(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 814 015 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.12.2014 Bulletin 2014/51

(51) Int Cl.:
G08G 1/04 *(2006.01)* ***G08G 1/017*** *(2006.01)*

(21) Application number: **14170560.8**

(22) Date of filing: **30.05.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **12.06.2013 IT MI20130963**

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(54) Electronic mobile device for reading a plate number of a vehicle

(57) A mobile electronic device (1) for reading the plate number (30) of a vehicle (20) is described. The device comprises means for fixing the device above the roof or above the bonnet or above the trunk of a moving vehicle (20), comprises a camera (2) configured to capture a plurality of images of the plate number of the vehicle (21, 22), comprises a memory (12) configured to store a check list indicating a plurality of plate numbers (30, 31, 32, 33) of vehicles and comprises a processing module (4) connected to the camera. The processing module is configured to receive the plurality of images, process the plurality of images received and recognize the plate number (30) associated to at least a part of the plurality of processed images and verify if the recognized plate number is included into the check list.

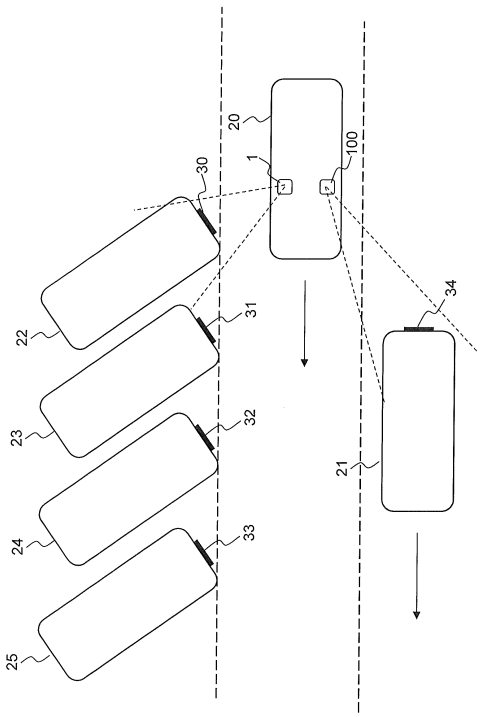

Fig.1

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Description

Technical field of the invention

[0001] The present invention generally relates to the field of vehicle monitoring. More in particular, the present invention concerns a mobile electronic device for reading a plate number of a vehicle.

Prior art

[0002] Devices for reading plate numbers of vehicles are known. In particular, mobile reading devices are known, that is they are installed on moving vehicles.

[0003] The moving vehicle is for example a police car. In this case, the plate reading mobile device is used, for example, to read the plates of parked or moving vehicles in order to verify whether the plate numbers belong to suspect or stolen vehicles, by means of a check list.

[0004] Mobile reading devices are composed of one or more cameras positioned on the roof of the moving vehicle and of a processing unit positioned inside the moving vehicle, typically in the trunk.

[0005] The Applicant has observed that a disadvantage of the mobile reading devices according to the prior art is that to require installation times which are too long, to be unreliable, to be moveable with difficulty from one vehicle to another, to occupy too much space and to be too expensive.

[0006] US patent 7504965-B1 shows in Fig.6 the block diagram of a mobile plate surveillance system. The system comprises a camera 70, an image processing device 74, an onboard processing unti 90 and a storage device 98 of the plate numbers. The system is mounted on a patrol car 64 (Fig.5). More in particular, camera 70 is mounted in the light bar 65 which is fixed above the roof of the patrol car 64 in order to hide the camera 70; differently, the onboard processing unti 90 is mounted inside the trunk of the patrol car 64.

[0007] US patent application with publication number 2007/085704 discloses a vehicle violation recording system using the position (for example, by means of GPS) of said vehicle. The system is mounted on a bus and it comprises a first camera mounted on the right front part of the bus (see 42 in Fig.3) for reading the plate number of the violating vehicle and it comprises a second camera mounted on the left front part of the bus (see 44 in Fig.3) for storing an image of the entire violating vehicle.

Brief summary of the invention

[0008] The present invention relates to a mobile electronic device for reading a plate number of a vehicle as defined in the enclosed claim 1 and by preferred embodiments thereof described in the dependent claims from 2 to 13.

[0009] The Applicant has perceived that the mobile reading electronic device according with the present invention has the following advantages:

- it requires a smaller installation time on the vehicle, that is it is easier to move the mobile reading electronic device from one vehicle to another;
- it is more reliable;
- it has a better data processing capability;
- it is more compact;
- it is less expensive.

[0010] It is also an object of the present invention a vehicle, in particular a motorvehicle, as defined in the enclosed claim 14.

[0011] It is also an object of the present invention a method for reading the plate number of a vehicle as defined in the enclosed claim 15.

Brief description of the drawings

[0012] Further characteristics and advantages of the invention will become apparent from the following description of a preferred embodiment and variants thereof provided by way of example with reference to the appended drawings, wherein:

- Figure 1 schematically shows a moving vehicle with two installed mobile reading electronic devices according to the invention;
- Figures 2A-2D schematically show perspective, front, rear and side views of the mobile reading electronic device according to a first embodiment of the invention;
- Figures 3A-3B schematically show a perspective and front view of the mobile reading electronic device according to a second embodiment of the invention;
- Figure 4A shows more in detail an electronic system inside the mobile reading electronic device according to the first embodiment of the invention;
- Figure 4B shows more in detail the electronic system inside the mobile reading electronic device according to a first variant of the first embodiment of the invention;
- Figure 4C shows more in detail the electronic system inside the mobile reading electronic device according to a second variant of the first embodiment of the invention.

Detailed description of the invention

[0013] With reference to Figure 1, it shows a moving vehicle 20 with installed a first mobile reading electronic device 1 according to the first embodiment of the invention and a second mobile reading electronic device 100 according to the second embodiment of the invention. The moving vehicle 20 is for example a police car or motorcycle, which is checking the plate numbers of parked vehicles and/or moving vehicles, in order to verify whether the plate numbers belong to suspect or stolen

vehicles.

[0014] Figure 1 further shows the vehicles 22, 23, 24, 25 (for example, cars) which are parked, while the vehicle 21 (for example, a car) is moving in the same direction as the vehicle 20, along an adjacent lane.

[0015] The first mobile reading electronic device 1 and the second mobile reading electronic device 100 are mounted on the roof of the moving vehicle 20. Alternatively, the first mobile reading electronic device 1 and the second mobile reading electronic device 100 are mounted on the bonnet and/or on the trunk of the moving vehicle 20: in the latter case, it is possible to read the plate numbers of vehicles behind the moving vehicle 20. For example, the first mobile reading electronic device 1 is mounted on the roof and the second mobile reading electronic device 100 is mounted on the trunk.

[0016] The first mobile reading electronic device 1 has the function of reading the plate numbers of the vehicles 22, 23, 24, 25 which are parked. In particular, Figure 1 shows that the vehicle 20 is positioned in such a way to allow the first mobile reading electronic device 1 to read the number of the plate 30 of the vehicle 22. Subsequently, the vehicle 20 will move along the travelling direction indicated by the arrow in order to read, in sequence, the number of the plate 31 of the vehicle 23, of the plate 32 of the vehicle 24 and tof he plate 33 of the vehicle 25.

[0017] The second mobile reading electronic device 100 has the function of reading the numbers on the rear plate of the vehicles travelling in the same travelling direction of the vehicle 20, along the adjacent lane. In particular, Figure 1 shows that the vehicle 20 is positioned in such a way to allow the second mobile reading electronic device 100 to read the number of the rear plate 34 of the vehicle 21 which is travelling in the same travelling direction of the vehicle 20, along the adjacent lane. It should be observed that the second mobile reading electronic device 100 is capable of reading also the numbers of the front plate of a vehicle (for the sake of simplicity, not shown in Figure 1) travelling in the travelling direction of opposite to that of the vehicle 20, along an adjacent lane.

[0018] It should be observed that the vehicle 20 shown in Figure 1 comprises two mobile electronic devices for reading the plate number of parked or moving vehicles, but the invention is also applicable in case that only one mobile reading electronic device (for example only the first mobile reading electronic device 1 or only the second mobile reading electronic device 100) is present and also in ase that more than two mobile reading electronic devices are present (for example, the first mobile reading electronic device 1 is such to read the plate numbers of the vehicles which are parked to the right with respect to the travelling direction of the vehicle 20, the second mobile reading electronic device 100 is such to read the numbers of the rear or front plate of the vehicles travelling in the same travelling direction or in the travelling direction opposite to that of the vehicle 20 respectively and a third mobile reading electronic device is such to read the plate numbers of the vehicles which are parked to the left with respect to the travelling direction of the vehicle 20).

[0019] With reference to Figure 2A, it shows a perspective view of the first mobile reading electronic device 1.

[0020] The first mobile electronic device 1 is enclosed by an external case at least partially made of metal. Preferably, the external case is partially made of metal material, partially made of plastic material.The perspective view of Figure 2A shows the front part of the first mobile reading electronic device 1, wherein a first camera 2 and a second camera 3 are visible; in particular, the lens of the objective of the first camera 2 and the lens of the objective of the second camera 3 are visible. The first mobile reading electronic device 1 further comprises an illuminator 7 comprising a diffuser lens.

[0021] The first camera 2 has the function of capturing a plurality of images of the plate number of parked or moving vehicles, while the second camera 3 has the function of capturing one or more images of the scene wherein the plate number of the vehicles framed by the first camera 2 is located, as it will be explained more in detail afterwards. For example, the scene comprises the entire vehicle and a part of the street wherein the vehicle is travelling, and the image of the scene is used as proof associated with the detected plate.

[0022] The first camera 2 has an optical axis positioned in a transversal direction with respect to the travelling direction of the moving vehicle 20, in order to allow the reading of the plate numbers of vehicles positioned transversely (for example, perpendicularly) to the travelling direction of the vehicle 20.

[0023] Alternatively, the first camera 2 has the optical axis positioned in a direction which forms an angle smaller than 90° wih respect to the travelling direction of the moving vehicle 20, in order to allow the reading of the plate numbers of the vehicles travelling in the same travelling direction or in the travelling direction opposite to that of the vehicle 20, along the adjacent lane.

[0024] The second camera 3 has an optical axis positioned in the same direction as the optical axis of the first camera 2.

[0025] It should be observed that the presence of the second camera 3 is not essential for the purposes of the invention, because it is used to capture the scene.

[0026] The illuminator 7 has the function to allow to read the plate number also under unfavourable lighting conditions, such as for example in the dark or in case of low light.

[0027] For example, the illuminator 7 is of the infra-red LED type, that is it comprises a LED such to generate a radiation in the invisible spectrum of the infra-red band. In this way the image sensor (for example CCD or CMOS) mounted in the first camera 2 is capable of detecting a sufficient light intensity in the infra-red band reflected from the plate of the framed vehicle, also under unfavourable lighting conditions.

[0028] Alternatively, the illuminator 7 is of the visible

light LED type, that is it comprises a LED such to generate a radiation in the visible spectrum, for example with a colour temperature comprised between 5400 °K and 6500 °K; preferably, the visible light is white light. Preferably, the colour of the visible light is function of the colour of the plate to be detected.

[0029] It should be observed that it is possible to use a combination of one or more infra-red illuminators with one or more white light illuminators.

[0030] The first mobile reading electronic device 1 comprises means for fixing the mobile electronic device to a part of the moving vehicle 20, such as for example above the roof, above the bonnet or or above the trunk of the vehicle 20.

[0031] Preferably, the fixing means are a magnet having the shape of a substantially planar surface.

[0032] Advantageously, said fixing means are adapted to allow to change the field framed by the cameras 2,3 and comprise for example a rotating support or magnet.

[0033] With reference to Figures 2B and 2D, they show a front view and side view of the first mobile reading electronic device 1 respectively. In the front view, the lens of the first camera 2, the lens of the second camera 3 and the lens of the illuminator 7 are visible.

[0034] Preferably, the width L1 of the first mobile reading electronic device 1 is equal to 17.2 cm, the height H1 of the first mobile reading electronic device 1 is equal to 6.6 cm and the depth of the first mobile reading electronic device 1 is equal to 12.3 cm: therefore the first mobile reading electronic device 1 is extremely compact. Moreover, the distance L2 between the optical axis of the first camera 2 and the optical axis of the second camera 3 is equal to 11.4 cm and the distance H2 between the optical axis of the first camera 2 (or of the second camera 3) and the upper surface of the first mobile reading electronic device 1 is equal to 3.3 cm.

[0035] With reference to Figure 2C, it shows a perspective view of the first mobile reading electronic device 1 wherein the rear part is visible.

[0036] With reference to Figures 3A and 3B, they show a perspective and front view of the second mobile reading electronic device 100 respectively.

[0037] The second mobile reading electronic device 100 differs from the first mobile reading electronic device 1 in the presence of six illuminators 7-1, 7-2, 7-3, 7-4, 7-5, 7-6.

[0038] Preferably, the illuminators 7-1, 7-2, 7-3 are of the infra-red LED type and the illuminators 7-4, 7-5, 7-6 are of white light LED type (or vice versa).

[0039] It should be observed that other combinations of the types (infra-red or white light LEDs) of the illuminators 7-1, ... 7-6 are possible.

[0040] With reference to Figure 4A, the first mobile reading electronic device 1 comprises an electronic system 50.

[0041] The electronic system 50 comprises the first camera 2, the second camera 3, the illuminator 7 and a processing module 4 connected to the first camera 2 and to the second camera 3; the processing module 4 further comprises a non-volatile memory 12 for storing a check list indicating the plates of suspect or stolen vehicles (hereinafter indicated as "blacklist") or, alternatively or in combination, a check list indicating the plates of vehicles that are neither suspect nor stolen (hereinafter indicated as "white list").

[0042] The electronic system 50 is enclosed inside the external case shown in Figure 2A. Therefore the first camera 2, the second camera 3, the illuminator 7, the memory 12 and the processing module 4 are enclosed inside the external case, which is mounted above the roof or above the trunk or above the bonnet of the moving vehicle 20.

[0043] The first camera 2 is such to capture a plurality of black-white or colour images of the plate number of vehicles and it is such to generate a first image capture signal S_I1 carrying first data indicating the first plurality of images which include a representation of the plate number of the vehicles framed by the first camera 2.

[0044] The first camera 2 includes an objective composed of one or more lenses and comprises an optical sensor, for example of the CMOS or CCD type.

[0045] For example, the first camera 2 comprises an optical sensor with a resolution of 1.3 megapixels (1280 x 1024) and the frequency of the captured images is equal to 60 frames per second. Advantageously, in case wherein the illuminator 7 is of infra-red LED type, the objective of the first camera 2 has a band-pass filter centred around 850 nm.

[0046] The second camera 3 is such to capture one or more images of the scene wherein the plate number of the vehicle framed by the first camera 2 is located and it is such to generate a second image capture signal S_I2 carrying second data indicating one or more images which represent the scene wherein the plate number of the vehicle framed by the first camera 2 is located. For example, in the case considered in Figure 1 wherein the first camera 1 of the first mobile reading electronic device 1 is detecting the plate number 30 of the vehicle 22, the second camera 3 is such to capture the scene which comprises the vehicle 22 (included the plate number 30 thereof) and part of the vehicle 23 parked adjacent to the vehicle 22 (see in Figure 1 the light beam comprised between the two broken lines).

[0047] The second camera 3 includes an objective composed of one or more lenses and comprises an optical sensor, for example of the CMOS or CCD type.

[0048] Preferably, the second camera 3 is such to capture colour images, it comprises an optical sensor with a resolution of 1.3 megapixels (1280 x 1024) and the frequency of the captured images is equal to 60 frames per second.

[0049] The processing module 4 is such to receive from the first camera 2 the first image capture signal S_I1 carrying first data indicating the first plurality of images which include a representation of the plate number of the vehicles framed by the first camera 2, it is such to process

the first data and it is such to store into the memory 12 first processed data indicating the first plurality of processed images.

[0050] Afterwards, the processing module 4 is such to read, from the memory 12, the first processed data indicating the first plurality of processed images, it is such to further process the first processed data by means of an optical character recognition (OCR) algorithm, which searches for and recognizes the plate number associated with at least a part of the images of the first plurality of processed images; advantageously, the recognized plate numbers are stored into the memory 12.

[0051] Afterwards, the processing module 4 is configured to perform a comparison between the recognized plate number and the plate numbers of the blacklist (or white list) stored into the memory 12 and it is such to generate a plate comparison signal indicating whether the read plate belongs to the blacklist (or white list); for example, the plate comparison signal is a logical signal having a high value if the recognized plate number belongs to the blacklist and having a low logical value if the recognized plate number does not belong to the blacklist.

[0052] Moreover, the processing module 4 is such to receive from the second camera 3 the second image capture signal S_I2 carrying second data indicating a second plurality of images which represent the scene wherein the plate number of the vehicle framed by the first camera 2 is located, it is such to process the second data and it is such to store into the memory 12 at least a part of the second processed data indicating at least a part of the second plurality of processed images.

[0053] The processing module 4 is implemented for example with a programmable electronic device (for example, an FPGA), with a microprocessor such to execute software code portions or with a combination of a programmable electronic device and a microprocessor.

[0054] According to a variant of the first embodiment of the invention, the second camera 3 is further configured to capture a further first plurality of colour images of vehicle plate numbers and it is such to generate a further first image capture signal S_I1' carrying further first data indicating a further first plurality of images including a representation of the plate number of the vehicles framed by the second camera 3. In this case the processing module 4 is configured to further receive, from the second camera 3, the further first image capture signal S_I1' carrying the further first data indicating the further first plurality of images that include a representation of the plate number of the vehicles framed by the second camera 3, it is such to process the further first data and it is such to store into the memory 12 further first processed data indicating the further first plurality of processed images. Subsequently, the processing module 4 is such to read, from the memory 12, the further first processed data indicating the further first plurality of processed images, it is such to further process the further first processed data by means of the optical character recognition algorithm, which searches for and recognizes the plate number associated to at least a part of the images of the further first plurality of processed images; advantageously, the recognized plate numbers are stored into the memory 12.

[0055] Moreover, the processing module 4 is such to compare the plate numbers detected by means of the first camera 2 with respect to respective plate numbers detected by means of the second camera 3 in substantially equal time instants and it is such to verify whether they are equal: in thisway the reliability of the plate number search and recognition process is further improved.

[0056] It is possible to observe that both the capture and the processing of the images is performed on board of the first mobile reading electronic device 1: in this way the time required to install the first mobile reading electronic device 1 on the roof of the vehicle 20 is reduced and it is easier to move the first mobile reading electronic device 1 from one vehicle to another, because it is no longer necessary to connect the cameras positioned on the roof of the vehicle 20 with a processing module positioned inside the vehicle 20, typically in the trunk (like performed in US patent 7504965-B1). In this manner the reliability of the mobile reading electronic device 1 is also increased, because it is no longer necessary to use a data link cable between the cameras positioned on the roof of the vehicle 20 and the processing module positioned inside the vehicle 20. In fact the only cable connected to the mobile reading electronic device 1 is the cable carrying the voltage to supply the mobile reading electronic device 1: said supply cable is connected from one side to the mobile reading electronic device 1 and from the other side to the socket positioned inside the passenger compartment of the vehicle 20, wherein said socket is such to generate a direct voltage (typically equal to 12 V).

[0057] The mobile reading electronic device 1 can also be used in a static mode. For example, the mobile reading electronic device 1 can be positioned at the roadside, for example fixed on a support which can be a trivet. In this case the mobile reading electronic device 1 can be supplied by a rechargeable external battery (for example, by means of a solar panel) having the function of supplying the electronic circuits positioned inside the mobile reading electronic device 1, such as the first camera 2, the second camera 3, the illuminator 7 and the processing module 4.

[0058] The easiness to assemble (and move) the mobile reading electronic device 1 and the reduced consumption considerably increase the applications wherein it can be used.

[0059] With reference to Figure 4B, it shows a first variant 150 of the electronic system positioned inside the first mobile reading electronic device 1.

[0060] It should be observed that in the present description, blocks, components or modules which are identical or analogous are indicated in Figures 4A and 4B with the same reference numbers.

[0061] The electronic system 150 differs from the electronic system 50 in that the processing module 4 is implemented with two separate components, in particular with an image processing module 5 and an optical character recognition module 6, which are connected to each other by means of a bus 9.

[0062] The image processing module 5 is such to receive from the first camera 2 the first image capture signal S_I1 carrying the first data indicating the first plurality of images that include a representation of the plate number of the vehicles framed by the first camera 2, it is such to process the first data and it is such to store the first processed data indicating the first plurality of processed images in the memory 12.

[0063] The optical character recognition module 6 is such to read, from the memory 12, the first processed data indicating the first plurality of processed images, it is such to further process the first processed data by means of the optical character recognition algorithm, which recognizes the plate number associated with at least a part of the images of the first plurality of processed images; advantageously, the identified plate numbers are stored into the memory 12.

[0064] Moreover, the image processing module 5 is such to receive, from the second camera 3, the second image capture signal S_I2 carrying second data indicating the second plurality of images that represent the scene wherein the plate number of the vehicle framed by the first camera 2 is located, it is such to process the second data and it is such to store into the memory 12 at least a part of the second processed data indicating at least a part of the second plurality of processed images.

[0065] It should be observed that the first mobile reading electronic device 1 having the electronic system 150 has the same advantages as the first mobile reading electronic device 1 having the electronic system 50, because in this case as well both the images capture and the processing is performed on board of the first mobile reading electronic device 1. Moreover, the image processing module 5 separated from the optical character recognition module 6 has the further advantages to improve the reliability of the mobile reading electronic device 1 (with respect to the mobile reading electronic device 1 with a single processing module 4) and to have a greater data processing capability. Moreover, the image processing module 5 separated from the optical character recognition module 6 has the further advantage that in caso of a modification of the optical character recognition algorithm, it will be necessary to modify only the optical character recognition module 6, while maintaining the image processing module 5 unchanged; analogously, in case of modification of the image processing algorithms, it will be necessary only to change the image processing module 5, while maintaining the optical character recognition module 6 unchanged.

[0066] Advantageously, the image processing module 5 is implemented with a programmable electronic device, in particular an FPGA (Field Programmable Gate Array), for example EP4CGX50F484 by Altera.

[0067] Preferably, the optical character recognition module is implemented with a microprocessor, for example the Qseven module based on the NVIDIA Tegra 3 processor.

[0068] With reference to Figure 4C, it shows a second variant 250 of the electronic system positioned inside the first mobile reading electronic device 1.

[0069] It should be observed that in the present description, blocks, components or modules which are identical or analogous are indicated in Figures 4B and 4C with the same reference numbers.

[0070] The electronic system 250 differs from the electronic system 150 in the presence of a tilt sensor 10 and of a radio signal transmitting/receiving module 8.

[0071] The tilt sensor 10 has the function of measuring the tilt of the first mobile reading electronic device 1 with respect to the plane defined by the ground. In this way it is possible to maintain the position of the first camera 2 and of the second camera 3 under control.

[0072] Moreover, the presence of the tilt sensor 10 contributes to a correct positioning of the first mobile reading electronic device 1 during the the installation phase on the roof (or on the bonnet or on the trunk) of the vehicle 20.

[0073] The transmitting/receiving module 8 has the function of connecting the first mobile reading electronic device 1 by means of a radio communication channel (for example, WiFi 802.11 b/g/n) with a central unit (for example, a laptop or a smartphone) positioned inside the vehicle 20 (for example, in the passenger compartment) on which the first mobile reading electronic device 1 is installed or with a central unit (for example, a smartphone) positioned in the proximity of the vehicle 20.

[0074] The central unit has the function of configuring and/or updating a check list stored into the first mobile reading electronic device 1 (or into the second mobile reading electronic device 100), by means of the transmission of radio signals (for example, WiFi 802.11 b/g/n) towards the transmitting/receiving module 8 of the first mobile reading electronic device 1 (or of the second mobile reading electronic device 100). Moreover, the central unit is such to receive the plate comparison signal indicating whether or not the detected plate belongs to the blacklist (or white list) and it is such to generate, as a function thereof, an alarm signal (for example, an audible signal) in case that the recognized plate number belongs to the blacklist (or in case that the recognized plate number does not belong to the white list).

[0075] The transmitting/receiving module 8 is such to transmit/receive data which fulfill short-medium distance radio protocols (for example, WiFi 802.11 b/g/n type) or long distance ones, such as second generation radiomobile protocols (GSM, GPRS, EDGE), third generation ones (UMTS, HSDPA, HSUPA) or fourth generation ones (LTE, Mobile WiMax). In this case the central unit is connected to the mobile electronic device 1 by means of a telecommunications network which can be, for example,

Internet.

[0076] Advantageoulsy, the mobile electronic device 1 comprises both a transmitting/receiving module of short-medium distance radio signals and a transmitting/receiving module of long distance signals. Therefore it is possible to configure/update the check list stored into the memory 12 both using the central unit positioned in the proximity of the mobile electronic device 1 (and thus in the proximity of the moving vehicle 20) and using a central unit positioned in a remote position with respect to the mobile electronic device 1 (and thus remote with respect to the moving vehicle 20)

[0077] It should be observed that the preceding considerations relating to the first mobile reading electronic device 1 are applicable in an analogous manner to the second mobile reading electronic device 100. In particular, also in the second mobile reading electronic device 100 both the capture and the processing of images is performed completely on board of the second mobile reading electronic device 100, thus reducing the installation time of the second mobile reading electronic device 100 on the roof of the vehicle 20 and improving the reliability of the second mobile reading electronic device 100.

[0078] Preferably, the mobile electronic device 1 according to the first or second embodiment of the invention (and variants thereof) further comprises a positioning module (for example, a satellite type, such as GPS= Global Position System) having the function to synchronize data and time of an internal clock placed inside the device 1 itself: this allows to provide the correct value of data and time wherein the mobile electronic device 1 is such to read a plate of a suspect vehicle.

[0079] In particular, the satellite-type positioning module is configured to receive the time signal which is radio transmitted from a satellite (belonging to the satellite constellation of the satellite system) which contains an atomic clock and is configured to perform, as a function of the received time signal, the synchronization of data and time of the clock internal to the positioning module with respect to data and time of the atomic clock positioned on the satellite.

[0080] The satellite-type positioning module (for example, GPS) is further configured to calculate the geographic position of the moving vehicle 20 on which it is fixed and it is configured to calculate an estimation of the geographic position of the vehicle framed by the first camera 2 (that is, one or more among the neighboring vehicles 21, 22, 23, 24). The geographic position is represented for example in terms of latitude and longitude coordinates and, preferably, also in terms of altitude.

[0081] More in particular, the satellite-type positioning module is configured to receive radio signals transmitted from a plurality of satellites which form the satellite positioning system, is configured to calculate, as a function of the received signals, information indicating the geographic position of the positioning module (and thus indicating the geographic position of the mobile electronic device 1 and of the vehicle 20 on which it is fixed) and it is configured to calculate, as a function of the geographic position of the mobile electronic device 1, an estimation of the geographic position of the vehicle framed by the first camera 2 (that is one or more among the neighboring vehicles 21, 22, 23, 24). Preferably, the satellite positioning module is such to store into the memory 12 information about the geographic position of the mobile electronic device 1 and of the vehicle framed by the first camera 2. It should be observed that the framed vehicle can be both the moving vehicle 21 having a speed different from zero, and a parked vehicle 22, 23, 24, 25 having a speed equal to zero.

[0082] The satellite-type positioning module (for example, GPS) is further configured to calculate an estimation of the speed of the moving vehicle 20 (that is, of the vehicle on which the positioning module inside the mobile electronic device 1 is mounted) and it is configured to calculate, as a function of the estimation of the speed of the moving vehicle 20, a further estimation of the speed of the vehicle framed by the first camera 2. It should be observed that the framed vehicle can be both the moving vehicle 21 having a speed different from zero, and a parked vehicle 22, 23, 24, 25 having a speed equal to zero.

Claims

1. Mobile electronic device (1) for reading a plate number (30) of a vehicle (21, 22), **characterized in that** the device comprises:

   - means for fixing the device above the roof or above the bonnet or above the trunk of a moving vehicle (20);
   - a camera (2) configured to capture a plurality of images of the plate number of the vehicle (21, 22);
   - a memory (12) configured to store a check list indicating a plurality of plates numbers (30, 31, 32, 33) of vehicles (22, 23, 24, 25);
   - a processing module (4) connected to the camera and configured to:

     • receive the plurality of images;
     • process the plurality of received images and recognize the plate number (30) associated to at least a part of the plurality of processed images;
     • verify if the recognized plate number is included into the check list.

2. Mobile electronic device according to claim 1, wherein the camera, the memory and the processing module are enclosed within a case at least partially made of metal.

3. Mobile electronic device according to claims 1 or 2, further comprising a satellite positioning module configured to:

- receive radio signals transmitted from a plurality of satellites which form the satellite positioning system;
- generate, as a function of the received signals, information indicating a geographic position of the mobile electronic device;
- calculate, as a function of the geographic position of the mobile electronic device, an estimation of the geographic position of the vehicle (21, 22) framed by the camera (2).

4. Mobile electronic device according to claim 3, wherein the satellite positioning module is configured to:

- calculate an estimation of the speed of the moving vehicle (20);
- calculate, as a function of the estimation of the speed of the moving vehicle (20), a further estimation of the speed of the vehicle (21, 22) framed by the camera (2).

5. Mobile electronic device according to claims 3 or 4, wherein the satellite positioning module comprises an internal clock, wherein the satellite positioning module is further configured to:

- receive a time signal which is radio transmitted from a satellite and generated from an atomic clock positioned on the satellite;
- perform the synchronization of data and time of the internal clock with respect to data and time of the atomic clock positioned on the satellite.

6. Mobile electronic device according to any of the previous claims, wherein the processing module comprises:

- an image processing module (5) configured to receive, process and store into the memory the plurality of processed images;
- an optical character recognition module (6) configured to read from the memory the plurality of processed images and to recognize therefrom the plate number.

7. Mobile electronic device according to any of the previous claims, comprising a further camera (3) configured to capture at least one image of the scene wherein said plate number of the vehicle is located, wherein the processing module is further configured to receive the at least one image from the further camera and to store it into the memory.

8. Mobile electronic device according to any of the previous claims, further comprising at least one infrared or visible light LED illuminator (7, 7-1, 7-2).

9. Mobile electronic device according to any of the previous claims, further comprising a tilt sensor (10) configured to measure the tilt of the mobile electronic device with respect to the ground.

10. Mobile electronic device according to any of the previous claims, further comprising a radio signal transmitting/receiving module (8) configured to transmit/receive data indicating the configuration of the check list.

11. Mobile electronic device according to any of the claims from 7 to 10, wherein said camera is a black-white camera and said further camera is a colour camera.

12. Mobile electronic device according to any of the previous claims, wherein the fixing means are adapted to allow to change the field framed by the camera and by the further camera.

13. Mobile electronic device according to the previous claim, wherein the fixing means comprise a rotating support or a magnet.

14. Vehicle (20), in particular a motorvehicle, comprising a mobile electronic device (1) according to at least one of the previous claims, wherein said mobile electronic device is mounted, alternatively:

- on the roof of the motorvehicle;
- on the bonnet of the motorvehicle;
- on the trunk of the motorvehicle.

15. Method for reading the plate number (30) of a vehicle (21, 22), comprising the steps of:

- fixing a mobile electronic device (1) above the roof or above the bonnet or above the trunk of a moving vehicle (20);
- storing, into a memory inside the mobile electronic device, a check list indicating a plurality of plates numbers (30, 31, 32, 33) of vehicles (22, 23, 24, 25);
- capturing, by means of a camera inside the mobile electronic device (1), a plurality of images of the plate number (21, 22) of the vehicle;
- processing, in a processing module inside the mobile electronic device, the plurality of images and recognizing the plate number (30) associated to at least a part of the plurality of processed images;
- verifying, by means of the processing module, if the recognized plate number is included into the check list.

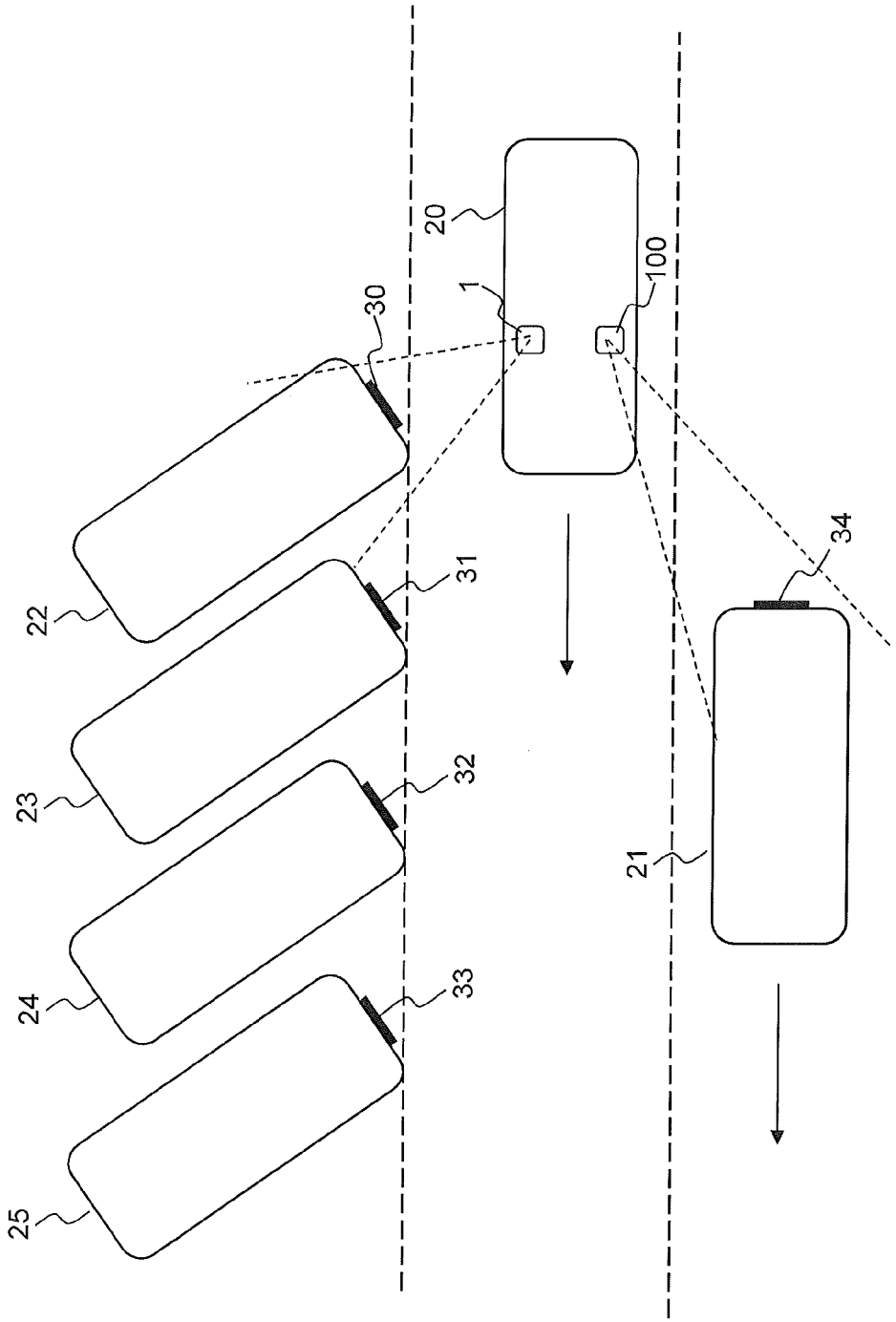

Fig.1

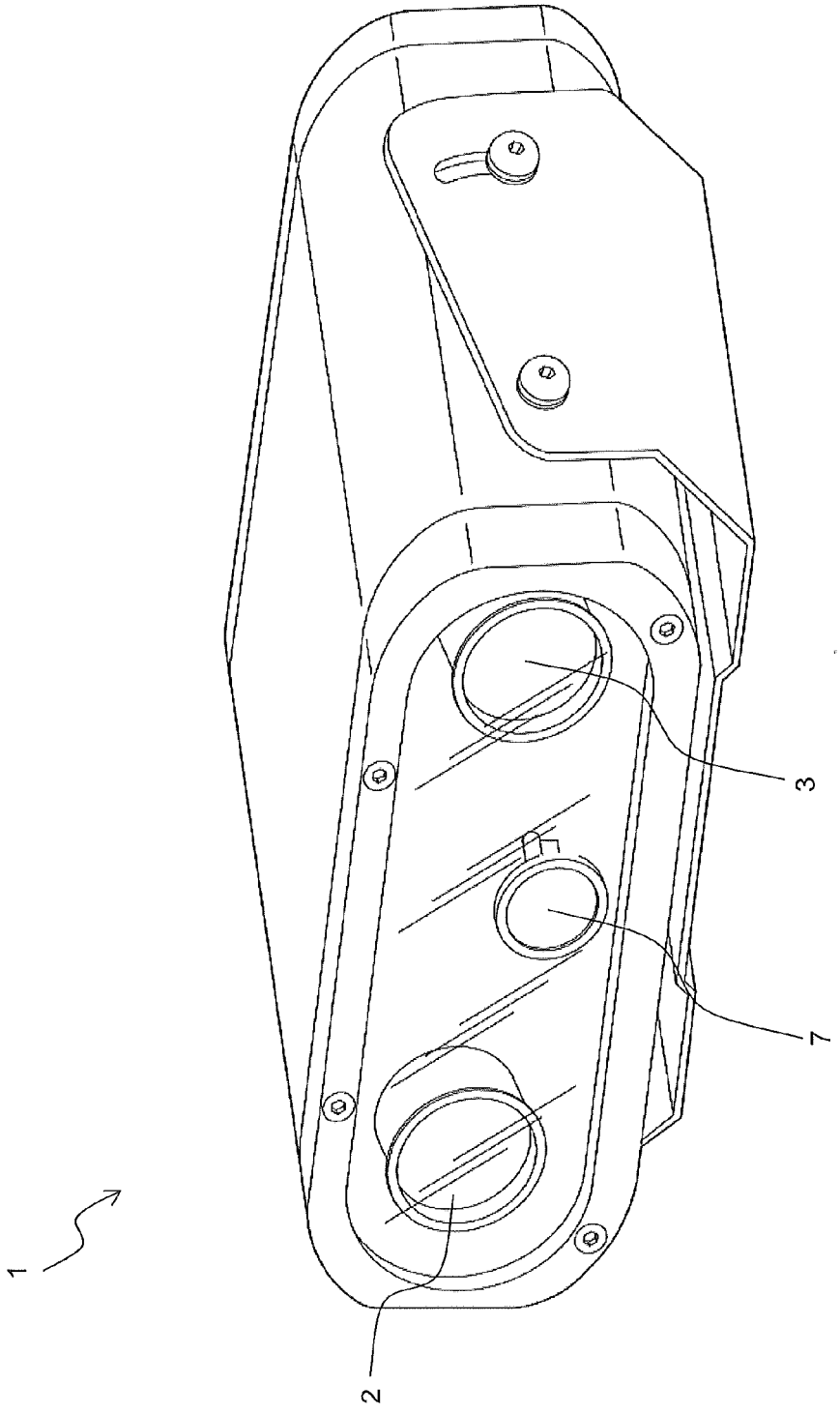

Fig. 2A

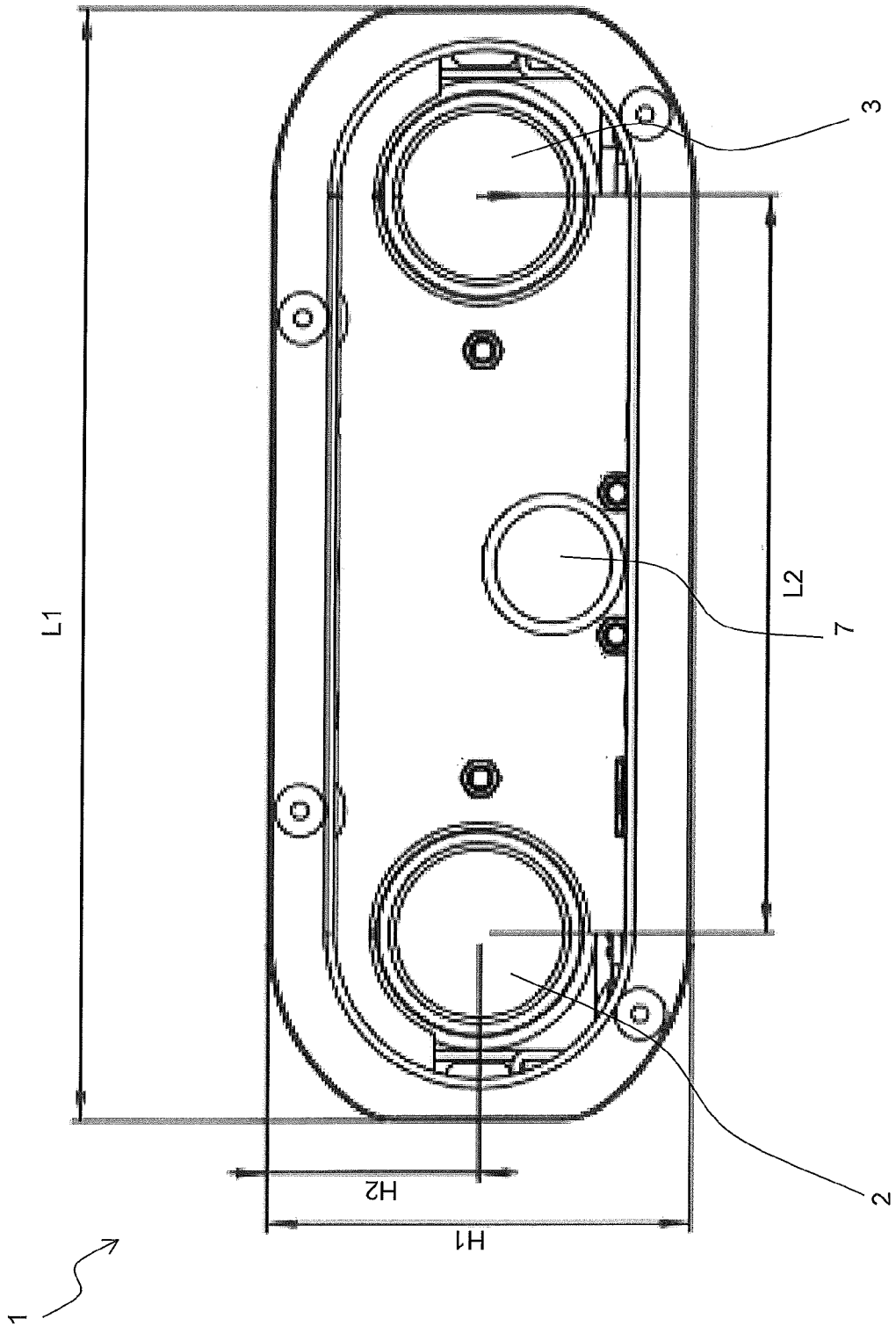

Fig. 2B

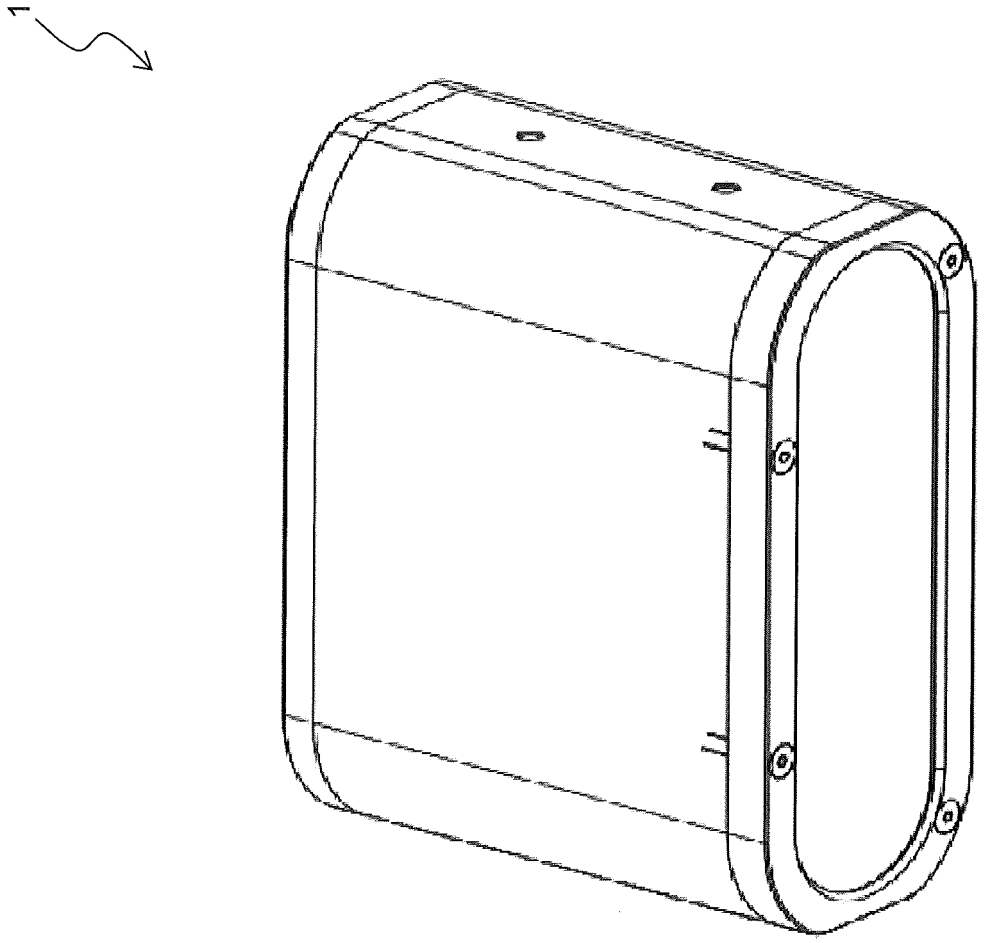

Fig. 2C

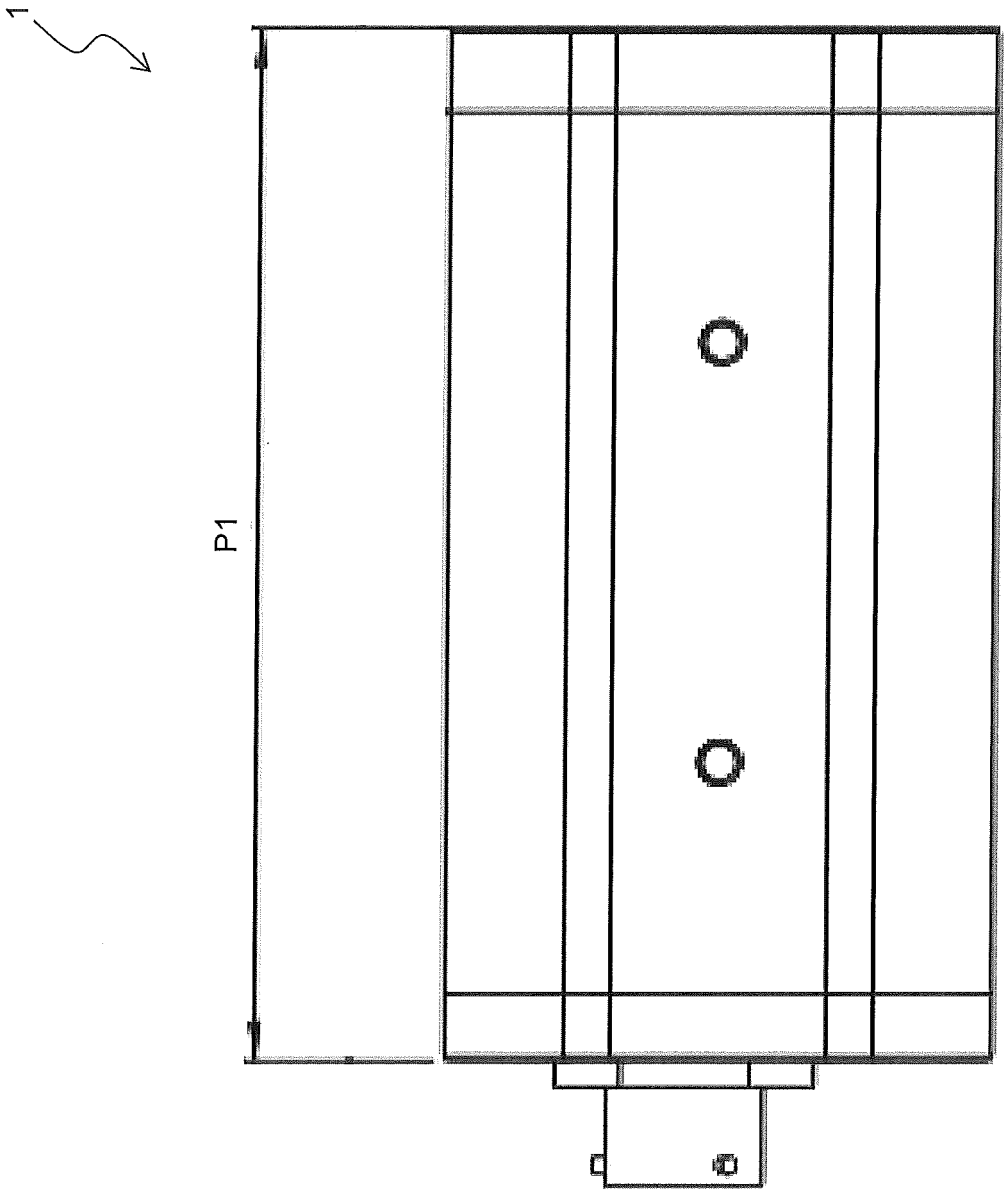

Fig. 2D

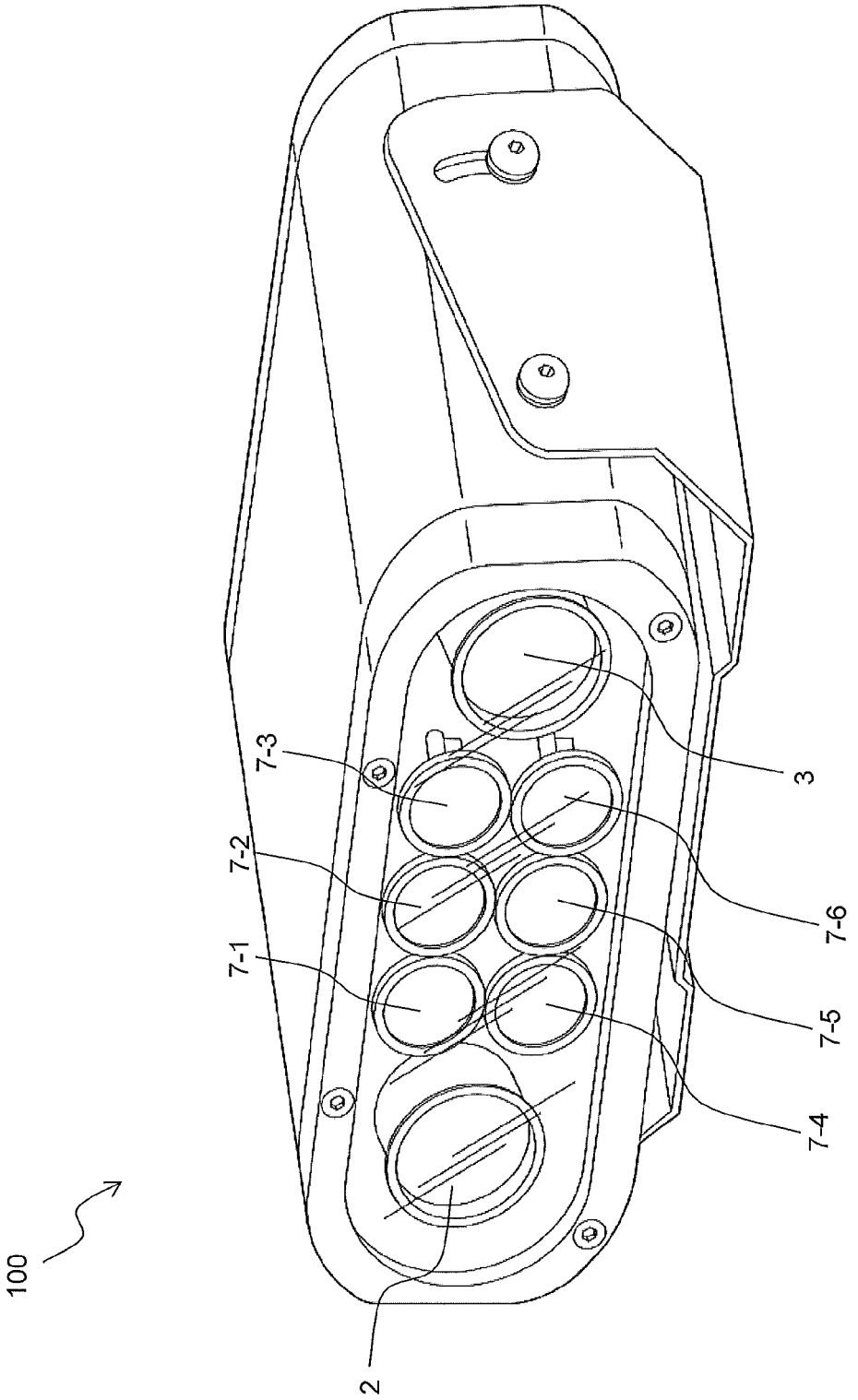

Fig. 3A

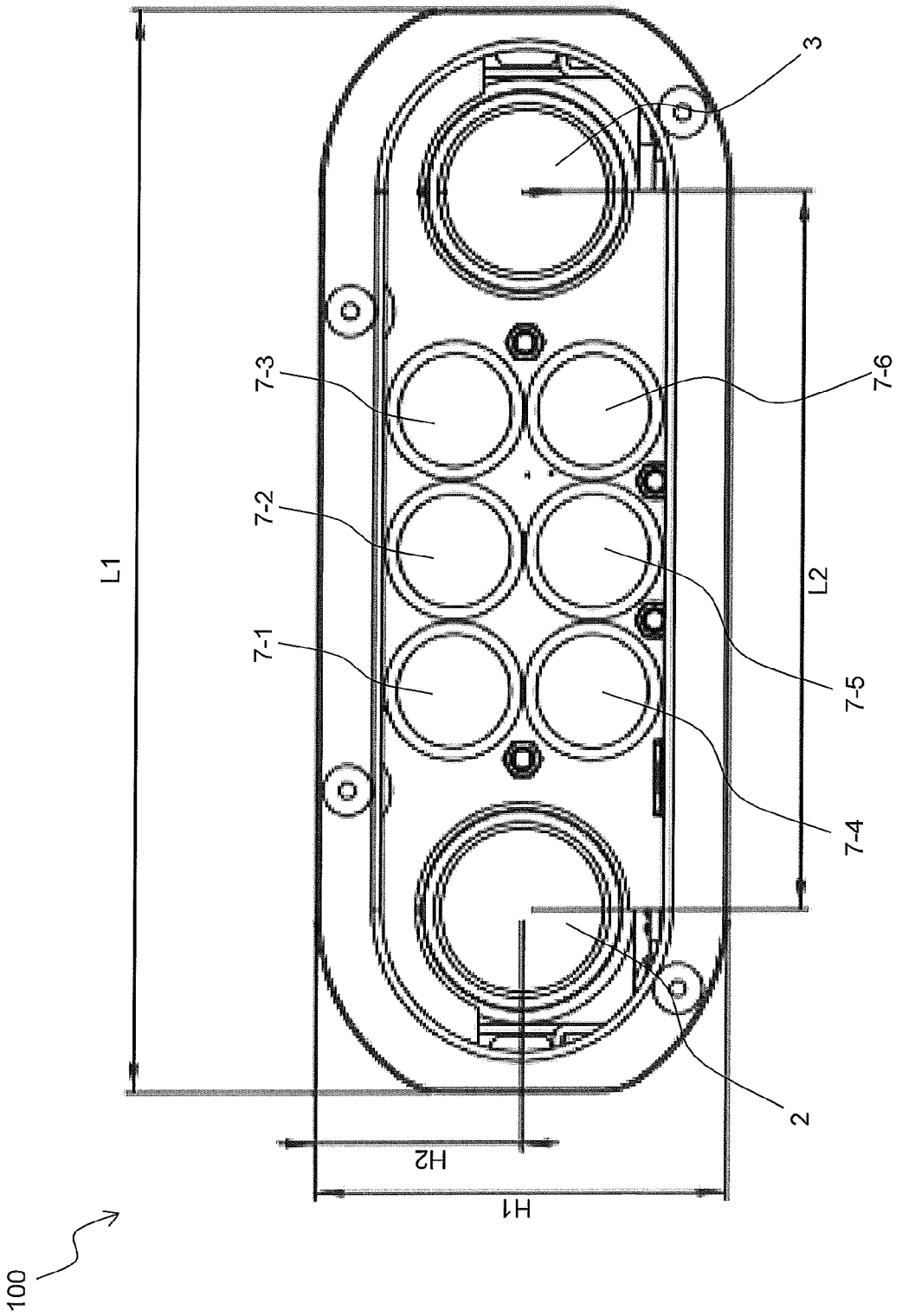

Fig. 3B

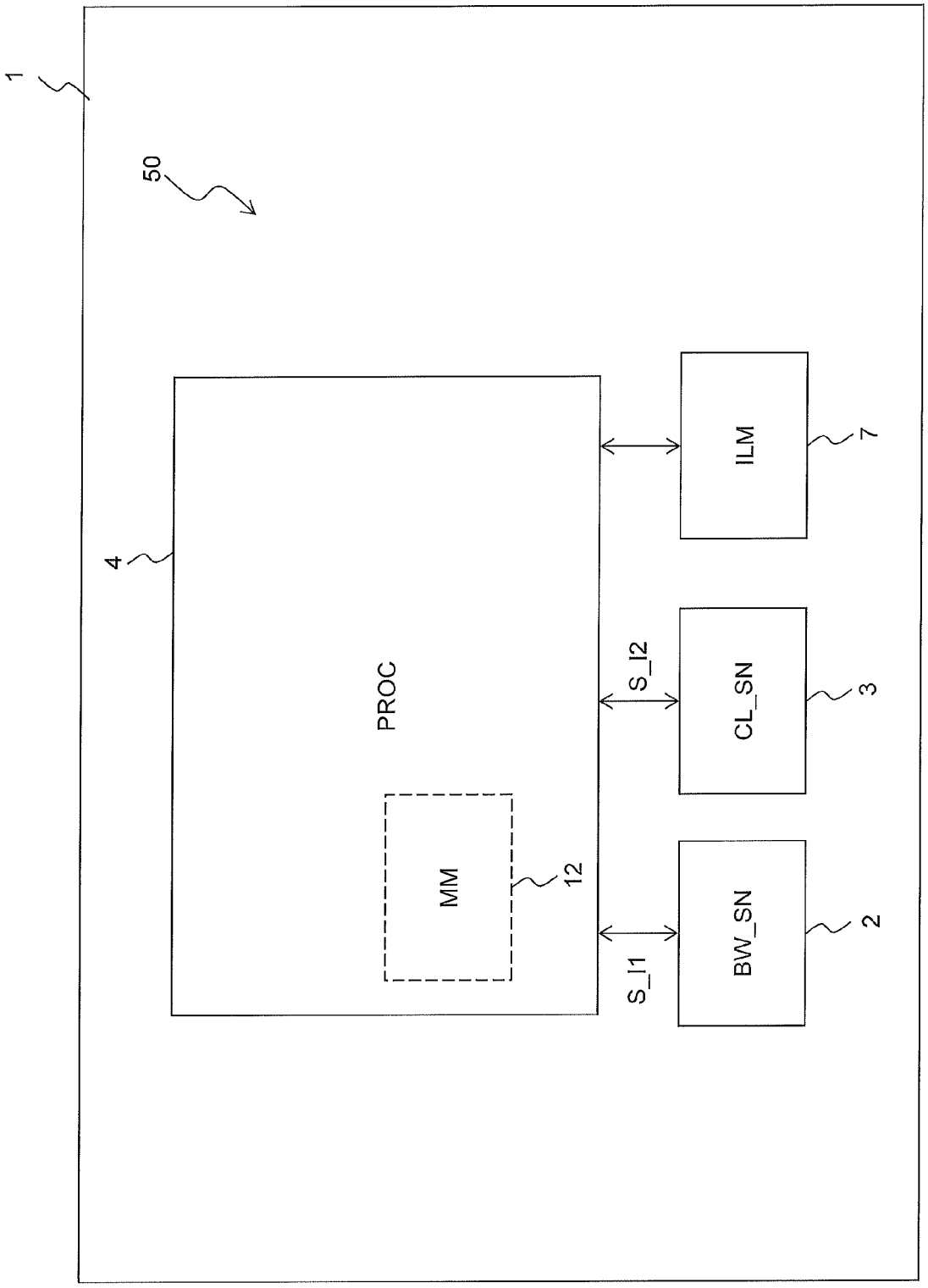

Fig. 4A

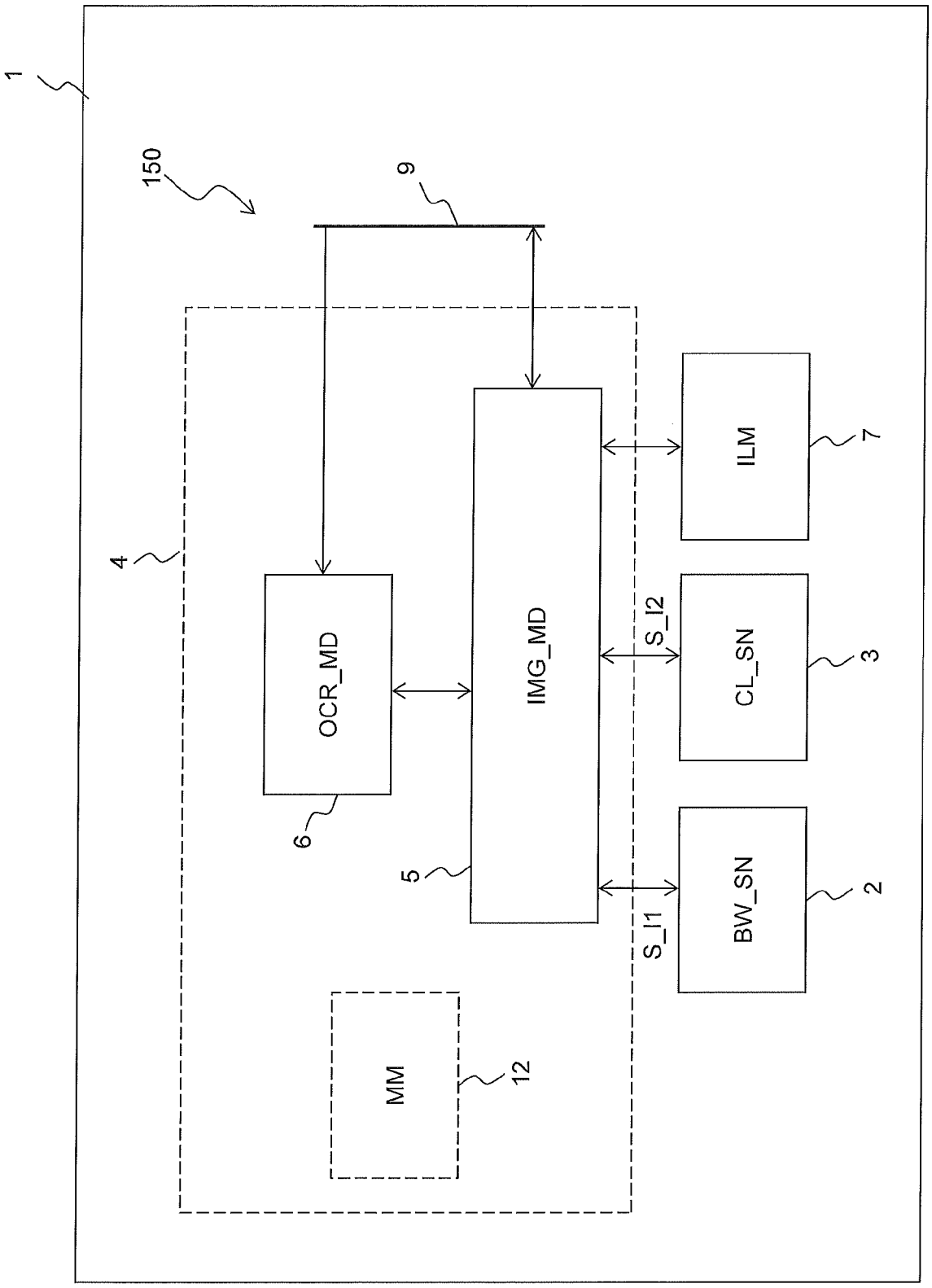

Fig. 4B

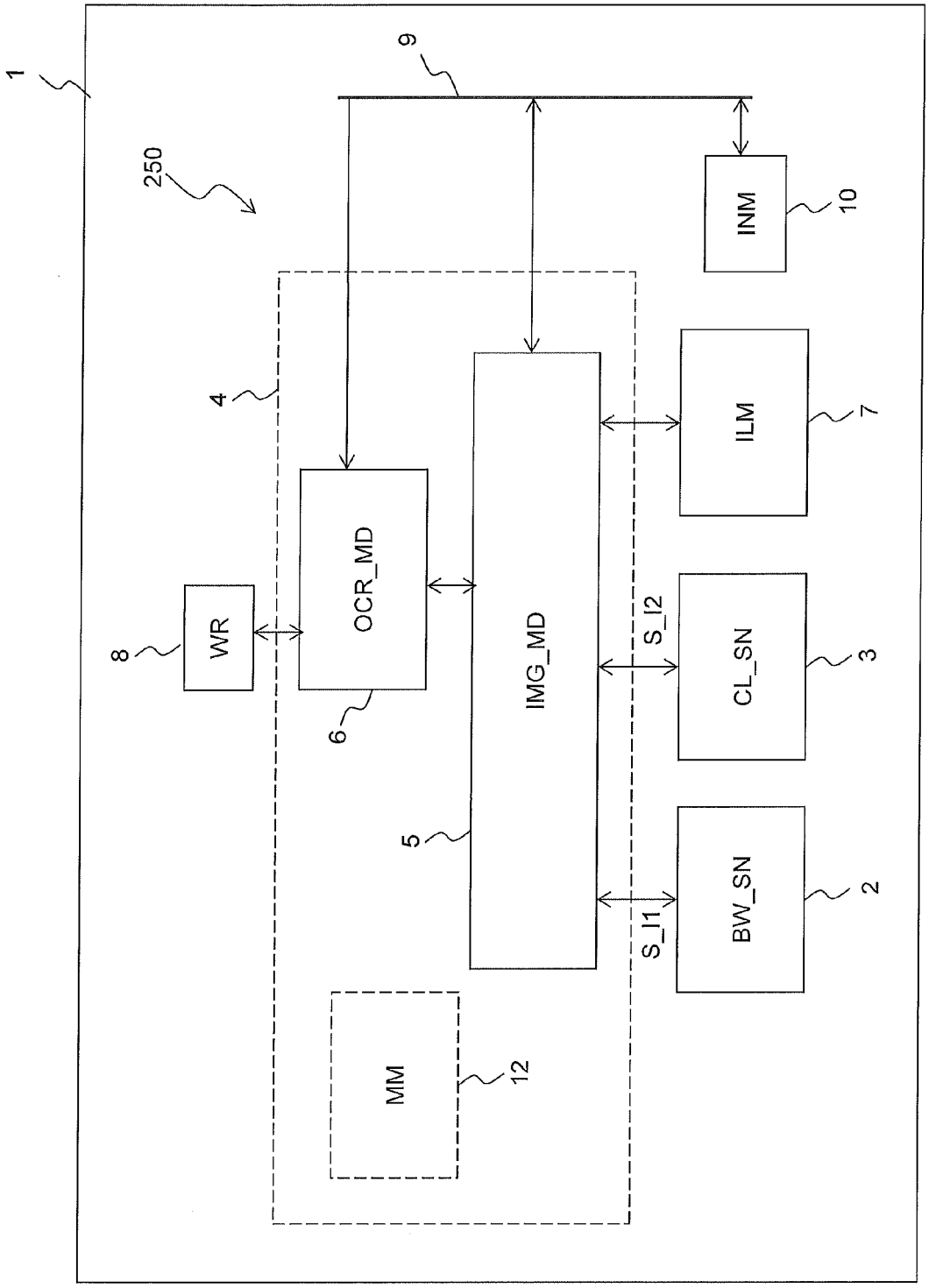
1
9
250
INM
10
4
ILM
7
OCR_MD
IMG_MD
S_I2
CL_SN
3
8
WR
6
5
S_I1
BW_SN
2
MM
12

Fig. 4C

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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT

	Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
3	X	US 7 504 965 B1 (WINDOVER MARK EDWARD [US] ET AL) 17 March 2009 (2009-03-17) * column 6, line 64 - column 8, line 60 *	1-15	INV. G08G1/04 G08G1/017
4	X	US 2007/085704 A1 (LONG WILLIAM E [US]) 19 April 2007 (2007-04-19) * the whole document *	1-15	
4	A	US 2002/145664 A1 (JONES JOSEPH [US]) 10 October 2002 (2002-10-10) * figures 1,2 *	1-15	
3	A	US 2012/280836 A1 (ROESNER BRUCE B [US]) 8 November 2012 (2012-11-08) * paragraphs [0016] - [0021] *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

G08G

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 October 2014	Créchet, Patrick

CATEGORY OF CITED DOCUMENTS

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14-10-2014

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US 2002145664 A1	10-10-2002	NONE	
US 2012280836 A1	08-11-2012	NONE	

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- US 2007085704 A **[0007]**