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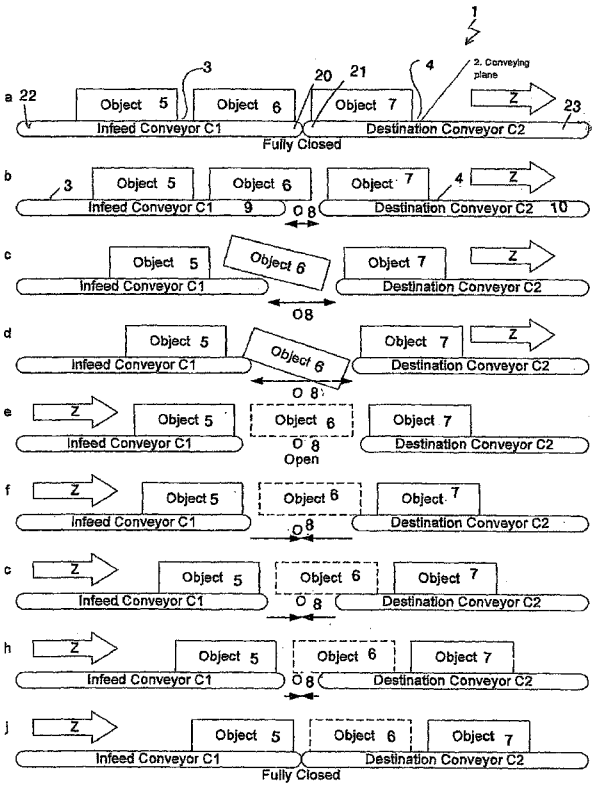

Figure 1. Operation of the invention

(57) Abstract: A conveyor apparatus including a frame and two or more conveyors supported by the frame, the conveyors being adapted to convey at least one object in a predetermined direction, wherein, in a closed state of the conveyor apparatus, at least a part of each conveyor together define a conveying surface and, in an open state of the conveyor apparatus, at least two of the two or more conveyors are separated by an opening in the conveying surface. The apparatus sorts selected items of baggage by either allowing an object to exit the conveyor through a n opening in the conveyor whilst the conveyor is still moving or by allowing an object to continue onto another application, the opening being closed.

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MODIFIED CONVEYOR

Technical Field of the Invention

The present invention relates to improvements in and/or relating to a conveyor apparatus. The present invention also provides a method of diverting an object, within a stream of objects, carried on a conveyor apparatus.

Background

Conveyor equipment is used throughout manufacturing and transportation industries. One application of conveyor technology has been in relation to air and sea transportation facilities to convey luggage and other objects from a check-in point to a loading point.

Baggage handling deals with dissimilar shaped objects of varying materials and surface textures. Baggage handling systems must maintain a record of the position and identity of every object that is being transported. Conveyor-based baggage handling systems rely on a fundamental assumption for their operation; that the object and conveying surface move at the same velocity without slipping. The object position is inferred from the conveyor position.

At intervals, the object is detected and the record of the object position is corrected to a newly detected position. Any operation or action that compromises the fundamental assumption noted above will impact on the reliability of the position information.

For an object's identity to be positively known, its recorded (and updated) position must be positively reconciled every time it is detected from the time it was first identified to the time the object leaves the zone of interest.

Often it is necessary to divert luggage or other objects carried on the conveyor to a second or alternative conveyor. Traditionally this has been performed manually or by a variety of mechanical devices such as:

- Ploughs, either plain-faced or powered-face, impact style or 'flipper'-type diverters
- Hinged/tilting conveyors

Hinged/tilting platforms divert a single object off a line of luggage from one conveyor to another. An object, for example, is recognised upstream of the hinged/tilting platform. The platform forms a section of the conveyor. Once the object is located on the platform, the conveyor is stopped to prevent the object leaving the platform and to stop other objects entering onto the platform. The platform is then rotated, to connect with an overhead conveyor belt. Once the platform is aligned with the overhead conveyor the platform conveyor section is restarted to convey the object from the platform onto the overhead conveyor to be conveyed to its destination. The platform can then be lowered to resume its position in the conveyor. It will be appreciated that to stop the conveyor is a significant problem in terms of output and wear and tear generally.

Even where tilting conveyors do not need to be stopped, they are typically heavy therefore can be moved only slowly, meaning the bags must be spaced (pitched) far apart on the conveyor. This means fewer bags can be processed in a given time, which is undesirable. Furthermore, if a bag slippage occurs in such conveyors, problems occur and such conveyors are typically expensive.

An alternative approach is the impact diverter or 'pusher'. This employs a revolving arm to divert an object from a line of like objects. In this case, a first conveyor and a second conveyor associated with the diverter are typically aligned in a parallel configuration at a portion of the conveyor tracks. The revolving arm is activated when an object for example is recognised upstream of the arm. As the object approaches, the arm commences a revolution, pushing the object off the first conveyor and on to the parallel or angularly aligned second conveyor. It is known that such diverters are hard on luggage or other objects and can also improperly divert objects leading to damage to both the objects and the equipment and loss of inventory knowledge with downstream complications.

The speed of a conveyor is typically determined by the maximum speed at which an X-ray machine can scan bags and objects on the conveyor. Modern X-ray technology is allowing for faster conveyor speeds, sometimes to the extent that X-ray machines can deal with speeds higher than a pusher conveyor is able to adequately deal with. Therefore, there is a need for a sorting conveyor which can match the higher speeds catered for by improvements in X-ray machines, to allow for greater baggage throughput. Another drawback with pusher-type conveyors is that the pitch of baggage can be changed, i.e. the relative spacing of bags may be altered, which can affect the successful detection of baggage.

Object of this Invention

It is an object of the present invention to provide an alternative conveyor apparatus which overcomes or ameliorates some of the abovementioned disadvantages and/or at least provides the public with a useful alternative.

Summary of the Invention

According to a first aspect of the invention, there is provided a conveyor apparatus including:

one or more frames; and

two or more conveyors supported by the frame(s), the conveyors being adapted to convey at least one object in a predetermined direction,

wherein, in a closed state of the conveyor apparatus, at least a part of each conveyor together define a conveying surface and, in an open state of the conveyor apparatus, at least two of the two or more conveyors are separated by an opening in the conveying surface.

Preferably, the state of the conveyor apparatus being open or closed is dependent on the object.

Preferably, objects exit the conveyor apparatus at substantially the same spacing as the spacing when the objects enter the conveyor apparatus.

Preferably, movement of one of the two or more conveyors relative to the other of the two or more conveyors causes the conveyor apparatus to change between the open and closed states.

Preferably, the conveying surface continues to convey a stream of objects in the predetermined direction while the conveyor apparatus moves between open and closed states.

Preferably, in the open state the conveyor apparatus is adapted to sort a conveyed object such that the object exits the conveying surface through the opening.

Preferably, in the closed state the conveyor apparatus is adapted to sort a conveyed object such that the object moves from a first of the two or more conveyors to a second of the two or more conveyors.

Preferably, the conveyor apparatus is adapted to be in the open or closed state for a period of time sufficient to permit only a selected object or selected objects to be sorted accordingly.

Preferably, the state of the conveyor apparatus can be changed at a speed such that a predetermined object can be selected from a series of objects and sorted without disturbing the adjacent objects.

Preferably, the state of the conveyor apparatus is adapted to change in the time between consecutive objects arriving at the end of an upstream conveyor.

Preferably, a conveyed object experiences substantially no change in speed or direction relative to the conveying surface while the state of the conveyor apparatus is changed.

Preferably, the opening opens and/or closes at substantially the same speed at which an object is conveyed on the conveying surface.

Preferably, the conveying surface is formed from at least first and second conveyor surfaces, each conveyor surface moving in the same predetermined direction at substantially the same speed.

Preferably, first and second conveyor surfaces form part of first and second conveyors respectively.

Preferably, the first conveyor and second conveyor each include a roller, at least one of the rollers being adapted to move towards and away from the other roller to close and open the opening in the conveying surface respectively.

Preferably, the rollers are positioned adjacent to each other at the opening in the closed state of the conveyor apparatus.

Preferably, in the open state the first conveyor conveys objects towards the opening and the second conveyor conveys objects away from the opening.

Preferably, a collection device receives an object which has exited the conveying surface through the opening.

Preferably, the collection device receives the exited object with minimal impact thereto.

Preferably, the collection device includes a further conveyor which resides substantially beneath the opening when formed.

Preferably, the collection device includes any one or more of a chute, a power-curve™, a roller-deck, or a ball-deck or other like device.

Preferably, wherein the collection device is an open topped container.

Preferably, the further conveyor includes a plurality of open topped containers.

According to a second aspect of the invention, there is provided a method of sorting a predetermined object on a conveying surface, the method including the step of opening and/or closing a gap in the conveying surface downstream of the predetermined object, such that the object exits the conveying surface through the opening when the gap is open and the object moves from a first conveyor to a second conveyor when the gap is closed.

Preferably, the gap is formed for a predetermined time sufficient to permit only the predetermined object to leave the conveying surface.

Preferably, the gap is closed for a predetermined time thereby permitting only the predetermined object to move from the first conveyor to the second conveyor.

Preferably, a collection device receives the predetermined object following its exit from the conveying surface through the gap.

Preferably, the collection device includes a conveyor.

Preferably, the predetermined object exits the conveying surface substantially under the influence of gravity.

According to a third aspect of the invention, there is provided a conveyor apparatus including first and second adjacent conveyors adapted to selectively move relative to each other, the conveyor apparatus having in a first configuration wherein an object on the first conveyor exits the conveyor apparatus through an opening between the conveyors, and the conveyor apparatus having a second configuration wherein the object moves from the first conveyor to the second conveyor.

Preferably, the configuration of the conveyor apparatus depends on identification of the object.

Further aspects of the invention, which should be considered in all its novel aspects, will become apparent to those skilled in the art upon reading of the following description which provides at least one example of a practical application of the invention.

Brief Description of the Figures

The present invention will now be described by example and with reference to the Figures in which:

Figure 1 is schematic view of a conveyor apparatus of one preferred embodiment of the present invention in various phases of use;

Figure 2 is a schematic side elevation of a conveying plane path of Figure 1;

Figure 3 is another schematic side elevation of the conveying plane of Figure 2.

Detailed Description of the Preferred Embodiments

Referring to Figure 1, a schematic view of a preferred embodiment of a conveyor apparatus 1 is illustrated. Conveyor apparatus 1 includes a frame (not shown) and two conveyors 9 and 10 The same frame may support both conveyors 9 and 10 or different frames may support each conveyor. In a closed state, conveyor apparatus 1 has a conveying surface or plane 2 defined by a part of each of conveyors 9 and 10, specifically the upper facing surfaces 3 and 4 thereof.

Conveying surface 2 conveys objects 5, 6 and 7 along the conveyor apparatus in a predetermined direction Z such that, in a closed state (shown in Figure 1a for example), conveying surfaces 3 and 4 of conveyors 9 and 10 are adjacent such that an object moves from the first (upstream) conveyor onto the second (downstream) conveyor without falling between them. Conveyor apparatus 1 also has an open state (shown, for example, in Figure 1e) in which there is an opening or gap between conveyors 9 and 10, such that a conveyed object on the upstream conveyor exits the conveying surface by falling through the opening.

Conveyor apparatus includes two conveyors by way of example only. It will become evident to those skilled in the art upon reading of the following description that a conveyor apparatus according to the invention may include more conveyors.

Upstream of the conveyor there is, in some embodiments, a sensor (not shown) which is adapted to identify objects conveyed on the conveying surface. The sensor may identify the object on the basis of specific criteria. Such criteria may include a bar code, the size of the object, weight, colour, smell or a like parameter. Those skilled in the art will be aware of possible sensors adapted to identify a predetermined object, which may include proximity or induction detectors, machine vision or barcode readers. Alternatively or additionally, operation of the conveying surface may be controlled manually.

Conveying surface 2 is adapted to form a temporary opening 8 in the conveying surface. In other embodiments of the invention, the apparatus is adapted to form a temporary closure in the conveying surface, but the present embodiment discusses forming a temporary opening by means of example. Temporary opening 8 is illustrated in Figures 1b to 1h. Temporary opening 8 is adapted to permit at least one of the objects (object 6) to exit from conveying surface 2.

Apparatus 1 includes a first conveyor 9 and a second conveyor 10. First conveyor 9 maintains conveyor surface 3 and second conveyor 10 maintains conveyor surface 4. Each conveyor 9 and 10 is supported by and forms part of the frame. Conveyor surfaces 3 and 4 are maintained at substantially the same speed and move in substantially the same direction as each other.

First conveyor 9 and second conveyor 10 each include a retract roller (not shown in Figure 1 but located at or near to 20 and 21) and a drive roller (not shown in Figure 1 but located at or near to 22 and 23). The retract roller at 20 of first conveyor 9 and the retract roller at 21 of second conveyor 10 are located adjacent to each other in the closed configuration of the conveying

surface (as best seen in Figures 1a and 1j). Each retract roller at 20 and 21 is adapted to slide in the frame away from each other to form temporary opening 8. The retract rollers at 20 and 21 of first and second conveyors 9 and10 are adapted to slide or retract towards the drive rollers at 22 and 23 respectively, when activated, thereby providing temporary opening 8 in the conveying surface 2.

Figure 1b to 1j illustrates the progressive forming of opening 8 by first conveyor 9 and second conveyor 10 of apparatus 1 (Figure 1b to 1e) and the subsequent closing (Figure 1f to 1h). In Figure 1e, object 6 is shown in outline and/or phantom. This indicates the approximate time when object 6 exits conveying surface 2. Object 6 remains in phantom in Figures 1e to 1j to indicate the approximate gap created by the absence of object 6.

Temporary opening 8 is created for a predetermined temporary time period. It will be appreciated that opening 8 must be open for sufficient time to allow object 6 to satisfactorily exit conveying surface 2. However opening 8 must also be adapted to close again rapidly, after object 6 exits conveying surface 2, to ensure that other objects (for example object 5) do not also exit conveying surface 2 at the downstream end of first conveyor 9.

It will be appreciated that there are various options for transferring object 5 once it has exited conveying surface 2. However, in a preferred embodiment, the object will be directed to a collection device, for example a further conveyor (not shown) located substantially beneath opening 8. In such a preferred embodiment, the object will be directed into/onto the collection device through a chute, a power curve, a roller-deck, a ball-deck or other similar device, incorporated into the collection device. Alternatively, the collection device could include a chute, power curve, roller-deck, ball-deck or other like device. In a preferred embodiment, the collection device is adapted to collect the object in a way that causes minimal damage to the object. For example, the collection device may be an inclined chute or inclined conveyor such that the distance through which an object exiting conveying surface 2 falls is small. In another example, the collection device includes a sprung resilient component or similar component to cushion the fall of the exiting object.

Referring to Figure 2, schematic side elevations of conveyor apparatus 1 in the closed configuration (Figure 2a) and in the open configuration (Figure 2b) are shown. In relation to Figure 1, like numerals refer to like components. It will be appreciated that first conveyor 9 is substantially a mirrored equivalent of second conveyor 10. However, it will also be appreciated

that conveyors 9 and 10 do not need to mirror each other and only do so in the embodiment discussed herein by way of example.

As mentioned, conveying surface 2 is formed from surfaces 3 and 4, which are part of conveyors 9 and 10. First and second conveyors 9 and 10 include retract rollers 20 and 21, drive rollers 22 and 23, static rollers 25 and 26 and belt uptake rollers 27 and 28. Conveyor means, for example conveyor belts or other suitable transporting means, weave around each set of rollers to create each conveyor surface 3 and 4 and together form conveying surface 2. The rollers are shown as schematic circles in Figure 2 and share the same reference numerals as the points at which they are located in Figure 1. The barrel of each roller is not shown but extends into the face of the paper.

It will be appreciated that there may be various configurations for operating conveyor apparatus 1 of the preferred embodiment. However the inventors have found that this embodiment described provides the optimum means of uptaking conveying surface 2 which is displaced by forming opening 8 when the conveyor apparatus adopts an open configuration (Figure 2a).

Drive rollers 22 and 23 drive conveying surfaces 3 and 4 respectively. Drive rollers 22 and 23 revolve in the frame in substantially the same direction and with the same speed. Drive rollers 22 and 23 may include teeth or other projections which are adapted to drive conveying surfaces 3 and 4, and hence conveying surface 2. Alternatively drive rollers 22 and 23 may be adapted to drive the conveying surfaces by friction. By way of example, a tracking (or multiple) strip(s) can be incorporated onto the belt to aid belt tracking. Those skilled in the art will be aware of various methods for driving a conveyor about a track.

Rotatable drive rollers 22 and 23 are located within the frame (not shown) and remain positionally stationary relative to the frame (not shown) regardless of whether conveyor apparatus 1 is in the open or closed configuration. Static rollers 25 and 26 also remain positionally stationary relative to the frame whether conveyor apparatus 1 is in the open or closed configuration. It will be appreciated that all rollers are positionally stationary within the frame or move relative to the frame. Rotation of the rollers allows movement of conveyor surfaces 3 and 4 thereover.

Retract roller 20 and belt uptake roller 27 are associated with each other in use and are adapted to slide conveying surface 3 between the open (Figure 2a) and closed (Figure 2b)

configurations. In one preferred embodiment retract roller 20 and belt uptake roller 27 are connected via a link means 29 to allow the rollers to move to the open or closed configurations, substantially in unison. Furthermore, retract roller 21 and belt uptake roller 28 are also associated with each other in use and are adapted to slide conveying surface 4 between the open (Figure 21a) and closed (Figure 2b) configurations. Retract roller 21 and belt uptake roller 28 are also connected via a similar link means 30. Retract rollers 20 and 21 and belt uptake rollers 27 and 28 are adapted to slide along a track or tracks (not shown) to facilitate movement between the open and closed configurations of first or second conveyors 9 and 10.

Retract roller 20 and belt uptake roller 27 are adapted to move in substantial unison towards drive roller 22 so that conveying surface 3 does not sag when conveyor apparatus 1 moves from a closed configuration to an open configuration. The distance through which belt uptake roller 27 moves is substantially equivalent to the length of conveyor displaced by movement of retract roller 20 forming the opening of a portion of opening 8. Furthermore, retract roller 21 and belt uptake roller 28 are adapted to move in substantial unison towards drive roller 23 so that conveying surface 4 does not sag when conveyor apparatus 1 moves from a closed configuration to an open configuration.

Retract roller 20 and belt uptake roller 27 may move to the open or closed position, corresponding to the open or closed configurations of the conveyor apparatus respectively, independently of retract roller 21 and belt uptake roller 28. However, in a preferred embodiment, they operate in a coordinated manner. For example, depending on the object size and the speed of the conveyor, retract roller 20 and 21 may move to the open or closed position in unison. Alternatively, retract roller 20 may move to the open or closed position before or after retract roller 21.

Embodiments of the invention include various mechanisms by which retract rollers 20 and 21 can be moved to the open and closed positions. For example, electro-linear actuators, fast acting nut and screw, hydraulic or pneumatic apparatus or other similar devices are used in different embodiments. The following embodiment provides one method for moving the retract rollers to the open and closed positions.

The present invention will now be described with reference to a preferred embodiment.

Referring to Figure 3, a further side elevation of a conveyor apparatus 1 is illustrated. For ease of reference, like numerals again refer to like components in relation to Figures 1 and 2. The conveyor apparatus is shown in a closed configuration. As described with reference to the embodiments shown in earlier figures, conveyor apparatus 1 includes a first conveyor 9 and a second conveyor 10 housed within a frame (not shown). It will be appreciated from the above description that first conveyor 9 and second conveyor 10 separate to form an opening 8 (not shown). First conveyor 9 includes a conveyor surface 3 and second conveyor 10 includes a conveyor surface 4. Conveyor surfaces 3 and 4 together form conveying surface 2.

Each conveyor 9 and 10 includes a drive roller 22 and 23 (not shown), a retract roller 20 and 21, a belt uptake roller 27 and 28 and a static roller 25 and 26. In first section 9, retract roller 20 and belt uptake roller 27 are linked via a link means. In preferred embodiments, the link means includes a bar 31 connecting retract roller 20 and belt uptake roller 27 via their respective associated roller housings 32 and 33. Retract roller 21 and belt uptake roller 28 of second conveyor 10 are also connected by a link means, which includes a bar 34 connecting the rollers via their respective roller housings 35 and 36. Those skilled in the art will be familiar with other possible link means. However for this embodiment to function to optimum requirements, the link means are preferably rigid.

The frame includes one or more tracks to support retract rollers 20 and 21 and belt uptake rollers 27 and 28. In a preferred embodiment, a single track 38 is used to support retract roller 20 and belt uptake roller 27 of first conveyor 9 and retract roller 21 and belt uptake roller 28 of second conveyor 10. Retract rollers 20 and 21 and belt uptake roller 27 and 28, each connected by a link means 31 and 34, are adapted to slide along track 38, substantially in unison, to provide the open or closed configurations of conveyor apparatus 1. Retract rollers 20 and 21 and belt uptake rollers 27 and 28 are maintained on track 38 by roller housings 32, 33, 35 and 36. Roller housings 32, 33, 35 and 36 are engageable with track 38. Roller housings 32, 33, 35 and 36 can be moved along track 38 in two directions.

The frame also includes a means to provide the open and closed configurations of conveyor apparatus 1. In a preferred embodiment, shown in the schematic diagram in Figure 3, the opening means includes two sprockets 39 and 40 (separated and straddling track 38), connected via a chain belt 29. A sprocket (in this example 40) can be driven and controlled by a motor control panel M. The motor control may include variable frequency controls or other similar devices. In the example, chain belt 29 is looped around the sprockets and is attached to:

a) roller housing 36 of the retract roller of second conveyor 10; and
b) roller housing 32 of the belt uptake roller of first conveyor 9.

Sprockets 39 and 40 support and drive chain belt 29. In the preferred embodiment, the sprockets include teeth or other projections which are adapted to engage with chain belt 29. Those skilled in the art will be aware of various alternative methods for driving the dynamic roller units 32, 33, 35 and 36 back and forth on track 38, providing the open and closed configurations of the invention.

In the embodiment illustrated in Figure 3, when chain belt 29 is driven in a clockwise direction, band uptake roller 27 (and retract roller 20 connected via a link means) will be pulled along track 38 towards sprocket 39, while retract roller 21 (and belt uptake roller 28 connected via a link means) will be pulled along track 38 towards sprocket 40, thus providing the open configuration of conveyor apparatus 1.

The conveying plane can be closed by movement of the chain belt in the opposite (anticlockwise) direction. Consequently, rollers 20 and 27 of conveyor 1 will be pulled away from sprocket 39, while rollers 21 and 28 of conveyor 2 will be pulled away from sprocket 40, thus providing the closed configuration of conveyor apparatus 1.

As the means to provide the open and closed configurations of conveyor apparatus 1 works by translating dynamic roller units 32, 33, 35 and 36 along a track 38, the rotational movement of rollers 20, 21, 27 and 28 is unaffected. Therefore conveying surface 2 can continue to transport objects in the predetermined direction Z.

In preferred embodiments, the speed at which the opening in the conveying surface opens and/or closes is substantially equal to the speed of conveyor surfaces 3 and 4, which are the same in this embodiment. This has been found to assist in maintaining the pitch or spacing between conveyed objects, which is important for automatic detection and processing of conveyed objects.

The retract roller 20 moving forward at the same speed at which conveyor surface 3 moves means a conveyed object on conveyor surface 3 maintains its position with respect to the retract roller. The object experiences no change in speed or direction relative to the conveying surface

while the temporary opening is forming. Therefore, if one object falls through the opening and the next is required to be sorted to a different location, i.e. move onto conveyor surface 4, the spacing between these objects can be small.

However, other speeds of opening and closing of the conveyor are provided in alternative embodiments. In one embodiment, the speed at which the opening means provides the open and closed positions is dependent on the size of the objects conveyed on conveying surface 2 and the speed at which the objects are conveyed along conveying surface 2. The speed of conveying surface 2 in direction Z can be synchronized to allow selected objects to pass through the opening, and non selected items can pass along conveyor surface 3 onto conveyor surface 4 in direction Z. The specified objects can be removed from conveying surface 2, without stopping or slowing conveyor surfaces 3 and 4.

One advantage of the invention is the relatively small amounts of mass that are required to be moved in order to open and/or close the opening, therefore allowing quick opening and/or closing movements easily.

It will be clear that conveyor apparatus 1 is not limited by size and larger apparatus may be constructed for larger objects. Furthermore, the examples show conveying surface 2 conveying objects in a horizontal direction. While this is a preferred embodiment, the invention may be used to sort objects where conveying plane 2 is inclining or declining.

It will also be appreciated that the invention provides a conveyor apparatus which is able to sort conveyed objects within a conveyor apparatus footprint no bigger than the size of the conveyor apparatus itself. That is, the area taken up by the conveyor apparatus in an open state or configuration is the same as the area taken up when in a closed configuration. This is advantageous in locations such as airports where space is valuable.

A conveyor apparatus according to embodiments of the invention has the advantage that objects on the apparatus may be sorted onto other conveyors or other locations while substantially maintaining the pitch (relative spacing) of the objects. This means that the conveyed objects are able to be processed more efficiently in other parts of the system the conveyor apparatus forms part of, for example in an airport baggage processing system.

The objects are also able to be sorted with minimal sliding, which helps maintain their position

and/or orientation through the conveyor system. This is advantageous, for example, in airport baggage systems where the position and/or orientation of baggage on conveyors affects the efficiency of automatic detection and identification of baggage.

The invention provides an improved conveyor apparatus able to cater for smaller object spacings at speeds which can reach those speeds that, for example, airport X-ray machines are increasingly being able to cope with and beyond. The invention therefore allows for increased baggage throughput.

While conveyor apparatuses according to the invention have been described above, for the purposes of example only, as including two conveyors, the invention also includes conveyor apparatuses with three or more separate conveyors whose conveyor surfaces (or parts thereof) together define the conveying surface of the conveyor apparatus. In one embodiment, two conveyors similar to conveyor 9 may be provided with a conveyor similar to conveyor 10 in between them, for example. In another embodiment, the middle conveyor may have retract rollers at both ends that are moveable, that is, both ends of a conveyor may be adjacent to an opening in the conveyor apparatus. Those skilled in the art will appreciate how the embodiments described herein may be adapted to such a system.

In another embodiment of the invention, the conveyor apparatus may include one fixed conveyor and one conveyor which is moveable to create an opening in the conveyor apparatus conveying surface. The invention therefore requires that at least one of the conveyors can form the temporary opening in the conveying surface.

In the above description, embodiments of the conveyor apparatus described have been able to form a temporary opening. In alternative embodiments, the conveyor apparatus has, in a preferred state, an opening, and as such can move to a state in which the opening is temporarily closed. It will be appreciated that the invention provides for both opening and closing of the gap in the conveying surface, irrespective of which state the conveyor apparatus is in for a majority of the time. The conveyor apparatus therefore can change between open and closed states.

The invention is primarily described above in relation to embodiments including belt conveyors. However, those skilled in the art will appreciate in light of the description that the invention may also be provided using other types of conveyor apparatuses. For example, driven roller

conveyors can be constructed in a substantially similar way to provide an opening in the conveyor. Another example is a gravity driven conveyor, such as a sliding chute. In such a chute, objects are conveyed along the surface of the chute by gravity. The chute may include two or more conveyor sections which can move apart to create an opening in the chute through which objects may fall and hence be sorted.

In a further embodiment of the invention, the objects exiting through the opening in the conveyor apparatus fall into an open topped container, for example a basket or tote. In one embodiment, the open topped container is itself carried by, or forms part of, another conveyor. This conveyor may include a plurality of containers or other discrete object receiving means. The edge of the first conveyor from which the object drops is preferably aligned such that the object drops directly into a container or via an intermediate chute, platform or the like. Preferably, the containers have soft or resilient bottom inner surfaces such that objects can be dropped into them with minimal damage.

In another embodiment of the invention, the conveyor apparatus is itself formed from at least one conveyor carrying or consisting of open topped containers. In one embodiment, the open topped containers are themselves transferred from one conveyor to the next or drop through the opening in conveyors.

Open topped containers such as totes are advantageous in object sorting systems such as airport baggage systems because identification means, such as barcodes, can be placed on the totes in a known position so that they can be reliably read. Furthermore, they can be easily used to enforce the maximum baggage rules since, if a piece of baggage cannot fit in a tote, the baggage is too big.

Reference to any prior art in this specification is not, and should not be taken as, an acknowledgement or any form of suggestion that that prior art forms part of the common general knowledge in the field of endeavour in any country in the world.

Wherein the foregoing description reference has been made to integers or components having known equivalents thereof, those integers are herein incorporated as if individually set forth.

It should be noted that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and

modifications may be made without departing from the spirit and scope of the invention and without diminishing its attendant advantages. It is therefore intended that such changes and modifications be included within the present invention.

Claims

1. A conveyor apparatus including:

one or more frames; and

two or more conveyors supported by the frame(s), the conveyors being adapted to convey at least one object in a predetermined direction,

wherein, in a closed state of the conveyor apparatus, at least a part of each conveyor together define a conveying surface and, in an open state of the conveyor apparatus, at least two of the two or more conveyors are separated by an opening in the conveying surface.

2. A conveyor apparatus as claimed in claim 1, wherein the state of the conveyor apparatus being open or closed is dependent on the object.

3. A conveyor apparatus as claimed in claim 1 or 2, wherein objects exit the conveyor apparatus at substantially the same spacing as the spacing when the objects enter the conveyor apparatus.

4. A conveyor apparatus as claimed in any one of the preceding claims, wherein movement of one of the two or more conveyors relative to the other of the two or more conveyors causes the conveyor apparatus to change between the open and closed states.

5. A conveyor apparatus as claimed in any one of the preceding claims, wherein the conveying surface continues to convey a stream of objects in the predetermined direction while the conveyor apparatus moves between open and closed states.

6. A conveyor apparatus as claimed in any one of the preceding claims, wherein in the open state the conveyor apparatus is adapted to sort a conveyed object such that the object exits the conveying surface through the opening.

7. A conveyor apparatus as claimed in any one of the preceding claims, wherein in the closed state the conveyor apparatus is adapted to sort a conveyed object such that the object moves from a first of the two or more conveyors to a second of the two or more conveyors.

8. A conveyor apparatus as claimed in claim 6 or 7, wherein the conveyor apparatus is adapted to be in the open or closed state for a period of time sufficient to permit only a selected object or selected objects to be sorted accordingly.

9. A conveyor apparatus as claimed in any one of claims 6 to 8, wherein the state of the conveyor apparatus can be changed at a speed such that a predetermined object can be selected from a series of objects and sorted without disturbing the adjacent objects.

10. A conveyor apparatus as claimed in any one of the preceding claims, wherein the state of the conveyor apparatus is adapted to change in the time between consecutive objects arriving at the end of an upstream conveyor.

11. A conveyor apparatus as claimed in any one of the preceding claims, wherein a conveyed object experiences substantially no change in speed or direction relative to the conveying surface while the state of the conveyor apparatus is changed.

12. A conveyor apparatus as claimed in any one of the preceding claims, wherein the opening opens and/or closes at substantially the same speed at which an object is conveyed on the conveying surface.

13. A conveyor apparatus as claimed in any one of the preceding claims, wherein the conveying surface is formed from at least first and second conveyor surfaces, each conveyor surface moving in the same predetermined direction at substantially the same speed.

14. A conveyor apparatus as claimed in claim 13, wherein first and second conveyor surfaces form part of first and second conveyors respectively.

15. A conveyor apparatus as claimed in claim 13 or 14, wherein the first conveyor and second conveyor each include a roller, at least one of the rollers being adapted to move towards and away from the other roller to close and open the opening in the conveying surface respectively.

16. A conveyor apparatus as claimed claim 15, wherein the rollers are positioned adjacent to each other at the opening in the closed state of the conveyor apparatus.

17. A conveyor apparatus as claimed in any one claims 13 to 16, wherein in the open state the first conveyor conveys objects towards the opening and the second conveyor conveys objects away from the opening.

18. A conveyor apparatus as claimed in any one of the preceding claims, wherein a collection device receives an object which has exited the conveying surface through the opening.

19. A conveyor apparatus as claimed in claim 18, wherein the collection device receives the exited object with minimal impact thereto.

20. A conveyor apparatus as claimed in claim 18 or 19, wherein the collection device includes a further conveyor which resides substantially beneath the opening when formed.

21. A conveyor apparatus as claimed in any one of claims 18 to 20, wherein the collection device includes any one or more of a chute, a power-curve™, a roller-deck, or a ball-deck or other like device.

22. A conveyor apparatus as claimed in claim 18 or 19, wherein the collection device is an open topped container.

23. A conveyor apparatus as claimed in claim 20, wherein the further conveyor includes a plurality of open topped containers.

24. A method of sorting a predetermined object on a conveying surface, the method including the step of opening and/or closing a gap in the conveying surface downstream of the predetermined object, such that the object exits the conveying surface through the opening when the gap is open and the object moves from a first conveyor to a second conveyor when the gap is closed.

25. A method as claimed in claim 24, wherein the gap is formed for a predetermined time sufficient to permit only the predetermined object to leave the conveying surface.

26. A method as claimed in claim 24, wherein the gap is closed for a predetermined time thereby permitting only the predetermined object to move from the first conveyor to the second conveyor.

27. A method as claimed in claim 24 or 25, wherein a collection device receives the predetermined object following its exit from the conveying surface through the gap.

28. A method as claimed in claim 27, wherein the collection device includes a conveyor.

29. A method as claimed in claim 27 or 26, wherein the predetermined object exits the conveying surface substantially under the influence of gravity.

30. A conveyor apparatus including first and second adjacent conveyors adapted to selectively move relative to each other, the conveyor apparatus having in a first configuration wherein an object on the first conveyor exits the conveyor apparatus through an opening between the conveyors, and the conveyor apparatus having a second configuration wherein the object moves from the first conveyor to the second conveyor.

31. A conveyor apparatus according to claim 30, wherein the configuration of the conveyor apparatus depends on identification of the object.

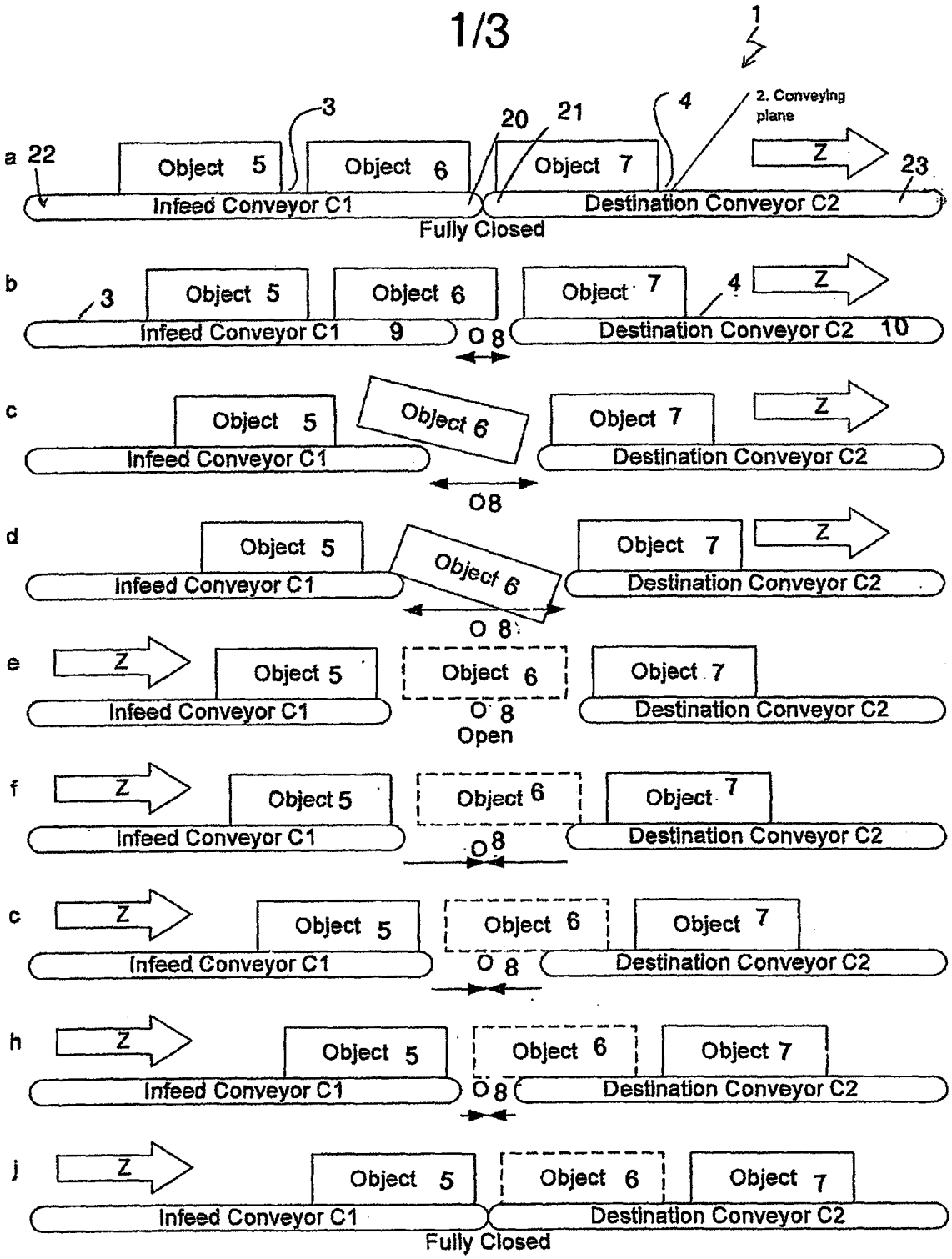

Figure 1. Operation of the invention

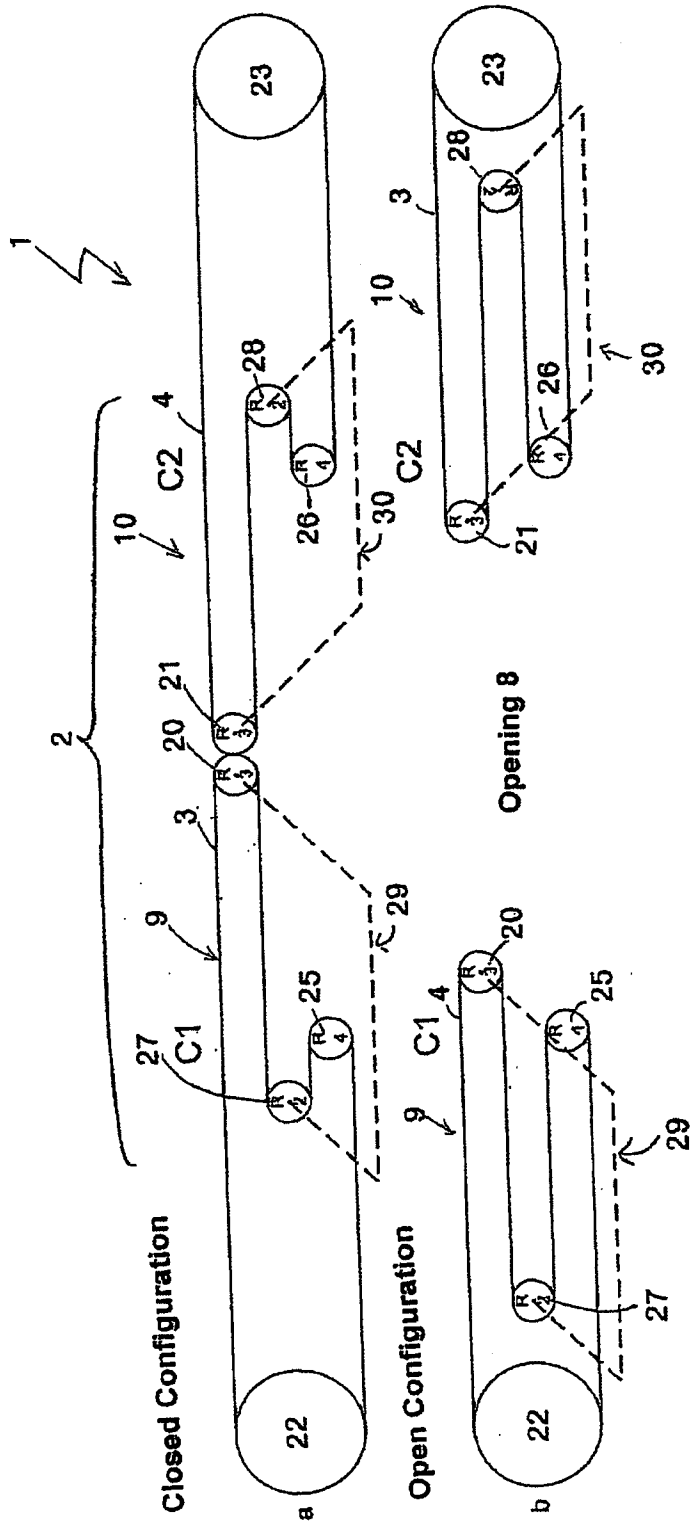

Figure 2. Side elevation of the conveyor sections 9 and 10

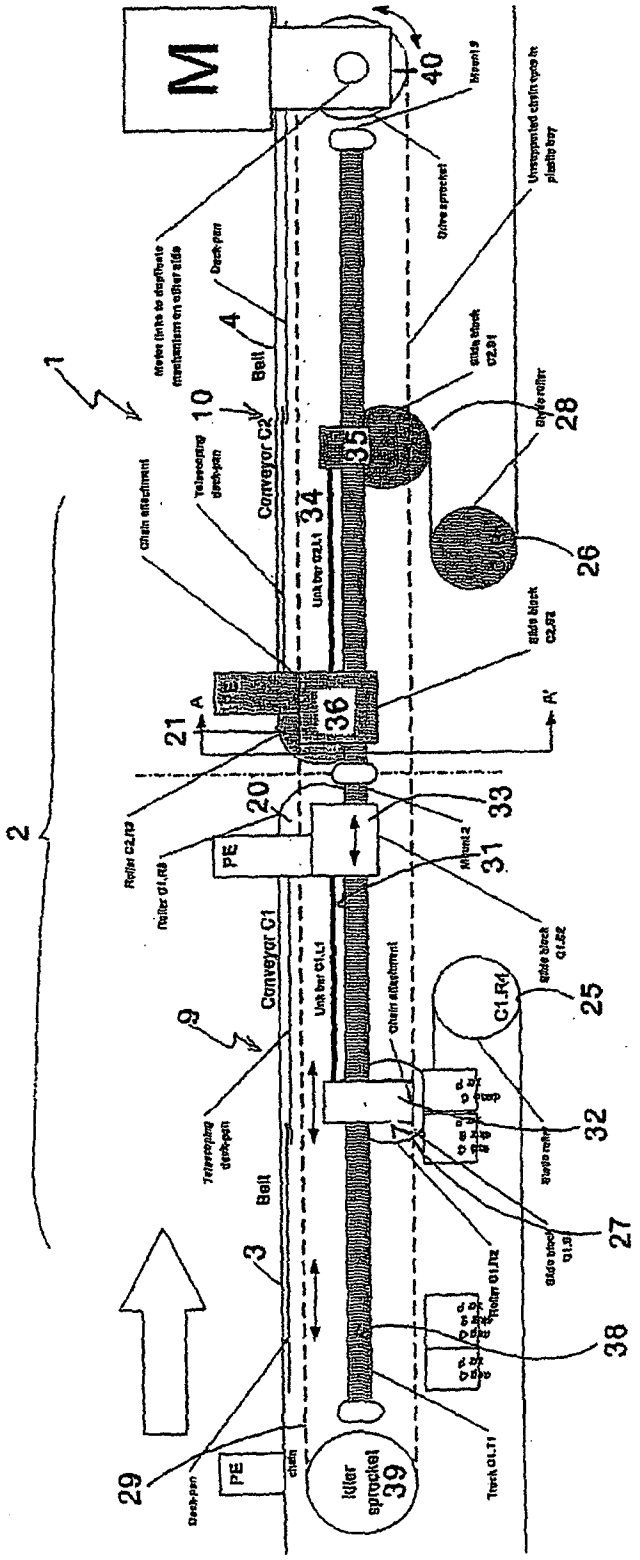

Figure 3. Side elevation of one embodiment of the invention

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2009/006562

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. ***B65G 21/14*** (2006.01) ***B65G 47/46*** (2006.01) ***B65G 47/51*** (2006.01) ***B65G 47/52*** (2006.01)

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)

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 practicable, search terms used)
WPI, EPODOC::IPC Marks B65G15, B65G21, B65G37, B65G46, B65G47; keywords: gap, space, separate, in-between, through, open, fall, drop, discharge, sort, divert, slide, expand, retract, contract, retract, and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/0272514 A1 (HAMERS et al.) 29 November 2007 Paragraphs: 0001-0002, 0006, 0009, 0011-0012, 0021-0022, 0024, 0026-0027, 0031, Figures 1-3 and 6a-6f	1-17, 21, 24-31
X	EP 0124177 A1 (TEVOPHARM SCHIEDAM B.V. (NL)) 7 November 1984 Page 3 line 3-Page 4 line 4, Page 7 line 2-Page 9 line 32, Figures 1, 2a-2b and 3a-3g	1, 3, 4, 18, 20, 23 and 30
X	US 4281757 A (MORTON) 4 August 1981 Col. 4 lines 34-48, Col.5 lines 5-18, Figs. 1, 7-11 and Figures 7, 10-11	1, 18, 20
X	GB 1013567 A (AUTOMAC LIMITED) 15 December 1965 Page 1 lines 55-56 and 62-81, Page 2 lines 12-19, Figs. 1 and 2	1, 2, 4, 6, 7, 24, 30-31

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 December 2009	09 DEC 2009
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2009/006562

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3426886 A (ARO) 11 February 1969 Col. 1 lines 29-36, Col 2 lines: 5-23, 37-65 and Figures 1-2	1, 4 and 30
X	US 3545630 A (IVANTO) 8 December 1970 Col. 1 lines 72-74, Col. 2 lines 53-55, Figures 2-3 and 5).	1, 18-19 and 22
X	US 5088592 A (PALMERS) 18 February 1992 Abstract, Col. 4 lines 19-41, Figures 3 and 4	1, 18, 19
A	US 4166525 A (BRUNO) 4 September 1979 Col. 5 lines 31-47 and Figures 4-9	1, 24, 30
A	US 2003/0196871 A1 (JONES, JR.) 23 October 2003 Paragraph 0006, 0031, 0044, 0045 and Figures 2a-2c, 5, 6a-6c, 7a-7b, 8-12	1, 6-13, 30-31

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/IB2009/006562

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	2007272514	EP	1860043	JP	2007326715	US	7490712
EP	0124177	NL	8301506				
US	4281757	CH	640794	DE	2932993	GB	2029353
GB	1013567	NONE					
US	3426886	NONE					
US	3545630	NONE					
US	5088592	AU	28137/89	BR	8807828	CN	1036727
		CS	8808008	DD	281796	EP	0395700
		PL	276212	SE	8704401	SU	1836216
		WO	8905223	YU	220188		
US	4166525	DE	2803223	FR	2377938	GB	1585451
US	2003196871	CA	2426088	US	7021450		

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX