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(71) Applicants:
- **Manco, Andrea**
  19123 LA Spezia (IT)
- **Dapozzo, Nicola**
  19123 LA Spezia (IT)

(72) Inventors:
- **Manco, Andrea**
  19123 LA Spezia (IT)
- **Dapozzo, Nicola**
  19123 LA Spezia (IT)

(74) Representative: **Piovesana, Paolo**
Via F. Baracca, 5/a
30173 Venezia-Mestre (IT)

(54) DEVICE FOR ALERTING ON THE APPROACHING OF EMERGENCY VEHICLES

(57) A device for alerting on the approaching of emergency vehicles (4, 5), characterized in that it comprises:
- means for detecting (8) acoustic signals (10) generated by an emergency vehicle and present outside and/or inside the vehicle (6), wherein said device (2) is intended to be installed, said detection means (8) comprise an omnidirectional acoustic sensor associated with means (40) for automatically adjusting the amplitude of the acoustic signals detected,
- a processing and analysis unit (12) configured to identify if there are acoustic signals (14) with characteristics similar to those of the acoustic signals emitted by said emergency vehicles (4, 5) among the acoustic signals (10) which were detected by said detection means (8) and which were adjusted in amplitude by said automatic adjustment means (40).
- signaling means (20) provided inside said vehicle (6) and which can be activated by said processing and analysis unit (12) upon the identification of said acoustic signals (14) emitted by said emergency vehicle (4, 5), among said acoustic signals detected (10), so as to alert the driver of said vehicle (6) on the presence and/or approaching of said emergency vehicle (4, 5).

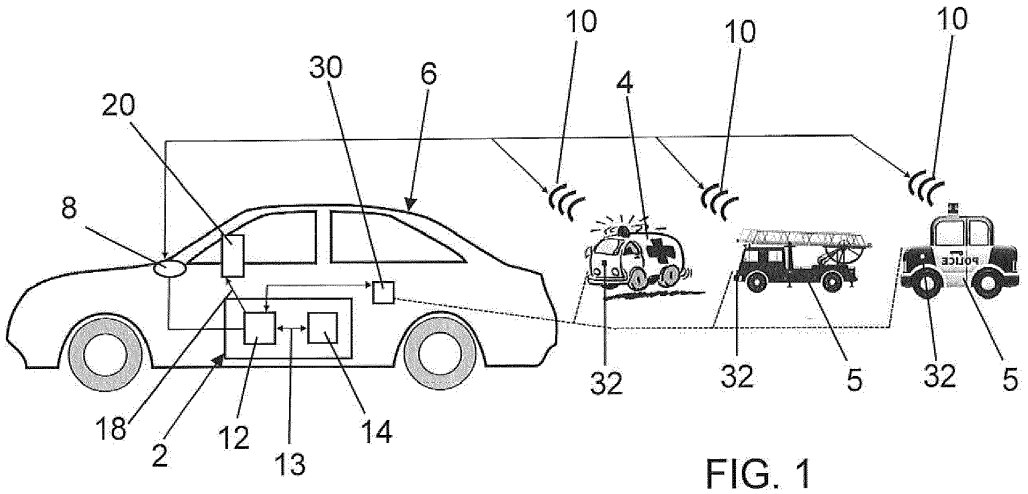

FIG. 1

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Description

[0001] The present invention relates to a device for alerting on the approaching of emergency vehicles.

[0002] In the current state, the approaching of emergency vehicles - both rescue vehicles such as an ambulance and public safety vehicles such as the fire brigade or law enforcement - is alerted by the activation of visual flashing light signals and acoustic signals, in particular a siren, which are both provided on the vehicles themselves.

[0003] However, it is easy to understand that these types of signaling are not always effective, especially in big cities characterized by chaotic and rather noisy traffic. Moreover, highly noisy conditions are also often created inside the vehicles, which are associated with the sound of the radio and/or the music player as well as with the voice of the navigation system, and which significantly deaden the acoustic signals emitted by the rescue and/or public safety vehicles.

[0004] It often occurs that the driver realizes the approaching of the emergency vehicle only when it is too close, and such a situation does not allow the driver to have a sufficient time and space to carry out the suitable maneuvers required in the specific circumstance.

[0005] DE 10 2010 022 165 includes detecting the presence of an emergency vehicle by means of a combined system which detects both the acoustic signal and the optical signal (flashing) emitted by the emergency vehicle itself. Such a combined system is rather complicated in terms of manufacturing, and furthermore is not completely satisfactory because the device does not operate properly in the absence of an optical signal (e.g. flashing signal damaged). Furthermore, it is worth noting that the optical signal of the flashing signal of the emergency vehicle is easily distorted by the inevitable reflecting surfaces present in the traffic context and this induces circumstances of failed or erroneous activation of the combined detection system of DE 10 2010 022 165. Furthermore, DE 10 2010 022 165 includes the use of a unidirectional microphone which captures sounds only in a precise and targeted direction and does not reveal how to assess and identify the type of emergency vehicle from the detection of the acoustic signals emitted therefrom.

[0006] US 2008/0150755 describes a system which uses a unidirectional microphone for detecting the acoustic signals of an emergency vehicle and, on the basis of the signal thus detected, determines the position, direction and speed of such an emergency vehicle with respect to said microphone. The information thus determined is then displayed on a dedicated display mounted inside the vehicle where the system itself is installed. The system of US 2008/0150755 is rather complicated to implement because it requires a dedicated display to be provided or installed inside the vehicle, and it also requires the presence of a specific software which maps the live position of the moving emergency vehicle on the display.

[0007] US 7061402 describes a system which, in order to alert on the presence or approaching of emergency vehicles, mainly uses a radio frequency transmission signal which may possibly be integrated with the detection of the acoustic signal emitted by said emergency vehicles. The system of US 7061402 is not completely satisfactory because it is rather complicated and costly to manufacture since it requires installing a unit for transmitting radio frequency signals in the emergency vehicles and a unit for receiving such signals in the other vehicles. Moreover, such a system also includes the use of a dedicated directional microphone, of a display and a software to display the live approaching position of the emergency vehicle.

[0008] It is the object of the invention to provide a device on board a vehicle for alerting on the approaching of rescue and/or public safety vehicles involved in an emergency intervention so as to capture and attract the attention of the driver of the vehicle, who will thus promptly carry out the suitable maneuvers in order not to hinder the passage of said rescue and/or public safety vehicles.

[0009] It is another object of the invention to manufacture a device which provides the driver of the vehicle with a plurality of alarm signals.

[0010] It is another object of the invention to provide a device capable of identifying the different types of emergency vehicles.

[0011] It is another object of the invention to provide a device which operates correctly even in the presence of two or more emergency vehicles, also of different type.

[0012] It is another object of the invention to provide a device which alerts on the approaching of an emergency vehicle even when the visual signals emitted by the latter are not functioning.

[0013] It is another object of the invention to provide a device which is easy to be installed and integrated within a traditional vehicle, whether this is a motor vehicle (cars, trucks, buses, etc.), a motorcycle (motorcycle, scooter, etc.) or even an emergency vehicle.

[0014] It is another object of the invention to provide a device which is simple to be used and recognizes the approach of the rescue and/or public safety vehicles operating in the various countries of the world in a clear, definite and completely automated manner.

[0015] It is another object of the invention to provide a device which has an alternative characterization with respect to traditional ones, both in construction and functional terms.

[0016] It is another object of the invention to propose a device which can be made in a simple and quick manner and with low costs.

[0017] These objects, both individually and in any combination thereof, and others which will become apparent from the description below are achieved, according to the invention, with a device with the characteristics indicated in claim 1.

[0018] The present invention is hereinbelow further clarified in certain preferred embodiments thereof, which

are described by mere way of non-limiting example, with reference to the accompanying drawings, in which:

Figure 1 diagrammatically shows the device according to the invention, and

Figure 2 shows the dashboard of a motor vehicle provided with a signaling device according to the invention, in activated condition,

Figure 3 diagrammatically shows the processing and analysis unit of the device according to the invention.

[0019] As shown in the figures, to alert on the approaching of emergency vehicles, that is of rescue 4 and/or public safety 5 vehicles, device 2 according to the invention is installed inside a vehicle 6 so as to attract the attention of the driver of the vehicle itself, and also of any passengers on board.

[0020] Hereinbelow, rescue vehicles 4 mean ambulances, medical cars, etc., while public safety vehicles 5 mean the vehicles of the fire brigade, police, customs, municipal police and generally of public safety.

[0021] Moreover, hereinbelow vehicle 6 means motor vehicles, trucks, buses, motorbikes, scooters, etc., and also an emergency vehicle.

[0022] The electronic device 2 comprises means for detecting 8 the characteristics, in particular in terms of frequency, of the acoustic signals 10 present outside and/or inside vehicle 6.

[0023] The acoustic signals 10 thus detected and acquired are sent to a processing and analysis unit 12 which is configured and programmed to filter and clean them so as to be able to then compare them with the reference acoustic signals 14, which correspond to those emitted by the rescue 4 and/or public safety 5 vehicles.

[0024] In particular, the processing unit 12 is configured to extract characteristic parameters from the acoustic signals detected 10 so as to make a comparison 13 of them with the characteristic parameters of the acoustic signals 14 emitted by the rescue 4 and/or public safety 5 vehicles, and stored beforehand in the unit itself.

[0025] In greater detail, the acoustic signals 14 emitted by the rescue vehicles 4 substantially have the following characteristic parameters:

- low-high frequency equal to about 392-660 Hz,
- duration of acoustic cycle 3 seconds,
- duration of low frequency 1 second,
- duration of high frequency 0.16 seconds,
- duration of pause less than or equal to 0.2 seconds.

[0026] In greater detail, the acoustic signals 14 emitted by the public safety vehicles 5 substantially have the following characteristic parameters:

- low-high frequency equal to about 466-622 Hz,
- duration of acoustic cycle 3 seconds,
- duration of low frequency 0.8 seconds,
- duration of high frequency 0.8 seconds,
- duration of pause less than or equal to 0.2 seconds.

[0027] The detection means 8 are acoustic sensors and conveniently comprise one or more omnidirectional microphones, that is microphones which have a uniform sensitivity for any origin direction of the acoustic signal 10.

[0028] Advantageously, the detection means 8 are associated with means 40 for automatically adapting the amplitude of the acoustic signal detected so as to keep constant the amplitude of the signal output therefrom while at the same time limiting the introduction of harmonic distortions. In particular, these means 40 are configured to keep constant the level of the signal to later be input into the processing and analysis unit 12 and comprise hardware means (also of the electro-mechanical type) and/or software means which implement an automatic control section of the volume or of the gain (also referred to as "Automatic Volume Control" or "Automatic Gain Control").

[0029] Preferably, the means 40 comprise an amplifier with dynamic compressor which advantageously allows the input signal to be compressed without distorting it. The use of the means 40 conveniently allows saturations to be avoided, thus allowing to operate with highly variable signals which also tend to become very strong, exactly as are the acoustic signals emitted by the emergency vehicles 4, 5. In other words, the broad variation in amplitude of the useful signal detected by the omnidirectional microphone 8 is thereby conveniently managed; indeed, when emitter emergency vehicles are very distant, the acoustic signal emitted is very weak and slightly higher than the background noise and therefore the means 40 act by amplifying the signal detected by the omnidirectional microphone 8; while, when emitter emergency vehicles are particularly close, the acoustic signal emitted is so strong that it could potentially be capable of saturating the dynamic capacities of the amplification circuit, and therefore the means 40 act on reducing the signal detected by the omnidirectional microphone 8.

[0030] The processing and analysis unit 12 comprises a processing section 42 for processing the acoustic signal 10 detected by the means 8 and a section 44 for analyzing the signal processed beforehand.

[0031] In particular, the processing section 42 comprises at least one digital signal processor (such as e.g. chip ADAU1452) receiving the acoustic signal 10 detected by the means 8 and conveniently stabilized by the means 40. Section 42 is configured to process such an acoustic signal 10 so as to provide the analysis section 44 with the information related to the active part and the pause step of the tones emitted by the sirens of the emergency vehicles 4 and 5.

[0032] The processing section 42 comprises at least two parallel and independent processing lines 45, one for each standard frequency of the rescue 4 or public safety 5 vehicles. Preferably, there are provided four

processing lines: two specific lines 45 for the acoustic signals emitted by the rescue vehicles at the frequencies of about 392 Hz and about 660 Hz, respectively, and two specific lines 45 for the acoustic signals emitted by the public safety vehicles at the frequencies of about 466 Hz and about 622 Hz.

[0033] In particular, the acoustic signal 10, which was detected by the means 8 and was conveniently stabilized by the means 40, enters each processing line 45 provided in section 42.

[0034] In greater detail, each processing line 45 comprises:

- a first module 46 configured to apply a band-pass filter on a specific frequency (e.g. 392 Hz, 660 Hz, 466 Hz and 622 Hz), thus eliminating the frequencies which are extraneous to such a specific frequency;
- a second module 48 configured to stabilize the amplitude of the cleaned signal from the preceding module 46 and to extract/reveal the envelope (that is the dynamic evolution of the volume for reproducing sound over time, an evolution which generally is obtained by means of the mode referred to as ADSR) and thus obtain raw information relative to the presence/absence of tones (which correspond to the intervals, or frequency ratios, between successive sounds) which are typical of the acoustic signals emitted by the emergency vehicles 4, 5;
- a third module 50 configured to square the signal from the envelope detector 48, thus standardizing the levels and transforming them into binary digital signals.

[0035] Obviously, it is understood that the pass-band of the frequencies of the band-pass filter of module 46 of each processing line 45 is different from that of the other lines. Preferably, the first module 46 comprises rather narrow band-pass filters with a high order and this allows only the frequencies which are typical of the sirens of emergency vehicles 4, 5 to be isolated, even in particularly noisy environments and/or in the presence of strong turbulence noise originating mainly from the fact that vehicle 6 may be moving.

[0036] Advantageously, at the first module 46, there is also a filtering of the harmonic frequencies of the base frequencies typical of the acoustic signals emitted by the emergency vehicles (preferably defined by the frequencies 392 Hz, 660 Hz, 466 Hz and 622 Hz). In particular, this allows the detection accuracy to be improved, also considering that device 2 generally operates in the presence of acoustic signals 10 with a wide spectrum, which often are difficult to be identified correctly due to the morphological structure of the surrounding environment.

[0037] The processing unit 12 is also conveniently configured to recognize the tones coming from relative moving sources (that is, emergency vehicles 4, 5) with respect to the detection means 8 associated with vehicle 6 where device 2 is installed, by calculating and compensating for the variation in tonality using the technique referred to as "Doppler Effect". Preferably, during acquisition, a window of about +/-10% is applied to the standard frequencies, corresponding to a theoretical relative speed of about +/-50Km/h (assuming a speed of propagation of sound in air of about 340 m/s). This is particularly advantageous considering that device 2 operates with acoustic signals of various intensity since transmitting and receiving vehicles are in relative movement, and the signal captured is not always of interest to the receiving device 2.

[0038] As mentioned, the analysis section 44 receives the information that section 42 has processed from the acoustic signal detected 10 and is configured to measure the duration and the alternation between the tones calculated by section 42 so as to identify the emitting emergency vehicle and promptly provide the subjects on board the vehicle 6 with the results of this identification.

[0039] Advantageously, the fact that the processing section 42 comprises several processing lines 45 which are independent from one another allows sufficient data to be sent in an optimal manner to the analysis module 44 which are sufficient to also identify any simultaneous presence of several emergency vehicles, even of different types, such as for example rescue vehicles 4 and public safety vehicles 5.

[0040] In particular, the analysis module 44 comprises:

- a module 52 which receives the data output from all the processing lines 45 of the first module 42 and which is configured to calculate the duration and the alternation of the digital signals created in module 50,
- a module 54 which implements comparison 13, and in particular is configured to compare the duration and alternation data calculated by module 52 with those stored in a table which contains the corresponding characteristic data of the acoustic signals 14 emitted by the rescue 4 and/or public safety 5 vehicles, so as to identify not only the presence but also the type of emergency vehicle which has emitted acoustic signal 10 detected.

[0041] The processing and analysis unit 12 is also configured to send an activation signal 18 to the signaling means 20 on board the vehicle 6 in the case of positive results of said comparison 13.

[0042] The analysis section 44 also conveniently comprises a module 56 which manages a graphic interface for displaying the results of comparison 13 made in module 54, the interface being preferably already provided in the vehicles 6 available on the market.

[0043] As mentioned, depending on the type of emergency vehicle identified from the acoustic signals emitted (that is, if they are of rescue 4 or of public safety 5 or of other type), the processing and analysis unit 12 conveniently activates different signaling means 20 which are on board the vehicle 6 so as to alert the driver of the latter if the vehicle approaching is a rescue and/or emergency

vehicle.

[0044] In particular, the signaling means 20 may be of visual type, such as e.g. a warning light (solid or flashing), an icon and/or a text displayed on dashboard 21, on the middle panel of the vehicle or in any case in a position easily seen by the driver. These signaling means 20 also conveniently comprise visual indicators which are projected onto the windshield of the vehicle.

[0045] Advantageously, the signaling means 20 may also be of the acoustic type so as to emit a particular acoustic signal 22 inside the passenger compartment of vehicle 6 which attracts the attention of the driver. In greater detail, this acoustic signal may consist for example of a voice command, such as e.g. "pay attention" or "rescue vehicles arriving", etc.

[0046] Advantageously, the signaling means 20 may also be of the tactile type. In greater detail, the processing and analysis unit 12 here may be connected to actuators (not depicted) which are mounted on the steering wheel 24 and/or in the driver's seat and which induce a slight vibration on the steering wheel and/or on the seat when the activation signal 18 emitted by the processing and analysis unit 12 is received.

[0047] The processing and analysis unit 12 may also be connected to the control station (installed inside vehicle 6 and not depicted), which controls the radio and/or a music player 23 and/or the voice of the navigation system and/or may interact with the mobile phone (an possibly its hands-free kit) connected via cable or via Bluetooth to the vehicle itself. Such a control station may be conveniently programmed so as to control the decrease in audio volume of them and/or the sending of an acoustic warning even during a phone conversation upon receiving the activation signal 18 emitted by the processing and analysis unit 12.

[0048] The processing and analysis unit 12 may also be connected to the control station of vehicle 6 or may form an integral part thereof, and be configured to induce the automatic and simultaneous switching on of all the direction indicators (the so-called "four flashers") of the vehicle itself in order to visually alert on an emergency circumstance even outside the vehicle 6 where device 2 is installed, and in particular in order to alert the other vehicles on such a situation.

[0049] Advantageously, the processing and analysis unit 12 may also be programmed to estimate the distance at which rescue 4 and/or public safety 5 vehicles are, their approaching speed as well as their time of arrival, on the basis of the acoustic signals detected 10. Therefore, on the basis of the values thus estimated, the processing and analysis unit 12 controls a different level of activation of the signaling means 20, a level which progressively increases as the emergency vehicles 4 and 5 approach.

[0050] In addition to the detection means 8 of the acoustic signals 10, device 2 may conveniently comprise proximity sensors and/or a receiver 30 of radio waves (at preset frequency having an encrypted data transmission) sent by suitable emitters 32 intended to be installed on the rescue 4 and/or emergency 5 vehicles. The signals transmitted by means of the radio waves are also sent to the processing and analysis unit 12 to control the activation inside vehicle 6 of one or more of the above-described signaling means 20.

[0051] Advantageously, the processing and analysis unit 12 may also be equipped with its own radio transmission means (not depicted) which are activated when the processing and analysis unit 12 identifies the acoustic signals 14 emitted by an emergency vehicle 4 or 5, among the acoustic signals 10 detected. The radio transmission means may also be conveniently activated when the traditional proximity or distance sensors, with which vehicle 6 is generally equipped, detect a contact, and therefore a collision of the vehicle itself. In greater detail, in case the presence or approach of an emergency vehicle is identified and/or in case of collision, the device 2 of vehicle 6 is configured to send, by means of the aforesaid radio transmission means, a suitable radio signal alerting the other vehicles which are following (e.g. within the radius of about 100 meters), and which in turn will send such a signal in a chain reaction. In case of collision, the radio signal transmitted may also be conveniently received by the emergency vehicle 4 or 5 which is approaching and may conveniently contain information related to the position of the vehicles involved in the accident.

[0052] Advantageously, device 2 may also be mounted and installed on board the vehicles 6 with rescue 4 and/or emergency 5 function with the same characteristics and modes described previously, and in particular may be connected to and/or integrated within the control station.

[0053] Essentially, device 2 according to the invention may be easily installed and integrated within any vehicle 6, such as a car, truck, bus, motorcycle, scooter, etc.

[0054] The processing and analysis modules implemented in unit 12 may also be conveniently loaded and executed on various types of hardware which are external to and independent from vehicle 6 and which are already normally available and widespread on the market, for example smartphones, tablets, phonepads, mobile navigation systems, etc. Preferably, device 2 according to the invention is capable of detecting acoustic signals emitted by emergency vehicles 4 and 5 at a distance of at least 100 meters and it was conveniently ascertained to this end that such a distance - especially in the city - is sufficient to ensure a suitable signaling and reaction by the driver of vehicle 6 where device 2 is installed.

[0055] It is apparent from above that the device according to the invention is particularly advantageous, because:

- by creating the signaling inside the vehicle itself, the probability is increased for the driver to promptly notice the presence and/or arrival of the rescue and/or public safety vehicles,
- it allows the safety level to be increased, since the

signaling modes attract the attention of the driver without inducing any disturbance during driving and without requiring the driver to perform any particular operation,

- it allows the driver to be alerted on the approaching of an emergency vehicle with suitable advance,
- it is easy to be installed and integrated within traditional vehicles.

[0056] In particular, unlike DE 10 2010 022 165, which describes the detection of an acoustic signal in order to alert only on the presence of an emergency vehicle, the device according to the invention is configured to detect an acoustic signal in order to specifically alert not only on the presence, but also and especially on the approaching of an emergency vehicle. Moreover, unlike DE 10 2010 022 165, which provides a detection which is always jointly acoustic and optical, the device according to the invention alerts on the approaching of emergency vehicles by only and directly picking up the frequency of the acoustic signal emitted by such vehicles, therefore without requiring or providing any type of optical detection. This is particularly advantageous since, according to the current regulations on the subject in various countries, the acoustic signal is the only signal which identifies with certainty an urgent request within a traffic context, also considering that the flashing optical signal of an emergency vehicle may be easily damaged or may be distorted by the reflective surfaces which are inevitably present within the traffic context.

[0057] Unlike US 2008/0150755 and US 7061402, the device according to the invention is also configured to identify the type of emergency vehicle approaching (that is, if it is a rescue or public safety vehicle) on the basis of the acoustic signals emitted by such vehicles and furthermore, does not necessarily include the presence of a dedicated display and software for the live display of the position and approaching speed of the emergency vehicle.

[0058] In particular, unlike DE 10 2010 022 165, US 2008/0150755 and US 7061402, the device according to the invention uses an omnidirectional acoustic sensor associated with means for automatically adjusting the amplitude of the acoustic signals detected. This allows the acoustic signals coming from any direction (without identifying the specific direction of origin of the signal) to be detected with uniform sensitivity, and highly variable acoustic signals which tend to become very strong (exactly as the acoustic signals emitted by the emergency vehicles) to be worked with simultaneously. In other words, the device according to the invention is an optimal solution in terms of simplicity and low manufacturing costs with respect to traditional devices because although it allows the presence and approaching of emergency vehicles to be conveniently identified within the traffic context, it does not require or need any laborious identification of the direction of origin thereof.

[0059] Furthermore, unlike the system described in EP 1953727, the device according to the invention is specifically provided with means for detecting acoustic signals generated by an emergency vehicle.

[0060] The present invention was disclosed and described in certain preferred embodiments thereof, but it is understood that manufacturing variants may practically be made thereto without departing from the scope of protection of the present patent for industrial invention.

Claims

1. A device for alerting on the approaching of emergency vehicles (4, 5), **characterized in that** it comprises:

   - means for detecting (8) acoustic signals (10) generated by an emergency vehicle and present outside and/or inside the vehicle (6), wherein said device (2) is intended to be installed, said detection means (8) comprise an omnidirectional acoustic sensor associated with means (40) for automatically adjusting the amplitude of the acoustic signals detected,
   - a processing and analysis unit (12) configured to identify if there are acoustic signals (14) with characteristics similar to those of the acoustic signals emitted by said emergency vehicles (4, 5) among the acoustic signals (10) which were detected by said detection means (8) and which were adjusted in amplitude by said automatic adjustment means (40).
   - signaling means (20) provided inside said vehicle (6) and which can be activated by said processing and analysis unit (12) upon the identification of said acoustic signals (14) emitted by said emergency vehicle (4, 5), among said acoustic signals detected (10), so as to alert the driver of said vehicle (6) on the presence and/or approaching of said emergency vehicle (4, 5).

2. A device according to claim 1, **characterized in that** said processing and analysis unit (12) is configured to filter the acoustic signals (10) detected and to extract therefrom characteristic parameters to be compared with the characteristic parameters of the acoustic signals (14) emitted by said emergency vehicles (4, 5), and stored beforehand in the unit itself.

3. A device according to one or more of the preceding claims, **characterized in that** said signaling means (20) include visual indicators already provided inside the vehicle (6) in a position easily seen by the driver, preferably at the dashboard (21) and/or the middle panel of the vehicle, and/or which are projected onto the windshield of the vehicle itself.

4. A device according to one or more of the preceding

claims, **characterized in that** said signaling means (20) comprise an apparatus for emitting acoustic warnings inside the vehicle (6), which are capable of attracting the attention of the driver of the vehicle (6).

5. A device according to one or more of the preceding claims, **characterized in that** said signaling means (20) comprise actuators which generate tactile type warnings, preferably on the steering wheel (24) and/or on the driver's seat of the vehicle (6).

6. A device according to one or more of the preceding claims, **characterized in that** said processing and analysis unit (12) is also configured so that, upon the identification of said acoustic signals (14) emitted by the emergency vehicle (4, 5), among said acoustic signals detected (10), it automatically controls the sending of an acoustic warning and/or the decreasing of the audio volume of the radio, the music player (23) and/or the voice of the navigation system and/or of a mobile phone which are provided or connected inside the vehicle (6) where said device (2) is intended to be installed.

7. A device according to one or more of the preceding claims, **characterized in that** said processing and analysis unit (12) is also configured so that, upon the identification of said acoustic signals (14) emitted by said emergency vehicles (4, 5), among said acoustic signals detected (10), it automatically and simultaneously controls the turning on of all direction indicators of the vehicle itself in order to visually alert on an emergency circumstance even outside said vehicle (6) where said device (2) is intended to be installed.

8. A device according to one or more of the preceding claims, **characterized in that** said processing and analysis unit (12) is also configured to estimate the distance, speed and/or approach time of said emergency vehicles (4, 5) on the basis of the acoustic signals detected (10), and to control a different level of activation of said signaling means (20) on the basis of the estimate made.

9. A device according to one or more of the preceding claims, **characterized in that** the processing and analysis unit (12) is configured to identify and establish if said acoustic signals (10) are emitted by a rescue vehicle (4) and/or a public safety vehicle (5), and **in that** it activates different signaling means (20) provided inside said vehicle (6), according to the type of vehicle identified, so as to alert the driver of said vehicle (6) on the presence and/or approaching of a rescue (4) and/or emergency (5) vehicle.

10. A device according to one or more of the preceding claims, **characterized in that** said processing and analysis unit (12) is also configured to control the transmission of radio signals to the other vehicles upon the identification of said acoustic signals (14) emitted by said emergency vehicles (4, 5), among said acoustic signals detected (10).

11. A device according to one or more of the preceding claims, **characterized in that** it also comprises a receiver (30) for receiving radio signals sent by emitters (32) installed on the emergency vehicles (4, 5) and/or on other vehicles (6), said radio signals also being processed by the processing and analysis unit (12) to control the activation of said signaling means (20).

12. A device according to one or more of the preceding claims, **characterized in that** it comprises transmission means configured to send a suitable radio warning signal to the other vehicles, preferably to the emergency vehicles (4, 5), upon a contact detected by the proximity or distance sensors with which the vehicle (6) is provided.

13. A device according to one or more of the preceding claims, **characterized in that** said processing and analysis unit (12) comprises at least two lines (45) for processing the acoustic signals (10) detected by said means (8), said at least two processing lines (45) are parallel, independent and each of them is associated with a specific frequency which is typical of the rescue (4) and/or public safety (5) vehicles.

14. A device according to one or more of the preceding claims, **characterized in that** each acoustic signal (10) detected by said means (8) is input into each processing line (45) provided in said processing and analysis unit (12), and **in that** each processing line (45) comprises:

- a filtration module (46) provided with a band-pass filter configured to allow the passage of a specific frequency band which is typical of rescue (4) and/or public safety (5) vehicles and is different from that of the other processing lines (45),
- a module (48) for sensing the envelope of the filtered signal output from the module (46),
- a module (50) for digitalizing the signal output from the module (48).

15. A device according to one or more of the preceding claims, **characterized in that** the processing and analysis unit (12) comprises:

- a module (52) which receives the digital signals of all the processing lines (45) and is configured to calculate the duration and the alternation of

said digital signals,

- a module (54) which is configured to compare the data calculated by the module (52) with those which are characteristic of the acoustic signals (14) emitted by said emergency vehicles (4, 5), and stored beforehand in the unit itself.

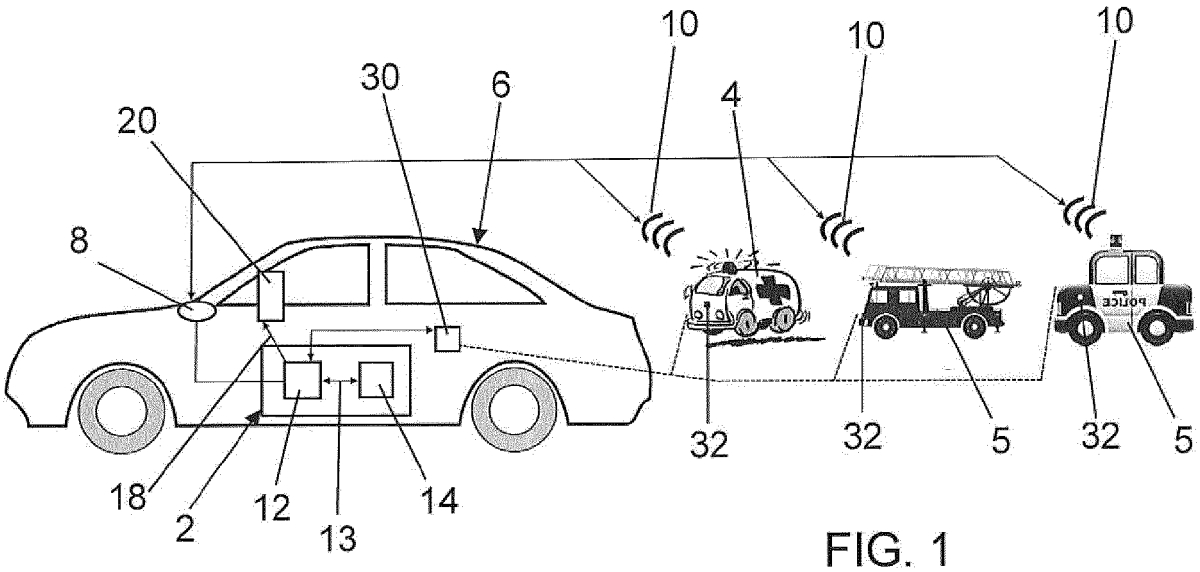


FIG. 1

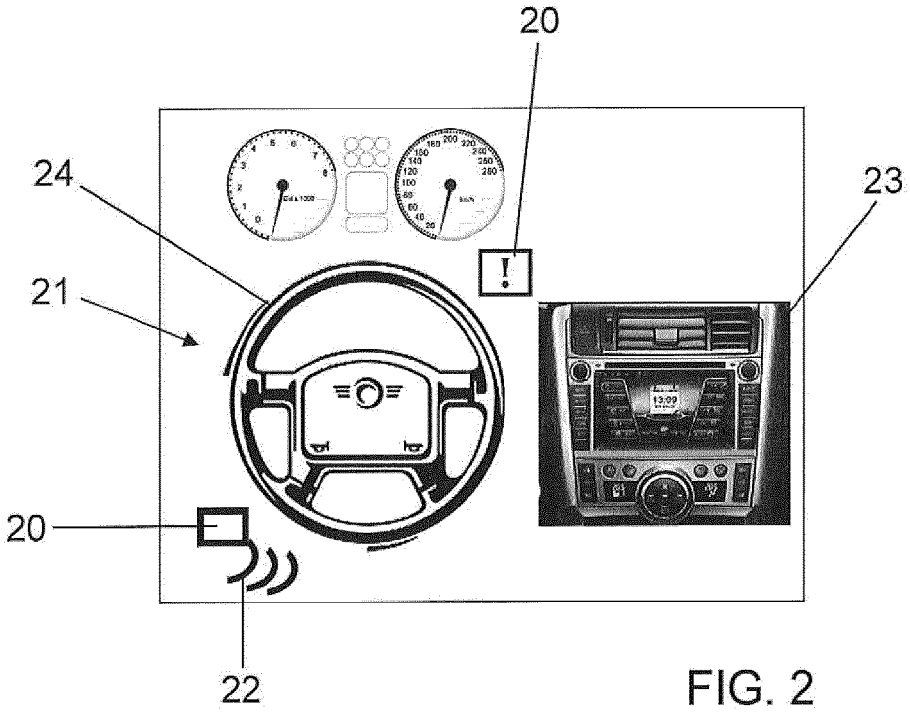
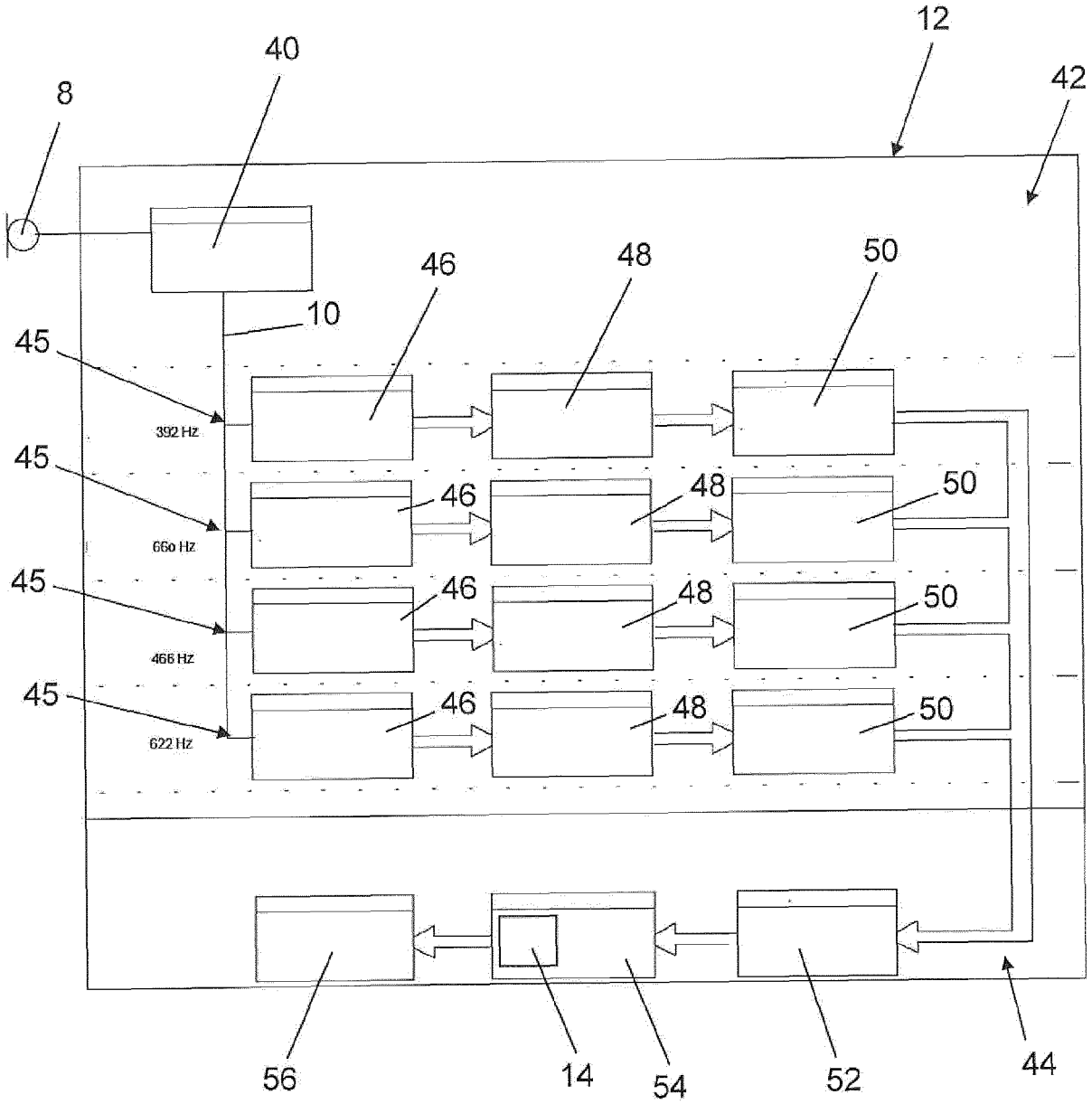


FIG. 2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8
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48
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56
14
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52
44

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 2452

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search	Date of completion of the search	Examiner
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