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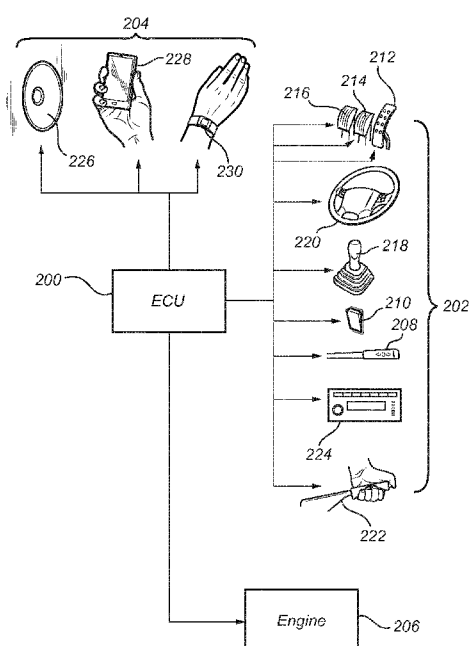


Fig. 2

(57) Abstract: The present disclosure relates to a method of preventing a driver (304) to drive a vehicle (100, 102) while intoxicated, by analyzing driver interactions performed by the driver (304) using a human-machine interface (HMI) (202) comprised with the vehicle (100, 102). The present disclosure also relates to a control unit (202) adapted to perform the method and to a corresponding computer program product.

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## A method of preventing a driver to drive a vehicle while intoxicated

### TECHNICAL FIELD

The present disclosure relates to a method of preventing a driver to drive a vehicle while  
5 intoxicated, by analyzing driver interactions performed by the driver using a human-machine interface (HMI) comprised with the vehicle. The present disclosure also relates to a control unit adapted to perform the method and to a corresponding computer program product.

### 10 BACKGROUND

Drunk driving continues to be an issue for modern society. One approach to combating drunk driving has been the installation of breathalyzer devices in vehicles of repeat drunk driver offenders. These devices require that a driver blow into a blow tube prior to operation of the vehicle. When blood alcohol content (BAC) over a predetermined legal  
15 limit is detected, the violation is logged and, in some cases, vehicle operation is prevented. In some implementation, it may be possible to prevent the vehicles from being started while the driver is intoxicated by connecting the breathalyzer device to the vehicle's ignition system.

20 Unfortunately, such breathalyzer devices can be circumvented, for example, by having a sober person, other than the driver, take a breathalyzer test. Alternatively, devices such as air pumps may be used to "fool" the breathalyzer device. In addition, installing a breathalyzer device into a vehicle is of course comes with a cost, due to the cost of the breathalyzer device in itself as well as possible costs for servicing the breathalyzer device.

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US20120112879 tries to overcome the above-mentioned issues relating to the use of a breathalyzer device for preventing a driver to drive a vehicle while intoxicated. Specifically, according to US20120112879 it may be possible to use voice analysis of the driver to determine if the driver is intoxicated, for example, due to alcohol consumption.  
30 Slurred speech has long been recognized as an indicator of intoxication and frequently used by law enforcement. It is also recognized that alcohol consumption has an effect on certain phonetic parameters of speech. In addition, US20120112879 disclose that it may be possible to ask the driver to perform tasks that are typically performed by the driver in

the normal course of vehicle use. For example, the driver of a car may be asked to press the horn, turn on the radio, select a certain station on the radio, turn on the high beams, turn on the emergency flashers or depress the brake pedal.

- 5 Even though US20120112879 provides an interesting approach for detecting if the driver is intoxicated, without using a breathalyzer device, the solution presented will only to a low certainty allow for determination of the level of intoxication of the driver. Accordingly, it would be desirable to provide further enhancements for improving the reliability in the determination of the intoxication level of the driver.

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## SUMMARY

- According to an aspect of the present disclosure, the above is at least partly alleviated by a method of preventing a driver to drive a vehicle while intoxicated, the method comprising the steps of receiving, at a control unit comprised with the vehicle, an  
15 indication of the driver initiating a driving session, in response to receipt of the driving session initiation indication providing the driver with an instruction to perform a predetermined set of actions using a human machine interface (HMI) comprised with the vehicle, comparing, by the control unit and subsequent to providing the instructions, driver interactions using the HMI with the predetermined set of actions, determining, by the  
20 control unit, whether a result of the step of comparing indicates that the driver is unacceptably intoxicated, and immobilizing, by the control unit, the vehicle if the result of the determination indicates that the driver is unacceptably intoxicated.

- In accordance to the present disclosure, when a driver wants to start driving, whereby the  
25 control unit receives an indication that the driver initiating a driver session, there is a possibility of (sometimes) initiate a test for determining if the driver is unacceptably intoxicated. Specifically, in accordance to the present disclosure the driver is requested to successfully perform a test that consists of a series of actions/operations using the existing human-machine interface (HMI) components in the vehicle, e.g. stalk switch,  
30 other switches, accelerator pedal, etc. The driver would be required to perform a sequence of actions requiring operation of some of these HMI components. It should be understood that the driver may initiate driving by e.g. activating an ignition switch to turn on the vehicle (using e.g. an ignition key or a start button).

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Advantageously, the predetermined set of actions of the HMI components is based on behavioral studies of the cognitive and physical faculties of persons who have consumed alcohol or other drugs. Thus, the predetermined set of actions may be differently targeted based on testing for different types of intoxication, possibly targeting a (known) previous behavior of the driver. That is, if it is known that the driver in a previous situation has been driving under the influence of alcohol, the test may be specifically targeted for identifying if the driver is intoxicated by alcohol. In a corresponding manner, if the driver is known to have previously abused other types of drugs, then the tests may be targeted accordingly. Furthermore, the tests may also be generally arranged to screen for any form of intoxication.

In an embodiment of the present disclosure, the instructions provided to the driver are at least one of audio and visual instructions. It may of course be possible to provide the driver with a combination of both audio and visual instructions. The audio instructions are provided using a speaker and the visual instructions are provided on a display member. It may for example be possible to make use of a speaker/display member arranged within a driver compartment of the vehicle. As an alternative, the speaker/display member is provided as components comprised with a mobile electronic device, such as a mobile phone of the driver or a wearable device worn by the user (such as a smart watch).

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Preferably, the series of driver interactions are performed using driver control members comprised with the HMI, including at least one of a stalk switch, an electrical switch, an accelerator pedal, a brake pedal, a clutch pedal, a gear lever, a steering wheel, a secondary brake handle, an input control for a vehicle accessory. In a specific embodiment, the predetermined set of actions comprises at least two actions simultaneously performed using different types of driver control members. By requiring the driver to perform simultaneous actions it may be possible to determining an intermediate coordination capability of the driver, where an in comparison low (such as below a predetermined threshold) intermediate coordination capability may be taken as an indication that the driver is unacceptably intoxicated.

In accordance to the present disclosure it may also be possible to allow the HMI to include at least one of a microphone and a touch panel (or similar) for receiving driver interactions. For example, in one embodiment the instruction provided to the driver may be to observe an output from a tachometer arranged within an instrument cluster

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comprised with the vehicle, and the driver interaction may be to “speak” (to the microphone) or input (using the touch panel) an observation of a current revolutions per minute (RPM) indicated at the tachometer. Accordingly, driver interactions using the HMI of the vehicle may also (or alternatively) include spoken or “typed” information provided by  
5 the driver.

In addition, in one embodiment the coordination capability between visually provided information and user interaction may be tested. That is, in accordance to the present disclosure it is possible to verify if the driver comprehend the information within the  
10 instrument cluster by instructing the driver to visually observe e.g. the intermediate RPM shown at the tachometer and then control a “level” at the accelerator pedal such that a specific RPM is “kept”. If the driver has trouble reading, the tachometer he will accordingly have trouble keeping the RPM at a requested level. A similar implementation may for example be possible for other type of information shown within the instrument cluster,  
15 such as for reading a pressure, etc.

In a possible embodiment of the present disclosure, it may additionally to using the HMI comprised with the vehicle, be suitable to allow the driver to interact with his mobile electronic device, possibly making use further testing possibilities achievable with typical  
20 sensor comprised with such a mobile electronic device, possibly including accelerometers, etc.

In an embodiment, the method further comprises the step of determining, by the control unit, a vehicle condition, wherein the steps of receiving, controlling, comparing,  
25 determining and immobilizing are performed only if the vehicle condition fulfills a predetermined criterion. That is, the test for determining if the driver is intoxicated must not necessarily be performed every time the driver is to start driving the vehicle. Rather, the test may for example be limited to be performed at certain times of the day (such as for example during evening/night time), or in case the vehicle is determined to be within a  
30 specific geographical area. Such an area may for example be defined in a similar manner as in regards to the previously known concept of “geofencing”. For example if the vehicle is determined to be within an area known for having an in comparison high statistic of (caught) intoxicated drivers, then such a criterion may be used for initiating the driver intoxication test according to the present disclosure. Similarly, in case the vehicle has  
35 been parked in closed vicinity to an alcoholic shop, such knowledge may be used for

initiating the test. It should be understood that the “reason” for initiating a driver intoxication test may be individual for different driver, for example dependent on if the driver has previously been determined to be possibly or unacceptably intoxicated. In addition, it may in accordance to the present disclosure be possible to collect  
5 behavioral data in relation to the driver for identifying how the driver normally is behaving, such as how he enters the truck, controls different HMI components, timing during general handling of the vehicle, etc. If a deviation from the regular pattern is observed, the driver intoxication test may be initiated. In addition to the above, the test may possibly be triggered when any compulsory action is not performed before attempting to start the  
10 vehicle (i.e. initiating a driver session as discussed above), for example without wearing his seat belt.

Preferably, the method further comprises determining, by the control unit, an identity of the driver, wherein the steps of receiving, controlling, comparing, determining and  
15 immobilizing are performed only if the driver is identified to be a correct driver. Accordingly, the vehicle may for example be equipped with means for acquiring biometric data in relation to the driver, including fingerprint matching, facial recognition, etc.

In a possible embodiment of the present disclosure, the actions comprised with the set of  
20 actions to be performed by the driver are randomly selected. That is, it is preferred if the drive is unable to learn a specific pattern for succeeding the test even in an intoxicated state. Accordingly, the actions comprised with the set of actions to be performed by the driver are different for each time the steps of receiving, controlling, comparing, determining and immobilizing are performed.

25 In accordance to a preferred embodiment of the present disclosure, the instruction to perform a predetermined set of actions comprises at least one implicit instruction. That is, rather than providing the driver with an explicit instruction, such as instructing the driver to rotate the steering wheel while pressing the brake pedal with his foot, an implicit  
30 instruction is given to the driver, such as instructing the driver to place the gear leaver in a specific position. To correctly place the gear leaver in the specific position, the driver must first press the clutch pedal with his foot before it is possible to change the gear leaver to the specific position. In a corresponding manner, with the radio turned off the implicit instruction given to the driver may be to change the radio to a specific station. However, to  
35 successfully perform the requested action, the driver must of course first turn the radio on.

Accordingly, the predetermined set of actions will also include implicit actions. It should be understood that it may be possible to combine implicit and explicit actions. In addition, if it is determined that the driver hasn't performed as per the expectation of the implicit condition involved, then the test will not only be considered as fail (not allowed to crank),  
5 but also, in the subsequent attempt, the test will be made even more difficult.

In accordance to the present disclosure it may possible to, previously to executing the driver intoxication test, form reference data to be used in the step of comparing the driver executed actions with the predetermined set of actions. The reference data may be  
10 collected during normal operation of the vehicle, during a period where the driver is guaranteed not to be unacceptably intoxicated. Accordingly, a behavior for example relating to how the driver is handling the steering wheel, gear shifting (combination of clutch, gear leaver and accelerator pedal), etc. may be collected. The collected data may then be compared to how the driver in fact is behaving when the test is performed. The  
15 reference data may be individual for a specific driver, or may be a correlated behavior relating to how a plurality of drivers are behaving when performing a set of action in a non-intoxicated state.

It would of course be possible, and within the scope of the present disclosure to form  
20 reference data also relating to the behavior of an intoxicated driver. Thereby, a comparison may be made with such reference data in the process of determining if the driver, during the driver intoxication test, is to be considered as intoxicated.

In a possible implementation of the present disclosure, it may be desirable to estimate, by  
25 the control unit, a value of intoxication for the driver based on the result of the step of comparing and possibly transmit information indicative of the result of the step of comparing to an entity associated with the driver. Accordingly, a supervisor of the driver (or the police) may be adapted to be informed in case the driver has been determined to be unacceptably intoxicated, for possibly taking further appropriate actions.

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According to another aspect of the present disclosure there is provided a control unit comprised with a vehicle, the control unit adapted to prevent a driver to drive the vehicle while intoxicated, wherein the control unit is further adapted to receive an indication of the driver initiating a driving session, provide the diver with an instruction to perform a  
35 predetermined set of actions using a human-machine interface (HMI) comprised with the

vehicle, compare, subsequent to providing the instructions, driver interactions using the HMI with the predetermined set of actions, determine whether a result of the step of comparing indicates that the driver is unacceptably intoxicated, and immobilize the vehicle if a result of the determination indicates that the driver is unacceptably intoxicated. This aspect of the present disclosure provides similar advantages as discussed above in relation to the previous aspect of the present disclosure.

The control unit may in one embodiment be an electronic control unit (ECU) is typically provided as an onboard component of the vehicle, the vehicle for example being a bus, a truck a car, or any form of construction equipment. The vehicle preferably comprised an engine and the above-mentioned HMI.

According to a further aspect of the present disclosure there is provided a computer program product comprising a non-transitory computer readable medium having stored thereon computer program means for operating a control unit for a vehicle, the control unit adapted to prevent a driver to drive the vehicle while intoxicated, wherein the computer program product comprises code for receiving, at the control unit, an indication of the driver initiating a driving session, code for providing, by the control unit, the driver with an instruction to perform a predetermined set of actions using a human-machine interface (HMI) comprised with the vehicle, code for comparing, by the control unit and subsequent to providing the instructions, driver interactions using the HMI with the predetermined set of actions, code for determining, by the control unit, whether a result of the comparing indicates that the driver is unacceptably intoxicated, and code for immobilizing, by the control unit, the vehicle if the result of the determination indicates that the driver is unacceptably intoxicated. Also this aspect of the present disclosure provides similar advantages as discussed above in relation to the previous aspects of the present disclosure.

The computer readable medium may be any type of memory device, including one of a removable nonvolatile random access memory, a hard disk drive, a floppy disk, a CD-ROM, a DVD-ROM, a USB memory, an SD memory card, or a similar computer readable medium known in the art.

Further advantages and advantageous features of the present disclosure are disclosed in the following description and in the dependent claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the appended drawings, below follows a more detailed description of embodiments of the present disclosure cited as examples.

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In the drawings:

Figs. 1A illustrates a truck and 1B a bus in which the vehicle immobilizing methodology according to the present disclosure may be incorporated;

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Fig. 2 conceptually illustrates the interrelation between an electronic control unit (ECU), a human-machine interface (HMI) and an engine comprised with the vehicle;

Fig. 3 illustrates an exemplary vehicle driver compartment provided with a human-machine interface (HMI) for performing a set of actions to be analyzed for possible driver intoxication, and

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Fig. 4 illustrates the processing steps for performing the method according to the present disclosure.

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## DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS OF THE INVENTION

The present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments of the present disclosure are shown. This disclosure may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided for thoroughness and completeness, and fully convey the scope of the disclosure to the skilled addressee. Like reference characters refer to like elements throughout.

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Referring now to the drawings and to Figs. 1 and 2 in particular, there is in Fig. 1A depicted an exemplary vehicle, here illustrated as a truck 100, in which vehicle immobilizing methodology according to the present disclosure may be incorporated. The immobilizing methodology may of course be implemented, possibly in a slightly different way, in a bus 102 as shown in Fig. 1B, a car, etc. The vehicle may for example be one of an electric or hybrid vehicle, or possibly a gas/gasoline/diesel vehicle. The vehicle

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comprises an electric machine (in case of being an electric or hybrid vehicle) or an engine (such as an internal combustion engine in case of being a gas/gasoline/diesel vehicle).

With further reference to Fig. 2, there is conceptually illustrates the interrelation between  
5 an electronic control unit (ECU) 200, components of a human-machine interface (HMI) 202 functioning as an input for receiving interactions by the driver, an output interface 204 to be used for providing the driver with instructions, and an engine 206 comprised with the vehicle 100, 102.

10 The ECU 200 may for example be manifested as a general-purpose processor, an application specific processor, a circuit containing processing components, a group of distributed processing components, a group of distributed computers configured for processing, a field programmable gate array (FPGA), etc. The processor may be or include any number of hardware components for conducting data or signal processing or  
15 for executing computer code stored in memory. The memory may be one or more devices for storing data and/or computer code for completing or facilitating the various methods described in the present description. The memory may include volatile memory or non-volatile memory. The memory may include database components, object code components, script components, or any other type of information structure for supporting  
20 the various activities of the present description. According to an exemplary embodiment, any distributed or local memory device may be utilized with the systems and methods of this description. According to an exemplary embodiment the memory is communicably connected to the processor (e.g., via a circuit or any other wired, wireless, or network connection) and includes computer code for executing one or more processes described  
25 herein.

In the illustration provided in Fig. 2 the HMI 202 is shown to comprise of a stalk switch 208, an electrical switch 210, an accelerator pedal 212, a brake pedal 214, a clutch pedal 216, a gear lever 218, a steering wheel 220, a secondary brake handle 222, and an input  
30 control for a vehicle accessory illustrated as an interface 224 for a radio module comprised with the vehicle 100, 102. The output interface 204 may be provided by means of one or a combination of e.g. a speaker 226 arranged within the vehicle (for example used together with the radio module of the vehicle), a mobile phone 228 possibly wirelessly connected to the ECU 200 (using e.g. Bluetooth, Wi-Fi, etc.) and a wearable  
35 device 230 (e.g. a smart watch) in a similar manner possibly wirelessly connected to the

ECU 200 (or to the ECU 200 through the mobile phone 228). In addition, and as stated above, the engine 206 may be either of a gas/gasoline/diesel engine or an electrical engine.

- 5 In Fig. 3 there is shown an exemplary vehicle driver compartment 302 provided with a human-machine interface (HMI) for performing a set of actions to be analyzed for possible driver intoxication. In line with the discussion in relation to Fig. 2, the vehicle driver compartment 302 is provided with the input interface 202 (i.e. the HMI interface comprising a selection of the above mentioned HMI components) and the output interface
- 10 204. In the illustrated example, the vehicle has been identified to be parked within a specific area, where it is known (previous information) that intoxicated drivers have been observed. Accordingly, the driver intoxication test is initiated as soon as the ECU 200 indicates that a driver 304 wants to crank the engine 206 of the vehicle 100, 102.
- 15 The ECU 200 will wirelessly connect to the smart watch 230 of the driver, where the driver will be provided with instructions to perform a predetermined sets of actions using the HMI, specifically using the steering wheel 220, the clutch pedal 216 and the gear lever 218. For example, the ECU 200 may have previously identified that the gear lever 218 is at a first gear. The driver may thus be instructed to change the gear to the third gear
- 20 (implicit instruction, where a combination of the clutch pedal 216 and the gear lever 218 is necessary) and then to turn the steering wheel 1/4 of a full turn (explicit instruction).

In such a situation, the driver is given the option to turn the steering wheel 220 to the left 90 degrees or to the right 90 degrees. A further implicit instruction may then, at a later

25 point in time, be to ask the driver to turn the steering wheel 220 an opposite 1/4 of a full turn in an opposite direction as compared to what he did before. Accordingly, it will be possible to test the intermediate memory capability of the driver.

To summarize, the present disclosure relates to a method of preventing a driver to drive a

30 vehicle while intoxicated, comprising receiving, S1, at a control unit comprised with the vehicle, an indication of the driver initiating a driving session, and in response to receipt of the driving session initiation indication, providing, S2, the driver with an instruction to perform a predetermined set of actions using a human machine interface (HMI) comprised with the vehicle. The method further comprises comparing, S3, by the control unit and

35 subsequent to providing the instructions, driver interactions using the HMI with the

predetermined set of actions, determining, S4, by the control unit, whether a result of the step of comparing indicates that the driver is unacceptably intoxicated, and immobilizing, S5, by the control unit, the vehicle 100/102 if the result of the determination indicates that the driver 304 is unacceptably intoxicated. If however the driver 304 is determined to not  
5 be intoxicated (or at least not unacceptably intoxicated, such as below a predetermined legal limit/level), the vehicle 100/102 is started, S5'.

Advantages with the present disclosure includes increased reliability in determining if the driver is in fact intoxicated, by carefully adapt how the instructions are provided to the  
10 driver for performing the predetermined set of actions. Preferably, the instructions are given as implicit instructions such that further related tasks must be performed for correctly perform the predetermined set of actions.

The present disclosure contemplates methods, devices and program products on any  
15 machine-readable media for accomplishing various operations. The embodiments of the present disclosure may be implemented using existing computer processors, or by a special purpose computer processor for an appropriate system, incorporated for this or another purpose, or by a hardwired system. Embodiments within the scope of the present disclosure include program products comprising machine-readable media for carrying or  
20 having machine-executable instructions or data structures stored thereon. Such machine-readable media can be any available media that can be accessed by a general purpose or special purpose computer or other machine with a processor.

By way of example, such machine-readable media can comprise RAM, ROM, EPROM,  
25 EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to carry or store desired program code in the form of machine-executable instructions or data structures and which can be accessed by a general purpose or special purpose computer or other machine with a processor. When information is transferred or provided over a network or  
30 another communications connection (either hardwired, wireless, or a combination of hardwired or wireless) to a machine, the machine properly views the connection as a machine-readable medium. Thus, any such connection is properly termed a machine-readable medium. Combinations of the above are also included within the scope of machine-readable media. Machine-executable instructions include, for example,  
35 instructions and data that cause a general-purpose computer, special purpose computer,

or special purpose processing machines to perform a certain function or group of functions.

Although the figures may show a specific order of method steps, the order of the steps  
5 may differ from what is depicted. In addition, two or more steps may be performed concurrently or with partial concurrence. Such variation will depend on the software and hardware systems chosen and on designer choice. All such variations are within the scope of the disclosure. Likewise, software implementations could be accomplished with standard programming techniques with rule-based logic and other logic to accomplish the  
10 various connection steps, processing steps, comparison steps and decision steps. Additionally, even though the disclosure has been described with reference to specific exemplifying embodiments thereof, many different alterations, modifications and the like will become apparent for those skilled in the art.

15 Variations to the disclosed embodiments can be understood and effected by the skilled addressee in practicing the claimed disclosure, from a study of the drawings, the disclosure, and the appended claims. Furthermore, in the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality.

## CLAIMS

1. A method of preventing a driver (304) to drive a vehicle (100, 102) while intoxicated, the method comprising the steps of:

- 5           - receiving (S1), at a control unit (200) comprised with the vehicle (100, 102), an indication of the driver (304) initiating a driving session,
- in response to receipt of the driving session initiation indication providing (S2) the driver (304) with an instruction to perform a predetermined set of actions using a human machine interface (HMI) (202) comprised with the vehicle (100, 102),
- 10           - comparing (S3), by the control unit (200) and subsequent to providing the instructions, driver interactions using the HMI (202) with the predetermined set of actions,
- determining (S4), by the control unit (200), whether a result of the step of comparing indicates that the driver is unacceptably intoxicated, and
- immobilizing (S5), by the control unit (200), the vehicle (100, 102) if the result of
- 15   the determination indicates that the driver (304) is unacceptably intoxicated.

2. The method according to claim 1, wherein the instructions provided to the driver (304) are at least one of audio and visual instructions.

- 20           3. The method according to claim 1, wherein instructions provided to the driver (304) are both audio and visual instructions.

4. The method according to any one of claims 2 and 3, wherein the audio instructions are provided using a speaker and the visual instructions are provided on a

25   display member.

5. The method according to claim 4, wherein at least one of the speaker and the display member is provided as components arranged within a driver compartment of the vehicle.

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6. The method according to claim 4, wherein at least one of the speaker and the display member is provided as components comprised with a mobile electronic device (204).

7. The method according to claim 6, wherein the mobile electronic device (204) is at least one of a mobile phone (228) and a wearable electronic device (230) operated by the driver (304).

5           8. The method according to any one of the preceding claims, wherein the series of driver interactions are performed using driver control members (202) comprised with the HMI, including at least one of a stalk switch (208), an electrical switch (210), an accelerator pedal (212), a brake pedal (214), a clutch pedal (216), a gear lever (218), a steering wheel (220), a secondary brake handle (222), an input control (224) for a vehicle  
10 accessory.

          9. The method according to claim 8, wherein the predetermined set of actions comprises at least two actions simultaneously performed using different types of driver control members (202).

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          10. The method according to claim 9, wherein the at least two actions simultaneously performed using different types of driver control members (202) are performed by the driver (304) using at least one hand and one leg.

20           11. The method according to any one of the preceding claims, further comprising the step of:

- determining, by the control unit (200), a vehicle condition,  
wherein the steps of receiving, controlling, comparing, determining and immobilizing are performed only if the vehicle condition fulfills a predetermined criteria.

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          12. The method according to claim 10, wherein the vehicle condition is a time of the day and the predetermined criteria is a set time duration.

          13. The method according to claim 10, wherein the vehicle condition is a  
30 predetermined testing interval for the driver of the vehicle and the predetermined criteria is a current state within the testing interval.

          14. The method according to claim 13, wherein the testing interval is individual for each driver (304).

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15. The method according to claim 13, wherein the testing interval is dependent on previous determination of driver intoxication.

16. The method according to claim 11, wherein the vehicle condition is a current  
5 location of the vehicle and the predetermined criteria is that the vehicle must be outside of a predefined geographical area.

17. The method according to claim 16, wherein the predefined geographical area is an area surrounding an alcoholic shop.

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18. The method according to claim 16, wherein the predefined geographical area is an area where a rate of previously registered drunk driving cases is above a predetermined threshold.

19. The method according to any one of the preceding claims, further comprising the step of:

- determining, by the control unit (200), an identity of the driver (304), wherein the steps of receiving, controlling, comparing, determining and immobilizing are performed only if the driver is identified to be a correct driver.

20

20. The method according to any one of the preceding claims, wherein the actions comprised with the set of actions to be performed by the driver are randomly selected.

21. The method according to any one of the preceding claims, wherein the actions  
25 comprised with the set of actions to be performed by the driver are different for each time the steps of receiving, controlling, comparing, determining and immobilizing are performed.

22. The method according to any one of the preceding claims, wherein the step of  
30 determining that the driver (304) is unacceptably intoxicated comprises the step of comparing a duration for performing the set of actions with a predetermined threshold.

23. The method according to any one of the preceding claims, wherein one action in the set of actions comprises keeping the engine at a predetermined revolutions per  
35 minute (rpm).

24. The method according to any one of the preceding claims, wherein the instruction to perform a predetermined set of actions comprises at least one implicit instruction.

5        25. The method according to claim 24, wherein the at least one implicit instruction comprises instructing the driver (304) to regulate a first component of the HMI (202), wherein regulating the first component of the HMI (202) implicitly requires the driver (304) to regulate a second component of the HMI (202), the second component being different from the first component.

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26. The method according to claim 24, wherein the first component is a gear lever (218) and the second component is a clutch pedal (216).

27. The method according to any one of the preceding claims, further comprising  
15 the step of:

- estimating, by the control unit (200), a value of intoxication for the driver (304) based on the result of the step of comparing.

28. The method according to any one of the preceding claims, further comprising  
20 the step of:

- transmitting information indicative of the result of the step of comparing to an entity associated with the driver.

29. A control unit (200) comprised with a vehicle (100, 102), the control unit (200)  
25 adapted to prevent a driver (304) to drive the vehicle while intoxicated, wherein the control unit (200) is further adapted to:

- receive an indication of the driver (304) initiating a driving session,
- provide the driver (304) with an instruction to perform a predetermined set of actions using a human-machine interface (HMI) (200) comprised with the vehicle (100,  
30 102),

- compare, subsequent to providing the instructions, driver interactions using the HMI (202) with the predetermined set of actions,

- determine whether a result of the step of comparing indicates that the driver (304) is unacceptably intoxicated, and

- immobilize the vehicle (100, 102) if a result of the determination indicates that the driver (304) is unacceptably intoxicated.

30. The control unit (200) according to claim 25, wherein the control unit is an  
5 electronic control unit (ECU).

31. A vehicle (100, 102), comprising the control unit (200) according to any one of claims 29 and 30.

10 32. The vehicle (100, 102) according to claim 31, further comprising:  
- an engine (206), and  
- a HMI (202).

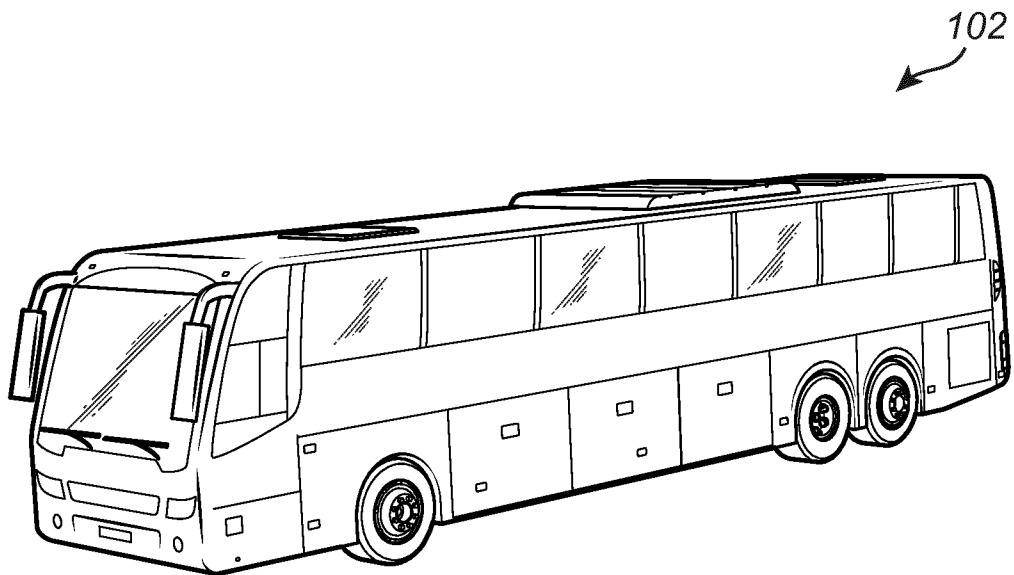
33. A computer program product comprising a non-transitory computer readable  
15 medium having stored thereon computer program means for operating a control unit (200) for a vehicle (100, 102), the control unit (200) adapted to prevent a driver (304) to drive the vehicle (100, 102) while intoxicated, wherein the computer program product comprises:

- code for receiving, at the control unit (200), an indication of the driver (304)  
20 initiating a driving session,  
- code for providing, by the control unit (200), the driver (304) with an instruction to perform a predetermined set of actions using a human-machine interface (HMI) (202) comprised with the vehicle (100, 102),  
- code for comparing, by the control unit (200) and subsequent to providing the  
25 instructions, driver interactions using the HMI (202) with the predetermined set of actions,  
- code for determining, by the control unit (200), whether a result of the comparing indicates that the driver (304) is unacceptably intoxicated, and  
- code for immobilizing, by the control unit (200), the vehicle (100, 102) if the result of the determination indicates that the driver (304) is unacceptably intoxicated.

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*Fig. 1A*



*Fig. 1B*

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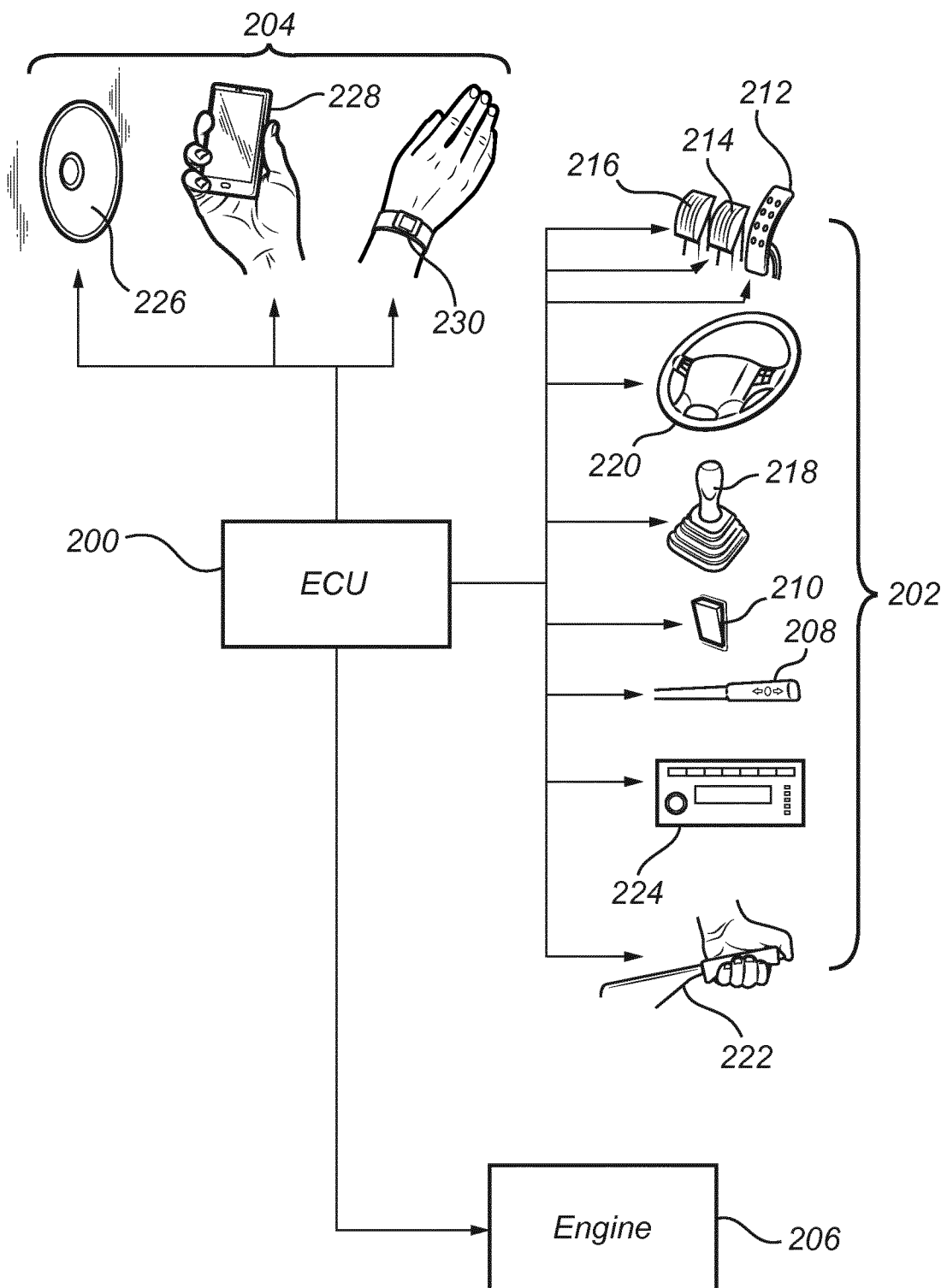
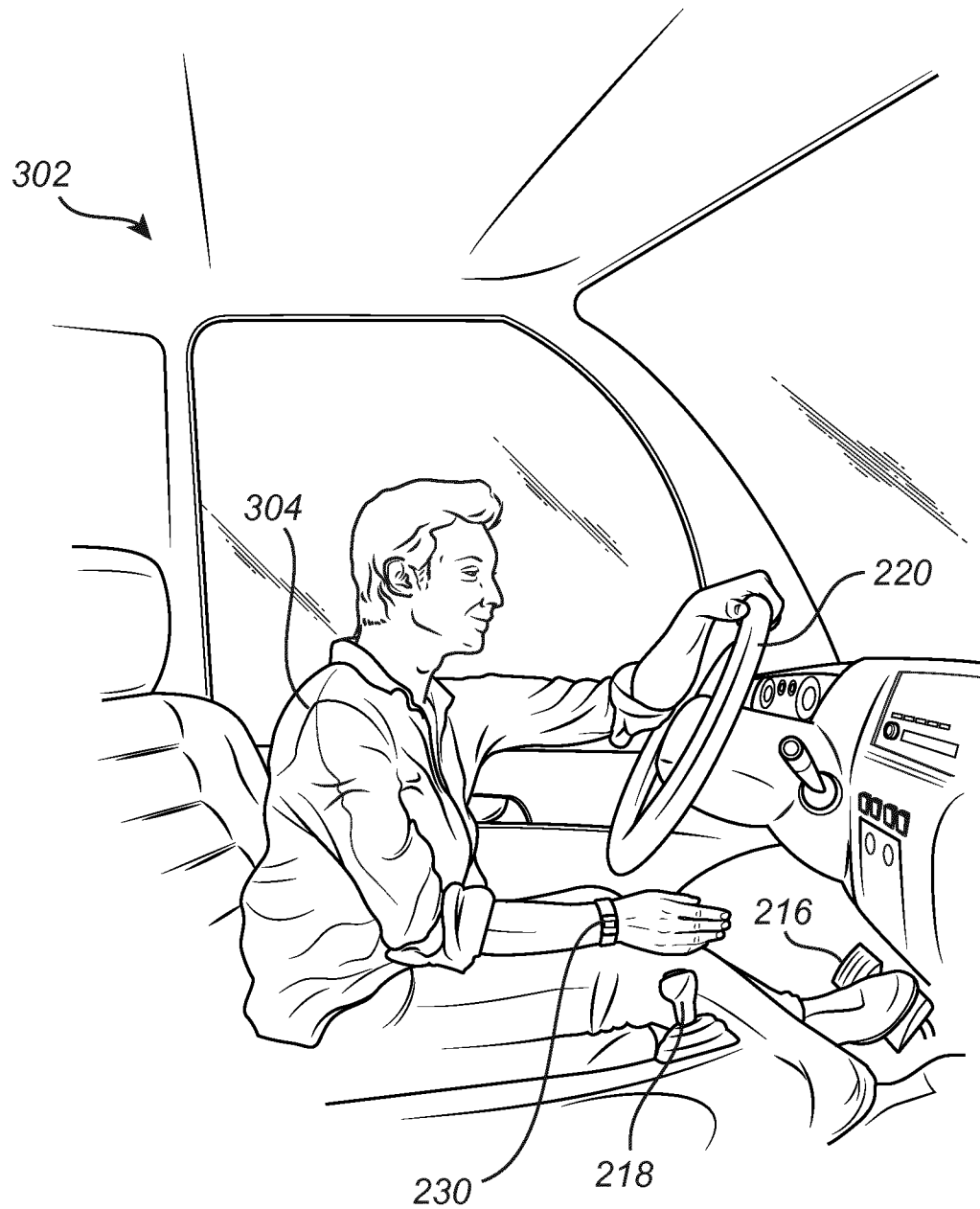


Fig. 2

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*Fig. 3*

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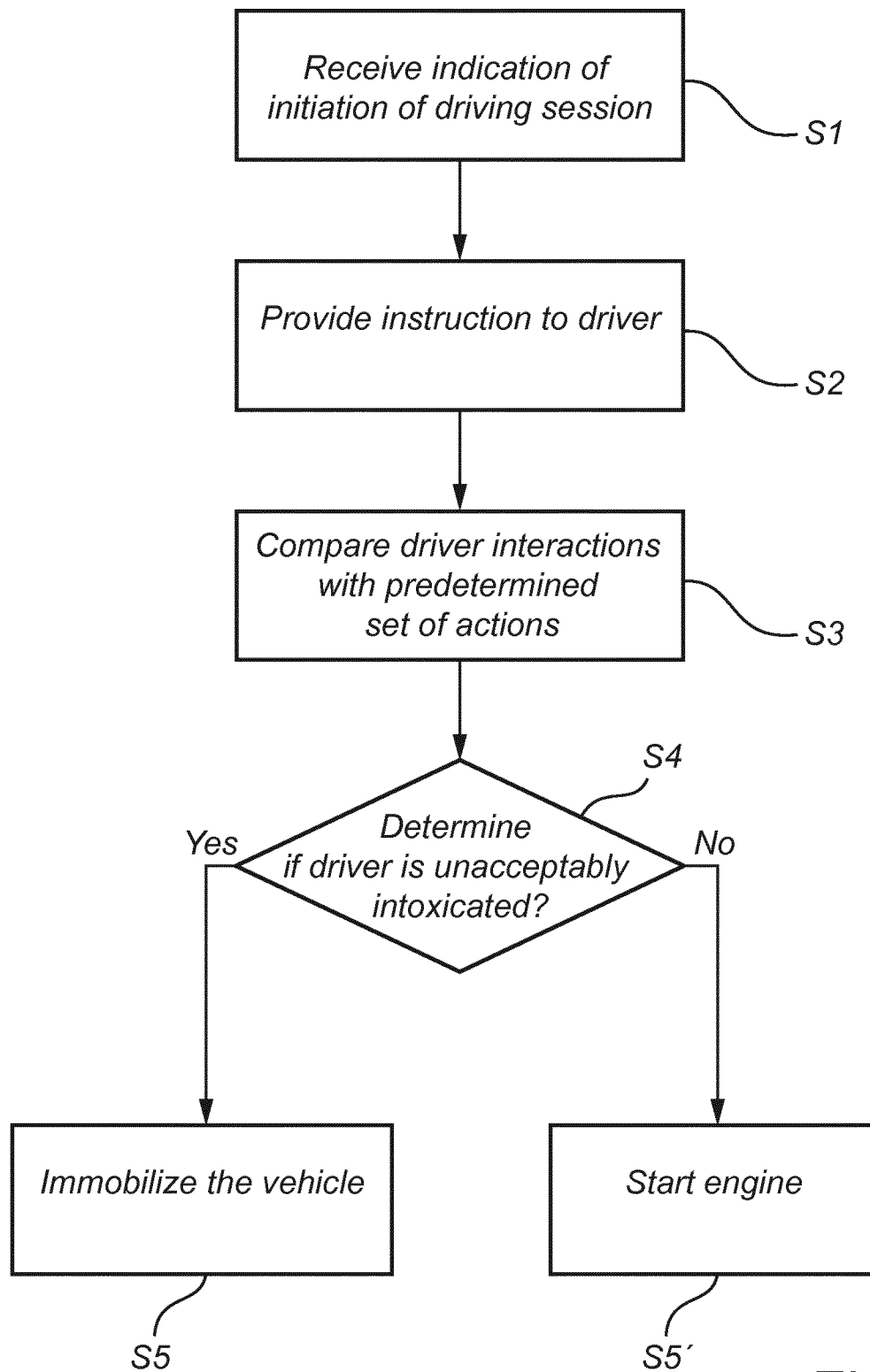


Fig. 4

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2017/079128

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                               |                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>INV. B60K28/06 B60K37/06 B60W50/14 B60K28/00 B60W40/08<br>ADD.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                               |                                                                                                                               |
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                               |                                                                                                                               |
| <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br>B60K B60W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                               |                                                                                                                               |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                               |                                                                                                                               |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)<br>EPO-Internal, WPI Data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                               |                                                                                                                               |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                               |                                                                                                                               |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                            | Relevant to claim No.                                                                                                         |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US 2012/112879 A1 (EKCHIAN CAROLINE M [US]<br>ET AL) 10 May 2012 (2012-05-10)<br>cited in the application<br><br>paragraphs [0010], [0015], [0020],<br>[0021], [0024] - [0028], [0064] -<br>[0066], [0087]; figure 2<br>----- | 1-6,8,9,<br>11-17,<br>19-22,<br>24,25,<br>27-33                                                                               |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US 2011/304465 A1 (BOULT TERRANCE E [US]<br>ET AL) 15 December 2011 (2011-12-15)<br><br>paragraphs [0019], [0025], [0038],<br>[0050]<br>-----                                                                                 | 1,2,4-8,<br>11,12,<br>14-22,<br>27-33                                                                                         |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US 2016/280230 A1 (HSIEH FENG-MING [TW])<br>29 September 2016 (2016-09-29)<br>paragraphs [0038], [0044] - [0046]<br>-----                                                                                                     | 1-33                                                                                                                          |
| <div style="display: flex; justify-content: space-between;"> <span><input type="checkbox"/> Further documents are listed in the continuation of Box C.</span> <span><input checked="" type="checkbox"/> See patent family annex.</span> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                               |                                                                                                                               |
| <div style="display: flex;"> <div style="flex: 1;"> <p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="flex: 1;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> </div> </div> |                                                                                                                                                                                                                               |                                                                                                                               |
| Date of the actual completion of the international search<br><br><div style="text-align: center; font-size: 1.2em;">19 January 2018</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                               | Date of mailing of the international search report<br><br><div style="text-align: center; font-size: 1.2em;">29/01/2018</div> |
| Name and mailing address of the ISA/<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                               | Authorized officer<br><br><div style="text-align: center; font-size: 1.2em;">Erbel, Christoph</div>                           |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/079128

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date                                      |
|-------------------------------------------|---------------------|----------------------------|----------------------------------------------------------|
| US 2012112879                             | A1                  | 10-05-2012                 | NONE                                                     |
| US 2011304465                             | A1                  | 15-12-2011                 | NONE                                                     |
| US 2016280230                             | A1                  | 29-09-2016                 | TW 201634320 A 01-10-2016<br>US 2016280230 A1 29-09-2016 |