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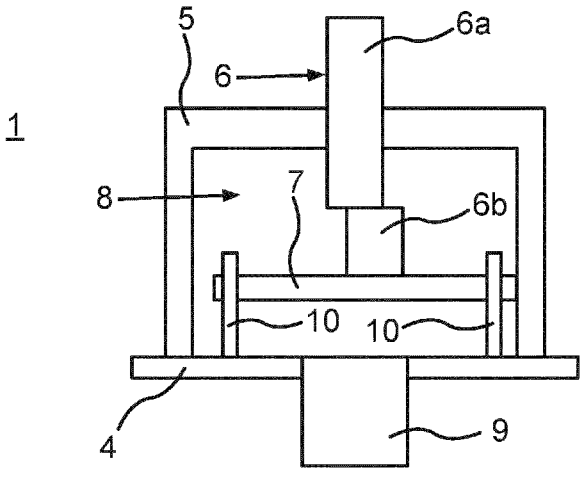


Fig.3

(57) Abstract: A method for manufacturing a camera (1) comprises connecting a lens unit (9) to a first housing part (4) and mounting a circuit board (7) to the first housing part (4), wherein a position and/or orientation of the circuit board (7) is aligned with respect to the lens unit (9). A second housing part (5) is connected to the first housing part (4), such that a housing interior (8) accommodates the circuit board (7). A first component (6a) of a connector assembly (6) is fastened to the second housing part (5) such that the connector assembly (6) passes through an opening of the second housing part (5). A second component (6b) of the connector assembly (6) is connected to the first component (6a), such that the first component (6a) and the second component (6b) are moveable with respect to each other.

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Automotive camera with connector assembly

The present invention is directed to an automotive camera comprising a first housing part and a lens unit, which is connected to the first housing part, a second housing part, which is connected to the first housing part, such that a housing interior is formed, a circuit board, which is accommodated in the housing interior and carries an imager chip, and a connector assembly for electrically connecting the circuit board to an external electronic circuit, wherein the connector assembly passes through an opening of the second housing part. The invention is further directed to a corresponding method for manufacturing an automotive camera, to a camera system and to a motor vehicle.

Cameras, which are designed to be arranged on motor vehicles, may be denoted as automotive cameras. Automotive cameras depicting an exterior environment of the motor vehicle are used for various driver assistance functions or other functions for partially or fully automatic driving of a motor vehicle. However, automotive cameras may also be employed for the capturing an interior of the vehicle and may be arranged correspondingly. Thus, automotive cameras may be exposed to significant temperature fluctuations and/or other environmental conditions. Moreover, automotive cameras are also exposed to mechanical stress due to the vibrations while the vehicle is moving. Automotive cameras for motor vehicles should therefore be designed to operate as desired under said conditions and to achieve sufficiently good image quality. The images may then be provided to driver assistance systems or other electronic vehicle guidance systems, which may use them as an input for driver assistance or at least partly automatically guiding the vehicle.

When capturing an image, light entering the housing interior through the lens unit is detected by the imager. Consequently, the relative position and/or orientation of the imager with respect to the lens unit should lie within predefined tolerance ranges in order to ensure a consistent and reproducible high imaging quality for the individual camera but also amongst different cameras. Furthermore, the connector assembly must be able to provide electrical signals based on data generated by the imager to the external electronic circuit. In addition, it is desirable that the first housing part and the second housing part are connected to each other and that the relative position of the first housing part and the second housing part with respect to each other lies in respective predefined tolerance ranges in order to allow for a robust connecting process during manufacturing of the camera.

It is an object of the present invention to achieve an accurate alignment of the imager chip with respect to the lens unit and at the same time an accurate alignment of the first housing part and the second housing part with respect to each other.

This objective is achieved by the respective subject matter of the independent claims. Further implementations and preferred embodiments are subject matter of the dependent claims.

The invention is based on the idea to connect the circuit board carrying the imager chip rigidly to the first housing part in order to align the imager chip and/or the circuit board with respect to the lens unit, which is also attached to the first housing part, to pass the connector assembly through an opening of the second housing part and to use a floating connector assembly in order to allow a movement of the second housing part with respect to the first housing part before the first and the second housing part are connected to each other.

According to an aspect of the invention, a method for manufacturing an automotive camera is provided. According to the method, a first housing part and a lens unit are provided and the lens unit is fastened to the first housing part. A circuit board, which carries an imager chip, is provided and, in particular after fastening the lens unit to the first housing part, the circuit board is mounted to the first housing part. Therein, a position and/or orientation of the circuit board is aligned with respect to the lens unit, which has been fastened to the first housing part, in particular during mounting of the circuit board to the first housing part or as a part of the mounting process. A second housing part is provided and, in particular after mounting the circuit board to the first housing part, the second housing part is connected to the first housing part, such that a housing interior is formed, which accommodates the circuit board. A connector assembly for connecting the circuit board electrically and, in particular, mechanically to an external electronic circuit is provided. A first component of the connector assembly, which is in particular a first component for electrically and mechanically connecting the connector assembly to the external electronic circuit, is fastened to the second housing part, such that the connector assembly, in particular the first component, passes through an opening of the second housing part. A second component of the connector assembly is connected to the first component, such that the first component and the second component are movable with respect to each other.

The housing interior may be understood as an enclosure formed by the first housing part in combination with the second housing part. The first and the second housing part may for example form a housing body of the automotive camera. The housing body may for example have an outer shape, which is essentially cuboid or, in other words, which has six mutually parallel side faces including a front face of the first housing part and a rear face of the second housing part.

The first housing part may also be denoted as front housing part or as lens holder. The first housing part, in particular, has an opening for fastening the lens unit. The lens unit may comprise a lens housing as well as one or more lenses inside the lens housing. For fastening the lens unit to the first housing part, the lens housing may for example be connected to the first housing part by means of a threaded connection, for example by using an external thread of the lens housing and an internal thread of the first housing part or vice versa.

The second housing part may also be denoted as rear housing part. The connector assembly, in particular the first component of the connector assembly, may be fastened in a rigid or moveable manner to the second housing part.

The connector assembly may comprise one or more further components in addition to the first and the second component or may consist of the first and the second component. Moreover, each of the first and the second component themselves may be made of multiple parts or of a single part.

An active optical surface of the imager chip is, in particular, arranged on a side of the circuit board, which faces the lens unit in the assembled state of the automotive camera. On the other hand, the connector assembly may be connected to the circuit board on an opposite side facing the opening of the second housing part.

The connector assembly, in particular the first and the second component when connected to each other, may have an essentially oblong shape and therefore a longitudinal axis of the connector assembly may be defined. In particular, the circuit board and the external electronic circuit may be connected to the opposite axial ends of the connector assembly.

It is pointed out that during a method for manufacturing an automotive camera according to the invention, not all of the steps necessarily have to be carried out in the described

order. However, in order to be able to align the position and/or orientation of the circuit board with respect to the lens unit when mounting the circuit board to the first housing part, the lens unit is fastened to the first housing part before the circuit board is mounted to the first housing part. Furthermore, the circuit board should be mounted to the first housing part before the second housing part is connected to the first housing part. On the other hand, however, the first component and the second component of the connector assembly may be connected to each other before or after the first component of the connector assembly is connected to the second housing part and/or before or after the circuit board is connected to the connector assembly. In particular, the exact order of the method steps may also depend on the concrete implementation of the movable connection of the first and the second component of the connector assembly with respect to each other.

For example, the first component is fastened to the second housing part and afterwards the second component is connected to the first component and afterwards the first component is connected to the circuit board. Alternatively, the first and the second component of the connector assembly may be connected to each other and afterwards the first component is connected to the second housing part. Obviously other sequences may be possible depending on the actual implementation.

In particular, the connector assembly may comprise a third component, which is arranged between the circuit board and the second component, or the second component may be directly connected to the circuit board.

The external electronic circuit may be considered as external in the sense that it is not a part of the automotive camera, in particular is not arranged in the housing interior. The external electronic circuit may for example be comprised by a vehicle or a camera system for the vehicle. In particular, the external electronic circuit may be an electronic control unit, ECU, or a part of an ECU.

Consequently, the external electronic circuit may be connected to the connector assembly, in particular to the first component of the connector assembly, by means of further connecting means, for example a cable, in particular a video cable or a coaxial cable. In some implementations, the connector assembly may also be designed such that the first component of the connector assembly is directly connectable to the external electronic circuit.

In an ideal situation, when mounting the circuit board to the first housing part, the imager chip is perfectly aligned with the lenses of the lens unit and at the same time the first housing part is perfectly aligned with the lens unit. In this case, it would make no difference, whether the circuit board is directly aligned with the lens unit or to the first housing part. In reality, however, certain tolerances must be allowed to be able to manufacture the camera. The tolerances may include tolerances of the lens unit itself and tolerances for connecting the lens unit to the first housing part.

When mounting the circuit board to the first housing part according to the invention, the circuit board and, in consequence, the imager, is actively aligned with respect to the lens unit. This may for example be achieved by allowing for a relatively large tolerance when mounting the circuit board to the first housing part. Therefore, relatively low tolerances may be achieved, since a potential misalignment between the lens unit and the first housing part does not have a negative impact. That means, however, that the circuit board is not necessarily exactly aligned with respect to the first housing part.

In order to avoid resulting problems for reliably connecting the circuit board to the external electronic circuit, the connector assembly is designed as a floating connector assembly or, in other words, is designed such that the first and second component of the connector assembly are moveable with respect to each other. In this way, it is achieved that the second housing part can be aligned accurately with respect to the first housing part and deviations caused by the alignment of the circuit board with respect to the lens unit are compensated by the movable interface given by the connector assembly.

That the first component and the second component of the connector assembly are moveable with respect to each other may for example be understood such that they are moveable within an x-y-plane and/or along a z-direction with respect to each other and/or they are tiltable or pivotable with respect to each other. Therein, the x-y-plane is for example parallel to the rear face of the second housing part, which comprises the opening through which the connector assembly passes. The z-direction is perpendicular to the x-y-plane.

In case the lens unit would be perfectly aligned with respect to the first housing part and the first housing part would be perfectly aligned with respect to the second housing part, the z-axis may correspond to the optical axis of the lens unit or be parallel to the optical axis and the x-y-plane is perpendicular to the optical axis.

Resulting advantages include the fact that the process of connecting the first housing part to the second housing part, for example by means of laser welding, may be carried out in a robust and reliable manner since the relative position and/or orientation of the first and the second housing part with respect to each other can have very low tolerances. On the other hand, if the connector assembly would not be a floating connector assembly, the misalignment of the circuit board with respect to the first housing part would have to be compensated by another misalignment of the second housing part with respect to the first housing part. This would result in an inconsistent connection interface between the first and the second housing part, which would render the connecting process, for example by means of laser welding, particularly difficult.

Consequently, a method for manufacturing according to the invention overcomes the described disadvantages by combining said method steps. The resulting automotive camera is characterized, in particular, by the floating connector assembly and the alignment of the circuit board with respect to the lens unit as well as the alignment of the first housing part with respect to the second housing part.

In particular, the step of connecting the second housing part to the first housing part comprises aligning the second housing part with respect to the first housing part, in particular aligning a position and/or an orientation of the first housing part with respect to the second housing part.

On the other hand, the second housing part is not actively or necessarily aligned with respect to the lens unit, the circuit board or the imager chip. Therefore, the tolerances of the second and the first housing part with respect to each other may be minimized.

In other words, the mounting of the circuit board to the first housing part may be carried out without aligning the circuit board with respect to the first housing part. Consequently, the exact position of the circuit board with respect to the first housing part and with respect to the second housing part is not fixed in the assembled automotive camera. Rather, the position and/or orientation of the circuit board with respect to the lens unit as well as the position and/or orientation of the first housing part with respect to the second housing part are fixed with respective tolerances.

In some implementations, aligning of the second housing part with respect to the first housing part comprises matching a predefined connection region of the second housing part to a predefined connection region of the first housing part.

The respective connection regions may for example be brought in contact to each other for aligning the housing parts.

According to several implementations, the first component is fastened to the second housing part at a first end, in particular a first axial end, of the first component, wherein the first component is pivotable around the first end. The second component is mounted on a surface of the circuit board and comprises a sleeve for receiving a second end of the first component, which is opposite to the first end of the first component.

For example, the first component may be fastened to the second housing part before the first housing part is connected to the second housing part.

The second component is rigidly fixed on the circuit board and is, in particular, not movable with respect to the circuit board. On the other hand, a shift of the circuit board with respect to the first housing part in the x-y-plane and/or along the z-direction and/or a tilt of the circuit board with respect to the first housing part may be compensated by the pivotable first component.

In alternative implementations, the connector assembly comprises a third component, which is mounted on a surface of the circuit board and is designed to receive the second component of the connector assembly. The second component is connected to the third component.

In particular, the second and the third component may not be moveable with respect to each other. Also, the third component is rigidly fixed to the circuit board and is not moveable with respect to the circuit board. A contact region between the first and the second component may be designed such that at least a relative movement in the x-y-plane is possible. In this way, the misalignment of the circuit board respect to the first housing part may also be compensated.

In particular, the first housing part comprises a front face and the second housing part comprises a rear face, which is parallel to the front face. The first component is moveable with respect to the second component within a plane, which is parallel to the rear face.

According to several implementation, the connecting of the second housing part to the first housing part comprises laser welding the second housing part and the first housing

part to each other, in particular at the respective connection regions, in particular after aligning the second housing part with respect to the first housing part.

By means of the invention, it is ensured that a contour to be followed by a laser for the laser welding is consistent and reliably close to the predefined target contour. This may simplify the laser welding process and/or increase the yield and/or reduce rework.

In particular, the first housing part or the second housing part, preferably the first and the second housing part, consists of or comprises a metal. The metal may for example be aluminum, magnesium or steel or another metal alloy.

According to a further aspect of the invention, an automotive camera, which is, in particular, obtained by a method of manufacturing according to the invention, is provided.

According to several implementations, the automotive camera comprises a first housing part and a lens unit, which is connected to the first housing part. The automotive camera comprises a second housing part, which is connected to the first housing part, such that a housing interior is formed. The automotive camera comprises a circuit board, which is accommodated in the housing interior and carries an imager chip. The automotive camera comprises a connector assembly for electrically and, in particular, mechanically, connecting the circuit board to an external electronic circuit. Therein, the connector assembly is connected to the circuit board and passes through an opening of the second housing part. The circuit board is connected to the first housing part, wherein a position and/or orientation of the circuit board is aligned with respect to the lens unit and the connector assembly comprises a first component, which is fastened to the second housing part and a second component, which is connected to the first component, such that the first component and the second component are movable with respect to each other.

That the position and/or orientation of the circuit board is aligned with respect to the lens unit may be understood such that it has been aligned accordingly during manufacturing of the automotive camera.

The first and the second component of the connector assembly being movable with respect to each other may be understood such that the connector assembly is a floating connector assembly. In other words, by connecting the circuit board and the second

housing part to the connector assembly during manufacturing of the automotive camera, the movement of the first and the second component with respect to each other may be restricted or blocked. However, the structural feature of the first and the second component being movable with respect to each other is meant to specify the connection of the first and the second component with respect to each other and/or the design of the first and the second component, respectively. In other words the first and the second component of the connector assembly are per se movable with respect to each other but the movement may be restricted or blocked by other components of the automotive camera.

According to several implementations of the automotive camera, the second housing part comprises or consists of the metal, in particular aluminum, magnesium, steel or a metal alloy. According to several implementations of the automotive camera, the first housing part comprises or consists of the metal, in particular aluminum, magnesium, steel or a metal alloy.

The automotive camera may further comprise a connector interface component for connecting the connector assembly to the external electronic circuit. The connector interface component may, in particular, allow to connect a predefined type of cable connector such as a FAKRA-connector to the connector assembly. The connector interface component is at least in part arranged outside of the housing interior.

For example, the connector interface component may be made of a plastic material and may for example be connected to the second housing part at the opening of the second housing part.

For example, the connector interface component may be denoted as a connector shroud. The connector interface may be retained to the second housing part for example by interference fit, swaging, screwing et cetera. In some implementations, potting rings or O-rings may be used to act as sealing to ensure that the automotive camera is watertight.

Advantages of using a plastic connector interface include the easy manufacturing of such components as well as a reduction of mating and/or unmating forces, which may occur when connecting the automotive camera to the external electronic circuit by means of the cable connector. Furthermore, the tolerances may be reduced by using a plastic connector interface.

According to several implementations, the first component is fastened to the second housing part at the first end of the first component, wherein the first component is pivotable around the first end. The second component is mounted on a surface of the circuit board and comprises a sleeve for receiving a second end of the first component, which is opposite to the first end.

According to several implementations, the first housing part comprises a front face and the second housing part comprises a rear face which is parallel to the front face. The first component of the connector assembly is movable with respect to the second component of the connector assembly within a plane, which is parallel to the rear face.

According to several implementations, the first component is movable with respect to the second component along a direction, which is perpendicular to the rear face.

Further implementations of the automotive camera according to the invention follow directly from the various implementations of the method for manufacturing an automotive camera according to the invention and vice versa. In particular, individual features and/or explanations with respect to the various implementations of the method according to the invention may be applied analogously for respective implementations of the automotive camera according to the invention and vice versa.

According to a further aspect of the invention, a camera system for a motor vehicle is provided. The camera system comprises an implementation of an automotive camera according to the invention and the external electronic circuit, wherein the external electronic circuit is connected to the circuit board by the connector assembly.

According to a further aspect of the invention, a motor vehicle comprising an automotive camera according to the invention or a camera system according to the invention is provided.

Further features of the invention are apparent from the claims, the figures and the figure description. The features and combinations of features mentioned above in the description as well as the features and combinations of features mentioned below in the description of figures and/or shown in the figures may be comprised by the invention not only in the respective combination stated, but also in other combinations. In particular, embodiments and combinations of features, which do not have all the features of an originally formulated claim, are also comprised by the invention. Moreover, embodiments

and combinations of features which go beyond or deviate from the combinations of features set forth in the recitations of the claims are comprised by the invention.

In the following, the invention will be explained in detail with reference to specific exemplary implementations and respective schematic drawings. In the drawings, identical or functionally identical elements may be denoted by the same reference signs. The description of identical or functionally identical elements is not necessarily repeated with respect to different figures.

In the figures,

Fig. 1 shows schematically a motor vehicle with an exemplary implementation of a camera system according to the invention;

Fig. 2 shows schematically a cross-section through an automotive camera;

Fig. 3 shows schematically a cross-section through an exemplary implementation of an automotive camera according to the invention;

Fig. 4 shows schematically an explosion view of a further exemplary implementation of an automotive camera according to the invention;

Fig. 5 shows schematically a part of a cross-section through a further exemplary implementation of an automotive camera according to the invention;

Fig. 6 shows schematically a part of a cross-section through a further exemplary implementation of an automotive camera according to the invention;

Fig. 7 shows schematically a part of a cross-section through a further exemplary implementation of an automotive camera according to the invention;

Fig. 8 shows schematically a top view on a further exemplary implementation of an automotive camera according to the invention without the second housing part; and

Fig. 9 shows schematically a rear-view of a further exemplary implementation of an automotive camera according to the invention.

Fig. 1 shows schematically a top view of a motor vehicle 11 comprising a camera system 3 according to the invention. The camera system 3 comprises an automotive camera 1 according to the invention and an electronic control unit, ECU, 2 of the motor vehicle 11. The automotive camera 1 is connected to the ECU 2 and may provide image data to the ECU 2.

Fig. 3 shows schematically a cross-section through an exemplary implementation of an automotive camera 1 according to the invention, for example an automotive camera 1 of the camera system 3 as described with respect to Fig. 1. The automotive camera 1 is, in particular, manufactured according to an exemplary implementation of a method for manufacturing according to the invention.

The automotive camera 1 comprises a first housing part 4, which has an opening for fastening a lens unit 9 of the camera 1. The automotive camera 1 further comprises a circuit board 7, which carries an imager chip (not shown). An active surface of the imager chip faces the lens unit 9. During manufacturing, the lens unit 9 is fastened to the first housing part 4 at the opening and afterwards the circuit board 7 is mounted to the first housing part 4, wherein the position and/or orientation of the circuit board 7 is actively aligned with respect to the lens unit 9.

For example, the circuit board 7 may be mounted to the first housing part 4 by means of mechanical contact pins 10, which are rigidly connected to the interior surface of the first housing part 4 and to which the circuit board 7 can also be attached. Therein, certain tolerance ranges are allowed for laterally shifting the circuit board 7 with respect to the first housing part 4 and/or for shifts perpendicular to the lateral directions and/or for tilting the circuit board 7 with respect to the first housing part 4. In this way, the position and/or orientation of the circuit board 7, and consequently the imager chip, may accurately be aligned with respect to the lens unit 9. As can be seen in the schematic view of Fig. 3, this may result in a situation where the circuit board 7, and correspondingly the imager chip, is not centered with respect to the first housing part 4.

The automotive camera 1 further comprises a second housing part 5, which is connected to the first housing part 4, such that a housing interior 8 is formed, which encloses the

circuit board 7 and, in particular, the contact pins 10. The first and the second housing part 4, 5 may for example be made of aluminum and in some implementations may be connected to each other by means of laser welding.

Furthermore, the automotive camera 1 comprises a connector assembly 6, which is connected to the circuit board 7 and passes through an opening of the second housing part 5, such that the ECU 2 may be electrically connected to the circuit board 7 via the connector assembly 6.

Therein, the connector assembly 6 comprises a first component 6a, which is fastened to the second housing part 5 and a second component 6b, which is connected to the first component 6a in a floatable manner, in particular such that the first and the second component 6a, 6b are movable with respect to each other. The second component 6b may be directly attached or mounted to the surface of the circuit board 7, as indicated in Fig. 3. In alternative implementations, the connector assembly 6 may comprise a third component 6c, as indicated schematically in Fig. 6, which is connected to the circuit board 7 as well as to the second component 6b.

Since the connector assembly 6 is designed as a floating connector, the second housing part 5 may be aligned accurately with respect to the first housing part 4 even though the circuit board 7 is misaligned with respect to the first housing part 4 and still an electrical connection of the circuit board is realized by the floating connector assembly 6.

Fig. 2 shows, for the sake of comparison, a respective cross-section through another automotive camera 1' which is not implemented according to the invention and where the respective connector assembly 6' is not implemented as a floating connector assembly. Therefore, in order to compensate for the misalignment of the circuit board 7' with respect to the first housing part 4', the second housing part 5' is shifted out of its optimal position with respect to the first housing part 4'. This results in an asymmetric connection interface between the first and the second housing part 4', 5' which is disadvantageous for connecting the two parts 4', 5', for example by means of laser welding.

The floating interface of the first and the second component 6a, 6b can be realized by means of different approaches. Some of them are described in the following with respect to Fig. 4 to Fig. 7.

Fig. 4 shows a perspective explosion view of a further exemplary implementation of an automotive camera 1 according to the invention. In this implementation, the first component 6a is designed as a so called bullet component, which has an essentially cylindrical outer shape and which is connected to the opening of the second housing part 5 at a top end of the first component 6a, such that the first component 6a is pivotable around the top end. The second component 6b is designed as a sleeve and may for example have a conical lead-in feature for receiving the first component 6a. Therefore, it is achieved that an electrical connection between the circuit board 7 and the ECU 2 is possible even when the first component 6a is tilted.

For example, the automotive camera 1 may comprise a plastic FAKRA shroud 12 to connect the ECU 2 via a coaxial cable and a respective connector to the connector assembly 6.

Fig. 5 shows a schematic cross-section of the connector assembly 6 according to the implementation of Fig. 4 in more detail. In particular, the second component 6b is shown to comprise an essentially cylindrical base portion, which is connected to the surface of the circuit board 7 and a conical lead-in feature facing the first component 6a.

Fig. 6 shows an alternative solution for realizing the floating connector assembly 6. Therein, the second component 6b is connected to the first component 6a in a slideable manner and is not directly connected to the circuit board 7. The connector assembly 6 comprises a further component 6c, which is for example implemented as a sleeve for receiving the second component 6b establishing an electrical connection between the circuit board 7 and the first and the second component 6a, 6b.

For example, the second component 6b may comprise a sliding sleeve, which maintains electrical contact to the first component 6a while being movable at least in lateral directions.

A further alternative solution for realizing the floating connector assembly 6 is shown schematically in Fig. 7. Here, the second component 6b is mounted to the surface of the circuit board 7 and is designed as a pedestal-like feature with a relatively large contact area facing the first component 6a. A spring loaded pin 6d is connected to the first component 6a and may be pressed on the surface of the second component 6b to establish the electrical contact.

Fig. 8 shows a schematic top view on a part of a further exemplary implementation of an automotive camera 1 according to the invention, wherein the second housing part 5 is not shown, such that the circuit board 7 mounted to the first housing part 4 is visible. As can be seen from Fig. 8, the circuit board 7 is slightly shifted with respect to its nominal position or with respect to the outline of the first housing part 4, respectively, to the lower and left direction.

Fig. 9 shows a corresponding top view on the automotive camera of Fig. 8 after the second housing part 5 has been connected to the first housing part 4. As can be seen, even though the circuit board 7 is shifted as described with respect to Fig. 8, the outlines of the first and the second housing part 4 match accurately, which simplifies the laser welding process or another connection process.

By means of the invention, it is achieved that a circuit board of an automotive camera, the circuit board carrying an imager chip, can be accurately aligned with respect to the lens unit and at the same time, housing parts of the automotive camera can be accurately be aligned with respect to each other.

In several implementations, a floating relationship between two components of the connector assembly allows the two housing parts to be centered with respect to each other, even though the circuit board is misaligned with respect to the housing parts. This improves weldability of the housing parts to each other and vehicle bracket integration.

In several implementations, a weld interface with minimum variations is achievable by controlling the position of the rear housing relative to the front housing. This may lead to a disparity between the circuit board and the position of the mating interface in the rear housing. The floating connector assembly may bridge this disparity. The connector assembly represents a variable intermediary component. As a consequence, a consistent weld geometry may be obtained improving the laser weld quality and/or yield.

In some implementations, a top end of a bullet is located in the rear housing and its opposite end is captured by a lead-in feature of an SMT connector on the circuit board. The bullet may pivot around the top end to create an electrical connection even when the SMT connector is not aligned to the rear housing.

In some implementations, a sliding sleeve can move in any direction in a circle of a certain diameter, for example 1 mm, to mate with the SMT connector regardless of its

position, while the electrical contact with the rear housing connector is maintained.

In some implementations, a large central pad is provided on the SMT connector to maintain contact as a spring-loaded pin moves on it. Outer spring contacts may be provided to adapt the position of the SMT connector.

Claims

1. Method for manufacturing an automotive camera (1), wherein the method comprises the following steps:
   - providing a first housing part (4) and a lens unit (9) and fastening the lens unit (9) to the first housing part (4);
   - providing a circuit board (7), which carries an imager chip;
   - mounting the circuit board (7) to the first housing part (4), wherein a position and/or orientation of the circuit board (7) is aligned with respect to the lens unit (9);
   - providing a second housing part (5) and connecting the second housing part (5) to the first housing part (4), such that a housing interior (8) is formed, which accommodates the circuit board (7);
   - providing a connector assembly (6) for electrically connecting the circuit board (7) to an external electronic circuit (2);
   - fastening a first component (6a) of the connector assembly (6) to the second housing part (5), such that the connector assembly (6) passes through an opening of the second housing part (5);
   - connecting a second component (6b) of the connector assembly (6) to the first component (6a), such that the first component (6a) and the second component (6b) are moveable with respect to each other while
   - the first component (6a) is fastened to the second housing part (5) at a first end of the first component (6a), wherein the first component (6a) is pivotable around the first end; and
   - the second component (6b) is mounted on a surface of the circuit board (7) and comprises a sleeve for receiving a second end of the first component (6a), which is opposite to the first end.

2. Method according to claim 1,
characterized in that
the connecting of the second housing part (5) to the first housing part (4) comprises aligning the second housing part (5) with respect to the first housing part (4).

3. Method according to claim 2,
characterized in that
the aligning of the second housing part (5) with respect to the first housing part (4) comprises matching a predefined connection region of the second housing part (5) to a predefined connection region of the first housing part (4).

4. Method according to one of the preceding claims,
characterized in that
the mounting of the circuit board (7) to the first housing part (4) is carried out without aligning the circuit board (7) with respect to the first housing part (4).

5. Method according to one of claims 1 to 4,
characterized in that
- a third component (6c) of the connector assembly (6), which is designed to receive the second component (6b), is mounted on a surface of the circuit board (7); and
- the second component (6b) is connected to the third component (6c).

6. Method according to one of the preceding claims,
characterized in that
- the first housing part (4) comprises a front face and the second housing part (5) comprises a rear face, which is parallel to the front face; and
- the first component (6a) is moveable with respect to the second component (6b) within a plane, which is parallel to the rear face.

7. Method according to one of the preceding claims,
characterized in that
the connecting the second housing part (5) to the first housing part (4) comprises laser welding the second housing part (5) and the first housing part (4) to each other.

8. Automotive camera (1) comprising
- a first housing part (4) and a lens unit (9), which is connected to the first housing part (4) and a second housing part (5), which is connected to the first housing part (4), such that a housing interior (8) is formed;

- a circuit board (7), which is accommodated in the housing interior (8) and carries an imager chip; and
- a connector assembly (6) for electrically connecting the circuit board (7) to an external electronic circuit (2), wherein the connector assembly (6) passes through an opening of the second housing part (5);

characterized in that

- the circuit board (7) is connected to the first housing part (4), wherein a position and/or orientation of the circuit board (7) is aligned with respect to the lens unit (9); and
- the connector assembly (6) comprises a first component (6a), which is fastened to the second housing part (5) and a second component (6b), which is connected to the first component (6a), such that the first component (6a) and the second component (6b) are moveable with respect to each other while
- the first component (6a) is fastened to the second housing part (5) at a first end of the first component (6a), wherein the first component (6a) is pivotable around the first end; and
- the second component (6b) is mounted on a surface of the circuit board (7) and comprises a sleeve for receiving a second end of the first component (6a), which is opposite to the first end.

9. Automotive camera (1) according to claim 8,
characterized in that
the second housing part (5) comprises or consists of a metal.

10. Automotive camera (1) according to claim 8 or 9,
characterized in that
- the first housing part (4) comprises a front face and the second housing part (5) comprises a rear face, which is parallel to the front face; and
- the first component (6a) of the connector assembly (6) is moveable with respect to the second component (6b) of the connector assembly (6) within a plane, which is parallel to the rear face.

11. Automotive camera (1) according to claim 10,
characterized in that

the first component (6a) is moveable with respect to the second component (6b) along a direction, which is perpendicular to the rear face.

12. Camera system (3) for a motor vehicle (11), the camera system (3) comprising an automotive camera (1) according to one of claims 8 to 11 and the external electronic circuit (2), wherein the external electronic circuit (2) is connected to the circuit board (7) by the connector assembly (6).

13. Motor vehicle (11) comprising an automotive camera (1) according to one of claims 8 to 11 or a camera system (3) according to claim 12.

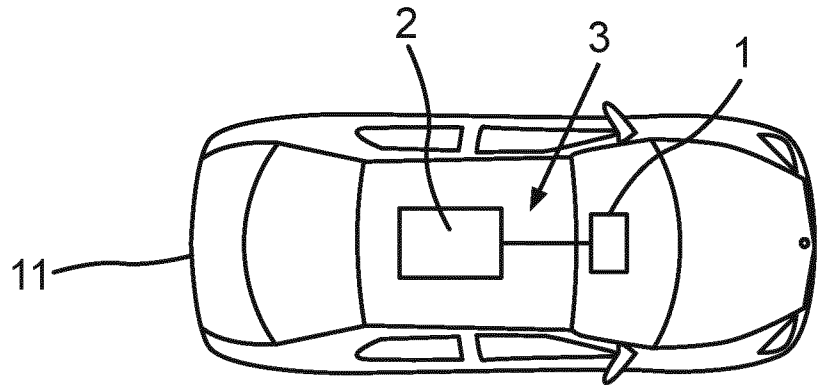


Fig.1

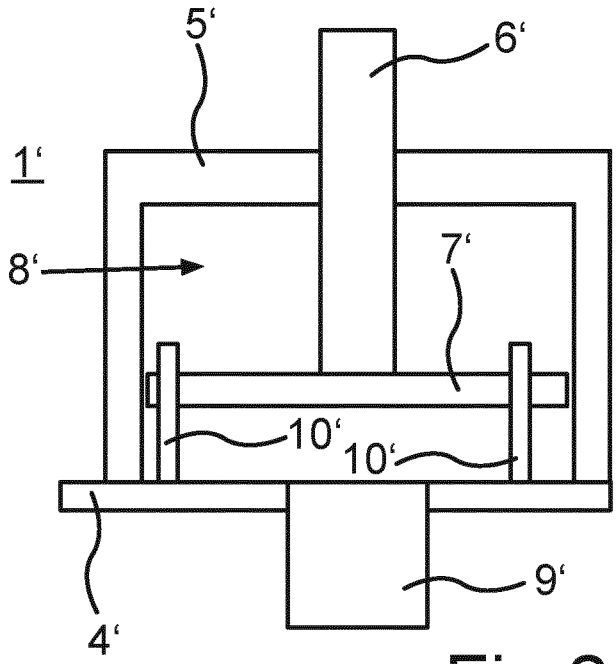


Fig.2

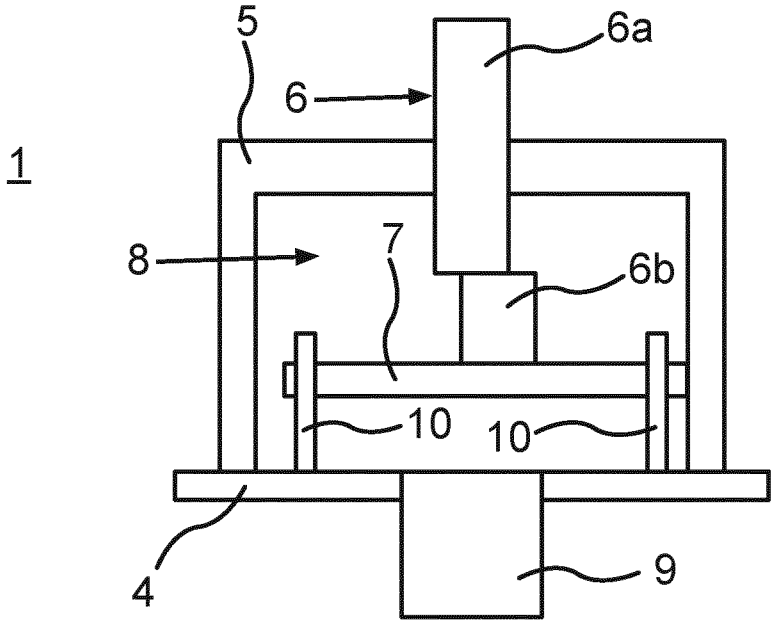


Fig.3

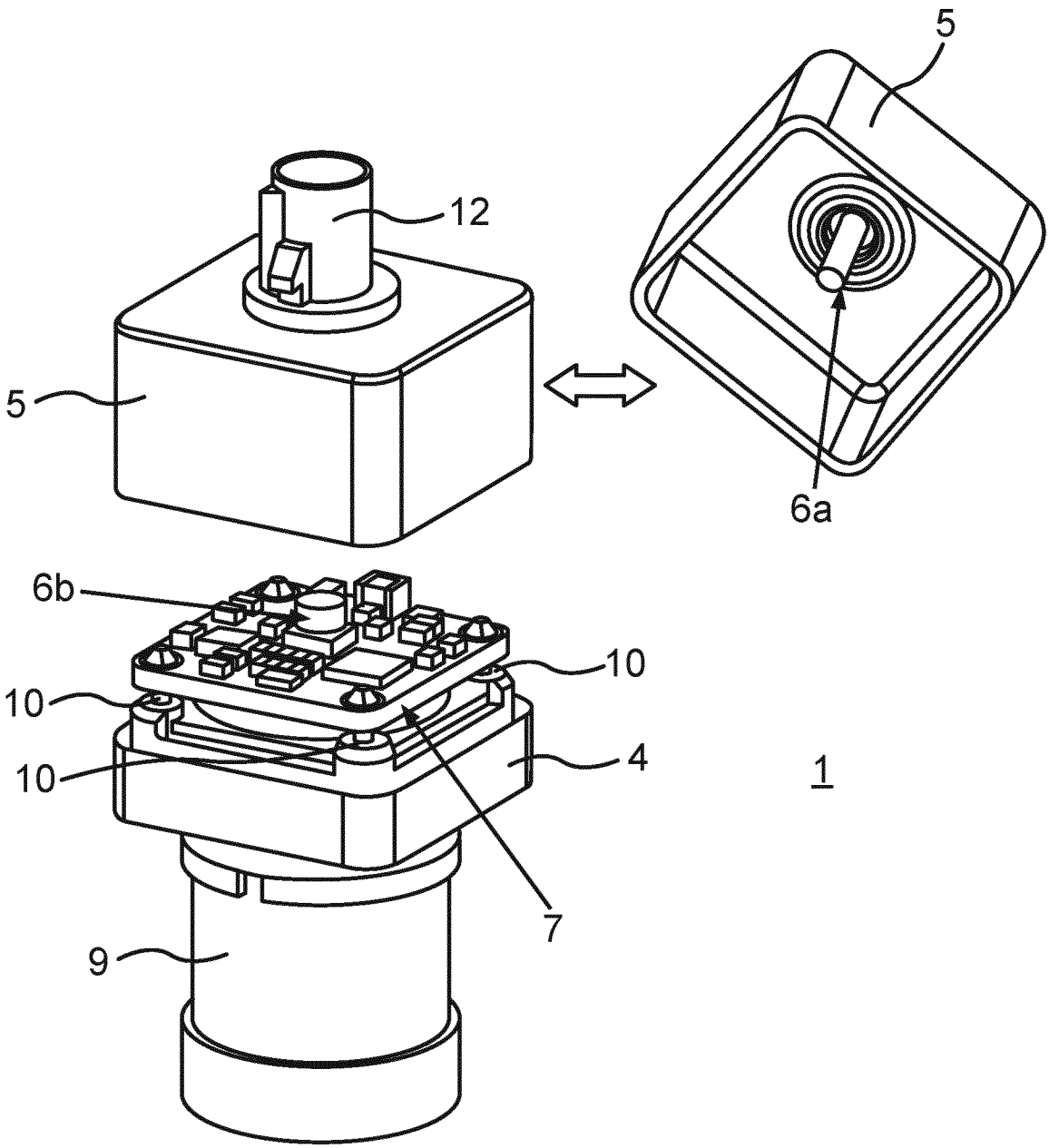


Fig.4

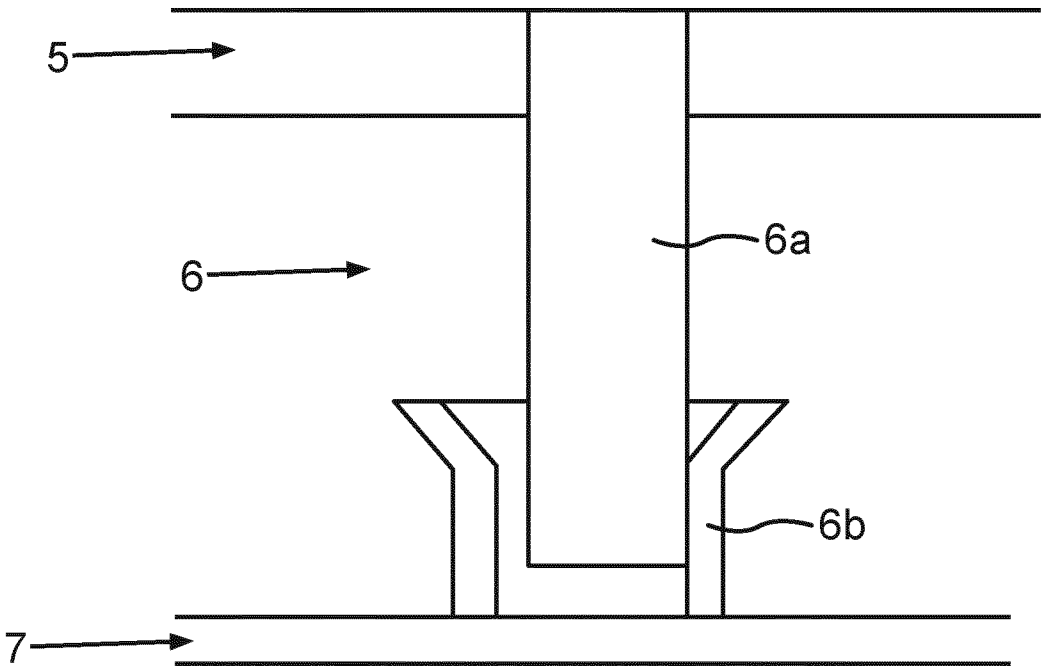


Fig.5

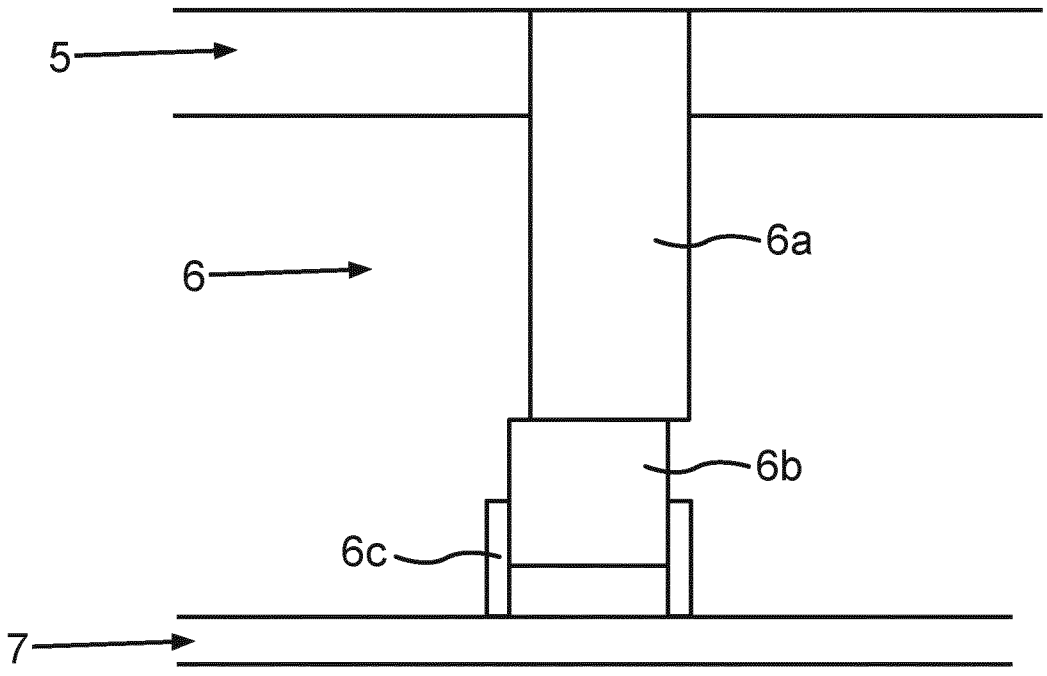


Fig.6

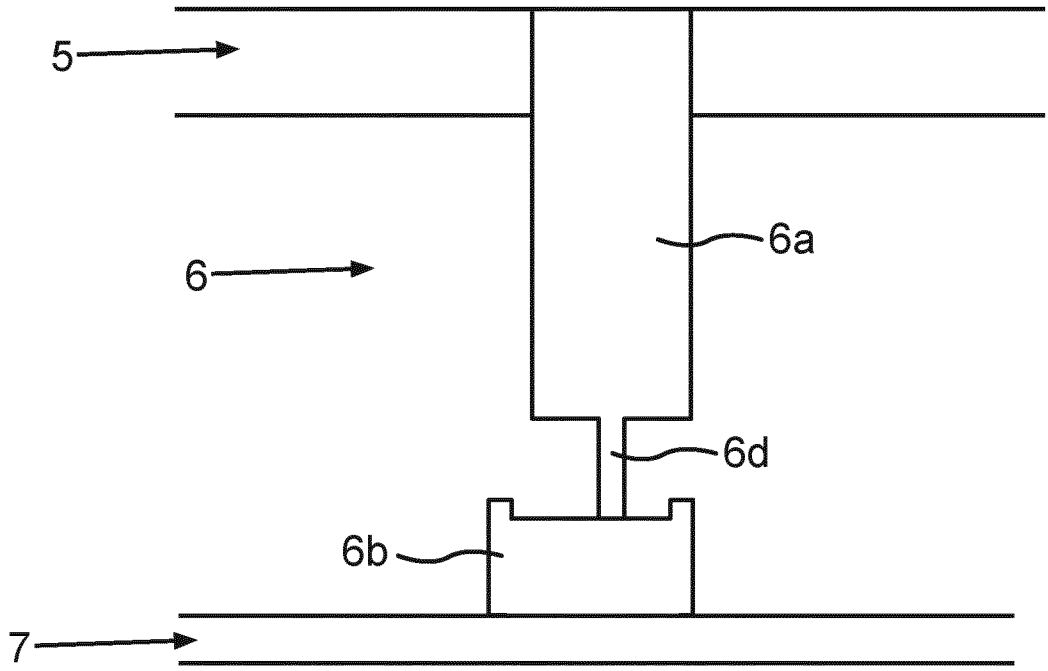


Fig.7

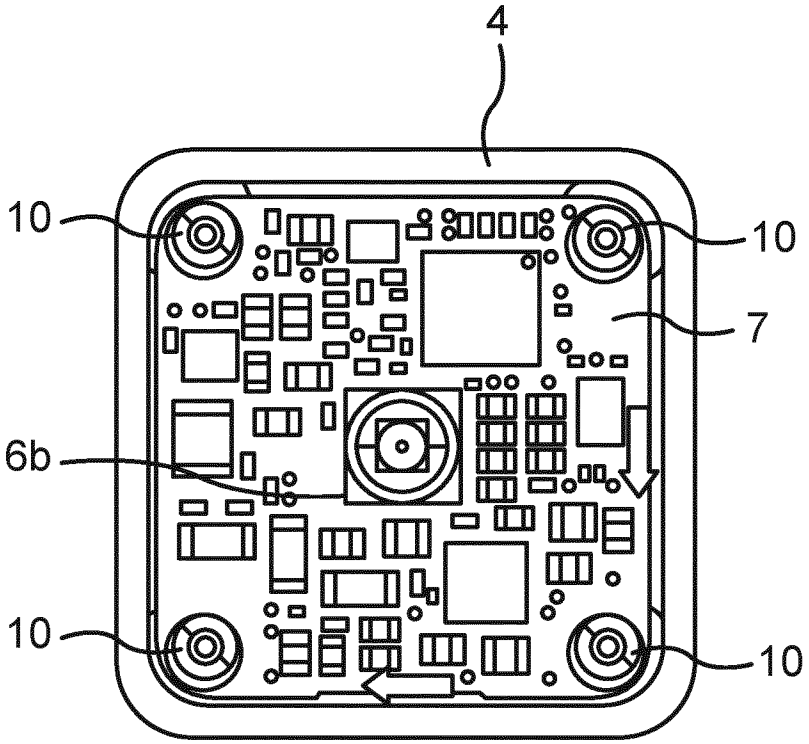


Fig.8

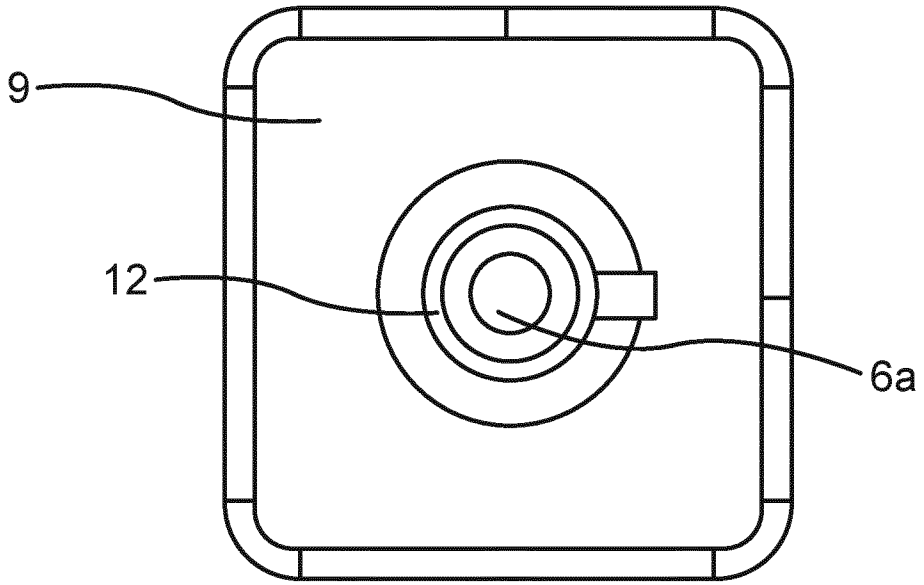


Fig.9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2022/084948

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04N23/51 B60R1/00 H04N23/57 H01R13/22
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)
H04N B60R H01R

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 207 150 702 U (HUIZHOU DESAY SV AUTOMOTIVE CO LTD) 27 March 2018 (2018-03-27)	1-4,6,8, 10,11
Y	abstract	7
A	paragraph [0017] - paragraph [0033] figures 1,2	5,9,12, 13
X	US 2019/143907 A1 (BYRNE STEVEN V [US] ET AL) 16 May 2019 (2019-05-16)	1,5,8,9, 12,13
Y	abstract	7
A	paragraph [0002] paragraph [0023] - paragraph [0035] figures 1-18	2-4,10, 11
Y	US 2017/302829 A1 (MLECZKO JAMIE A [US] ET AL) 19 October 2017 (2017-10-19)	7
A	abstract paragraph [0034] - paragraph [0035] figures 1-11	1-6,8-13

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 February 2023	20/02/2023

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	Schreib, Franz

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2022/084948

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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