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(54) **Vehicle driver assist arrangement**

Fahrzeugfahrerassistenzeinrichtung

Dispositif d'assistance de conducteur de véhicule

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(73) Proprietor: **Volvo Car Corporation**
40 531 Göteborg (SE)

(72) Inventors:
- **Jönsson, Matthias**
  412 54 Göteborg (SE)
- **Landfors, Per**
  412 62 Göteborg (SE)

(74) Representative: **Kransell & Wennborg KB**
P.O. Box 2096
403 12 Göteborg (SE)

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Description

TECHNICAL FIELD

[0001] The present invention relates to a vehicle driver assist arrangement. The present invention also relates a vehicle comprising a vehicle driver assist arrangement and a method of assisting a driver of a vehicle.

BACKGROUND

[0002] Vehicle driver assist arrangements, such as curve speed warning arrangements, have been available in cars for some years. Such arrangement may be capable of issuing a warning to a driver of a vehicle if the vehicle approaches a curve with a speed being too high to pass the curve in a pleasant or safe manner. Input to such arrangements may for example be data from a positioning system together with data from an electronic map, and when it is determined that a curve in front of a vehicle, having a certain velocity, either will result in an unpleasant passing or dangerous passing of the curve, a warning will be issued to the driver. Such an arrangement is for example described in the document GB 2413884 A. A problem with such an arrangement is that the issuance of the warning by the arrangement is not very accurate. That is, such systems tends to either issue a warning too often, and thus tends to annoy the driver which may even adjust the arrangement such that the warning will not be issued that often, or may even shut off the arrangement. Those skilled in the art easily recognizes the hazard with such arrangements since the arrangements in a potential dangerous situation may either warn too late or even not warn at all. Thus, there is a need for an arrangement that overcomes the above described shortcomings with the prior-art arrangements to thereby improve driving safety.

[0003] The document US 6141619 A discloses a vehicle control system which controls vehicle speed and provides a warning by deciding whether or not the prevailing vehicle speed allows the vehicle to pass a curve in the road ahead in accordance with the surrounding environment of the vehicle. The system calculates a gaze angle, theta which is made between a direction of a vehicle in its actual position P0 and a segment b joining the actual position P0 and a prospective position Pn. The vehicle speed control or warning is performed when the gaze angle theta exceeds a reference gaze angle. This reference gaze angle varies with the angle of view of the driver. At high-speed travel or at night where the drivers visibility angle is reduced, the reference gaze angle is set to a small value so that the vehicle control may be advanced. At low-speed travel or in the daytime where the driver's visibility angle is increased, the reference gaze angle is set to a large value so that the vehicle control may be delayed.

[0004] The document EP 1087358 A2 relates to a curve approaching mode controller capable of continuing vehicle control operations for the longest possible time even if curve information is not available from a navigation system. The navigation system provides curve information about a curve on a road stretching ahead of a vehicle. A control unit estimates a curve approaching mode in which the vehicle will approach the curve on the basis of the curve information and, when necessary, gives a warning and executes a decelerating control operation.; If only insufficient curve information is available from the navigation system, a road attribute calculating and storing unit stores the normal node information received immediately before receiving the insufficient node information (curve information) without updating the same, and informs a warning speed calculating and storing unit of a fact that the node information is insufficient. A warning speed calculating and storing unit calculates a warning speed that serves as a reference for warning on the basis of the normal node information received immediately before receiving the insufficient node information, taking a distance traveled by the vehicle after the insufficient node information has been received.

[0005] The document EP 2048476 A1 relates to a method which involves determining bend data indicating a course of the bend in the road. The road condition data indicating a condition of the road surface in front of the vehicle in the direction of travel, is determined. The bend data and the road condition data are analyzed to determine the recommended maximum speed. The recommended maximum speed is provided to the driver in advance of the vehicle entering the bend. An independent claim is also included for driver assistance system.

SUMMARY

[0006] An object of the present invention is to improve driving safety of a vehicle.

[0007] According to an aspect of the invention, the object is achieved by a vehicle driver assist arrangement, comprising processing means, road profile input means, current vehicle velocity input means, and a user interface. The processing means is arranged to communicate with the road profile input means, the current vehicle velocity input means and the user interface. The processing means further being arranged to receive road profile data representative of a road profile in front of the vehicle from the road profile input means, and to receive current vehicle velocity data representative of a current vehicle velocity of the vehicle from the current vehicle velocity input means. The processing means still further being adapted to process the road profile data to detect if the road in front of the vehicle contains a curve which is hidden or at least partially hidden from an estimated line of sight of the driver. The arrangement is adapted to issue a warning, via the user interface, if a hidden or at least partially hidden curve is detected and if the current vehicle velocity exceeds a threshold velocity. The processing means are arranged to process the road profile data to detect if a segment of the road ahead of the vehicle contains a hidden or at least partially hidden curve, to calculate a plurality of threshold velocities each being associated with a segment of the road ahead of the vehicle, and to calculate a predicted future vehicle velocity at a predetermined distance from a current vehicle position, or at a predetermined time from a current time, and to compare the current vehicle velocity, and/or the predicted future vehicle velocity, with the threshold velocities, and if the current vehicle velocity, and/or the predicted future vehicle velocity, exceeds one or more of the threshold velocities, determine a first point of activation based at least on the comparison and on whether one or more of the segments of the road in front of the vehicle comprises a hidden or at least partially hidden curve, and to issue the warning when the vehicle passes the first point of activation.

[0008] Since the arrangement is adapted to issue a warning if a hidden or at least partially hidden curve is detected and if the current vehicle velocity exceeds a threshold velocity, driving safety is improved.

[0009] As a result, the above mentioned object is achieved.

[0010] The vehicle referred to herein may be an automobile, truck, buss, or the like. The vehicle referred to herein is the vehicle hosting the arrangement.

[0011] Since the warning is issued when the vehicle passes the first point of activation and the first point of activation is determined based at least on a comparison between the current vehicle velocity, and/or the predicted future vehicle velocity, and the plurality of threshold velocities, a predictable arrangement is provided issuing a warning at a determined point of activation. The first point of activation may be determined using inputs not forming part of the comparison such as a distance from the vehicle to a segment of the road ahead of the vehicle, road conditions, driver reaction time, settings in sub-systems, weather conditions, visibility, road markings, type of road, traffic density, a width of the side of the road, speed limits, driving behaviour of the driver, detection of potentially dangerous objects at the side of the road, environment at the side of the road, e.g. the presence of cliffs, rock walls, etc. By using such input in the determining of the first point of activation, the accuracy of the issuing of the warning may be improved. Thereby, the driving safety may be further improved.

[0012] According to some embodiments, the processing means are adapted to determine a second point of activation based at least on the comparison, the second point of activation being further down the road in an intended direction of travel than the first point of activation, and if no hidden or at least partially hidden curve is detected, issue a warning when the vehicle passes the second point of activation. Thus, according to these embodiments, the vehicle driver assist arrangement may issue a warning even if/when no hidden or at least partially hidden curve is detected. Accordingly, the arrangement may serve as a curve speed warning system. That is, the arrangement may issue a warning to the driver via the user interface in case the vehicle is approaching a curve with a velocity being too high for passing the curve in a pleasant and/or safe manner, even if no hidden or at least partially hidden curve is detected. Thereby, driving safety is further improved.

[0013] According to some embodiments, the calculation of the plurality of threshold velocities is based on the road profile data and limitations in lateral and/or longitudinal acceleration of the vehicle. The road profile data and limitations in lateral and/or longitudinal acceleration of the vehicle indicate if the vehicle is capable of passing a curve in a pleasant and/or safe manner. Thus, since the calculation of the plurality of threshold velocities is based on the road profile data and limitations in lateral and/or longitudinal acceleration of the vehicle, driving safety is improved. Also, according to some embodiments, the calculation of the plurality of threshold velocities may be based on a distance from the vehicle to a segment of the road ahead of the vehicle, road conditions, driver reaction time, settings in sub-systems, etc.

[0014] The road profile data may comprise data being representative of the curvature of the road, the slope of the road, the superelevation of the road, presence of intersections, road type, a width of the side of the road, speed limits, detection of potentially dangerous objects at the side of the road, environment at the side of the road, e.g. the presence of cliffs, rock walls, etc. Since the road profile data may comprise such data, and the calculation of the plurality of threshold velocities is based on the road profile data, the calculation of the plurality of threshold velocities may encompass such data. Thereby, the driving safety may be further improved.

[0015] According to some embodiments, the road profile data contains slope data being representative of the slope of the road in front of the vehicle, the detection of a hidden curve or at least a partially hidden curve is based on processing of the slope data to detect if a part of the road is hidden or at least partially hidden. The detection may be based on an assumption that a part of the road is hidden from an estimated line of sight of the driver, e.g. by a crest, edge, or a top of a hill. Thus, by using road profile data containing slope data and process this data to detect if a part of the road is hidden or at least partially hidden and to issue a warning to the driver via the user interface if a hidden or at least partially hidden curve is detected and if the current vehicle velocity, and/or the predicted future vehicle velocity, exceeds a threshold velocity, the warning can be issued in an reliable manner to thereby further improve driving safety.

[0016] According to some embodiments, the detection of a hidden or at least a partially hidden curve is based on detection of a curve having a progressive curvature. A curve having a progressive curvature is a curve having a radius of curvature that decreases when traveling along the curve. Such curves may be hard to identify by a driver approaching such a curve since a part of the curve may be hidden and/or the driver is not following the curve with his eyes. Thus, issuing a warning to the driver in case of approaching a curve having a progressive curvature may further improve driving safety.

[0017] According to some embodiments, the detection of a hidden or at least a partially hidden curve is based on detection of an object obscuring the curve from an estimated line of sight of the driver. Such object may for example be a building, another vehicle, a tree or any other object obscuring the curve from an estimated line of sight of the driver. Thus, by issuing a warning to the driver in case of approaching such a curve, driving safety may be further improved.

[0018] According to some embodiments, the detection of a hidden or at least a partially hidden curve is based on illumination conditions and/or the presence of haze or fog. By issuing a warning to the driver in case of approaching a curve being hidden or at least partially hidden due to poor illumination conditions and/or the presence of haze or fog, driving safety may be further improved.

[0019] According to some embodiments, the vehicle driver assist arrangement further comprises means for detection of a direction of the driver's line of sight, the detection of a hidden or at least a partially hidden curve being based on the direction of the driver's line of sight. Accordingly, the detection of the driver's line of sight may be used to determine if the driver has seen the curve. In case it is determined that the driver has not seen the curve, the arrangement may be arranged to classify the curve as hidden. Thereby, driving safety may be further improved since the arrangement will issue a warning when it is detected that the driver has not seen the curve.

[0020] According to some embodiments, the road profile input means comprises an electronic map and a positioning device. Thus, in such embodiments, an electronic map and a positioning device may provide reliable road profile data representative of a road profile in front of the vehicle.

[0021] According to some embodiments, the road profile input means comprises an imaging device. In such embodiments, the imaging device may comprise a camera device, a Light Detection And Ranging (LIDAR) device, and/or a RAdio Detection And Ranging (RADAR) device to thereby provide reliable road profile data representative of a road profile in front of the vehicle.

[0022] According to an aspect of the invention, the object is achieved by a method of assisting a driver of a vehicle using processing means, road profile input means, current vehicle velocity input means, and a user interface, the processing means being arranged to communicate with the road profile input means, the current vehicle velocity input means and the user interface, the method comprising;

- receiving, in the processing means, road profile data representative of a road profile in front of the vehicle from the road profile input means, the road profile data containing slope data being representative of the slope of the road in front of the vehicle and,
- receiving, in the processing means, current vehicle velocity data representative of a current vehicle velocity of the vehicle from the current vehicle velocity input means,
- processing the slope data of the road profile data to detect if the road in front of the vehicle contains a curve which is hidden or at least partially hidden from an estimated line of sight of the driver, and
- issuing a warning, via the user interface, if a hidden or at least partially hidden curve is detected and if the current vehicle velocity exceeds a threshold velocity, wherein the method further comprises:

    - processing the road profile data to detect if a segment of the road ahead of the vehicle contains a hidden or at least partially hidden curve, to calculate a plurality of threshold velocities each being associated with a segment of the road ahead of the vehicle, and,
    - calculating a predicted future vehicle velocity at a predetermined distance from a current vehicle position, or at a predetermined time from a current time, and
    - comparing the current vehicle velocity, and/or the predicted future vehicle velocity, with the threshold velocities, and if the current vehicle velocity, and/or the predicted future vehicle velocity, exceeds one or more of the threshold velocities,
    - determining a first point of activation based at least on the comparison and on whether one or more of the segments of the road in front of the vehicle comprises a hidden or at least partially hidden curve, and
    - issuing the warning when the vehicle passes the first point of activation.

[0023] Again, since a warning is issued if a hidden or at least partially hidden curve is detected and if the current vehicle velocity exceeds a threshold velocity, driving safety is improved.

[0024] Since the warning is issued when the vehicle passes the first point of activation and the first point of activation is determined based at least on a comparison between the current vehicle velocity and/or the predicted future vehicle velocity and the plurality of threshold velocities, a predictable method is provided issuing a warning at a determined point of activation. Thereby, driving safety may be further improved. The first or second point of activation may be determined using inputs not forming part of the comparison, such as distance from the vehicle to a segment of the road ahead of the vehicle, road conditions, driver reaction time, settings in sub-systems, weather conditions, visibility, road markings, type of road, traffic density, a width of the side of the road, speed limits, driving behaviour of the driver, detection of potentially dangerous objects at the side of the road, environment at the side of the road, e.g the presence of cliffs, rock walls, etc. By using such input in the determining of the first or second point of activation, accuracy of the issuing of the warning may be improved. Thereby, the driving safety may be further improved.

[0025] Further features of, and advantages with, the present invention will become apparent when studying the appended claims and the following detailed description. Those skilled in the art will realize that different features of the present invention may be combined to create embodiments other than those described in the following, without departing from the scope of the present invention, as defined by the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The various aspects of the invention, including its particular features and advantages, will be readily understood from the following detailed description and the accompanying drawings, in which:

Fig. 1 illustrates a vehicle 3 driver assist arrangement 1 according to some embodiments.

Fig. 2 illustrates a vehicle 3 comprising a vehicle driver assist arrangement 1 according to some embodiments.

Fig. 3 illustrates a curve 16 having a progressive curvature.

Fig. 4 illustrates a method of assisting a driver of a vehicle.

DETAILED DESCRIPTION

[0027] The present invention will now be described more fully with reference to the accompanying drawings, in which example embodiments are shown. However, this invention should not be construed as limited to the embodiments set forth herein. Disclosed features of example embodiments may be combined as readily understood by one of ordinary skill in the art to which this invention belongs. Like numbers refer to like elements throughout.

[0028] Well-known functions or constructions will not necessarily be described in detail for brevity and/or clarity.

[0029] Fig. 1 illustrates a vehicle 3 driver assist arrangement 1. The arrangement 1 comprises processing means 5, road profile input means 7, current vehicle velocity input means 9, and a user interface 11. The processing means 5 are arranged to communicate with the road profile input means 7, the current vehicle velocity input means 9 and the user interface 11. The processing means 5 are further arranged to receive road profile data, representative of a road profile in front of the vehicle 3, from road profile input means 7, and to receive current vehicle velocity data representative of a current velocity of the vehicle 3 from the current vehicle velocity input means 9. The processing means 5 are still further adapted to process the road profile data to detect if the road 13 in front of the vehicle 3 contains a hidden or at least partially hidden curve 15. The arrangement 1 is adapted to issue a warning, via the user interface 11, if a hidden or at least partially hidden curve 15 is detected and if the current vehicle velocity exceeds a threshold velocity.

[0030] The threshold velocity may be based on the road profile data and limitations in lateral and/or longitudinal acceleration of the vehicle 3, and/or may be predetermined to a value being low, e.g. a value merely indicating that the vehicle 3 is moving.

[0031] The road profile data may comprise data being representative of a curvature of the road 13, a slope of the road 13, objects 25 obscuring the road 13, illumination conditions, the presence of haze, fog, snow- and/or rainfall, and/or speed limits of the road 13 in front of the vehicle 3, superelevation, banking of the road 3, presence of intersections, road type, a width of the side of the road, detection of potentially dangerous objects at the side of the road 13, environment at the side of the road 13, e.g. the presence of cliffs, rock walls, etc. Thus, by processing of such road profile data, a more accurate issuing and determining of the first point of activation can be achieved. Thereby, the driving safety is improved.

[0032] The processing means 5 may comprise one or more processing units, such as one or more processors, being capable of processing the road profile data, to thereby detect a hidden or at least partially hidden curve 15.

[0033] The road profile input means 7 may comprise means to detect and/or recognise the road profile of the road 13 in front of the vehicle 3. The road profile input means 7 may comprise an electronic map and a positioning device such as a spaced based satellite navigation system such as a Global Positioning System GPS, The Russian GLObal NAvigation Satellite System (GLONASS), European Union Galileo positioning system, Chinese Compass navigation system, or Indian Regional Navigational Satellite System. In such embodiments, the positioning device may provide a position of the vehicle 3 and the processing means 5 may be adapted to process data from the electronic map to detect if the road 13 in front of the vehicle 3 contains a hidden or at least partially hidden curve 15. As an alternative, or in combination, the electronic map may comprise information associated with curves on the map, providing information about whether a curve is hidden or not.

[0034] As an alternative, or in combination with the above, the road profile input means 7 may comprise an imaging device, such as a camera device. In such embodiments, the imaging device may form part of a camera system and/or an imaging system device being capable of capturing a digital image representation of the environment in front of the vehicle 3, to thereby provide the road profile input data. The processing means 5 may be adapted to process the digital image representation of the environment in front of the vehicle 3, captured by the imaging device, to thereby detect if the road 13 in front of the vehicle 3 contains a hidden or at least partially hidden curve 15. The camera may be a camera capable of capturing an image of visible light and/or a camera capable of capturing an image of invisible light, such as an infrared camera. The imaging device may comprise one or more cameras. The imaging device may be positioned in an area near a rear view mirror of the vehicle 3, similar to the position of the road profile input means 7 in Fig. 1. However, the imaging device may be positioned at any other position at the vehicle 3 allowing the imaging device to capture a digital image representation of the environment in front of the vehicle 3. Such position may for example be in the front of the vehicle 3.

[0035] Also, as an alternative, or in combination with the above, the imaging device may comprise a Light Detection And Ranging (LIDAR) device, and/or a RAdio Detection And Ranging (RADAR) device to thereby provide reliable road profile data representative of a road profile in front of the vehicle.

[0036] The current vehicle velocity means 9 comprises means for providing current vehicle velocity data being representative of a current velocity of the vehicle 3 hosting the arrangement 1, such as a sensor, a positioning system, or the like.

[0037] The user interface 11 may comprise a display, a speaker, and/or an arrangement 1 being capable of providing a haptic signal or any other device being capable of issuing a warning to the driver. The warning issued to the driver may comprise information such as a distance to the curve, such as a graphical presentation of such information displayed on a display. Also, a speaker voice may provide such information via a speaker. As an alternative, or in combination, the warning issued may comprise a symbol being displayed, indicating that the vehicle 3 is approaching a hidden curve 15, such as a flashing symbol being displayed in the instrument panel.

[0038] In Fig. 1 segments 20.1-20.7 of the road 13 ahead of the vehicle 3 are illustrated. According to some embodiments, the processing means 5 are arranged to process the road profile data to calculate a plurality of threshold velocities, each being associated with a segment 20.1-20.7 of the road 13 ahead of the vehicle 3, and to calculate a predicted future vehicle velocity at a predetermined distance from a current vehicle position, or at a predetermined time from a current time, and to compare the current vehicle velocity, and/or the predicted future vehicle velocity, with the threshold velocities, and if the current vehicle velocity, and/or the predicted future vehicle velocity, exceeds one or more of the threshold velocities, determine a first point of activation 17 based at least on the comparison, and to issue the warning when the vehicle 3 passes the first point of activation 17. The processing means 5 may calculate the predicted future vehicle velocity from a current vehicle velocity and a previous vehicle velocity. Thereby, it can recognize whether the vehicle is accelerating and/or decelerating and calculate a value of vehicle acceleration or deceleration. With the value of vehicle acceleration or deceleration and the current vehicle velocity, the predicted future vehicle velocity can be calculated at a predetermined distance from a current vehicle position, or at a predetermined time from a current time. Also, data from an accelerometer and/or gyroscope, which may be comprised in the arrangement 1, may be used to measure vehicle acceleration and/or deceleration, to thereby provide values by which the predicted future vehicle velocity can be calculated. In embodiments wherein the predicted future vehicle velocity is calculated at a predetermined distance from a current vehicle position, the predetermined distance may be predetermined to a distance being dependent on vehicle velocity such that a higher vehicle velocity provides a greater distance and a lower vehicle velocity provides a shorter distance. In embodiments wherein a predicted future vehicle velocity is calculated at a predetermined time from a current time, the predetermined time may be predetermined to a value similar to an estimated driver reaction time, e.g. 1,5 seconds.

[0039] In embodiments wherein the processing means 5 are arranged to calculate a predicted future vehicle velocity at a predetermined distance from a current vehicle position, or at a predetermined time from a current time, and to compare the predicted future vehicle velocity, with the threshold velocities, and if the predicted future vehicle velocity, exceeds one or more of the threshold velocities, determine a first point of activation 17 based at least on the comparison, and to issue the warning when the vehicle 3 passes the first point of activation 17, a more accurate issuing of the warning can be achieved since vehicle acceleration and deceleration is taken into account. That is, if the vehicle is accelerating, the predicted future vehicle velocity will become higher than in case of an vehicle deceleration, and thus, given a certain road profile and a given current vehicle velocity, the driver assist arrangement will more likely issue a warning. This further improves driving safety since a vehicle accelerating when approaching a curve is a more dangerous situation than a vehicle decelerating or keeping a constant velocity when approaching a curve.

[0040] A segment 20.1-20.7 of the road 13 in front of the vehicle 3 is an imaginary division of the road 13 in front of the vehicle 3. Each segment 20.1-20.7 may have a predetermined length, e.g. 5,5 meters. The calculation of the plurality of threshold velocities may be based on the road profile data and limitations in lateral and/or longitudinal acceleration of the vehicle 3. That is, the processing means 5 may divide the road 13 in front of the vehicle 3 into segments 20.1-20.7, and calculate a threshold velocity for each segment 20.1-20.7, e.g. based on the road profile data and limitations in lateral and/or longitudinal acceleration of the vehicle 3. The processing means 5 may compare the current vehicle velocity, and/or the predicted future vehicle velocity, with each of the threshold velocities associated with segments 20.1-20.7 up to a certain distance in front of the vehicle 3. This distance may be predetermined, e.g. 500

meters and/or may be dependent on the current vehicle velocity e.g. such that the distance is longer in case of a high current vehicle velocity and shorter in case of a low current vehicle velocity. The processing means 5 may determine a first point of activation 17, based at least on the comparison, and to issue the warning when the vehicle 3 passes the first point of activation 17. Since the warning is issued when the vehicle 3 passes the first point of activation 17, the warning may be issued at an appropriate distance to the hidden or at least partially hidden curve 15.

[0041] Determining of the first point of activation 17 may further be based inputs representative of a distance from the vehicle 3 to a segment 20.1-20.7 of the road 13 ahead of the vehicle 3, vehicle velocity, road conditions, driver reaction time, settings in sub-systems, weather conditions, visibility, road markings, type of road, traffic density, driving behaviour of the driver, a width of the side of the road, speed limits, detection of potentially dangerous objects at the side of the road, environment at the side of the road, e.g. the presence of cliffs, rock walls, etc. By using such input in the determining of the first point of activation, accuracy of the issuing of the warning may be improved. Thereby, the driving safety may be further improved. For example, in case a road mark is detected indicating an overtaking ban, such as a solid line in the middle of the road, the first point of activation can be determined to a point being closer to the vehicle, and thus further from a curve. Likewise, in case of detection of badly worn road markings, or lack of road markings, the first point of activation can be determined to a point being closer to the vehicle, and thus further from a curve. Further, the first point of activation can be determined at a point being closer to the vehicle in case of a driver having a calm driving pattern than in case of a driver having an aggressive driving pattern.

[0042] Issuance of the warning may be performed in dependence of a severity of a driving situation. That is, issuance of the warning may be performed in dependence of the comparison between the current vehicle velocity and/or the predicted future vehicle velocity and the threshold velocities, such that a certain degree of warning is performed with regard to the displaying of symbols and/or displaying of graphical information and/or issuance of warning sounds, in case the comparison indicates a vehicle velocity, and/or a predicted future vehicle velocity, being significantly higher than one or more of the threshold velocities. Also, the degree of the warning may be performed in dependence of a distance to a segment of the road 13 being associated with a threshold velocity, such that a certain degree of warning is performed with regard to the displaying of symbols and/or displaying of graphical information and/or issuance of warning sounds, in case the vehicle 3 is at a certain distance to the segment. In such embodiments, a degree of warning may be such that a low degree of warning is performed when the distance to a segment is long and as the vehicle 3 is approaching the segment, i.e. the distance to the segment becomes shorter, the degree of warning is increased. Thereby, warning is performed in dependence of a severity of a driving situation. Due to the warning being performed in dependence of a severity of a driving situation, driving safety may be further improved.

[0043] According to some embodiments, the plurality of threshold velocities, each being associated with a segment 20.1-20.7 of the road 13 ahead of the vehicle 3, may be provided in the form of a threshold velocity vector 24, containing threshold velocity vector elements 24.1-24.7, with values being representative of the plurality of threshold velocities. Each threshold velocity vector element 24.1-24.7 is associated with a segment 20.1-20.7 of the road 13. In Fig. 1, the threshold velocity vector element 24.1 is associated with road segment 20.1, the threshold velocity vector element 24.2 is associated with road segment 20.2, the threshold velocity vector element 24.3 is associated with road segment 20.3, and so forth.

[0044] According to some embodiments, the processing means 5 are adapted to determine a second point of activation 19, based at least on the comparison. The second point of activation 19 being further down the road 13 in an intended direction of travel than the first point of activation 17. If no hidden or at least partially hidden curve 15 is detected, the warning is issued when the vehicle 3 passes the second point of activation 19. The warning issued if no hidden or at least partially hidden curve 15 is detected may be different from the warning issued if a hidden or at least partially hidden curve 15 is detected. That is, the warning issued if no hidden or at least partially hidden curve 15 is detected may be issued such that a driver may distinguish between the warnings, e.g. by means of a symbol displayed, or a sound/speaker voice, being distinguishable from the warning being issued in case a hidden or at least partially hidden curve 15 is detected. In these embodiments, the driver will receive a warning in case of approaching a curve with too high velocity, even if the curve is not hidden and the driver may be able to separate between hidden and unhidden curves due to the different warnings being issued. Thus, in case no hidden or partially hidden curve 15 is detected, the arrangement 1 may function as an ordinary curve speed arrangement, as previously known in the art. Since the driver receives a warning in case of approaching a curve with too high velocity, even if the curve is not hidden, driving safety is further improved. Also, since the second point of activation 19 is further down the road 13, in an intended direction of travel, than the first point of activation 17, the driver will receive a warning at appropriate distance with regard to the type of curve being approached, since a hidden curve may pose a greater hazard to driving safety than a curve being visible to the driver.

[0045] According to some embodiments, the processing means 5 are adapted to determine further points of activations, such as a third, a forth and/or a fifth point of activation based at least on the comparison. In such embodiments, these points of activation may differ from the first and second point of activation to provide different levels of warnings and/or a warning being issued stepwise.

[0046] The first and/or the second point of activation 17, 19 may coincide with and/or be associated with one of the segments 20.1-20.7. In such embodiments, a warning may be issued when the vehicle 3 passes or enters such a segment 20.7-20.7 of the road 13.

[0047] According to some embodiments, the first and/or the second point of activation 17, 19 may be determined assessing a future deceleration process. That is, the first and/or the second point of activation 17, 19 may e.g. be determined by comparing the threshold velocities and estimate a necessary future deceleration in order to adopt a suitable velocity. This may be achieved using an acceleration vector 26. The acceleration vector 26 may comprise acceleration vector elements 26.1-26.7, each element 26.1-26.7 being associated with two threshold velocity vector elements 24.1-24.7, in the sense that a value of an acceleration vector element is representative of the relative difference between values of the two adjacent threshold velocity vector elements. In Fig. 1, the acceleration vector element 26.1 has a value being representative of the relative difference between the threshold velocity in threshold velocity vector element 24.1 and the threshold velocity in threshold velocity vector element 24.2. The result given in the acceleration vector element 26.1 indicates whether the road 13 admits acceleration or deceleration with regard to limitations in lateral and/or longitudinal acceleration of the vehicle 3. A positive value indicates that limitations in lateral and/or longitudinal acceleration of the vehicle 3 admits an acceleration of the vehicle 3 in the intended direction of travel, whereas a negative value indicates that limitations in lateral and/or longitudinal acceleration of the vehicle 3 implies that deceleration must be performed on the associated segment of the road 13 in order to pass a curve safely. Accordingly, the processing means 5 may perform a comparison between values of the acceleration vector 26.1-26.7 and the current vehicle velocity, and/or the acceleration of the vehicle 3, and/or the predicted future vehicle velocity, such that the first or second point of activation 17, 19 is moved or determined to a location being closer to the vehicle 3, in an intended direction of travel, in case the comparison indicates any reduction in driving safety. For example, if the driver forces the vehicle 3 to accelerate while an element of the acceleration vector 26 indicates that two adjacent segments of the road 13 implies deceleration, issuance of the warning may be performed at a greater distance from the two segments, e.g. at a greater distance from a curve.

[0048] According to some embodiments, detection of a hidden curve 15 or at least a partially hidden curve 15 is based on detection of an object 25 obscuring the curve 15 from an estimated line of sight of the driver. The object 25 is illustrated as a tree in Fig. 1. However, the object 25 may be any other type of object obscuring the curve 13 from an estimated line of sight of the driver, such as a building, another vehicle, etc. The detection of the object obscuring the curve 15 from an estimated line of sight of the driver may be performed by means of an imaging device, such as a camera device a Light Detection And Ranging (LIDAR) device, and/or a RAdio Detection And Ranging (RADAR) device. Thus, the processing means 5 may, in such embodiments, may be adapted to process a digital image representation of the environment in front of the vehicle 3, captured by the imaging device, to thereby detect if a curve 15 in front of the vehicle 3 is hidden or at least partially hidden by an object 25 obscuring the curve 15 from an estimated line of sight of the driver.

[0049] According to some embodiments, the processing means 5 may process the road profile input data to detect if a segment 20.1-20.7 of the road 13 in front of the vehicle 3 contains a hidden or at least partially hidden part 15 of the road 13 and to set values of visibility vector elements 33.1-33.7 of a visibility vector 33 such that the values indicates if a segment 20.1-20.7 of the road 13 associated with respective visibility vector elements 33.1-33.7 comprises a hidden part of the road 13, e.g. in the form of values 1 (one) and 0 (zeros) wherein the value 1 indicates that the segment is visible to the driver and the value 0 (zero) indicates that the segment is hidden to the driver. In Fig. 1, the visibility vector elements 33.6 and 33.7 are illustrated as having a value of 0 (zero), since visibility vector elements 33.6 and 33.7 are associated with segments 20.6 and 20.7 of the road 13 being hidden from an estimated line of sight of the driver, due to the object 25 obscuring the curve 15, whereas the visibility vector elements 33.1-33.5 are illustrated as having a value of 1, since visibility vector elements 33.1-33.5 are associated with segments 20.1- 20.5 of the road 13 being visible from an estimated line of sight of the driver. Thus, the processing means 5 may compare values of the visibility vector 33 with the road profile data and if one or more segments of the road 13 in front of the vehicle 3 comprises a hidden or at least partially hidden curve 15, issue the warning and/or determine the first point of activation 17.

[0050] For example, if the vehicle 3 is approaching a curve with a velocity exceeding, and/or a predicted future vehicle velocity exceeding, one or more of the plurality of threshold velocity values, e.g. given in the threshold velocity vector 24, the processing means 5 may determine a first point of activation 17 in case the road 13 in front of the vehicle 3 contains a hidden or at least partially hidden curve 15, e.g. the visibility vector indicates that a part of the road 13, containing a curve, is hidden from an estimated line of sight of the driver, whereas the processing means 5 may determine a second point of activation 19 in case the road 13 in front of the vehicle 3 contains a visible curve, e.g. the visibility vector indicates that a part of the road, containing a curve, is visible from an estimated line of sight of the driver.

[0051] Further, according to some embodiments, detection of a hidden or at least a partially hidden curve 15 may be based on illumination conditions and/or the presence of haze or fog and/or snow- and/or rain-fall. The illumination conditions and/or the presence of haze or fog and/or snow- and/or rain-fall may, according to some embodiments, be detected using the imaging device being comprised in the road profile input means 7. Thus, the processing means 5 may, in such embodiments, be adapted to process a digital image representation of the environment in front of the vehicle 3 captured by the imaging device to thereby determine illumination condition and/or the presence of haze or fog and/or snow- and/or rain-fall on the road 13 in front of the vehicle 3. As an alternative, or in combination with the above, a sensor or the like, appropriate for the purpose, may be used to determine illumination conditions and/or the presence of haze or fog and/or snow- and/or rain-fall.

[0052] According to some embodiments, the arrangement 1 may further comprise means 27 for detection of a direction of the driver's line of sight, the detection of a hidden or at least a partially hidden curve 15 being based on the direction of the driver's line of sight. The means 27 for detection of a direction of the driver's line of sight may comprise a camera, or the like, monitoring movement of and/or direction of the driver's eyes and/or head. Thereby, the direction of the driver's line of sight may be determined and may be used by the arrangement 1 to determine whether the driver has seen a curve or not. In these embodiments, the processing means 5 may be adapted to determine a first or second point of activation 17, 19 at a point closer down the road 13 in an intended direction of travel, in case it is determined that the driver has not seen the curve, than in case it is determined that the driver has seen the curve. In doing so, driving safety may be further improved, since the driver will receive the warning at a point being further from the curve if he or she looks in a direction not being towards the curve.

[0053] Fig. 2 illustrates a vehicle 3 comprising a vehicle driver assist arrangement 1 according to some embodiments. The vehicle 3 is traveling along a road 13. Due to a geographical formation of the road 13, a driver of the vehicle 3 is able to see the part 30 of the road 13 while a part 31 of the road 13 is hidden from an estimated line of sight of the driver. According to some embodiments, the road profile data contains slope data being representative of the slope of the road 13 in front of the vehicle 3, the detection of a hidden curve or at least a partially hidden curve is based on processing of the slope data to detect if a part of the road 13 is hidden or at least partially hidden. Thus, the slope data may indicate if a part of the road 13 is hidden from an estimated line of sight of the driver, e.g. if a part of the road 13 is hidden by a crest, edge, a top of a hill, etc. The slope data may be provided in the form of a slope data vector 32, containing slope data vector elements 32.1-32.6 with values representative of the slope of the road 13 in front of the vehicle 3, either calculated by the processing means 5 or retrieved by the processing means 5 from the road profile input data. In such embodiments, the processing means 5 may process the slope data vector 32 to create a visibility vector 33 containing visibility vector elements 33.1-33.6 with values indicating if segments associated with respective vector elements comprises a hidden part of the road 13, e.g. in the form of values 1 (one) and 0 (zeros) wherein the value 1 indicates that the segment is visible to the driver and the value 0 (zero) indicates that the segment is hidden to the driver. In Fig. 2, the visibility vector elements 33.5-33.6 are illustrated as having a value of 0 (zero), since visibility vector elements 33.5 and 33.6 are associated with a segments 20.5 and 20.6 of the road 13 being hidden from an estimated line of sight of the driver, whereas the visibility vector elements 33.1-33.4 are illustrated as having a value of 1, since visibility vector element 33.1-33.4 are associated with segments 20.1-20.4 of the road 13 being visible from an estimated line of sight of the driver. Also, according to some embodiments, the visibility vector 33 may not be created by the processing means 5 by a processing of the slope data vector 32. Instead, the visibility vector 33 may already be comprised in the road profile input data.

[0054] Fig. 3 illustrates a curve 16 having a progressive curvature. According to some embodiments, the detection of a hidden curve or at least a partially hidden curve is based on detection of a curve 16 having a progressive curvature. A curve having a progressive curvature is a curve having a radius of curvature that decreases when traveling along the curve. A curve having a progressive curvature may pose a greater hazard to driving safety than a curve having a continuous or increasing radius of curvature since a curve having a progressive curvature admits a higher vehicle velocity in the beginning of the curve as compared to the end of the curve. Therefore, it may be difficult for a driver to determine an appropriate entrance velocity in such curve. Also, such curves may be hard to identify by a driver approaching a curve since a part of the curve may be hidden and/or the driver not following the curve with his eyes. The detection of a curve having a progressive curvature may be performed by processing road profile input data. In embodiments wherein the road profile input means 7 comprises an electronic map and a positioning device, data from the electronic map may be processed in order to detect curves having a progressive curvature.

[0055] According to some embodiments, data from an accelerometer and/or gyroscope, which may be comprised in the arrangement 1, may be used to detect if the road 13 is inclined, is super elevated, or has a slope. This information may be used to verify road profile data and/or modify the first and/or second point of activation 17, 19.

[0056] Fig. 4 illustrates a method of assisting a driver of a vehicle using processing means, road profile input means, current vehicle velocity input means, and a user interface, the processing means are arranged to communicate with the road profile input means, the current vehicle velocity input means and the user interface, the method comprising;

- receiving 101, in the processing means, road profile data representative of a road profile in front of the vehicle from the road profile input means and,
- receiving 102, in the processing means, current vehicle velocity data representative of a current vehicle velocity of the vehicle from the current vehicle velocity input means,
- processing 103 the road profile data to detect if the road in front of the vehicle contains a hidden or at least partially hidden curve, and
- issuing 104 a warning, via the user interface, if a hidden or at least partially hidden curve is detected and if the current vehicle velocity exceeds a threshold velocity.

[0057] Again, since a warning is issued if a hidden or at least partially hidden curve is detected and if the current vehicle velocity exceeds a threshold velocity, driving safety is improved.

[0058] The method further comprises;

- processing 105 the road profile data to calculate a plurality of threshold velocities each being associated with a segment of the road ahead of the vehicle, and
- calculating 106 a predicted future vehicle velocity at a predetermined distance from a current vehicle position, or at a predetermined time from a current time, and
- comparing 107 the current vehicle velocity, and/or the predicted future vehicle velocity, with the threshold velocities, and if the current vehicle velocity, and/or the predicted future vehicle velocity, exceeds one or more of the threshold velocities,
- determining 108 a first point of activation based at least on the comparison, and
- issuing 109 the warning when the vehicle passes the first point of activation.

[0059] In such embodiments, since the warning is issued when the vehicle passes the first point of activation and the first point of activation is determined based at least on a comparison between the current vehicle velocity, and/or the predicted future vehicle velocity, and the plurality of threshold velocities, a predictable method is provided issuing a warning at a determined point of activation. Thereby, driving safety may be further improved. The first point of activation may be determined using inputs not forming part of the comparison, such as distance from the vehicle to a segment of the road ahead of the vehicle, road condition, driver reaction time, settings in sub-systems, weather conditions, visibility, road markings, type of road, traffic density, a width of the side of the road, speed limits, driving behaviour of the driver, detection of potentially dangerous objects at the side of the road, environment at the side of the road, e.g. the presence of cliffs, rock walls, etc.

Claims

1. A vehicle (3) driver assist arrangement (1), the arrangement (1) comprising processing means (5), road profile input means (7), current vehicle velocity input means (9), and a user interface (11), the processing means (5) being arranged to communicate with the road profile input means (7), the current vehicle velocity input means (9) and the user interface (11), the processing means (5) further being arranged to receive road profile data representative of a road profile in front of the vehicle (3) from the road profile input means (7), and to receive current vehicle velocity data representative of a current vehicle velocity of the vehicle (3) from the current vehicle velocity input means (9), wherein the processing means (5) still further are adapted to process the road profile data to detect if the road (13) in front of the vehicle (3) contains a curve (15) which is hidden or at least partially hidden from an estimated line of sight of the driver, the arrangement (1) being adapted to issue a warning, via the user interface (11), if a hidden or at least partially hidden curve (15) is detected and if the current vehicle velocity exceeds a threshold velocity, **characterized in that** the processing means (5) are arranged to process the road profile data to detect if a segment (20.1-20.7) of the road (13) ahead of the vehicle (3) contains a hidden or at least partially hidden curve, to calculate a plurality of threshold velocities each being associated with a segment (20.1-20.7) of the road (13) ahead of the vehicle (3), and to calculate a predicted future vehicle velocity at a predetermined distance from a current vehicle position, or at a predetermined time from a current time, and to compare the current vehicle velocity, and/or the predicted future vehicle velocity, with the threshold velocities, and if the current vehicle velocity, and/or the predicted future vehicle velocity, exceeds one or more of the threshold velocities, determine a first point of activation (17) based at least on the comparison and on whether one or more of the segments of the road (13) in front of the vehicle (3) comprises a hidden or at least partially hidden curve, and to issue the warning when the vehicle (3) passes the first point of activation (17).

2. The vehicle (3) driver assist arrangement (1) according to claim 1, **characterized in that** the processing means (5) are adapted to determine a second point of activation (19) based at least on the comparison, the second point of activation (19) being further down the road (13) in an intended direction of travel than the first point of activation (17), and if no hidden or at least partially hidden curve (15) is detected, issue a warning when the vehicle (3) passes the second point of activation (19).

3. The vehicle (3) driver assist arrangement (1) accord-

ing to claim 1 or 2, **characterized in that** the calculation of the plurality of threshold velocities, is based on the road profile data and limitations in lateral and/or longitudinal acceleration of the vehicle (3).

4. The vehicle (3) driver assist arrangement (1) according to any of the claims 1-3, **characterized in that** the detection of a hidden or at least a partially hidden curve (15) is based on detection of a curve (16) having a progressive curvature.

5. The vehicle (3) driver assist arrangement (1) according to any of the claims 1-4, **characterized in that** the detection of a hidden or at least a partially hidden curve (15) is based on detection of an object (25) obscuring the curve (15) from an estimated line of sight of the driver.

6. The vehicle (3) driver assist arrangement (1) according to any of the claims 1-5, **characterized in that** the detection of a hidden or at least a partially hidden curve (15) is based on illumination conditions and/or the presence of haze or fog.

7. The vehicle (3) driver assist arrangement (1) according to any of the claims 1-6, **characterized in that** it further comprises means (27) for detection of a direction of the drivers line of sight, the detection of a hidden or at least a partially hidden curve (15) being based on the direction of the drivers line of sight.

8. The vehicle (3) driver assist arrangement (1) according to any of the claims 1-7, **characterized in that** the road profile input means (7) comprises an electronic map and a positioning device.

9. The vehicle (3) driver assist arrangement (1) according to any of the claims 1-8, **characterized in that** the road profile input means (7) comprises an imaging device.

10. A vehicle (3), **characterized in that** it comprises a vehicle (3) driver assist arrangement (1) according to any one of the preceding claims.

11. A method of assisting a driver of a vehicle using processing means, road profile input means, current vehicle velocity input means, and a user interface, the processing means being arranged to communicate with the road profile input means, the current vehicle velocity input means and the user interface, the method comprising;

- receiving (101), in the processing means, road profile data representative of a road profile in front of the vehicle from the road profile input means, the road profile data containing slope data being representative of the slope of the road (13) in front of the vehicle (3) and,
- receiving (102), in the processing means, current vehicle velocity data representative of a current vehicle velocity of the vehicle from the current vehicle velocity input means,
- processing (103) the slope data of the road profile data to detect if the road in front of the vehicle contains a curve which is hidden or at least partially hidden from an estimated line of sight of the driver, and
- issuing (104) a warning, via the user interface, if a hidden or at least partially hidden curve is detected and if the current vehicle velocity exceeds a threshold velocity, wherein the method further comprises:
- processing (105) the road profile data to detect if a segment (20.1-20.7) of the road (13) ahead of the vehicle (3) contains a hidden or at least partially hidden curve, to calculate a plurality of threshold velocities each being associated with a segment of the road ahead of the vehicle, and ,
- calculating (106) a predicted future vehicle velocity at a predetermined distance from a current vehicle position, or at a predetermined time from a current time, and
- comparing (107) the current vehicle velocity, and/or the predicted future vehicle velocity, with the threshold velocities, and if the current vehicle velocity, and/or the predicted future vehicle velocity, exceeds one or more of the threshold velocities,
- determining (108) a first point of activation based at least on the comparison and on whether one or more of the segments of the road (13) in front of the vehicle (3) comprises a hidden or at least partially hidden curve, and
- issuing (109) the warning when the vehicle passes the first point of activation.

Patentansprüche

1. Fahrerassistenzeinrichtung (1) eines Fahrzeugs (3), wobei die Anordnung (1) Verarbeitungsmittel (5), Straßenprofileingabemittel (7), aktuelle Fahrzeuggeschwindigkeitseingabemittel (9) und eine Benutzerschnittstelle (11) umfasst, wobei die Verarbeitungsmittel (5) vorgesehen sind, um mit dem Straßenprofileingabemittel (7), dem aktuellen Fahrzeuggeschwindigkeitseingabemittel (9) und der Benutzerschnittstelle (11) zu kommunizieren, wobei die Verarbeitungsmittel (5) ferner vorgesehen sind, um von dem Straßenprofileingabemittel (7) Straßenprofildaten zu empfangen, die für ein Straßenprofil vor dem Fahrzeug (3) repräsentativ sind, und um von dem aktuellen Fahrzeuggeschwindigkeitseingabemittel (9) aktuelle Fahrzeuggeschwindigkeitsdaten zu empfangen, die für eine aktuelle Fahrzeugge-

schwindigkeit des Fahrzeugs (3) repräsentativ sind, wobei die Verarbeitungsmittel (5) ferner noch vorgesehen sind, um die Straßenprofildaten zu verarbeiten, um zu erkennen, ob die Straße (13) vor dem Fahrzeug (3) eine Kurve (15) enthält, die vor einer geschätzten Sichtlinie des Fahrers verborgen oder mindestens teilweise verborgen ist, wobei die Anordnung (1) vorgesehen ist, um eine Warnung über die Benutzerschnittstelle (11) auszugeben, falls eine verborgene oder mindestens teilweise verborgene Kurve (15) erkannt wird und falls die aktuelle Fahrzeuggeschwindigkeit eine Schwellenwertgeschwindigkeit überschreitet,
dadurch gekennzeichnet, dass die Verarbeitungsmittel (5) vorgesehen sind, um die Straßenprofildaten zu verarbeiten, um zu erkennen, ob ein Segment (20.1-20.7) der Straße (13) vor dem Fahrzeug (3) eine verborgene oder mindestens teilweise verborgene Kurve enthält, um eine Vielzahl von Schwellenwertgeschwindigkeiten zu berechnen, die jeweils einem Segment (20.1-20.7) der Straße (13) vor dem Fahrzeug (3) zugeordnet sind, und eine prognostizierte zukünftige Fahrzeuggeschwindigkeit in einem vorbestimmten Abstand zu einer aktuellen Fahrzeugposition oder zu einer vorbestimmten Zeit von einer aktuellen Zeit zu berechnen, und die aktuelle Fahrzeuggeschwindigkeit und/oder die prognostizierte zukünftige Fahrzeuggeschwindigkeit mit den Schwellenwertgeschwindigkeiten zu vergleichen, und um, falls die aktuelle Fahrzeuggeschwindigkeit und/oder die prognostizierte zukünftige Fahrzeuggeschwindigkeit eine oder mehrere von den Schwellenwertgeschwindigkeiten überschreitet bzw. überschreiten, einen ersten Aktivierungspunkt (17) basierend mindestens auf dem Vergleich und darauf, ob ein oder mehrere der Segmente der Straße (13) vor dem Fahrzeug (3) eine verborgene oder mindestens teilweise verborgene Kurve umfassen, zu ermitteln, und um die Warnung auszugeben, wenn das Fahrzeug (3) den ersten Aktivierungspunkt (17) passiert.

2. Fahrerassistenzeinrichtung (1) eines Fahrzeugs (3) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verarbeitungsmittel (5) eingerichtet sind, um einen zweiten Aktivierungspunkt (19) basierend mindestens auf dem Vergleich zu ermitteln, wobei der zweite Aktivierungspunkt (19) sich in einer vorgesehenen Reiserichtung weiter abwärts auf der Straße (13) befindet als der erste Aktivierungspunkt (17), und um, falls keine verborgene oder mindestens teilweise verborgene Kurve (15) erkannt worden ist, eine Warnung auszugeben, wenn das Fahrzeug (3) den zweiten Aktivierungspunkt (19) passiert.

3. Fahrerassistenzeinrichtung (1) eines Fahrzeugs (3) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Berechnung der Vielzahl von Schwellenwertgeschwindigkeiten auf den Straßenprofildaten und Einschränkungen in der lateralen und/oder longitudinalen Beschleunigung des Fahrzeugs (3) basiert.

4. Fahrerassistenzeinrichtung (1) eines Fahrzeugs (3) nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Erkennung einer verborgenen oder mindestens teilweise verborgenen Kurve (15) auf der Erkennung einer Kurve (16) mit einer progressiven Krümmung basiert.

5. Fahrerassistenzeinrichtung (1) eines Fahrzeugs (3) nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die Erkennung einer verborgenen oder mindestens teilweise verborgenen Kurve (15) auf der Erkennung eines Objekts (25) basiert, das die Kurve (15) vor einer geschätzten Sichtlinie des Fahrers verdeckt.

6. Fahrerassistenzeinrichtung (1) eines Fahrzeugs (3) nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** die Erkennung einer verborgenen oder mindestens teilweise verborgenen Kurve (15) auf den Beleuchtungsbedingungen und/oder der Anwesenheit von Dunst oder Nebel basiert.

7. Fahrerassistenzeinrichtung (1) eines Fahrzeugs (3) nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** sie ferner Mittel (27) zum Erkennen einer Richtung der Sichtlinie des Fahrers umfasst, wobei die Erkennung einer verborgenen oder mindestens einer teilweise verborgenen Kurve (15) auf der Richtung der Sichtlinie des Fahrers basiert.

8. Fahrerassistenzeinrichtung (1) eines Fahrzeugs (3) nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** das Straßenprofileingabemittel (7) eine elektronische Karte und eine Positioniervorrichtung umfasst.

9. Fahrerassistenzeinrichtung (1) eines Fahrzeugs (3) nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet, dass** das Straßenprofileingabemittel (7) eine Bildgebungsvorrichtung umfasst.

10. Fahrzeug (3), **dadurch gekennzeichnet, dass** es eine Fahrerassistenzeinrichtung (1) eines Fahrzeugs (3) gemäß einem der vorhergehenden Ansprüche umfasst.

11. Verfahren zum Assistieren eines Fahrers eines Fahrzeugs unter Verwendung von Verarbeitungsmitteln, Straßenprofileingabemitteln, aktuellen Fahrzeuggeschwindigkeitseingabemitteln und einer Benutzerschnittstelle, wobei die Verarbeitungsmittel vorgesehen sind, um mit dem Straßenprofileingabemittel, dem aktuelle Fahrzeuggeschwindigkeitseingabemittel und der Benutzerschnittstelle zu kommunizieren, wobei das Verfahren umfasst:

- Empfangen (101) von Straßenprofildaten, die für ein Straßenprofil vor dem Fahrzeug repräsentativ sind, in dem Verarbeitungsmittel von dem Straßenprofileingabemittel, wobei die Straßenprofildaten Neigungdaten enthalten, die für die Neigung der Straße (13) vor dem Fahrzeug (3) repräsentativ sind, und
- Empfangen (102) von aktuellen Fahrzeuggeschwindigkeitsdaten, die für eine aktuelle Fahrzeuggeschwindigkeit des Fahrzeugs repräsentativ sind, in dem Verarbeitungsmittel von dem aktuellen Fahrzeuggeschwindigkeitseingabemittel,
- Verarbeiten (103) der Neigungsdaten der Straßenprofildaten, um zu erkennen, ob die Straße vor dem Fahrzeug eine Kurve enthält, die vor einer geschätzten Sichtlinie des Fahrers verborgen oder mindestens teilweise verborgen ist, und
- Ausgeben (104) einer Warnung mittels der Benutzeroberfläche, falls eine verborgene oder mindestens teilweise verborgene Kurve erkannt wird und falls die aktuelle Fahrzeuggeschwindigkeit eine Schwellenwertgeschwindigkeit überschreitet, wobei das Verfahren ferner umfasst:
- Verarbeiten (105) der Straßenprofildaten, um zu erkennen, ob ein Segment (20.1-20.7) der Straße (13) vor dem Fahrzeug (3) eine verborgene oder mindestens teilweise verborgene Kurve enthält, um eine Vielzahl von Schwellenwertgeschwindigkeiten zu berechnen, die jeweils einem Segment der Straße vor dem Fahrzeug zugeordnet sind, und
- Berechnen (106) einer prognostizierten zukünftigen Fahrzeuggeschwindigkeit in einem vorbestimmten Abstand zu einer aktuellen Fahrzeugposition oder zu einer vorbestimmten Zeit von einer aktuellen Zeit, und
- Vergleichen (107) der aktuellen Fahrzeuggeschwindigkeit und/oder der prognostizierten zukünftigen Fahrzeuggeschwindigkeit mit den Schwellenwertgeschwindigkeiten, und falls die aktuelle Fahrzeuggeschwindigkeit und/oder die prognostizierte zukünftige Fahrzeuggeschwindigkeiten einen oder mehrere der Schwellenwertgeschwindigkeiten überschreitet bzw. überschreiten,
- Ermitteln (108) eines ersten Aktivierungspunkts basierend mindestens auf dem Vergleich und darauf, ob ein oder mehrere der Segmente der Straße (13) vor dem Fahrzeug (3) eine verborgene oder mindestens teilweise verborgene Kurve umfassen, und
- Ausgeben (109) der Warnung, wenn das Fahrzeug den ersten Aktivierungspunkt passiert.

Revendications

1. Agencement d'assistance à la conduite (1) d'un véhicule (3), l'agencement (1) comprenant des moyens de traitement (5), des moyens d'entrée de profil de route (7), des moyens d'entrée de vitesse de véhicule actuelle (9) et une interface utilisateur (11), les moyens de traitement (5) étant arrangés pour communiquer avec les moyens d'entrée de profil de route (7), les moyens d'entrée de vitesse de véhicule actuelle (9) et l'interface utilisateur (11), les moyens de traitement (5) étant en outre arrangés pour recevoir des données de profil de route représentant un profil de route devant le véhicule (3) en provenance des moyens d'entrée de profil de route (7) et pour recevoir des données de vitesse de véhicule actuelle représentant une vitesse de véhicule actuelle du véhicule (3) en provenance des moyens d'entrée de vitesse de véhicule actuelle (9), dans lequel les moyens de traitement (5) sont encore en outre conçus pour traiter les données de profil de route pour détecter si la route (13) devant le véhicule (3) contient une courbe (15) qui est cachée ou au moins partiellement cachée d'une ligne de vision estimée du conducteur, l'agencement (1) étant conçu pour émettre une alarme, par le biais de l'interface utilisateur (11), si une courbe cachée ou au moins partiellement cachée (15) est détectée et si la vitesse de véhicule actuelle dépasse une vitesse de seuil, **caractérisé en ce que** les moyens de traitement (5) sont arrangés pour traiter les données de profil de route pour détecter si un segment (20.1 à 20.7) de la route (13) devant le véhicule (3) contient une courbe cachée ou au moins partiellement cachée, pour calculer une pluralité de vitesses de seuil, chacune étant associée à un segment (20.1 à 20.7) de la route (13) devant le véhicule (3) et pour calculer une future vitesse de véhicule prédite à une distance prédéterminée par rapport à une position de véhicule actuelle, ou à un moment prédéterminé par rapport au moment actuel, et pour comparer la vitesse de véhicule actuelle et/ou la future vitesse de véhicule prédite, avec les vitesses de seuil, et, si la vitesse de véhicule actuelle et/ou la future vitesse de véhicule prédite dépassent une ou plusieurs des vitesses de seuil, pour déterminer un premier point d'activation (17) en se basant au moins sur la comparaison et sur le fait qu'un ou plusieurs des segments de la route (13) devant le véhicule (3) comprennent ou non une courbe cachée ou au moins partiellement cachée et pour émettre l'avertissement lorsque le véhicule (3) passe le premier point d'activation (17).

2. Agencement d'assistance à la conduite (1) d'un vé-

hicule (3) selon la revendication 1, **caractérisé en ce que** les moyens de traitement (5) sont conçus pour déterminer un second point d'activation (19) en se basant au moins sur la comparaison, le second point d'activation (19) se trouvant plus loin sur la route (13) dans une direction prévue de déplacement que ne l'est le premier point d'activation (17) et, si aucune courbe cachée ou au moins partiellement cachée (15) n'est détectée, pour émettre un avertissement lorsque le véhicule (3) passe le second point d'activation (19).

3. Agencement d'assistance à la conduite (1) d'un véhicule (3) selon la revendication 1 ou 2, **caractérisé en ce que** le calcul de la pluralité de vitesses de seuil est basé sur les données de profil de route et sur des limitations de l'accélération latérale et/ou longitudinale du véhicule (3).

4. Agencement d'assistance à la conduite (1) d'un véhicule (3) selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** la détection d'une courbe cachée ou au moins d'une courbe partiellement cachée (15) est basée sur la détection d'une courbe (16) ayant une courbure progressive.

5. Agencement d'assistance à la conduite (1) d'un véhicule (3) selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** la détection d'une courbe cachée ou au moins d'une courbe partiellement cachée (15) est basée sur la détection d'un objet (25) cachant la courbe (15) d'une ligne de vision estimée du conducteur.

6. Agencement d'assistance à la conduite (1) d'un véhicule (3) selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** la détection d'une courbe cachée ou au moins d'une courbe partiellement cachée (15) est basée sur des conditions d'éclairage et/ou sur la présence de brume ou de brouillard.

7. Agencement d'assistance à la conduite (1) d'un véhicule (3) selon l'une quelconque des revendications 1 à 6, **caractérisé en ce qu'**il comprend en outre des moyens (27) pour la détection d'une direction de la ligne de vision du conducteur, la détection d'une courbe cachée ou au moins d'une courbe partiellement cachée (15) étant basée sur la direction de la ligne de vision du conducteur.

8. Agencement d'assistance à la conduite (1) d'un véhicule (3) selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que** les moyens d'entrée de profil de route (7) comprennent une carte électronique et un dispositif de positionnement.

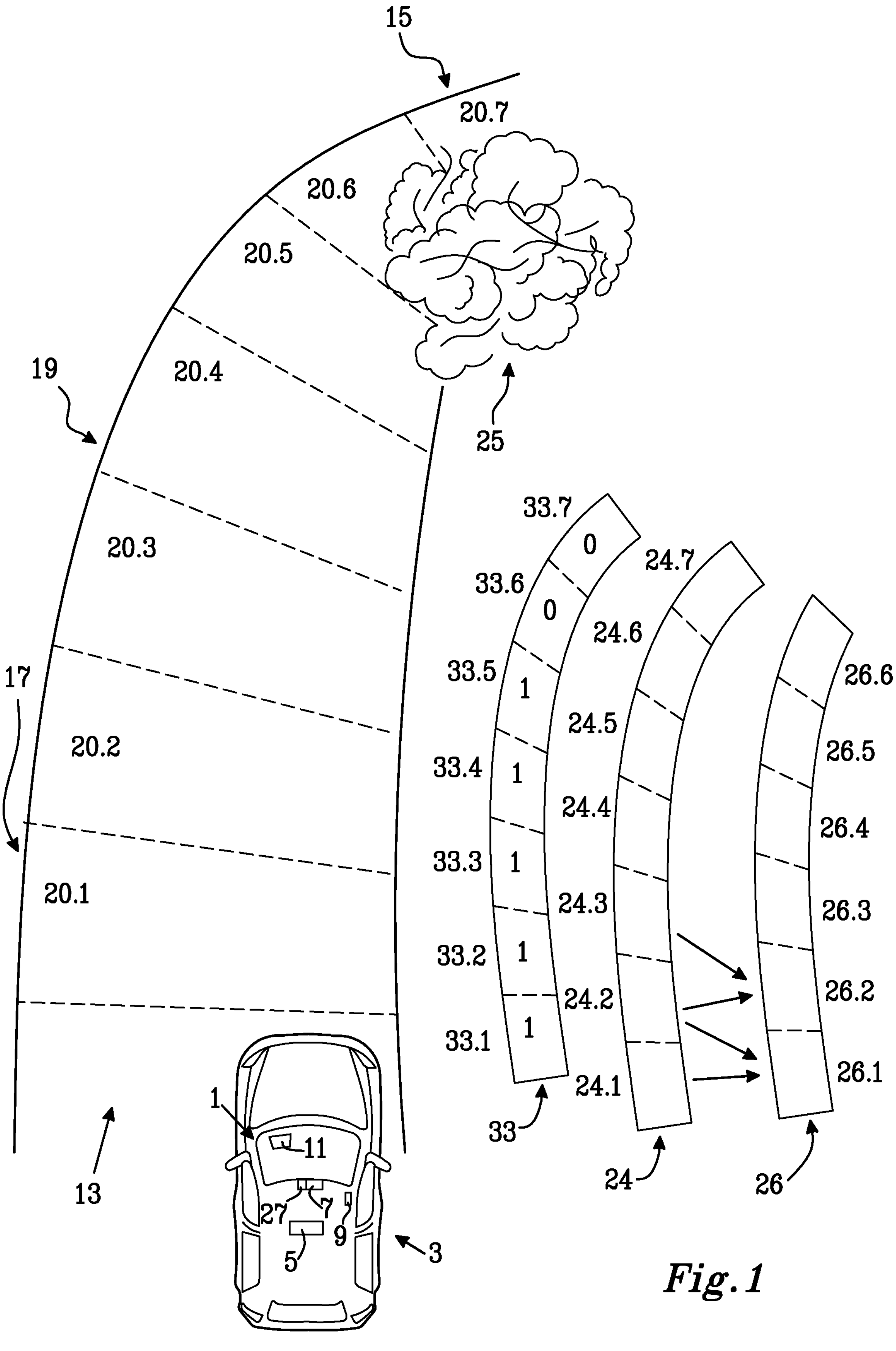
9. Agencement d'assistance à la conduite (1) d'un véhicule (3) selon l'une quelconque des revendications 1 à 8, **caractérisé en ce que** les moyens d'entrée de profil de route (7) comprennent un dispositif d'imagerie.

10. Véhicule (3) caractérisé ce qu'il comprend un agencement d'assistance à la conduite (1) d'un véhicule (3) selon l'une quelconque des revendications précédentes.

11. Procédé d'assistance à un conducteur d'un véhicule à l'aide de moyens de traitement, de moyens d'entrée de profil de route, de moyens d'entrée de vitesse de véhicule actuelle et d'une interface utilisateur, les moyens de traitement étant arrangés pour communiquer avec les moyens d'entrée de profil de route, les moyens d'entrée de vitesse de véhicule actuelle et l'interface utilisateur, le procédé consistant :

- à recevoir (101), dans les moyens de traitement, des données de profil de route représentant un profil de route devant le véhicule en provenance des moyens d'entrée de profil de route, les données de profil de route contenant des données de pente représentant la pente de la route (13) devant le véhicule (3), et
- à recevoir (102), dans les moyens de traitement, des données de vitesse de véhicule actuelle représentant une vitesse de véhicule actuelle du véhicule en provenance des moyens d'entrée de vitesse de véhicule actuelle,
- à traiter (103) les données de pente des données de profil de route pour détecter si la route devant le véhicule contient une courbe qui est cachée ou au moins partiellement cachée d'une ligne de vision estimée du conducteur, et
- à émettre (104) une alarme, par le biais de l'interface utilisateur, si une courbe cachée ou au moins partiellement cachée est détectée et si la vitesse de véhicule actuelle dépasse une vitesse de seuil, le procédé consistant en outre :
- à traiter (105) les données de profil de route pour détecter si un segment (20.1 à 20.7) de la route (13) devant le véhicule (3) contient une courbe cachée ou au moins partiellement cachée, pour calculer une pluralité de vitesses de seuil, chacune étant associée à un segment de la route devant le véhicule et
- à calculer (106) une future vitesse de véhicule prédite à une distance prédéterminée par rapport à une position de véhicule actuelle, ou à un moment prédéterminé par rapport au moment actuel, et
- à comparer (107) la vitesse de véhicule actuelle et/ou la future vitesse de véhicule prédite, avec les vitesses de seuil, et, si la vitesse de véhicule actuelle et/ou la future vitesse de véhicule prédite dépassent une ou plusieurs des vitesses de seuil,

- à déterminer (108) un premier point d'activation en se basant au moins sur la comparaison et sur le fait qu'un ou plusieurs des segments de la route (13) devant le véhicule (3) comprennent ou non une courbe cachée ou au moins partiellement cachée et
- à émettre (109) l'avertissement lorsque le véhicule passe le premier point d'activation.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24.2
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3
5

Fig.1

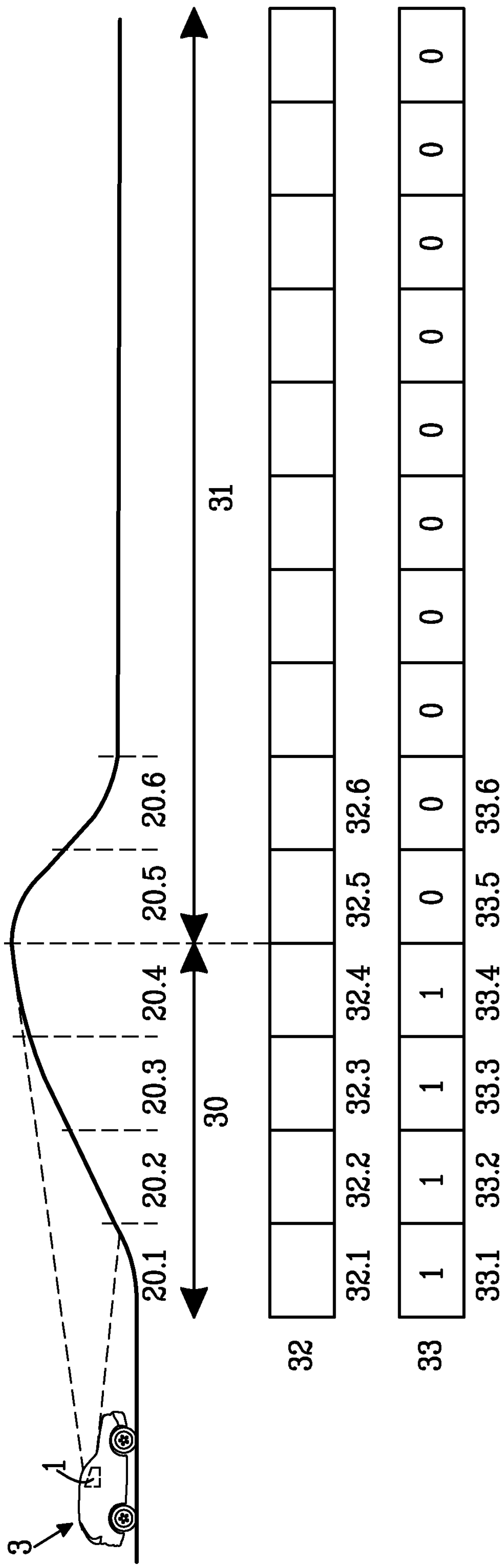
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Fig.2

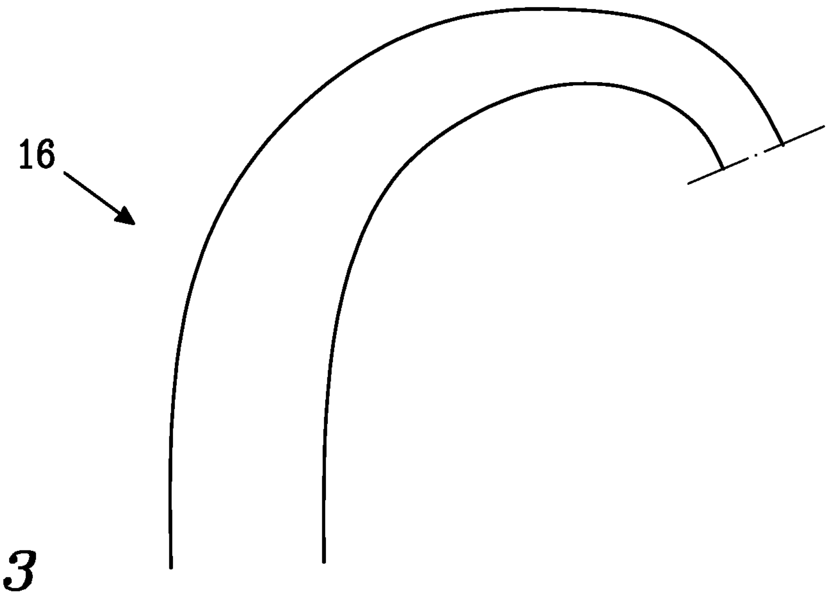

Fig.3

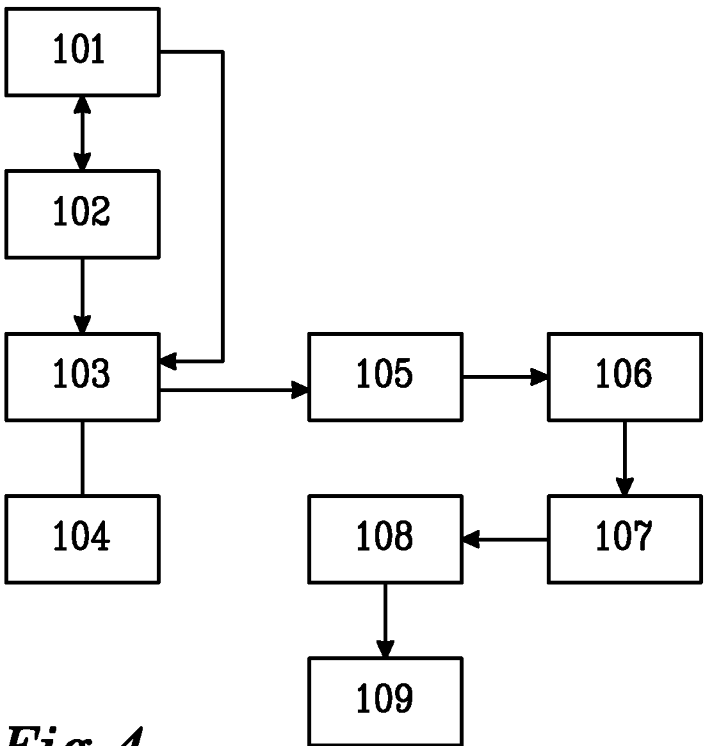

Fig.4

REFERENCES CITED IN THE DESCRIPTION

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