

(19)



(11)

**EP 3 518 208 A1**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**31.07.2019 Bulletin 2019/31**

(51) Int Cl.:  
**G08G 1/0967<sup>(2006.01)</sup> G08G 1/16<sup>(2006.01)</sup>**

(21) Application number: **19000042.2**

(22) Date of filing: **25.01.2019**

(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**  
 Designated Validation States:  
**KH MA MD TN**

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(30) Priority: **29.01.2018 IT 201800002118**

(54) **VEHICLE-TO-VEHICLE COMMUNICATION APPARATUS**

(57) Vehicle-to-vehicle communication apparatus installable on a vehicle comprising an electronic processing unit (1) including a microprocessor, a user interface capable of interacting with one or more persons on board the vehicle, a search and identification module (2) by radio of similar devices on board neighbouring vehicles, a communication module (3) with similar apparatus, wherein said apparatus is identified with the licence plate

number of the vehicle on which it is installed, wherein this search and identification module (2) is a radio-frequency module and allows one to find apparatus of the same type in neighbouring vehicles, identifying them with their licence plate number, this communication module (3) being a module able to communicate with the apparatus thus identified.



*Fig. 2*

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## Description

**[0001]** This invention relates to a vehicle-to-vehicle communication apparatus.

**[0002]** In particular, this invention relates to an apparatus that allows audio and data communication between the drivers of two vehicles.

**[0003]** Communication is an important activity in everyday life and among all individuals. The progress of digital technology has allowed very efficient and reliable communication between people and things. In general, communication has increased, in every sector, especially in the industrial and "automotive", wellbeing, comfort and above all safety sectors.

**[0004]** Technology currently allows vehicles to "talk" to each other for the purpose of avoiding accidents by detecting position and speed. The US Department of Transportation (DOT) and the National Highway Traffic Safety Administration (NHTSA) have announced the release of the new V2V (Vehicle-to-Vehicle) technology, a vehicle-to-vehicle communication technology for "light" vehicles, such as cars, SUVs, pick-ups and motorcycles.

**[0005]** This technology, like others introduced in Europe, can help for the majority of multi-vehicle accidents. V2V communication is able to provide the driver with all the data necessary to evaluate a potential accident situation. According to the NHTSA, the blanket introduction of systems with which cars "talk" to each other and communicate their mutual position could save more than a thousand lives a year.

**[0006]** Similarly to this system, in order to improve mobility on the roads, the European Commission has adopted the ITS action plan that will provide new active safety measures to further improve the existing passive safety systems that prevent or mitigate road accidents. Since it is necessary to reduce energy consumption, polluting emissions and road traffic, new forward-looking and sustainable driving measures are needed. The CAR 2 CAR communication consortium (C2C-CC) defines "cooperative ITS" as a network of systems in which communication partners (vehicles, traffic infrastructure and service providers) exchange information as a basis for a new level of traffic safety and to improve efficiency.

**[0007]** Intelligent Transport Systems (ITS) comprise a set of tools for managing transport networks, as well as services for travellers. ITS tools are based on three central aspects: information acquisition, processing and dissemination, the lowest common denominator of which is integration.

**[0008]** The processes of data acquisition, processing and integration of the same and the information chain to be supplied to the users of the transport system are at the heart of ITS systems.

**[0009]** These systems are fundamental in the ability to offer:

- real-time information on the current traffic conditions for a road or motorway network.

- online information for planning a trip;
- a tool that allows the authorities, operators and individual travellers to have better information, more coordinated and thus make "smart" decisions.

**[0010]** All the systems adopted so far aim at road safety and deal with direct data communication between vehicles and vehicles or between vehicles and a centralised base unit almost in real time, indirectly informing the driver.

**[0011]** None of these systems provides direct voice communication between a vehicle driver and another vehicle passing close by. The applicant has perceived that the use of a unique identification element of a vehicle, such as its licence plate, can be advantageously used to establish communication between the vehicles themselves and, in particular, between their drivers.

**[0012]** Therefore, the apparatus according to this invention, exploits the currently available technology in order to be able to put two drivers in vocal communication using only vehicle licence plates as identification tool.

**[0013]** With this system it will be possible for each driver to be informed about potential dangers, identify the risks in time and be able to warn other users to avoid the most common accidents (for example, in case of crashes, dangerous intersections, etc ...).

**[0014]** In assistance to the proposed system, the new Bluetooth RF technology and the consolidated GSM/4G technology, allow the realisation and the diffusion of the apparatus.

**[0015]** This invention relates to an apparatus for communication between vehicles having the characteristics of claim 1.

**[0016]** Further characteristics of the communication apparatus between vehicles according to the present invention are given in the dependent claims. The characteristics and the advantages of the apparatus according to this invention will be clearer and more evident from the following illustrative and non-limiting description of an embodiment made with reference to the following Figures:

- Figure 1 represents a block diagram of the device according to this invention;
- Figure 2 illustrates communication between three vehicles provided with the apparatus according to this invention;
- Figure 3 shows the user interface of the device in a touch-screen version;
- Figure 4 illustrates a possible connection scheme of the apparatus according to this invention to a vehicle;
- Figure 5 illustrates an embodiment of the apparatus in which a smartphone is used to implement the user interface, the search and identification module and the communication module.

**[0017]** With reference to the aforementioned Figures, the apparatus according to this invention can be installed

on board a vehicle, for example, in the vicinity of the dashboard-steering zone. Appropriately configured, it allows audio, data or SMS communication with a similar device present on another vehicle.

**[0018]** This apparatus essentially comprises an electronic processing unit 1 equipped with a microprocessor (CPU), a user interface for interacting with one or more persons on board the vehicle, a module 2 for searching and radio identification of apparatuses of the same type present on board neighbouring vehicles, a communication module 3 with devices of the same type.

**[0019]** According to this invention, this apparatus is identified by the licence plate number of the vehicle on which it is installed and said identification and search module 2 is a radio-frequency module which allows one to find apparatuses of the same type in neighbouring vehicles, identifying them with their number plate, while said communication module 3 is a module able to communicate with the apparatuses thus identified.

**[0020]** It is therefore possible through the search and identification module 2 to establish a radio frequency communication with the other devices, in order to obtain all the information necessary to start the actual audio communication through the communication module 3.

**[0021]** For the purposes of this invention, interface user means that set of devices, connected to the processing unit 1, which allow the user on board the vehicle to receive information from the apparatus or supply the same to the apparatus itself.

**[0022]** This interface includes, for example, a pushbutton group between which there may be an on/off button of the apparatus 4, a start button for recording 5, a pause button for recording 6 and a button to end recording 7 which allows one to record voice messages to be sent via said communication module 3.

**[0023]** There may also be buttons relating to telephone calls always to be made via this communication module, such as, for example, an incoming call accept button and call forwarding button 8, an incoming call reject button and a conversation interruption button 9. Furthermore, a configuration button 10 of the apparatus may be provided.

**[0024]** This user interface can also include an alphanumeric keypad 11 and a graphic display 12. All the elements of the user interface can also be provided by a touch-screen, such as, for example, that of a tablet or smartphone.

**[0025]** This user interface can still include a plurality of signalling LEDs for the user, for example a green LED 13 to turn on the device, a red LED 14 to signal a failed call, a blue LED 15 to signal calls to special vehicles, a red LED 16 to report that a recording is in progress.

**[0026]** In case the user interface is a touch-screen, these LEDs can be replaced by specially lit areas of the screen, as shown in Figure 3.

**[0027]** Finally, the apparatus comprises a microphone 17 and a loudspeaker 18 for managing messages and voice calls.

**[0028]** The communication module, preferably a GSM/4G module or equivalent, takes care of the audio communication on the GSM network or on the current 3G or 4G networks, which are at present the most widespread mobile telephone standards in the world. The main service of the GSM network is clearly voice communication. The GSM module communicates with the processing unit to receive the activation commands of the audio channel as well as the commands to send and receive text messages. The GSM module is designed to receive and house a SIM card 19 and includes an antenna calibrated on the GSM/4G frequencies. The apparatus is also advantageously arranged to receive the housing suitable for the most common SIM formats available on the market.

**[0029]** The search and identification module 2 is an RF (radiofrequency) module that allows connection between the two vehicles.

**[0030]** Preferably this module is of the Bluetooth type, but, in an equivalent way, other RF data transmission modules such as, for example, ZigBee, UWB, WI-FI, or other similar ones can be used. In the present embodiment of the invention, such a Bluetooth module has been exhibited and described since, in telecommunications, it is a technical-industrial data transmission standard for wireless networks which is becoming more widespread, being a standardised, economic and safe way to exchange information between different devices through a secure short-range radio frequency.

**[0031]** Bluetooth technology, especially the low-power Bluetooth technology called BLE, is a low-power universal wireless standard that simplifies the connection of any product to a smartphone or tablet. Bluetooth version 5.0 (latest version on the market) is promoting the evolution of Bluetooth low energy from personal area networks to ever wider networks, for example, in the automotive and industrial sectors.

**[0032]** Indeed, said Bluetooth technology allows the construction of types of meshed data networks in which multiple devices communicate with each other as a cooperative network consisting of a large number of nodes acting as receivers, transmitters and repeaters, which makes the size and the area covered by the network almost unlimited.

**[0033]** As with all wireless transmissions, the range and accessibility to most Bluetooth "advertising" depends on the transmitter's power class and the range of the receiving equipment. However, with advances in mobile device technology, the distance to proper reception is increasing up to 250 metres or more in smartphones, tablets and today's other mobile devices.

**[0034]** The apparatus, according to this invention, advantageously comprises a memory module 20, further to that already present in the microprocessor. Thanks to this module, it is possible to record the audio communication in progress in files. Said memory module 20 and, moreover, interfaced with the processing unit 1 which controls it through a serial connection. Other types of

non-volatile memory and other types of media (HD, Ribbons, Optical Disc, etc.) can be used to achieve the same purpose.

**[0035]** Finally, the apparatus comprises an interaction module 21 with the vehicle and, in particular, a module that allows data communication between it and the vehicle control unit. This connection is used to initially configure the car number (licence) plate and other data, thus avoiding a manual setting by the vehicle driver. The device, therefore, to be operational and functional, must be configured before use through the user interface and the configuration consists of writing in the flash memory 20 of the corresponding data relating to the vehicle, the licence plate number and the telephone number of the SIM card 19 associated with it.

**[0036]** Once the configuration button 10 has been pressed (Figure 1), the microprocessor will start a screen prepared for the introduction of the above data on the display. The vehicle data (as will be named the number plate, the telephone number and the type of vehicle hereinafter) will be inserted in memory as a lookup table generating a correspondence between the number (licence) plate and the telephone number (SIM device) associated with other information relating to the vehicle on which the apparatus is installed, according to this invention.

**[0037]** Following the introduction of data (licence plate and telephone number and other data), the device is ready to be operational. By pressing the ON/OFF button 4, the CPU unit 1 is powered, thus allowing the integrated software to manage the various modules. Initially, the CPU unit 1 reads from the memory 20 the data of the vehicle and communicates it to the Bluetooth module 2, connected via UART or SPI, so that the latter is able to insert them in the advertising message. The advertising message (coded) entered into the air by the Bluetooth module 2 will then be of the type:

Adv[.....] = < Manufacturer's data > + < Vehicle data >  
 Adv[.....] = < Manufacturer's data > + < Telephone number > + < Licence plate number > + < Vehicle type >

**[0038]** In this way, the vehicle data will be present 'on air' and in broadcasting, encoded in a message, available for other Bluetooth modules of the network (same manufacturer and in the area of a few hundred metres).

**[0039]** The driver of the vehicle is thus able to select, from the list proposed on touch-screen, the chosen number plate (or to enter it in the appropriate box or via alphanumeric keypad, if present) and start by button 8 the call which, if accepted by the interlocutor, allows audio communication. Once the number plate has been selected (or entered) by the call forwarding button 8, the driver can request an audio connection with the driver of the chosen vehicle. In this case, the CPU 1 activates the GSM module (also connected with a UART or SPI channel), sending it the appropriate call commands knowing (always via associated table) the relative telephone

number of the future interlocutor. The CPU of the called device (called vehicle) will see an incoming call coming from the GSM module. Thanks also to the Licence Plate Number - Telephone Number correspondence, the CPU 1 will be able to present the calling plate number to the driver's display and issue a sound, via loudspeaker 18, for call waiting. Pressing the call accept button 8 causes the CPU 1 to send all the necessary commands to the GSM module to open the required communication channel. In this way, via GSM or 4G, the two drivers can talk and start a telephone audio discussion.

**[0040]** At the same time, the CPU 1 sends commands to the Bluetooth module 2 so that a data communication channel is also opened between the corresponding Bluetooth modules. In this way, there will be an audio communication channel open on the GSM network and a data communication channel open between the two Bluetooth modules that can also send digital commands and/or additional information such as 'start recording in progress' or 'stop recording'.

**[0041]** In automatic mode or, if the recording start button 5 is pressed, the CPU 1, thanks to the connected AD and DA channels relative to the input audio amplifiers 25 and output 24, can record the conversation on the flash memory 20. The recording can be paused by pressing button 6 or interrupted definitively by pressing stop button 7.

**[0042]** Both drivers are aware of the recording in progress through the signalling by the CPU 1 of the lighting up of the relative red LED 16. The sending of commands such as, for example, the activation or the interruption of recording, can occur through advertising messages on the Bluetooth channel or via the previously opened direct data connection.

**[0043]** In an alternative embodiment, the scheme of Figure 1 can be implemented and realised using a smartphone and a docking station or support base, with internal hardware modules communicating with the mobile phone through the USB port of which they are generally provided. In this way, data and commands can be transferred from the CPU 1 to a specially developed application, for example, in an Android or IOS environment.

**[0044]** In practice, in this embodiment of the apparatus, a smartphone is used to realise the user interface, the search and identification module and the communication module. The control of these modules is done through a special App that will talk with the CPU 1 module always present but on the docking station. The CPU 1, therefore, instead of managing the various modules, will assign the task to the App through commands.

**[0045]** According to a further variant, the communication module can be an additional Bluetooth module instead of GSM.

**[0046]** Bluetooth modules were also born for data and audio communication. They are widely used to obtain wireless systems between smartphones and headphones. In this case, for example, the two Bluetooth modules have different specifications: one of them (tele-

phone) acts as Exchange (sending data) and the other (headphones) as Peripheral (data arrival).

**[0047]** In this case, the audio channel is unidirectional, from Exchange to Peripheral and not vice versa. To obtain two-way audio communication, it is possible to introduce into the device two Bluetooth modules, one incoming module and one outgoing module, instead of one module. The same two-way audio communication may, finally, be achieved through new generation Bluetooth modules that can act as Exchange and Peripheral.

**[0048]** The apparatus is powered by supply module 23 which, preferably, is connected to the vehicle battery 26 (Figure 1).

**[0049]** All the modules described above, the loudspeaker, the microphone and the user interface are controlled by the CPU 1 microprocessor processing unit.

### Claims

1. Vehicle-to-vehicle communication apparatus installable on a vehicle comprising an electronic processing unit (1) including a microprocessor, a user interface capable of interacting with one or more persons on board the vehicle, a search and identification module (2) by radio of similar devices on board neighbouring vehicles, a communication module (3) with similar apparatus, **characterized in that** said apparatus is identified with the licence plate number of the vehicle on which it is installed, wherein this search and identification module (2) is a radio-frequency module and allows one to find apparatus of the same type in neighbouring vehicles, identifying them with their licence plate number, this communication module (3) being a module able to communicate with the apparatus thus identified.
2. Apparatus according to claim 1, wherein said search and identification module (2) is a Bluetooth module or other communication standard operating in radiofrequency such as ZigBee, UWB, Wi-Fi, or similar.
3. Apparatus according to claim 1, wherein said communication module (3) is a GSM/4G module or equivalent.
4. Apparatus according to claim 1, wherein said communication module is an additional Bluetooth module.
5. Apparatus according to claim 1, wherein said user interface comprises buttons (4, 5, 6, 7, 8, 9, 10), signalling LEDs (13, 14, 15, 16), an alphanumeric keypad (11), a graphic display (12).
6. Apparatus according to claim 1, wherein said user interface is a touch-screen display.
7. Apparatus according to claim 1, further comprising a microphone (17) and a loudspeaker (18) for managing voice messages and communications.
8. Apparatus according to claim 1, wherein the user interface, the search and identification module (2) and the communication module (3) are implemented by a smartphone.
9. Apparatus according to claim 8, comprising a docking station, connected to said smartphone, wherein there are the processing unit (1), the power supply module (23) and a further search and identification module (2).
10. Apparatus according to claim 1, comprising a discrete memory module (20) in addition to the memory already present in the microprocessor.
11. Apparatus according to claim 1, comprising an interaction module (21) with the vehicle and, in particular, a module that allows data communication between it and the vehicle control unit.

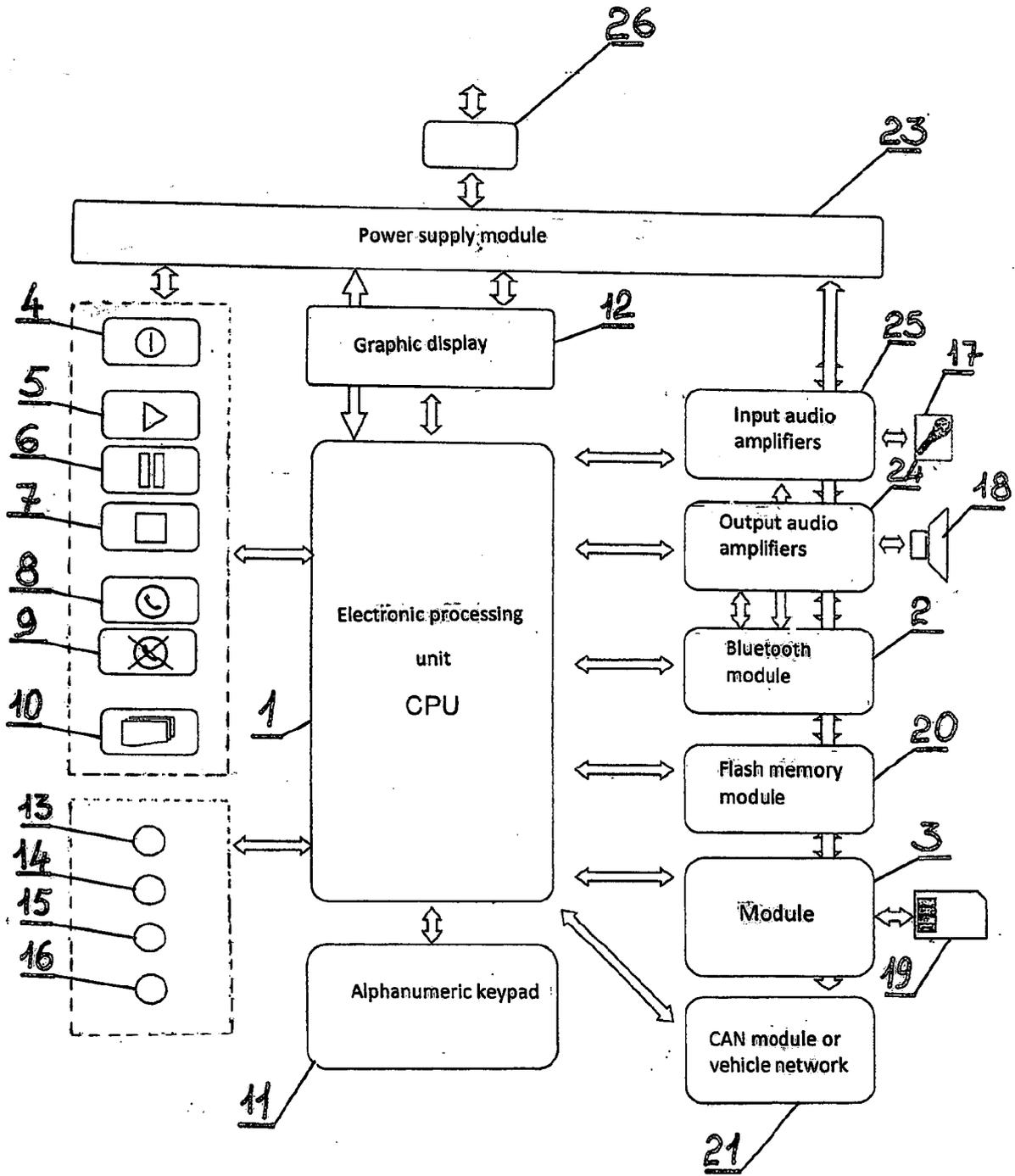
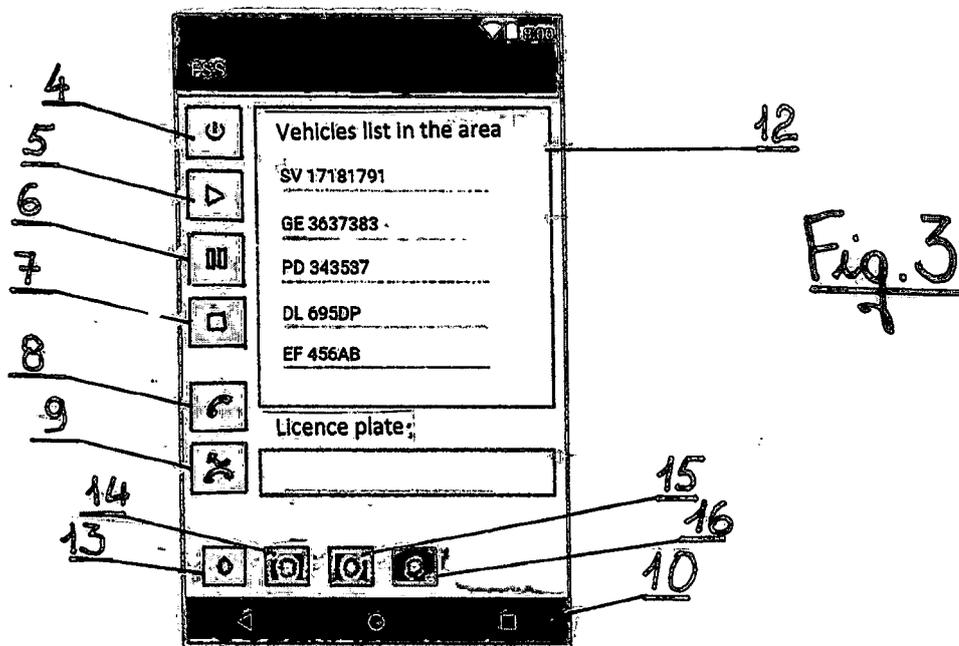
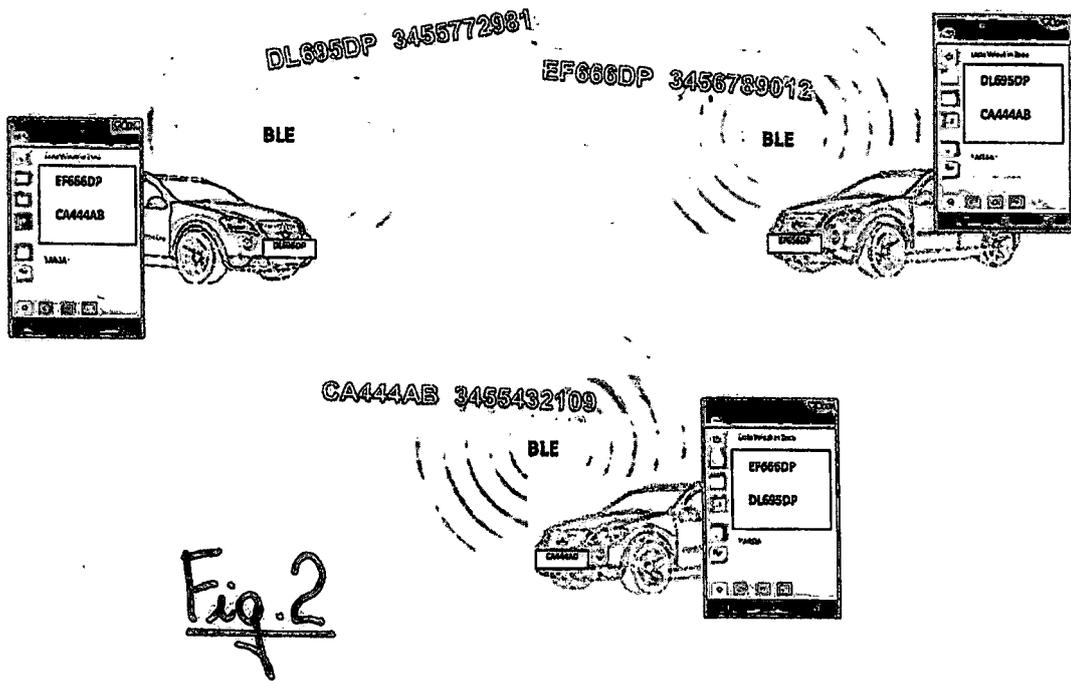


Fig. 1



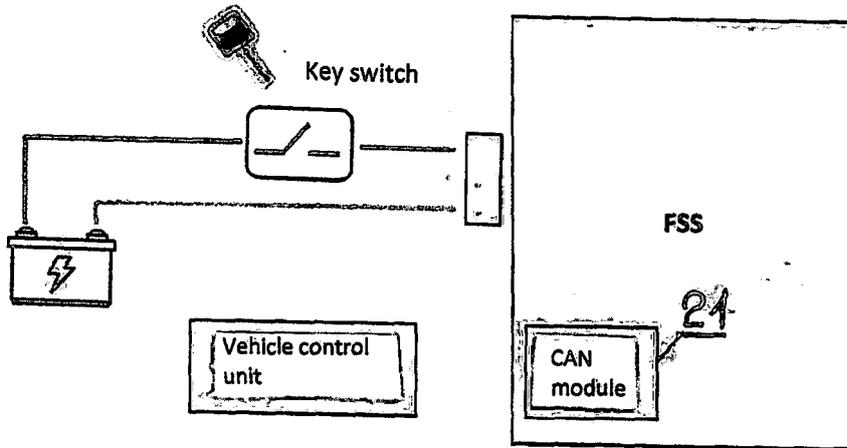


Fig. 4

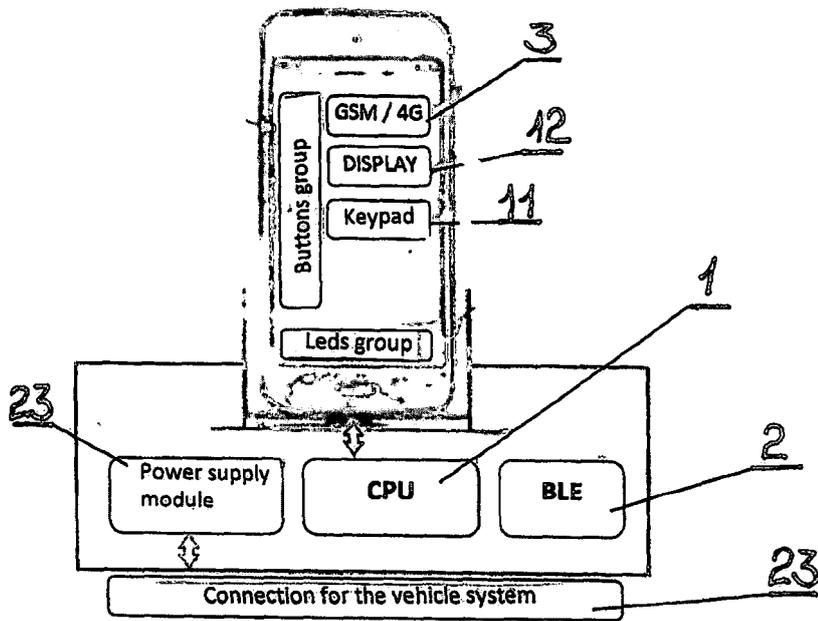


Fig. 5



EUROPEAN SEARCH REPORT

Application Number  
EP 19 00 0042

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The present search report has been drawn up for all claims			
Place of search <b>The Hague</b>		Date of completion of the search <b>18 June 2019</b>	Examiner <b>Malagoli, M</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date 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 (P04/C01)

ANNEX TO THE EUROPEAN SEARCH REPORT  
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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