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(54) **Automatic door**

(57) The method for opening an automatic two-leaf door includes sub-dividing a movement area into a series of adjacent movement zones (M_1 ... M_x) and into a series of adjacent presence zones (P_1 ... P_x), distributed regularly in a transversal direction to a door area such as to cover a whole width of the area; and independently monitoring each of the zones (M_1 ... M_x), (P_1 ... P_x) by means of a specific motion sensor (A_1 ... A_x) and respectively (B_1 ... B_x) exclusively dedicated to monitoring movement of persons or things in the respective zone; sending the signals of the sensors (A_1, A_x), (B_1 ... B_x) to a logic circuit which commands activation of the movement means of at least a door leaf such as to cause it respectively to open, up to involving all of a width occupied by the activated sensors (A_1 ... A_x) and inhibit closure thereof if one of the sensors (B_1 ... B_x) is activated.

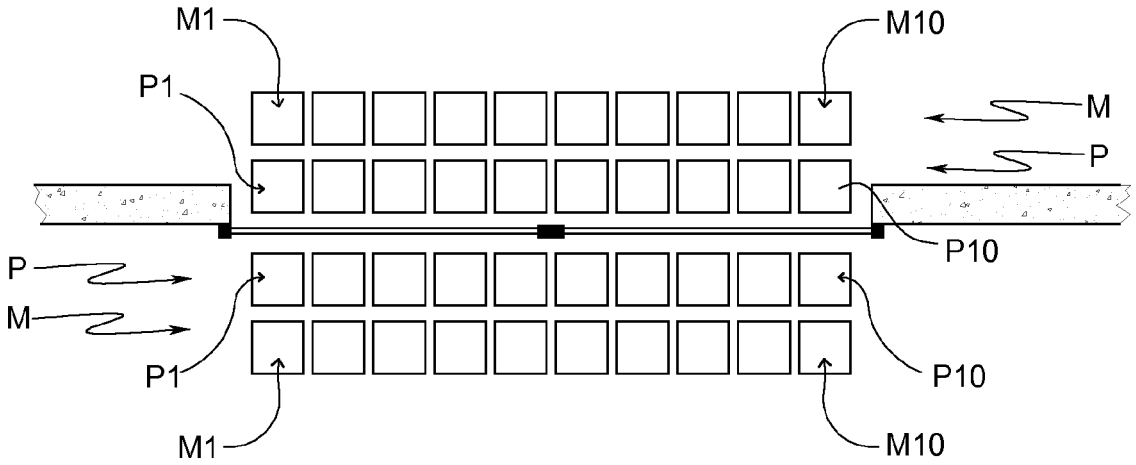

Fig.3

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Description

[0001] The present invention relates to automatic doors, particularly to doors of a sliding type comprising at least a leaf or two coplanar leaves that move symmetrically to open and close with respect to the central axis of the opening constituting the door.

[0002] The means for opening and closing of the door comprise an electric motor a rotor of which is mechanically connected to a drive pulley of a pair of pulleys between which a loop-closed belt, a strap or another flexible means is stretched.

[0003] A leaf of the door is connected to each of the branches of the flexible means, in such a way that when the flexible means is actuated in a direction the leaves near one another symmetrically, and vice versa.

[0004] The invention relates more particularly to automatic opening doors, which are activated by an electric motor having a stator winding, the output of which is commanded by a first sensor, called a "motion" sensor and located on each side of the door, which indicates when a user is about to pass through the door, and is moving in the area monitored by the sensor.

[0005] For security reasons, a second sensor is located on the same side of the door, called the "presence sensor", which signals when a person is present, even without moving, in the area proximal to the door leaves.

[0006] Obviously, the area monitored by the second sensor is closely adjacent to the doors, while the area monitored by the first sensor is adjacent to the first but more distant from the doors.

[0007] If the area to be monitored located in front of the door is very large, a plurality of motion sensors can be provided, which monitor adjacent strips parallel to the door, thus covering the whole width of the door.

[0008] Since automatic doors are generally located at the entrance of areas destined to contain a large number of people, for safety reasons they are very wide in order to ensure a rapid evacuation of the area should it be necessary.

[0009] The operating cycle of automatic doors, according to the prior art, is as follows:

1) the person about to cross the door activates the motion sensor;
2) the door opens completely;
3) the door remains open for a predetermined pause time;
4) when the person has left the area covered by the sensor, the door closes.

[0010] The opening and closing of the door are commanded only by the "motion sensor", which can be realized using different technologies (active infrared, passive infrared, microwave, ultrasound, etc..) and which in each case communicates with the means for moving the door by means of an output contact.

[0011] The second "presence" sensor has only safety functions, and is placed in series with the first sensor, the two contacts being in serial communication, and only the state of the contacts of the two sensors is transmitted to the activating means of the door, which are activated when the person enters the area of the first sensor and when the person is present in the area involved in the movement of the doors.

[0012] With this system, the person who enters any point of the area monitored by the motion sensor triggers the output contact of the motion sensor which commands the opening of the door.

[0013] When the person leaves the area monitored by the motion sensor, the motion sensor commands the closing of the door which, however, is prevented until the presence sensor is activated.

[0014] The command of the motion sensor always causes the complete opening of the door, whatever the number or position of the persons who are about to cross it.

[0015] A large opening makes it quick and easy to gain access to the building, as well as making it safe to escape through in an emergency, but with the traditional automatic opening thereof, there is considerable heat loss at each opening.

[0016] Remedies to this, in the prior art, involve reducing the width of the opening, but also reducing the safety; thus the prior art does not offer appreciable results in terms of heat savings, since when the door is crossed by a large group of people, the time for which it remains open increases, effectively nullifying the advantage of having a small passage space.

[0017] The aim of the present patent is to obviate the above-mentioned drawbacks with a solution that is simple and relatively economical.

[0018] The above aim is attained by a method and a device having the characteristics recited in the independent claims.

[0019] The dependent claims relate to characteristics able to lend to the invention further advantages.

[0020] According to the invention the door area is closed by two doors that move independently of one another.

[0021] The area in front of the door is sub-divided into a presence area adjacent to the door, and into a movement area adjacent to the presence area.

[0022] Each of the areas is sub-divided into adjacent zones each of which is monitored by a specific sensor, which signals the presence of a person in the area assigned to it.

[0023] The adjacent areas in their entirety cover the entire width of the door.

[0024] The specific motion sensors are connected in parallel and send their signals to a logic circuit which commands activation and deactivation of the activating means of the door.

[0025] In response to the signal of each specific sensor, the logic circuit commands the activation of the opening means of the leaf facing the area monitored by the

specific sensor, and commands the deactivation of the opening means when the door opens the position facing the area monitored by the specific sensor.

[0026] In this way the opening of the door is limited to the space necessary to allow passage of the person or persons who are about to cross it, and if they are close to one side of the area, the door that opens affects only this one side. The automated door according to the invention is a double-leaf door with the leaves independent of one another, each associated to an activating motor therefor which is controlled by a logic circuit according to the position of the person who is about to pass through the door.

[0027] The advantages and the constructional and functional characteristics of the invention will emerge from the detailed description that follows, with reference to the accompanying drawings, which illustrate a particular preferred embodiment thereof given by way of non-limiting example.

Figure 1 schematically illustrates a front view of an automatic door with an opening device thereof.

Figure 2 shows the partial section II-II of figure 1 with an detail in larger scale.

Figure 3 illustrates the invention seen in plan view with the sensor assembly schematically represented.

Figure 4 illustrates the invention in schematic section.

Figures 5 and 6 schematically illustrate the invention in two different operating conditions.

Figures 6 and 7 illustrate the invention of figures 1 and 2 in a different configuration.

[0028] The figures show the opening of a door area 1, where the door has two sliding leaves 21, 22 sliding on suitable guides (not shown).

[0029] Each of the two leaves is connected by means of a cogged belt, respectively 23 and 24, moved by a pulley, respectively 25 and 26, activated by an electric gear reducer 27 and 28 having two rotation directions.

[0030] The two electric motors are powered via two logic circuits respectively 3 and 4 that receive the signals of two series of sensors, respectively, the motion sensors Ax and the presence sensors Bx (schematically figures 5 and 6). The tread surface in front of the area is sub-divided into two areas M and P, respectively a movement area and a presence area (figure 3).

[0031] Each of these areas is sub-divided into ten adjacent zones, respectively, M_1 and M_{10} .. P_1 ... P_{10}.

[0032] Each zone M_1 ... M_{10} is monitored by a specific motion sensor A_1 ... A_{10}, and each zone P_1 ... P_{10} is monitored by a specific presence sensor B_1 ... B_{10} (figure 6).

[0033] The sensors A_1... A_{10} and B_1...B_{10} send their signals to the logic circuits 3 and 4.

[0034] The logic circuits 3 and 4 are not described in detail since they can be easily realized by a person skilled in the sector.

[0035] The logic circuits 3 and 4 are configured such that on receiving the signal of a sensor A_1 ... A_{10} they power the motor of the leaf relating to the area in front of the sensor, moving it in the opening direction, and the power supply is interrupted when the door has opened the leaf area serving the area in front of the zone M_1 ... M_{10} of the respective sensor.

[0036] After a predetermined time, the motor is set in motion in the opposite direction unless one of the safety sensors B_1 ... B_{10} has been activated, which causes the motor to stop in the closing direction of the respective leaf. Sensors $\underline{A}_3$ and $\underline{A}_4$ are active in the configuration of figure 5, while all the other sensors are inactive.

[0037] In the configuration of figure 6 sensors $\underline{A}_3$ $\underline{A}_5$ $\underline{A}_6$ $\underline{A}_7$ $\underline{B}_4$ and $\underline{B}_8$ are active, while all the others are inactive.

[0038] Figures 7 and 8 illustrate the invention in a different configuration and, more precisely, the two leaves are drawn by a single cogged belt 23 moved by means of a pulley 25 and powered by an electric gear reducer 27 in two rotation directions.

[0039] The operating principle remains the same with the only difference that the partial opening of the two panels is symmetrical, being controlled by a single motor.

[0040] It is understood that the invention is not limited to the examples described above, and that variants and improvements can be made thereto without forsaking the scope of the appended claims.

Claims

1. A method for opening an automatic two-leaf door comprising a movement area interesting all of a width of a door area, and a presence area which interests all of a width of the door area and is located between the door and the movement area, which comprises following activities:

   - monitoring a presence of persons or things in the areas by means of respective motion and presence sensors;
   - collecting a signal from the sensors in order to command opening and closing of the door;

   characterised by:

   - sub-dividing the movement area into a series of adjacent movement zones (M_1 ... M_x), distributed regularly in a transversal direction to the door area such as to cover all the width of the area;
   - sub-dividing the presence area into a series of adjacent presence zones (P_1 ... P_x), distributed regularly in a transversal direction to the door area such as to cover all the width of the area;
   - independently monitoring each of the zones (M_1 ... M_x) by means of a specific motion sensor

(A_1 ... A_x) exclusively dedicated to monitoring movement of persons or things in the respective zone;

- independently monitoring each of the zones (P_1 ... P_x) by means of a specific presence sensor (B_1 ... B_x) exclusively dedicated to monitoring a presence of persons or things in the respective zone;
- sending the signals of the sensors (A_1, A_x) to a logic circuit commanding activation of the movement means of at least a leaf of a door such as to cause opening thereof up to involving a whole width occupied by the sensors (A_1 ... A_x) that have been activated;
- sending the signals of the sensors (B_1, B_x) to a logic circuit commanding activation of the movement means of at least a leaf of a door such as to inhibit closure thereof.

2. A device for opening an automatic door comprising at least an electric motor having at least a stator winding, means for transmitting motion from the motor to at least a leaf of the automatic door, and means for commanding power supply to the stator winding, **characterised in that** it comprises a first series of motion sensors (A_1 ... A_x) distributed over a whole width of each leaf and a second series of presence sensors (B1 ... Bx) located between the motion sensors and the respective leaf, a logic circuit suitable for receiving the signals of the sensors (A_1 ... A_x) such as to command opening of the at least a leaf for a width occupied by the activated sensors; a logic circuit suitable for receiving signals from the sensors (B_1 ... B_x) such as to inhibit closure of the leaf.

3. The device for opening an automatic door as in claim 2, **characterised in that** it comprises an independent activating motor for each leaf, a first series of motion sensors (A_1 ... A_x) distributed over a whole width of each leaf and a second series of presence sensors (B_1 ... B_x) positioned between the motion sensors and the respective leaf, a logic circuit suitable for receiving the signals of the sensors (A_1 ... A_x) such as to command opening of the leaf for a width occupied by the activated sensors; a logic circuit suitable for receiving signals from the sensors (B_1 ... Bx) such as to inhibit closure of the leaf.

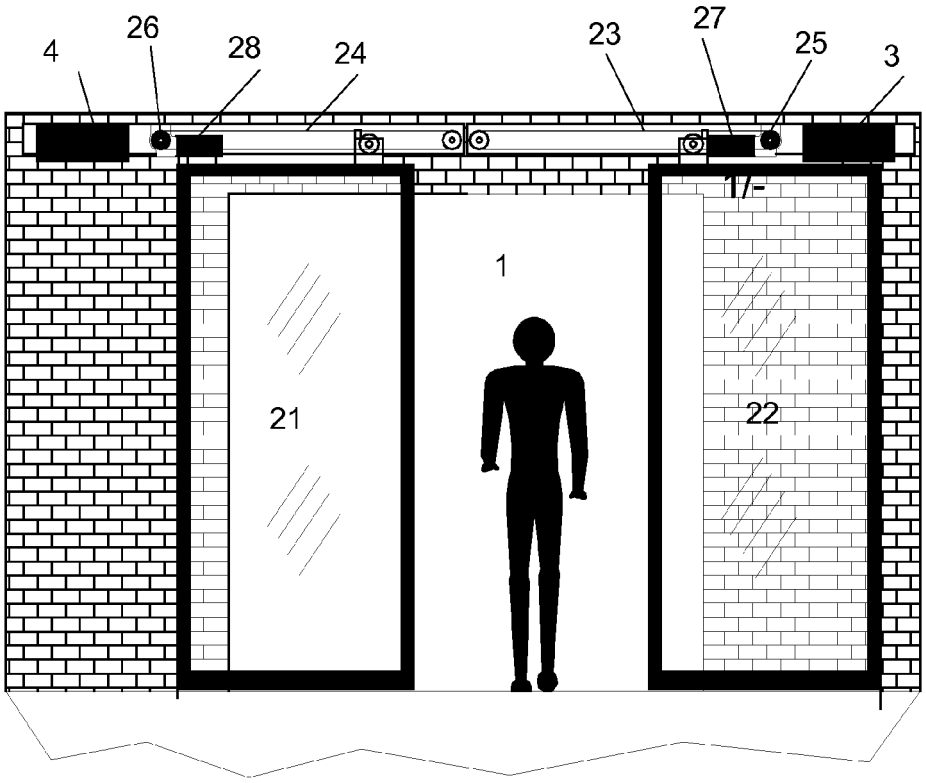


Fig.1

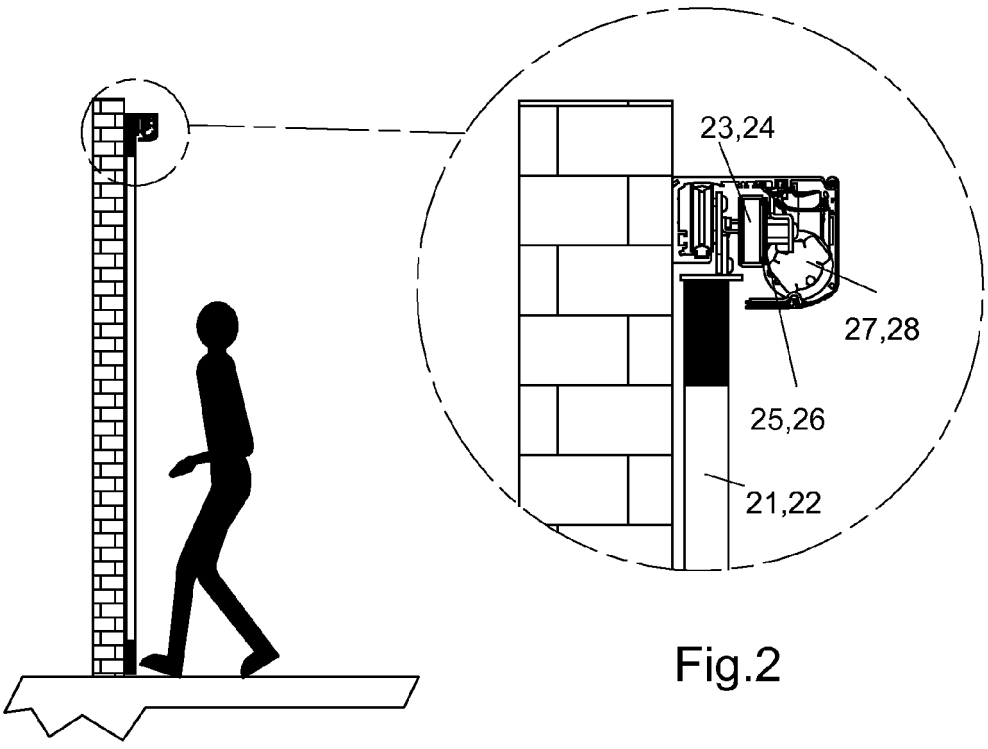


Fig.2

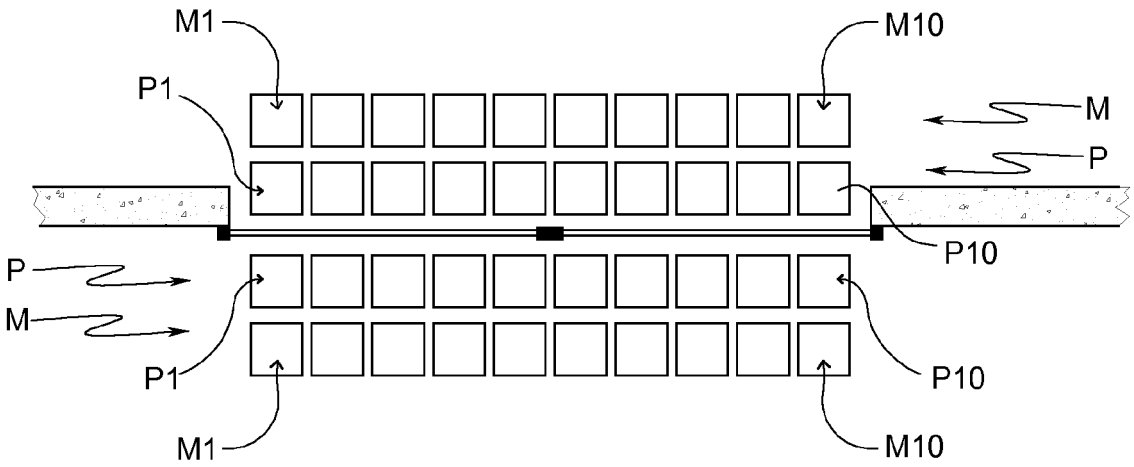


Fig.3

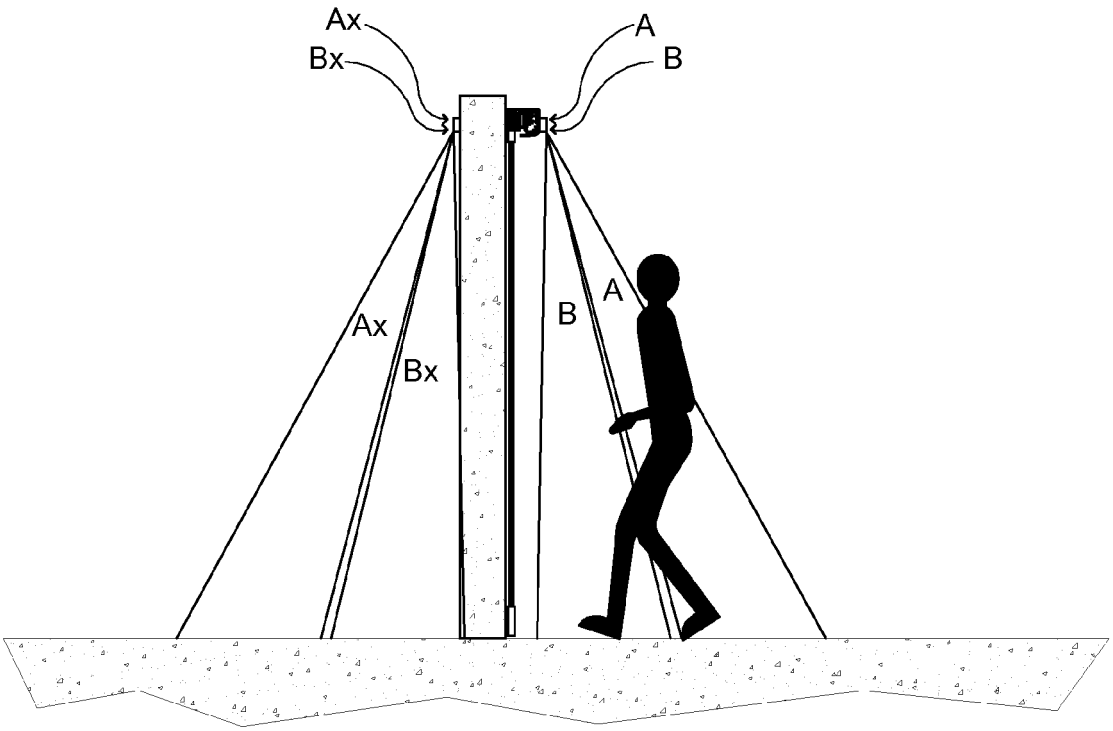
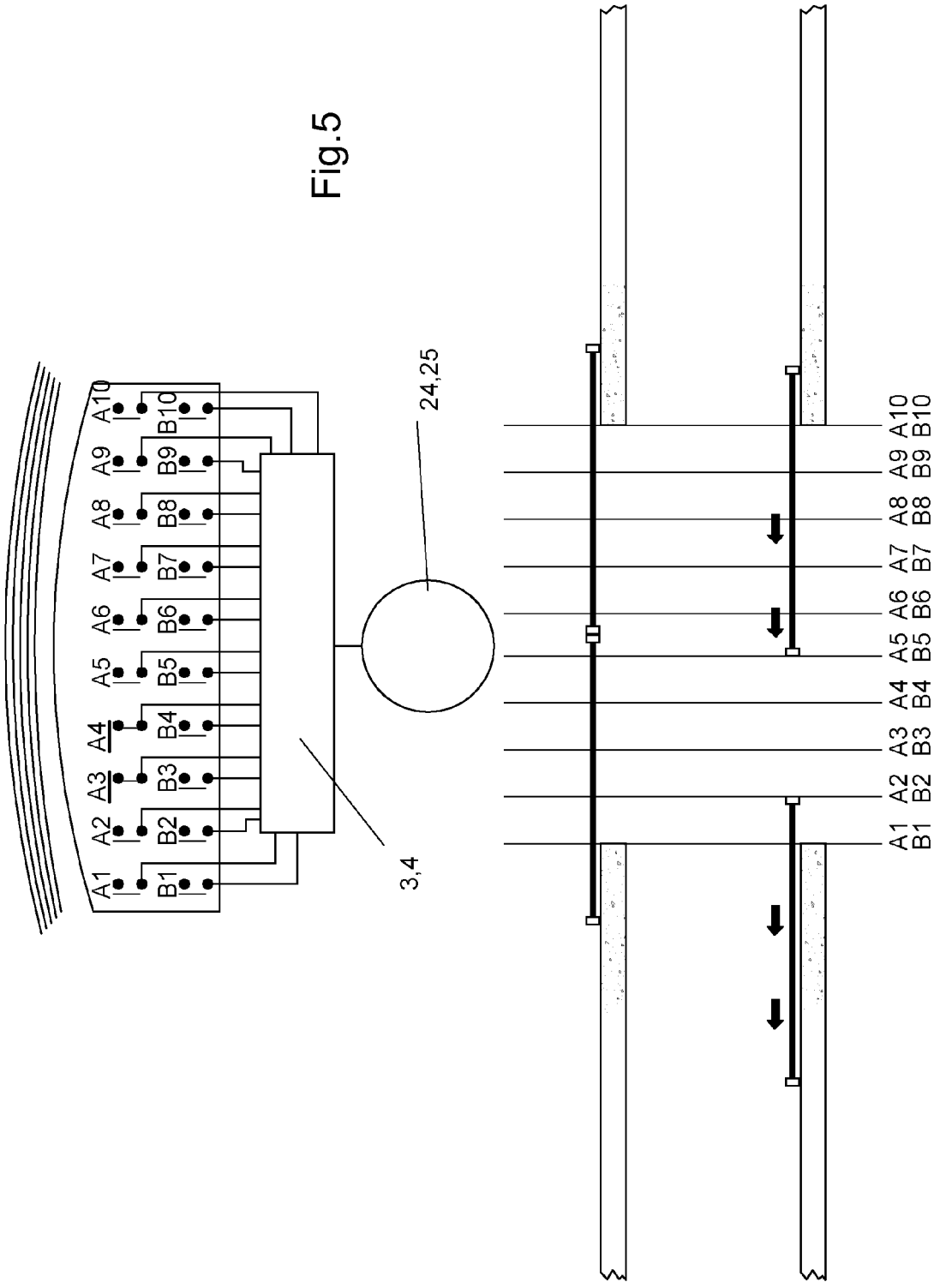


Fig.4

Fig.5


A1
B1
A2
B2
A3
B3
A4
B4
A5
B5
A6
B6
A7
B7
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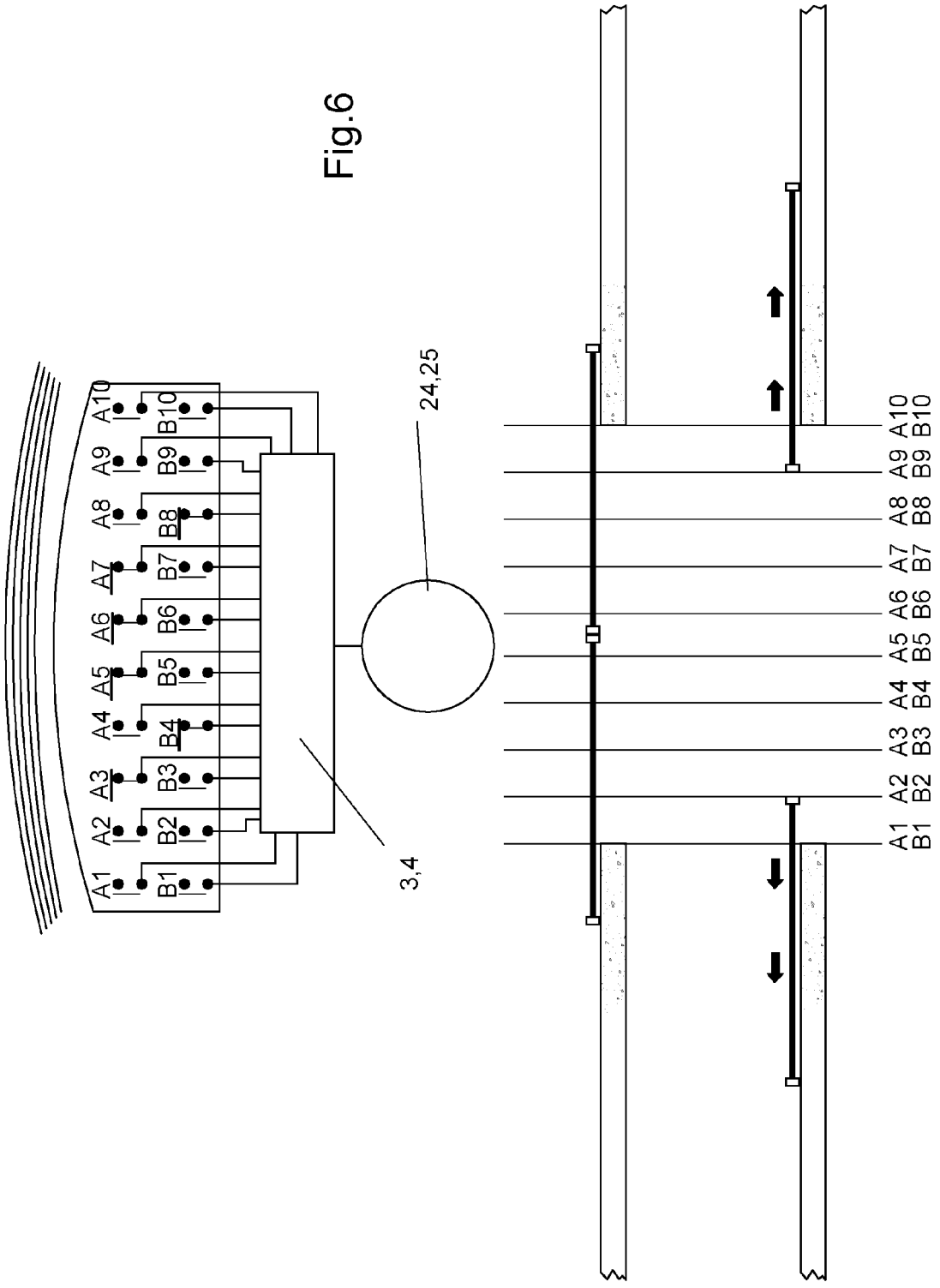
B8
A9
B9
A10
B10
24,25
3,4
A1 A2 B1 B2
A3 B3
A4 B4
A5 B5
A6 B6
A7 B7
A8 B8
A9 B9
A10 B10

Fig.6


A1
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B2
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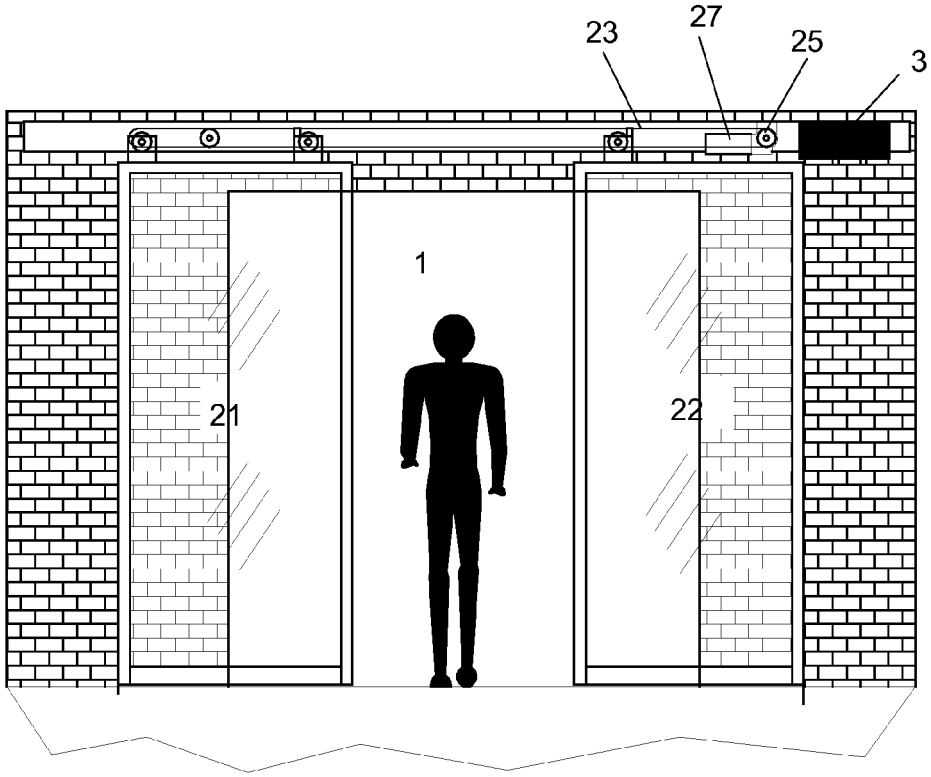

Fig.7

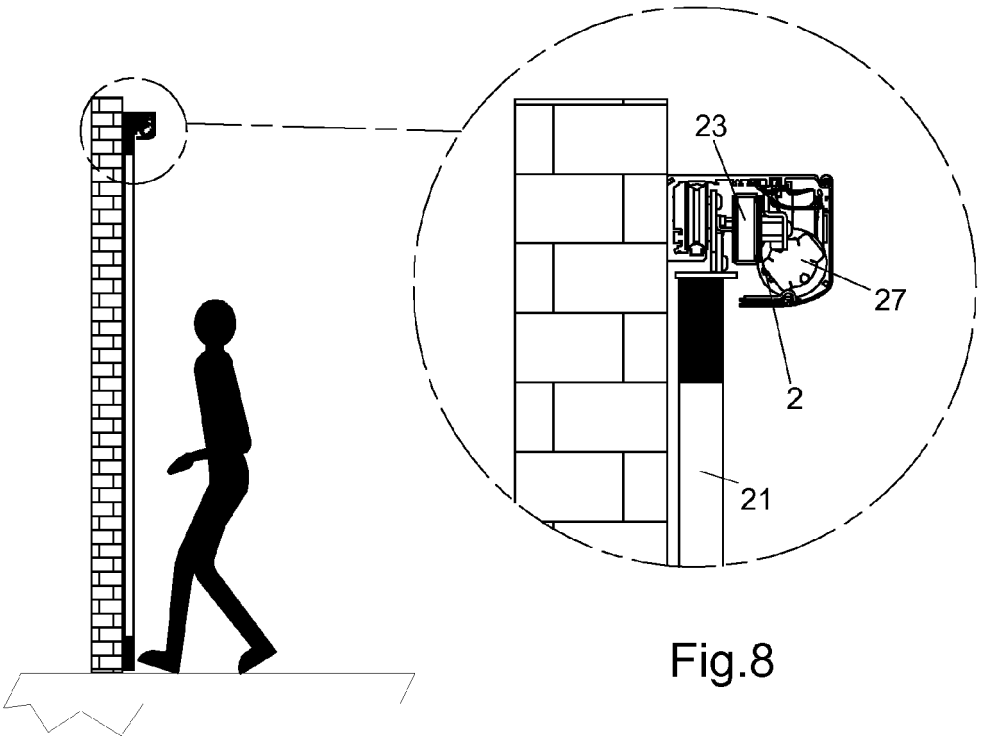

Fig.8

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EUROPEAN SEARCH REPORT

Application Number
EP 13 16 6978

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	EP 0 799 962 A1 (LANDERT H [CH]) 8 October 1997 (1997-10-08) * column 1, line 59 - column 2, line 9 * * column 2, line 53 - column 3, line 1 * * column 3, lines 9-37 * * column 8, lines 13-39, 51-53 * * column 9, line 55 - column 10, line 10 *	1-3	
A	EP 1 491 709 A1 (OPTEX CO LTD [JP]) 29 December 2004 (2004-12-29) * paragraph [0018] * * figure 3 *	1-3	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 June 2013	Mund, André

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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