transport path which leads to the store Tk.

In one variant two identified output devices are used for the second sort pass.
25 Two transport paths lead to these two output devices. The accumulation devices are divided between these two transport paths and this is done so that the sequence is adhered to. The accumulation devices for the first half of the discharge sequence are located in the first transport path, those for the second half in the second transport path. The stacks will in turn be discharged in accordance with the discharge sequence into the two output
30 devices.

In one embodiment of this variant the first output device AE-1 of Fig. 1 is used again in the second sort pass as the first identified output device. The other identified output device is an additional output device AE which is only used in the second, but not in the first sort pass. A first transport path Tp-1 leads to the first identified output device

AE-1, a second transport path Tp-2 to the second identified output device AE. The accumulation devices are distributed between the two transport paths. After the first sort pass the mail items from the first output device AE-1 are first fed back to the feed device ZE. The first output device AE-1 is then empty again, as is the output device AE. In the
5 second sort pass the sorting system collects these mail items together into small stacks and discharges these via the two transport paths Tp-1 and Tp-2 into the two output devices AE-1 and AE.

After all mail items have been taken out of the first output device of the feed sequence and fed back into the feed device ZE, the same is done with the mail items of
10 the second output device AE-2. The sorting system begins to form the stack for the mail items from the second output device AE-2. At the earliest it begins to do this at the point in time at which it has discharged the stack with the mail items originating from the first output device into the at least one identified output device, i.e. the second sort pass is completed for these mail items and these mail items are no longer located in the at least
15 one transport path.

It is not necessary to empty the identified output device AE before this has reached a predetermined fill level. The identified output device AE is only to be emptied after it has reached this fill level. However it is especially possible to collect mail items in the output device AE which have been discharged after the first sort pass into different
20 output devices.

In the embodiment just described each destination address is assigned a respective accumulation device. It is possible however that not all mail items addressed to a destination address are able to be grouped together into a single stack, because their dimensions differ too widely for example. Thus in an alternate embodiment each
25 destination address is assigned a number of accumulation devices, for example one accumulation device for mail items with standard dimensions ("letters") and one for large mail items ("flats").

A measuring device measures during the first sort pass the respective dimensions of each mail item. These dimensions are stored in the data record about the mail item. In
30 the second sort pass the destination address as well as the dimensions of the mail item are determined by reading the data record, and the mail item is transported depending on its dimensions to the one or to the other assigned accumulation device. In this way the accumulation device in the second sort pass creates stacks with standard letters and stacks with flats.

List of reference symbols

<i>Reference symbol</i>	<i>Meaning</i>
AE-1, AE-2, ...	Output devices for the first sort pass
AE	Identified output device for the second sort pass
AS-1, ..., AS-4	Discharge switches in the conveyor FS
AT-1, ..., AT-4	Discharge transport paths
Alignment	device of the feed device ZE
AW	Evaluation unit of the read device
Beh	Container with which the identified output device AE is emptied.
Beh-1, Beh-2	Containers with which the output devices AE-1, AE-2, ... are emptied
DB	Database of the evaluation unit
FS	Conveyor from the separator Ve to the discharge switches AS-1, ..., AS-4
K	Camera of the read device
SB-1, ..., SB-4	Accumulation devices
Tk	Store for divider cards
Tp	Transport path for identified output devices AE, is only used in the second sort pass
VCS	Video Coding Station
Ve	Separator of the feeder ZE
ZE	Feeder
ZR	Feed direction in which postal items are fed to the separator
T alt	Old direction of conveyance (along of the discharge transport path AT-1)

The claims defining the invention are as follows:

1. A method for sorting a quantity of flat objects, with
each object of the quantity being provided with a respective identifier of a
5 destination point, to which the object is to be transported.
each object passing at least twice through a sorting system with a number of
output devices and
the sorting system, in each pass of an object, determining the destination
identification of the object and discharging the object, depending on the destination
10 identification determined, into one of the respective output devices,
with the sorting system distributing the objects in the first sort pass to a number
of output devices so that it discharges each object into that output device which is
assigned to the respective destination of the object,
after the first pass each object is taken out of the respective output device and fed
15 to the sorting system again,
with the objects being fed to the sorting system such that,
when they are fed, a mixture of objects from different output devices is avoided
and the objects will be fed in accordance with a predetermined feed sequence among the
output devices used in the first sort pass,
20 wherein,
during the second sort pass the sorting system groups
– all objects which are provided with identifications of the same destination point
into at least one stack in each case, such that
each stack comprises a number of objects,
25 all objects of a stack are provided with identifications of the same destination
point, and
the objects of each stack at least partly overlap each other, and
– transports each stack formed in this way to one of the output devices and
discharges it into this output device.
30
2. The method as claimed in claim 1,
wherein,
the sorting system, for a destination point, when an object is the only object
passing through the system which is provided with the identification of this destination,

in the second sort pass transports this object spaced from the other objects to an output device and discharges it into this output device.

3. The method as claimed in claim 1 or claim 2,
5 wherein,
the sorting system employs a sorting plan in the second sort pass,
the sorting plan
- for each possible destination point of an object, defines at least one output device
 - in each case and for each output device which the sorting system uses in the
- 10 second sort pass, a destination point sequence among the destination points which is assigned to this output device,
- the sorting system, in the second sort pass, discharges the stack in accordance with the sorting plan such that,
- after discharging, each stack is located in the output device defined by the sorting
- 15 plan and
- in each output device the stacks are arranged in the destination sequence predetermined by the sorting plan.

4. The method as claimed in any one of claims 1 to 3
20 wherein,
in the second sort pass,
the sorting system either determines that at most one object to be sorted is provided with an identification of this destination point,
or
- 25 – establishes the occurrence of the event that each object with an identification of this destination point is contained in one of the previously formed stacks, and
- after occurrence of this event, ends the grouping of objects with identifications of this destination point into at least one stack and initiates the transport of each of these previously formed stacks to the respective output device.

30

5. The method as claimed in claim 4,
wherein,

for each destination point the sorting system stores the information about how many objects with an identification of this destination point have passed through the sorting system in the first sort pass, and

5 this stored information is used in the second sort pass to execute the specifications.

6. The method as claimed in any one of claims 1 to 5,
wherein,

- 10 – the sorting system, in the second pass first discharges all objects which it has discharged in the first pass into the same output device and
- subsequently the objects from the next output device in the feed sequence are fed to the sorting system.

15 7. The method as claimed in any one of claims 1 to 6,
wherein,

- the sorting system, in the second pass
- creates at least a first stack which consists of objects with identifications of a first destination point,
- creates at least one further stack which consists of objects with identifications of
- 20 a further destination point, and
- discharges the two stacks in turn into the same output device.

25 8. The method as claimed in claim 7,
wherein,
the sorting system, in the second pass
discharges all stacks into this one output device.

30 9. The method as claimed in claim 7,
wherein,
the first stack is created by a first accumulation device which is assigned to the first destination point,
the at least one further stack is created by a further accumulation device which is assigned to the further destination points,
the sorting system, in the second sort pass,

transports all objects which are provided with an identification of the first or of the at least one further destination point by means of a conveyor,

diverts each object which is provided with an identification of the first destination point from the conveyor into the first accumulation device, and

5 diverts each object which is provided with an identification of the further destination point from the conveyor into the further accumulation device.

10 10. The method as claimed in any one of claims 1 to 9,
wherein,
the sorting system in the second sort pass
– aborts the grouping into a stack of objects of an identification of a destination if a
parameter of the stack has reached a predetermined limit, and
– groups further objects with an identification of this destination into a second
stack.

15 11. The method as claimed in claim 10,
wherein,
the sorting system
– counts for each destination how many objects are provided with an identification
20 of this destination, and
– uses the number of objects of the stack as a parameter of the stack and a
maximum number as a limit.

25 12. The method as claimed in claim 10 or claim 11,
wherein,
when, during the second sort pass the sorting system divides up into a number of
stacks those objects which are provided with identifications of the same destination point,
the sorting system discharges all these stacks in turn into the same output device.

30 13. The method as claimed in claim 12,
wherein,
its thickness is used as a parameter of the stack and
the sorting system measures the thickness of each object before this object
becomes an element of a stack, and

for each destination adds the thickness of the objects with an identification of this destination.

14. The method as claimed in any one of claims 1 to 9,
5 wherein,
the sorting system
- measures for each object which value a predetermined physical parameter for this object assumes, and
 - in the second sort pass, groups the objects into stacks such that
 - 10 – the measured parameter values of the objects of a stack lie in a predetermined range of values in each case.

- 15 15. A sorting system for sorting a quantity of flat objects, with
each object of the quantity being provided with a respective identifier of a
destination to which the object is to be transported and
the sorting system
- featuring a number of output devices and
 - being designed so that each object passes through the sorting system at least
twice,
 - 20 with the sorting system being designed, in each pass of an object
 - to determine the destination identification of the object and
 - to discharge the object depending on the destination identification determined
into one of the respective output devices,
 - with the sorting system during the first sort pass distributing the objects to a
25 number of output devices so that each object is discharged into that output device which
is assigned to the respective destination point of the object,
with the sorting system being further designed so that
 - after the first pass each object is taken out of the respective output device and fed
to the sorting system again,
 - 30 – with the objects being fed to the sorting system such that, when they are fed, a
mixture of objects from different output devices is avoided and the objects will be fed in
accordance with a predetermined feed sequence among the output devices used in the first
sort pass,
 - wherein,

- the sorting system is further designed so that in the second sort pass
- all objects which are provided with identifications of the same destination point are grouped into at least one stack in each case,
 - each stack includes a number of objects,
 - 5 all objects of a stack are provided with identifications of the same destination point, and
 - the objects of each stack at least partly overlap, and
 - to transport each stack formed in this manner to one of the output devices and discharge it into this output device.

10

16. The sorting system as claimed in claim 15,
wherein,

the sorting system additionally comprises

- a first accumulation device and
- 15 – at least one further accumulation device,

the first accumulation device is embodied, in the second sort pass, to group together the objects which are provided with an identification of a first destination point into at least one first stack,

20 the further accumulation device is embodied, in the second sort pass, to group together the objects which are provided with an identification of a further destination point, into at least one further stack,

the sorting system is designed to discharge at least a first stack and the at least one further stack into the same output device.

25 17. The sorting system as claimed in claim 16,
wherein,

the sorting system additionally comprises

- a conveyor,
- a first discharge device,
- at least one further discharge device,
- 30 – a transport path,

the sorting system is designed, in the second sort pass, to transport all objects which are provided with an identification of the first or of the at least one further destination point by means of the conveyor,

the first discharge device is embodied, in the second sort pass, to divert each object which is provided with an identification of the first destination point from the conveyor into the first accumulation device,

5 the further discharge device is embodied, in the second sort pass, to divert each object which is provided with an identification of the further destination point from the conveyor into the further accumulation device,

the sorting system is embodied, by means of the transport path, to discharge the two stacks one after the other into the same output device.

10 18. A method for sorting a quantity of flat objects, the method substantially as hereinbefore described with reference to the accompanying drawings.

19. A sorting system for sorting a quantity of flat objects, the sorting system substantially as hereinbefore described with reference to the accompanying drawings.

15

Dated 29 January, 2009

Siemens Aktiengesellschaft

Patent Attorneys for the Applicant/Nominated Person

SPRUSON & FERGUSON

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FIG 1

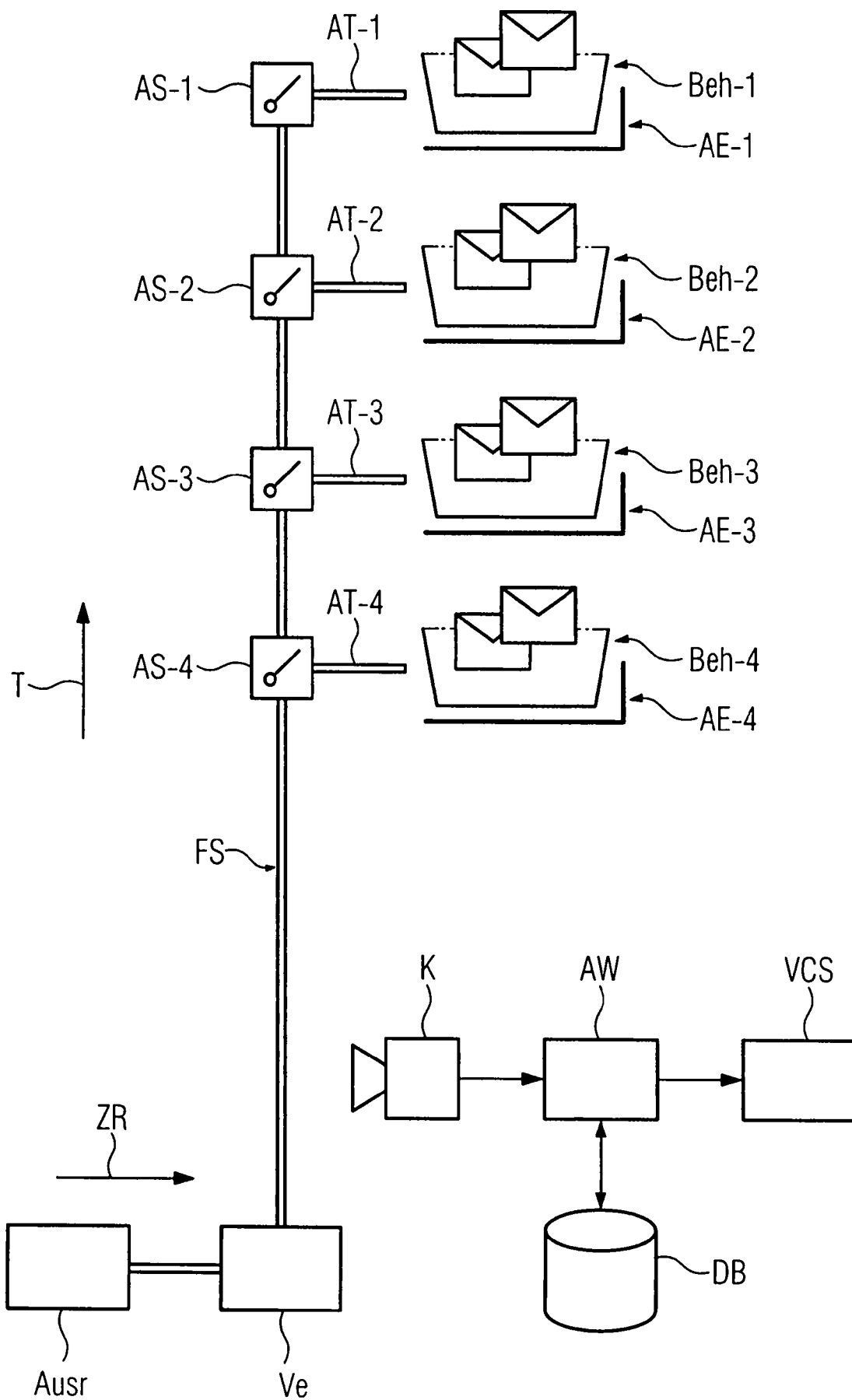


FIG 2

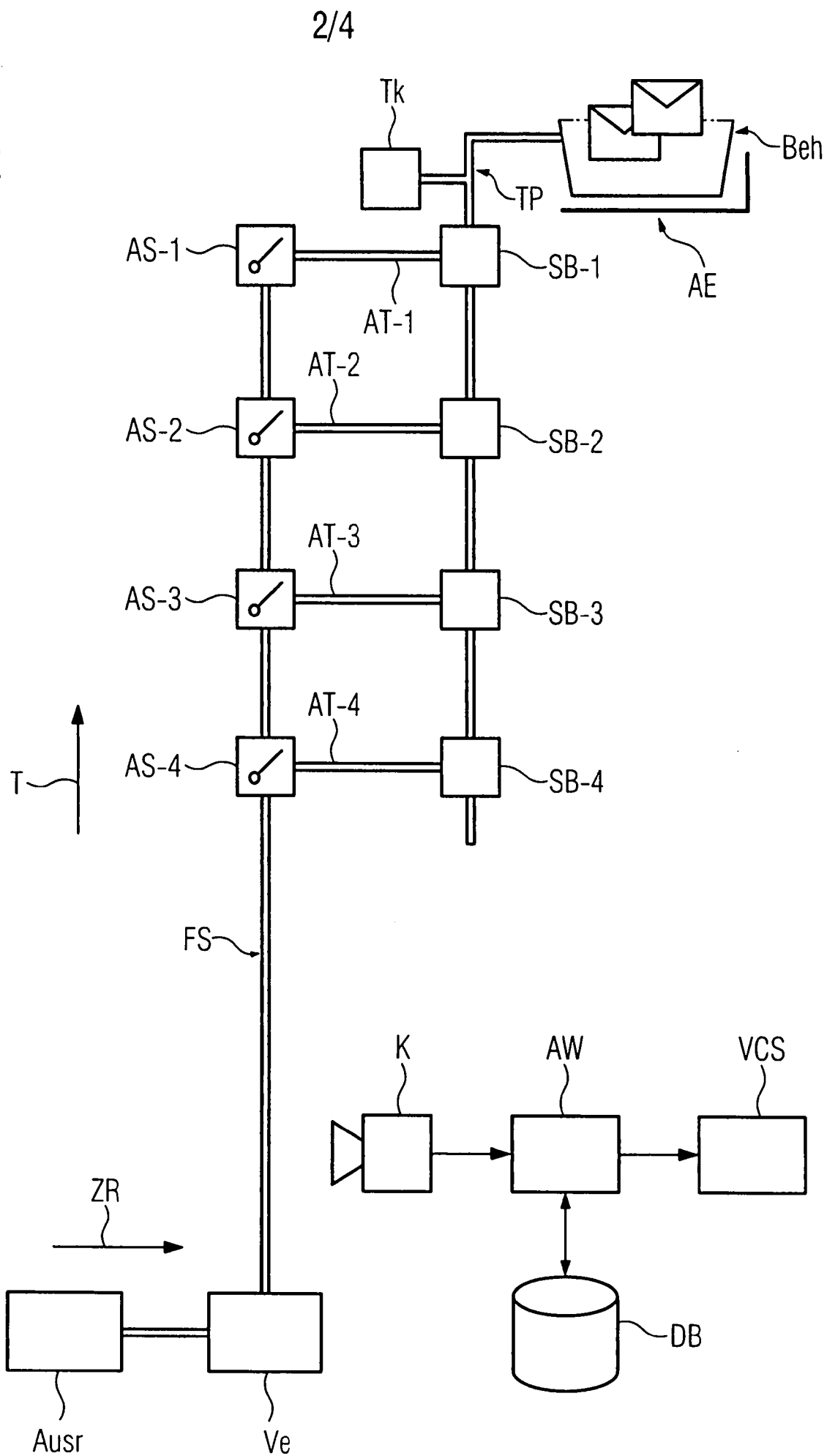


FIG 3

Delivery address				Outp. dev.	Stacker point
ZA-1	ZA-2	ZA-3	ZA-4	AE-1	SB-1
ZA-5	ZA-6	ZA-7	ZA-8	AE-2	SB-2
ZA-9	ZA-10	ZA-11	ZA-12	AE-2	SB-3
ZA-13	ZA-14	ZA-15	ZA-16	AE-2	SB-4

FIG 4

