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(54) EQUIPMENT FOR DETECTING PRESENCE OF A MOTOR VEHICLE ON A TRAFFIC AREA

(57) An equipment (VPDE) is a general-use prefabricated multinode sensor ribbon (MNSR), which is fabricated as a flexible stripwise printed circuit board (PCB), which is tightly enclosed by an insulating sheath (IS) and on which sensor nodes (SN) spaced from each other at equidistant internodal spacing ins, which is about equally large as a half width of the narrowest anticipated motor vehicle. The sensor ribbon (MNSR) is installed simply and rapidly and can be done by non-qualified staff.

In the special embodiment of the equipment of the invention, physical reasons for an upper limit of the length of a serial communications bus advantageously set no upper limit to the length of the installed sensor ribbon; therefore, all monitored spaces, even on a vast traffic area, can be covered by one single sensor ribbon.

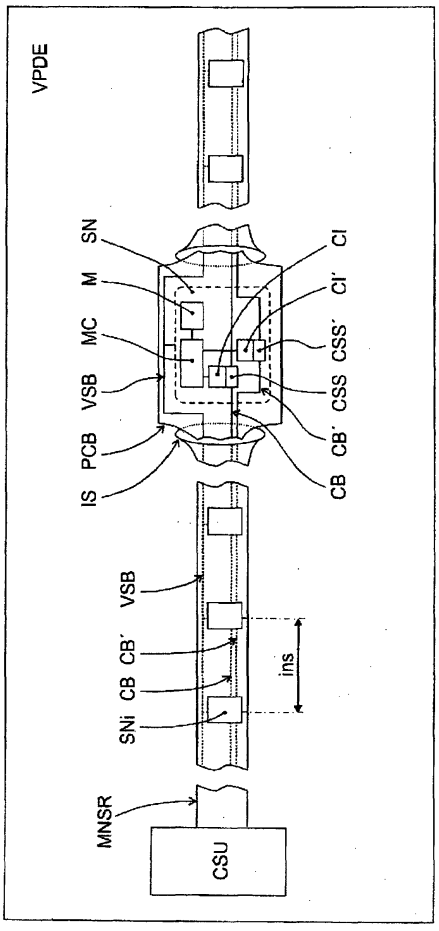

Fig.1

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Description

[0001] The invention concerns an equipment for detecting presence of a motor vehicle on a traffic area comprising a control and supply unit and a multinode sensor cable connected thereto and comprising, besides a voltage supply bus and a serial communications bus, also sensor nodes each of which comprises a magnetometer, a microcontroller controlling said magnetometer and gathering data on measured magnetic field density on a location of said magnetometer when a motor vehicle is set thereabove, as well as a communication interface connecting said microcontroller with the serial communications bus.

[0002] A magnetometer detector detecting motor vehicles is known (US 5,491,475). A plurality of magnetometers fixed to a cable and arranged at premeasured distances is placed in a lane of a roadway. Each magnetometer is mounted on a small printed wiring board provided with a signal-conditioning and data-communication electronics as well as in a sealed way attached to the cable, which conducts the lane traffic information to a handhole and further to a controller. Processed outputs pass a modem and are transferred to a remote control-data station. Fabrication of a special cable equipment for each situation and its installation are expensive. Said costs must be reduced. Additionally, a failure of any component causes said equipment to fail.

[0003] An apparatus for contactless detection of vehicles comprises an evaluation module, a power supply module, and a string consisting of a plurality of sensor nodes and connected to said modules (US2014/0021947 A1). The modules are arranged in a distribution box. The sensor nodes comprise a magnetometer, a microcontroller as well as a communication interface and are connected to adjacent sensor nodes by means of a cable comprising a voltage supplying bus and one serial communications bus. The disclosure mainly deals with several advantageous but not necessarily reasonable sensor nodes configuration along said string to be adapted to existing parking places: the sensor nodes within a sensor nodes group are arranged at equidistant spaces, yet two adjacent sensor nodes belonging to the adjacent sensor nodes groups are spaced in a different way; also a space from the first sensor node in the string to the distribution box is different, moreover a plurality of segments of the sensor nodes string in a star-shaped or tree-shaped form is suggested, wherein the segments may comprise only one magnetometer. The plurality of said sensor nodes configurations results in a time consuming and expensive fabrication and installation of the sensor nodes string. Installation of such strings needs to be performed by qualified staff.

[0004] The technical problem to be solved by the present invention is to fabricate an equipment for detecting presence of a motor vehicle on a traffic area in the form of a prefabricated universal equipment, which will be suitable for a rapid and simple installation at optionally arranged monitored spaces of a traffic area, in a special embodiment also for monitored spaces on a very vast traffic area.

[0005] Said technical problem is solved by the equipment of the invention for detecting presence of a motor vehicle on a traffic area, wherein its preferred embodiment is characterized by the features of the first claim, and its special embodiment is additionally characterized by the features of the second claim. Other dependent claims characterize the variants of both embodiments.

[0006] Fabrication of a sensor ribbon of the equipment of the invention intended for detecting presence of a motor vehicle on a traffic area is uncomplicated as the sensor ribbon

[0007] Fabrication of a sensor ribbon of the equipment of the invention intended for detecting presence of a motor vehicle on a traffic area is uncomplicated as the sensor ribbon does not need to be matched to each disposition of monitored spaces, in which the presence of a motor vehicle should be detected. Such sensor ribbon can be used universally irrespective of the disposition of the monitored spaces. It is fabricated in several variants differing from each other in an internodal spacing.

[0008] The sensor ribbon of the equipment of the invention is installed in a simple way and substantially more rapidly since there is no need to deal with positioning sensor nodes with respect to borderlines of the monitored spaces, this means that positions of the sensor nodes do not need to be marked in advance. Installation may be performed by non-qualified staff.

[0009] The equipment redundancy is advantageously provided at the installation of the equipment of the invention at the very laying of the sensor ribbon since, in any monitored space, at least two sensor nodes detect the presence of a motor vehicle; if any of them fails the equipment of the invention continues to operate. Maintenance costs of the installed equipment of the invention are considerably reduced. Due to high uniform linear density of the sensor nodes the price is only slightly increased.

[0010] In the special embodiment of the equipment of the invention, physical reasons for an upper limit of the length of a serial communications bus advantageously set no upper limit to the length of the installed sensor ribbon; therefore, all monitored spaces, even on a vast traffic area, can be covered by one single sensor ribbon.

[0011] The equipment according to said special embodiment of the invention is more fail-safe, too. If separate segments in one serial communications bus get interrupted the data flow bypasses said segments through the other serial communications bus and the equipment of the invention operates properly. Only the interruption of both serial communications buses between two adjacent sensor nodes negatively impacts the operation of the equipment.

[0012] The invention will now be explained in more detail by way of a description of a preferred embodiment and of a special embodiment of the equipment of the invention for detecting presence of a motor vehicle on a

traffic area and with reference to the accompanying drawing representing in

Fig. 1 the equipment of the invention schematically with an exploded view of a stripped section of a multinode sensor ribbon in the region around a sensor node,

Figs. 2a and 2b an installation of the equipment of the invention provided with the multinode sensor ribbon in the traffic area region intended for parking motor vehicles side by side and behind one another, respectively, and

Fig. 3 in the special embodiment of the equipment of the invention two adjacent sensor nodes together with a voltage supply bus, a serial communications bus and an additional scrial communications bus.

[0013] An equipment VPDE detecting presence of a motor vehicle on a traffic area in a known way comprises a control and supply unit CSU and a multinode sensor cable connected thereto (Fig. 1). In a known way, the multinode sensor cable comprises a voltage supply bus VSB, a serial communications bus CB, and sensor nodes SN.

[0014] Each sensor node SN in a known way comprises a magnetometer M, a microcontroller MC that controls said magnetometer M and gathers data on a variation in the magnetic field density due to a the motor vehicle approaching the magnetometer M, and a communication interface CI. The communication interface CI connects said microcontroller MC with the serial communications bus CB.

[0015] According to the invention, the sensor nodes SN along the entire multinode sensor cable are advantageously equidistantly spaced from each other for an identically selected internodal spacing ins (Figs. 1 and 2a). The selected internodal spacing ins between the sensor node SNi and the one or the other adjacent sensor node is about equally large as a half width of a narrowest anticipated motor vehicle; therefore a parked motor vehicle is detected by at least two sensor nodes SN. The selected internodal spacing ins can also be somewhat shorter or longer depending on the realization.

[0016] According to the invention, the equipment VPDE for detecting presence of a motor vehicle on the traffic area logically identifies consecutive stationary states by means of signals generated by all magnetometers M. Said stationary states are established by consecutively setting only one motor vehicle into one selected monitored space of the traffic area. Said signals are the signals generated by all magnetometers M being close to said motor vehicle upon the establishment of each of these stationary states, said magnetometers M detecting a variation in earth magnetic field density due to a motor vehicle approaching them.

[0017] The equipment VPDE of the invention now assigns a label for each selected monitored space to the corresponding consecutive stationary state, which label is communicated to the equipment VPDE by means of an external communications link.

[0018] The equipment VPDE of the invention is set in a way that either the sensor nodes SN send measured values to the control and supply unit CSU, which decides on the presence of a motor vehicle in the monitored spaces, or the sensor nodes SN alone decide on the presence of a motor vehicle in the monitored spaces and they communicate their decisions to the control and supply unit CSU.

[0019] The equipment VPDE of the invention is advantageously fabricated with a general-use prefabricated multinode sensor ribbon MNSR as the multinode sensor cable. A central portion of the general-use prefabricated multinode sensor ribbon MNSR is advantageously fabricated as a flexible stripwise printed circuit board PCB, whereon the voltage supply bus VSB, the serial communications bus CB and the sensor nodes SN spaced from each other at equidistant internodal spacing ins are fabricated.

[0020] The flexible stripwise printed circuit board PCB is made from an endless flexible stripwise printed circuit board, and is tightly enclosed by an insulating sheath IS in a way that outer transverse dimensions of the multinode sensor ribbon MNSR are barely 1 to 3 millimetres times 5 to 20 millimetres. The insulating sheath IS can be in the form of a tube, too.

[0021] The equipment VPDE of the invention advantageously uses a three-axis magnetoresistive sensor as the magnetometer M. The magnetoresistive sensor is suitable due to its low price, low energy consumption and a size of merely several square millimetres.

[0022] The preferred embodiment of the equipment VPDE of the invention for detecting the presence of a motor vehicle on the traffic area in the scope of the above description is represented in Figure 1, whereas the entire Figure 1 in fact represents a special embodiment of the equipment VPDE of the invention.

[0023] The special embodiment of the equipment VPDE of the invention along with the serial communications bus CB advantageously also comprises at least one additional serial communications bus CB' and within each sensor node SN along with the communication interface CI also comprises at least one additional communication interface CI' as well as controlled semiconductor switches CSS, CSS'.

[0024] The controlled semiconductor switches CSS and CSS' connect the microcontroller MC with the serial communications bus CB and the additional serial communications bus CB', respectively.

[0025] One of those controlled semiconductor switches is connected in a way that said disconnecting the controlled switch breaks the serial communications bus in two segments; a second controlled switch is connected

in a way that said connecting the controlled switch connects communication interface with a first segment of the serial communications bus; a third controlled switch is connected in a way that said connecting the controlled switch connects communication interface with a second segment of the serial communications bus.

[0026] The controlled semiconductor switches CSS and CSS' are assumed to be set in a way that each of said two serial communications buses CB and CB', respectively, is closed and the communication interfaces CI and CI', respectively, of the sensor node SN are disconnected from the serial communications buses CB and CB', respectively.

[0027] In the event of failure of the microcontroller MC, the semiconductor switches CSS and CSS' are set in the assumed position and the non-functioning sensor node SN is disconnected from the serial communications bus CB and CB', respectively.

[0028] The controlled semiconductor switches CSS and CSS' enable the sensor node SN to break the serial communications bus CB and CB', respectively, and to connect its communication interface CI and CI', respectively, to the uninterrupted serial communications bus CB and CB', respectively, or to one of said two segments of the interrupted serial communications bus CB and CB', respectively.

[0029] The microcontroller MC may break one of the serial communications buses CB, CB', to which it is connected, in two segments. In this way, it is connected to one of the segments of the interrupted serial communications bus CB, CB'. In this case, it passes data between the segment of the serial communications bus, to which it is connected, and the other segment of the serial communications bus, thus preserving the data flux through the entire multinode sensor ribbon MNSR.

[0030] Segmentation of the serial communications bus into several segments guarantees that a particular segment does not exceed the largest physically admissible length of the serial communications bus as well as the largest number of the sensor nodes connected to the selected type of the serial communications bus. Segmentation of the serial communications bus does not limit the data flux since it is redirected to the other serial communications bus.

[0031] When individual segments of one serial communications bus break, the data flux bypasses said segments through the other serial communications bus and the equipment of the invention functions properly. Only an interruption of both serial communications buses between two adjacent sensor nodes SN negatively impacts the operation of the equipment VPDE of the invention, which in this special embodiment is more fail-safe.

[0032] The multinode sensor ribbon MNSR of the equipment of the invention is laid over the entire traffic area from the control and supply unit CSU up to the last monitored space of the traffic area along the shortest connecting path such that it runs roughly through the middle of each monitored space - *e.g.* intended for parking motor vehicles side by side (Fig. 2a) and behind one another (Fig. 2b) - of the monitored traffic area and it is secured to the traffic area covering; an upper surface of the multinode sensor ribbon MNSR is protected. The sensor ribbon may be installed by non-qualified staff since the path selection is not too demanding. Namely, due to high linear density of the sensor nodes SN within the multinode sensor ribbon MNSR no special laying configurations within an individual monitored space are needed.

[0033] The laid multinode sensor ribbon MNSR is either inserted into a groove cut into the traffic area and cast with a suitable protective mass or simply secured to the traffic area covering.

Claims

1. An equipment (VPDE) for detecting presence of a motor vehicle on a traffic area comprising
a control and supply unit (CSU) and
a multinode sensor cable
connected thereto and comprising
a voltage supply bus (VSB), a serial communications bus (CB) and sensor nodes (SN) wherein any of said sensor nodes (SN) comprises
a magnetometer (M),
a microcontroller (MC),
which controls said magnetometer (M) and gathers data on the magnetic field density measured when a motor vehicle is set in its vicinity, and
a communication interface (CI) connecting said microcontroller (MC) with the serial communications bus (CB),
characterized in
that the sensor nodes (SN) along the entire multinode sensor cable are equidistantly spaced at identical internodal spacing (ins),
which is about equally large as a half width of the narrowest motor vehicle detected, and that the equipment (VPDE) for detecting presence of a motor vehicle on the traffic area logically identifies consecutive stationary states,
which stationary states are established by consecutively each time setting one single motor vehicle into one of monitored spaces of the traffic area,
by means of signals,
which, after setting said motor vehicle into any selected monitored space and hereby establishing the selected stationary state, are generated by all magnetometers (M) detecting said motor vehicle,
and the equipment (VPDE) for detecting presence of a motor vehicle on the traffic area assigns a label selected for said selected monitored space to said selected stationary state,
which label is communicated to the equipment (VPDE) by means of an external link.

2. The equipment (VPDE) as recited in claim 1, **characterized in**
that the multinode sensor cable along with the serial communications bus (CB) also comprises at least one additional serial communications bus (CB') and each sensor node (SN) along with the communication interface (CI) also comprises at least one additional communication interface (CI') as well as
controlled semiconductor switches (CSS, CSS')
controlled by the microcontroller (MC) and
connecting said microcontroller (MC) with the serial communications bus (CB) and the additional serial communications bus (CB'), respectively.

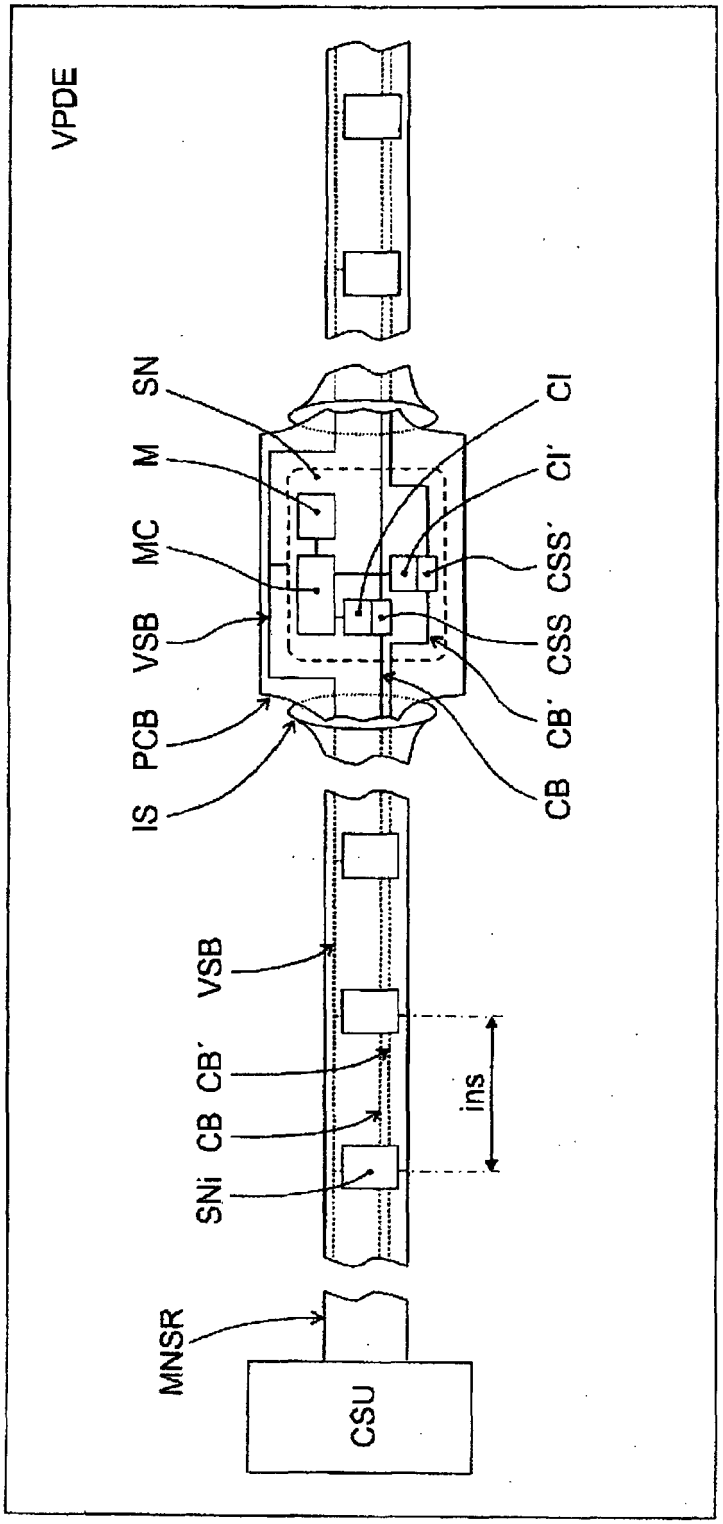
3. The equipment (VPDE) as recited in claim 1 or 2, **characterized in**
that the multinode sensor cable is embodied as a general-use prefabricated multinode sensor ribbon (MNSR),
which is a flexible stripwise printed circuit board (PCB) enclosed by an insulating sheath (IS).

4. The equipment (VPDE) as recited in claim 3, **characterized in**
that the magnetometer (M) is a three-axis magnetoresistive sensor.

5. The equipment (VPDE) as recited in claim 4, **characterized in**
that the multinode sensor ribbon (MNSR) is laid over the entire traffic area along the shortest connecting path such that it runs roughly through the middle of each monitored space of the monitored traffic area and is secured to a traffic area covering.

6. The equipment (VPDE) as recited in claim 5, **characterized in**
that the multinode sensor ribbon (MNSR) is secured to the traffic area covering by inserting it into a groove cut into the traffic area covering and cast with a protective mass.

7. The equipment (VPDE) as recited in claim 5, **characterized in**
that the multinode sensor ribbon (MNSR) is secured to a surface of the traffic area covering and an upper surface of the multinode sensor ribbon (MNSR) is protected.


VPDE
SN
M
MC
VSB
PCB
IS
CI
CI'
CSS'
CSS
CB'
CB
VSB
CB'
CB
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ins
MNSR
CSU

Fig.1

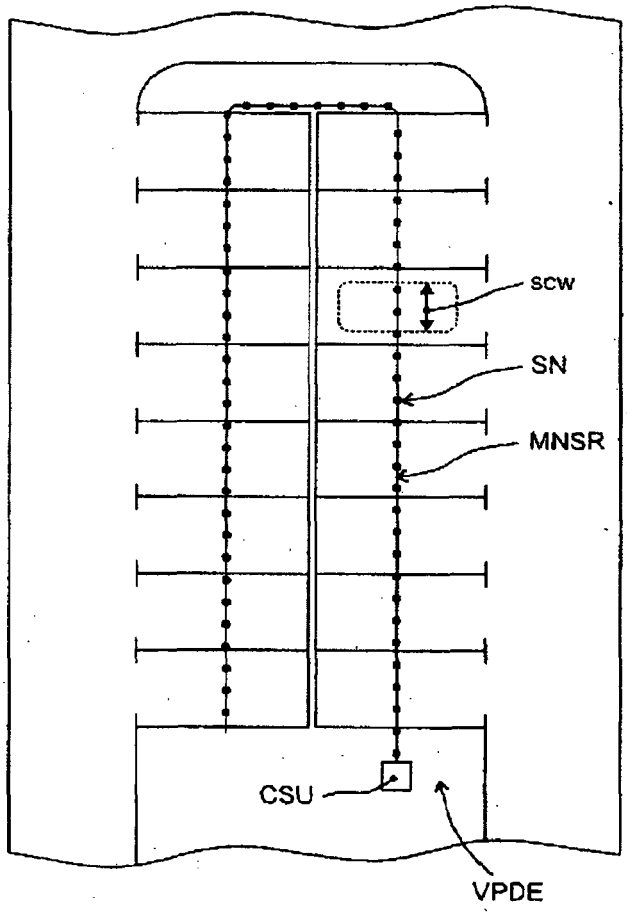

Fig.2a

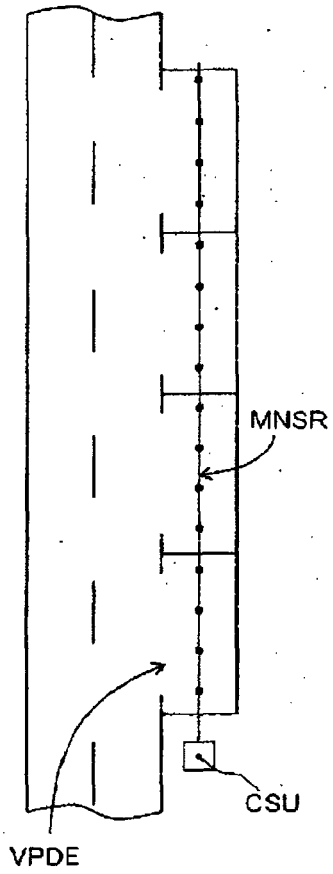

Fig.2b

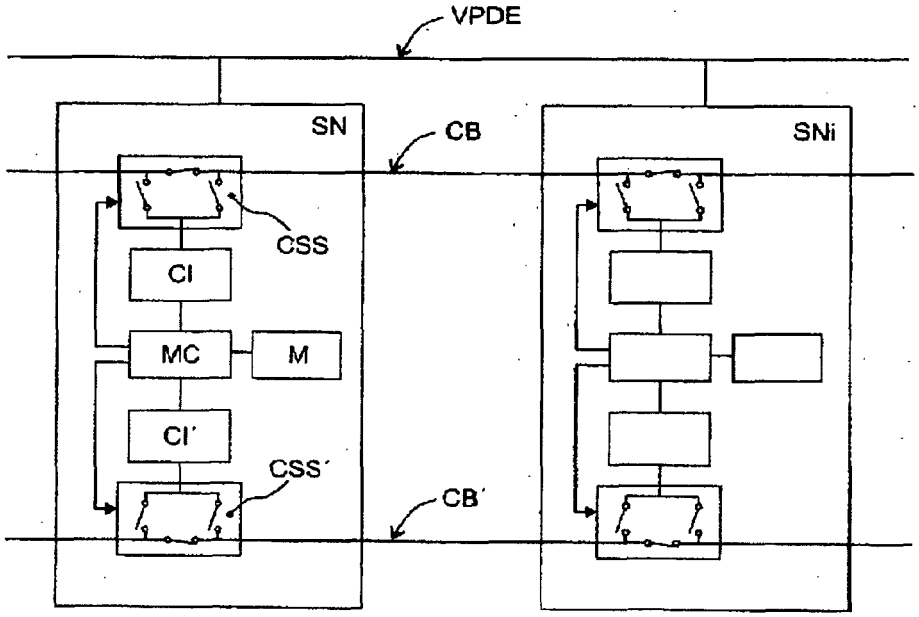

Fig.3

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EUROPEAN SEARCH REPORT

Application Number
EP 17 00 0517

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2009/144029 A1 (MEAS DEUTSCHLAND GMBH [DE]; PIEPER REINHOLD [DE]; BROWN RICHARD HUNTER) 3 December 2009 (2009-12-03) * abstract * * page 4, line 22 - page 10, line 7 * * figures 4, 5, 6b, 7 * -----	1-7	INV. G08G1/042
X	US 5 471 139 A (ZADOFF LEON N [US]) 28 November 1995 (1995-11-28) * abstract * * column 5, line 58 - column 8, line 64 * * figures 3, 6, 7 * -----	1-7	

TECHNICAL FIELDS SEARCHED (IPC)

G08G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 August 2017	Van den Bosch, I

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 00 0517

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30-08-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2009144029 A1	03-12-2009	EP 2128837 A1	02-12-2009
		WO 2009144029 A1	03-12-2009
US 5471139 A	28-11-1995	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5491475 A **[0002]**
- US 20140021947 A1 **[0003]**