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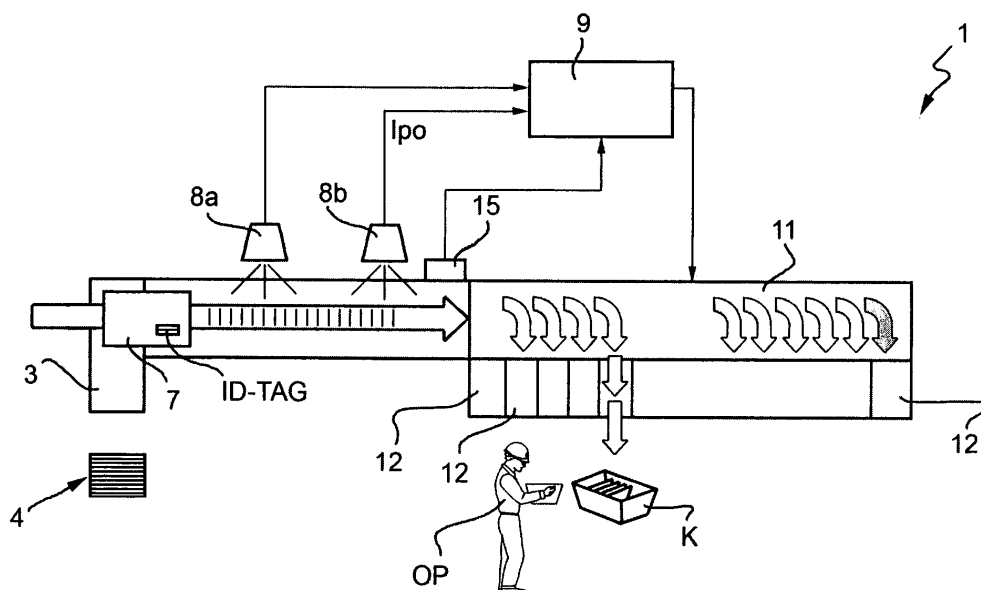
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(54) **Mail sorting device**

(57) A mail sorting device (1) having a mail receiving and singling module (3) which receives packs (4) of mail items (7) and feeds out single mail items; and a sorting module (11) input-connected to an output of the receiving and singling module (3), and which directs each incoming single mail item (7) to a selected accumulating device (12) forming part of a number of accumulating devices (12) of the sorting module (11). A measuring device (15)

upstream from the sorting module (11) determines at least one dimensional parameter (dc, de) of the single mail item fed to the sorting module (11); and the dimensional parameter information (dc, de) is associated with an indicator (E1, E2, ..., En, E20) of the selected accumulating device to perform a procedure by which to determine the fill level of the accumulating device as a function of the number and size of the mail items fed to the accumulating device.

FIG. 1



Description

[0001] The present invention relates to a mail sorting device.

[0002] Devices for sorting flat, rectangular mail items (letters, postcards, documents, magazines, etc.) are known comprising:

- a mail receiving and singling module, which receives packs (stacks) of flat, rectangular mail items, and feeds out single, i.e. physically separate, mail items spaced a minimum distance apart; and
- a sorting module, which is input-connected to an output of the receiving and singling module and, by means of deflectors, directs each incoming single mail item to one of a number of accumulating devices of the sorting module.

[0003] Each accumulating device is normally associated with one or a number of postal destinations.

[0004] Each mail item is directed to an accumulating device on the basis of data (e.g. a printed bar code and/or receiver data) on the mail item.

[0005] The sorted mail is accumulated in the accumulating devices in the form of respective packs; and, when the size of the pack exceeds the maximum capacity of the accumulating device, the sorting device is forced to direct the mail elsewhere, thus increasing operating cost.

[0006] That is, the pack must be physically removed from the accumulating device and placed inside one or more containers. When full, each container is tagged with a tag bearing a serial identification bar code and the next destination, and is sent either for further processing or to the output of the system.

[0007] The capacity of the containers normally differs from (e.g. is roughly 75% of) that of the respective accumulating device.

[0008] To avoid reaching the full capacity of the accumulating devices, the operator in charge of emptying the accumulating devices normally : checks fill-up of the accumulating devices; selects the fullest accumulating device at any given time; approaches the device; removes one or more handfuls of mail; and places the mail inside a relative container next to the accumulating device.

[0009] The full level of known accumulating devices is determined by a sensor, which detects the end position of a retaining device or separating slat retaining the front face of the pack.

[0010] In known devices, an almost- or half-full level is also indicated by a sensor, which determines the position of the retaining device (separating slat) with respect to its end position.

[0011] The half-full indication enables more effective preventive intervention by the operator than the full-level.

[0012] The full and half-full levels are normally indicated by steady or flashing lights to draw the operator's attention to the full or half-full device.

[0013] Computer machine control systems are known which, for each mail item loaded into the device and bearing a machine-readable identification code (ID-tag), record :

- the date and time the item was loaded;
- the identification code (scanned or newly printed ID-tag);
- the postal destination;
- the accumulating device the item was directed to;
- general data relating to processing or the mail stream of the item.

[0014] Known computer systems of known sorting devices employing accumulating devices of the type described fail to associate an item directed to a given accumulating device with the container used to empty the accumulating device and for transfer to further processing or to the output of the system.

[0015] This is due to the different size and capacity of the accumulating device with respect to the containers, and hence the way in which the device must be emptied. That is, systematically waiting for the device to fill up completely would result in additional cost and work to reload the items that could not be loaded into the full accumulating device during sorting.

[0016] It is an object of the present invention to provide a mail sorting device which determines the fill level of each accumulating device as a function of the number and size of the mail items fed into the accumulating device, and which, by means of a manual emptying procedure into one or more containers, provides for accurately associating a list of the mail identification codes (ID-tags) with the identification code on the container tag.

[0017] According to the present invention, there is provided a mail sorting device comprising a mail receiving and singling module which receives packs of mail items and feeds out single, i.e. physically separate, mail items; and a sorting module input-connected to an output of the receiving and singling module, and which directs each incoming single mail item to a selected accumulating device forming part of a number of accumulating devices of the sorting module; the sorting device being **characterized by comprising** a measuring device located upstream from the sorting

module to determine at least one dimensional parameter of the single mail item fed to said sorting module; the dimensional parameter information being associated with an indicator of the selected accumulating device to perform a procedure by which to determine the fill level of the accumulating device as a function of the number and size of the mail items fed to the accumulating device.

[0018] A preferred embodiment of the invention will be described with reference to the accompanying drawings, in which:

Figure 1 shows a schematic of a sorting device in accordance with the teachings of the present invention;

Figure 2 shows a portion of the Figure 1 device in more detail;

Figure 3 shows a detail of Figure 1.

[0019] Number 1 in Figure 1 indicates as a whole a mail sorting device in accordance with the teachings of the present invention.

[0020] Device 1 comprises a known mail receiving and singling module 3 (therefore not described in detail) which receives parallelepiped-shaped packs 4 (not shown to scale) of flat, rectangular mail items 7 (letters, postcards, documents, etc.), and feeds out single, i.e. physically separate, mail items.

[0021] Mail receiving and singling module 3 comprises a first known reading device 8a for recognizing a unique ID-TAG (e.g. a bar code) on each single mail item 7. The information acquired from the unique ID-TAG is transmitted to an electronic control unit 9 of device 1. Reading device 8a may be associated with a known second reading device 8b for conveniently acquiring a two-dimensional (grey-level, colour or binary) image I_{PO} of mail item 7; which image I_{PO} may be processed by automatic coding (OCR) systems of control unit 9, or by manual coding (VCD) systems for reading the address on mail item 7. If the mail item originally has no ID-TAG, one may be printed by a printer (not shown) activated after the image is processed. In which case, the on-line printed ID-TAG is read by another reading device (not shown) identical to reading device 8a and downstream from the printer.

[0022] Device 1 also comprises a sorting module 11 (shown schematically) input-connected to an output of receiving and singling module 3, and which directs each incoming single mail item 7 to one of a number of accumulating devices 12 of module 11. Each accumulating device 12 is typically associated with one or a number of postal destinations.

[0023] For example, twenty adjacent accumulating devices 12 are provided, each associated with a respective logic output indicator E1, E2, ..., En, E20.

[0024] The output is typically selected by unit 9 by means of known sorting programs employing the information in the two-dimensional image I_{PO} of the mail item and/or on the ID-TAG to select a logic output indicator E1, E2, ..., En, E20.

[0025] According to the present invention, a measuring device 15 upstream from sorting module 11 determines at least one dimensional parameter of the single mail item fed to sorting module 11. Measuring device 15 conveniently determines at least the thickness of a mail item 7, though the length and width of mail item 7 may also be determined.

[0026] The dimensional parameter information is associated, at electronic control unit 9 level, with the selected accumulating device indicator (E1, E2, ..., En, E20) in the course of a procedure (described in detail below) for real-time determining the fill level of each accumulating device 12 as a function of the number and size of mail items 7 fed to the selected accumulating device.

[0027] Figure 2 shows part of device 1 in more detail.

[0028] More specifically, module 3 comprises a push device (separating slat) 17 movable along a straight runner 18 to push pack 4, resting on a flat supporting wall 19, onto a locating wall 20 fitted with two rollers 21, which withdraw the leading item in pack 4 facing wall 20, so mail items 7 are removed one at a time (i.e. singled out) from pack 4.

[0029] The single mail items 7 are fed to the input of a known conveying system 22 (shown schematically), in which a straight conveyor belt 23, extending between end pulleys 21 and 24, feeds mail items 7, positioned substantially vertically, along a straight path.

[0030] First and second reading devices 8a, 8b are located along conveying system 22 and positioned facing belt 23.

[0031] Thickness measuring device 15 comprises a first locator (roller 26) defining a supporting position for an inner portion of belt 23; and a second locator (roller 27) located on the opposite side of belt 23 to roller 26 and having elastic means 28 for pressing roller 27 onto a flat outer portion of belt 23. Roller 27 is associated with a position sensor 29 for measuring displacement of roller 27 with respect to the supporting position and therefore the thickness d_c (dimensional parameter) of the mail item resting on belt 23 and interposed between belt 23 and roller 27.

[0032] Thickness d_c is measured with mail item 7 compressed between rollers 26 and 27 by elastic means 28.

[0033] The analog signal produced by position sensor 29 is first digitized by an A/D converter 30 and then sent to unit 9, which thus knows the thickness of each mail item travelling along the conveying system.

[0034] Downstream from rollers 26 and 27, which compress the mail item by exerting pressure on its opposite faces, the mail item may expand (as shown schematically by mail item 7 at the end of belt 23) to an unconfined thickness d_e greater than the measured thickness, i.e. ($d_e > d_c$).

[0035] In the case of a letter, for example, expansion of mail item 7 is caused by the intrinsic resilience of the folded

sheets inside the envelope of the letter.

[0036] The other dimensions (width and height) of the mail item are determined by photocells (not shown) in known manner.

[0037] Accumulating devices 12 are selected by known deflectors 31 (Figure 3) controlled by electronic control unit 9, communicating with conveying system 22, and movable between a rest position (not shown in Figure 3) in which they have no effect on the mail items travelling along conveying system 22, and an intercept position (shown in Figure 3) in which mail items 7 impinge on and are diverted by deflector 31 to the input of accumulating device 12.

[0038] Accumulating device 12 comprises an elongated accumulating bin 32, into which the mail items are fed successively to form a pack 4b of mail items in a direction D parallel to the lengthwise extension of accumulating bin 32.

[0039] Accumulating bin 32 is bounded by a flat, rectangular bottom wall 33 and two lateral walls 34. A slat 35 has an end portion that slides along a straight runner 37 fitted to a lateral wall 34. Slat 35 extends crosswise to straight runner 37, is perpendicular to bottom wall 33, and so forms a stop for a first face of pack 4b, a second face of which is defined by the last mail item 7 fed into accumulating bin 32. As mail items are fed into bin 32, the size (length L) of pack 4b increases in direction D and moves slat 35 towards a front end portion 32a of bottom wall 33.

[0040] Accumulating devices 12 are shown coplanar in Figure 1 for the sake of simplicity, but may lie in different, e.g. two or four superimposed, planes.

[0041] Accumulating device 12 may differ from the one shown in Figure 3 and comprise, for example, a bin (not shown) for accumulating mail items vertically one on top of the other. Such bins are normally arranged in a matrix structure.

[0042] As described below, packs 4b may be removed from the accumulating devices (the accumulating devices may be emptied) either manually by an operator OP (Figures 1 and 3) or by a known robot device (not shown) for transferring a group of mail items from an accumulating device to a container.

[0043] Each accumulating device 12 is associated with a printer 40 (Figure 3) for printing tags 41, and which interfaces with electronic control unit 9 and is activated by the operator pressing a button 42.

[0044] More specifically, electronic control unit 9 controls printer 40 to perform the following function :

- if button 42 is pressed when accumulating device 12 is empty, no tags 41 are produced;
- if button 42 is pressed when accumulating device 12 contains mail items, a tag 41 is produced, on which are printed the destination of the mail items in pack 4b, an identification code of pack 4b of mail items 7 in the form of a bar code, processing and system information, and the date and time the tag was printed.

[0045] For each accumulating device 12, electronic control unit 9 receives the following data :

- a) the number of mail items fed into the accumulating device;
- b) the dimensional data (minimum thickness d_c and possibly also the height and width) of each flat mail item 7.

[0046] From the sequentially acquired thickness data, the instantaneous length of the pack of compressed mail items is calculated by adding the thicknesses of the mail items travelling through thickness measuring device 15, i.e. compressed pack length $L_c = \text{sum of thicknesses } d_c$

[0047] Length L_c is calculated assuming all the mail items in the pack are compressed, i.e. are no thicker than the thickness measured when the mail item is pressed between rollers 26 and 27.

[0048] Electronic control unit 9 also calculates a decompressed pack length L_d (to allow for expansion of the mail items as described above) by multiplying length L_c by an expansion factor F_c (determined experimentally) which takes into account expansion of the accumulated mail items after they are measured (which involves compressing the mail items) :

$$L_d = L_c \times F_c$$

[0049] A first threshold value P1 defining the maximum length of a compressed pack of mail items, and a second threshold value P2 defining the maximum length of a decompressed pack of mail items are also defined; the latter maximum length being defined so the decompressed pack can be accommodated in a container K (Figure 1).

[0050] The sorting device continuously determines the following conditions for each accumulating device 12, enables or disables loading of the mail items into accumulating device 12, and accordingly indicates the fill level of the accumulating device as follows :

- a) if the decompressed pack length L_d is below first threshold P1, sorting continues normally, and no warning signal is emitted;

b) if the decompressed pack length L_d is above first threshold P_1 but below second threshold P_2 (i.e. a decompressed pack of mail items can be accommodated in container K), sorting continues, but an almost-full warning signal is emitted, for example, by flashing button 42, to indicate the accumulating device is nearly full and only a small margin remains in which to accommodate the mail items in the relative container K;

c) if the decompressed pack length L_d is just above second threshold P_2 (i.e. a decompressed pack of mail items can just about be accommodated in container K), sorting is stopped and a full warning signal is emitted.

[0051] When an almost-full warning signal is emitted, the operator OP may decide to cut off flow of the mail items from conveying device 22 to the almost-full accumulating device 12 manually, and remove the contents of the accumulating device, which can undoubtedly be accommodated in container K with no manual compression required.

[0052] When the accumulating device is emptied and relative button 42 is pressed, electronic control unit 9 associates the identification code list and characteristics of the mail items fed into the accumulating device with the container identification code printed on the tag affixed to the container by the operator, so as to record a precise trace between the mail items and container K. This is known as computer closure of the pack, and may be performed by prolonged pressure on button 42, which accordingly flashes rapidly to indicate no more mail items can be loaded into the accumulating device until the button is pressed again.

[0053] When prolonged pressure is applied on button 42, a signal is sent to electronic control unit 9 indicating closure of pack 4b of mail items, and, if the relative tag has not yet been printed, a tag 41 is printed showing the destination of the mail items in pack 4b, identification of pack 4b of mail items 7 in the form of a bar code, as well as processing and system information and the date and time the tag was printed.

[0054] Pressing the button again allows mail items to be fed once more into the accumulating device, and the button light goes off.

[0055] When length L_d exceeds second threshold P_2 , electronic control unit 9 cuts off flow of mail items 7 from conveying device 22 to the relative accumulating device 12.

[0056] This condition is indicated by a steady light of button 42.

[0057] In which case, the operator (or robot, if any) transfers the whole pack to container K, compressing the pack by hand to a greater or lesser degree, depending on the set values of thresholds P_1 and P_2 .

[0058] The operator OP then exerts prolonged pressure on button 42, in response to which the device records and associates the identification code list and characteristics of the mail items with the identification code of the container on the tag, if already printed (to effect computer closure of the pack), and button 42 flashes rapidly to indicate no more mail can be loaded into the accumulating device.

[0059] If the tag relative to the pack of mail items has not yet been printed, in response to the above command, a tag 41 is printed showing the destination of the mail items in pack 4b, identification of pack 4b of mail items 7 in the form of a bar code, as well as processing and system information and the date and time the tag was printed.

[0060] Pressing the button again allows mail items to be fed once more into the accumulating device, and the button light goes off.

[0061] The length and width data of each measured mail item 7 may be used by electronic control unit 9 to calculate the volume of the mail item as follows :

$$\text{mail item volume} = \text{width} \times \text{length} \times d_c$$

[0062] The calculated volumes may be added sequentially to calculate the volume V_p of the pack forming in each accumulating device 12; which volume information is associated with the logic output indicator.

[0063] The advantage of the invention lies in enabling a different operating procedure providing the operator with an indirect but precise indication of the actual fill level of each accumulating device.

[0064] Each container is thus filled precisely with the mail items fed into the respective accumulating device, so the computer tracking system is able to keep a record of the identification code list and characteristics of the mail items fed into the accumulating device, and accurately associate the list with the container identification code (e.g. bar code) printed by the sorting device on the container tag.

[0065] Since the containers for mail items removed from different accumulating devices 12 may differ in shape and size, thresholds P_1 and P_2 may differ from one accumulating device 12 to another.

[0066] Thresholds P_1 and P_2 may also vary according to the type of mail items being sorted, in that the best arrangement of the mail items inside the containers (fill level and density) is achieved by calculating the compression factor F_c of the mail items and setting the threshold accordingly.

Claims

1. A mail sorting device (1) comprising :

- a mail receiving and singling module (3) which receives packs (4) of mail items (7) and feeds out single, i.e. physically separate, mail items; and
- a sorting module (11) input-connected to an output of the receiving and singling module (3), and which directs each incoming single mail item (7) to a selected accumulating device (12) forming part of a number of accumulating devices (12) of the sorting module (11);

the sorting device being **characterized by comprising** a measuring device (15) located upstream from the sorting module (11) to determine at least one dimensional parameter (dc, de) of the single mail item fed to said sorting module (11);

the dimensional parameter information (dc, de) being associated with an indicator (E1, E2, ..., En, E20) of the selected accumulating device to perform a procedure by which to determine the fill level (Lc, Ld) of the accumulating device as a function of the number and size of the mail items fed to the accumulating device (12).

2. A device as claimed in Claim 1, wherein said measuring device (15) determines at least the thickness (dc, de) of the mail item.

3. A device as claimed in Claim 2, wherein said measuring device (15) determines the thickness (dc) of the mail item in a compressed condition, wherein the measuring device (15) exerts pressure on opposite faces of the flat, rectangular mail item.

4. A device as claimed in Claim 2 or 3, and comprising a processing unit (9), which receives at least said thickness (dc, de) and calculates at least one characteristic dimension (Ld, Lc) of the pack (4b) of mail items forming in each accumulating device (12).

5. A device as claimed in Claim 4, wherein said characteristic dimension is calculated by adding the successively acquired thicknesses.

6. A device as claimed in Claim 5, wherein said characteristic dimension is a length Ld of the pack in a decompressed condition, obtained by multiplying a length Lc by an expansion factor Fc which takes into account the tendency of the accumulated mail items to expand after they are measured;

said length Lc being obtained by adding the successively acquired thicknesses dc of the mail items in a compressed condition, wherein the measuring device (15) applies pressure on opposite faces of the flat, rectangular mail item.

7. A device as claimed in Claim 6, wherein said processing unit defines a first threshold value P1 defining, for a given accumulating device (12), a maximum length of a compressed pack of mail items; and a second threshold value P2 defining a maximum length of a decompressed pack of mail items; said second threshold value P2 being defined to accommodate the decompressed pack inside a container (K) with substantially no compression of said pack required.

8. A device as claimed in Claim 7, wherein, if the length Ld of the decompressed pack is below the first threshold P1, sorting is continued.

9. A device as claimed in Claim 7 or 8, wherein, if the length Ld of the decompressed pack is above the first threshold P1 and below the second threshold P2, sorting is continued, and an almost-full accumulating device signal is emitted to indicate little space remaining in the accumulating device (12) for further mail items.

10. A device as claimed in Claim 7, 8 or 9, wherein, if the length Ld of the decompressed pack is above the second threshold P2, sorting is stopped, and a full accumulating device (12) signal is emitted.

FIG. 1

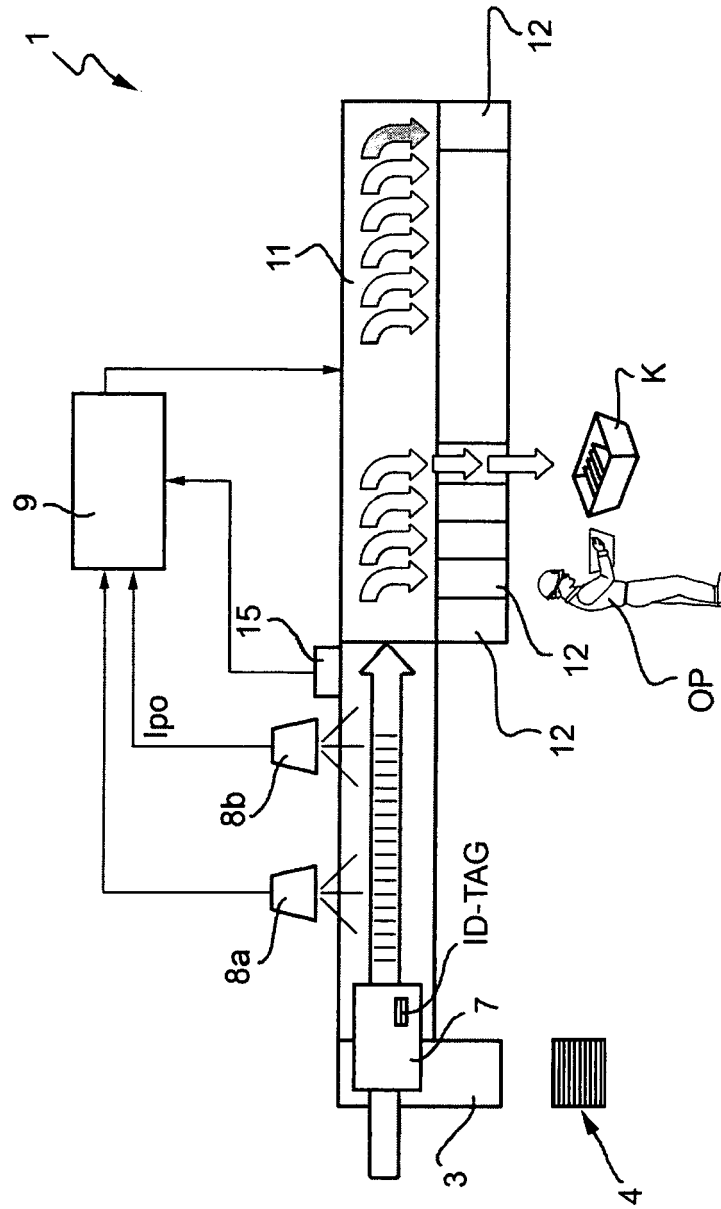


FIG. 2

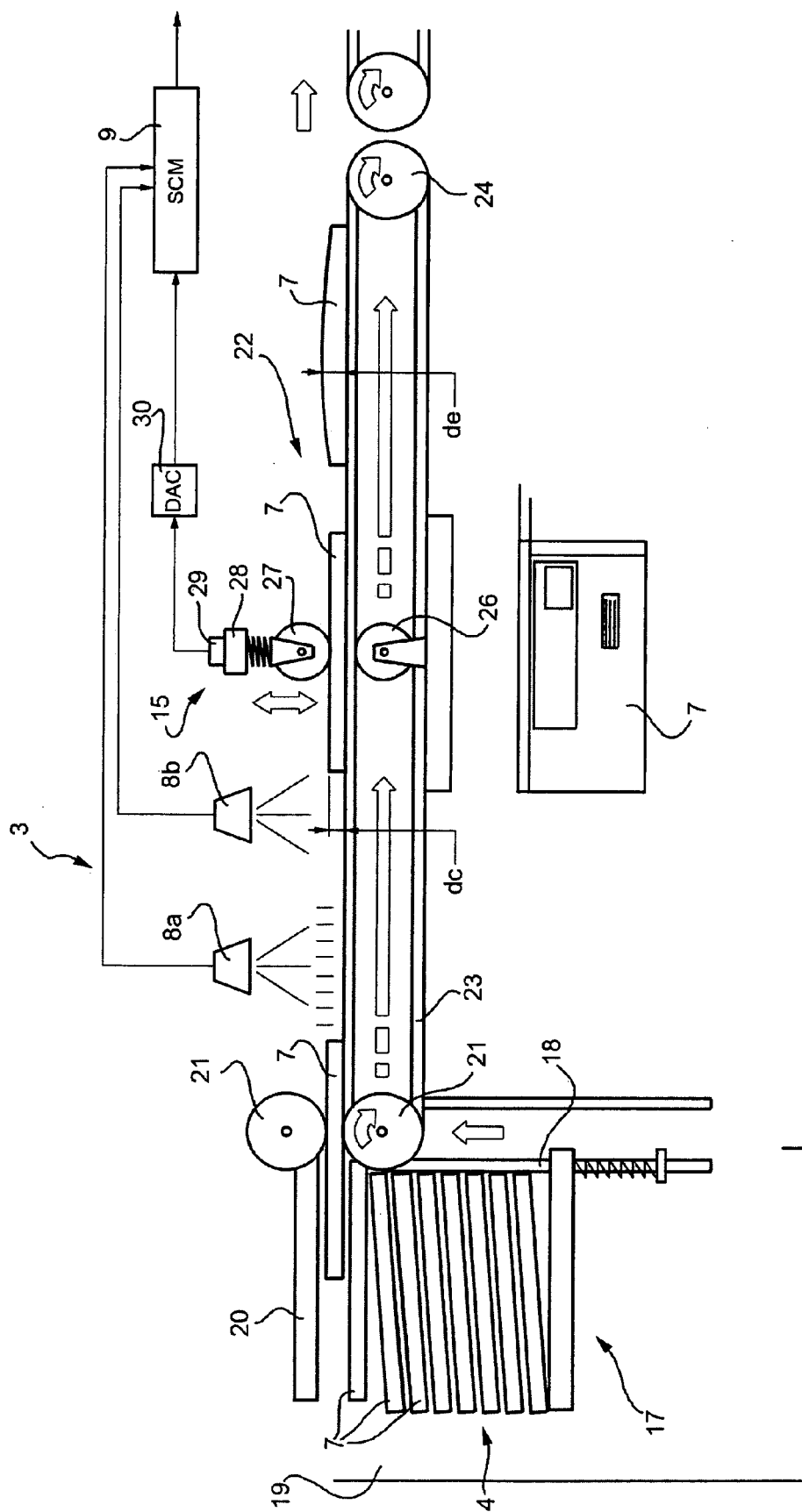
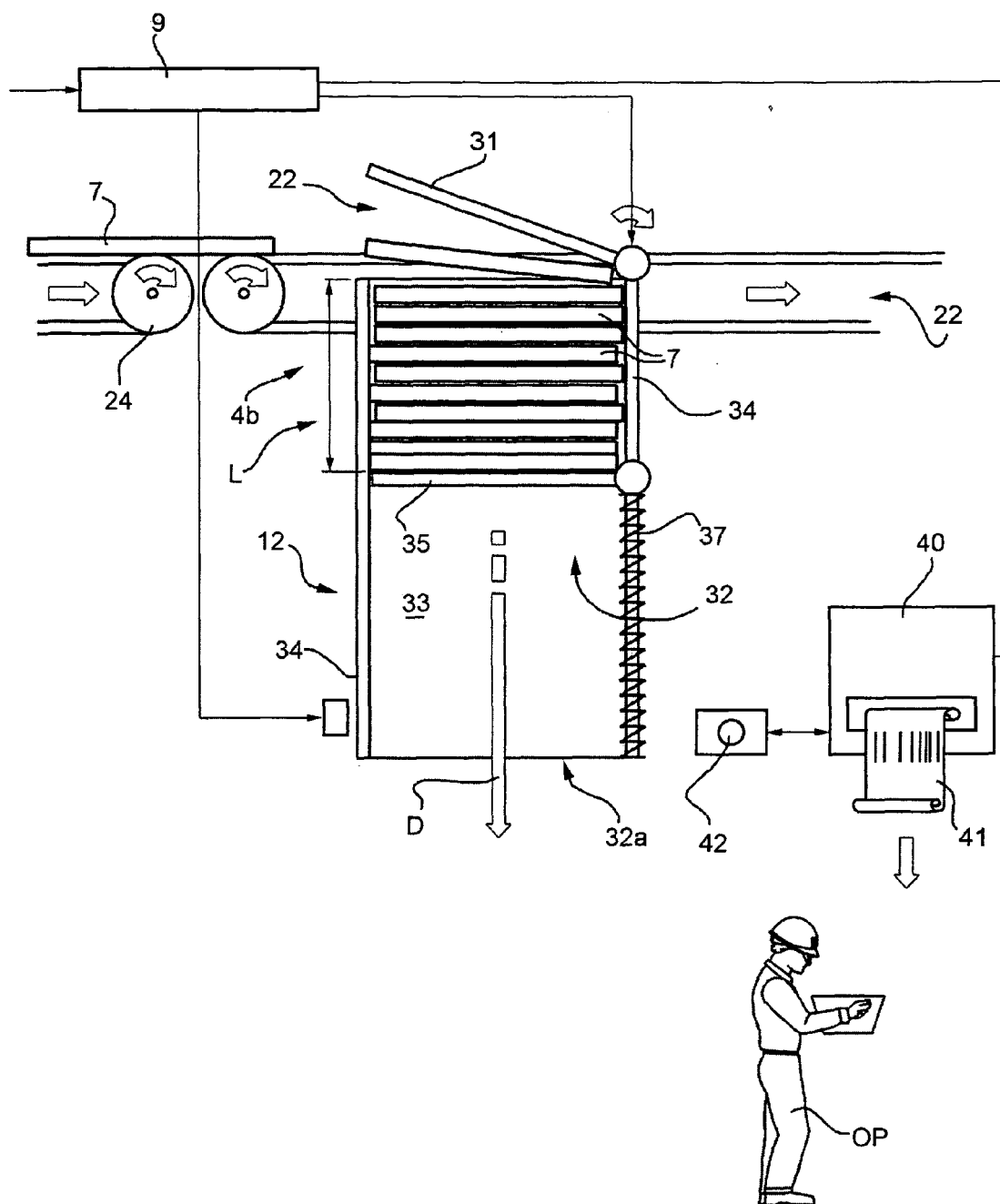


FIG. 3





EUROPEAN SEARCH REPORT

Application Number
EP 09 42 5357

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 718 049 A2 (HITACHI LTD [JP]) 26 June 1996 (1996-06-26) * abstract; figure 4 *	1-2,4	INV. B07C3/00
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 19 February 2010	Examiner Wich, Roland
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)



Application Number

EP 09 42 5357

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☒ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 09 42 5357

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3

Compressed condition

2. claims: 4-10

Calculating dimension

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 42 5357

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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