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(54) **INDUSTRIAL TRUCK WITH DISPLAY FUNCTION FOR SHOWING THE DRIVING DIRECTION**

(57) An industrial truck (10) comprises:
-a frame (11),
-handling means (12, 13) mounted on the frame for handling a load (14),
-a camera (51, 52) configured to capture a video of an environment to which the industrial truck is directed,
-steering angle detecting means (50) for detecting a steering angle of the industrial truck,
-a display device (17), and
-a controller (40) configured to control a displaying function of the display device (17) so that a dedicated area (20) of the display device displays the video captured by

the camera without any superimposition of a trajectory of the industrial truck.

The controller is further configured to control the display device (17) so that a border region (21) of the display device surrounding the dedicated area (20) displays a movable cursor (22). The controller (40) is configured to dynamically determine the position of the cursor (22) with respect to the dedicated area (20) based on the steering angle detected by the steering angle detecting means (50) to provide an indication of the direction of the industrial truck (10) with respect to the environment represented in the dedicated area (20).

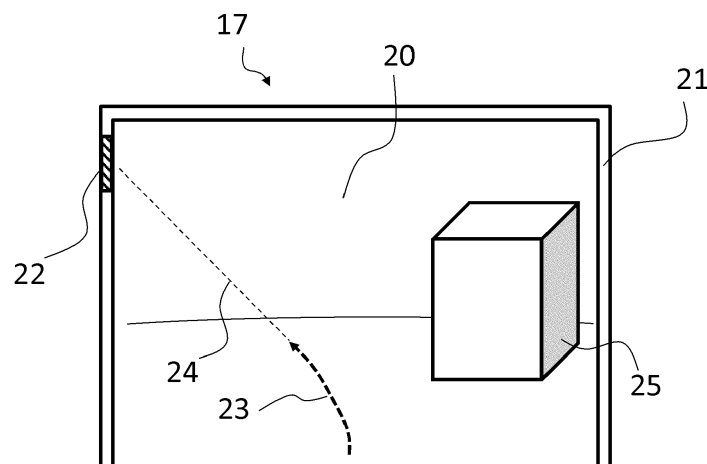


Fig. 2

Description**TECHNICAL FIELD OF THE INVENTION**

[0001] The field of the present invention concerns an industrial truck, such as a forklift truck, with an improved display function for showing the driving direction.

BACKGROUND OF THE INVENTION

[0002] Forklift trucks including a chassis, a mast pivotally mounted on the chassis and a fork slidably mounted on the mast are known in the art. The fork is used to lift a load, for example for transporting ware in a store. The mast can be tilted with respect to the chassis to facilitate loading and unloading of the ware.

[0003] It is also known to provide the forklift truck with one or more displays for showing control information relating to the operation of the truck. The display may typically display several different types of control information relating to the operation of the truck, including e.g. truck speed, information relating to the position of the fork, the load weight on the fork, and the like.

[0004] Among other things, the display can show a video streamed by a camera mounted on the industrial truck, e.g. on the front of the truck or on the back, to show the area towards which the truck is directed, either when driving forwards or backwards. It is also known to show the trajectory of the truck overlapped on the video representing the area towards which the truck is directed, based on the current steering angle of the truck. The indication of the trajectory may be helpful to avoid collisions and to better control the driving direction, especially when the industrial truck is starting to move from standstill. However, as the image of the video is overlaid with the trajectory, some information included in the video may be lost and the vision of the area to which the truck is directed may be impaired for the truck user.

[0005] Giving an indication of the direction the vehicle will take is an essential aid, especially in cases where the vehicle is not translating. The need to view this information in a way that is correlated to the video images shown on the display clashes with the known solutions. Hence, there is a need of an improvement in the display function of the trajectory or of the direction of the vehicle in the display area of the display of the industrial truck.

SUMMARY OF THE INVENTION

[0006] In view of the above problems, it is a general object of the present invention to improve the display function of the display of an industrial truck. More specifically, it is an object of the invention to provide a display function that enables the user to recognize the direction of the truck with respect to the image of the area to which the industrial truck is directed as captured by a camera of the industrial truck, without impairing the vision of the area to which the industrial truck is directed.

[0007] In view of the above object, the present invention proposes an industrial truck comprising:

- a frame,
- handling means mounted on the frame for handling a load,
- a camera configured to capture a video of an environment to which the industrial truck is directed,
- steering angle detecting means for detecting a steering angle of the industrial truck,
- a display device, and
- a controller configured to control a displaying function of the display device so that a dedicated area of the display device displays the video captured by the camera without any superimposition of a trajectory of the industrial truck,

characterized in that the controller is further configured to control the display device so that a border region of the display device surrounding the dedicated area displays a movable cursor, wherein the controller is configured to dynamically determine the position of the cursor with respect to the dedicated area based on the steering angle detected by the steering angle detecting means to provide an indication of the direction of the industrial truck with respect to the environment represented in the dedicated area.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The above and other advantages of the present invention will be illustrated with reference to an example embodiment of the invention, described with reference to the appended drawings listed as follows.

Fig. 1 shows a schematic lateral view of an industrial truck according to an embodiment of the invention; Fig. 2-5 show the display area of the display of the industrial truck according to the invention under different operating circumstances; Fig. 6 shows an embodiment of the hardware implementation of the control unit of the industrial truck; Fig. 7 shows a schematic view of the camera, the display, the control unit and the sensors of the industrial truck.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] Figure 1 shows an industrial truck 10 according to an embodiment of the present invention, e.g. a forklift truck. The industrial truck 10 includes a chassis (or frame) 11, a mast 12 pivotally mounted on the chassis 11 and lifting element 13 (e.g. a fork) for lifting a load 14; the lifting element 13 is mounted on the mast 12 in a slidable manner along the mast 12; in figure 1 the lifting element

13 is shown in a lowered position. However, the material handling device for handling the load could also be implemented in different ways, according to the known art.

[0010] The industrial truck 10 may be electrically driven or may include an endothermic motor, or may have a hybrid drive system. Further, the industrial truck 10 might include four wheels or three wheels disposed on a front axle and a rear axle, as well as a steering wheel for steering the truck while driving. The industrial truck comprises a user seat 15 and an armrest 16 on a side of the user seat, preferably on the right side of the user seat 15. A display 17 (or display device) may be positioned at the end of the armrest 16. However, also other positions of the display 17 can be considered according to the present invention.

[0011] The industrial truck includes a control unit 40 (schematically represented in dashed lines in fig. 1) configured to control various operation of the industrial truck. In the present disclosure, the control unit 40 can be also referred to as controller 40. The display function of the display 17 is controlled by the controller 40.

[0012] Furthermore, the industrial truck 10 includes steering angle detecting means 50 for detecting a steering angle of the industrial truck; the steering angle detecting means 50 may be implemented according to any known art, e.g. by means for a sensor, and encoder associated to the steering column or the like. The steering angle detecting means 50 are communicably connected to the controller 40 to provide the controller with a signal representing the current steering angle of the industrial truck.

[0013] The industrial truck 10 further comprises one or more cameras 51, 52 for capturing a video of an environment to which the industrial truck is directed. For example, the industrial truck may include a front camera 51 for capturing a video of the area in front of the industrial truck and/or a rear camera 52 for capturing a video of the area behind the industrial truck. The cameras 51 and 52 are communicably connected to the control unit 40 to provide a respective video signal or may be directly be connected to the display device 17 to provide a streamed video. The position of the cameras 51 and 52 may vary according to the implementation of the industrial truck. Furthermore, also only one camera may be provided in the industrial truck 10. The cameras 51, 52 captures a video of an environment to which the industrial truck is directed, which may be in front of the truck or behind it.

[0014] As well shown in figures 2-5, according to the invention, the controller 40 controls a displaying function of the display device 17 so that a dedicated area 20 of the display device 17 displays the video captured by one of the cameras 51, 52 without any superimposition of a trajectory of the industrial truck. In the example of figures 2-4, a dashed arrow 23 and the dashed lines 24 are represented for explanatory purpose only, while in the actual implementation the display 17 does not show these dashed elements 23, 24. In figure 5, the actual representation of the dedicated area 20 is shown, in which only

the streamed video fed by the camera 51 or 52 is shown in the dedicated area 20. The dedicated area 20 shows an environment to which the industrial truck 10 is directed.

[0015] According to the present disclosure, the controller 40 controls the display device 17 so that a border region 21 of the display device 17 surrounding the dedicated area 20 displays a movable cursor 22, as shown in figures 2-5. The position of the cursor 22 is representative of the direction of the industrial truck 10. In fact, the controller 40 is configured to dynamically determine the position of the cursor 22 with respect to the dedicated area 20 based on the steering angle detected by the steering angle detecting means 50 to provide an indication of the direction of the industrial truck 10 with respect to the environment represented in the dedicated area 20. The controller 40 applies the above described control of the display also in case the industrial truck 10 is at standstill. In this case, the direction of the truck is a potential direction based on the position of the steering wheels in case the industrial truck 10 starts translating. This is particularly important because, when the industrial truck 10 is at standstill, it is more difficult for the user to foresee the trajectory of the vehicle.

[0016] The solution of the present invention consists in surrounding the dedicated area 20 intended for video streaming with a frame or border region 21. In this frame 21 a cursor 22 of arbitrary shape will vary its position according to the future direction of the truck. The arrows 23 in figure 2, 3 and 4 show the direction of the truck 10 based on the steering angle of the vehicle 10. The position of the cursor 22 corresponds to the direction of the truck 10, as it is positioned in correspondence of the direction in which the truck 10 is moving (or will move, if at stillstand) starting from a central position in the dedicated area 20, as shown by the dashed line 24. In other words, the trajectory of the truck 10 with respect of the image shown in the dedicated area 20 substantially corresponds to a line starting from a central lower portion of the dedicated area 20 towards the cursor 22. However, only the cursor 22 is shown on the border region 21 and no impairment or overlay on the image in the dedicated area 20 occurs. Accordingly, the user obtains an indication of the future trajectory of the truck without impairment of the vision of the image streamed by the video camera in the dedicated area 20. The cursor 22 moves along the border region 21 around the video stream in the dedicated area 20 while the movement is connected to the processed signal that represents the steering angle. This angle is calculated by the control unit 20 of the industrial truck 10, by processing a signal coming from any type of sensor 50 for detecting the steering angle.

[0017] In figure 2, an obstacle 25 is shown and the position of the cursor 22 indicates that the trajectory of the truck 10 will not collide with the obstacle 25. In figure 4, to the contrary, the user obtains the information that the truck 10 may collide with the obstacle, even if the image in the dedicated area 20 is fully visible without

overlays. In figure 5 the steering angle is the maximum mechanically allowed, i.e. the industrial truck 10 is steered completely to the right.

[0018] The color, transparency or filling pattern of this cursor 22 can also vary according to need. In particular, the color of the cursor 22 can change in relation to angle intervals that have a particular meaning. As an example, the color can turn red when the steering angle has reached the mechanical limit stop, this corresponds to the portion 61 of the border area 21 in figure 3. In other words, when the cursor 22 is in the segments 61 of the border area 21, the cursor is colored in red and indicates that mechanical limit stop has been reached. When the cursor 22 is in the segment 62 of the border region 21, it may be colored in green and this indicates a substantial rectilinear trajectory of the truck 10. In the remaining intermediate segments 63 of the border region 21 shown in figure 3, the color of the cursor 22 may be orange and this may indicate a steering which is not close to the limit.

[0019] The cursor 22 may have the ability to move around the whole frame (or border region) 22 or just a part of it.

[0020] Preferably, the controller 20 is configured to change, in addition to the position of the cursor, also a representation of the cursor 22 depending on the steering angle. The representation may include anyone or more of: the shape, the color and the filling patterns. The cursor can change shape, as well as duration or mode of permanence on the screen - for example blinking - depending on whether it is connected to information transmitted by other types of sensors: for example, anti-collision sensors. The cursor can also be accompanied by acoustic signals.

[0021] In a preferred embodiment, the border region 21 surrounds the dedicated area 20 on two opposite lateral sides and on an upper side of the dedicated area 20. For example, the dedicated area 20 may be rectangular as shown in figures 2-5. The border region 21 surrounds the dedicated area 20 and is in the form of a stripe of substantially constant thickness.

[0022] In a preferred embodiment, the industrial truck 10 includes anti-collision sensing means; for example, the anti-collision means may be implemented in the control unit 40 as a software module configured to assess the risk of collision based on the estimated trajectory of the truck and other inputs relating to obstacles in the vicinity of the industrial truck. The controller 40 is configured to change a representation of the cursor 22 depending on a signal representing a risk of collision generated by the anti-collision sensing means, for example by making the cursor blink or changing the color thereof.

[0023] Preferably, the border region 21 is positioned along a border of the dedicated area 20. Most preferably, the border region 21 is positioned adjacent to a border of the dedicated area 20, as shown in the examples of figure 2-5. This allows to minimize the dimension of the display while achieving an efficient usage of the available display area.

[0024] The frame or border region 21 can be more or less wide depending on the size of the video stream or other needs. In a preferred embodiment, the border region 21 has a thickness equal to or lower than a tenth of the width of the dedicated area 20. This ensures an efficient usage of the available area of the display 17 for the streamed images, while conveying the information relating to the direction in the border region 21.

[0025] Preferably, as shown in figures 2-5, the border region 21 does not extend below the dedicated area 20. This further improves the usage of the display area, by dedicating a largest area to the streamed images captured by the cameras. Preferably, the border region 21 is continuous.

[0026] Fig. 6 shows a possible implementation of the control unit 40. In an embodiment, the control unit 40 includes a processor 42, a memory 43 and a I/O interface 41. The processor is configured to execute a control software stored on the memory 43 to execute any of the functions of the control unit 40 as above described. When executing the control software, the processor 42 outputs control signals to the display 17 of the industrial truck using the I/O interface 41 to cause the display 17 to display the cursor 22 as above described. Furthermore, when executing the control software, the processor 42 may receive as inputs the information from one or more sensors of the industrial truck by means of the I/O interface 41 and output control signals to one or more actuators of the industrial truck using the I/O interface 41 as well. Also other possible implementations of the control unit can be conceived, e.g. including a plurality of distributed processors or the like. The processing by the control unit may also be performed by a remote control board or circuit board connected to the sensors, the actuators and the display of the industrial truck via a bus, e.g. via a CAN bus. Furthermore, the display 17 may be equipped with one or more communication interfaces, such as Ethernet, BT, Can, USB. Through its communication interfaces, the display may access other communication channels, such as a channel in a WI-FI network or a channel in a cellular network, or the like.

[0027] The position of the cursor 22 on the display 17 is refreshed periodically, so that the cursor 22 reflects constantly the direction of the truck even during steering.

[0028] Figure 7 shows a schematic representation of the display 17, the controller 40 and the sensors of the industrial truck 10 that are relevant for the present disclosure. In particular, the camera 51 can be connected directly to the display 17 to feed the stream via a dedicated bus or any other type of connection. On the other side, the display 17 may be connected to a CAN bus 56 of the industrial truck 10, on which the control signals generated by the control unit 40 are circulating, e.g. the signal relating to the position of the cursor 22 in the frame 21. In the example in the figure, only a single control unit 40 is shown, although also more than one control unit may be provided. The control unit 40 receives signals from the sensors of the industrial truck, e.g. the steering

angle sensor 50 and also a sensor 55 detecting the driving direction (forwards or backwards). Depending on the driving direction detected by the sensor 55, the control unit 40 may command the display 17 to switch the streamed image by switching from the video fed by the rear camera 52 to the front camera 52 and vice versa. The position of the cursor 22 is also determined based on the driving direction detected by the sensor 55.

[0029] The above description of embodiments applying the innovative principles of the invention is provided solely for the purpose of illustrating said principles and must thus not be considered as limiting the scope of the invention claimed herein.

Claims

1. An industrial truck (10) comprising:

- a frame (11),
- handling means (12, 13) mounted on the frame for handling a load (14),
- a camera (51, 52) configured to capture a video of an environment to which the industrial truck is directed,
- steering angle detecting means (50) for detecting a steering angle of the industrial truck,
- a display device (17), and
- a controller (40) configured to control a displaying function of the display device (17) so that a dedicated area (20) of the display device displays the video captured by the camera without any superimposition of a trajectory of the industrial truck,

characterized in that the controller is further configured to control the display device (17) so that a border region (21) of the display device surrounding the dedicated area (20) displays a movable cursor (22), wherein the controller (40) is configured to dynamically determine the position of the cursor (22) with respect to the dedicated area (20) based on the steering angle detected by the steering angle detecting means (50) to provide an indication of the direction of the industrial truck (10) with respect to the environment represented in the dedicated area (20).

2. An industrial truck (10) according to claim 1, wherein the border region (21) surrounds the dedicated area (20) on two opposite lateral sides and on an upper side of the dedicated area (20).

3. An industrial truck (10) according to any of claims 1 or 2, wherein the controller is configured to change, in addition to the position of the cursor, also a rep-

resentation of the cursor (22) depending on the steering angle.

4. An industrial truck (10) according to any of claims 1 to 3, wherein the industrial truck includes anti-collision sensing means, wherein the controller is configured to change a representation of the cursor (22) depending on a signal representing a risk of collision generated by the anti-collision sensing means.

5. An industrial truck (10) according to any of claims 1 to 4, wherein the border region (21) is positioned along a border of the dedicated area (20).

6. An industrial truck (10) according to any of claims 1 to 5, wherein the border region (21) is positioned adjacent to a border of the dedicated area (20).

7. An industrial truck (10) according to any of claims 1 to 6, wherein the border region (21) has preferably a thickness equal to or lower than a tenth of the width of the dedicated area (20).

8. An industrial truck (10) according to any of claims 1 to 7, wherein the border region (21) does not extend below the dedicated area (20).

9. An industrial truck (10) according to any of claims 1 to 8, wherein the border region (21) is continuous.

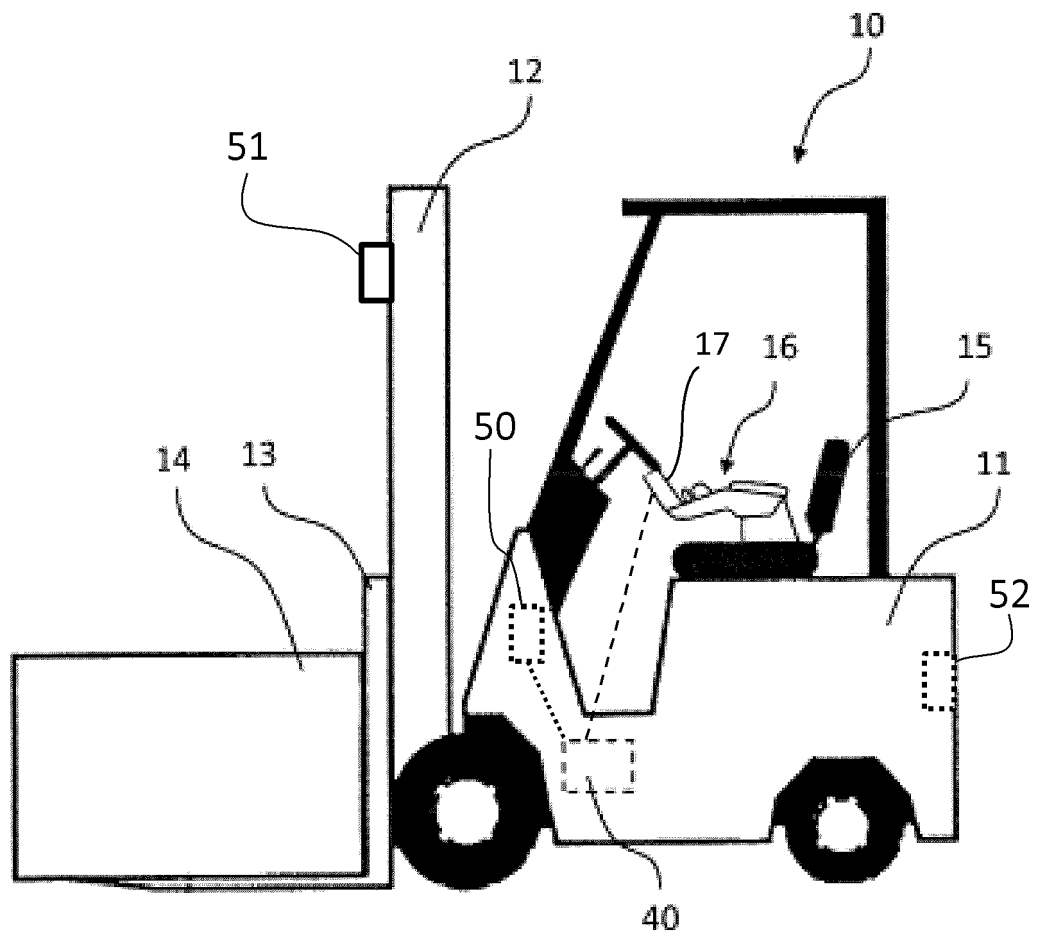


Fig. 1

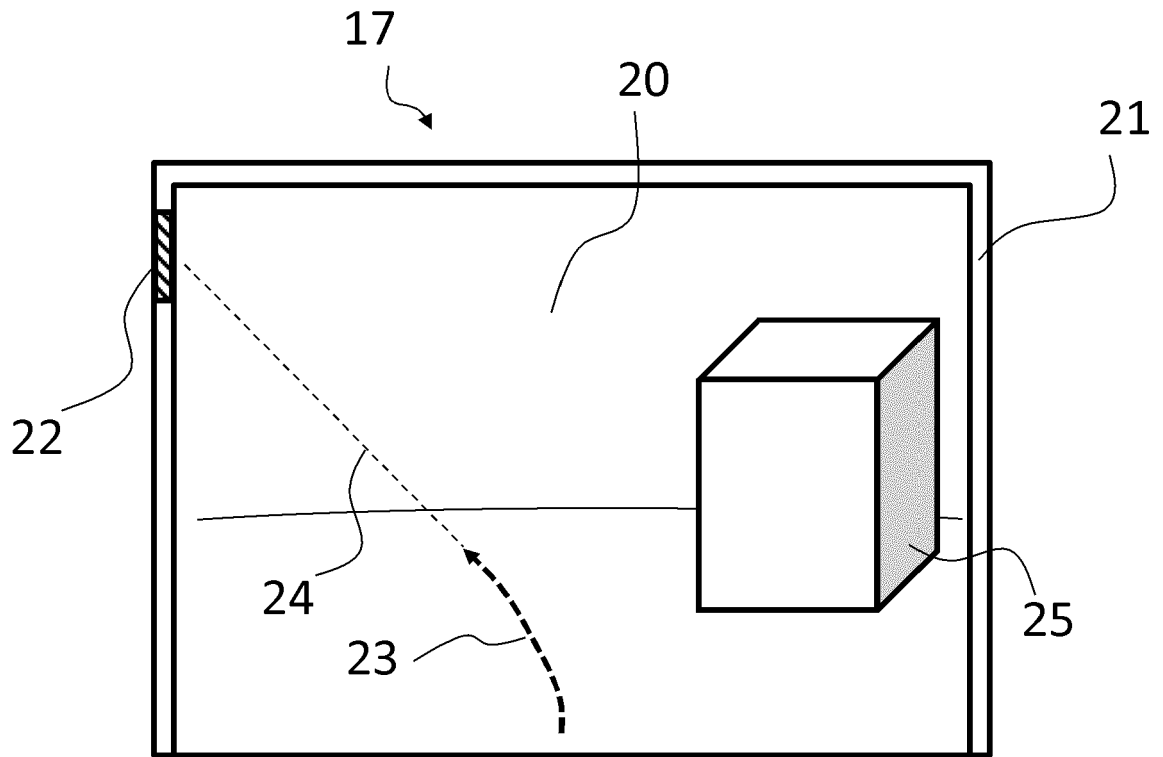


Fig. 2

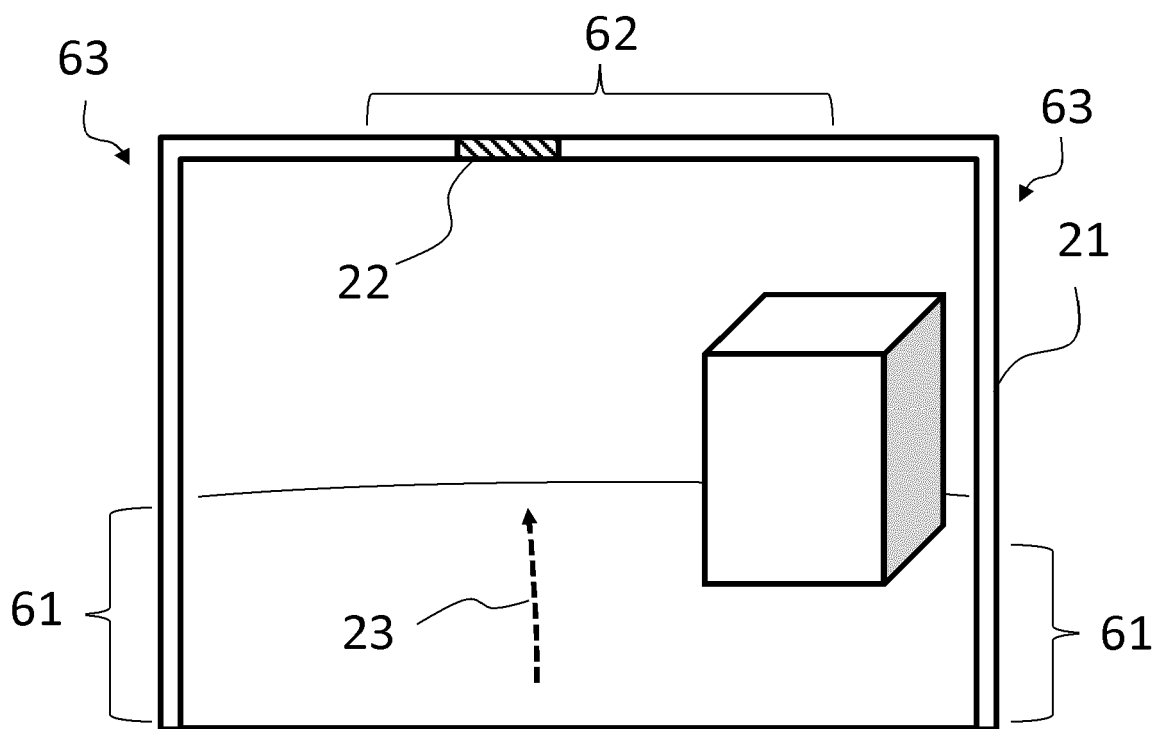


Fig. 3

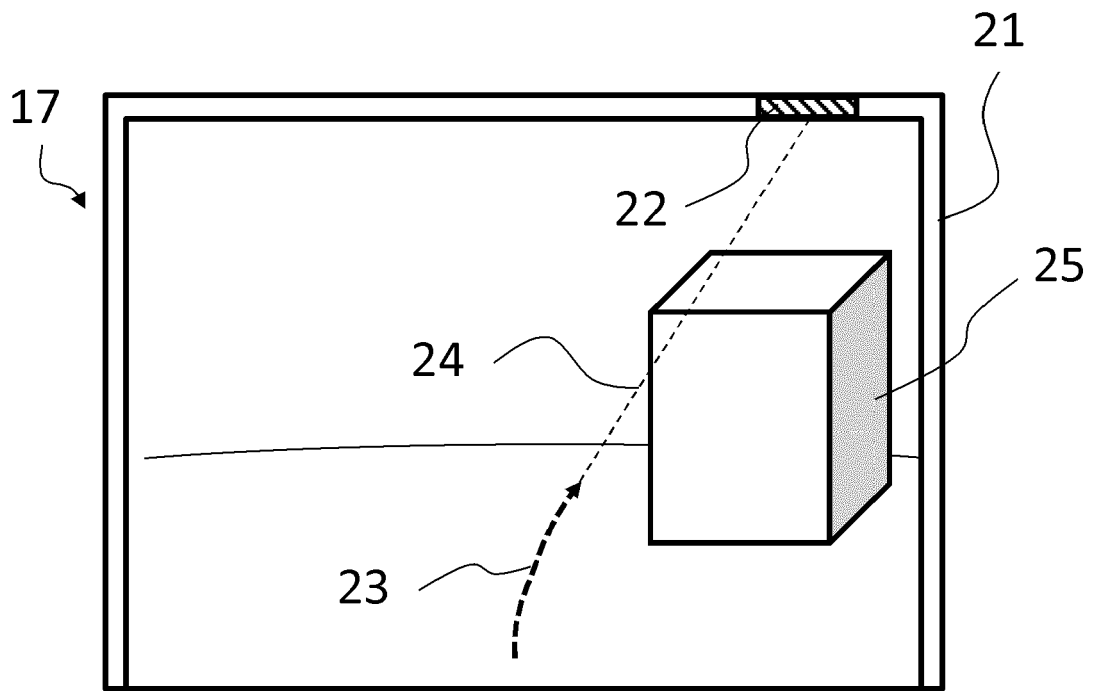


Fig. 4

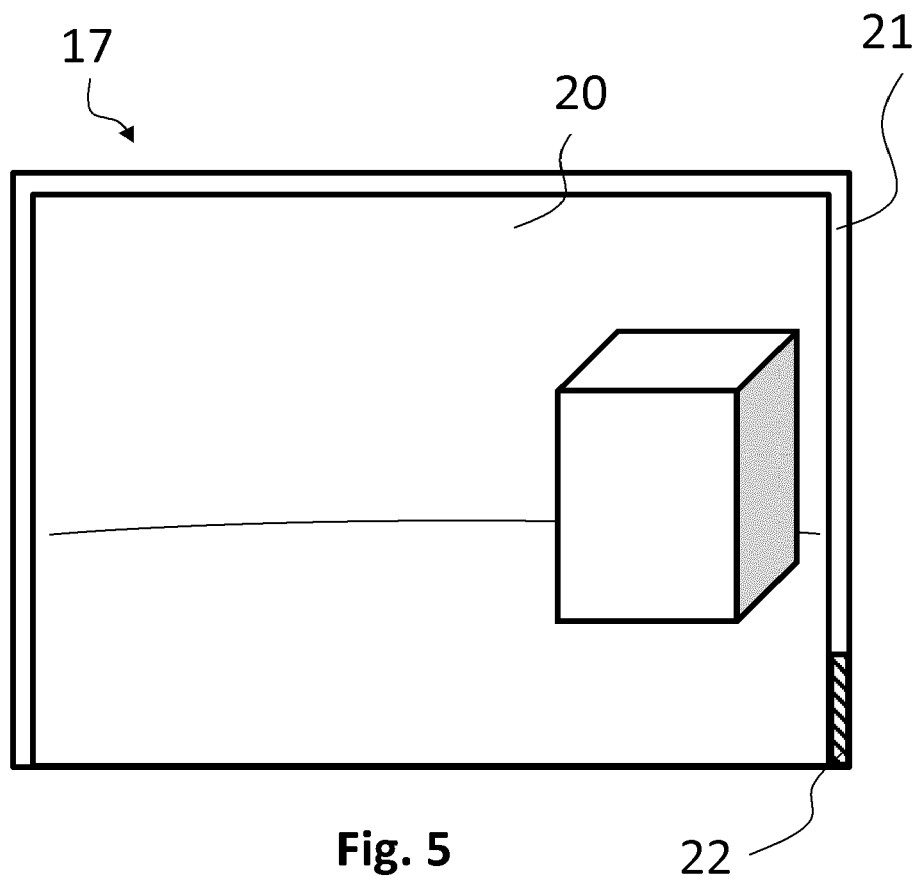


Fig. 5

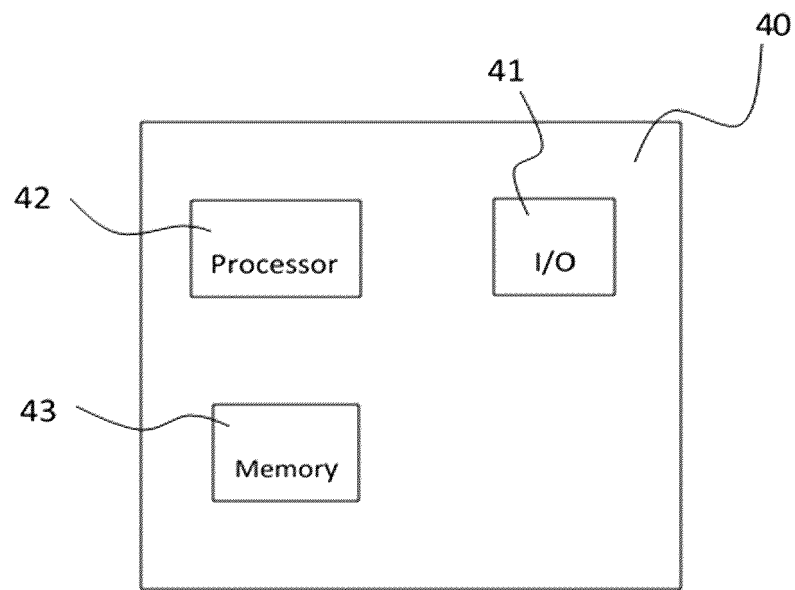


Fig. 6

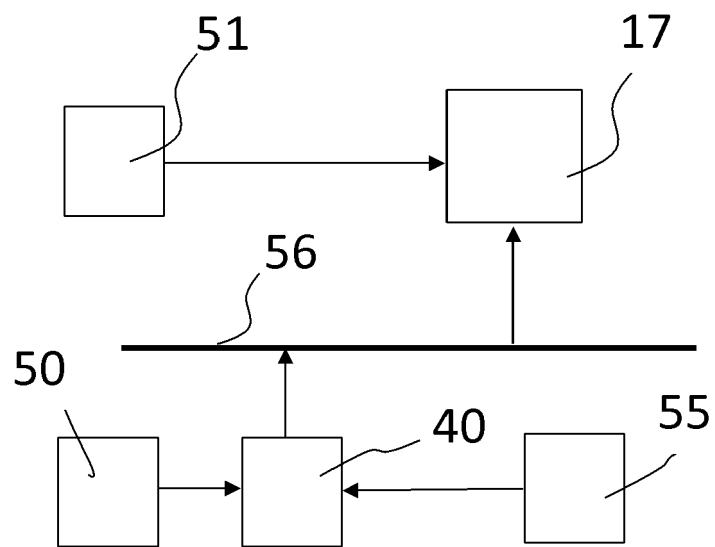


Fig. 7



EUROPEAN SEARCH REPORT

Application Number

EP 23 16 0022

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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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			TECHNICAL FIELDS SEARCHED (IPC)
			B66F
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		30 March 2023	Delval, Stéphane
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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