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(54) Title: OBSERVATION DEVICE, VEHICLE WITH AN OBSERVATION DEVICE AND METHOD FOR OPERATING AN OBSERVATION DEVICE

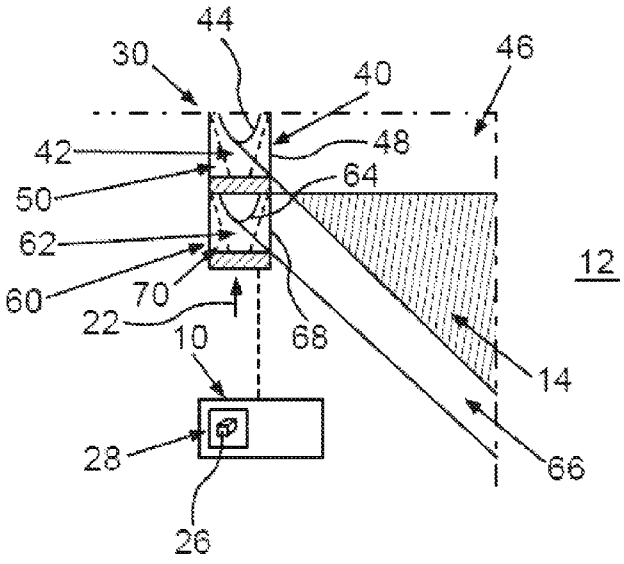


Fig. 1a

(57) Abstract: The invention relates to an observation device for a vehicle (10), comprising a camera device (30) for observing the vehicle's surroundings (12), wherein the camera device (30) comprises at least a first camera (40) and a second camera (60) for observing the vehicle's surroundings (12), wherein an outer sector (14) of the vehicle's surroundings (12) is situated outside a field of view (42) of at least the first camera (40) of the camera device (30), wherein the observation device comprises a mirror element (44) which is at least partially arranged in the field of view (42) of the first camera (40) such, that the outer sector (14) is observable by the first camera (40) by means of the mirror element (44). The invention also relates to a vehicle (10) and a method for operating an observation device. (Figure la selected as the figure accompanying abstract)

Observation device, vehicle with an observation device and method for operating an observation device

Field of the Invention

The invention relates to an observation device for a vehicle, comprising a camera device for observing the vehicle's surroundings. The invention further relates to a vehicle comprising such an observation device and to a method for operating an observation device for a vehicle.

Background Art

Document US 8 228 177 B1 discloses an erectable, pivotable mooring post providing power and control to devices mounted to the post. These devices include camera and sound recording systems, lights and sensors. The disclosed camera systems and sound recording systems can be mounted to the roof of a vehicle.

A camera system for a vehicle is also described in document JPH10136263 A. The camera system there is designed as a vehicle-mounted thermal picture recording device comprising an infrared camera which is mounted on an electric stretching pole. The electric stretching pole can be extended in such a manner, that the infrared camera can take pictures of the surrounding of the vehicle. Furthermore, document US 2007/0160364 A1 discloses an articulating arm for retaining a camera to a vehicle, which is designed as a two wheeled vehicle, such as a bicycle.

It is an object of the present invention to provide an observation device, a vehicle and a method of the initially mentioned kind, which provides for enhanced overview of the vehicle's surroundings.

Summary of the Invention

Technical problem to be solved

This object is solved by an observation device having the features of claim 1, a vehicle having the features of claim 12 and a method having the features of claim 13. Advantageous embodiments with convenient developments of the invention are specified in the dependent claims.

Technical solution

According to the invention the observation device for a vehicle comprises a camera device for observing the vehicle's surroundings, wherein the camera device comprises at least a first camera and a second camera for observing the vehicle's surroundings, wherein an outer sector of the vehicle's surroundings is situated outside a field of view of at least the first camera of the camera device, wherein the observation device comprises a mirror element which is at least partially arranged in the field of view of the first camera such, that the outer sector is observable by the first camera by means of the mirror element.

In videography, photography and other optical imaging techniques where e.g. cameras may be used, the field of view (FOV) is defined as that part of the surrounding of the respective camera that is visible through the camera lens (or optical sensor) at a particular position and orientation in space. Thus, such objects which are situated somewhere outside the FOV when the picture is taken or the video is made cannot be recorded with the respective camera, generally. By means of the mirror element, also objects at least partially outlying the FOV of the first camera are observable. The mirror element may be at least partially curved, which means that the mirror element surface is designed as an at least partially

curved surface. In other words, the mirror element may comprise a reflective surface which may have a curvature which is e.g. convex or concave to name but a few appropriate forms of the curvature or contour of the mirror element's reflective surface. The curvature or contour of the reflective surface may also be formed as spheric or aspheric curvature or contour, to name further possible embodiments which allow an enhanced overview of the vehicle's surroundings by means of the camera device.

The mirror element allows to mount the camera on the vehicle and to orientate e.g. at least the first camera with its FOV upwards in a vertical direction of the vehicle. Due to this orientation of the first camera, the first camera's FOV faces away from the vehicle. In other words, the camera may be oriented in such a manner, that the FOV points towards the sky at least substantially. But with the mirror element placed in the FOV of the first camera, the FOV of the first camera is redirected according to the curvature or contour of the mirror element. In other words, light reflected from the object to be observed is directed to the first camera by means of the mirror element, wherein the object is situated outside the FOV of the first camera. By using a suitable mirror element (with a mirror element surface having an appropriate curvature or contour) the FOV of the first camera may be redirected sideways and circumferential in order to widen a visible area of the first camera to a 360 degree view. This 360 degree view corresponds to a part of the vehicle's surroundings including the outer sector or several outer sectors which are outlying the FOV of the first camera. In other words, by means of the mirror element with an appropriate curvature, the field of visible area of the first camera is expanded to a round view (a panoramic view) which allows a 360 degree observation of the vehicle's surroundings and

the outer sector. For the purpose of better illustration: The 360 degree view may be e.g compared to a rotational body (e.g. to a part of the outer zone of a torus) which is generated by rotating a spherical sector around an axis of orientation of the mirror element. For the purpose of better illustration: the axis of orientation of the mirror element may be arranged on a central axis of the FOV of the first camera (defined by the conical form of the first camera's angle of view which corresponds to the FOV which is enlarged by means of the mirror element). In other words, the rotationally symmetrical mirror element's rotational axis and the axis of orientation of the first camera may be arranged coaxially or parallel, for example.

In an advantageous embodiment the first camera and the second camera are both oriented towards the same orientation direction, wherein the first camera is arranged in a field of view of the second camera.

This arrangement of the first camera and the second camera allows an image processing (e.g. by means of a processing unit of the observation device), in which only little effort must be made for the synchronization of the pictures made by the first camera and the second camera. Synchronization can be understood as at least partial superposition of respective images or videos of each of the cameras which are part of the camera device, wherein any edge distortions between the pictures or videos are corrected and any time delay between the pictures taken by the cameras is avoided. The synchronization effort is low, if the first camera and the second camera are both oriented e.g. parallel or coaxially. A coaxially arrangement means, that the optical sensors of the first camera and the second camera are arranged coaxially and thus face towards the same direction. The synchronization effort is particularly low, if both

cameras have at least almost the same optical properties and/or settings.

It has further proven to be advantageous if the observation device comprises another mirror element which is arranged in the field of view of the second camera, wherein by means of the other mirror element of the observation device the outer sector is observable by the second camera.

The arrangement of the other mirror element in the second camera's FOV allows a redundant usage of the first camera and the second camera. If one of the cameras has a malfunction, at least parts of the vehicle's surroundings are still observable by means of the other camera, which is still in order. If the cameras are arranged coaxially in addition and have identical mirror elements (e.g same shape, same surface quality, same dimension, to name only a few properties) the synchronization effort to derive one picture out of the two pictures taken by means of the respective cameras is particularly low.

It is particularly helpful, if by means of the camera device a stereoscopic picture is derivable from the outer sector.

In other words an object in the vehicle's surroundings is both detectable by the first camera and the second camera, wherein the observation device is capable of deriving a stereoscopic picture or a stereoscopic film from first pictures of the object taken with the first camera and second pictures of the object taken with the second camera. The at least two cameras are arranged in an offset (the at least two cameras are arranged in a distance between each other) in order to generate a stereoscopic illustration of the observation area by means of the observation device. In other words, by means of the pictures from the two cameras a

stereoscopic observation zone can be derived by means of the observation device. Thus, the observation device is capable of generating a depth effect picture or film (3D-effect picture or film) out of the stereoscopic illustration of the vehicle's surroundings including the outer sector. This depths effect picture or film may be monitored by means of a monitor device, which is connected with the observation device, and thus e.g a passenger of the vehicle may see the vehicle's surroundings including the outer sector with an illusion of depth, namely as stereoscopic observation zone. The monitor device (monitor) may be arranged inside the passenger compartment.

Preferably the first camera and the second camera each comprise a transparent tube for delimiting a respective camera chamber of the first camera and of the second camera, wherein the respective camera chamber is at least partially filled with a transparent, nonconductive cooling liquid.

This decreases the risk of overheating of the observation device due to e.g. sunlight. By means of the transparent tube and the transparent, nonconductive cooling liquid an undisturbed observation of the vehicle's surroundings is possible. Due to the fact, that the cooling liquid is nonconductive, a short circuit may be avoided effectively.

Furthermore, it has proven to be advantageous if the observation device comprises at least one extendable supporting arm, by means of which the camera device is moveable between a non-use position, in which the camera device is stowed and at least another position, in which the camera device is capable of observing the vehicle's surroundings.

The use-position may correspond to any position except the storage position. In other words, the observation device can be stowed e.g. in a

storage area of the vehicle especially aerodynamically. In the non-use position, the observation device has a very low aerodynamic drag.

In another advantageous configuration the observation device comprises a retaining element by means of which the camera device is pivotable mounted on top of the at least one extendable supporting arm and by means of which the camera device is rotatable relative to the at least one extendable supporting arm.

This allows the usage of the camera device as stereoscopic 360 degree monitoring system, wherein a picture frequency may be derived dependent on the rotation of the camera device. The camera device is then oriented laterally or in other words, the cameras are oriented laterally and thus both cameras are perpendicularly arranged with respect to the vehicle's vertical axis. This allows an especially precise estimation of the speed of an object, which is observed by means of the observation device, wherein only optical detection means (the cameras) are used.

It has proven to be further advantageous if the at least one extendable supporting arm of the observation device comprises a plurality of arm members which are pivotable connected together in pairs.

In other words, the extendable supporting arm may be designed as multiple-member holding device, which has many degrees of freedom concerning the movement of the extendable supporting arm.

Preferably, the arm members each have a different axial length according to a respective pivoting axis of each of the arm members.

In other words, due to their different axial length, the arm members are pivotable in such a manner that the arm member with the largest axial

length includes and covers the other arm members with smaller axial length. Thus, the arm members may be nested in one another. This allows an especially space saving arrangement of the observation device.

It is further advantageous if the at least one extendable supporting arm is mounted on a vehicle roof or on a tail gate of the vehicle.

In the other position (not the non-use position) also the area between the underbody of the vehicle and the road surface is observable, although the extendable supporting arm and thus the camera device may be mounted on the vehicle roof. In other words, the at least one extendable supporting arm is extendable past the chassis of the vehicle, and the camera device may be moved into a position, in which the area between the underbody of the vehicle and the road surface is observable. This allows e.g. the detection of sharp-edged objects which might damage the tires of the vehicle.

It is particularly advantageous if the at least one extendable supporting arm is mounted on the vehicle by means of pivotable mounting by means of which the camera device is pivotable according to the vehicle's vertical axis.

This allows an especially flexible usage of the observation device. Thus, e.g. scratches or dents in the paintwork of the vehicle may be easily detected and recorded, regardless where the scratches or dents are situated on the vehicle. Due to the possibility of deriving a stereoscopic picture, it is also possible to evaluate the depth of the scratches or dents.

The vehicle according to the invention comprises an observation device according to the invention. With such a vehicle an improved overview of the vehicle's surroundings is provided since the observation device allows

for an especially extensive overview.

In the method for operating an observation device for a vehicle according to the invention the vehicle's surroundings are observed by means of at least a first camera and a second camera of the camera device. An outer sector of the vehicle's surrounding is situated outside a field of view of at least the first camera of the camera device. The observation device comprises a mirror element which is at least partially arranged in the field of view of the first camera such, that the outer sector is observed by the first camera by means of the mirror element.

By observing the vehicle's surroundings, generating video data (e.g. 4k ultra high definition) or images of the vehicle's surroundings and providing this data for a monitor, which is situated in the passenger cell, the passengers feel more comfortable and save due to a better overview which allows the observation of surrounding objects and respective detection and visual presentation of these objects.

The preferred embodiments presented with respect to the observation device and the vehicle and the advantages thereof correspondingly apply to the method for operating an observation device and vice versa.

The features and feature combinations mentioned above in the description as well as the features and feature combinations mentioned below in the description of figures and/or shown in the figures alone are useable not only in the respectively specified combination, but also in other combinations or alone without departing from the scope of the invention.

Further advantages, features and details of the invention are apparent from the claims, the following description of preferred embodiments as well as based on the drawings. Therein show:

Brief Description of the Drawings

Fig. 1a a sectional view of a camera device which is a part of an observation device, wherein a first camera and a second camera of the camera device are both oriented towards the same orientation direction;

Fig. 1b a sectional view of another embodiment of the camera device, wherein two cameras are oriented towards the same orientation direction and two other cameras are oriented towards the opposite direction;

Fig. 1c a top view of the camera device which is directing laterally at present;

Fig. 2 another sectional view of the camera device, wherein respective camera chambers of the first camera and the second camera are filled with a cooling liquid at present;

Fig. 3a a sectional view of an observation device which comprises the camera device and an extendable supporting arm, wherein the observation device is mounted on a vehicle roof;

Fig. 3b a schematic perspective view of the observation device which is in a non-use position;

Fig. 3c a schematic perspective view of the observation device which is in an use position;

Fig. 4a a top view of a vehicle, wherein another embodiment of the observation device is mounted on the vehicle roof;

Fig. 4b a sectional view of the embodiment of the observation device shown in Fig. 4a;

Fig. 4c a schematic perspective view of another embodiment of the camera device;

Fig. 5a a schematic side view of an embodiment of the observation device, wherein the camera device is connected with the supporting arm, which comprises a plurality of arm members which are pivotable connected together in pairs;

Fig. 5b a schematic side view illustrating the freedom of movement of the supporting arm shown in Fig. 5a;

Fig. 5c a schematic side view of the supporting arm which is in the non-use position at present;

Fig. 6a a top view of a pivotable mounting by means of which the camera device may be pivotably mounted to the vehicle;

Fig. 6b a schematic side view of the supporting arm;

Fig. 6c another schematic side view of the supporting arm, wherein the camera device is mounted on top of the supporting arm;

Fig. 6d another schematic side view of the supporting arm;

Fig. 7a a front view of the vehicle, wherein according to another embodiment, two observation devices are mounted on the vehicle roof;

Fig. 7b a top view of the vehicle shown in Fig. 7a;

Fig. 8a a front view of the vehicle wherein the supporting arm of the observation device is mounted on a tail gate of the vehicle; and in

Fig. 8b a side view of the vehicle shown in Fig. 8a.

Detailed Description of Embodiments

Fig. 1a shows a schematic sectional view of a camera device 30 which comprises a first camera 40 and a second camera 60. The camera device 30 is a part of an observation device 20 for a vehicle 10, wherein the vehicle 10 is illustrated in a highly simplified manner. The camera device 30 and thus both the first camera 40 and the second camera 60 are used for observing the vehicle's surroundings 12. An outer sector 14 of the vehicle's surroundings 12 is situated outside a field of view 42 of the first camera 40 of the camera device 30 at present. The outer sector 14 is also situated outside another field of view 62 of the second camera 60 at present. In order to detect and take pictures from an object which is situated in the outer sector 14 the observation device 20 comprises two mirror elements, a mirror element 44 and another mirror element 64, wherein the mirror element 44 is arranged in the field of view 42 of the first camera 40 and the other mirror element 64 is arrange in the other field of view 62 of the second camera 60. Both mirror elements 44, 64 are arranged in the respective field of view 42, 62 in such a manner, that the outer sector 14 and thus any objects which are situated in the outer sector 14 is observable by the first camera 40 by means of the mirror element 44 and by the second camera 60 by means of the other mirror element 64. In other words by means of the respective mirror elements 44, 64 the outer sector 14 may be observed by the first camera 40 and by the second camera 60 although the outer sector 14 is situated both outside the field of view 42 of the first camera 40 and the other field of view 62 of the second camera 60. Due to the fact that the first camera 40 and the second camera 60 are arranged in an offset (a distance between the cameras 40, 60) by means of the camera device 30 a stereoscopic picture 26 is derivable from

the outer sector 14 or from objects which are situated in the outer sector 14 respectively. Although both the first camera 40 and the second camera 60 are oriented towards the same orientation direction 22, which is illustrated with an arrow, and thus, the first camera 40 is arranged in the field of view 62 of the second camera 60, both cameras 40, 60 can take pictures or even a film of objects which are situated in the outer sector 14. The stereoscopic picture 26 or a stereoscopic film, respectively, can be displayed on a monitor 28 in the vehicle 10. Each of the cameras 40, 60 can detect objects in a respective mirror zone 46, 66, wherein the mirror element 44 enables the observation of objects which are situated in the mirror zone 46 due to redirection of the optical path of the first camera 40 by means of the mirror element 44. The mirror element 64 enables the observation of objects which are situated in the mirror zone 66 due to redirection of the optical path of the second camera 60 by means of the mirror element 64. In other words, the outer sector 14 corresponds to an overlapping zone, in which the mirror zones 46, 66 overlap and thus the outer sector 14 defines a stereoscopic field of view in which objects which are situated in the outer sector 14 can be observed both by the first camera 40 and the second camera 60.

Fig. 1b agrees with Fig. 1a over a wide range hence in the following only the differences are discussed. According to the embodiment shown in Fig. 1b the camera device 30 comprises a third camera 74 and a fourth camera 76 in addition to the above mentioned cameras 40, 60. The third camera 74 and the fourth camera 76 are oriented back-to-back with the first camera 40 and the second camera 60. In other words the third camera 74 and the fourth camera 76 are symmetrically arranged with respect to the first camera 40 and the second camera 60 according to a mirror plane 72

and thus the outer sector 14 which may be observed with the camera device 30 in Fig. 1b is twice as large as the outer sector 14 which may be observed by the camera device 30 shown in Fig. 1a. In other words while the first camera 40 and the second camera 60 are oriented both according to the orientation direction 22, the third camera 74 and the fourth camera 76 are oriented in the opposite direction of the orientation direction 22 on the contrary. Fig. 1b also shows a schematic illustration of the resulting outer sector 14 which may be observed by the four cameras 40, 60, 74, 76, wherein the outer sector 14 corresponds to a wide area of the vehicle's surroundings 12 and thus only small blind areas 78 of the vehicle's surroundings 12 cannot be observed by any of the cameras 40, 60, 74, 76. By taking a look on the illustration of the vehicle's surroundings 12 one can see that the outer sector 14 which can be observed by the camera device 30 corresponds to a rotationally symmetrical area, wherein the part of the outer sector 14 below the mirror plane can be observed by the first and second cameras 40, 60 and the other part of the outer sector 14, which is situated above the mirror plane 72 can be observed by the third and fourth cameras 74, 76. It is clear, that the area of the outer sector 14 around the mirror plane 72 has to be synchronized by the camera device 30 in order to provide the stereoscopic picture 26 of the outer sector 14 without having an interruption in the picture in the area of the mirror plane 72. In other words the below and above part of the outer sector 14 have to be synchronized in order to avoid edge effects when displaying the stereoscopic picture or stereoscopic film respectively, on the monitor 28. Both the embodiment of the camera device 30 shown in Fig. 1a and the embodiment of the camera device 30 shown in Fig. 1b enable to take 360 degrees pictures (spheric pictures) from which the stereoscopic

picture 26 or a stereoscopic film, respectively may be derived. Fig. 1c illustrates that the camera device 30 and thus both cameras 40, 60 may also direct laterally (in contrast to the vertical direction shown in Fig. 1a and Fig. 1b) and the camera device 30 can also be rotated in the mirror plane 72 in order to provide a stereoscopic 360 degrees view, wherein a certain picture frequency depends on the rotational speed of the camera device 30. The usage of only one stereo channel enables a simple 2D-360 degree picture replay, if the mirror elements 44, 64 have a spherically curved mirror surface. The data transfer from the camera device 30 to the monitor 28 may be achieved e.g. by Wi-Fi thus no wiring or attachment is arranged in the respective field of view 42, 62 hence an undisturbed panoramic view may be achieved. As well as the wireless data transfer, also the charging of the camera device 30 may be achieved wireless. Hence, the camera device 30 comprises a chargeable battery (not shown) which may be charged e.g. by induction. It is clear, that in this case the camera device 30 also comprises induction means such as a secondary coil (also not shown). This allows the autarchic positioning and mounting on the vehicle 10 without the need of supply components, such as e.g. cables.

Fig. 2 shows an enlarged sectional view of the first camera 40. Both in Fig. 2 and in Fig. 1a one can see that the first camera 40 comprises a transparent tube 48 for delimiting a camera chamber 50 of the first camera 40 and the second camera 60 comprises another transparent tube 68 for delimiting another camera chamber 70 of the second camera 60. The respective camera chambers 50, 70 are each filled with a transparent, non-conductive cooling liquid 36 which may also be used as antifreeze fluid. In other words by means of the cooling liquid 36 both cameras 40,

60 of the camera device 30 can be protected from extreme temperatures and both the first camera 40 and the second camera 60 are filled with the cooling liquid 36. Each of the transparent tubes 48, 68 may be designed as a partially transparent tube, which means that the outer surface of the respective transparent tube 48, 68 facing the vehicle's surroundings 12 may be metalized for the purpose of aesthetically appearing.

Fig. 3a shows a sectional view of an embodiment of the observation device 20 which is mounted on a vehicle roof 16 of the vehicle 10 at present. In the embodiment shown in Fig. 3a the observation device 20 comprises an extendable supporting arm 80 which is designed as a hydraulic cylinder at present. In order to avoid movement induced vibrations, the supporting arm 80 comprises an anti-shock spring damper system (not shown). By means of the supporting arm 80 the camera device 30 can be moved upwards and downwards, wherein in Fig. 3b the camera device 30 and thus the observation device 20 is shown in a non-use position 96 and in Fig. 3c the observation device 20 is shown in a use position 98 which corresponds to another position which is different from the non-use position 96. In the embodiment shown in Fig. 3a the observation device 20 is also in the use position 98 thus the supporting arm 80 is extended at least partially wherein the camera device 30, which is surrounded by an acrylic box 108 at present is kept in a distance from the vehicle roof 16 by means of the supporting arm 80. In the non-use position 96 at least parts of the observation device 20 are stowed in a box 118 which is arranged below the vehicle roof 16 and which comprises an air inlet 110 and an air outlet 112. The air inlet 110 and the air outlet 112 are used for a convective heat exchange or heat transfer respectively between the cooling liquid 36 which is stored in fluid tanks 114, wherein

the cooling liquid 36 can be pumped through the whole observation device 20 (also through the cameras 40, 60, 74, 76) by means of a pump 116. The camera device 30 is connected with the extendable supporting arm 80 by means of a retaining element 88.

Fig. 4a and Fig. 4b show another embodiment in which the observation device 20 comprises a sonic cap 102 which may be used to keep the camera device 30 clean by means of ultrasonic waves. The camera device 30 shown in Fig. 4a and Fig. 4b may e.g. be arranged on the vehicle roof 16 as shown in Fig. 4a, wherein the camera device 30 is mounted on a roof holder 104. In an alternative embodiment the camera device 30 may also be mounted on a tail gate 18 of the vehicle 10. In the embodiments shown in Fig. 4a and Fig. 4b respectively the camera device 30 is arranged parallel to a vertical axis 86 of the vehicle 10. Fig. 4c shows another embodiment of the observation device 20 wherein the supporting arm 80 is not extendable and both ends of the supporting arm 80 each hold one camera device 30. Furthermore, the supporting arm 80 shown in Fig. 4c comprises members for fixing the observation device 20 e.g. to the vehicle roof 16 or the tail gate 18 of the vehicle 10 to name but a few possibilities of fixation.

Fig. 5a shows a side view of another embodiment of the observation device 20. The observation device 20 also comprises the extendable supporting arm 80 by means of which the camera device 30 is moveable between the non-use position 96, in which the camera device 30 is stowed and the use position 98 (the other position), in which the camera device 30 is capable of observing the vehicle's surroundings 12. In Fig. 5a the camera device 30 is in the use position 98 and in Fig. 5c the camera device is in the non-use position 96. In order to provide many degrees of

freedom concerning the movability of the observation device 20, the extendable supporting arm 80 comprises a plurality of arm members 82, 84 which are pivotable connected in pairs. In order to further enhance the movability, the observation device 20 also comprises the retaining element 88, by means of which the camera device 30 is pivotable mounted on top 90 of the extendable supporting arm 80 and by means of which the camera device 30 is rotatable relative to the extendable supporting arm 80. Fig. 5b shows the high movability of the supporting arm 80, wherein due to the plurality of degrees of free movement even e.g scratches on the side of the vehicle 10 or objects between the underbody of the vehicle 10 and the road surface can be observed by means of the observation device 20. In other words, although the observation device 20 is mounted on the vehicle roof 16 or the tail gate 18 objects between the underbody of the vehicle 10 and the road surface are observable by means of the camera device 30 of the observation device 20.

Fig. 6a shows a pivotable mounting 24 which may be used to pivotable mount the observation device 20 e.g. on the vehicle roof or the tail gate 18. The pivotable mounting 24 is designed as a ring with circumferential grooves. Furthermore, the pivotable mounting 24 comprises motors 106 by means of which the supporting arm 80 which may be engaged with the grooves and thus guided in its movement may be rotated accurately.

Fig. 6b shows, that in a further embodiment a motor 100 between the arm members 82, 84 is arranged, wherein the motor 100 comprises a simple transmission (not shown) for a controlled relative movement between the arm member 82 and the arm member 84.

Fig. 6c shows, that the arm members 82, 84 each have a different axial

length l, L according to a respective pivoting axis 92, 94 of each of the arm members 82, 84. This allows a nesting of the arm members 82, 84 in such a manner, that the supporting arm can be moved into the non-use position 96 as it is shown in Fig. 5c. By means of the motor 100 (e.g. electric motor) the observation device 20 can be easily moved from the non-use position 96 (see Fig. 5c) into the use position 98, as it is shown in Fig. 6c and Fig. 6d.

Fig. 7a and Fig. 7b each show another embodiment in which the extendable supporting arm 80 is designed as a roof railing. As well as in the embodiments e.g. shown in Fig. 5a the support arm 80 is mounted on the vehicle by means of the pivotable mounting 24 by means of which the camera device 30 is pivotable according to the vehicle's vertical axis 86.

Fig. 8a and Fig. 8b each show another view of the observation device 20 with the extendable supporting arm 80 according to the embodiment shown in Fig. 5a. The observation device 20 is mounted on the tail gate 18 of the vehicle 10 and thus the camera device 30 can be stowed in the luggage compartment of the vehicle 10 whereby the camera device 30 is then in the non-use position 96.

What is claimed is:

1. Observation device (20) for a vehicle (10), comprising a camera device (30) for observing the vehicle's surroundings (12),
   characterized in that,
   the camera device (30) comprises at least a first camera (40) and a second camera (60) for observing the vehicle's surroundings (12), wherein an outer sector (14) of the vehicle's surroundings (12) is situated outside a field of view (42) of at least the first camera (40) of the camera device (30), wherein the observation device (20) comprises a mirror element (44) which is at least partially arranged in the field of view (42) of the first camera (40) such, that the outer sector (14) is observable by the first camera (40) by means of the mirror element (44).
2. Observation (20) device according to claim 1,
   characterized in that,
   the first camera (40) and the second camera (60) are both oriented towards the same orientation direction (22), wherein the first camera (40) is arranged in a field of view (62) of the second camera (60).
3. Observation device (20) according to claim 2,
   characterized in that,
   the observation device (20) comprises another mirror element (64) which is arranged in the field of view (62) of the second camera (60), wherein by means of the other mirror element (64) of the observation device (20) the outer sector (14) is observable by the second camera (60).
4. Observation device (20) according to any one of claims 1 to 3,
   characterized in that,

by means of the camera device (30) a stereoscopic picture (26) is derivable from the outer sector (14).

5. Observation device (20) according to any one of claims 1 to 4, characterized in that,

the first camera (40) and the second camera (60) each comprise a transparent tube (48, 68) for delimiting a respective camera chamber (50, 70) of the first camera (40) and of the second camera (60), wherein the respective camera chamber (50, 70) is at least partially filled with a transparent, nonconductive cooling liquid (36).

6. Observation device (20) according to any one of claims 1 to 5, characterized in that,

the observation device (20) comprises at least one extendable supporting arm (80), by means of which the camera device (30) is movable between a non-use position (96), in which the camera device (30) is stowed and at least another position (98), in which the camera device (30) is capable of observing the vehicle's surroundings (12).

7. Observation device (20) according to claim 6, characterized in that,

the observation device (20) comprises a retaining element (88) by means of which the camera device (30) is pivotable mounted on top (90) of the at least one extendable supporting arm (80) and by means of which the camera device (30) is rotatable relative to the at least one extendable supporting arm (80).

8. Observation device (20) according to claim 6 or 7, characterized in that,

the at least one extendable supporting arm (80) of the observation device (20) comprises a plurality of arm members (82, 84) which are

pivotable connected together in pairs.

9. Observation device (20) according to claim 8,
characterized in that,
the arm members (82, 84) each have a different axial length (l, L) according to a respective pivoting axis (92, 94) of each of the arm members (82, 84).

10. Observation device (20) according to any one of claims 6 to 9,
characterized in that,
the at least one extendable supporting arm (80) is mounted on a vehicle roof (16) or on a tail gate (18) of the vehicle (10).

11. Observation device (20) according to any one of claims 6 to 10,
characterized in that,
the at least one extendable supporting arm (80) is mounted on the vehicle (10) by means of a pivotable mounting (24), by means of which the camera device (30) is pivotable according to the vehicle's vertical axis (86).

12. A vehicle (10) comprising an observation device (20) according to any one of claims 1 to11.

13. A method for operating an observation device (20) for a vehicle (10), which comprises a camera device (30) for observing the vehicle's surroundings (12),
characterized by the step of,
observing the vehicle's surroundings (12) by means of at least a first camera (40) and a second camera (60) of the camera device (30), wherein an outer sector (14) of the vehicle's surroundings (12) is situated outside a field of view (42) of at least the first camera (40) of the camera device (30), wherein the observation device (20)

comprises a mirror element (44) which is at least partially arranged in the field of view (42) of the first camera (40) such, that the outer sector (14) is observed by the first camera (40) by means of the mirror element (44).

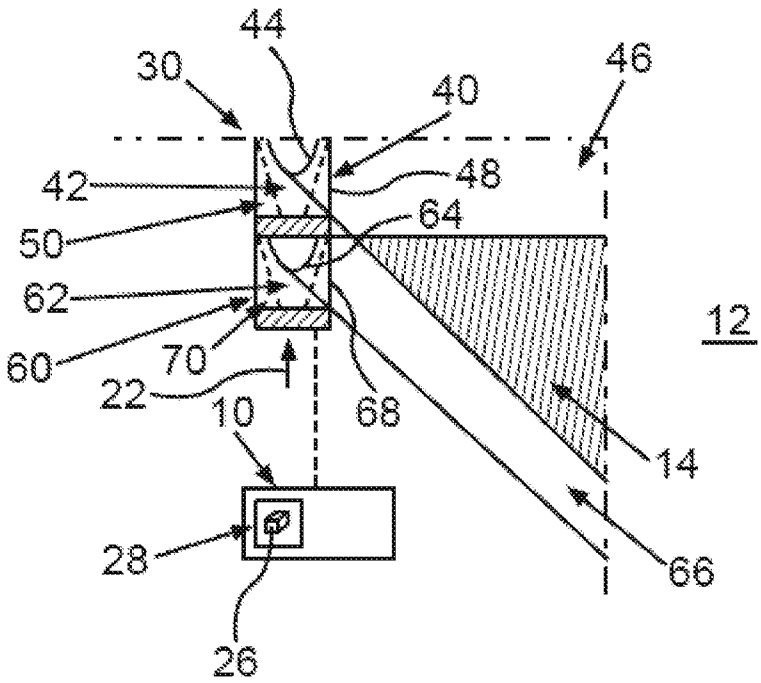


Fig. 1a

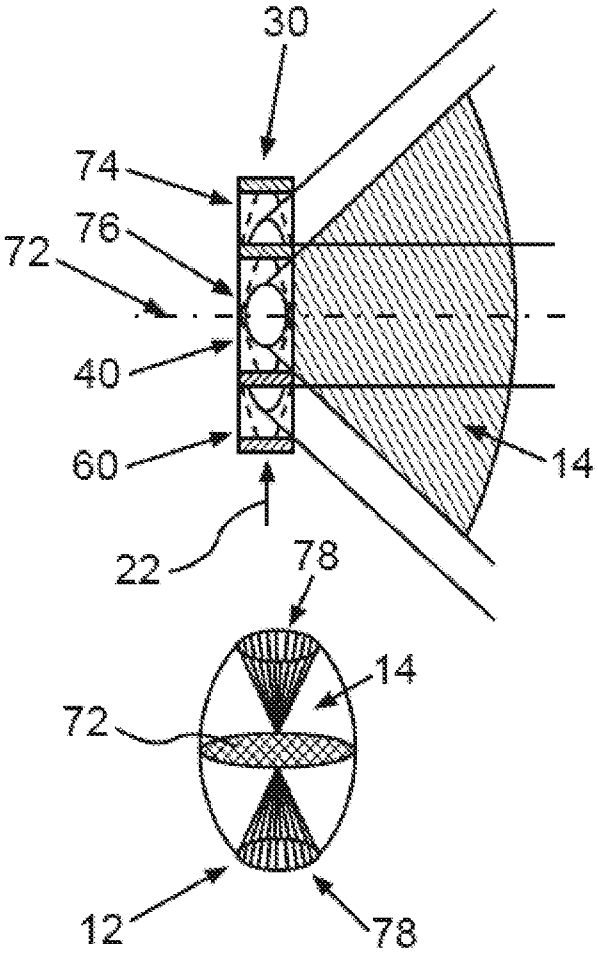


Fig. 1b

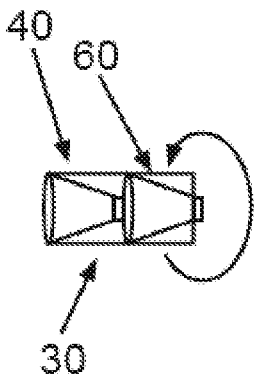


Fig. 1c

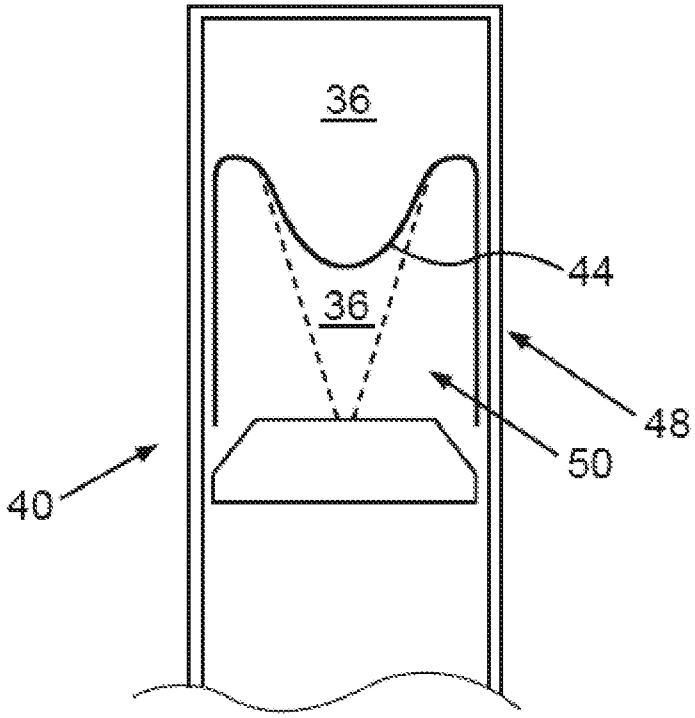

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Fig. 2

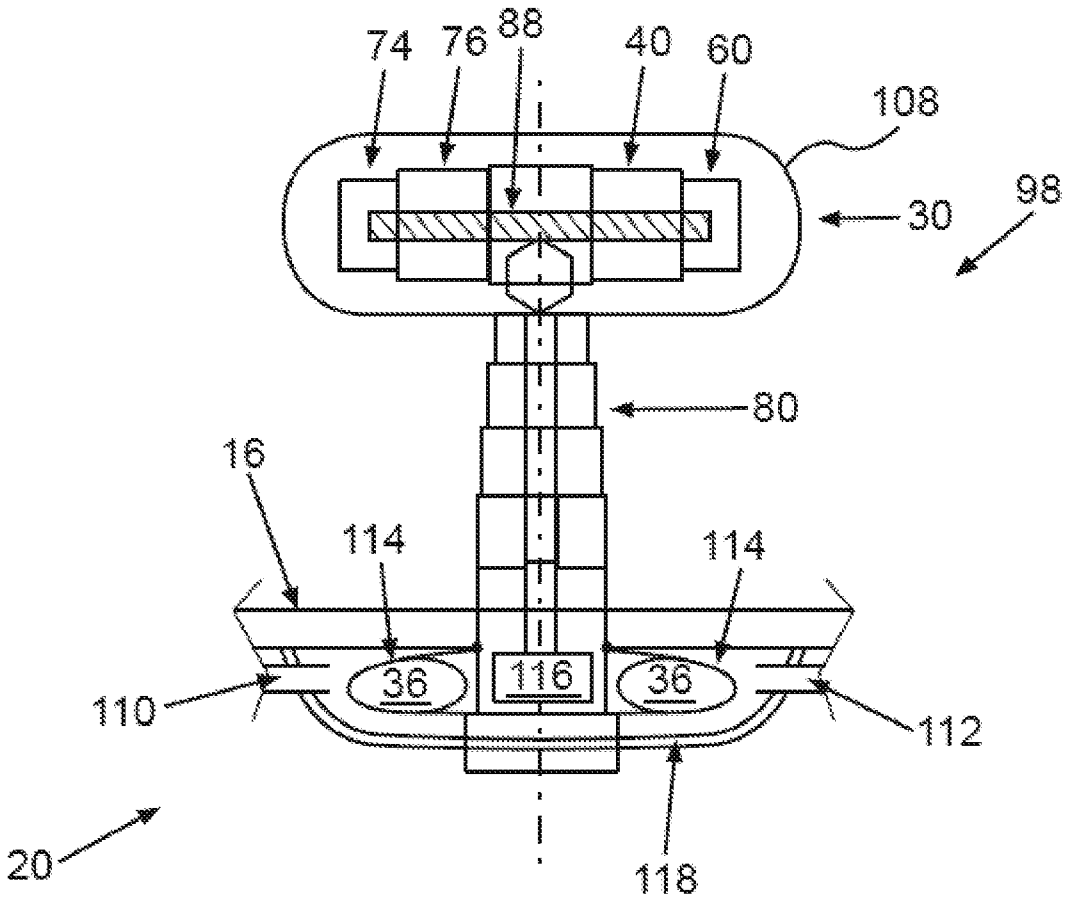

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Fig. 3a

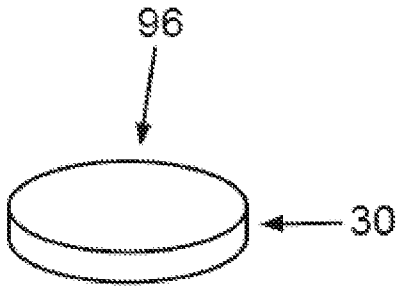


Fig. 3b

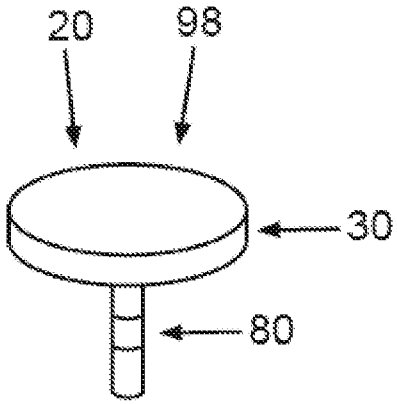


Fig. 3c

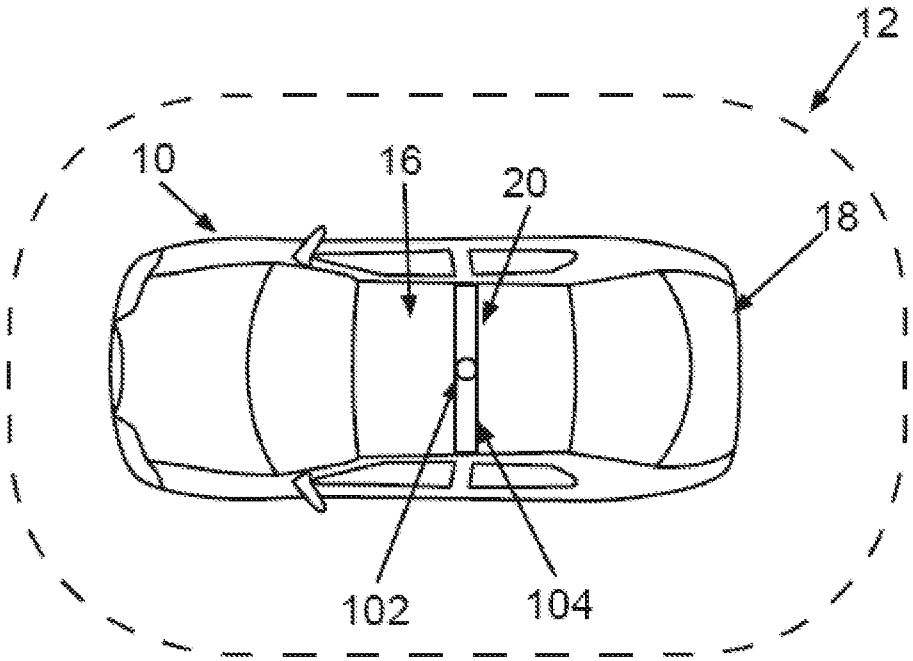


Fig. 4a

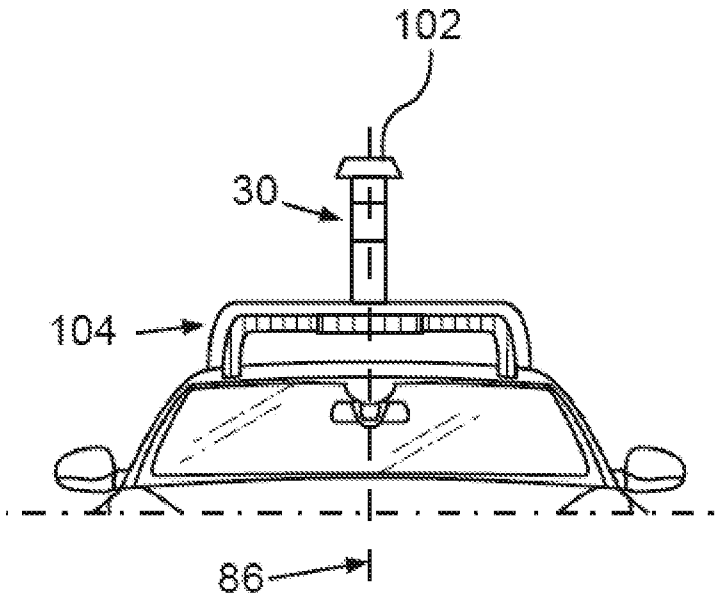


Fig. 4b

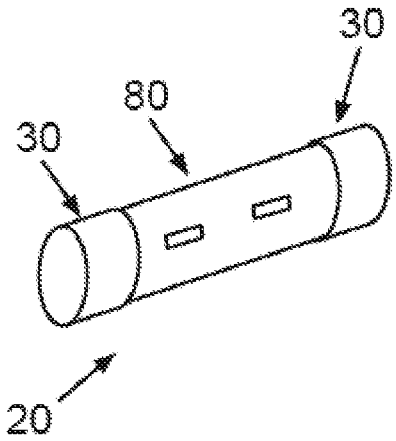


Fig. 4c

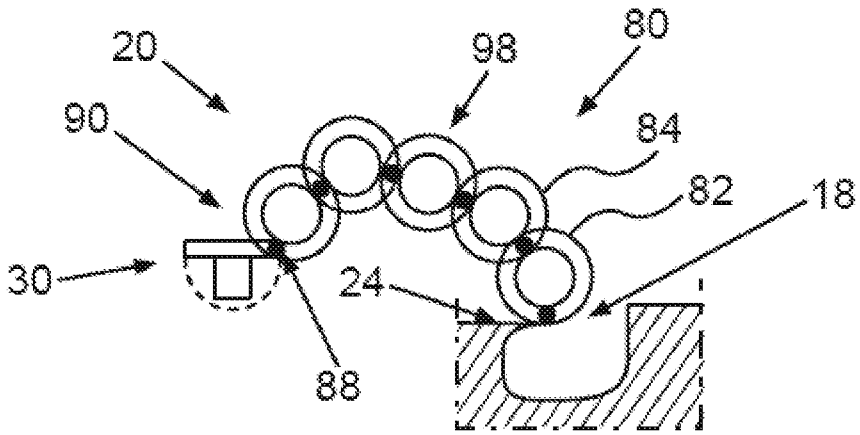


Fig. 5a

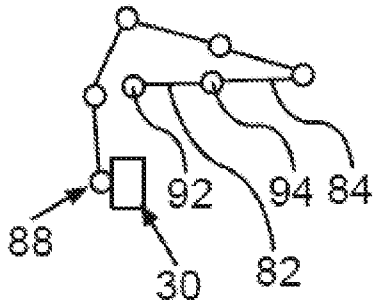


Fig. 5b

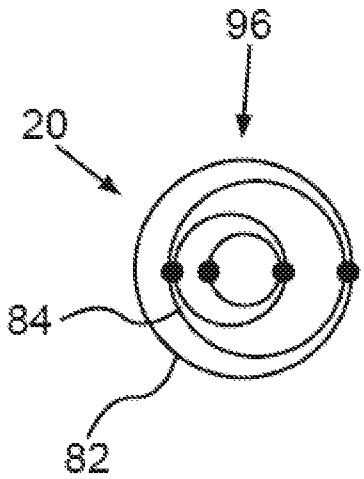


Fig. 5c

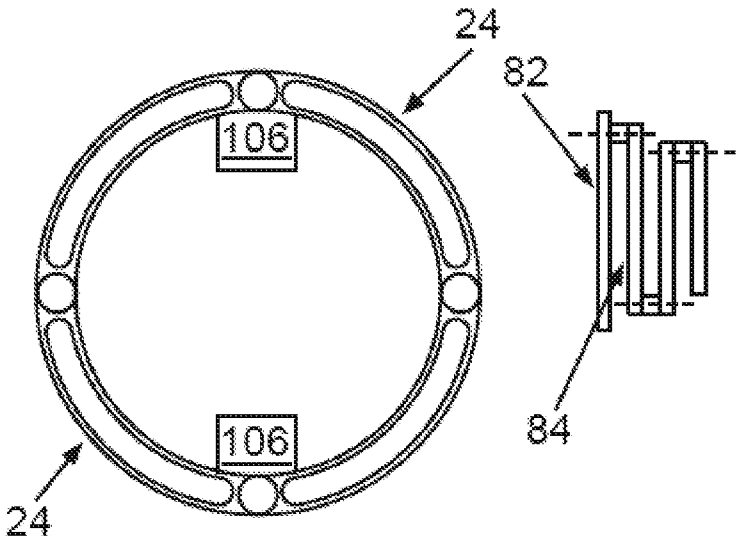


Fig. 6a

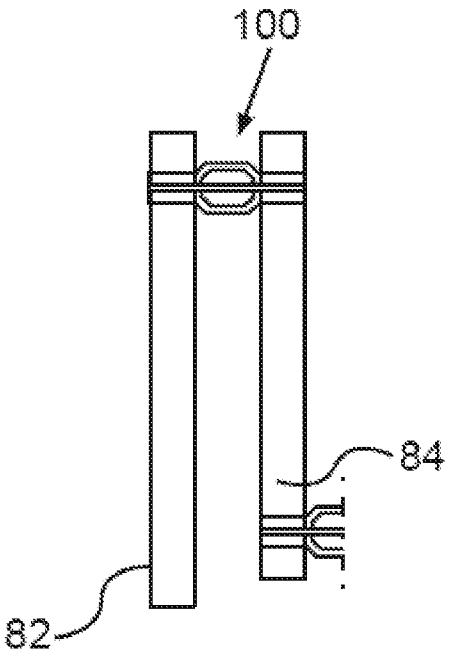


Fig. 6b

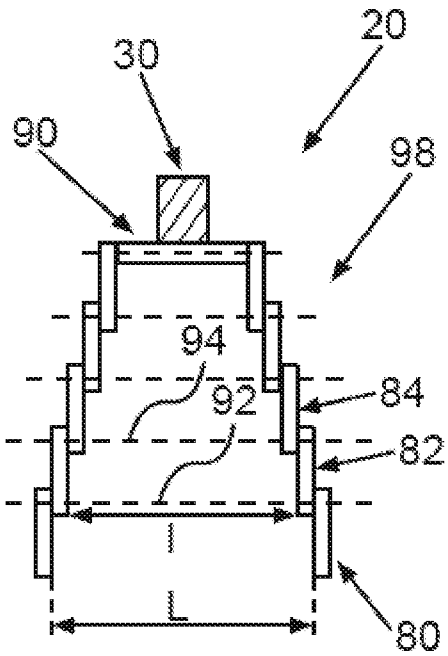


Fig. 6c

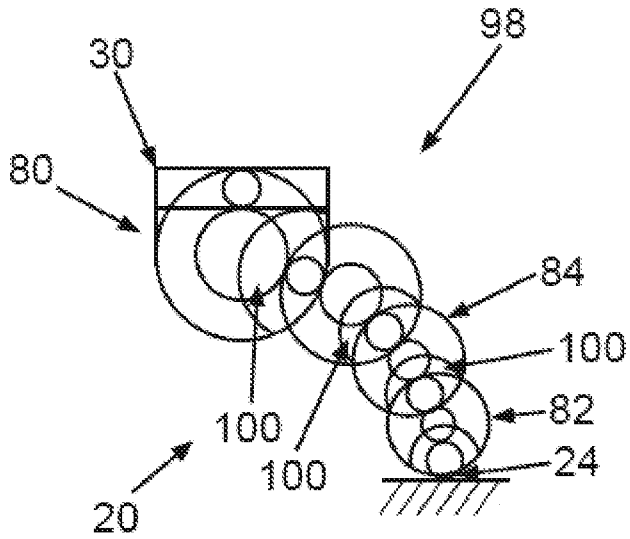


Fig. 6d

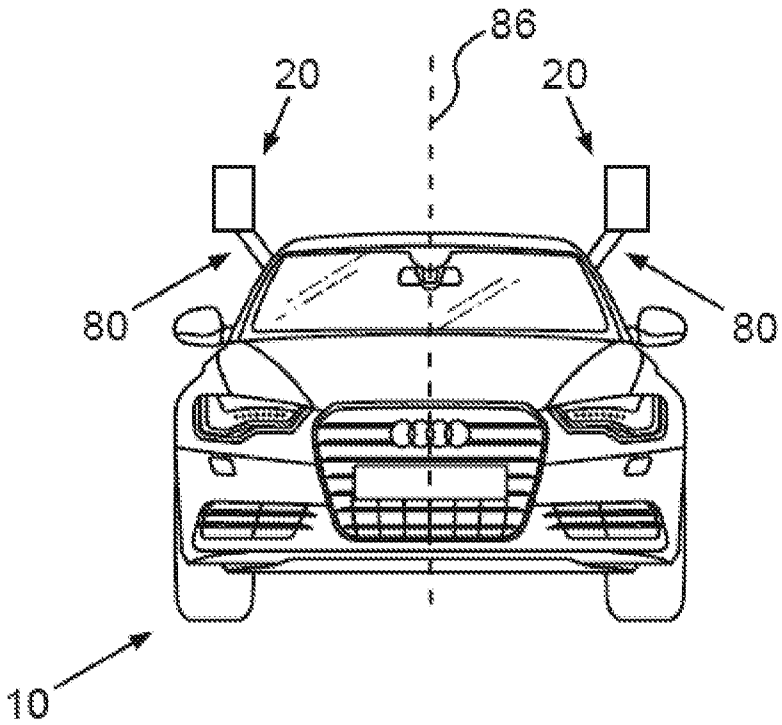


Fig. 7a

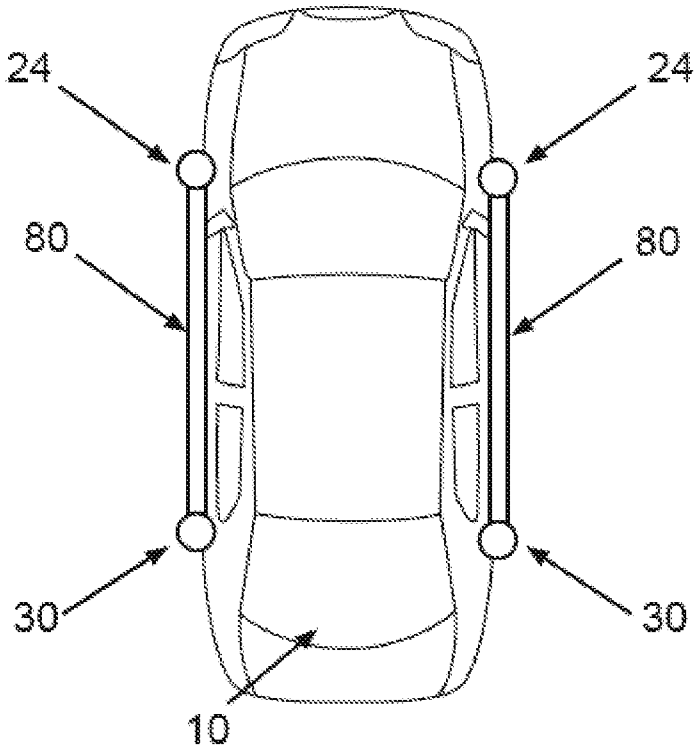


Fig. 7b

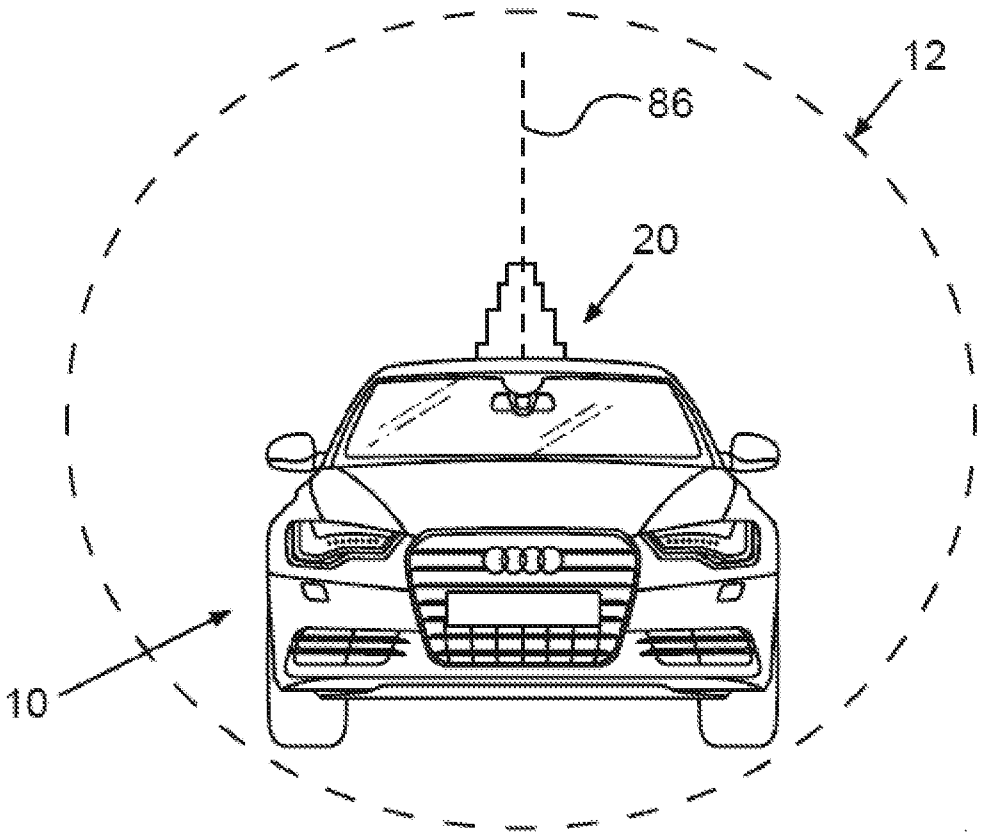


Fig. 8a

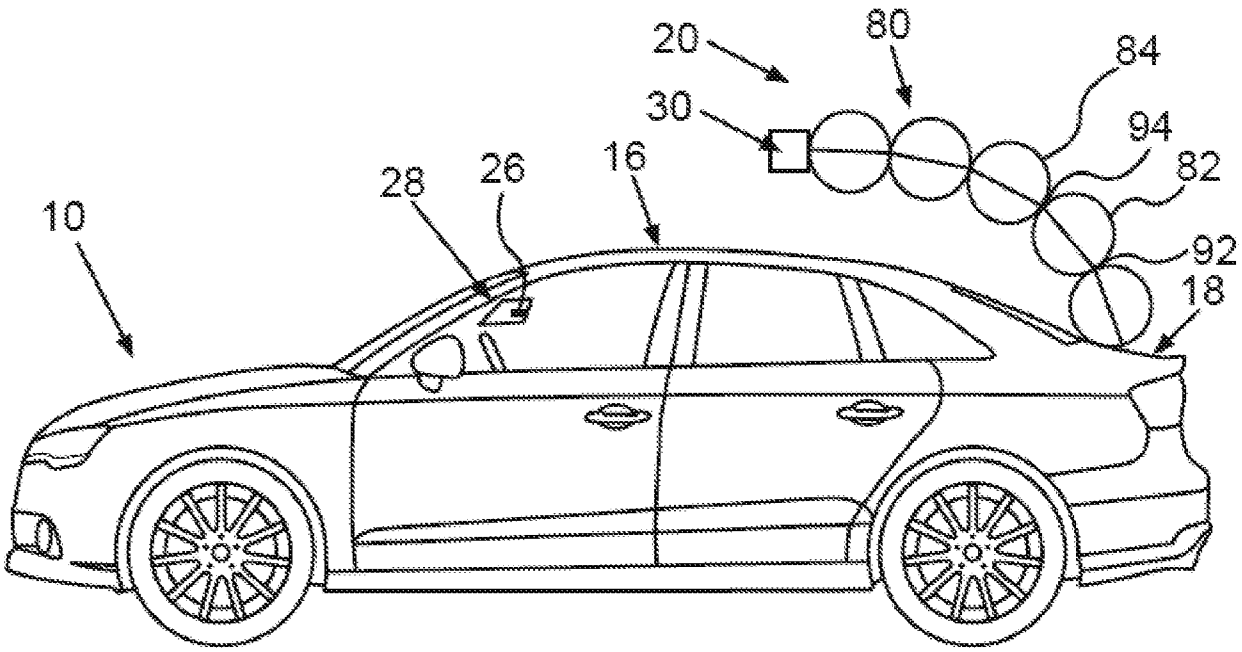


Fig. 8b

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/066622

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60R11/04 H04N13/02 H04N5/232 G02B7/18 G02B13/06
ADD.

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)
B60R G03B H04N G02B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, 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	WO 2005/106543 A1 (NANOPHOTONICS LTD [KR]; KWEON GYEONG-IL [KR]) 10 November 2005 (2005-11-10)	1-4,12, 13
Y	paragraph [0036] - paragraph [0037]; figure 9	6,7

X	JP 2003 023623 A (SHARP KK; MAZDA MOTOR) 24 January 2003 (2003-01-24)	1,4,6,7, 12,13
Y	paragraph [0001] - paragraph [0054]; figures	10,11

X	US 6 313 865 B1 (DRISCOLL JR EDWARD [US] ET AL) 6 November 2001 (2001-11-06) column 3, line 63 - column 4, line 55; figures 5,6	1,4,13

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 July 2015	13/10/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	David, Pascal

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/066622

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 101 487 703 A (UNIV ZHEJIANG TECHNOLOGY [CN] UNIV ZHEJIANG TECHNOLOGY; YIPING TANG) 22 July 2009 (2009-07-22) figure 8	1,13
Y	US 2004/201674 A1 (MIYAZAKI HIDETO [JP] ET AL) 14 October 2004 (2004-10-14) paragraph [0037] - paragraph [0110]; figures	6,7
Y	US 8 228 177 B1 (YAMADA STANLEY TOSHIO [US]) 24 July 2012 (2012-07-24) cited in the application	10,11
A	column 2, line 39 - column 3, line 12; figures	1,13
A	JP 2000 180954 A (SONY CORP) 30 June 2000 (2000-06-30) paragraph [0006]; figure 6	5
A	US 2007/160364 A1 (PEIKA STEPHEN J [US]) 12 July 2007 (2007-07-12) cited in the application column 2, line 39 - column 3, line 12; figures	1,13
A	JP H10 136263 A (N II C SANEI KK) 22 May 1998 (1998-05-22) cited in the application abstract; figures	1,13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2014/066622

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-5, 12, 13

   The first camera and the second camera each comprise a transparent tube for delimiting a respective camera chamber of the first camera and of the second camera, wherein the respective camera chamber is at least partially filled with a transparent, non conductive cooling liquid.

   ---

2. claims: 6-11

   The observation device comprises at least one extendable supporting arm, by means of which the camera device is movable between a non-use position, in which the camera device is stowed and at least another position, in which the camera device is capable of observing the vehicle's surroundings.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2014/066622

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2005106543 A1	10-11-2005	KR 100491271 B1	25-05-2005
		WO 2005106543 A1	10-11-2005
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		JP 2004312638 A	04-11-2004
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US 8228177 B1	24-07-2012	NONE	
JP 2000180954 A	30-06-2000	NONE	
US 2007160364 A1	12-07-2007	NONE	
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