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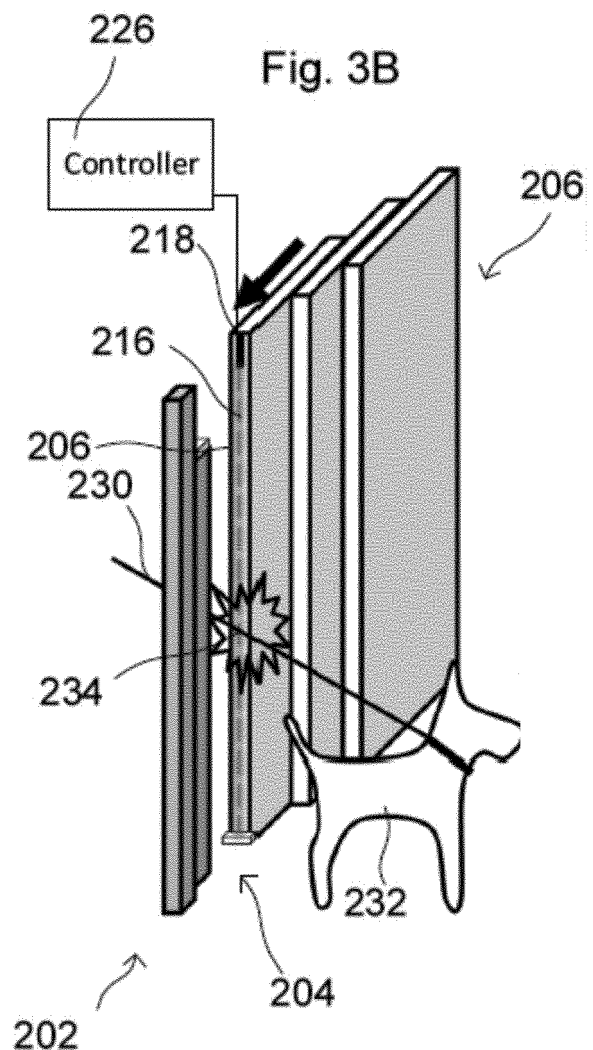
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(54) **OBSTRUCTION DETECTION SYSTEMS**

(57) An obstruction detection system (202) for detecting an obstruction in a doorway (204) closable by a door (206). The system (202) comprises a door (206) arranged in a doorway (204) and movable between an open position and a closed position.

The door (206) comprises a leading edge (208) which moves across the doorway (204) as the door (206) is moved from the open position to the closed position. The system (202) further comprises an obstruction detector (212) comprising an emitter (214) configured to emit a beam (216) along the leading edge (208) of the door (206) and a receiver (218) configured to detect the beam (216) incident thereon. The system 202 also comprises a controller (226) configured to control movement of the door (206) and coupled to the obstruction detector (212), wherein the controller (226) is configured to at least stop closing the door (206) when an object obstructs the beam (216).



Description**Technical Field**

[0001] This disclosure relates to obstruction detection systems and methods for detecting an obstruction in a doorway.

Background Art

[0002] When a door is being closed, it is often desirable to be able to stop the closure of the door if there is an obstruction within the doorway. This is particularly relevant with automatic doors which open and close automatically. Stopping the closure of the door may help prevent harm or damage being caused to the obstruction, or indeed the door itself. Elevator systems typically comprise a sensor arrangement for detecting the presence of an obstruction in a doorway, e.g. an elevator car doorway or a landing doorway. Such sensor arrangements typically comprise a horizontally extending beam which extends across the width of the doorway. When the beam is obstructed, the doors may be opened. Whilst such arrangements are capable of detecting obstructions across the full width of a doorway, they are not capable of detecting obstructions across the full height of the doorway. In an effort to detect obstructions across the height of the doorway, some prior art systems comprise multiple horizontal beams arranged at different vertical positions in the doorway. However, whilst such systems may increase the range over which obstructions may be detected, there are nonetheless certain regions in the height of the doorway whereby the beams do not extend. Accordingly, obstructions which only occupy a small vertical space may not be detected. For example, small objects such as fingers or dog leashes may not be detected.

[0003] It would be advantageous to provide a system which addresses the problems outlined above.

Summary of the Disclosure

[0004] In accordance with a first aspect, the present disclosure provides an obstruction detection system for detecting an obstruction in a doorway closable by a door, the system comprising:

a door arranged in a doorway and movable between an open position and a closed position, wherein the door comprises a leading edge which moves across the doorway as the door is moved from the open position to the closed position;

an obstruction detector comprising an emitter configured to emit a beam along the leading edge of the door and a receiver configured to detect the beam incident thereon; and

a controller coupled to the obstruction detector and

configured to control movement of the door, wherein the controller is configured to at least stop closing of the door when an object obstructs the beam.

[0005] Accordingly, the obstruction detection system is capable of detecting obstructions along the length of the leading edge of the door. The leading edge may extend in a vertical direction within the doorway and thus the beam may also extend in a vertical direction. Advantageously, when compared to prior art systems, the obstruction detection system may thus be capable of detecting obstructions along substantially all of the height of the doorway. As the leading edge of the door is the portion of the door which will first come into contact with an obstruction in the doorway, arranging the emitter to emit the beam along the leading edge means that as soon as any obstruction is at least proximal to the leading edge, movement of the door is at least stopped. The obstruction detection system thus minimises the risk of harm or damage being caused to an object obstructing the doorway, or indeed the door itself.

[0006] The obstruction detector itself may be capable of determining the presence of an obstruction, and may output an appropriate signal to the controller to at least stop movement of the door. For example, the obstruction detector may comprise its own dedicated processor which monitors the beam detected by the receiver. Alternatively, the controller may be configured to monitor the obstruction detector, specifically an output of the receiver, and the controller itself may determine the presence of an obstruction and take appropriate action. An obstruction in the doorway may completely obstruct the beam such that the receiver does not detect the beam at all. Accordingly, when the receiver does not detect a beam thereon, this may indicate the presence of an obstruction. However, there may be certain instances in which the object obstructing the beam only partially obstructs the beam. Accordingly, the obstruction detector or the controller may be configured to monitor the receiver to monitor for a drop in detected beam intensity. If the beam intensity drops below a certain threshold, it may be determined that there is an obstruction present. Similarly, the obstruction detector or controller may be configured to monitor for a change in shape of the detected beam, which may also be indicative of an obstruction in the path of the beam.

[0007] The emitter and receiver may be arranged in a through beam arrangement or retro-reflective arrangement in which an obstruction reduces the amount of the beam which is able to reach the receiver. In such arrangements, the obstruction detector or controller may, for example, be configured to monitor for a change, e.g. a decrease, in detected intensity or a change in the shape of the beam detected by the receiver. Alternatively, the emitter and receiver may be arranged such that an obstruction to the beam redirects a portion of the beam towards the receiver. In such an arrangement, when there is no obstruction, a minimal portion of the beam may be

detected by the receiver. This may, for example, be due to the beam reflecting from surfaces of the system, e.g. due to reflections from the floor. In some examples, the emitter and receiver may be arranged such that when there is no obstruction, no beam is detected by the receiver. When an object obstructs the beam, the object may redirect, e.g. reflect, at least a portion of the beam towards the receiver. In this case, the obstruction detector or the controller may be configured to monitor for a change in intensity, e.g. for an increase, detected by the receiver, or monitor for a change in the shape of the beam detected by the receiver.

[0008] The controller may be coupled to the obstruction detector in any suitable manner. For example, the controller may be connected to the obstruction detector, e.g. the receiver thereof, via wiring. Alternatively, the controller may be wirelessly connected to the obstruction detector. In order to control movement of the door, the controller may also be connected to means capable of controlling movement of the door. For example, the controller may be connected to a motor which drives movement of the door between the open and closed positions. In this respect, the door may be an automatic door.

[0009] As will be appreciated by those skilled in the art, in passing along the leading edge of the door, the beam may be separated from the leading edge by a small distance. This separation may be determined by the mounting of the obstruction detector. For example, the beam may pass along the leading edge at a distance of 1 mm to 10 mm from the leading edge of the door. The beam may travel in a plane which is parallel to the leading edge of the door. The emitter and receiver may be mounted in close proximity to the leading edge of the door, e.g. by mounting the emitter and receiver on the leading edge of the door. When an object obstructs the beam, the controller may only stop the closing of the door. Depending on the position of the door in the doorway, stopping of the door alone may be sufficient to prevent any harm or damage to the object and also allow the object to move from within the doorway. However this may not always be the case and in a set of examples, the controller is configured to open the door when an object obstructs the beam. Accordingly, by opening the door upon the detection of an object obstructing the beam, this may further minimise the risk of harm or damage to the object as well as allowing the object to more easily be moved from within the doorway as the object will not be hindered by the door being partially closed.

[0010] The emitter and receiver of the obstruction detector may be arranged in any suitable manner such that the beam passes along the leading edge of the door so as to be capable of detecting an obstruction along the length of the leading edge of the door. The emitter and receiver may be arranged separately at different vertical positions on the leading edge of the door. In a set of examples, the leading edge of the door comprises an upper portion and a lower portion and wherein one of the emitter or receiver is positioned at the upper portion of

the leading edge, and the other of the emitter or receiver is positioned at the lower portion of the leading edge. Separating the emitter and receiver in this manner may remove the need to provide any means for directing the beam, e.g. towards the receiver. This arrangement may therefore be simple to implement.

[0011] When the door is moved into the closed position, the beam may be obstructed by a permanent feature of the doorway rather than an obstruction within the doorway. For example, the beam may be obstructed by part of a door frame or another door which the door may meet when in the closed position. Of course, in such examples, it is not necessary to re-open the door. Therefore, in a set of examples, the obstruction detector comprises a further receiver arranged to detect the beam when the door is in a closed position. For example, the further receiver may be arranged on a door frame or another door which the door meets when in the closed position. Thus, even when in the closed position, the beam may be detected by the further receiver. The obstruction detector or controller may thus be configured to monitor the further receiver and if the beam is detected it may be concluded that there is no obstruction present, even though the receiver no longer detects the beam. The door will not therefore be opened due to an output of the obstruction detector when the door is in the closed position. Of course, the door may be opened for other reasons, e.g. to gain access through the doorway.

[0012] Depending on the relative positions of the emitter and the receiver, the beam may travel directly from the emitter to the receiver without requiring any redirection. This may, for example, be the case when the emitter and receiver are arranged separately, e.g. on upper and lower portions of the leading edge of the door. However, depending on the particular arrangement of the emitter and receiver, and depending on the shape of the leading edge of the door, this may not be possible. Accordingly, in a set of examples, the obstruction detection system further comprises a beam director arranged to direct the beam towards the receiver when the door is in an open position. The beam director may comprise any suitable arrangement for directing the beam. For example, the beam director may comprise a reflector arranged to reflect the beam emitted from the emitter towards the receiver. The use of a beam director may allow more freedom in the positioning of the emitter and the reflector of the obstruction detector as the beam director may be used to guide the beam. The beam director may direct the beam along substantially the same path along which it travelled to the beam director. This may, for example, be the case when the emitter and receiver are arranged together.

[0013] In a set of examples, the emitter and receiver are arranged together. For example, the emitter and receiver may be arranged next to one another. In such examples, the emitter may emit the beam towards a beam director which may redirect the beam back towards the receiver. Arranging the emitter and receiver together may

advantageously simplify the arrangement of the obstruction detector. For example, it may simplify the wiring of the obstruction detector, in examples wherein the obstruction detected is connected to the controller and/or a power source via a wired connection. The emitter and receiver may, for example, be arranged together at upper portion or lower portion of the leading edge of door and beam director may be arranged at other of the upper or lower portion of the leading edge. The emitter and receiver may be provided together as a single device. Of course, the emitter and detector may be in wireless communication with the controller, and be powered by a battery, and so the routing of wiring may not necessarily be a concern.

[0014] As discussed above with respect to the further receiver, parts of a doorframe or another door which the door meets when in the closed position may obstruct the beam thereby causing the obstruction detector to indicate the presence of an obstruction. Thus, in a set of examples, the obstruction detection system comprises a further beam director arranged to direct the beam towards the receiver when the door is in a closed position. The further beam director may, for example, be arranged on the door frame, or indeed on another door. The further beam director may comprise any suitable means for directing the beam towards the receiver. Similarly to the beam director mentioned above, the further beam director may comprise a reflector, e.g. a mirror. The further beam director may ensure that the beam is able to travel, unobstructed, towards the receiver when the door is in the closed position. Accordingly, when in the closed position, the controller will not cause the doors to be opened due to any obstruction of the beam. Of course, similarly to examples described above, the controller may cause the doors to open for other reasons, e.g. due to a user wanting to pass through the doorway.

[0015] The use of a further receiver or a further beam director as described in the examples above may ensure that the obstruction detector does not cause the controller to open the doors when in the closed position. In another set of examples, the obstruction detection system further comprises a door sensor configured to detect when the door is in the closed position, and wherein the controller is configured to not open the door based on any obstruction detected by the obstruction detector when the door sensor detects that the door is in the closed position. Accordingly, any obstruction caused by features of the doorframe or another door which the door meets, will not cause the door to be opened. Similarly to the examples described above, the controller may nonetheless open the door for other reasons, e.g. to allow a user to pass through the doorway.

[0016] As will be appreciated by those skilled in the art, the door sensor may be arranged in any suitable position which is capable of detecting when the door is in a closed position. For example, it may be arranged on the door, e.g. a leading edge thereof, or on the door frame, specifically on a portion which receives the door when moved

into the closed position. The door sensor may be connected to the controller and when the door sensor detects that the door is in the closed position it may cause the controller to ignore, or no longer monitor, the obstruction detector. Additionally, the door sensor may cause the obstruction detector to be turned off, e.g. by stopping the emission of a beam from the emitter, when the door sensor detects that the door is closed. The door sensor may be in addition to, or instead of, the further receiver or further beam director in the examples discussed above. The door sensor may be any device which is capable of detecting when the door is in a closed position. For example, the door sensor may comprise a mechanical switch which is operated when the door is moved into the closed position. Alternatively, the door sensor may comprise a contact switch. The door sensor may also comprise an inductive proximity sensor configured to detect when the door is in a closed position.

[0017] The obstruction detector may be arranged in any suitable manner such that the beam passes along the leading edge of the door. For example, the emitter, receiver, and beam director where included, may be attached to the leading edge of the door. The door frame, or another door, which the door meets may be designed to accommodate the emitter, receiver and beam director when the door is in the closed position. In a set of examples, however, the door comprises at least one recess into which the emitter and receiver are resiliently mounted, such that when the door is in an open position the emitter and receiver are positioned such that the beam passes along the leading edge of the door, and when moved into the closed position the emitter and receiver are moved into the at least one recess. In such examples, the emitter and receiver may conveniently be housed within the door itself, in the at least one recess, when in the closed position thereby removing the need to accommodate the emitter and receiver on the door frame or another door. The resilient mounting may, for example, comprise a resilient member having any suitable form. For example, the resilient member may comprise a helical spring arranged to bias the emitter and receiver out of the recess.

[0018] In examples comprising a door sensor, the door sensor may also be located in the at least one recess and be arranged to be triggered by the emitter or receiver as they are moved into the recess when the door moves into the closed position. Further, in examples comprising a beam director, the beam director may also be resiliently mounted into at least one recess on the door such that when the door is in an open position the beam director is positioned so as to direct the beam towards the receiver and when moved into the closed position the beam director is moved into the at least one recess. The door sensor may also be arranged such that it is triggered by movement of the beam director into the at least one recess.

[0019] The beam which passes along the leading edge of the door may be a single beam, albeit it may comprise

a component travelling in one direction and a component travelling in the opposite direction but occupying the same, or approximately the same, volume of space. This may be the case, in examples wherein a beam director is provided which directs the beam back along substantially the same path. In a set of examples, the width of the beam is substantially the same as the width of the leading edge of the door. This may allow the obstruction detector to detect even small obstructions which only extend partially across the width of the door.

[0020] In an alternative set of examples, the beam comprises a first beam which passes along a forward portion of the leading edge and a second beam which passes along a rearward portion of the leading edge. Accordingly, similarly to the example above wherein the width of the beam matches the width of the leading edge, this arrangement may also advantageously detect the presence of a small obstruction even if it only extends partially across the forward or rearward portions of the leading edge of the door. The first beam and second beam may be generated by a single emitter with a suitable optical arrangement capable of splitting a single beam into multiple beams. However, in a set of examples, the emitter comprises a first emitter configured to emit the first beam and a second emitter configured to emit the second beam. Control over the position of the first and second beams may be achieved more easily using such an arrangement. The beam may thus comprise a plurality of beams which are independently emitted. The first and second beams may be detected by a single receiver. However, alternatively, the receiver may comprise a first receiver arranged to detect the first beam and a second receiver arranged to detect the second beam. Such examples may also comprise one or more beam directors arranged to direct the beams towards the receiver(s).

[0021] In another set of examples, the first and second beams may be separate portions of a single beam. In a set of examples, the obstruction detection system further comprises a beam director arranged to redirect the first beam, emitted from the emitter along a forward portion of the leading edge, along a rearward portion of the leading edge thereby forming the second beam. This arrangement may effectively convert a single emitted beam into two separate beams which travel along different portions of the leading edge. Of course, forward and rearward are relative terms which may be used interchangeably.

[0022] The obstruction detector may be arranged such that the beam passes along at least 50%, e.g. at least 60%, e.g. at least 70%, e.g. at least 80%, e.g. at least 90% of the leading edge of the door. Accordingly, the obstruction detector may thus be capable of detecting obstructions at a range of heights adjacent the leading edge of the door. The extent to which the beam passes along the leading edge may be determined by the relative positioning of the emitter receiver and beam director where provided.

[0023] The beam may be any beam which can pass

along the leading edge of a door and be detected by the receiver. The beam may, in some examples, be capable of travelling along the leading edge, and then being re-directed back along the leading edge towards a receiver.

5 The beam, for example, may comprise an infrared beam, or a light beam. For example, the light beam may be a visible or non-visible light beam. The beam may be a laser beam. In other examples, the beam may comprise ultrasound.

10 **[0024]** Whilst the obstruction detection system has been described above with respect to a single door, in a doorway comprising multiple doors, each of the doors may comprise an obstruction detector coupled to a controller as described in the examples above. As mentioned
15 above, the door may be an automatic door which is opened and closed by a suitable motor configured to move the door. The door may be any door which moves across a doorway. For example, the door may be a sliding door wherein the door slides laterally. The sliding door
20 may be a sliding door which slides along a curved path. In this case, the doorway may be curved and the leading edge may follow a curved path. The door may also be one of two doors which form part of a centre opening door wherein the doors meet together and slide laterally.
25 The door may also be one of a plurality of doors in a telescopic door arrangement. The door may also be a pivotally mounted door which rotates about a pivot point. In such examples, a leading edge of the pivotally mounted door may follow a curved path as it moves across the doorway. In these examples, the doorway may thus en-
30 compass a volume of space through which the door moves in moving between its open and closed positions, i.e. the space into which the door pivots.

35 **[0025]** The obstruction detection system may be employed in any doorway wherein it is desirable to detect an obstruction. For example, it may be employed in a doorway to a building which utilises an automatic door. In a set of examples, however, the door is a door within an elevator system. For example, the door may be an
40 elevator car door, or a landing door. Detecting an obstruction in doorways of an elevator system is particularly important. For example, in the case of elevator doors, once the elevator doors are closed, the elevator car may proceed to move away from its current landing. As will be appreciated, if there is an object trapped within the door and the elevator car begins to move, this may cause significant harm to the trapped object, or indeed anything attached to the trapped object. Accordingly, being able to detect an obstruction across the height of the doorway
45 in an elevator system may be particularly advantageous.

[0026] According to another aspect of the present disclosure there is provided a method for detecting an obstruction in a doorway comprising a door movable between an open position and a closed position, the method comprising:
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passing a beam along a leading edge of a door from an emitter towards a receiver;

detecting when the beam is obstructed; and

at least stopping closing of the door when the beam is obstructed.

[0027] The at least stopping movement of the door when the beam is obstructed may be achieved using a controller which is coupled to emitter and receiver which may together form an obstruction detector.

[0028] In another set of examples, the method comprises opening the door when an object obstructs the beam.

[0029] In another set of examples, the method comprises arranging the emitter and receiver such that the beam is emitted from one of an upper portion of the leading edge or a lower portion of the leading edge of the door, and the beam is detected by the receiver at the other of the upper portion of the leading edge or the lower portion of the leading edge.

[0030] In another set of examples, the method comprises arranging a receiver to detect the beam when the door is in the closed position.

[0031] In another set of examples, the method comprises directing the beam using a beam director towards the receiver when the door is in an open position.

[0032] In another set of examples, the method comprises arranging the emitter and receiver together.

[0033] In another set of examples, the method comprises arranging a further beam director to direct the beam towards the receiver when the door is in the closed position.

[0034] In another set of examples, the method comprises arranging a door sensor so as to detect when the door is in the closed position and further configuring the controller to not open the door based on any obstruction detected, e.g. by the obstruction detector, when the door sensor detects that the door is in the closed position.

[0035] In another set of examples, the method comprises resiliently mounting the emitter and receiver in at least one recess on the door such that when the door is in an open position, the emitter and receiver are positioned such that the beam passes along the leading edge of the door and when the door is moved into the closed position the emitter and receiver are moved into the at least one recess.

[0036] In another set of examples, the width of the beam is substantially the same as the width of the leading edge of the door.

[0037] In another set of examples, the beam comprises a first beam which passes along a forward portion of the leading edge and a second beam which passes along a rearward portion of the leading edge.

[0038] In another set of examples, the emitter comprises a first emitter configured to emit the first beam and a second emitter configured to emit the second beam.

[0039] In another set of examples, the method comprises arranging a beam director to redirect the first beam, emitted from the emitter along a forward portion

of the leading edge, along a rearward portion of the leading edge thereby forming the second beam.

[0040] In another set of examples, the door is a door within an elevator system.

[0041] Advantages of the system detailed above equally apply to the method and associated examples set out herein. Similarly, features of the system described above may also be applied to the method and associated examples set out above.

Brief Description of the Drawings

[0042] Certain examples of the present disclosure will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a schematic illustration of an elevator system that may employ various examples of the present disclosure;

Fig. 2 is a schematic illustration of an obstruction detection system in accordance with an example of the present disclosure;

Figs. 3A-3C illustrate the obstruction detection system shown in Fig. 2 when detecting an obstruction;

Figs. 4A-4C illustrate the obstruction detection system shown in Fig. 2 when there is no obstruction present;

Fig. 5 is a flow chart illustrating operation of the obstruction detection system shown in Fig. 2;

Fig. 6 is a schematic illustration of another example of an obstruction detection system comprising first and second beams;

Fig. 7A is a schematic illustration of the obstruction detection system shown in Fig. 6 with the presence of an obstruction;

Fig. 7B is a top plan view of the obstruction detection system shown in Fig. 7A with the obstruction present;

Fig. 8 is a schematic illustration of another example of an obstruction detection system comprising first and second beams, wherein the second beam is generated by redirecting the first beam;

Fig. 9 is a schematic illustration of another example of an obstruction detection system wherein the emitter and receiver are arranged separately on upper and lower portions of the leading edge;

Fig. 10 is a schematic illustration of another example of an obstruction detection system wherein the emitter, receiver and beam director are arranged to move

into recesses on the door;

Fig. 11 is a flow chart illustrating operation of the obstruction detection system shown in Fig 10;

Fig. 12 is an illustration showing another example of an obstruction detection system wherein the width of the beam is substantially the same as the width of the leading edge of the door;

Fig. 13A and 13B are schematic illustrations of another example of an obstruction detection system wherein an obstruction redirects the beam towards the receiver; and

Fig. 14 is a flow chart illustrating operation of the obstruction detection system shown in Figs. 13A and 13B.

Detailed Description

[0043] FIG. 1 is a perspective view of an elevator system 101 including an elevator car 103, a counterweight 105, a tension member 107, a guide rail 109, a machine 111, an encoder 113, and a controller 115. The elevator car 103 and counterweight 105 are connected to each other by the tension member 107. The tension member 107 may include or be configured as, for example, ropes, steel cables, and/or coated-steel belts. The counterweight 105 is configured to balance a load of the elevator car 103 and is configured to facilitate movement of the elevator car 103 concurrently and in an opposite direction with respect to the counterweight 105 within an elevator shaft 117 and along the guide rail 109.

[0044] The tension member 107 engages the machine 111, which is part of an overhead structure of the elevator system 101. The machine 111 is configured to control movement between the elevator car 103 and the counterweight 105, and thus control the position of the elevator car 103 within the elevator shaft 117. The encoder 113 may be mounted on a fixed part at the top of the elevator shaft 117, such as on a support or guide rail, and may be configured to provide position signals related to a position of the elevator car 103 within the elevator shaft 117. In other embodiments, the encoder 113 may be directly mounted to a moving component of the machine 111, or may be located in other positions and/or configurations as known in the art. The encoder 113 can be any device or mechanism for monitoring a position of an elevator car and/or counterweight, as known in the art.

[0045] The controller 115 is located, as shown, in a controller room 121 of the elevator shaft 117 and is configured to control the operation of the elevator system 101, and particularly the elevator car 103. For example, the controller 115 may provide drive signals to the machine 111 to control the acceleration, deceleration, levelling, stopping, etc. of the elevator car 103. The controller 115 may also be configured to receive position signals

from the encoder 113 or any other desired position reference device. When moving up or down within the elevator shaft 117 along guide rail 109, the elevator car 103 may stop at one or more landings 125 as controlled by the controller 115. Although shown in a controller room 121, those of skill in the art will appreciate that the controller 115 can be located and/or configured in other locations or positions within the elevator system 101. In one embodiment, the controller may be located remotely or in the cloud.

[0046] The machine 111 may include a motor or similar driving mechanism. The machine 111 may be configured to include an electrically driven motor. The power supply for the motor may be any power source, including a power grid, which, in combination with other components, is supplied to the motor. The machine 111 may include a traction sheave that imparts force to tension member 107 to move the elevator car 103 within elevator shaft 117.

[0047] Although shown and described with a roping system including a tension member 107, elevator systems that employ other methods and mechanisms of moving an elevator car within an elevator shaft may employ embodiments of the present disclosure. For example, embodiments may be employed in ropeless elevator systems using a linear motor to impart motion to an elevator car. Embodiments may also be employed in ropeless elevator systems using a hydraulic lift to impart motion to an elevator car. FIG. 1 is merely a nonlimiting example presented for illustrative and explanatory purposes. Features of the elevator system 101 may be applied to the elevator system described below.

[0048] Figure 2 shows a perspective view of an obstruction detection system 202 for detecting an obstruction in a doorway 204 closable by a door 206 in accordance with an example of the present disclosure. In the example shown, the door 206 is a three-part sliding telescopic door 206, however the obstruction detection system 202 may work with any suitable door. The door 206 may be moved between an open position in which people and objects can pass through the doorway 204, and a closed position in which the doorway 204 is closed such that people and objects cannot pass through the doorway 204. The door comprises a leading edge 208 which moves across the doorway 204 as the door 206 is moved from the closed position to the open position. The leading edge 208 comprises the entire end face of the door 206. The leading edge 206 moves towards and meets a door frame 210 when the door 206 is in the closed position.

[0049] The obstruction detection system 202 comprises an obstruction detector 212 which comprises an emitter 214 configured to emit a beam 216 towards a receiver 218. In the example illustrated in Figure 2, the emitter 214 and receiver 218 are arranged together on an upper portion 220 of the leading edge 208. The emitter 214 and receiver 218 may be integrally provided as a single device. A beam director 222 is arranged on a lower portion 224 of the leading edge 208 and is arranged to direct the beam 216, emitted from the emitter 214, back towards

the receiver 218. The beam director 222 may be a reflector, e.g. a mirror. In the example illustrated, the beam 216 passes along the entire length of the leading edge 208 of the door 206.

[0050] The obstruction detection system 202 further comprises a controller 226. Whilst not depicted, the controller 226 may be coupled to appropriate door driving means, e.g. a motor, so as to be able to control movement of the door 206. The controller 226 is also coupled to the obstruction detector 212. For example, the controller 226 may be coupled to the receiver 218. The obstruction detector 212 itself may monitor the beam 216 detected by the receiver 218 and output a signal to the controller 226 when it detects an obstruction. Alternatively, the controller 226 may directly monitor the receiver 218, e.g. the intensity of the beam 216 detected, so as to detect for an obstruction.

[0051] The obstruction detection system 202 further comprises a further beam director 228 arranged on the door frame 210. The further beam director 228 may also be a reflector, e.g. a mirror, for reflecting the beam 216. When the door 206 is moved into a closed position, the beam 216 will be directed by the further beam director 228, e.g. reflected, back towards the receiver 218. Accordingly, closing of the door will not be confused with an obstruction in the path of the beam 216.

[0052] Detection of an obstruction in the doorway 204 will now be described with reference to Figures 3A to 3C. Operation will be described with reference to the detection of an obstruction in the form of a dog lead 230 attached to a dog 232. Figure 3A shows the door 206 in the open position in which the doorway 204 is fully open. As shown, the dog 232 has passed through the doorway 204, however the dog lead 230 is still extending through the doorway 4. At this point the door 206 may begin to close.

[0053] As depicted in Figure 3B, the door 206 has begun to move towards a closed position. As a result, the leading edge 208 of the door 206 moves across the doorway 204. As depicted, the dog 232 and thus the dog lead 230 have not moved and thus the dog lead 230 is still present within the doorway 204. Once the door 206 has sufficiently moved across the doorway 204, the dog lead 230 will obstruct the beam 216 at the point indicated by obstruction 234. As a result, the receiver 218 will no longer detect the beam 216, or at least the intensity of the beam detected may be reduced if the beam 216 is only partially obstructed by the dog lead 230. Consequently, the controller 226 stops the movement of the door 206, i.e. the controller 226 stops the door 206 from advancing further towards the closed position, and opens the door 206. As will be appreciated by those skilled in the art, the arrangement of the beam 216 which passes along the leading edge 208 of the door is capable of detecting an obstruction which has a small vertical extent, i.e. the dog lead 230, which may otherwise not be detected in a system which comprises sensors which utilise horizontally extending beams. This arrangement is capable of detect-

ing the presence of an obstruction at a wide range of heights across the height of the doorway 204.

[0054] The opening of the door 206 is depicted in Figure 3C whereby the direction of movement of the door 206 has been reversed such that the door 206 moves back towards an open position. As a result, the beam 216 is no longer obstructed and the doorway 204 becomes fully open. With the door 206 in the open position, the dog lead 230 will no longer become trapped in the doorway 204 and any harm to the dog 232, or to the person holding the dog lead 230 is avoided.

[0055] Figures 4A to 4C show the obstruction detection system 202 described above, when there is no obstruction in the doorway 204. Figure 4A shows the door 206 in the open position in which the doorway 204 is fully open. As depicted, there are no obstructions within the doorway 204 which would impede the movement of the door 206. In this position, the beam 216 is not obstructed.

[0056] Figure 4B shows the obstruction detection system 202 as the door 206 begins to move from its open position illustrated in Figure 4A, towards a closed position. As depicted, the leading edge 208 of the door 206 moves across the doorway 204 towards the door frame 210. As there are no obstructions which act to obstruct the beam 216, the door 206 is free to move across the doorway 204.

[0057] Figure 4C shows the obstruction detection system 202 with the door 206 in its closed position. In this closed position, the doorway 204 is fully closed. In this fully closed position, the beam director 222 on the leading edge 208 of the door 206 becomes obstructed by the door frame 210 such that it is no longer capable of directing the beam 216 back towards the receiver 218. However, the further beam director 228 which is arranged on the door frame 210, directs the beam 216 back towards the receiver 218 when the door 206 is in the closed position. Accordingly, the obstruction detector 212 does not confuse the doorframe 210 with an obstruction and thus when in the fully closed position, the controller 226 does not cause the door 206 to open due to the detection of an obstruction. Of course, as mentioned previously, once in the closed position, the door 206 may be opened for other reasons, e.g. to allow a user to pass through the doorway 204 as is required.

[0058] Figure 5 is a flow chart illustrating the operation of the obstruction detection system 202 described above and reference will be made to the obstruction detection system 202 as illustrated in Figure 2. Operations starts at step 236, wherein the doors 206 begin closing. Sensor data 238, from the obstruction detector 212, is then provided. The sensor data 238 is analysed in step 240 wherein it is determined whether the obstruction detector 212 detects an obstruction in the doorway 204. The sensor data 238 may be analysed by the obstruction detector 212 itself, which may then output a suitable control signal to the controller 226. Alternatively, the sensor data 238 may be analysed by the controller 226. If the sensor data 238 indicates the presence of an obstruction, the method

proceeds to step 242 in which the door 206 is stopped from closing any further. In step 244 the door 206 is then opened. Following the opening of the door 206 in step 244, the obstruction detection system 202 may wait for a time period in step 246. The wait may be for 5 to 10 seconds. This may allow any obstruction within the doorway 204 to be moved. Following this wait, in step 248 the door 206 may once again be closed. The process then proceeds to step 240 in which sensor data 238 is analysed again.

[0059] When the sensor data 238 does not indicate the presence of an obstruction, either following an initial closing of the door 206, or after an initial closing, opening and reclosing of the door 206, step 240 proceeds to step 250 in where it is determined whether the door 206 is in a closed position. This determination may also be performed by the controller 226. If it is determined that the door is not in a closed position, the door 206 is allowed to continue to close and steps 240 and 150 described above are repeated as necessary.

[0060] As previously described, the door 206 may be a door 206 of an elevator system, for example a door 206 of the elevator system 101 shown in Figure 1. Therefore, optionally, following a determination that the door 206 is closed in step 250, in the case wherein the door 206 is part of an elevator system, an elevator of the elevator system may then be allowed to travel in step 252.

[0061] The method as described above may be applied to any of the examples disclosed herein. Additionally, whilst it has been described above with reference to a single door, it may also be applied to a plurality of doors.

[0062] Figure 6 shows an obstruction detection system 302 in accordance with another example of the present disclosure. The obstruction detection system 302 is identical to the obstruction detection system 202 shown in Figure 2, except that instead of a single emitter and receiver as is the case in the obstruction detection system 202, the obstruction detector 312 comprises a first obstruction detector 312A and a second obstruction detector 312B. The first obstruction detector 312A comprises a first emitter 314A arranged to emit a first beam 316A and a first receiver 318A arranged to detect the first beam 316A. The second obstruction detector 312B comprises a second emitter 314B arranged to emit a second beam 316B and a second receiver 318B arranged to detect the second beam 316B. The first beam 316A and second beam 316B are both directed by the beam director 322 towards the first receiver 318A and second receiver 318B respectively. The beam director 322 may act to reflect the first and second beams 318A, 318B. Whilst one beam director 322 is shown, of course independent beam directors for each of the first and second beams 316A, 316B may be used. For example, the beam director 322 may comprise independent reflectors each having a parabolic shape which redirect the first and second beams 316A, 316B to their respective receivers 318A, 318B. As depicted, the first beam 316A passes along a forward portion 308A of the leading edge 308 of the door 306 and

the second beam 316B passes along a rearward portion 308B of the leading edge 308 of the door 306. The first obstruction detector 312A and second obstruction detector 312B are each connected to the controller 326.

[0063] The obstruction detection system 302 operates in an identical manner to that described above with respect to the obstruction detection system 202 shown in Figure 2, except that if either of the first beam 316A or second beam 316B are obstructed, the controller 326 causes the door 306 to stop and move back towards the open position, i.e. open the door 306.

[0064] The advantage of the obstruction detection system 302 will now be described with reference to Figure 7A and Figure 7B. Figure 7A shows a perspective view of the obstruction detection system 302 with a dog lead 330 passing through the doorway 304 and Figure 7B shows a plan view from above of the obstruction detection system 302 focussing on the leading edge 308 of the door 306 and the first and second beams 316A, 316B. As can be seen more clearly in Figure 7B, the dog 332 may be positioned such that the dog lead 330 extends at an angle through the doorway 304. Such an angle may mean that the dog lead 330 comes close to, and potentially in contact with, a rearward portion 308B of the leading edge 308 of the door 306, but not necessarily with other portions of the leading edge 308. Accordingly, with a first beam 316A which passes along the forward portion 308A of the leading edge 308 and a second beam 316B which passes along the rearward portion 308B of the leading edge 308, it may be possible to detect an object which comes close to only part of the leading edge 308. In the example depicted, the dog lead 330 may only obstruct the second beam 316B. Such an arrangement may also be able to detect the presence of other objects which only protrude across part of the width of the leading edge 308, for example a fingertip of a user of the doorway 304. As depicted in Figure 7B, in passing along the leading edge 308, the first and second beams 316A, 316B may be physically separated from the leading edge by a small distance, e.g. by 1 mm to 10 mm. This may also be the case for any of the beams described in the examples above and below.

[0065] Figure 8 shows a perspective view of another obstruction detection system 402 in accordance with another example of the present disclosure. The obstruction detection system 402 is similar to the obstruction detection system 302 described above, in that it comprises a first beam 416A which passes along a forward portion 408A and a second beam 408B which passes along a rearward portion 408B of the leading edge 408. However, instead of using two separate obstruction detectors, the obstruction detection system 402 comprises a single obstruction detector 412 which comprises a single emitter 414 and a single receiver 418. The emitter 414 is arranged to direct the first beam 416A along the forward portion 408A of the leading edge 408 and the beam director 422 is arranged to direct the first beam 416A in such a manner so as to form the second beam 416B

which passes along the rearward portion 408B of the leading edge 408. In the example shown, the beam director 422 comprises a first reflector 422A and second reflector 422B which are arranged relative to one another to direct the beam 416A in the manner described above. The obstruction detection system 402 provides the same advantage as the obstruction detection system 302 as described above. However, the obstruction detection system 402 advantageously minimises the number of emitters and receivers required. The controller 426 thus only has to monitor an input from single obstruction detector 412. The obstruction detection system 402 also comprises a further beam director 428 which is arranged on the door frame 410. The further beam director 428 may function in an identical manner to the beam director 422 described above, and may ensure that the beam 416A, 416B is able to reach the receiver 418 when the door 406 is in the closed position. The beam director 428 may thus function in a similar manner to the further beam director described above with reference to the obstruction detection system 202 shown in Figure 2.

[0066] Figure 9 shows a perspective view of another obstruction detection system 502 in accordance with another example of the present disclosure. The obstruction detection system 502 is similar to the obstruction detection system 202 shown in Figure 2. The emitter 514 of the obstruction detector 512 is arranged on an upper portion 522 of the leading edge 508 of the door 506 and the receiver 518A is arranged on a lower portion 524 of the leading edge 508 of the door 506. Accordingly, as will be appreciated by those skilled in the art, in this example, the beam 516 passes along the leading edge 508 from the upper portion 522 to the lower portion 524 where it is detected by the receiver 518A. The beam 516 is not redirected towards the receiver 512 as is the case with the examples described above. This arrangement may thus remove the need to provide a beam director. The controller 526 may be coupled to the receiver 518A, and whilst not shown it may also be coupled to the emitter 514 if required.

[0067] The obstruction detection system 502 operates in a similar manner to the examples described above. When an object obstructs the beam 516 a reduction in intensity is detected by the receiver 518A and the controller 526 may subsequently stop the closing of the door 506 and open the door 506.

[0068] The obstruction detection system 502 comprises a further receiver 518B arranged on the door frame 510. The further receiver 518B is also connected to the controller 526. When the door 506 is in a closed position, the door frame 510 may prevent the beam from travelling towards the receiver 518A. Accordingly, the further receiver 518B is arranged to detect the beam 516 when the door 506 is in the closed position. Therefore, when in the closed position, the controller 526 will not cause the door 506 to re-open due to an obstruction. Of course, the controller 526 may cause the door 506 for other reasons, e.g. due to a user wanting to pass through the door-

way 504. The emitter 514, receiver 518A and further receiver 518B may be arranged in any suitable manner on the door 6 and door frame 510 to achieve the above.

[0069] Figure 10 shows another obstruction detection system 602 in accordance with an example of the present disclosure. In the obstruction detection system 602, the obstruction detector 612, which comprises the emitter 614 and receiver 618, is resiliently mounted on a spring 656 arranged within a first recess 654 on the door 606. Additionally, a beam director 622 is also resiliently mounted on a spring 660 arranged within a second recess 658 on the door 606. The obstruction detection system 602 further comprises a door sensor 662, e.g. in the form of a mechanical switch, arranged in the first recess 564. The door sensor 662 and the obstruction detector 612 are operatively connected to the controller 626.

[0070] Operation of the obstruction detection system 602 will now be described. When the door 606 is in the open position, or indeed any position between the open position and the closed position, the springs 656, 660 bias the obstruction detector 612 and beam director 622 into the position shown in Figure 10 in which the beam 616 is emitted from the emitter 614 passes along the leading edge 608 of the door 606. Accordingly, the obstruction detector 612 is thus able to detect the presence of obstructions in the path of the beam 616 and functions in an identical manner to the obstruction detection system 202 described above.

[0071] As the door 606 moves into its closed position and in the situation wherein there is no obstruction present, the obstruction detector 612 and the beam director 622 may come into contact with the door frame 610. As the door 606 closes further, the obstruction detector 612 and beam director 622 are forced against their respective springs 656, 660, thereby pushing the obstruction detector 612 and beam director 622 into the first recess 654 and second recess 658 respectively. As the obstruction detector 612 moves into the first recess 654, it may operate the door sensor 662. Operation of the door sensor 662, which is connected to the controller 626, may cause the controller 626 to disregard any obstructions, e.g. the obstruction provided by the recess 654, and thus no longer cause the controller 626 to open the door 606 due to the presence of an obstruction. In addition or alternatively, operation of the door sensor 662 may cause the controller 626 to control the obstruction detector 612 such that it is effectively switched "off", i.e. such that the beam 616 is no longer emitted from the emitter 614. This may reduce power consumption and improve the lifespan of the obstruction detection system 602. Any door sensor 662 that is capable of detecting the movement of the obstruction detector 612 into the first recess may be used.

[0072] Of course, instead of the door sensor 662, the first recess 654 could comprise a further beam director arranged to direct the beam 622 towards the receiver 612 when the obstruction detector 612 is moved into the first recess 654. In this regard, the obstruction detection system 602 would operate in a similar manner to that

described above in relation to obstruction detection system 202, with particular reference to Figures 4A-4C.

[0073] Figure 11 shows a flow chart illustrating the operation of the obstruction detection system 602 described above. The process begins at step 636 wherein the door 606 begins to close. Sensor data 638 from the obstruction detector 612 is then monitored and at step 640 it is determined whether the obstruction detector 612 detects the presence of an obstruction. This determination may be performed by the obstruction detector 612 itself, or the controller 626 may be configured to monitor an output of the obstruction detector 612 to determine the presence of an obstruction.

[0074] If it is determined that there is an obstruction present, the process proceeds to step 641 wherein it is determined whether the door sensor 662, e.g. a switch, detects that the door has been closed. This determination is performed based on a switch signal 643. The switch signal 643 may be input into the controller 626. When it is determined that the door sensor 662 has not detected that the door 606 is closed, the process proceeds to step 642 in which the door 606 is stopped from closing further. Following this, step 644 is performed in which the door 606 is opened. Then, at step 646, there may be a small wait, for example 5 to 10 seconds, so as to allow any obstruction to be moved from within the doorway. After this, the door 606 may once again be closed in step 648. The steps described above are then repeated until the door 606 is able to fully close.

[0075] As discussed above, the obstruction detection system 602 may be part of an elevator installation. If it is determined at step 641 that the door sensor 662 has detected that the door 606 is closed, in some examples, the process may proceed to step 652 in which an elevator to which the door 606 provides access, may be allowed to move.

[0076] Figure 12 shows an obstruction detection system 702 in accordance with another example of the present disclosure. The obstruction detection system 702 is similar to the obstruction detection system 202 described above, except that the beam 716 has a beam width 768 which is substantially the same width as the width 770 of the leading edge 708 of the door 708. The obstruction detection system 702 may thus, similarly to the obstruction detection systems 302, 402 described above, be capable of detecting small obstructions which only extend part way across the leading edge 308. The obstruction detector 712 and/or the controller 726 may be configured to monitor for a drop in intensity of the detected beam 716 and may therefore not require the beam 716 to be blocked completely. The obstruction detection system 702 may function in an otherwise similar manner to the obstruction detection system 202 described above.

[0077] Figure 13A shows an obstruction detection system 802 in accordance with another example of the present disclosure. The obstruction detection system 802 comprises an obstruction detector 812 which com-

prises an emitter 814 configured to emit a beam 816 along the leading edge 808 of the door 806. The obstruction detector 812 further comprises a receiver 818 arranged to detect the beam 816. A controller 826 is operatively connected to the obstruction detector 812, e.g. the receiver 818 thereof, and is configured to control operation of the door 806. In the examples described above, when an object obstructs the beam, the object acts to reduce the amount of the beam which is able to reach the receiver. This is contrasted to the obstruction detection system shown in Figure 13A, wherein the object may act to redirect the beam 816 back towards the receiver 818, and thereby potentially increase the amount of the beam 816 which reaches the receiver 818. This may result in an increase the intensity of the beam 816 detected by the receiver 818. In order to achieve this, the beam 816 may be chosen such that it is capable of being redirected by an object. For example, the beam 816 may be an ultrasonic beam. The obstruction detector 812 may thus be considered to be an ultrasound sensor.

[0078] The detection of an obstruction in the obstruction detection system 802 is illustrated in Figure 13B. As depicted, when an obstruction in the form of a dog lead 830 attached to a dog 832 intersects the beam 816, a portion 816C of the beam is redirected back towards the receiver 818. The obstruction, i.e. the dog lead 830, may not redirect the beam 816 entirely and a further portion 816D may continue to travel along the leading edge 808 of the door 806. When the receiver 818 detects the beam 816C redirected by the dog lead 830, the controller 826 may proceed to stop, and optionally open, the door 806 as in the examples described above.

[0079] In the obstruction detection system 802, when there is no obstruction, the beam 816 may travel freely to a floor of the doorway 804. At this point, a portion of the beam 816 may be reflected back towards the receiver 818. The obstruction detector 812 and the controller 826 may thus be configured such that the detection of the beam 816 reflected from the floor does not cause the stopping or opening of the door 806. In a similar manner, when the door 806 is in the closed position, a portion of the beam 816 may be redirected back towards the receiver 818 by a part of the door frame 810. Accordingly, the obstruction detector 812 and/or the controller 826 may be configured to recognise the detection of the beam 816 when it is redirected by the door frame 810, and thus not cause the door 806 to stop or reopen when the door 806 reaches the closed position.

[0080] Figure 14 shows a flow chart illustrating the operation of the obstruction detection system 802 described above. The process begins at step 836 wherein the door 806 begins to close. Sensor data 838 from the obstruction detector 812 is then monitored and at step 840 it is determined whether the obstruction detector 812 detects a beam 816C incident on the receiver 818. This determination may be performed by the obstruction detector 812 itself, or the controller 826 may be configured to monitor an output of the obstruction detector 812 to determine

the presence of an obstruction.

[0081] At step 845 it is determined whether the beam detected corresponds to a beam redirected by the floor or door frame. If it is determined that the beam does not correspond to a beam redirected by the floor or the door-frame then it is assumed that the redirection is the result of an obstruction. The process then proceeds to step 842 in which the door 806 is stopped from closing further. Following this, step 844 is performed in which the door 806 is opened. Then, at step 846, there may be a small wait, for example 5 to 10 seconds, so as to allow any obstruction to be moved from within the doorway 804. After this, the door 806 may once again be closed in step 848. The steps described above are then repeated until the door 806 is able to fully close.

[0082] If at step 840 there is no beam detected by the receiver 818, or if at step 845 it is determined that the floor or door frame 810 are detected, the process proceeds to step 847 whereby it is determined whether the door 806 is closed. This may be achieved by determining whether the receiver 818 detects the presence of a beam which is redirected by the door frame 810 or by any other suitable means. If the door 806 is allowed to continue closing and the process repeats as described above until at step 847 it is determined that the door 806, at which point the process may stop.

[0083] As discussed above, the obstruction detection system 802 may be part of an elevator installation. If it is determined at step 847 that the door 806 is closed, in some examples, the process may proceed to step 852 in which an elevator to which the door 806 provides access, may be allowed to move.

[0084] In any of the examples above comprising a beam director, the beam director, or further beam director may be any beam director which is capable of directing the beam towards the receiver. For example, the beam director or further beam director may comprise a reflector, e.g. a reflector having a parabolic shape arranged to focus the beam back towards the receiver.

[0085] In any of the examples described above, whilst the obstruction detector or controller has been described as monitoring an intensity of the detected beam, the obstruction detector or controller may monitor any suitable parameter detected by the receiver to determine the presence of an obstruction. For example, the obstruction detector or controller may monitor for a change in the shape of the beam detected by the receiver.

[0086] Additionally, in the examples described above, the steps of opening the doors, waiting for a small period of time, and subsequently reclosing the doors may be optional further steps which may be included as necessary. In its simplest form the door may simply be stopped from closing.

[0087] In any of the examples described above, the controller may be connected to the obstruction detector including the emitter and receiver and any further receivers via any suitable means. For example, the controller may be connected to the aforementioned components

by a wired or wireless connection. Further, whilst all of the examples above have been described with respect to a single sliding door, the obstruction detection system may equally be applied to multiple doors. For example, the obstruction detection system may comprise multiple doors in a doorway, each moving towards one another to close the doorway. Each of the doors may comprise their own respective obstruction detector in accordance with any of the examples described above. Additionally, the obstruction detection system described in any of the examples above may also be utilised on other types of doors, for example a pivotally mounted door which rotates about a pivot point between its open and closed positions.

[0088] The obstruction detection system of any of the examples described above may be employed as part of an elevator system. For example, the door of any of the obstruction detection system described above may be an elevator car door or a landing door. For example, it may be a door of the elevator car 103 shown in Figure 1 or a landing door to a landing 125 shown in Figure 1.

Claims

1. An obstruction detection system (202, 302, 402, 502, 602, 702, 802) for detecting an obstruction in a doorway (204, 304, 804) closable by a door (206, 306, 406, 506, 606, 706, 806), the system comprising:
 - a door (206, 306, 406, 506, 606, 706, 806), arranged in a doorway (204, 304) and movable between an open position and a closed position, wherein the door comprises a leading edge (208, 308, 408, 508, 608, 708, 808) which moves across the doorway as the door is moved from the open position to the closed position;
 - an obstruction detector (212, 312, 412, 512, 612, 712, 812) comprising an emitter (214, 314A; 314B, 414, 514, 614, 814) configured to emit a beam (216, 316A; 316B, 416A; 416B, 516, 616, 716, 816) along the leading edge of the door and a receiver (218, 318A; 318B, 418, 518A, 618, 818) configured to detect the beam incident thereon; and
 - a controller (226, 326, 426, 526, 626, 726, 826) coupled to the obstruction detector and configured to control movement of the door, wherein the controller is configured to at least stop closing the door when an object (230, 330, 830) obstructs the beam.
2. An obstruction detection system (202, 302, 402, 502, 602, 702, 802) as claimed in any preceding claim, wherein the controller (226, 326, 426, 526, 626, 726) is configured to open the door (206, 306, 406, 506, 606, 706, 806) when an object (230, 330, 830) obstructs the beam (216, 316A; 316B, 416A; 416B,

516, 616, 716, 816).

3. An obstruction detection system (502) as claimed in any preceding claim, wherein the leading edge (508) of the door (506) comprises an upper portion (522) and a lower portion (524) and wherein one of the emitter (514) or receiver (518A) is positioned at the upper portion of the leading edge, and the other of the emitter or receiver is positioned at the lower portion of the leading edge. 5
4. An obstruction detection system (502) as claimed in any preceding claim, wherein the obstruction detector (512) comprises a further receiver (518B) arranged to detect the beam (516) when the door (506) is in a closed position. 10
5. An obstruction detection system (202, 302, 402, 602, 702) as claimed in any preceding claim, further comprising a beam director (222, 322, 422, 622) arranged to direct the beam (216, 316A; 316B, 416A; 416B, 616, 716) towards the receiver (218, 318A; 318B; 418, 618) when the door (206, 306, 406, 606, 706) is in an open position. 20
6. An obstruction detection system (202, 302, 402, 602, 702, 802) as claimed in any one of claims 1, 2, 4 or 5, wherein the emitter (214, 314A; 314B, 414, 614, 814) and receiver (218, 318A; 318B; 418, 618, 818) are arranged together. 25
7. An obstruction detection system (202, 302, 402, 702) as claimed in any preceding claim, further comprising a further beam director (228) arranged to direct the beam (216) towards the receiver (218) when the door (206) is in the closed position. 30
8. An obstruction detection (602) system as claimed in any preceding claim, further comprising a door sensor (662) configured to detect when the door (606) is in the closed position, and wherein the controller (626) is configured to not open the door based on any obstruction detected by the obstruction detector (612) when the door sensor detects that the door is in the closed position. 35
9. An obstruction detection system (602) as claimed in any preceding claim, wherein the door (606) comprises at least one recess (654) into which the emitter (614) and receiver (618) are resiliently mounted (656), such that when the door is in an open position the emitter and receiver are positioned such that the beam (616) passes along the leading edge (608) of the door, and when moved into the closed position the emitter and receiver are moved into the at least one recess.. 40
10. An obstruction detection system (702) as claimed in 45

any preceding claim, wherein the width (768) of the beam (716) is substantially the same as the width (770) of the leading edge (708) of the door (706).

11. An obstruction detection system (302, 402) as claimed in any preceding claim, wherein the beam comprises a first beam (316A, 416A) which passes along a forward portion (308A, 408A) of the leading edge (308, 408) and a second beam (316B, 416B) which passes along a rearward portion (308B, 408B) of the leading edge. 50
12. An obstruction detection system (302) as claimed in claim 11, wherein the emitter comprises a first emitter (314A) configured to emit the first beam (316A) and a second emitter (314B) configured to emit the second beam (316B).
13. An obstruction detection system (402) as claimed in claim 11, further comprising a beam director (422) arranged to redirect the first beam (416A), emitted from the emitter (414) along a forward portion (408A) of the leading edge (408), along a rearward portion (408B) of the leading edge (408) thereby forming the second beam (416B). 25
14. An obstruction detection system as claimed in any preceding claim, wherein the door (206, 306, 406, 506, 606, 706, 806) is a door (206, 306, 406, 506, 606, 706, 806) within an elevator system (101).
15. A method for detecting an obstruction in a doorway comprising a door (206, 306, 406, 506, 606, 706, 806) movable between an open position and a closed position, the method comprising: 30
 - passing a beam (216, 316A; 316B, 416A; 416B, 516, 616, 716, 816) along a leading edge (208, 308, 408, 508, 608, 708, 808) of a door from an emitter (214, 314A; 314B, 414, 514, 614, 814) towards a receiver (218, 318A; 318B, 418, 518A, 618, 818);
 - detecting when the beam is obstructed; and
 - at least stopping closing of the door when the beam is obstructed.

Fig. 1

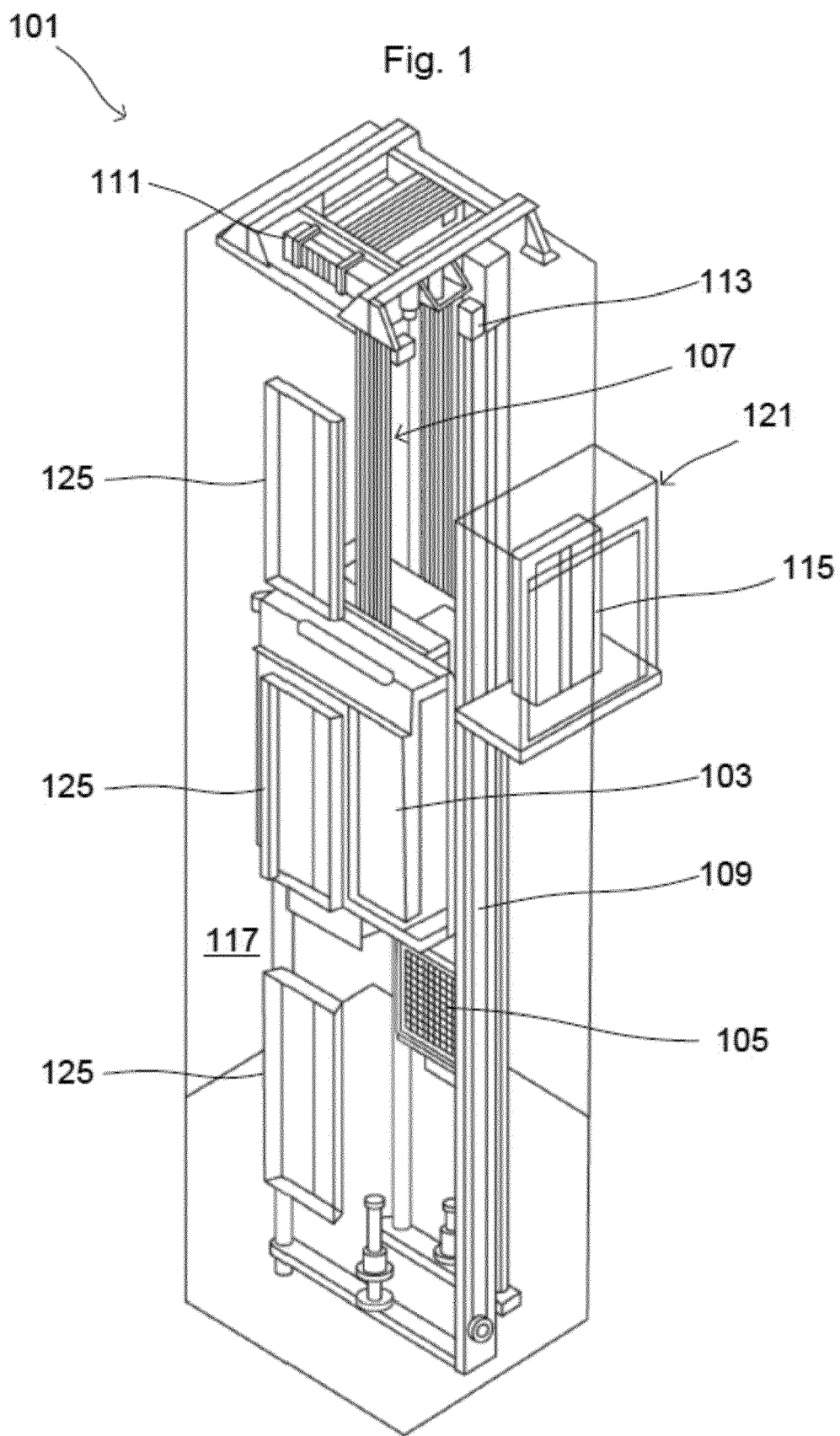
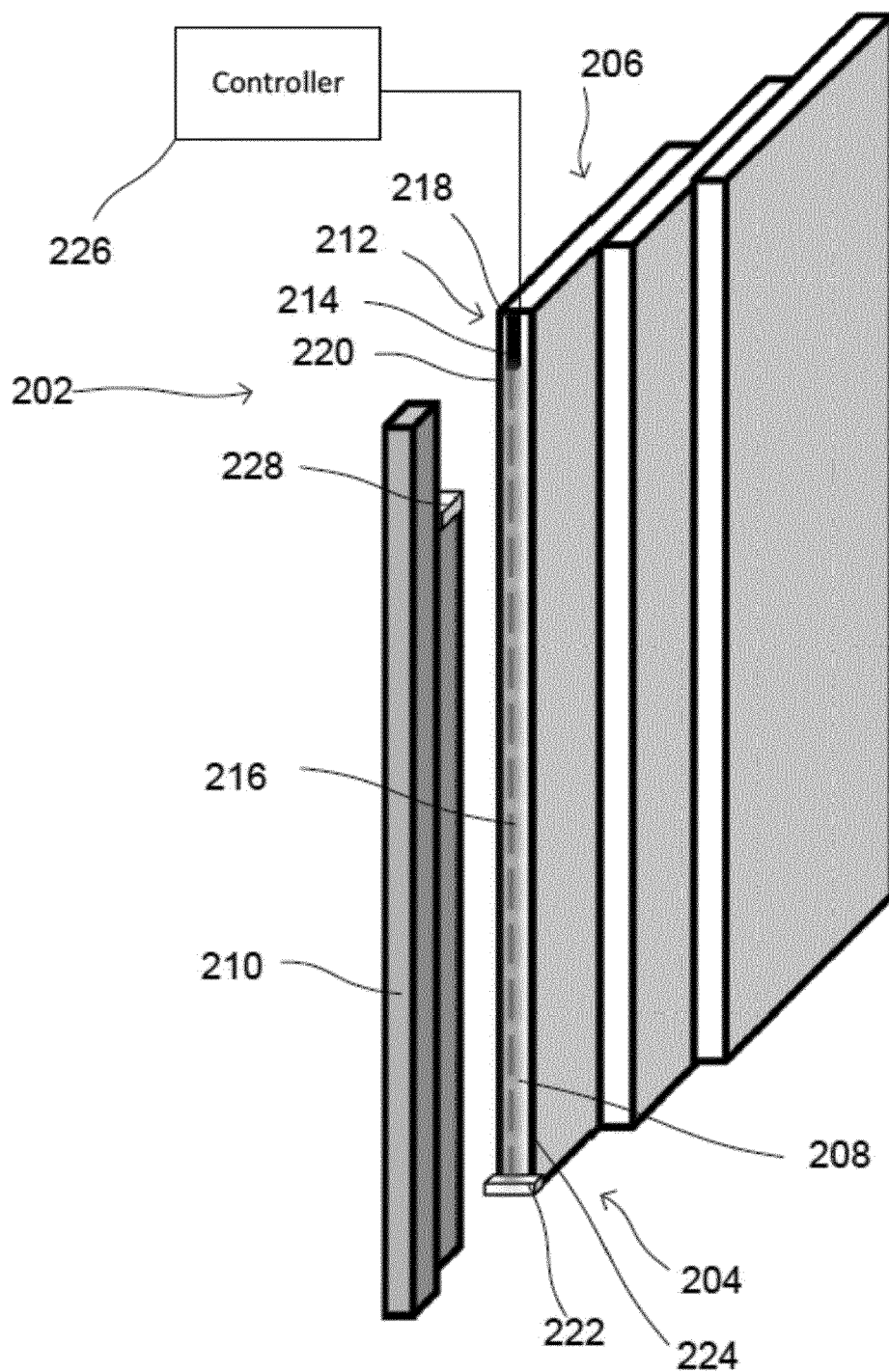
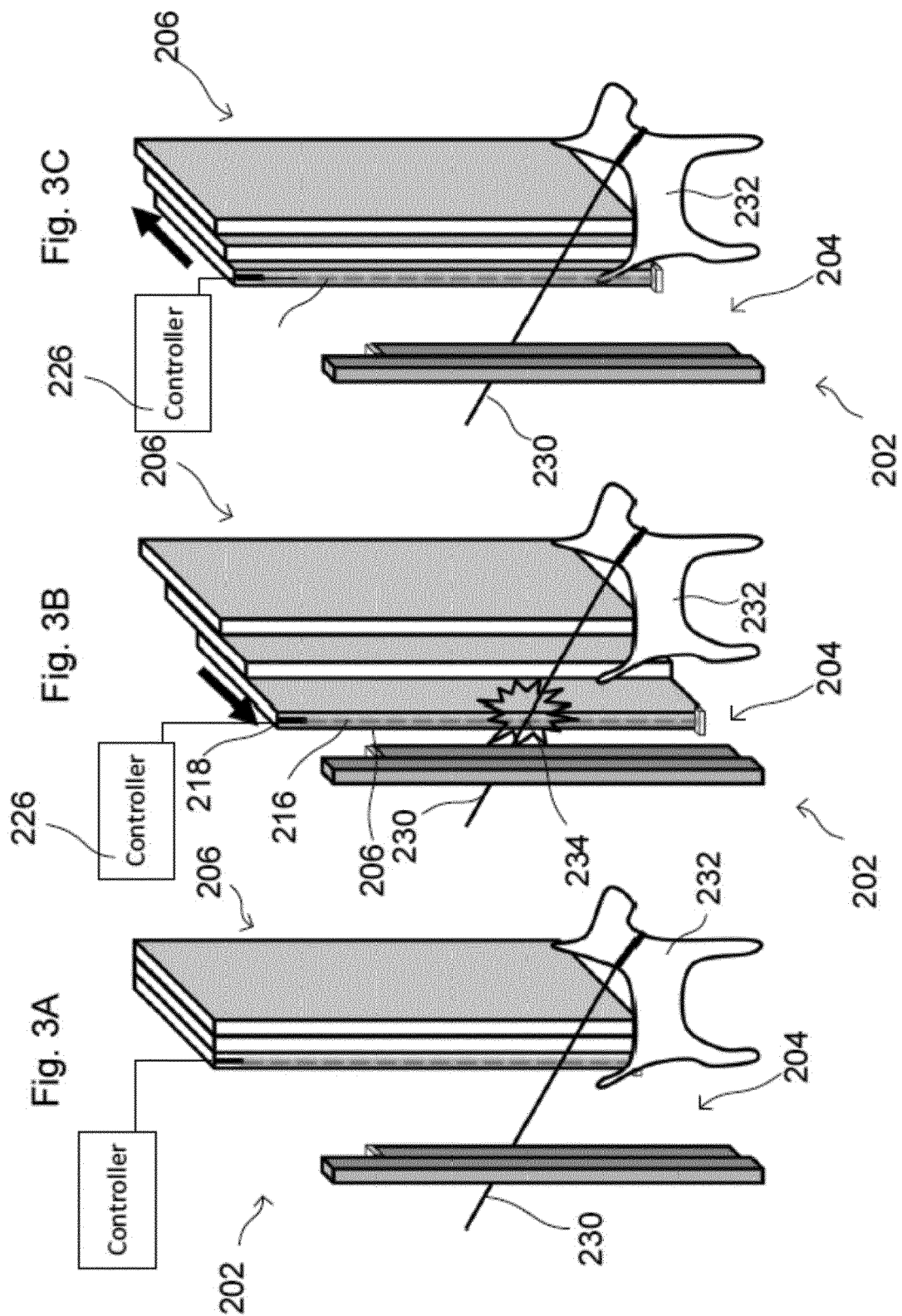


Fig. 2





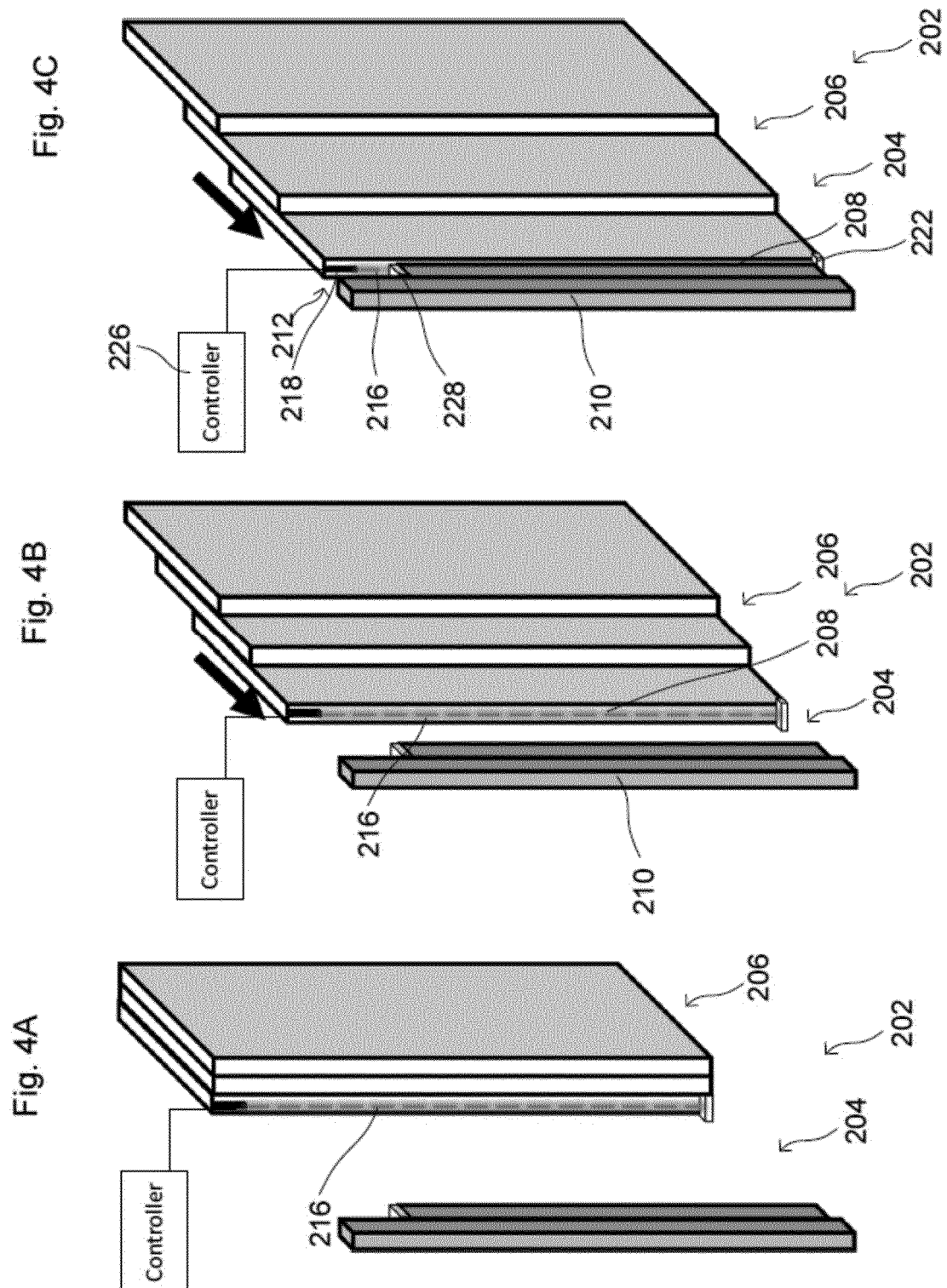


Fig. 5

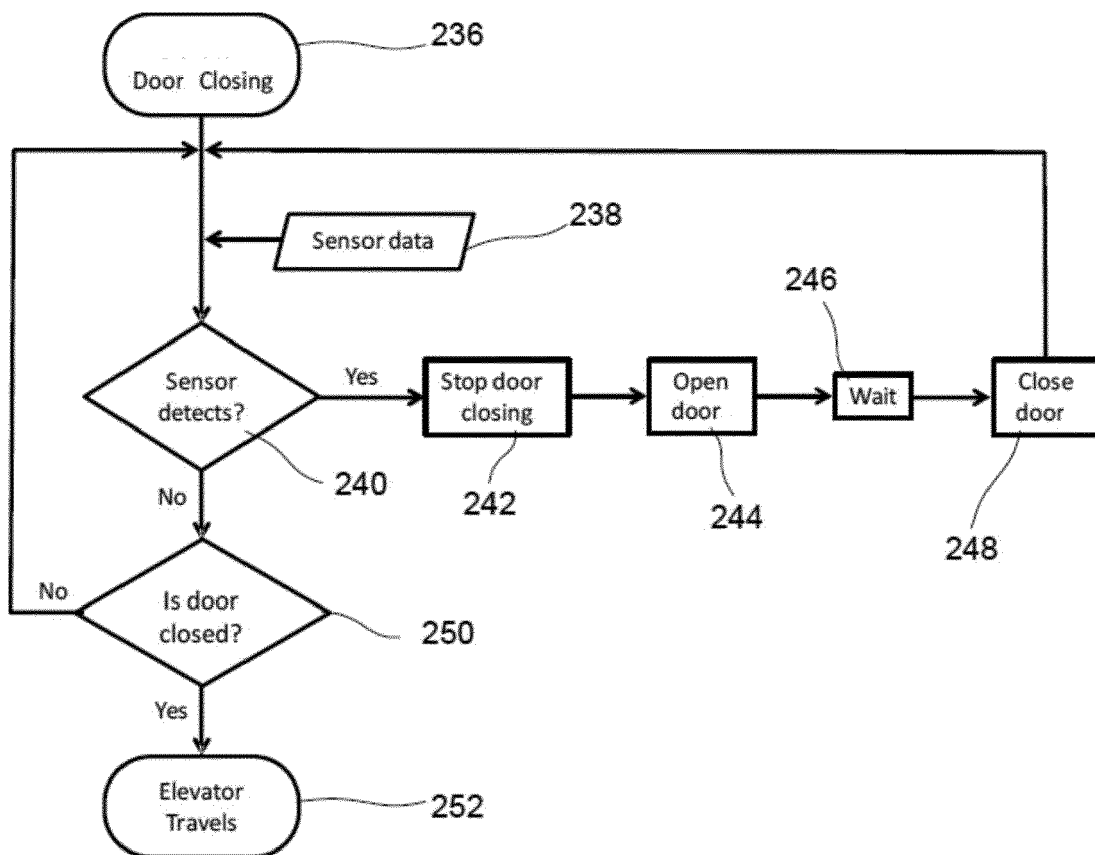
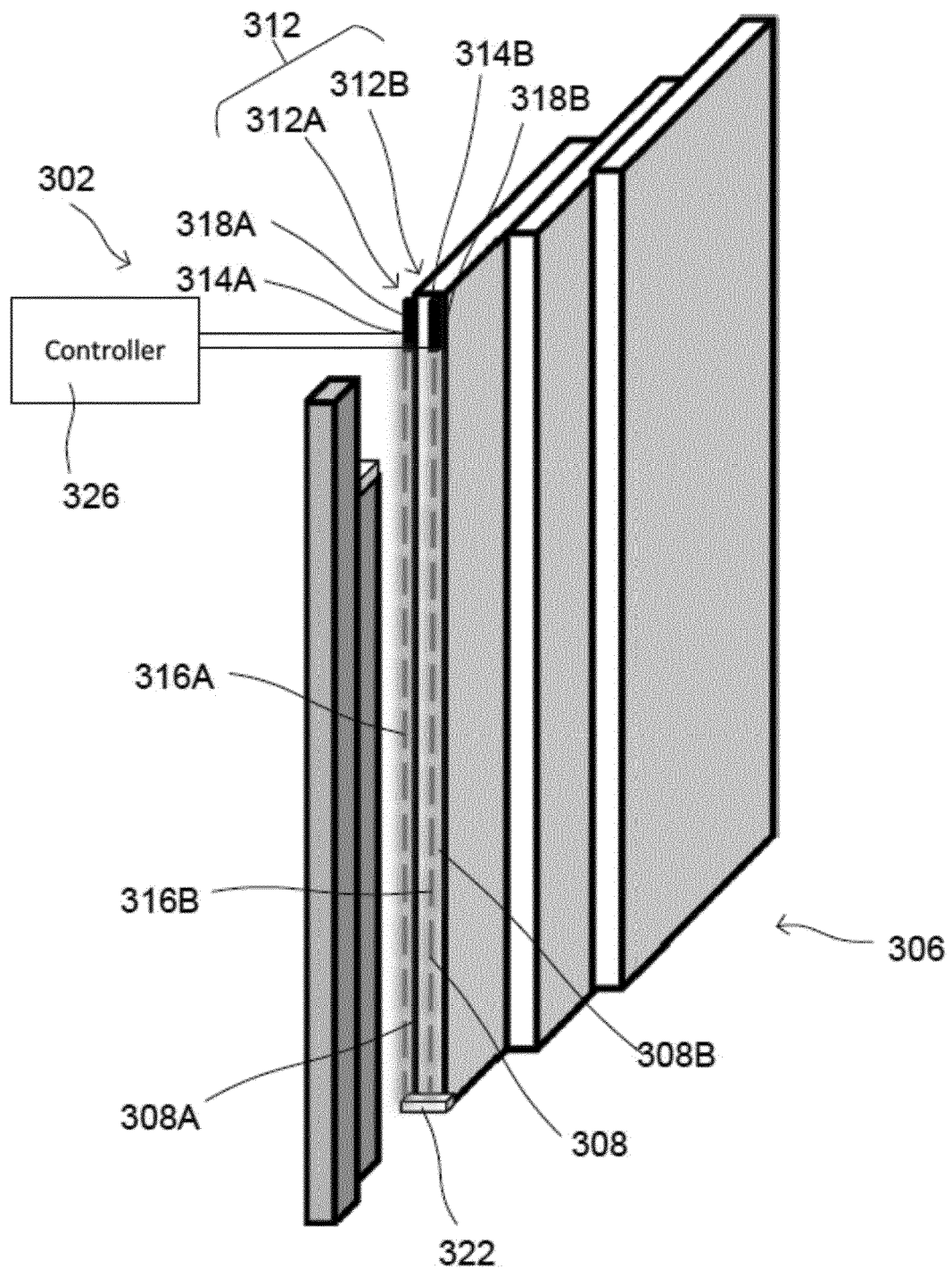


Fig. 6



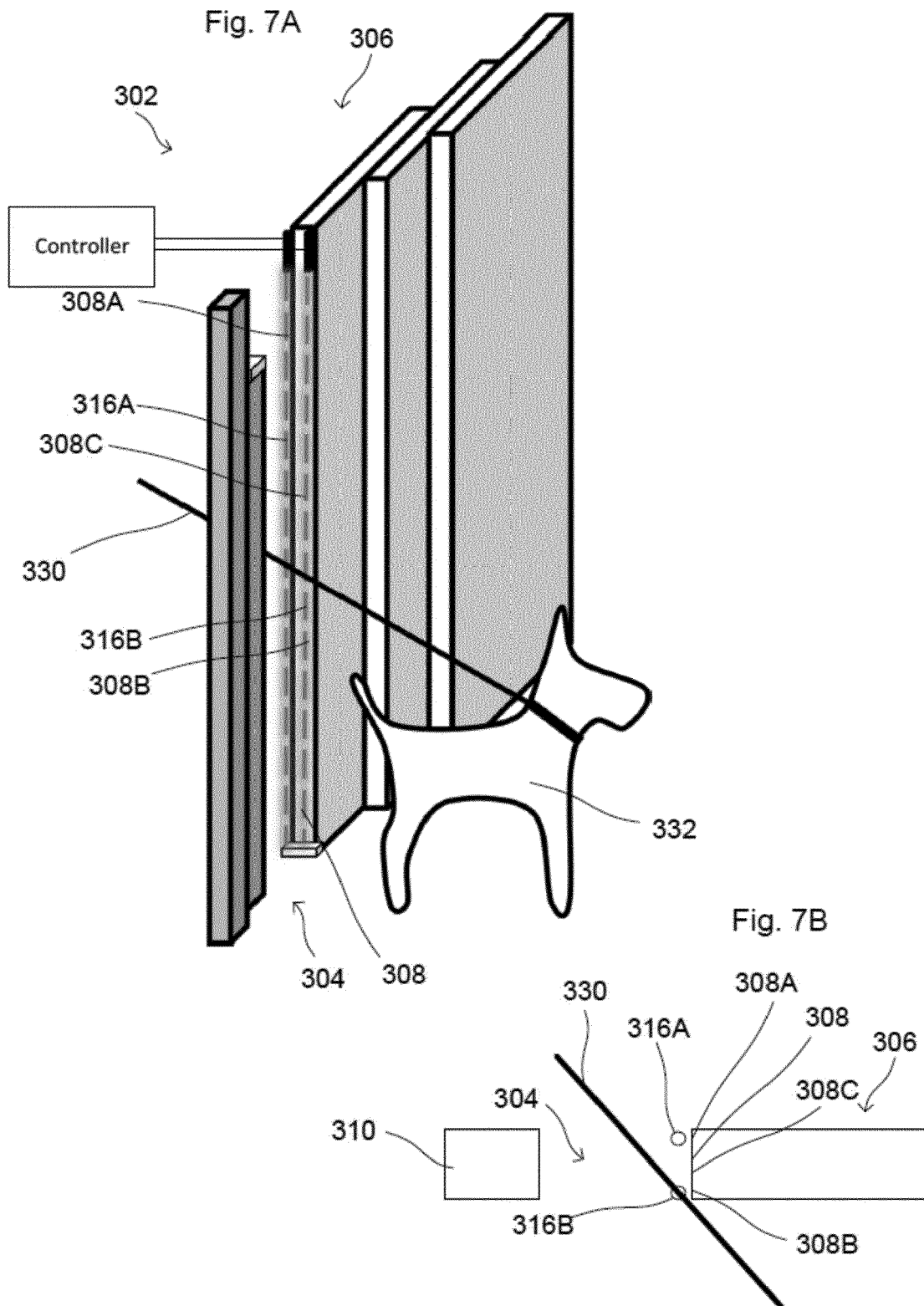


Fig. 8

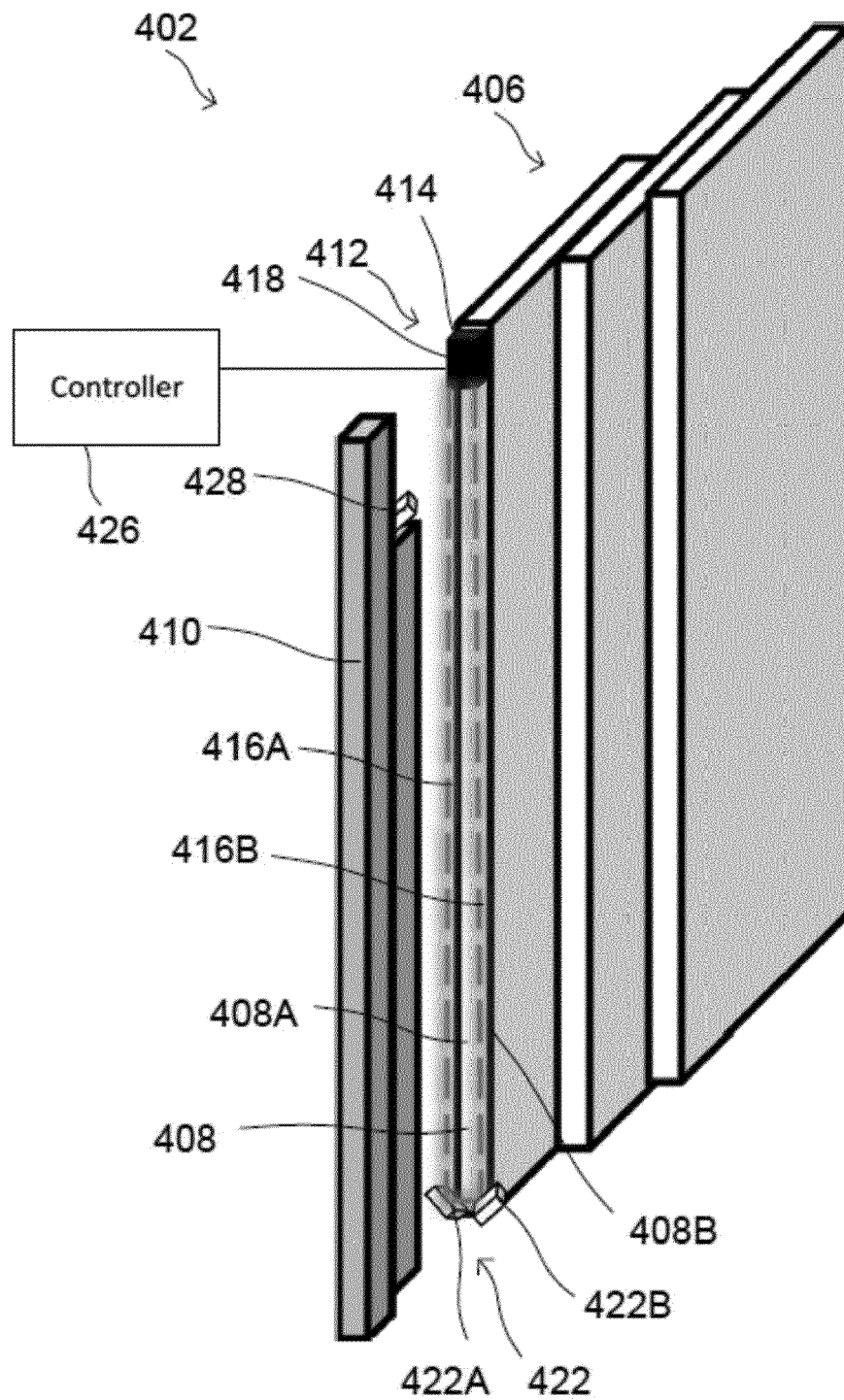


Fig. 9

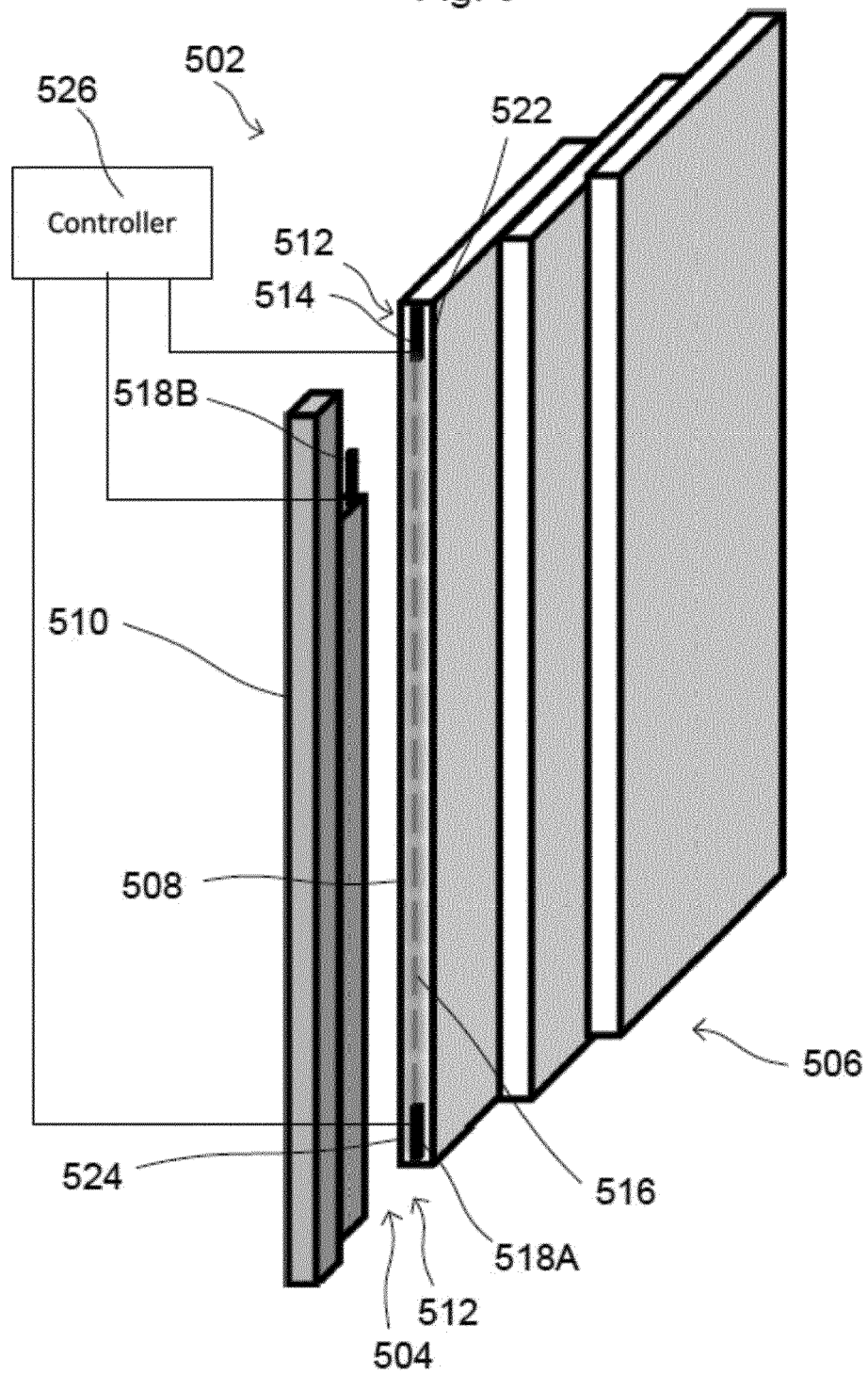


Fig. 10

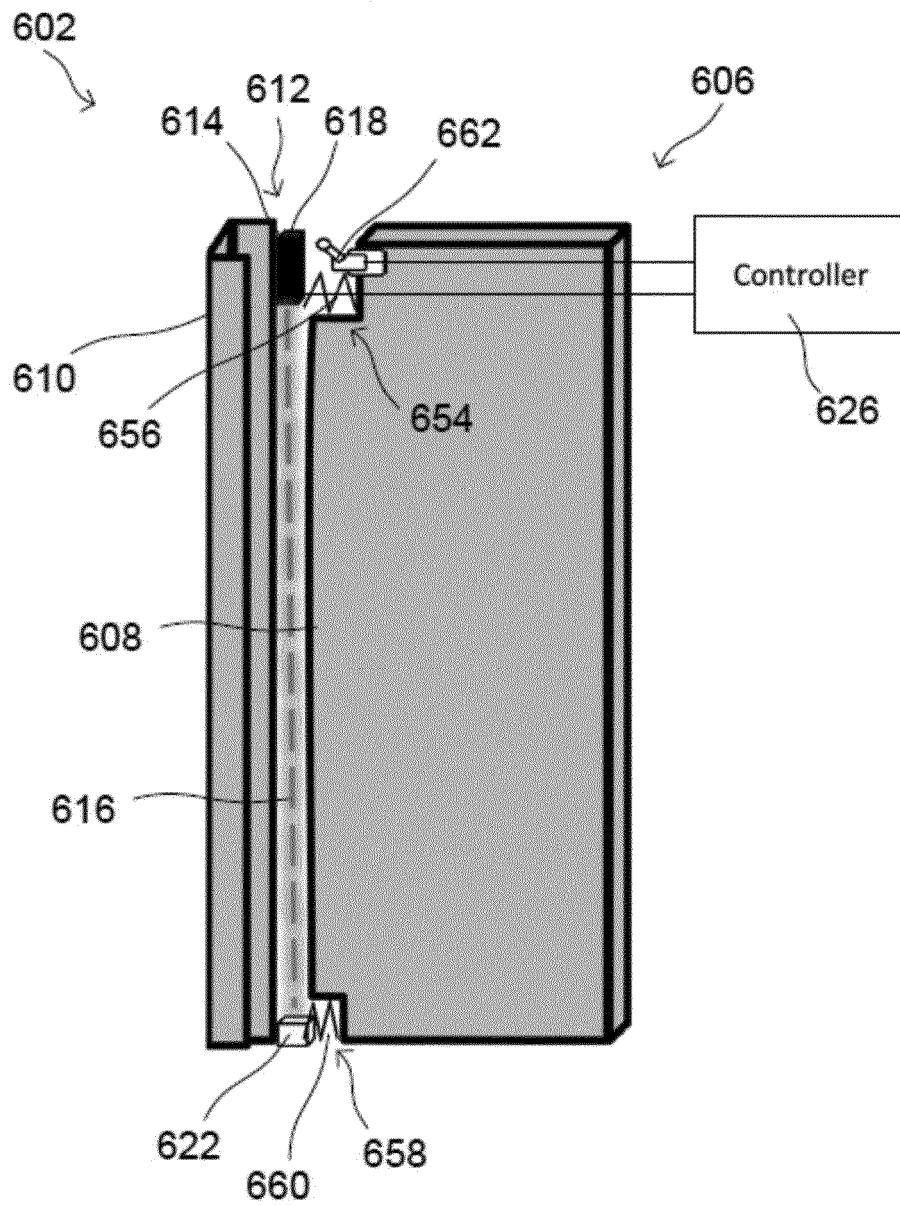


Fig. 11

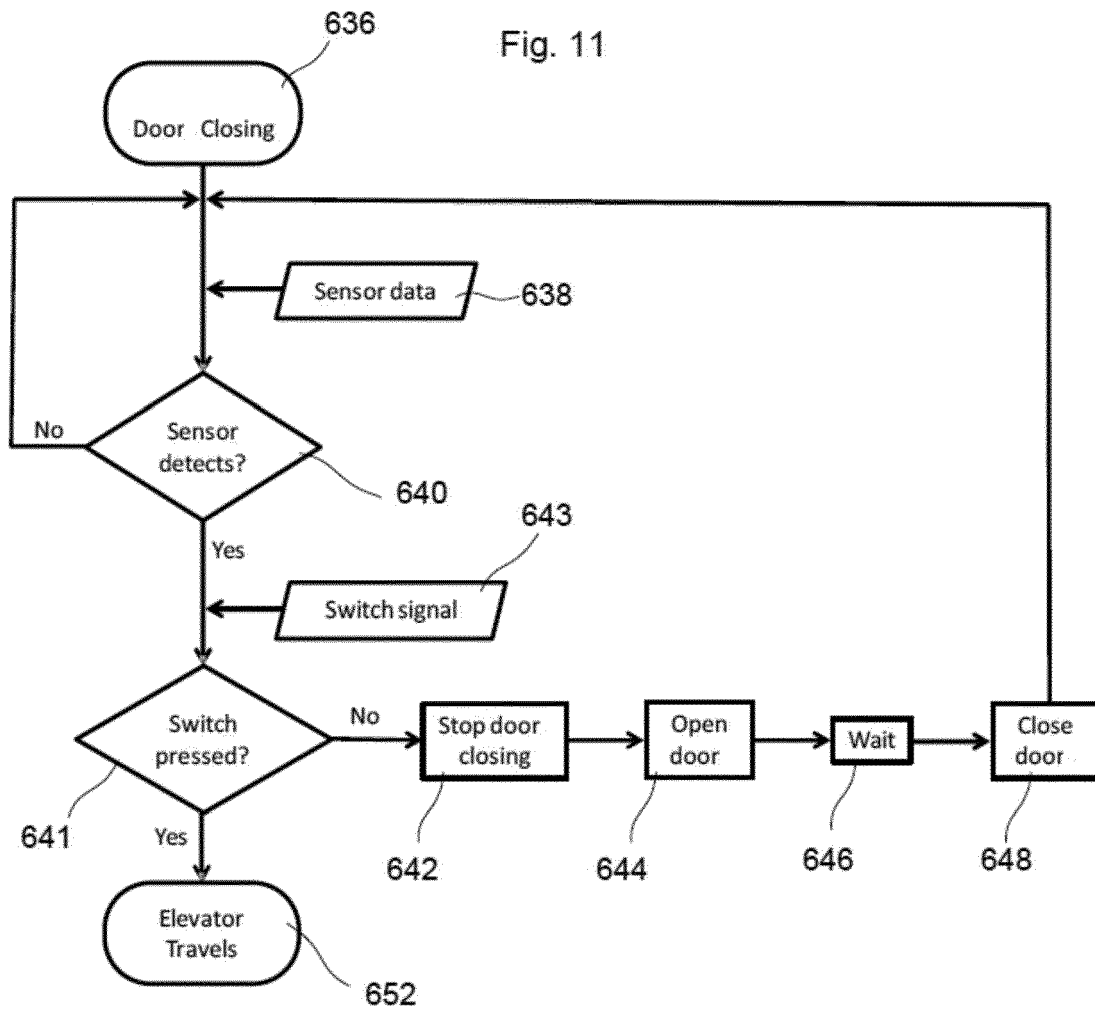
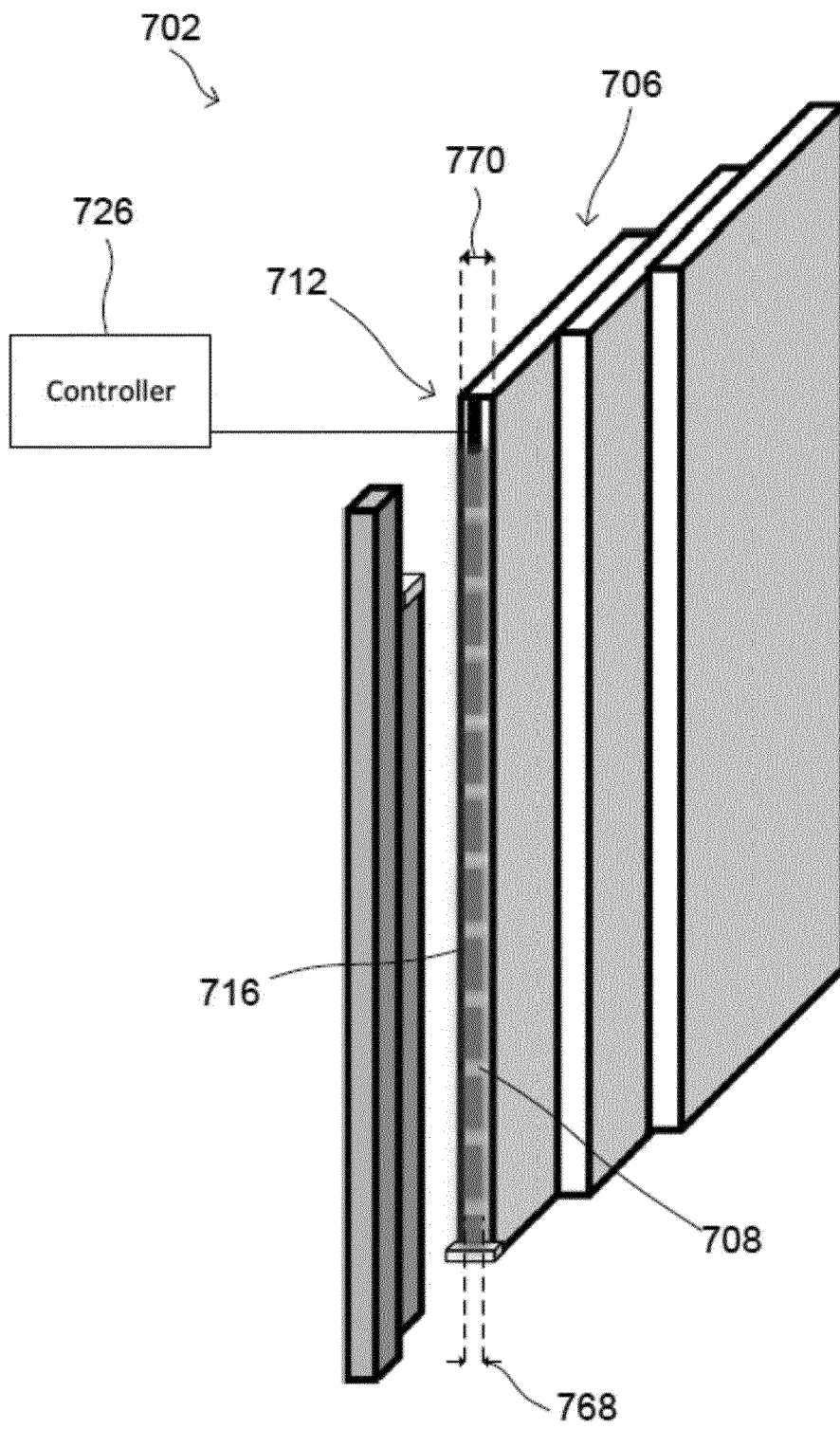
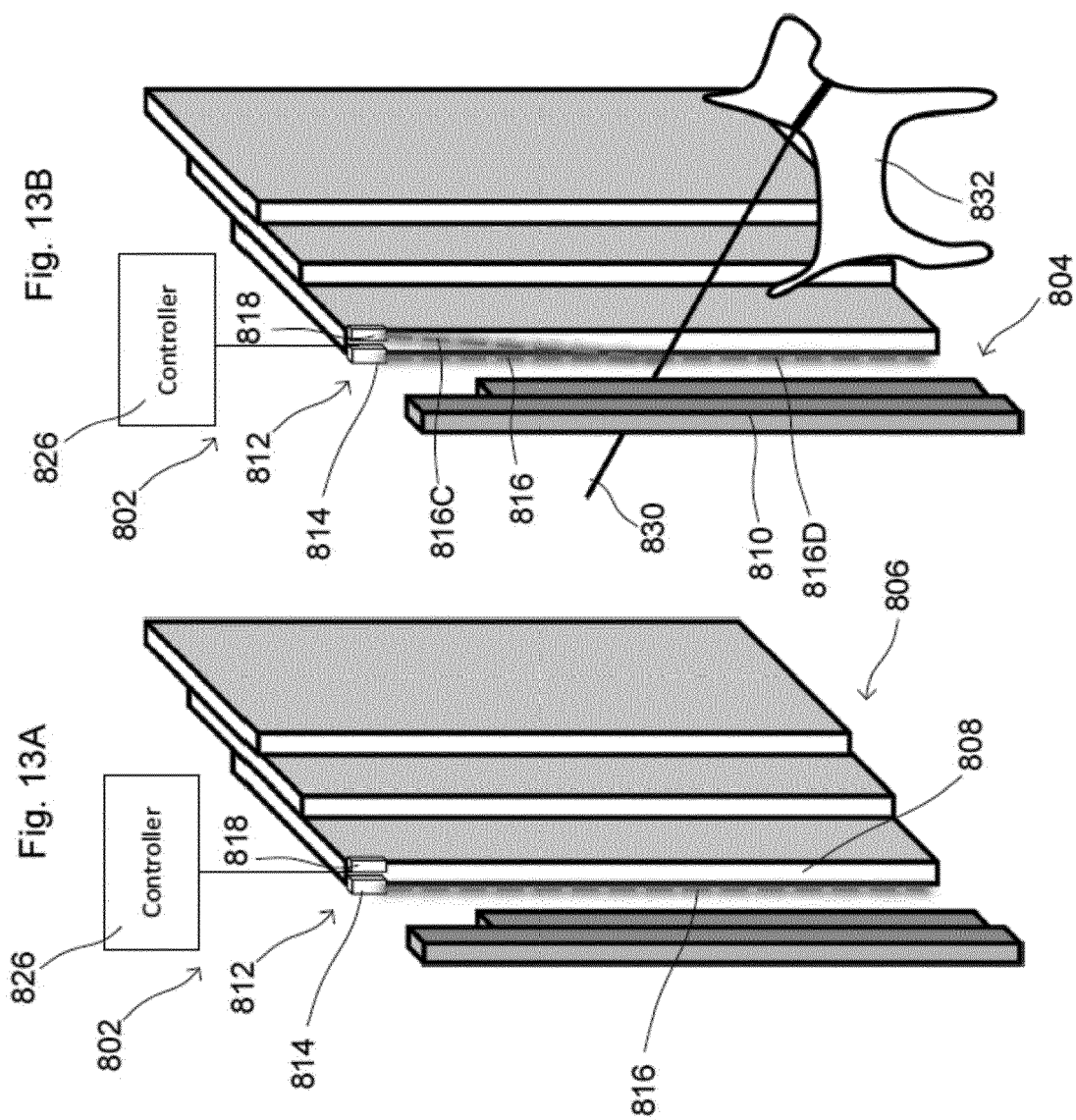
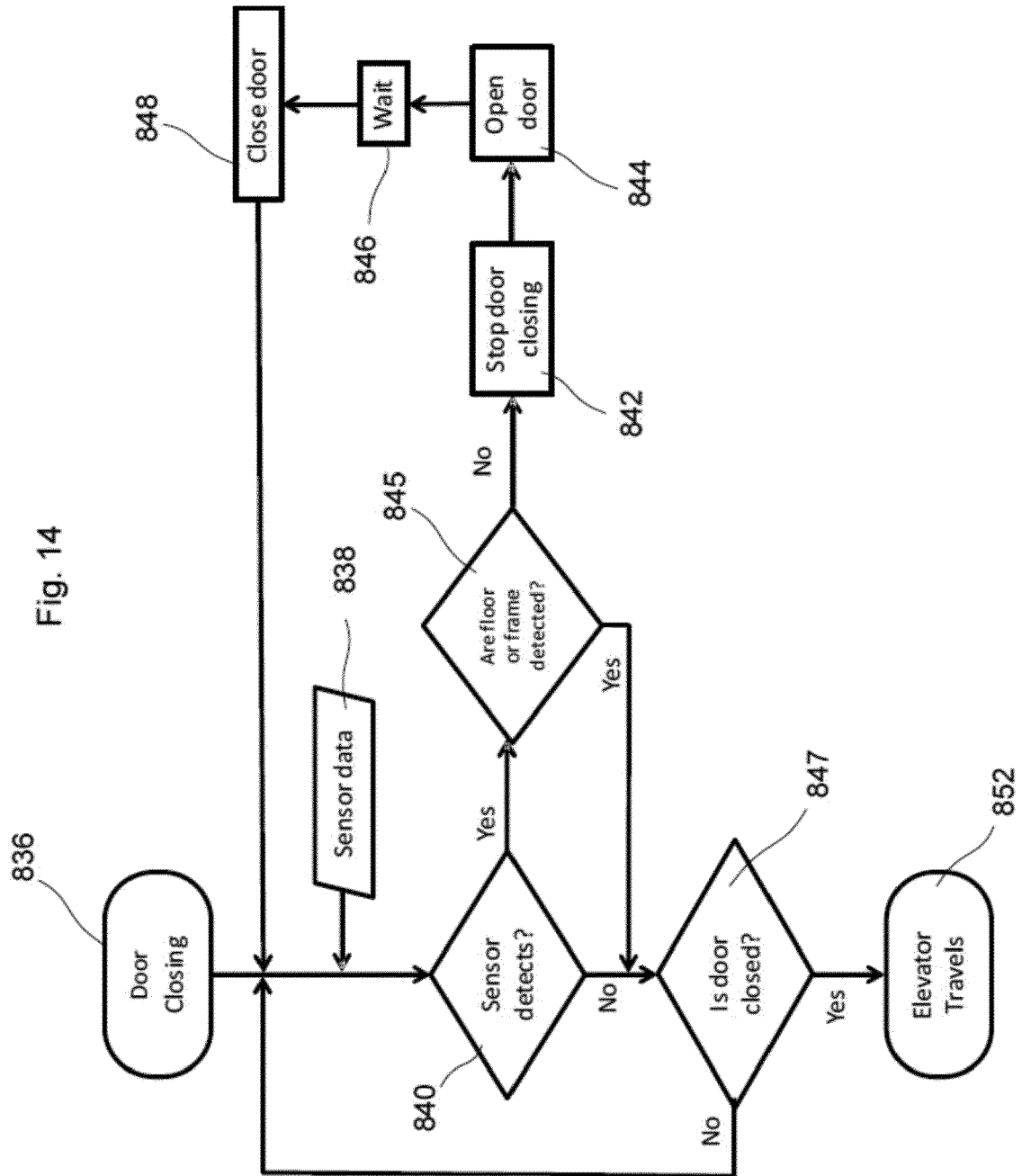


Fig. 12









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