METHOD AND APPARATUS FOR STACKING PRODUCTS IN A ROOF TILE FASHION

 FIG. 1A

 FIG. 1B

Abstract: A method for stacking substantially two-dimensional products in a roof-tile fashion, comprising supplying a series of sequentially separated products (3, 3’, 3”) with the aid of the first conveyor (1) at a first conveying speed along the first conveying path in the conveying direction (T1); each time at the end of the first conveying path ejecting a product from a conveying surface of the first conveyor onto a conveying surface of the second conveyor (2); discharging a series of products stacked in roof-time fashion (5, 4’, 4”) with the aid of the second conveyor at a second conveying speed, which second conveying speed is less than the first conveying speed, along the second conveying path in the conveying direction (T2), and each time gathering information about the distance between two successive products supplied with aid of the first conveyor, and, if required, lengthening the first conveying path in the conveying direction in accordance with an established increase in this distance. The invention also provides an apparatus for carrying out the method according to the invention.
Title: Method and apparatus for stacking products in a roof tile fashion.

The invention relates to a method and apparatus for stacking substantially two-dimensional products in a roof-tile fashion.

In industrial product processing lines, stacking substantially two-dimensional products such as magazines, cards, newspapers, envelopes etc. in a roof-tile fashion is usually carried out in two steps. The first step comprises providing a supply of products in the form, for instance, of a supply flow or stock of sequentially separated or discrete, respectively, products, which products, in a second step, are stacked one by one in roof-tile fashion and are then discharged. In practice, guaranteeing a discharge flow continuous in time of products stacked in a roof-tile fashion forms a problem. The origin of this problem resides in the often not completely regular continuous nature of the supply flow or the temporarily unavailability of sufficient stock. This can have different causes, such as, for instance, removing damaged products from the supply flow or stock upstream of the stacking location. As no products are available, stacking can, at least temporarily, not take place so that the continuity of a discharge flow of regularly stacked products is disturbed.

The object of the present invention is to provide a method for stacking products in a roof-tile fashion, without the mentioned drawback. The present invention also contemplates providing an apparatus for carrying out the intended method.

To this end, the present invention provides a method of the above-intended type, comprising providing a first conveyor for supplying sequentially separated products along a first conveying path in a conveying direction; providing a second conveyor for discharging products stacked in a roof-tile fashion along a second conveying path in the conveying direction, with respect to which second conveyor the first conveyor is at least partly in an elevated position such that an end of the first conveying path is in a position elevated with respect to a beginning of the second conveying path; supplying a series of
sequentially separated products with the aid of the first conveyor at a first conveying speed along the first conveyor path in the conveying direction; each time, at the end of the first conveying path, ejecting a product from a conveying surface of the first conveyor onto a conveying surface of the second conveyor; discharging a series of products stacked in a roof-tile fashion with the aid of the second conveyor at a second conveying speed, which second conveying speed is less than the first conveying speed, along the second conveying path in the conveying direction; and each time gathering information about the distance between two successive products supplied with the aid of the first conveyor, and, if required, lengthening the first conveying path in the conveying direction in accordance with an established increase of this distance.

The invention utilizes two conveyors, of which a first is located at least partly above a second one. In the possibly most favourable configuration—as it can be manufactured in a highly economical manner—the two conveyors extend along a linear conveying path and convey products in this conveying direction, wherein the first/upper conveyor conveys the products at a higher speed than the second/lower conveyor. With the aid of the first conveyor, the products to be stacked are supplied in a sequentially separated manner, i.e. successively and mutually separated by a certain separating distance, also called pitch. This pitch is preferably substantially constant, as a regular pitch allows, in a simple manner, a regular stacking in roof-tile fashion with the aid of conveyors having constant conveying speeds. At the end of the first conveying path, the products are poured from the first/upper conveyor onto the second/lower conveyor. As the second conveyor conveys at a lesser speed than the first conveyor, the products will end up with a mutual overlap—corresponding to a negative pitch—on the conveyor surface of the second conveyor. Thus, stacking in a roof-tile fashion is realized. When, due to circumstances, a gap has formed in the supply flow of products—so that a pitch between two successive products on the first conveyor does not have the
normal size, but is greater — there is the danger of an irregular stacking on the second conveyor. This danger can be averted by each time monitoring the actual pitch between two products supplied on the first conveyor and, when a gap is observed, lengthening the first conveying path for the product directly following the gap in accordance with the size of the gap. By lengthening the conveying path along which the intended product is conveyed by the first conveyor, the product will move longer at higher speed in the conveying direction than the already stacked products on the second conveyor. In other words, the product gains on those products and can be ejected after having made up a distance as great as the gap. The possible adverse affect of the gap is thus undone without stopping the discharge of products regularly stacked in a roof-tile fashion with the aid of the second conveyor. Preferably, the conveying speed of the second conveyor, like that of the first conveyor, is even held constant so that the processing operations carried out both upstream and downstream of the stacking location can take place independently of the stacking process.

According to a further elaboration of the invention, the method further comprises further to a lengthening to be effected or having been effected of the first conveying path, reducing the distance between successive products supplied by the first conveyor; and shortening the first conveying path in accordance with the reduced distance between the respective products when these products are supplied and ejected.

The above-described method is based on lengthening the first conveying path. Depending on the specific implementation of the method with the aid of an apparatus, lengthening the first conveying path can involve the physical lengthening or displacement of (parts of) the conveyor. There are practical limits to such a physical lengthening or displacement. As a result, the above-described method is primarily suitable for situations in which the batches of products to be processed and the frequency with which gaps occur in the supply flow are relatively small. With each occurring gap, the conveying
path is to be lengthened, at least, if one is unwilling to change the conveying speeds of the conveyors. In order to provide a solution to this problem, the method according to the invention provides in an addition which ensures shortening of the first conveying path after lengthening. When a gap in the supply flow of products is observed, the pitch between the products following the gap is reduced. This means that, assuming that the conveying speeds of the conveyors remain the same, the distance between the products following the gap and located on the first conveyor is reduced. This is preferably done as soon as possible after the gap is observed, so that reducing the first conveying path, to be discussed hereinafter, can be realized as soon as possible after it has been lengthened, and no unnecessary intervening following lengthening of the first conveying path occurs. Reducing the pitch between products following the gap can be carried out, for instance, by placing the products at shorter intervals on the advancing conveying surface of the first conveyor. Reducing the pitch without adjusting the length of the first conveying path would effect an increase in the overlap between the products stacked on the second conveyor. This variation in overlap is not desired as it disturbs the regular stacking. However, by shortening the conveying path when the products placed closer together are supplied and ejected, the regular stacking in roof-tile fashion on the second conveyor can be maintained. Compacting the products on a first conveyor and the associated shortening of the first conveying path can be sustained until the conveying path has regained its original length. It holds once more that all this is preferably carried out at substantially constant conveying speeds of the first and the second conveyor, although this is not required.

The invention also provides an apparatus for stacking substantially two-dimensional products in a roof-tile fashion, comprising a first conveyor for supplying a series of sequentially separated products along a first conveying path in a first conveying direction; a second conveyor for discharging a series of products stacked in roof-tile fashion along a second conveying path in a second
conveying direction; wherein the first conveyor is at least partly in a position elevated with respect to the second conveyor such that an end of the first conveying path is in a position elevated with respect to a beginning of the second conveying path, from which end a product of a conveying surface of the first conveyor can be ejected onto a conveying surface of a second conveyor; and means for moving the end of the first conveying path in a direction parallel to the second conveying direction.

The invention utilizes two conveyors, a first of which being at least partly situated above a second one. In the possibly most favourable configuration - as it can be manufactured in a highly economical manner - the two conveyors extend along a substantially linear conveying path, and convey products in the same conveying direction, wherein the first/upper conveyor conveys the products at a higher speed than the second/lower conveyor. However, it is also possible that the conveying directions of the first and the second conveyor are not parallel, but are for instance perpendicular to each other. In both cases, stacking in roof-tile fashion of the products supplied with the aid of the first conveyor is obtained by ejecting these products at the end of the first conveying path from the conveying surface of the first conveyor onto the conveying surface of the second conveyor. It should be noted that with a mutually perpendicular orientation of the conveying directions of the conveyors, the required ratio between the conveying speeds of the conveyors for obtaining stacking in roof-tile fashion largely depends on the dimensions of the products to be stacked. A substantially two-dimensional product which is considerably longer than it is wide can for instance also be stacked in roof-tile fashion when the conveying speed of the first conveyor is lesser than the conveying speed of the second conveyor. This is the case when the intended products are supplied in a manner such that the width direction of the products extends parallelly to the conveying direction of the first conveyor. When, in the supply flow of products, a gap occurs, i.e. an undesired increase of the distance between two products measured in a first conveying direction, at
least the end of the first conveying path can be moved in the second conveying direction. As a result, without necessary adjustment of the conveying speeds of the first and the second conveyor, it can be effected that the supplied products following the gap are ejected onto the conveying surface of the second conveyor such that they link up with the regular stacking in roof-tile fashion of the products already present thereon, which are discharged. Also, at least the end of the first conveying path can be moved in a direction opposite to the second conveying direction in order to cancel the above-intended movement.

According to a further aspect of the invention, the first and the second conveying direction are substantially parallel, and moving the end of the first conveying path in the conveying direction involves lengthening or shortening the first conveying path.

The embodiment of the apparatus according to the invention intended here is in particular suitable for carrying out the method according to the invention. Compared to an apparatus having an other than parallel orientation of the conveying directions, the configuration has furthermore as an advantage that it is simple to construct, and that the products ejected from the conveying surface of the first conveyor, upon reception by the conveying surface of the second conveyor, need no longer undergo a change of conveying direction. This enhances the manoeuvrability/verifiability of the products, in particular at high processing speeds, which improves the reliability of use of the apparatus.

According to a further elaboration of the invention, the means for lengthening and/or shortening the first conveying path comprise a return pulley translatable in a direction parallel to the conveying direction, around which return pulley a conveying medium of the first conveyor is tensioned with the aid of tensioning means, and which return pulley is always at the end of the first conveying path.

The use of a translatable return pulley at the head of, for instance, a belt conveyor is a simple and efficient provision for moving the end of the first
conveying path. Naturally, the configuration of the conveyor serves for enabling the translation of the return pulley. This can be realized in different manners, which will be discussed when describing the Figures. The return pulley is preferably translatably drivable by means of a controllable drive mechanism. As a result, the return pulley can be included as a component in an automated system for carrying out the method according to the invention.

According to a further aspect of the invention, the apparatus further comprises a process control unit designed for, each time, gathering information about a distance between two successive products supplied by the first conveyor, and lengthening or shortening the first conveying path on the basis of this information by thereto controlling the controllable drive mechanism of the return pulley.

For the purpose of automated design of the method according to the invention, the apparatus is further preferably provided with a process control unit. The unit has as a task, on the one side, to monitor the distance between preferably each two successive products supplied by the first conveyor, and, on the other side, on the basis thereof, controlling the drive mechanism which controls the translation movement of the return pulley. The process control unit can gather the information about the distance between successive products via, for instance, sensors which record passing of products on the first conveyor.

According to a further aspect of the invention, the apparatus further comprises a supply device designed to cooperate with the process control unit, for placing products at a mutual distance on the conveying surface of the first conveyor, wherein the process control unit and the supply device exchange information with respect to the placing of products on the conveying surface of the first conveyor.

By further including in the apparatus a supply device designed to cooperate with the process control unit, carrying out the method according to the present invention can take place fully automatically. It is after all the
supply device which controls, given the conveying speed of the first conveyor, the distance between two successive products in the supply flow. Preferably, the supply device is therefore designed, on the one side, for providing information to the process control unit about products just placed (or not placed) and, on the other side, for receiving information containing instructions for placing products. The provision of information by the supply device is in particular relevant when a gap occurs in the supply flow. The supply device can communicate the absence of a product to be placed to the process control unit which, based on this information, can proceed to lengthen the first conveying path. The supply device receiving information is in particular relevant when the process control unit proceeds to shortening the first conveying path. The fact is that in that case the distance between the supplied products is to be temporarily reduced, to which end instructions can be sent to the supply device.

According to a further aspect of the invention, the apparatus according to the present invention further comprises a guide for each time guiding a product ejected from the first conveyor to a location on the conveying surface of the second conveyor, which guide takes a fixed position with respect to the end of the first conveyor.

The guide effects that an ejected product accurately ends up, via a predetermined path, on the intended location on the conveying surface of the second conveyor. It will often suffice to guide only the downstream side of an ejected product. A guide can be constructed in different manners. One or more receiving wheels located somewhat downstream of the end of the first conveyor and resting on the configuration stacked in roof-tile fashion can be considered, or a concave guide cover extending from a position adjacent the end of the first conveyor towards the conveying surface of the second conveyor.

With regard to the terminology in this text, the following is noted. A conveying path is understood to mean the path along which an individual product is conveyed by the first or the second conveyor. Both the first conveyor
path and the second conveying path can differ per conveyed product. The fact is that when the first conveying path is lengthened for one product, the second conveying path is, in principle, shortened for the same product, and vice versa. Despite the fact that a conveying path along which a conveyor conveys products needs not be linear, and a conveyor can therefore convey products in more than one direction, when a relation is formed between a first and a second conveying direction, the conveying direction is understood to mean the direction in which the first and the second conveyor convey the products immediately before they are ejected from the first conveyor or immediately after they have been received by the second conveyor, respectively.

The invention will be elucidated further in the following on the basis of the following Figures.

Figs. IA-IH show, in chronological order, different stages in carrying out the method according to the invention;

Figs. 2A and 2B schematically show, in side view, two possible implementation examples of a translatable return pulley with the aid of which the first conveying path can be lengthened or shortened; and

Figs. 3a and 3B schematically show, in side view, two possible implementation examples of a guide for guiding a product ejected from a first conveyor towards a location on the conveying surface of the second conveyor.

Figs. IA-IH show, in chronological order, different stages in carrying out the method according to the invention. For the sake of clarity, the parts to be mentioned hereinbelow are indicated in only a few Figures with reference symbols in; in the remaining Figures, the intended parts are immediately recognizable.

Fig. IA shows a first conveyor 1 which supplies a series of sequentially separated products 3, 3', 3", etc. in a first conveying direction T1. The Figure also shows a second conveyor 2 with a second conveying direction T2 (which is in line with the first conveying direction T1) on which
the products mentioned will be ejected and will be discharged regularly stacked in roof-tile fashion; see Figs. 1B and 1C. With constant conveying speeds of the conveyors 1 and 2, this requires that the conveying speed of the first conveyor is higher than that of the second conveyor. In Fig. 1B a gap 5 is visible, occurring between product 3" and product 3"'. This gap might have been formed because the supply device 4 was temporarily unable to present a new product to the first conveyor. If, as a result of the gap 5, no action in the stacking process were to be taken, product 3"' would still be ejected onto the conveying surface of conveyor 2, but it would not conform to the regularly stacking in roof-tile fashion. Product 3"' would be discharged by conveyor 2 with an overlap smaller than intended, or even be discharged without overlap with the preceding product 3". Therefore, in reaction to the discovery of the gap, the distance between the products to be supplied (located upstream of the gap) is reduced. This reduction of the pitch is already visible in Fig. 1B, and can be discerned even better by comparing Fig. 1A to Fig. 1C. Also, the first conveying path is lengthened as soon as product 3" - temporarily the last product following a normal pitch - is ejected. This lengthening of the first conveying path is visible in Figs. 1C-IE. By lengthening the first conveying path along which, inter alia, product 3" is conveyed by the first conveyor 1, product 3"' will move longer at a higher speed in the conveying direction T1. As a result, the product 3"' gains on the products 3, 3', 3', already stacked in roof-tile fashion and, after it has made up a distance the size of the gap 5, can be ejected onto the second conveyor. The possible danger produced by the gap 5 to the regular stacking in roof-tile fashion is thus undone without stopping the discharge of stacked products by the second conveyor. In order to shorten the first conveying path again, the pitch between products following the gap is temporarily shortened already after the detection of the gap 5. As a result, immediately after ejecting the product 3"' following the gap, the end of the first conveying path can be moved back. This operation is shown in Figs. IF- IH. The number of products which is separated by a shortened pitch is chosen such
that the products which are to be ejected after the first conveying path has regained its initial length, are mutually separated by a normal pitch again.

Figs. 2A and 2B schematically show, in side view, two possible implementation examples of a translatable return pulley with the aid of which the first conveying path can be lengthened or shortened. Fig. 2A in particular shows a first conveyor 31 having a conveying surface provided by a belt 31', a second conveyor 32 having a conveying surface provided by a belt 32', two translatable return pulleys 33, 33' and a fixed return pulley 34 around which the conveying belt 31' is tensioned, a spring 35, a controllable drive mechanism 36 connected by way of a movable rod 37 to the return pulley 33, and a supply device 38 for placing products, from above, on the conveying belt 31'. When the controllable drive mechanism 36 receives instructions from a process control unit (not shown) to lengthen the first conveying path (i.e. the path over which the first conveyor conveys the products placed by the supply device 38 on the conveyor belt 31') it will slide out the rod 37 with the rotatably connected return pulley 33 (to the right hand side in the drawing). The additional conveying belt length required for lengthening the first conveying path then becomes available in that, by means of a spring 35 under tensile stress, the return pulley 33' is connected to a fixed point F. Shortening the first conveying path is done in a corresponding but reversed manner. Apart from the parts already indicated at the description of Fig. 2A, Fig. 2B shows in particular a return pulley 33' which is connected to a fixed point F by means of a spring 39 under compressive stress. When the rod 37 with the return pulley 33 rotatably connected thereto is slid out (to the right in the drawing), the return pulley 33' will move in corresponding direction against the spring force of the spring 39. As a result, the first conveying path is lengthened; the fact is that the distance between the return pulley 33 and the location where the supply device 38 places the products on the belt is increased. In a corresponding but reversed manner, the first conveying path can also be shortened.
The implementation examples shown in Figs. 2A and 2B are not intended to be limitative in any manner. They only provide an indication as to how a translatable return pulley can be used in an apparatus according to the present invention.

Figs. 3A and 3B schematically show, in side view, two possible implementation examples of a guide for guiding a product ejected from the first conveyor to a location on the conveying surface of the second conveyor. Both Figures show a first conveyor 41 and a second conveyor 42, wherein on the end of the first conveying path, a return pulley 43 is located, the axis of which is non-rotatably connected to a fitting 44. In Fig. 3A, the fitting 44 is further hingedly connected to a guide 45. On the product receiving side, the guide has a concave profile with which the products ejected by the first conveyor 41 are smoothly guided to the conveying surface of the second conveyor 2. The hinged suspension of the guide 45 from the fitting 44 ensures that somewhat thicker/higher products or (periodical) peaks in the stacking in a roof-tile fashion can pass underneath the guide 45 without being appreciably hindered after they have been placed on the second conveyor 2. In Fig. 3B, the fitting is connected to a flexible foam rubber roller wheel 46, which roller wheel is suspended for free rotation from the fitting 44. The surface of the roller wheel 46 resting, and hence rotating, on the already formed configuration stacked in roof-tile fashion diverts products on the product receiving side towards the conveying surface of the second conveyor 2. The foam rubber is deformable, so that somewhat thicker/higher products and (periodical) peaks in the discharge flow stacked in roof-tile fashion can simply pass underneath.

It holds once more that the examples shown in Figs. 3A and 3B are not intended to be limitative in any manner. They only mean to serve as inspiration for the purpose of implementing a guide in an apparatus according to the present invention.
Although in the above, the present invention is elucidated on the basis of a few exemplary embodiments it should be noted that the invention is not limited to these exemplary embodiments. The skilled person can provide different adaptations and modifications to the discussed exemplary embodiments without, as a result thereof, departing from the concept and the range of the invention as laid down in the following claims.
Claims

1. A method for stacking substantially two-dimensional products in a roof-tile fashion, comprising:
   • providing a first conveyor (1) for supplying sequentially separated products along a first conveying path in a conveying direction (T1, T2);
   • providing a second conveyor (2) for discharging products stacked in roof-tile fashion along a second conveying path in the conveying direction (T1, T2), with respect to which second conveyor (2) the first conveyor (1) is at least partly in an elevated position, such that an end of the first conveying path is in a position elevated with respect to a beginning of the second conveying path;
   • supplying a series of sequentially separated products with the aid of the first conveyor (1) at a first conveying speed along the first conveying path in the conveying direction (T1, T2);
   • each time at the end of the first conveying path ejecting a product from a conveying surface of the first conveyor (1) onto a conveying surface of the second conveyor (2);
   • discharging a series of products stacked in roof-tile fashion with the aid of the second conveyor (2) at a second conveying speed, which second conveying speed is less than the first conveying speed, along the second conveying path in the conveying direction (T1, T2); and
   • each time gathering information about the distance between two successive products supplied with the aid of the first conveyor (1), and, if required, lengthening in the conveying direction (T1, T2) the first conveying path in accordance with an established increase of this distance.
2. A method according to claim 1, wherein the conveying speed of the first conveyor is substantially constant.

3. A method according to any one of the preceding claims, wherein the conveying speed of the second conveyor is substantially constant.

4. A method according to any one of the preceding claims, further comprising
   • further to a lengthening to be effected or having been effected of the first conveying path reducing the distance between successive products supplied with the first conveyor; and
   • shortening the first conveying path in accordance with the reduced distance between the respective products when these products are supplied and ejected.

5. An apparatus for stacking substantially two-dimensional products in roof-tile fashion, comprising:
   • a first conveyor (1) for supplying a series of sequentially separated products along a first conveying path in a first conveying direction (T1);
   • a second conveyor (2) for discharging a series of products stacked in a roof-tile fashion along a second conveying path in a second conveying direction (T2);
   • wherein the first conveyor (1) is at least partly in a position elevated with respect to the second conveyor (2), such that an end of the first conveying path is in a position elevated with respect to the beginning of the second conveying path, from which end a product can be ejected from a conveying surface of the first conveyor (1) onto a conveying surface of the second conveyor (2); and
• means for moving the end of the first conveying path in a direction parallel to the second conveying direction (T2).

6. An apparatus according to claim 5, wherein the first and the second conveying direction are substantially at right angles to each other.

7. An apparatus according to claim 5, wherein the first and the second conveying direction are substantially parallel, and wherein moving the end of the first conveying path in the conveying direction involves lengthening or shortening the first conveying path.

8. An apparatus according to claim 7, wherein the means for lengthening and/or shortening the first conveying path comprise a return pulley translatable in a direction parallel to the conveying direction, around which return pulley a conveying medium of the first conveyor is tensioned with the aid of tensioning means, and which return pulley is always at the end of the first conveying path.

9. An apparatus according to claim 6, wherein the return pulley is translatably drivable by means of a controllable drive mechanism.

10. An apparatus according to claim 8, further comprising a process control unit designed for each time gathering information about a distance between two successive products supplied by the first conveyor, and, on the basis of this information, lengthening or shortening the first conveying path by controlling to this end the controllable drive mechanism of the return pulley.

11. An apparatus according to claim 10, further comprising a supply device designed to cooperate with the process control unit, for placing products at a mutual distance on the conveying surface of the first conveyor, wherein
the process control unit and the supply device exchange information with respect to the placement of products on the conveying surface of the first conveyor.

12. An apparatus according to any one of claims 5 - 11, further comprising a guide for each time guiding a product ejected from the first conveyor to a location on the conveying surface of the second conveyor, which guide takes up a fixed position with respect to the end of the first conveyor.
### A. Classification of Subject Matter

**INV.** B65H5/02  B65H5/24

According to International Patent Classification (IPC) or to both national classification and IPC

### B. Fields Searched

Minimum documentation searched (classification system followed by classification symbols)

B65H  B65G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

### C. Documents Considered to Be Relevant

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<td>A</td>
<td>EP 0 259 650 A (FERAG AG [CH]) 16 March 1988 (1988-03-16) column 1, lines 33-39 column 3, lines 29-58 column 6, line 28 - column 8, line 58; figures</td>
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<td>WO 99/55609 A (FERAG AG [CH]; REIST WALTER [CH]) 4 November 1999 (1999-11-04) page 11 - page 13; figures 5,6</td>
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Further documents are listed in the continuation of Box C

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- Special categories of cited documents
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Date of the actual completion of the international search

3 February 2009

Date of mailing of the international search report

11/02/2009

Name and mailing address of the ISA/

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Authorized officer

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