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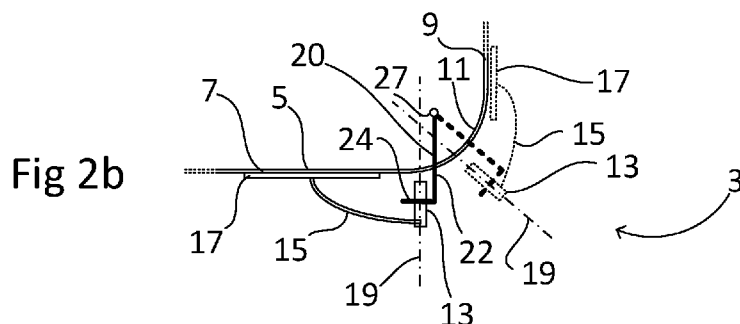
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(54) Title: WINDSHIELD WIPER DEVICE FOR A MOTOR VEHICLE AND A METHOD FOR WIPING A WINDSHIELD



(57) **Abstract:** The invention relates to a windshield wiper device (3) for a motor vehicle (1), which windshield wiper device (3) comprises at least one drive unit (29) which is coupled to a wiper shaft (13), having a wiper arm (15) arranged to hold a wiper blade (17). The wiper shaft (13) is arranged so as to rotate about a rotation axis (19), wherein at least the wiper shaft (13) of the wiper device (3) is mounted pivotally about a pivoting axis (27), wherein the rotation axis (19) and the pivoting axis (27) are arranged at an angle to each other. A hinge element (20) is pivotably arranged about the pivoting axis (27). The wiper arm (15) is arranged on the hinge element (20), so that the rotating axis (19) and the pivoting axis (27) extend in a respective direction without intersecting each other. The invention also relates to a vehicle (1) and a method for wiping a windshield (5).



WINDSHIELD WIPER DEVICE FOR A MOTOR VEHICLE AND A METHOD FOR WIPING A WINDSHIELD

TECHNICAL FIELD

The present invention relates to a windshield wiper device, a vehicle with such a
5 wiper device, and a method for wiping a windshield comprising a curvature.

BACKGROUND AND PRIOR ART

The present invention relates to a windshield wiper device, a vehicle with such a
wiper device, and a method for wiping a windshield comprising a curvature according
10 to the appended claims.

Vehicles, and in particular heavy goods vehicles, such as trucks and buses, are
usually equipped with a windshield in the front regions of said vehicles. The
windshield serves to protect the driver and passengers from weather conditions such
15 as rain and wind. As rain, or water from other sources, impair the visibility for the
driver, windshield wipers are commonly used to wipe the windshield by means of a
wiper blade swiping over the windshield. Windshield wiper devices and systems are
known in the art and typically comprise a drive unit coupled to a wiper shaft via a
transmission device, wherein the transmission device rotates the wiper shaft back
20 and forth by means of the power provided by the drive unit. The wiper shaft is further
equipped with a wiper arm upon which a wiper blade suitable for the particular
vehicle can be mounted.

Windshield wiper devices and systems may be designed in several ways depending
25 on the vehicle. Said wiper devices and systems may have one wiper arm and wiper
blade swiping over the majority of the windshield, or a plurality of wiper arms and
wiper blades, wherein each arm and blade covers separate portions of the
windshield. Usually the speed of the movement of the wiper device may be
controlled by means of a control unit, which control unit typically has a user interface
30 within reach of the driver operating the vehicle.

Wiper devices and systems as described above are well designed to wipe an essentially flat surface with good results. However, as aerodynamics is of great importance for the wind resistance affecting the vehicle when driving, the shape of the windshield may not always be essentially flat in shape. To decrease wind resistance and increase the aerodynamic behaviour of vehicles it is more and more common, for heavy goods vehicles in particular, to design the windshield with a sharper curvature, and/or having curved lateral edges to lower said wind resistance.

The document US 3768112 discloses a windshield wiper drive comprising windshield wipers which are rigidly mounted on carriages guides along a guide track, so that the wipers move in a translatory movement along the windshield when the carriages are on substantially straight track portions, but move angular when the carriages are on curved track portions.

The document EP 1939054 A2 discloses a windshield wiper device which comprises a wiper shaft coupled to a drive unit via a transmission device. The drive unit is further mechanically coupled to an actuator which shifts the rotating axis for the wiper shaft by means of mechanically pivoting the wiper device when it is operated, wherein the rotation of the wiper shaft automatically pivot the axis of rotation of the wiper shaft to shift the angle of attack of the wiper arm in relation to the windshield.

SUMMARY OF THE INVENTION

The known wiper devices and systems may not handle windshields with too sharp curves because the wiper blades may extend past the curvature in a straight direction and thus cannot wipe said curved portion of the windshield. This is an imperative problem as heavy goods vehicles are not, in some countries, authorized to be driven if large enough portions of the windshield in front of the driver cannot be wiped from water sufficiently.

Despite prior art there is a need to develop a windshield wiper device, which can wipe a windshield having a curvature. Also, there is a need to develop a wiper device, which can be used with high accuracy to guarantee good results to ensure safety when driving a vehicle equipped with such a wiper device. Furthermore, there

is a need to develop a windshield wiper device which is customizable for windshields having different designs with different shaped curvatures.

5 An object of the present invention is thus to provide a windshield wiper device, which can wipe windshield having a curvature with high accuracy. Another object of the invention is to provide a wiper device which is customizable so as to be able to use for windshields having different designs with different shaped curvatures.

10 The herein mentioned objects are achieved by a windshield wiper device, a vehicle with such a windshield wiper device, and a method for wiping a windshield, which windshield comprises at least one curved portion according to the independent claims.

15 It would be advantageous to achieve a windshield wiper device overcoming, or at least alleviating, at least some of the above mentioned drawbacks. In particular, it would be desirable to enable a windshield wiper device which can wipe windshield having a curvature with high accuracy and which is customizable so as to be able to use for windshields having different designs with different shaped curvatures. To better address one or more of these concerns, a windshield wiper device having the
20 features defined in the independent claim is provided.

According to an aspect of the invention the windshield wiper device for a motor vehicle, comprises at least one drive unit which is coupled to a wiper shaft, having a wiper arm arranged to hold a wiper blade, the wiper shaft being arranged so as to
25 rotate about a rotation axis, wherein at least the wiper shaft of the wiper device is mounted pivotally about a pivoting axis, wherein the rotation axis and the pivoting axis are arranged at an angle to each other. A hinge element is pivotably arranged about the pivoting axis and the wiper arm is arranged on the hinge element, so that the rotating axis and the pivoting axis extend in a respective direction without
30 intersecting each other.

This has the advantage that the pivoting motor can pivot the wiper shaft in such a way that the wiper arm and thus the wiper blade can be aligned with the curvature of the windshield. This further has the advantage that the pivoting motor can be

adjusted for different curvatures or disabled if the wiper device is coupled to a windshield without a curvature present. When arranging the pivoting axis and the wiper arm on the hinge element, so that the rotating axis and the pivoting axis extend in a respective direction without intersecting each other, a windshield wiper device is achieved, which can wipe a windshield having a curvature with high accuracy. Also, such wiper device may be customizable so as to be able to be used for windshields having different designs with different shaped curvatures. When arranging the pivoting axis at the centre of the radius of the shaped curvature the wiper blade may be aligned with the curvature of the windshield.

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According to another aspect of the invention the at least one drive unit also is coupled to the hinge element for pivoting the hinge element about the pivoting axis.

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This has the advantage that the pivoting arrangement may be mechanically controlled and thus be arranged without a control unit.

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According to another aspect of the invention the at least one linkage element is arranged to connect the at least one drive unit to the wiper shaft and to the hinge element.

This has the advantage that the pivoting arrangement may be mechanically controlled and thus be arranged without a control unit.

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According to another aspect of the invention the wiper device further comprises a pivoting motor arranged to pivot the hinge element about the pivoting axis.

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This has the advantage that the pivotal movement of the hinge element about the pivoting axis may be performed independent of the rotational movement of the wiper shaft about the rotation axis.

According to another aspect of the invention the pivoting motor is a servo motor.

This has the advantage that high accuracy is achieved for the pivoting movement of the wiper shaft.

According to another aspect of the invention the pivoting motor is connected to the
5 hinge element by means of at least one linkage element.

This has the advantage that only one pivoting motor may be arranged for pivoting two hinge elements about the pivoting axis

10 According to yet another aspect of the invention the wiper device further comprises a control unit arranged to control the pivoting of the hinge element provided by the pivoting motor.

This has the advantage that said pivoting is controlled in a very precise way by
15 means of the control unit. This is advantageous as the control unit is adapted to control the pivoting only and can therefore be designed for this object with high accuracy.

According to a further aspect of the invention the wiper device further comprises a
20 sensor, arranged to determine the position of the wiper arm and provide said position to the control unit.

This has the advantage that the position of the wiper arm, and thus the wiper blade, always is available for the control unit, wherein the control unit therefore can control
25 the pivoting of the wiper shaft in a very precise manner.

According to an even further aspect of the invention the sensor determines the position of the wiper arm by means of determining a rotational position of the wiper shaft.

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This has the advantage that the sensor is easy to install into the wiper device and that it can be securely attached to the wiper device where it is protected from outer sources such as weather conditions. This further has the advantage that the windshield is not obscured by the need of placing a sensor thereupon, or in the

vicinity thereof.

According to an aspect of the invention the pivoting motor pivots the hinge element when pivoting is performed.

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This has the advantage that the transmission device is easier and less expensive to manufacture as only the rotational movement of the wiper shaft needs to be provided by the transmission device.

10 According to yet another aspect of the invention a vehicle is provided, which vehicle comprises a windshield wiper device according to the present invention.

This has the advantage that a vehicle with a windshield wiper device which can wipe a windshield having a curvature is provided.

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According to a further aspect of the invention a method for wiping a windshield is provided using a windshield wiper device comprising at least one drive unit which is coupled to a wiper shaft, having a wiper arm arranged to hold a wiper blade. The wiper shaft is arranged so as to rotate about a rotation axis, wherein at least the shaft of the wiper device is mounted pivotally about a pivoting axis, wherein the rotating axis and the pivoting axis are arranged at an angle to each other. The method comprising the steps of:

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a) rotating the wiper shaft by means of the drive unit so as to generate an angular movement of the wiper arm and the wiper blade, wherein said angular movement of the wiper blade wipes a portion of the windshield, which portion is defined by said angular movement;

b) determining if the wiper blade is in the proximity of at least one curved portion of the windshield; and

c) adjusting the direction of the rotation axis of the wiper shaft by pivoting a hinge element about the pivoting axis, on which hinge element the wiper arm is so arranged that the rotating axis and the pivoting axis extend in a respective direction without intersecting each other, wherein said pivoting aligns the wiper blade with a curvature of the at least one curved portion of the windshield.

This has the advantage that a method is provided, which method can wipe windshield having a curvature. The pivoting motor can pivot the wiper shaft in such a way that the wiper arm and thus the wiper blade can be aligned with the curvature of the windshield. This further has the advantage that the pivoting motor can be

5 adjusted for different curvatures.

According to a further aspect of the invention the method, after step a) and before step b), may further comprising the step of d) generating an angular movement of the wiper arm and the wiper blade back and forth on the portion of the windshield. In

10 some situations only a portion of the windshield may be wiped by the wiper blade.

When the vehicle is driven on a road without curves or with curves having a small curvature only the front part, or a section of the front part of the windshield may be wiped since there is no need for the driver to look out of the windshield in the side directions. Under such conditions the driver may select to control the windshield wiper

15 device to generate an angular movement of the wiper arm and the wiper blade back and forth on the portion of the windshield which may represent a front portion of the windshield. Thus, before the wiper blade reaches the curved portion of the

windshield or when the wiper blade is in the proximity or in the area of a curved portion of the windshield the wiper arm and the wiper blade change the direction of movement and return to a start position. At the start position the wiper arm and the wiper blade change the direction of movement and move in the direction of the curved portion of the windshield. As a result the wiper blade may move back and forth in order to wipe the portion of the windshield free from water. When the driving conditions are changed the driver may select to control the windshield wiper device

20 to wipe the curved portion of the windshield according to step c.

According to a further aspect of the invention the method may further comprise the step of e) increasing the speed of the angular movement of the wiper arm and the wiper blade from a first speed to a second speed. In heavy rain or when water from

30 the road is sprayed from other vehicles on the windshield, the water on the windshield must be quickly removed, so that the driver of the vehicle has a clear through the windshield. In order to quickly remove the water from the windshield the speed of the angular movement of the wiper arm and the wiper blade may be increased. The driver may select to control the windshield wiper device to move

faster, so that the water on the windshield is quickly removed. When the windshield has been wiped free from water and/or when the driving conditions have been changed the driver may select to control the windshield wiper device to decrease the speed of the angular movement of the wiper arm and the wiper blade.

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According to an even further aspect of the invention the wiper device of the method further comprises a control unit, which is arranged for calculating a position of the wiper blade during step a), which position is used by the control unit to perform step b), wherein the control unit transmits an output signal to a pivoting motor for pivoting the hinge element, so as to perform the adjustment of step c) based on the result of step b).

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This has the advantage that the control unit can operate the pivoting motor in a very precise and controlled way. This further has the advantage that the control unit may be adapted for windshields with different curvatures, thus making the method customizable without having to mechanically re-design the windshield wiper device being used.

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According to an aspect of the invention the wiper device of the method further comprises a sensor, which sensor is arranged to determine a rotational position of the wiper shaft, wherein the rotational position of the wiper shaft, in combination with design data for the wiper arm and the wiper blade, is used for calculating the position of the wiper blade.

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This has the advantage that the method can use a sensor which is easy to install into the wiper device, and achieve a position of the wiper arm and blade with high accuracy as the angular position of the wiper shaft is easy to determine with such a sensor.

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According to another aspect of the invention the control unit compares the position of the wiper blade to surface curvature data for the windshield to perform step b).

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This has the advantage that the control unit at any given time will know if the wiper blade is located near a curvature present in the windshield. As the surface curvature

data for the windshield tells the control unit where curvature is present the control unit can easily be adapted to perform step b) knowing the position of the wiper blade.

5 According to yet another aspect of the invention a method for wiping a windshield is provided, wherein the windshield comprises a first essentially flat portion, an intermediate curved portion and a second essentially flat portion, the first and second essentially flat portions being at an angle to each other, wherein the method comprises the steps of: d) wiping the first essentially flat portion in a direction towards the curved portion, by means of performing step a); e) wiping the curved
10 portion in a direction towards the second essentially flat portion, by means of performing step a), b) and c) simultaneously; and f) wiping the second essentially flat portion in a direction away from the curved portion, by means of performing step a) using the adjusted direction of the rotation axis of the wiper shaft of step e).

15 This has the advantage that the method may be used to wipe a type of windshield which is suitable for heavy goods vehicles, wherein the windshield is adapted for low wind resistance due to the added curvature. The method further has the advantage that the method wipes both the windshield in front of, and on the side towards meeting traffic in relation to the driver driving said vehicle.

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Further objects, advantages and novel features of the present invention will become apparent to one skilled in the art from the following details, and also by putting the invention into practice. Whereas embodiments of the invention are described below, it should be noted that it may be not restricted to the specific details described.

25 Specialists having access to the teachings herein will recognise further applications, modifications and incorporations within other fields, which are within the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

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Below is a description of, as examples, preferred embodiments with reference to the enclosed drawings, wherein like reference characters refer to like parts throughout the several views, and in which:

Figure 1 schematically illustrates a vehicle provided with a windshield wiper device according to an embodiment,

5 Figure 2a schematically illustrates a perspective view of a windshield provided with a windshield wiper device according to an embodiment,

Figure 2b schematically illustrates a top down sectional view of a windshield provided with a windshield wiper device according to an embodiment,

10 Figures 3a and 3b schematically illustrate front views of an exemplary embodiment of a windshield wiper device with a wiper blade in first and second positions,

Figures 4a and 4b schematically illustrate front views of an exemplary embodiment of a windshield wiper device with a wiper blade in first and second positions,

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Figures 5a – 5c schematically illustrate top down views of an exemplary embodiment of a windshield wiper device with a wiper blade in three different positions,

20 Figure 6 schematically illustrates a top down view of an exemplary embodiment of a windshield wiper device with a wiper blade in a first position, and

Figures 7a - 7c show flowcharts of a method according to different embodiments for wiping a windshield according to an embodiment.

25 DETAILED DESCRIPTION OF THE DRAWINGS

Figure 1 schematically illustrates a vehicle 1 provided with a windshield wiper device 3 according to an embodiment. The vehicle 1 may comprise a windshield 5 which comprises a front portion 7 and a side portion 9. The windshield may further
30 comprise a curved portion 11, which curved portion 11 couples the front portion 7 and the side portion 9 to each other. The windshield wiper device 3 may comprise a wiper shaft 13, a wiper arm 15 extending from the wiper shaft 13, and a wiper blade 17, detachably coupled to the wiper arm 15. The front and the side portion 7, 9 of the windshield 5 of this example may have flat surfaces, which flat surfaces may extend

in two planes being essentially perpendicular to each other. The curved portion 11 may comprise a curvature which may couple said two perpendicular planes to each other so as to provide a windshield 5 with a curved edge. Thus, the windshield 5 may be viewed as a one sheet of material covering the front portion 7, the side portion 9, and the intermediate curved portion 11 in relation to a driver and/or a passenger within the vehicle 1.

Windshields 5 may be provided with curvatures for better aerodynamic behaviour, wherein said curvatures may be oriented in various directions in relation to the area the windshield 5 is meant to cover. For curvatures having large radiuses, in the range of about 1500 mm to about 2000 mm and above, the design of the wiper arms 15 and wiper blades 17, being supported with springs and flexible joints, may provide enough flexibility so as to wipe such curvatures with good results. However, for a windshield 5 such as exemplified in figure 1 or similar, wherein the windshield 5 comprises a curved portion 11 provided to bridge a front portion 7 and a side portion 9, the radius of such a curvature may be much smaller, typically going down in the region of a few hundred mm. As will be realized, the object of the present invention is to be able to wipe such curvatures with radiuses below the range of about 1500 mm to about 2000 mm, which may be viewed as sharp curvatures. The term curvature used in the patent application may therefore be viewed as a curvature which may not be wiped by means of a windshield wiper device 3 only relying of the flexibility of the wiper blade 17, and the typically spring loaded mountings of such wiper blades 17.

Figure 2a schematically illustrates a perspective view of a windshield 5 provided with a windshield wiper device 3 according to an embodiment. The windshield 5 may comprise an essentially flat front portion 7, two curved edge portions 11, and two laterally essentially flat side portions 9. The windshield wiper device 3 of this example is schematically illustrated and comprises a wiper shaft 13, arranged to rotate about a rotation axis 19, a wiper arm 15 extending radially from the wiper shaft 13 and extending essentially parallel to the windshield 5. The windshield wiper device 3 may further comprise a wiper blade 17, detachably coupled to the wiper arm 15 and being arranged to wipe the windshield 5 in a back and forth swiping movement by means of an alternating clockwise and anti-clockwise rotation of the wiper shaft 13 about the rotation axis 19. In this embodiment the windshield wiper

device 3 may be represented by a butterfly mechanism in which the wiper shafts 13 may be located at each corner of the lower edge of the windshield 5. Said rotation may be provided by a drive unit and transferred to the wiper shaft via a transmission device (the drive unit and the transmission device are not shown in figure 2a). The windshield wiper device 3 may further comprise a pivoting arrangement, which may be a pivoting motor 21 and a control unit 23. However, the pivoting arrangement may be mechanically controlled and thus be arranged without a control unit 23. The control unit 23 is however in this example arranged in communication with the wiper shaft 13 wherein the control unit 23 may receive data for the rotational movement of the wiper shaft 13 by means of a sensor 25. The sensor 25 is in this example a sensor arranged on, or in the proximity of, the wiper shaft 13 wherein the sensor 25 may read the rotational displacement, the speed of said rotation and the direction of said rotation of the wiper shaft 13. As the wiper arm 15 holding the wiper blade 17 may be attached on the wiper shaft 13, so that the control unit 23 may thus calculate the position of the wiper blade 17. The control unit 23 may further comprise surface curvature data for the windshield 5 to which the windshield wiper device 3 is mounted, wherein said data may be stored in the control unit 23, on a separate memory or in a computer feeding the data to the control unit 23. By means of a computer program P comprising computer code the control unit 23 may then determine if the wiper blade 17 is in proximity of, and may thus move in a direction towards a curvature of the windshield 5. When this occurs, the control unit 23 may operate the pivoting motor 21 to pivot the rotation axis 19 about a pivoting axis 27 so as to align the wiper blade 17 with the present curvature of the windshield 5, wherein the contact between the wiper blade 17 and the windshield surface area may be maximized. As seen in figure 2a, the wiper blade may be movable so as to wipe a segment of the essentially flat front portion 7, a segment of one of the curved edge portions 11 and one of the laterally essentially flat side portions 9. This may be performed by means of pivoting the wiper shaft 13 and thus the rotation axis 19 about the pivoting axis 27. Said pivoting may be performed by means of the pivoting motor 21 which may be pivotally coupled to the windshield wiper device 3, or parts of said wiper device 3 via an hinge element. The pivotal coupling may be arranged to pivot the wiper shaft 13, the wiper shaft 13 and the transmission device, or the wiper shaft 13, the transmission device and the drive unit (the hinge element, the transmission device and the drive unit are not shown in figure 2a). The pivoting

motor 21 may be a servo motor, but other types of motors known in the art may also be used. By means of controlling the pivoting of the rotation axis 19, a device may thus be provided which may wipe windshields 5 of various designs comprising various curvatures. Further, depending on the need and/or desire regarding how far
5 the wiper blade 17 needs to move in a rotational direction in relation to a driver in a vehicle, the control unit 23 may be programmed to pivot the rotation axis 19 to a corresponding desired angle. It may thus be easy to modify the windshield wiper device 3 according to the embodiment to different types of windshields 5 and vehicles, as the pivoting provided by the pivoting motor 21 may be adjusted to
10 different predetermined angles, or even turned off if no curvature is present.

Figure 2b schematically illustrates a top down sectional view of a windshield 5 provided with a windshield wiper device 3 according to an embodiment. The section of the windshield 5 can be viewed as part of the windshield 5 shown in figure 2a.
15 This figure further illustrates how the rotation of the wiper shaft 13 about the rotation axis 19 and the pivoting of said rotation axis 19 about the pivoting axis 27 provides a wiper device 3 which can wipe a curved portion 11 of a windshield 5 as well as the essentially flat front portion 7 in front of the driver, and an essentially flat side portion 9 on the side of the driver. The hinge element 20 may according to an embodiment
20 have an L-shape provided with a first and a second portion 22, 24. The first portion 22 of the hinge element 20 may be pivotably arranged about the pivoting axis 27. The wiper arm 15 may be arranged on the second portion 24 of the hinge element 20. The wiper shaft 13 may be connected to the second portion 24 of the hinge element 20, so that the rotating axis 19 and the pivoting axis 27 may extend in a
25 respective direction without intersecting each other. When arranging the pivoting axis 27 at the centre of the radius of the shaped curvature the wiper blade 17 may be aligned with the curvature of the windshield.

Figure 3a schematically illustrates a schematically front view of a windshield wiper device 3 with a wiper blade 17 in a first position P_1 according to an embodiment. The
30 windshield wiper device 3 may comprise a drive unit 29 which may be coupled via a transmission device 31 to a wiper shaft 13, having a wiper arm 15 arranged to hold a wiper blade 17. The wiper shaft 13 may be arranged so as to rotate about a rotation axis 19, wherein at least the wiper shaft 13 of the wiper device 3 may be mounted

pivotaly about a pivoting axis 27 by means of the hinge element 20, wherein the rotating axis 19 and the pivoting axis 27 are arranged at an angle to each other without intersecting each other. In this example, the rotating axis 19 and the pivoting axis 27 are arranged essentially perpendicular to each other but other angles may also be possible. The hinge element 20 may comprise first fastening means 33 arranged so as to attach the hinge element 20 to the vehicle (fig. 1), in particular a heavy goods vehicle comprising a windshield with at least one curved portion. The first fastening means 33 may be provided with bearing or similar to allow the hinge element 20 to be pivoted about the pivoting axis 27. The wiper device 3 may further comprise a pivoting motor 21 arranged to pivot the hinge element 20 about said pivoting axis 27. The pivoting motor 21 may be a servo motor. The pivoting motor 21 may be attached to the vehicle by means of second fastening means 35. The pivoting motor 21 may further comprise a pivoting shaft 37 which pivots at least the wiper shaft 13 of the wiper device 3. Even further, the windshield wiper device 3 may comprise a control unit 23, which may be arranged in communication with the wiper shaft 13 and the pivoting motor 21. A sensor 25 may be arranged to determine the position of the wiper arm 15 and provide said position to the control unit 23. The sensor 25 in this embodiment may be a sensor 25 which determines the position of the wiper arm 15 by means of determining a rotational position of the wiper shaft 13, being arranged in proximity to the wiper shaft 13. The sensor 25 may be arranged on the hinge element 20. The control unit 23 may comprise a computer, or a link to a computer, comprising a computer program P with programme code for receiving the data containing the current position of the wiper arm 15 to calculate the position of the wiper blade 17 in relation to the windshield of the vehicle. The control unit 23 may further comprise stored data in a memory M, or a link to readable data, containing the design parameters of the windshield to control the pivoting of the hinge element 20 and the rotation axis 19 when the wiper blade 17 is moved towards a curvature in the windshield.

As is illustrated in figure 3a, a rotation of the wiper shaft 13 rotates the wiper arm 15 holding the wiper blade 17 about the rotation axis 19. This is illustrated by the wiper arm 15 and wiper blade 17 in a first position P_1 , and the wiper arm 15' and wiper blade 17' drawn with dotted lines being in an angled position P_a in relation to the first

position P_1 . Said rotation may be used to wipe essentially flat portions of a windshield of a vehicle on which the windshield wiper device 3 may be arranged.

Figure 3b schematically illustrates a front view of an exemplary embodiment of a windshield wiper device 3 with a wiper blade 17 in a second position P_2 . In this embodiment the pivoting motor 21 has pivoted the hinge element 20 and thus the wiper shaft 13 and the transmission device 31 about the pivoting axis 27 to a position which may be perpendicular to the position of the wiper shaft 13 and transmission device 31 seen in figure 3a. This in turn may move the rotation axis 19 of the wiper shaft 13 to a direction which may extend in a direction perpendicular to the rotation axis 19 seen in figure 3a. Hence, a windshield wiper device 3 may be provided which can wipe windshields having a curvature. This because the wiper blade 17 can be pivoted about a pivoting axis 27, which pivoting may align the wiper blade 17 with a curved portion of the windshield as well as a side portion, if present. This may be applied to wipe windshields with essentially flat portions coupled with an intermediate curved portion, wherein the windshield wiper device is mounted in such a way that the pivoting aligns the wiper blade 17 with said curvature. It may also further be applied to wipe windshields having one essentially flat portion and one curved portion, wherein the pivoting of the hinge element 20 pivots the rotation axis 19 to align the wiper blade 17 with the curvature during the wiping procedure. The control unit 23 comprising a computer program P with program code may thus control the pivoting motor 21 and thus the pivoting motion of the hinge element 20 so as to be adapted to an existing curvature in a windshield to which the windshield wiper device 3 is mounted. The example seen in figure 3a pivots both the wiper shaft 13 and the transmission device 31 arranged on the hinge element 20, which makes manufacturing of the wiper shaft 13 and the transmission device 31 easy as the rotation of the wiper shaft 13 within the transmission device 31 only needs to be designed for a rotational movement of the wiper shaft 13 within the transmission device 31. That means mechanically simple bearings can be used for said rotation which provides a precise rotational movement with good results but still being cost effective and easy to manufacture. The wiper shaft 13 can thus be mounted to the transmission device 31 by means of single axis rotational bearings, and the transmission device 31 can also be mounted to the drive unit 29 by means of single axis rotational bearings. This allows for a simple design as bearings allowing for a

three dimensional movements are not needed. It may also be possible to arrange the wiper shaft 13 on the hinge element 20 without using the transmission device 31. The drive unit 29 may in such a case be designed to rotate the wiper shaft 13 with torque and speed adapted for the required rotation of the wiper shaft 13.

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Figures 4a and 4b schematically illustrate front views of an exemplary embodiment of a windshield wiper device with a wiper blade in first and second positions. In this embodiment the windshield wiper device may be represented by a butterfly mechanism in which the wiper shafts 13 may be located at each corner of the lower edge of the windshield. In the first position P_1 the wiper blades 17 overlap each other. According to this embodiment first and second linkage elements 26, 28 are arranged to connect one drive unit 29 to the wiper shafts 13 and to the hinge element 20.

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The wiper arm 15 is arranged to hold the wiper blade 17 and the wiper shaft 13 may be arranged so as to rotate about a rotation axis 19, wherein at least the wiper shaft 13 of the wiper device 3 may be mounted pivotally about the pivoting axis 27 by means of the hinge element 20. The rotating axis 19 and the pivoting axis 27 are arranged at an angle to each other without intersecting each other. In this example, the rotating axis 19 and the pivoting axis 27 are arranged essentially perpendicular to each other but other angles may also be possible.

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The drive unit 29 may be arranged to pivot the hinge elements 20 about said pivoting axis 27. The drive unit 29 may be a servo motor. The first and second linkage elements 26, 28 are adapted to the design parameters of the windshield to control the pivoting of the hinge elements 20 and the rotation axis 19 when the wiper blades 17 are moved towards a curvature in the windshield.

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As is illustrated with dotted lines in figure 4a, a rotation of the wiper shafts 13 by means of the first linkage elements 26 rotates the wiper arms 15 holding the wiper blades 17 about the rotation axis 19. This is illustrated by the wiper arms 15' and wiper blades 17' in an angled position P_a in relation to the first position P_1 . Said rotation may be used to wipe essentially flat portions of a windshield of a vehicle on which the windshield wiper device 3 may be arranged.

The drive unit 29 may be connected to the first and second linkage elements 26, 28 by means of a gear element 30.

- 5 Figure 4b schematically illustrates a front view of an exemplary embodiment of a windshield wiper device 3 with the wiper blades 17 in a second position P_2 . In this embodiment the drive unit 29 has pivoted the hinge elements 20 and thus the wiper shafts 13 and the transmission devices 31 about the pivoting axis 27 to a position which may be perpendicular to the position of the wiper shafts 13 and transmission devices 31 seen in figure 4a. The drive unit 29 has pivoted the hinge elements 20 via the second linkage elements. This pivotation may in turn move the rotation axis 19 of the wiper shafts 13 to a direction which may extend in a direction perpendicular to the rotation axis 19 seen in figure 4a. Hence, the windshield wiper device 3 according to this embodiment may wipe windshields having a curvature since the wiper blades 17 can be pivoted about a pivoting axis 27, which pivoting may align the wiper blades 17 with a curved portions of the windshield as well as side portions, if present. This may be applied to wipe windshields with essentially flat portions coupled with intermediate curved portions, wherein the windshield wiper device is mounted in such a way that the pivoting aligns the wiper blades 17 with said curvature. It may also further be applied to wipe windshields having one essentially flat portion and one curved portion, wherein the pivoting of the hinge element 20 pivots the rotation axis 19 to align the wiper blades 17 with the curvature during the wiping procedure. The pivoting motion of the hinge elements 20 may be adapted to the existing curvatures in a windshield to which the windshield wiper device 3 is mounted. The drive unit 29 may be designed to rotate the wiper shafts 13 with torque and speed adapted for the required rotation of the wiper shafts 13. The drive unit 29 may be designed to pivot the hinge elements 20 with torque and speed adapted for the required pivotation of the hinge elements 20.
- 30 Figures 5a – 5c schematically illustrate top down views of an exemplary embodiment of a windshield wiper device with a wiper blade 17 in three different positions. In this embodiment the windshield wiper device may be represented by a butterfly mechanism in which the wiper shafts 13 may be located at each corner of the lower edge of the windshield. In the first position P_1 illustrated in fig. 5a the wiper blades

17 overlap each other. According to this embodiment first and second linkage elements 26, 28 are arranged to connect one pivoting motor 21 to the hinge elements 20.

- 5 The wiper arms 15 may be arranged to hold the wiper blades 17 and the wiper shafts 13 may be arranged so as to rotate about a rotation axis 19, wherein at least the wiper shafts 13 of the wiper device 3 may be mounted pivotally about the pivoting axis 27 by means of the hinge element 20. The rotating axis 19 and the pivoting axis 27 are arranged at an angle to each other without intersecting each other. In this example, the rotating axis 19 and the pivoting axis 27 are arranged essentially perpendicular to each other but other angles may also be possible.

The pivoting motor 21 may be arranged to pivot the hinge elements 20 about said pivoting axis 27. The drive unit 29 may be a servo motor. The first and second linkage elements 26, 28 are adapted to the design parameters of the windshield to control the pivoting of the hinge element 20 and the rotation axis 19 when the wiper blade 17 is moved towards a curvature in the windshield.

As is illustrated with dotted lines in figure 5b, a rotation of the wiper shafts 13 by means of a respective drive unit rotates the wiper arm 15 holding the wiper blade 17 about the rotation axis 19. This is illustrated by the wiper arms 15' and wiper blades 17' in an angled position Pa in relation to the first position P1. Said rotation may be used to wipe essentially flat portions of a windshield of a vehicle on which the windshield wiper device 3 may be arranged.

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Figure 5c schematically illustrates a top down view of an exemplary embodiment of a windshield wiper device 3 with the wiper blades 17 in a second position P2. In this embodiment the pivoting motor 21 has pivoted the hinge elements 20 and thus the wiper shafts 13 and the transmission devices 31 about the pivoting axis 27 to a position which may be perpendicular to the position of the wiper shafts 13 and transmission devices 31 seen in figures 5a and 5b. The pivoting motor 21 has pivoted the hinge elements 20 via the second linkage elements 28. This pivotation may in turn move the rotation axis 19 of the wiper shaft 13 to a direction which may extend in a direction perpendicular to the rotation axis 19 seen in figures 5a and 5b.

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Hence, the windshield wiper device 3 according to this embodiment may wipe windshields having a curvature since the wiper blade 17 can be pivoted about a pivoting axis 27, which pivoting may align the wiper blade 17 with a curved portion of the windshield as well as a side portion, if present. This may be applied to wipe
5 windshields with essentially flat portions coupled with an intermediate curved portion, wherein the windshield wiper device is mounted in such a way that the pivoting aligns the wiper blade 17 with said curvature. It may also further be applied to wipe windshields having one essentially flat portion and one curved portion, wherein the pivoting of the hinge element 20 pivots the rotation axis 19 to align the wiper blade
10 17 with the curvature during the wiping procedure. The pivoting motion of the hinge elements 20 may be adapted to the existing curvature in a windshield to which the windshield wiper device 3 is mounted. The drive units 29 may be designed to rotate the wiper shafts 13 with torque and speed adapted for the required rotation of the wiper shafts 13. The pivoting motor 21 may be designed to pivot the hinge elements
15 20 with torque and speed adapted for the required pivotation of the hinge elements 20.

The windshield wiper device 3 may comprise a control unit 23, which may be arranged in communication with the wiper shafts 13 and the pivoting motor 21. A
20 sensor 25 may be arranged to determine the position of the wiper arms 15 and provide said position to the control unit 23. The sensor 25 in this embodiment may be a sensor 25 which determines the position of the wiper arms 15 by means of determining a rotational position of the wiper shafts 13, being arranged in proximity to the wiper shafts 13. The sensor 25 may be arranged on the hinge element 20. The
25 control unit 23 may comprise a computer, or a link to a computer, comprising a computer program P with programme code for receiving the data containing the current position of the wiper arms 15 to calculate the position of the wiper blades 17 in relation to the windshield of the vehicle. The control unit 23 may further comprise stored data in a memory M, or a link to readable data, containing the design
30 parameters of the windshield to control the pivoting of the hinge element 20 and the rotation axis 19 when the wiper blades 17 are moved towards curvatures in the windshield.

Figure 6 schematically illustrates a top down view of an exemplary embodiment of a windshield wiper device with a wiper blade in a first position. The difference between this embodiment and the embodiment illustrated in figures 5a – 5c is that a pivoting motor 21 is arranged at each hinge element 20 in order to pivot the hinge elements 20 about the pivoting axis 27. Also in this embodiment the windshield wiper device may be represented by a butterfly mechanism in which the wiper shafts 13 may be located at each corner of the lower edge of the windshield 5.

Figure 7a shows a flowchart of a method according to a first embodiment for wiping a windshield according to an embodiment. The windshield wiper device 3 and the windshield 5 may according to this embodiment be viewed as described in accordance with figure 2a. The method may be performed by means of using a windshield wiper device 3, which may comprise at least one drive unit 29 to a wiper shaft 13, having a wiper arm 15 arranged to hold a wiper blade 17, the wiper shaft 13 may be arranged so as to rotate about a rotation axis 19, wherein at least the wiper shaft 13 of the wiper device 3 may be mounted pivotally about a pivoting axis 27, wherein the rotating axis 19 and the pivoting axis 27 may be arranged at an angle to each other. The method comprises the steps of a) rotating the wiper shaft 13 by means of the drive unit 29 so as to generate an angular movement of the wiper arm 15 holding the wiper blade 17, wherein said angular movement may wipe a portion of the windshield 5 with the wiper blade 17, which portion may be defined by said angular movement. Further, the method may comprise the steps of b) determining if the wiper blade 17 may be in the proximity or in the area of a curved portion 11 of the windshield 5, and c) adjusting the direction of the rotation axis 19 of the wiper shaft 13 by pivoting a hinge element 20 about the pivoting axis 27, on which hinge element 20 the wiper arm 15 may be so arranged that the rotating axis 19 and the pivoting axis 27 may extend in a respective direction without intersecting each other, wherein said pivoting may align the wiper blade 17 with a curvature of the at least one curved portion 11 of the windshield 5. Steps a) and b) may be simultaneously performed by means of a control unit 23 which operates step b) and c). Step a) may be continuously performed by means of the drive unit 29 of the wiper device 3, wherein a sensor 25 may provide the control 23 unit with data regarding the position of the wiper blade 17 in relation to the surface area of the windshield 5 underneath, and in proximity of the position of the wiper blade 17. By means of determining the

direction and speed of the wiper blade 17 during step a), and comparing said variables with surface area design data of the windshield 5, the control unit 23 may determine if a pivoting of the hinge element 20 and thus a pivoting of the rotation axis 19 of the wiper device 3 may be needed by means of a computer program P and may operate the pivoting motor 21 accordingly. This means that step a) may be continuously performed as long as the drive unit 29 may provide power to the transmission device 31, and that step b) simultaneously may be performed by means of the input data from step a) which may be fed into the control unit 23. Based on the results of step b), the control unit 23 may perform step c) if a curvature may be present in relation to the movement of the wiper blade 17.

This may provide a method for wiping windshields 5, which may comprise curvatures, wherein the method may wipe several types of curvatures without the need to mechanically redesign the windshield wiper device 3. For example, if a windshield 5 may consist of a curved portion 11 only, the steps a), b) and c) may all be performed simultaneously so as to constantly adjust the rotation axis 19 of the wiper shaft 13 while the wiper blade 17 may be moved back and forth over said curved portion 11.

Figure 7b shows a flowchart of a method according to a second embodiment for wiping a windshield. The windshield wiper device 3 and the windshield 5 may according to this embodiment be viewed as described in accordance with figure 2a. The method, after step b) and before step c), may further comprising the step of d) generating an angular movement of the wiper arm 15 and the wiper blade 17 back and forth on the portion of the windshield 5. In some situations only a portion of the windshield 5 may be wiped by the wiper blade 17. When the vehicle 1 is driven on a road without curves or with curves having a small curvature only the front part, or a section of the front part of the windshield 5 may be wiped since there is no need for the driver to look out of the windshield 5 in the side directions. Under such conditions the driver may select to control the windshield wiper device 3 to generate an angular movement of the wiper arm 15 and the wiper blade 17 back and forth on the portion of the windshield 5 which may represent a front portion of the windshield 5. Thus, before the wiper blade 17 reaches the curved portion 11 of the windshield 5 or when the wiper blade 17 is in the proximity or in the area of a curved portion 11 of the

windshield 5 the wiper arm 15 and the wiper blade 17 change the direction of movement and return to a start position. At the start position the wiper arm 15 and the wiper blade 17 change the direction of movement and move in the direction of the curved portion 11 of the windshield 5. As a result the wiper blade 17 may move back and forth in order to wipe the portion of the windshield 5 free from water. When the driving conditions are changed the driver may select to control the windshield wiper device 3 to wipe the curved portion 11 of the windshield 5 according to step c).

The method may further comprise the step of e) increasing the speed of the angular movement of the wiper arm 15 and the wiper blade 17 from a first speed to a second speed. In heavy rain or when water from the road is sprayed from other vehicles on the windshield 5, the water on the windshield 5 must be quickly removed, so that the driver of the vehicle 1 has a clear through the windshield 5. In order to quickly remove the water from the windshield 5 the speed of the angular movement of the wiper arm 15 and the wiper blade 17 may be increased. The driver may select to control the windshield wiper device 3 to move faster, so that the water on the windshield 5 is quickly removed. When the windshield 5 has been wiped free from water and/or when the driving conditions have been changed the driver may select to control the windshield wiper device 3 to decrease the speed of the angular movement of the wiper arm 15 and the wiper blade 17.

Figure 7c shows a flowchart of a method according to a third embodiment for wiping a windshield 5, which may comprise a first essentially flat portion 7 and a second essentially flat portion 9, which may be coupled with an intermediate curved portion 11. This embodiment may be as described in accordance with figure 2a and 2b, wherein the first essentially flat portion 7 may be a portion covering a front view for a driver driving a vehicle, and the second essentially flat portion 9 may be a portion covering a side view of a driver driving the vehicle, but other similar arrangements are also possible. In the example described herein, the windshield wiper device 3 may be arranged to perform the method according to an embodiment by the steps of f), g) and h), wherein step f) may comprise wiping the first essentially flat portion 7 in a direction towards the curved portion 11, by means of performing step a). The step g) then may comprise wiping the curved portion 11 in a direction towards the second essentially flat portion 9, by means of performing step a), b) and c) simultaneously.

Step h) further may comprise wiping the second essentially flat portion 9 in a direction away from the curved portion 11, by means of performing step a) using the adjusted direction of the rotation axis 19 of the wiper shaft 13 of step g). Hence all three portions 7, 11, 9 of the windshield 5 may be wiped in a correct and precise manner by means of the method of an embodiment.

Due to the pivoting of the hinge element 20 and thus the pivoting of the rotation axis 19 being performed and adjusted by means of a separate control unit 23, the wiper device 3 and the method according to an embodiment may easily be adjusted to work on different types of windshields 5 and in various different ways. Different modes of operation may easily be obtainable by changing mode and/or programming of the control unit 23. The wiper device 3 and method may for example be set to primarily wipe an essentially flat portion 7 of a windshield 5 and periodically wipe a curved portion 11 as well, or to wipe one portion, being either essentially flat or curved, exclusively. The wiper device 3 and method may further also be set to wipe a plurality of essentially flat and curved portions 7, 9, 11 together in one stroke of the wiper blade 17 by means of a clockwise rotation and then wipe the same area of the windshield 5 in a single stroke by means of a following anti-clockwise rotation. Or as another example, the wiper device 3 and method may be set to first wipe one portion of the windshield 5 by means of the back and forth rotation of the wiper shaft 13, and then pivot the rotation axis 27 to wipe a second portion of the windshield. Hence, a versatile wiper device 3 and method for wiping windshields 5 are provided, wherein the wiper device 3 and method can be customized for several types of windshields 5 and different types of needs, the different types of need being based on, for example, different weather conditions.

As should be realized, the components and features specified above may within the framework of an embodiment be combined between the different embodiments specified.

CLAIMS

- 5 1. A windshield wiper device (3), for a motor vehicle (1), which windshield wiper device (3) comprises at least one drive unit (29) which is coupled to a wiper shaft (13), having a wiper arm (15) arranged to hold a wiper blade (17), the wiper shaft (13) being arranged so as to rotate about a rotation axis (19), wherein at least the wiper shaft (13) of the wiper device (3) is mounted pivotally about a pivoting axis (27), wherein the rotation axis (19) and the
- 10 pivoting axis (27) are arranged at an angle to each other,
characterized in
that a hinge element (20) is pivotably arranged about the pivoting axis (27) and that the wiper arm (15) is arranged on the hinge element (20), so that the rotating axis (19) and the pivoting axis (27) extend in a respective direction
- 15 without intersecting each other.
2. The wiper device (3) according to claim 1, wherein the at least one drive unit (29) also is coupled to the hinge element (20) for pivoting the hinge element (20) about the pivoting axis (27).
- 20 3. The wiper device (3) according to claim 2, wherein at least one linkage element (26, 28) is arranged to connect the at least one drive unit (29) to the wiper shaft (13) and to the hinge element (20).
- 25 4. The wiper device (3) according to claim 1, wherein the wiper device (3) further comprises a pivoting motor (21) arranged to pivot the hinge element (20) about the pivoting axis (27).
- 30 5. The wiper device (3) according to claim 4, wherein the pivoting motor (21) is a servo motor.

6. The wiper device (3) according to any of claims 4 and 5, wherein the pivoting motor (21) is connected to the hinge element (20) by means of at least one linkage element (28).
- 5 7. The wiper device (3) according to any of claims 4-6, wherein the wiper device (3) further comprises a control unit (23) arranged to control the pivoting of the hinge element (20) provided by the pivoting motor (21).
- 10 8. The wiper device (3) according to claim 7, wherein the wiper device (3) further comprises a sensor (25), arranged to determine the position of the wiper arm (15) and provide said position to the control unit (23).
- 15 9. The wiper device (3) according to claim 8, wherein the sensor (25) determines the position of the wiper arm (15) by means of determining a rotational position of the wiper shaft (13).
10. The wiper device (3) according to any of claims 4-9, wherein the pivoting motor (21) pivots the hinge element (20) when pivoting is performed.
- 20 11. A vehicle (1), **characterized in that** the vehicle (1) comprises a windshield wiper device (3) according to any of the preceding claims.
- 25 12. A method for wiping a windshield (5) by using a windshield wiper device (3) comprising at least one drive unit (29) which is coupled to a wiper shaft (13), having a wiper arm (15) arranged to hold a wiper blade (17), the wiper shaft (13) being arranged so as to rotate about a rotation axis (19), wherein at least the wiper shaft (13) of the wiper device (3) is mounted pivotally about a pivoting axis (27), wherein the rotating axis (19) and the pivoting axis (27) are arranged at an angle to each other, comprising the steps of:
- 30 a) rotating the wiper shaft (13) by means of the drive unit (29) so as to generate an angular movement of the wiper arm (15) and the wiper blade (17), wherein said angular movement of the wiper blade (17) wipes a portion of the windshield (5), which portion is defined by said angular movement, **characterized in that** the method further comprises the steps of:

b) determining if the wiper blade (17) is in the proximity of at least one curved portion (11) of the windshield (5);

c) adjusting the direction of the rotation axis (19) of the wiper shaft (13) by pivoting a hinge element (20) about the pivoting axis (27), on which hinge element (20) the wiper arm (15) is so arranged that the rotating axis (19) and the pivoting axis (27) extend in a respective direction without intersecting each other, wherein said pivoting aligns the wiper blade (17) with a curvature of the at least one curved portion (11) of the windshield (5).

13. The method according to claim 12, wherein the method, after step b) and before step c), further comprising the step of:

d) generating an angular movement of the wiper arm (15) and the wiper blade (17) back and forth on the portion of the windshield (5).

14. The method according to claim 13, further comprising the step of:

e) increasing the speed of the angular movement of the wiper arm (15) and the wiper blade (17) from a first speed to a second speed.

15. The method according to any one of claims 12-14, wherein the wiper device (3) further comprises a control unit (23), which is arranged for calculating a position of the wiper blade (17) during step a), which position is used by the control unit (23) to perform step b), wherein the control unit (23) transmits an output signal to a pivoting motor (21) for pivoting the hinge element (20), so as to perform the adjustment of step c) based on the result of step b).

16. The method according to claim 15, wherein the wiper device (3) further comprises a sensor (25), which sensor (25) is arranged to determine a rotational position of the wiper shaft (13), wherein the rotational position of the wiper shaft (13), in combination with design data for the wiper arm (15) and the wiper blade (17), is used for calculating the position of the wiper blade (17).

17. The method according to any one of claims 15 and 16, wherein the control unit (23) compares the position of the wiper blade (17) to surface curvature

data for the windshield (5) to perform step b).

- 5 18. The method according to any of claims 12 to 17, wherein the windshield (5) comprises a first flat portion (7), an intermediate curved portion (11) and a second flat portion (9), the first and second flat portions (7, 9) being at an angle to each other, wherein the method comprises the further steps of:
- 10 f) wiping the first flat portion (7) in a direction towards the curved portion (11), by means of performing step a);
- g) wiping the curved portion (11) in a direction towards the second flat portion (9), by means of performing step a), b) and c) simultaneously; and
- h) wiping the second flat portion (9) in a direction away from the curved portion (11), by means of performing step a) using the adjusted direction of the rotation axis (19) of the wiper shaft (13) of step g).
- 15 19. A computer program (P) comprising instructions which, when the program is executed by a computer, cause the computer to carry out the method according to any one of the claims 12-18.
- 20 20. A computer-readable medium comprising instructions which, when executed by a computer, cause the computer to carry out the method according to any one of the claims 12-18.

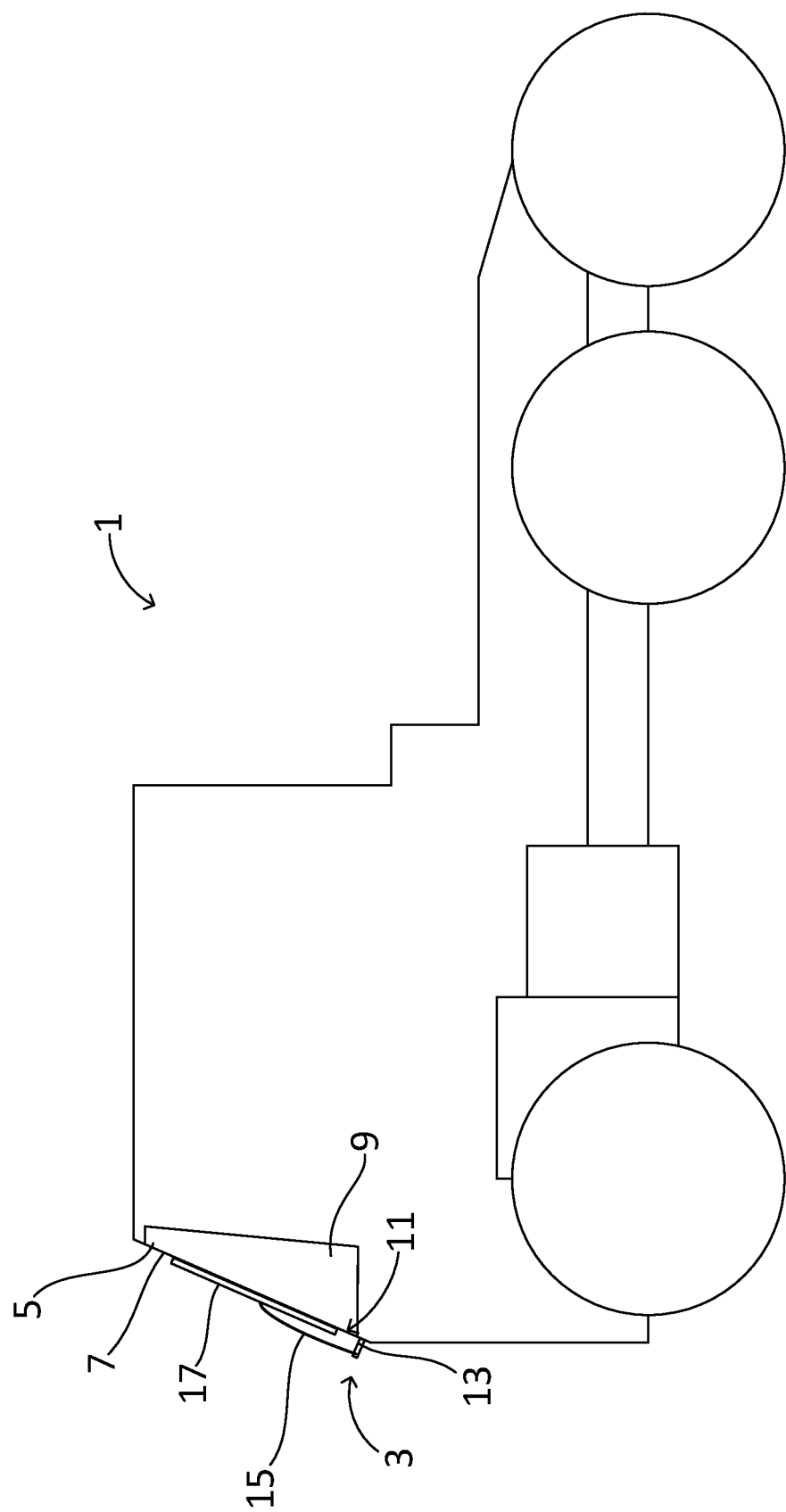
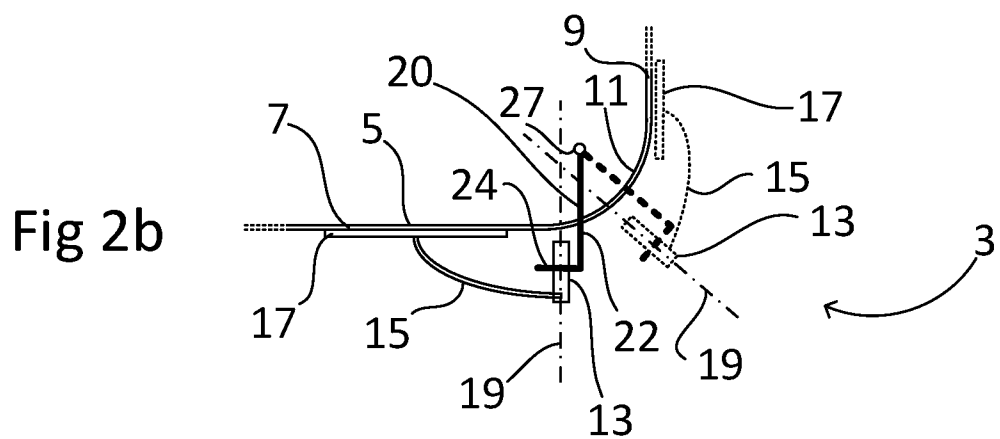
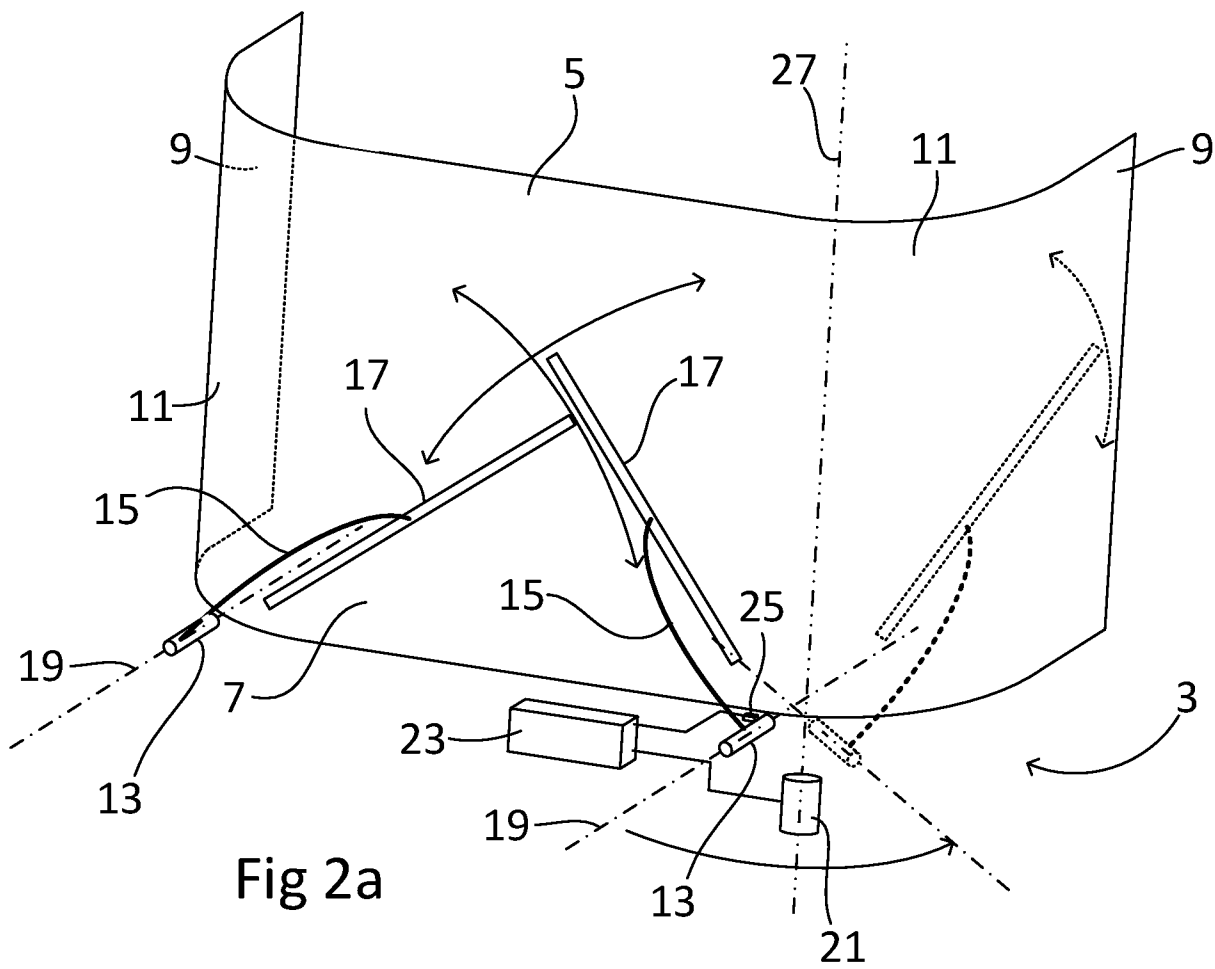
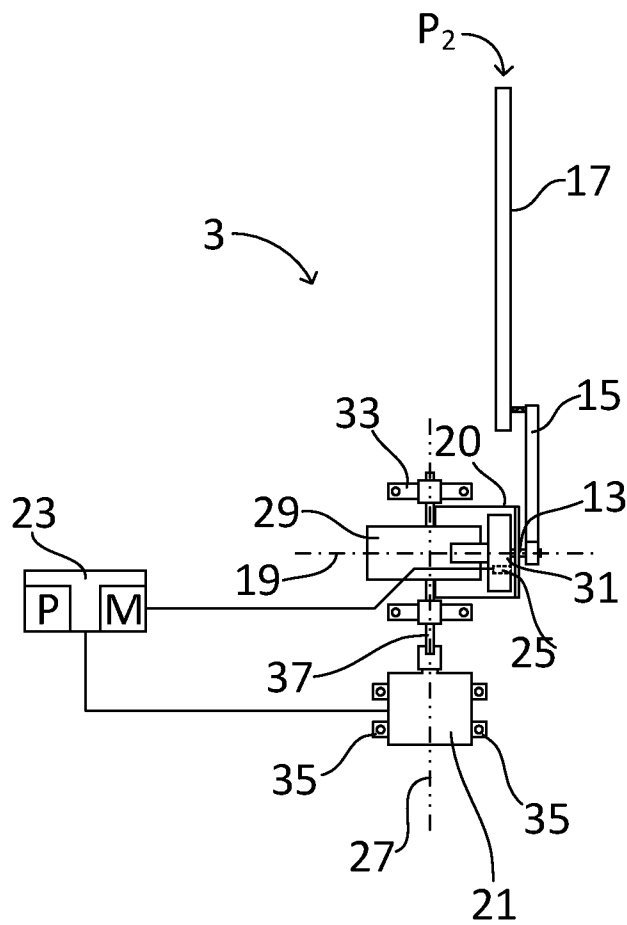
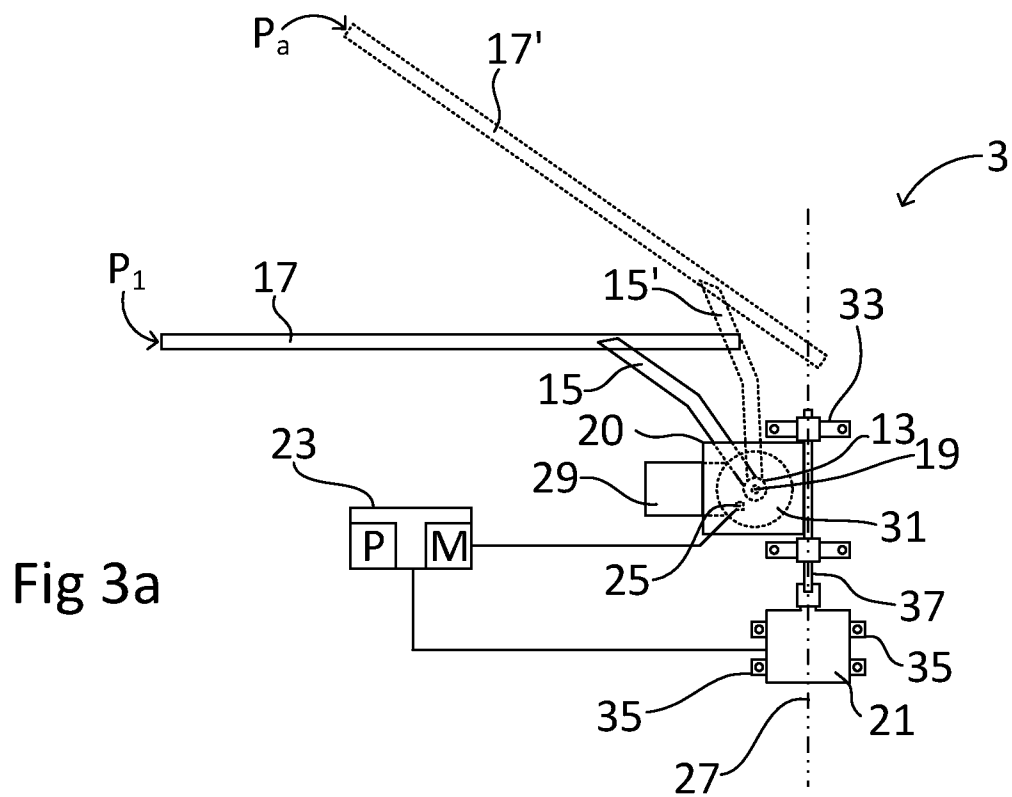


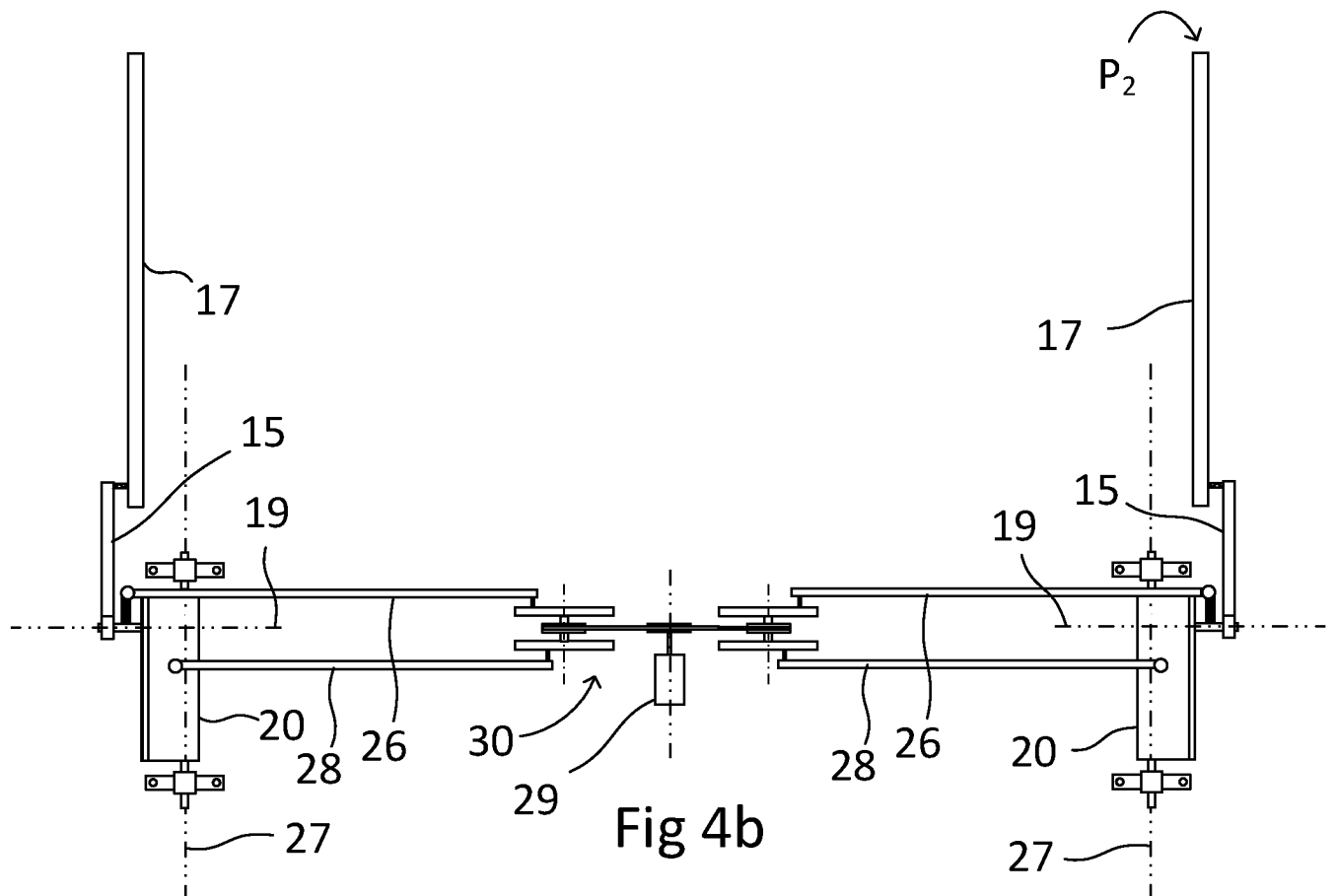
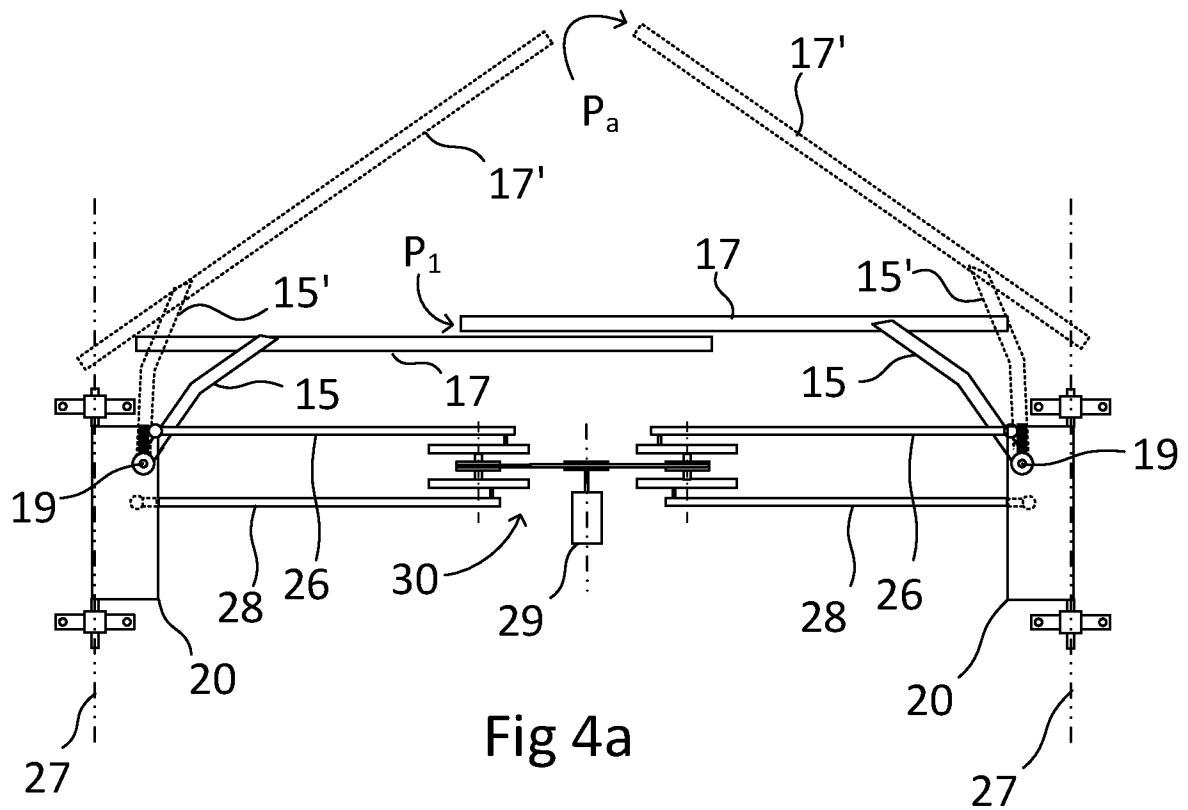
Fig 1



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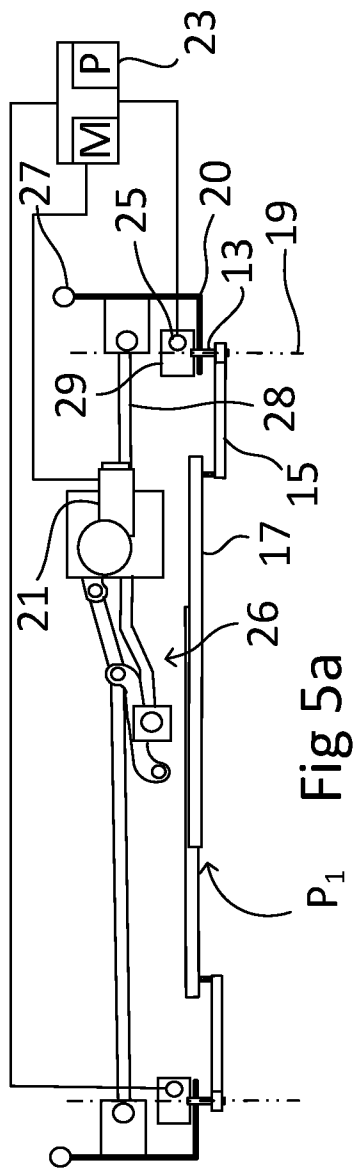


Fig 5a

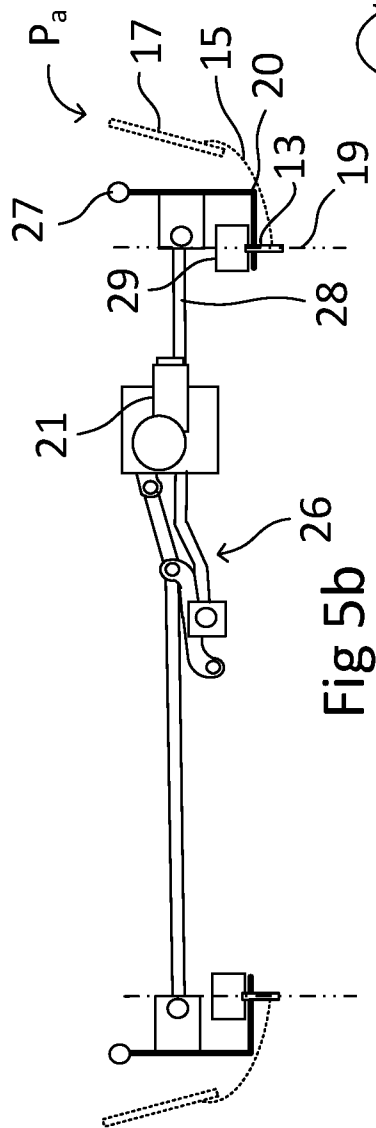


Fig 5b

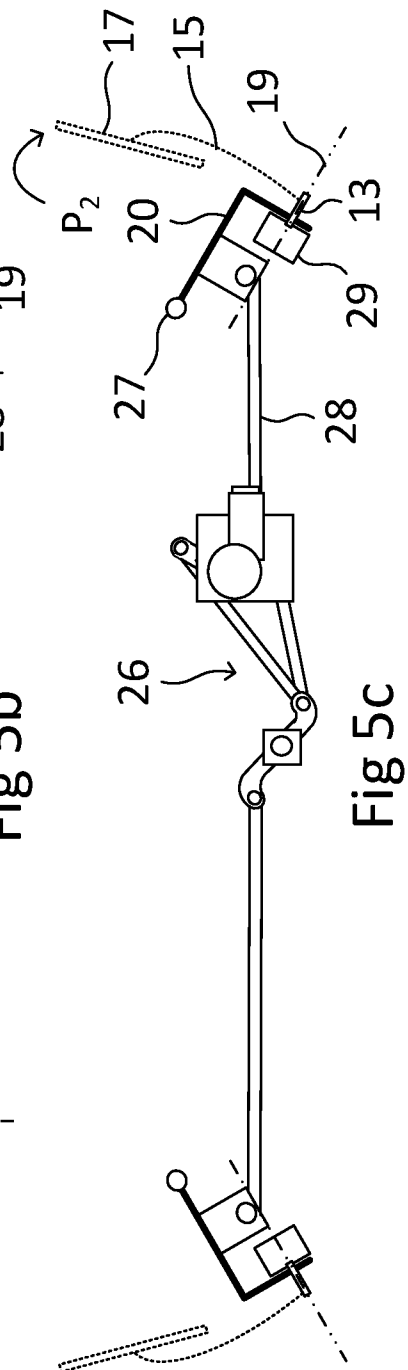


Fig 5c

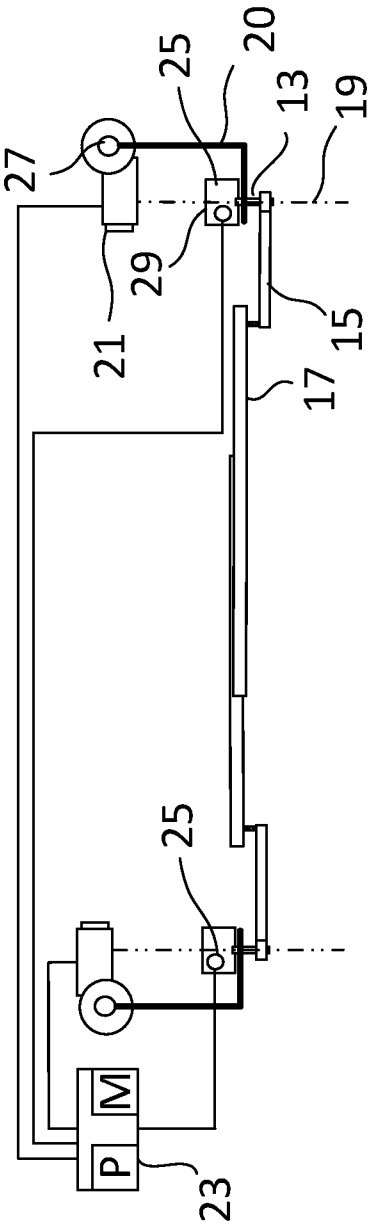


Fig 6

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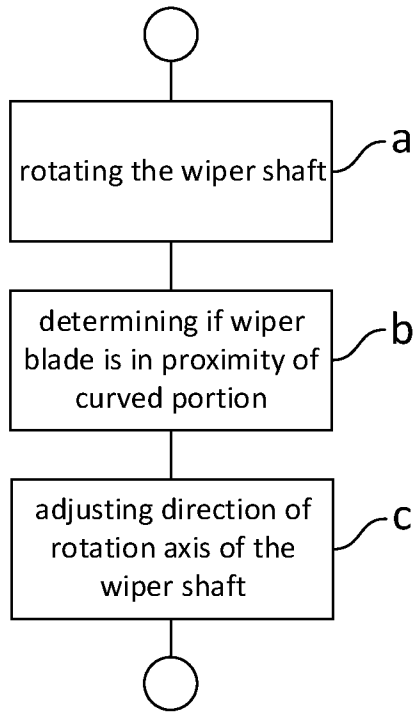


Fig 7a

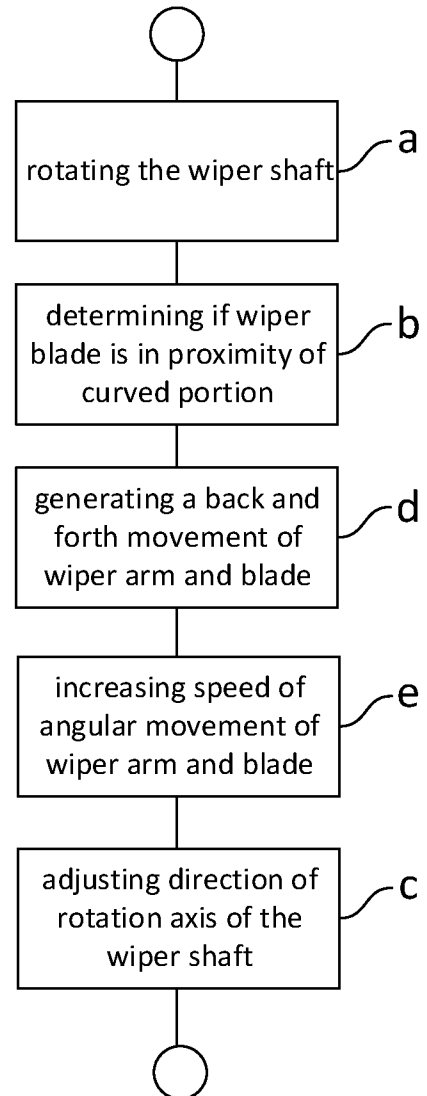


Fig 7b

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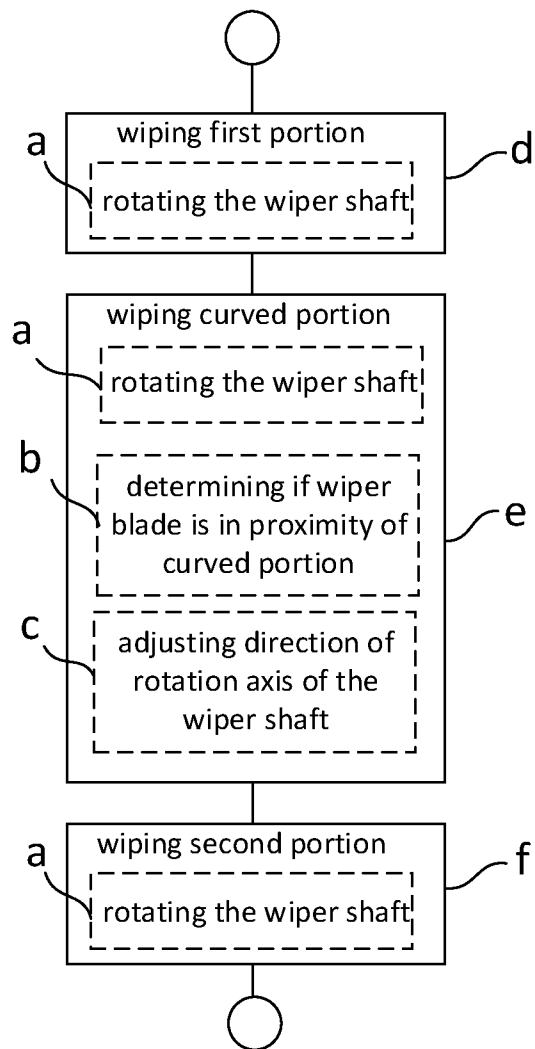


Fig 7c

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2018/050432

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B60S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5186064 A1 (MATSUMOTO HIROSHI ET AL), 16 February 1993 (1993-02-16); column 4, line 9 - line 14; figure 2 --	1-3, 11
A	EP 2730470 A1 (DOGA S A), 14 May 2014 (2014-05-14); abstract; figures 3A-3C, 4A-4C --	1-20
A	FR 2907733 A1 (VALEO SYSTEMES ESSUYAGE), 2 May 2008 (2008-05-02); abstract; figures --	1-20
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Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No.
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International Patent Classification (IPC)

B60S 1/44 (2006.01)

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