



(51) International Patent Classification:
H04N 5/225 (2006.01)

(21) International Application Number:
PCT/US2010/023475

(22) International Filing Date:
8 February 2010 (08.02.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/150,364 6 February 2009 (06.02.2009) US

(71) Applicant (for all designated States except US):
MAGNA ELECTRONICS INC. [US/US]; 10410 N.
Holly Road, Holly, Michigan 48442-9332 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MCELROY, Clarence, Patrick** [US/US]; 4141 Oak Street, Grand Blanc, Michigan 48439 (US). **SESTI, Matthew, C.** [US/US]; 1202 Germany Road, Williamston, Michigan 48895 (US). **RIEDEN, Richard** [US/US]; 21177 Little River Boulevard, Clinton Township, Michigan 483036 (US).

(74) Agents: **PORAT, Alex** et al.; Magna International Inc., 337 Magna Drive, Aurora, Ontario L4G 7K1 (CA).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) Title: IMPROVEMENTS TO CAMERA FOR VEHICLE

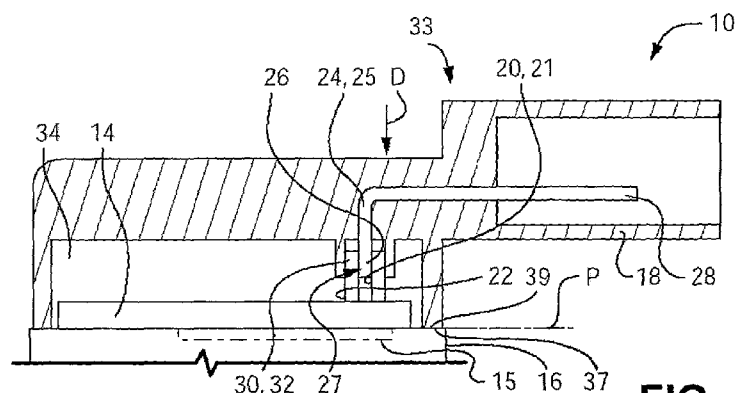


FIG. 4

(57) Abstract: In a first aspect, the invention is directed to a camera for mounting on a vehicle, wherein the camera includes a front housing member that holds a lens member and a circuit board with at least one front electrical connector thereon, and a rear housing member that holds at least one rear electrical connector that is directly mounted to the at least one front electrical connector. By directly mounting the front and rear electrical connectors, a jumper wire is not needed, thereby reducing cost and eliminating potential sources of circuit failures that are associated with the use of jumper wires.

Title: IMPROVEMENTS TO CAMERA FOR VEHICLE

FIELD OF THE INVENTION

5 **[0001]** The present invention relates to a camera for use in vehicles, and more particularly rearview cameras for use in vehicles.

BACKGROUND OF THE INVENTION

10 **[0002]** A typical camera for mounting on a vehicle has a lens member, an imaging element, a circuit board and housing members that connect together. In particular for certain applications, such as for some applications wherein the camera is rearwardly facing and is mounted in a rear panel on a vehicle, there can be relatively severe space restrictions for the camera. Additionally, some cameras are relatively complex assemblies that are expensive, and that can suffer from reliability problems due to the number of
15 components and the number of individual electrical connections that are associated therewith. Another problem with some cameras is that their mounting position can be significantly out from their intended position due to a stack up of tolerances that may exist with the components that make up the camera and that are involved in its mounting to the vehicle panel.

20 **[0003]** It would be advantageous to provide a camera that addresses one or more of these considerations.

SUMMARY OF THE INVENTION

25 **[0004]** In a first aspect, the invention is directed to a camera for mounting on a vehicle, wherein the camera includes a front housing member that holds a lens member, an imaging element and a circuit board with at least one front electrical connector thereon, and a rear housing member that holds at least one rear electrical connector that is directly mounted to the at least one front electrical connector. By directly mounting the front and rear

electrical connectors, a jumper wire is not needed, thereby reducing cost and eliminating potential sources of circuit failures that are associated with the use of jumper wires.

[0005] In one embodiment of the first aspect, the front and rear housing members are not aligned with respect to each other. The rear housing member has a rear alignment structure that aligns the rear electrical connector with respect to the at least one front electrical connector. The rear housing member mates with the front housing member to define a camera interior. The circuit board, the at least one front electrical connector and the at least one rear electrical connector are positioned in the camera interior.

[0006] In another embodiment of the first aspect, the rear housing member has a rear alignment structure that aligns the rear electrical connector with respect to the at least one front electrical connector. The rear housing member mates with the front housing member generally along a plane so that the rear housing member and front housing member are unaligned with respect to each other and wherein the rear housing member and the front housing member together define a camera interior. The circuit board, the at least one front electrical connector and the at least one rear electrical connector are positioned in the camera interior.

[0007] In yet another embodiment, the front and rear housing members are aligned with respect to each other. The at least one rear electrical connector and the at least one front electrical connector are urged together by at least one biasing member. The rear housing member mates with the front housing member to define a camera interior. The circuit board, the at least one front electrical connector and the at least one rear electrical connector are positioned in the camera interior.

[0008] In yet another embodiment, the invention is directed to a method of assembling a camera for a vehicle, comprising:

- 5 (a) mounting a lens member, an imaging element and a circuit board to a front housing member, wherein the imaging element is positioned to receive images from the lens member, wherein the circuit board is mounted to the front housing member, wherein the circuit board is configured to send to another component signals relating to images received by the imaging element, wherein the circuit board has at least one front electrical connector thereon;
- 10 (b) providing a rear housing member with at least one rear electrical connector thereon;
- (c) aligning the rear electrical connector with respect to the at least one front electrical connector;
- 15 (d) forming at least one connection between the at least one rear electrical connector and the at least one front electrical connector; and
- (e) joining the front and rear housing members together to define a camera interior in which the circuit board, the at least one front electrical connector and the at least one rear electrical connector are positioned, without aligning the front and rear housing members with respect to one another.
- 20

[0009] In a second aspect, the invention is directed to a camera for mounting on a vehicle, wherein the camera includes a front housing member that holds a lens member, an imaging element, a circuit board and a rear housing member. At least the front housing member includes a coating of electrically conductive material on its inner surface, that is electrically connected to the circuit board and that is electrically connectable to ground.

25

[0010] In an embodiment of the second aspect, the circuit board has at least one front electrical connector thereon. One of the at least one front connector is in electrical communication with the front housing member coating and is electrically connectable to ground. The rear housing member

30

has at least one rear electrical connector thereon. The at least one rear electrical connector is connected to the at least one front electrical connector.

[0011] In a third aspect, the invention is directed to a camera for mounting on a vehicle panel, wherein the camera is configured to rotate into a locking position on the vehicle panel, without the need for camera mounting fasteners.

[0012] In an embodiment of the third aspect, the camera includes a front housing member, a lens member, an imaging element, a circuit board, a rear housing member and a camera-associated locking structure. The lens member extends along a camera axis. The lens member and circuit board are mounted to the front housing member. The camera-associated locking structure is connected to at least one of the front housing member, the lens member and the rear housing member. The camera-associated locking structure is engageable with a vehicle panel-associated locking structure on the vehicle panel. The camera-associated locking structure is rotatable between an unlocked position wherein the camera-associated locking structure is disengaged from the vehicle panel-associated locking structure and a locked position wherein the camera-associated locking structure is engaged with the vehicle panel-associated locking structure to prevent axial movement of the camera relative to the vehicle panel. One of the camera-associated and vehicle panel-associated locking structures includes a first locking surface and a second locking surface that generally axially face each other. The other of the camera-associated and vehicle panel-associated locking structures includes a third locking surface and a fourth locking surface that generally axially face away from each other. In another embodiment of the third aspect, the invention is directed to a combination of the camera and the vehicle panel.

[0013] In a fourth aspect, the invention is directed to a combination of a camera and a vehicle panel wherein the camera lacks a front housing

member and instead includes components that are directly mounted to the vehicle panel.

[0014] In an embodiment of the fourth aspect, the camera includes a lens member, an imaging element and a circuit board. The lens member is
5 fixedly connected with respect to the circuit board. The circuit board is mounted to the vehicle panel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The present invention will now be described by way of example
10 only with reference to the attached drawings, in which:

[0016] Figure 1 is a perspective view of a camera in accordance with an embodiment of the present invention;

[0017] Figure 2 is a magnified perspective view of a portion of the camera shown in Figure 1;

15 **[0018]** Figure 3 is a plan view of a rear housing member from the camera shown in Figure 1;

[0019] Figure 4 is a magnified sectional side view of a portion of the camera shown in Figure 1;

20 **[0020]** Figure 5 is a magnified sectional side view of an alternative structure for the portion of the camera shown in Figure 4;

[0021] Figure 6 is a magnified sectional side of another alternative structure for the portion of the camera shown in Figure 4;

25 **[0022]** Figure 7 is another magnified sectional side view of a portion of the camera shown in Figure 1, showing structure used to ground elements of the camera;

[0023] Figure 8 is a flow diagram illustrating a method of making a camera in accordance with another embodiment of the present invention;

- [0024]** Figure 9 is a perspective view of a camera in accordance with another embodiment of the present invention;
- [0025]** Figure 10 is a magnified perspective view of a portion of the camera shown in Figure 9;
- 5 **[0026]** Figure 11 is a magnified sectional side view of a portion of the camera shown in Figure 9;
- [0027]** Figure 12 is a perspective view of a camera in accordance with another embodiment of the present invention;
- [0028]** Figure 13 is a perspective view from another viewpoint of the
10 camera shown in Figure 12;
- [0029]** Figure 14 is an elevation view of a vehicle panel showing a lens member from the camera shown in Figure 12 engaged therewith;
- [0030]** Figure 15 is a sectional side view of the vehicle panel shown in Figure 14 and the camera shown in Figure 12;
- 15 **[0031]** Figure 16 shows a trim piece that can be mounted to the vehicle panel with the camera shown in Figure 12;
- [0032]** Figure 17 is a perspective view of a camera in accordance with another embodiment of the present invention;
- [0033]** Figure 18 is a perspective view of a vehicle panel for receiving
20 the camera shown in Figure 17;
- [0034]** Figure 19 is a sectional side view of the camera shown in Figure 17 assembled with the vehicle panel shown in Figure 18;
- [0035]** Figure 20 is a perspective view of a camera in accordance with another embodiment of the present invention;
- 25 **[0036]** Figure 21 is a perspective view of a vehicle panel for receiving the camera shown in Figure 20;

[0037] Figure 22 is a perspective view of the camera shown in Figure 20 assembled with the vehicle panel shown in Figure 21;

[0038] Figure 23 is a perspective view of a camera in accordance with another embodiment of the present invention;

5 **[0039]** Figure 24 is a perspective view of a vehicle panel for receiving the camera shown in Figure 23;

[0040] Figure 24a is a sectional side view of the camera shown in Figure 23 assembled with the vehicle panel shown in Figure 24;

10 **[0041]** Figure 25 is a sectional side view of a combination of a camera and a vehicle panel camera in accordance with another embodiment of the present invention; and

[0042] Figure 26 is an elevation view of the vehicle panel shown in Figure 25;

15 **[0043]** Figure 27 is a perspective view of an alternative set of front and rear connectors for use with the camera shown in Figures 9-11; and

[0044] Figure 28 is a perspective view of a plurality of the rear connector shown in Figure 27 and a plurality of the front connector shown in Figure 27, in a connector housing for mounting to a circuit board in the camera shown in Figures 9-11.

20

DETAILED DESCRIPTION OF THE INVENTION

25 **[0045]** Reference is made to Figure 1, which shows a camera 10 for use in a vehicle, and in particular for use as a rearview camera in a vehicle. The camera 10 includes a lens member 12, a circuit board 14, an imaging element 15, a front housing member 16 and a rear housing member 18 (shown for illustrative purposes only in Figure 1 as being transparent). The

lens member 12 may be any suitable lens member known in the art, and is mounted to the front housing member 16.

[0046] Note that the terms 'front' and 'rear' as used in the present document refer to the front of the camera 10 (ie. the portion of the camera
5 where the lens member is located), and the rear of the camera 10 (ie. the portion of the camera 10 opposite the front of the camera 10). When the camera 10 is used in a rearview application in a vehicle, the front of the camera 10 thus faces rearwardly relative to the vehicle and the rear of the camera 10 faces towards the front of the vehicle.

10 **[0047]** The imaging element 15 is positioned in a selected position to receive images through the lens member 12. The imaging element 15 may be any suitable imaging element a charge-coupled device (CCD) or a complimentary metal-oxide semiconductor (CMOS) sensor. The circuit board 14 receives signals from the imaging element 15 and sends signals relating to
15 images received on the imaging element 15 to one or more other components such as another computing device within the vehicle. The imaging element 15 may be mounted directly on the circuit board 14.

[0048] The circuit board is mounted to the front housing member 16. Referring to Figure 2, a plurality of front electrical connectors 20 are provided
20 on the circuit board 14, which are used to electrically connect the circuit board 14 to associated elements in the vehicle (not shown). For example, a first front electrical connector 20a may be a power connector, and may be configured to receive power from a power source (not shown) located in the vehicle. A second front electrical connector 20b may be configured to send
25 video signals to a controller (not shown) in the vehicle, which displays the video signals on a screen inside the vehicle cabin. A third front electrical connector 20c may connect to ground, and may be configured to conduct any buildup of static electricity that might otherwise damage the circuit board, which is described in further detail below. While a plurality of front electrical

connectors 20 are shown, it is alternatively possible for the circuit board 14 to have as few as one front electrical connector thereon.

[0049] The front electrical connectors 20 may be female electrical connectors 21, and may be provided in a female electrical connector housing
5 22 that is fixedly mounted to the circuit board 14.

[0050] The rear housing member 18 has a plurality of rear electrical connectors 24 that are electrically connected to the front electrical connectors 20 on the circuit board 14 and are configured to electrically connect the circuit board 14 to associated elements in the vehicle. For example, a first rear
10 electrical connector 24a connects between the first front electrical connector 20a and a power source in the vehicle. A second rear electrical connector 24b connects between the second front electrical connector 20b and the controller in the vehicle. A third rear electrical connector 24c connects between the third front electrical connector 20c and a grounding element in
15 the vehicle. A plurality of rear electrical connectors 24 are shown, however it is alternatively possible for the rear housing member 18 to have as few as one rear electrical connector 24 therein.

[0051] The rear electrical connectors 24 may be conductive pins 25 that are received in the female electrical connectors 21. The rear electrical
20 connectors 24 may be incorporated into the rear housing member 18 by any suitable means, such as by insert molding. In such embodiments, the rear electrical connectors 24 may be integral with the rear housing member 18.

[0052] Each rear electrical connector 24 has a front end 26 where it connects to one of the front electrical connectors 20. The connection
25 between the rear electrical connector 24 and the front electrical connector 20 is shown at 27. Each rear electrical connector 24 further has a rear end 28 that is configured to connect with an associated element in the vehicle (eg. a power source, a controller).

[0053] A rear alignment structure 30 (Figures 3 and 4) is provided that aligns the rear electrical connectors 24 with respect to the front electrical connectors 20 (Figure 4). The rear alignment structure 30 may comprise a sleeve 32 that is molded integrally with the rear housing member 18. The sleeve 32 snugly receives the female electrical connector housing 22 when the rear electrical connectors 24 are connected to the front electrical connectors 20. Because the sleeve 32 and the pins 25 are integrally formed together in a single part 33 (which includes the rear housing member 18, the rear electrical connectors 24 and the sleeve 32), the sleeve 32 may be considered to align the rear electrical connectors 24 with the front electrical connectors 20. The sleeve 32 may surround the rear electrical connectors 24, as shown in Figure 3, or alternatively, it may be positioned remotely from the rear electrical connectors 24 and may snugly receive some other structure than the female electrical connector housing 22.

[0054] As shown in Figure 5, it is alternatively possible for the rear electrical connectors 24 themselves to be the sole rear alignment structure 30.

[0055] Referring to Figure 4, the rear housing member 18 has a front face 37 that mates with a rear face 39 on the front housing member 16. It will be noted that the mating of the front face 37 and rear face 39 takes place along a mating plane P. As a result, the mating of the front face 37 and rear face 39 does not serve to align the rear housing member 18 with the front housing member 16. By not aligning the front and rear housing members 16 and 18 with each other, a potential source of stress on the front and rear electrical connectors 20 and 24 is eliminated, since alignment between the front and rear housing members 16 and 18 might not correspond precisely to alignment of the front and rear electrical connectors 20 and 24.

[0056] The mating plane P is shown in Figure 4 as being generally perpendicular to the direction of insertion of the pins 25 into the female

electrical connectors 21, which is shown at D. It will be noted that the mating plane P need not be perpendicular to the direction of insertion D, and may instead extend at some other angle to the direction of insertion D.

5 **[0057]** Additionally, the front and rear faces 37 and 39 of the rear and front housing members 18 and 16 respectively need not themselves be flat in profile. For example, they may have a rounded profile or some other suitable shape.

10 **[0058]** The front and rear housing members 16 and 18 together define a camera interior 34 in which the circuit board 14 and the connection between the front and rear electrical connectors 20 and 24 are positioned. In this way, the front and rear housing members 16 and 18 protect the connection 27 between the front and rear electrical connectors 20 and 24 from exposure and damage.

15 **[0059]** The front and rear housing members 16 and 18 may be sealingly joined together by some suitable means, such as by welding or by use of adhesive.

[0060] Referring to Figure 6, it is alternatively possible for the front electrical connectors 20 to be mounted directly in the circuit board 14, eg. in the form of apertures 35 in the circuit board 14.

20 **[0061]** The front and rear housing members 16 and 18 may be made from any suitable material, such as a polymeric material, such as a material called Xenoy™ from Sabic Americas, Inc in Houston, Texas, USA. In instances wherein the front and rear housing members 16 and 18 may build up a static electrical charge it is preferable to provide means to inhibit such a build up so as to protect components such as the circuit board 14.

25 **[0062]** Referring to Figure 7, to inhibit the buildup of static electricity on the front housing member 16, a front housing member coating 36 of electrically conductive material may be provided on the front housing member

interior surface, shown at 38. The front electrical connector 20c (which may be referred to as a front ground connector) may be electrically connected to the front housing member coating 36 any suitable way. For example, the circuit board 14 may be mounted to the front housing member 16 by an electrically conductive circuit board mounting fastener 40, which may be a mechanical fastener such as a machine screw that engages an aperture 41 (eg. a threaded aperture) on the front housing member 16. The aperture 41 may have the front housing member coating 36 thereon so that the circuit board mounting fastener 40 is in direct contact with the front housing member coating 36. The front ground connector 20c may be electrically connected to the circuit board mounting fastener 40 by an electrical trace (not shown) on the circuit board 14. The front ground connector 20c thereby conducts any buildup of electricity away from the front housing member 16 to the rear electrical connector 24c (which may be referred to as a rear ground connector), which in turn conducts the electricity to a ground point in the vehicle. The front housing member coating 36 may be any suitable material, such as Aluminum.

[0063] To inhibit the buildup of static electricity on the rear housing member 18, a rear housing member coating 42 of electrically conductive material may be provided on the rear housing member interior surface, shown at 44. The rear housing member coating 42 may be applied to both the rear housing member interior surface 44 and to at least a base portion of the rear ground connector 24c to electrically connect the rear ground connector 24c to the rear housing member coating 42. As a result, any electrical charge that is built up on the rear housing member 18 is conducted away by the rear housing member coating 42 to the rear ground connector 24c and out to ground at a suitable location in the vehicle. It will be understood that the other rear electrical connectors 24 (eg. the rear electrical connectors 24a and 24b shown in Figure 2) are not electrically connected to the rear housing member

coating 42 (Figure 7). The rear housing member coating 42 may be any suitable material, such as Aluminum.

[0064] Reference is made to Figure 8, which shows a method 50 of assembling a camera, such as the camera 10 shown in Figure 4, in accordance with another embodiment of the present invention. The method steps shown in Figure 8 may be described in relation to features shown in the exemplary camera 10 shown in Figure 4. The method 50 begins at step 52. At step 54, the lens member 12 and the circuit board 14 are mounted to the front housing member 16. At step 56, the rear housing member 18 is provided which has the one or more rear electrical connectors 24 thereon. At step 58, the at least one rear electrical connector 24 is aligned with respect to the at least one front electrical connector 20. In a particular embodiment, such as that shown in Figure 4, step 58 may comprise inserting the female electrical connector housing 22 into the sleeve 32. Alternatively, step 58 may comprise inserting the pins 25 themselves into the female electrical connectors 21. At step 60, at least one connection is formed between the at least one rear electrical connector 24 and the at least one front electrical connector 20. It will be noted that step 60 and step 58 may both be carried out by comprise inserting the pins 25 into the female electrical connectors 21 in embodiments wherein no other alignment means is provided and wherein the rear connectors 24 are pins 25 and the front connectors 20 are female electrical connectors 21. At step 62, the front and rear housing members 16 and 18 are joined together to define the camera interior 34 in which the circuit board 14, the at least one front electrical connector 20 and the at least one rear electrical connector 24 are positioned, without aligning the front and rear housing members 16 and 18 with respect to one another. The front and rear housing members 16 and 18 may be sealingly joined together using such means as adhesive or welding.

[0065] It will be noted that several of the aforementioned steps may take place simultaneously. For example, when the pins 25 are inserted fully into the at least one female electrical connector 21, the rear electrical connector 24 is aligned with respect to the at least one front electrical connector 20, a connection is made between the front and rear electrical connectors 20 and 24, and the front and rear housing members 16 and 18 are joined together to define the camera interior 34.

[0066] In embodiments wherein the front housing member 16 has a front housing member interior surface 38 that has a front housing member coating 36 of electrically conductive material thereon, the method 50 may further include step 64, which is electrically connecting one of the at least one front electrical connector 20 with the front housing member coating 36.

[0067] In embodiments wherein the rear housing member 18 has a rear housing member interior surface 44 that has a rear housing member coating 42 of electrically conductive material thereon, the method 50 may further include step 66, which is electrically connecting one of the at least one rear electrical connector 24 with the rear housing member coating 42.

[0068] With continued reference to Figure 4, providing a camera with the front and rear electrical connectors 20 and 24 aligned with each other permits them to be directly connected to one another without the need for intermediate electrical connectors, such as jumper wires. Eliminating jumper wires eliminates a source of electrical failure for the camera 10.

[0069] In an alternative embodiment that is not shown it is possible for the front electrical connectors 20 to be pins 25 (eg. which extend from a pin housing (not shown) that is mounted onto the circuit board 14), and for the rear electrical connectors 24 to be female electrical connectors 21. As another alternative, some of the front electrical connectors 20 may be pins 25 and some may be female electrical connectors 21, and some of the rear

electrical connectors 24 may be female or male, in a complementary arrangement.

5 [0070] It has been shown for the rear electrical connectors 24 to be integral (eg. by insert molding) with the rear housing member 18. It is alternatively possible however, for the rear electrical connectors 24 to not be integral with the rear housing member 18, particularly in embodiments wherein the sleeve 32 is omitted.

10 [0071] By providing instead a direct connection between the front and rear electrical connectors 20 and 24, the overall size of the camera 10 may be reduced, since room for a jumper cable with connectors at each end is not needed.

15 [0072] Reference is made to Figure 9, which shows a camera 80 in accordance with another embodiment of the present invention. The camera 80 permits alignment of the front and rear housing members, shown at 82 and 84, which can reduce the overall space necessary for the camera 80 relative to the camera 10 (Figure 2) which has unaligned front and rear housing members 16 and 18. The rear housing member 84 is shown as transparent in Figure 9 to more clearly show the underlying structure.

20 [0073] The camera 80 includes a lens member 86, which may be similar to the lens member 12 (Figure 1), an imaging element 87 which may be similar to the imaging element 15 (Figure 1), a circuit board 88 which may be similar to the circuit board 14 (Figure 1), the front housing member 82 and the rear housing member 84. The lens member 86 and circuit board 88 may mount to the front housing member 82 in any suitable way. The circuit board 25 88 has thereon a plurality of front electrical connectors 90 which have rear ends 92 that form connections 93 with front ends 94 of a plurality of rear electrical connectors 96 that are connected to the rear housing member 84. The rear electrical connectors 96 may be integral with the rear housing

member 84 (eg. by insert molding) or they may be connected in some other way.

[0074] To form the connections 93, the rear ends 92 of the front electrical connectors 90 and the front ends 94 of the rear electrical connectors 96 may be configured to permit some misalignment therebetween. For example, the rear ends 92 of the front electrical connectors 90 may be configured as generally circular conductive pads 97 (shown more clearly in Figure 10) of a selected size to permit the connections 93 to be formed even in situations where the front and rear electrical connectors are significantly misaligned due to the tolerances that play a role in their relative positions.

[0075] Biasing members 98 may be provided to urge the rear ends 92 of the front electrical connectors 90 and the front ends 94 of the rear electrical connectors 96 towards engagement with each other. For example, the front electrical connectors 90 may include a bend 100 thereby providing a biasing member and live hinge that urges the rear ends 92 into engagement with the front ends 94. The biasing members 98 are preferably configured to urge the engagement between the rear and front ends 92 and 94 with a sufficiently high force that the connection 93 remains made even when the vehicle encounters bumps (eg. from road or route surface imperfections during travel).

[0076] Referring to Figure 11, an alignment mechanism 99 may be provided on the front and rear housing members 82 and 84 to align them with respect to each other. The alignment mechanism 99 may have any suitable structure. For example, the alignment mechanism 99 may include a rear alignment surface 99a on the rear housing member 84 that mates with a shoulder 99b on the front housing member 82.

[0077] Instead of providing the conductive pads 97 at the rear ends 92 of the front electrical connectors 90, conductive pads may alternatively be formed on the front ends 94 of the rear electrical connectors 96. As yet

another alternative, it is possible to provide conductive pads on both the rear and front ends 92 and 94.

5 **[0078]** The rear electrical connectors 96 may have rear ends 101 that are similar in configuration to the rear ends 28 (Figure 1) of the rear electrical connectors 24.

[0079] The functions of the front and rear electrical connectors 90 and 96 may be similar to the functions of the front and rear electrical connectors 20 and 24 in the embodiment shown in Figure 2 (eg. for carrying power, data, current to ground).

10 **[0080]** The grounding of the front and rear housing members 90 and 96 and the circuit board 88 may be achieved similarly to the grounding that is achieved for the camera 10, ie. by coating the front and rear housing members 90 and 96 with electrically conductive material and by electrically connecting the circuit board 88, and one of the front and rear electrical
15 connectors 90 and 96 to the associated coatings.

[0081] Reference is made to Figure 12, which shows a camera 150 in accordance with another embodiment of the present invention. The camera 150 is capable of being mounted to a vehicle panel, shown at 152 (Figure 14) relatively simply and with high positional accuracy. The vehicle panel 152 may
20 be any suitable vehicle panel, such as a liftgate handle or panel, a tailgate handle or panel, a spoiler or a lightbar.

[0082] Referring to Figure 12, the camera 150 includes a lens member 154 which may be similar to the lens member 12 (Figure 1), an imaging element 155 (Figure 15) which may be similar to the imaging element 15
25 (Figure 1), a circuit board 156 (Figure 12) which may be similar to the circuit board 14 (Figure 1), a front housing member 158 and a rear housing member 160. The lens member 154 extends along (and defines) a camera axis Ac.

[0083] The camera 150 includes a camera-associated locking structure 161, including two first locking surfaces 162 (Figures 13 and 15) and a second locking surface 164 (Figures 12 and 15). Each first locking surface 162 is situated on a locking element 163 and faces in a first axial direction, eg. rearwardly. The second locking surface 164 faces in a second axial direction that is opposed to the first axial direction, eg. forwardly, and is rearward of the first locking surface 162. Thus, the first and second locking surfaces 162 and 164 face each other. Referring to Figure 15, the first locking structure 161 cooperates with a vehicle panel-associated locking structure 165 on the vehicle panel 152 to lock the camera 150 to the vehicle panel 152. The vehicle panel-associated locking structure 165 includes third and fourth locking surfaces 166 and 168, which may be on the outside and inside surfaces of the vehicle panel 152, shown at 170 and 171. The third and fourth locking surfaces 166 and 168 thus face away from each other.

[0084] As shown in Figure 14, the vehicle panel 152 includes a camera mounting aperture 172, and a first locking element pass-through 173 for the locking elements 163 on which the first locking surfaces 162 are situated.

[0085] Referring to Figure 15, the first and second locking surfaces 162 and 164 may be spaced apart by a spacing S that may be related to the local thickness of the vehicle panel 152, shown at T in Figure 15. The spacing S may be the same as the spacing T. The spacing S may alternatively be different than the spacing T. For example, the spacing S may be less than the spacing T, thereby providing an interference fit between the camera-associated locking structure 161 and the vehicle-based locking structure 163.

[0086] The description of the mounting of the camera 150 will be made with reference to Figure 15. To mount the camera 150 to the vehicle panel 152, the camera 150 is inserted through the camera mounting aperture 172 with the first locking elements 163 oriented to pass through the first locking element pass-throughs 173 (Figure 14). The first locking surfaces 162 are

then rotated about the axis A_c (shown as a point in Figure 14) to a locking position (shown in Figures 14 and 15). Referring to Figure 15, in the locking position the first and second locking surfaces 162 and 164 capture the vehicle panel 152 therebetween. A detent mechanism 173 may be provided to hold
5 the camera 150 rotationally in its operating position. The detent mechanism 173 may include a first detent element 174, which may be, for example, a boss, on the third locking surface 170 and a second detent element 176, which may be, for example, a notch (shown more clearly in Figure 13), on one or more of the first locking surfaces 162. In an embodiment that is not shown,
10 it will be understood that the boss 174 (Figure 15) could alternatively be positioned on one or more of the first locking surfaces 162 and the notch 176 may be positioned on the vehicle panel 152.

[0087] Referring to Figure 14, to facilitate rotation of the camera 150 when the locking elements 163 are passed through the first locking element
15 pass-throughs 173, a lead-in 178 (shown also in Figure 13) may be provided on each front locking element 163. A shoulder 180 (Figures 13 and 14) may also be provided on the first locking elements 163 to engage the edge of the camera mounting aperture 172 (Figure 14) to center the camera 150 therein.

[0088] While one second locking surface 164 is shown (eg. a
20 continuous flange that extends circumferentially all the way around the camera 150) it is optionally possible to have a plurality of second locking surfaces 164 that are situated on small flange portions that are circumferentially spaced from one another (similar to the circumferentially spaced first locking elements 163).

25 **[0089]** Referring to Figure 15, an optional trim piece 182 (also shown individually in Figure 16) may be provided that clips into a depression 184 (Figure 15) in the vehicle panel 152 in which the camera mounting aperture 172 and first locking element pass-throughs 173 (Figure 14) are provided. The trim piece 182 rests flush with the vehicle panel 152 and itself has a

camera aperture 186 for the pass-through of the lens member 154. The lens member 154 may rest substantially flush with the camera aperture 186. The camera 150 may further include a seal member 188 that is positioned between the lens member 154 and the trim piece 182 to inhibit the pass
5 through of contaminants from outside the vehicle panel 152 into the depression 184 to potentially damage the camera 150.

[0090] As shown in Figure 15, the first locking surfaces 162 are shown as being provided on the lens member 154, and the second locking surface 164 is shown as being provided on the front housing member 158. It is
10 alternatively possible for the first locking surfaces 162 to be provided on the front housing member 158, along with the second locking surface 164.

[0091] Reference is made to Figure 17, which shows a camera 200 in accordance with another embodiment of the present invention. The camera 200 may be similar to the camera 150 (Figure 12). One difference in
15 particular is that the first locking elements, shown at 202, are incorporated into the front housing member, shown at 204, instead of being incorporated into the lens member. By eliminating any locking surfaces from the lens member, shown at 206, the lens member 206 is subject to reduced stress during installation of the camera 200 on the vehicle panel, shown at 208 (Figure 18).
20 Reducing the stresses on the lens member 206 (Figure 17) reduces the likelihood that the lens member 206 will come out of its optimal position for focusing images on the imaging element, shown at 210. The camera 200 further includes a circuit board 212 and a rear housing member 214 which may be similar to the circuit board 156 and the rear housing member 160
25 respectively (Figure 15). The vehicle panel 208 (Figure 18) may include a camera mounting aperture 216, a pair of first locking element pass-throughs 218, a third locking surface 220 (Figure 19) and a fourth locking surface 222, which may be similar to the camera mounting aperture 172 (Figure 14), the pair of first locking element pass-throughs 173 (Figure 14), the third locking

surface 170 (Figure 15) and the fourth locking surface 171 (Figure 15) respectively.

[0092] With reference to Figure 19, another difference with the camera 200 is that it may include a gasket 224 that rests on a shoulder 226 on the front housing member 204, and that has an axially facing surface 228 that acts as the second locking surface. The gasket 224 is compressed by a selected amount when the camera 200 is mounted on the vehicle panel 208.

[0093] As shown in Figure 17, the camera 200 may further include a first detent element 230 in associated with each first locking element 202, the front housing member 204 and a second detent element 232 for each first detent element 230, positioned on the edge of the camera mounting aperture 216 (Figure 18). The first detent elements 230 (Figure 17) engage the second detent elements 232 (Figure 18) to hold the camera 200 at a selected rotational position, and also to center the camera 200 in the camera mounting aperture 216. The first and second detent elements 230 and 232 make up a detent mechanism 234. It will be noted that only one first detent element 230 is shown in Figure 17 due to the viewpoint portrayed in that figure.

[0094] Reference is made to Figure 20, which shows a camera 250 in accordance with another embodiment of the present invention. The camera 250 may be similar to the camera 150 (Figure 12). One difference in particular is that the camera-associated locking structure, shown at 251 includes the third and fourth locking surfaces shown at 252 and 253 respectively. The third and fourth locking surfaces are provided on locking elements 254 that are incorporated into the rear housing member, shown at 255, instead of being incorporated into the lens member. The camera 250 further includes an imaging element 256, a circuit board 258 and a front housing member 260.

[0095] The vehicle panel that receives the camera 250 is shown at 262 (Figure 21). The vehicle panel 262 includes an outside surface (not shown)

and an inside surface 266. The vehicle panel-associated locking structure is shown at 268 and is mounted to the inside surface 266 about a camera mounting aperture 269. The vehicle panel-associated locking structure 268 includes the first and second locking surfaces, shown at 270 and 272.

5 **[0096]** To mount the camera 250 to the vehicle panel 262, the camera 250 is inserted through the camera mounting aperture 269, and the camera-associated locking elements 254 are rotated until they are captured by the vehicle panel-associated locking elements 268.

10 **[0097]** Reference is made to Figure 23, which shows a camera 300 in accordance with another embodiment of the present invention. The camera 300 may be similar to the camera 250 (Figure 20). One difference in particular is that the camera-associated locking structure, shown at 302 includes four locking elements 304 on the front housing member, shown at 305. Each locking element 304 has thereon third and fourth locking surfaces
15 shown at 306 and 308 respectively. The third and fourth locking surfaces 306 and 308 are captured by a vehicle panel-associated locking element 310 (Figure 24) that includes first and second locking surfaces 312 and 314 (Figure 24a) on the vehicle panel, shown at 316. The camera 300 further includes a lens member 317, an imaging element 318, a circuit board 320 and
20 a rear housing member 322.

25 **[0098]** Providing a camera, such as the cameras 150, 200, 250 and 300 (Figures 12, 17, 20 and 23), that mounts directly onto the vehicle panel without separate mounting fasteners (eg. screws) reduces cost of the camera. Additionally, the mounting of the camera can be carried out relatively quickly, further reducing the cost associated with the camera. Additionally, it will be noted that, in some embodiments, namely those shown in Figures 12, 20 and 23, the camera-associated locking structure is shown as being mounted on the front housing member and/or on the lens member 154. The tolerances that are involved in the orientation and position of the lens member 154

include the tolerances associated with the vehicle panel 152, the lens member 154 and the front housing member 158. By comparison, some prior art cameras mount to a vehicle panel through their rear housing member.

[0099] In the embodiments shown in Figures 12, 17, 20 and 23, the first and second locking surfaces have been shown to face directly axially towards each other and the third and fourth locking surface have been shown to face directly axially away from each other. It will be understood that the first and second locking surfaces may generally face each other (eg. they may both be angled to some extent away from each other) while still performing their function as locking surfaces. Similarly the third and fourth locking surfaces may generally face away from each other (eg. they may both be angled to some extent from being oriented directly away from each other) while still performing their function as locking surfaces.

[00100] Reference is made to Figure 25, which shows a camera 400 in accordance with another embodiment of the present invention. The camera 400 mounts to a vehicle panel 402 without the need for a front housing member. An advantage of eliminating the front housing member is that the camera 400 may occupy a reduced amount of space relative to some cameras of the prior art. The camera 400 may face rearwardly on the vehicle. Additionally, the steps in assembling the camera 400 and assembling the camera 400 to the vehicle panel 402 may be reduced relative to a camera that includes a separate front housing member.

[00101] The camera 400 includes a lens member 404, an imaging element 403 which may be similar to the imaging element 15 (Figure 1), a circuit board 406 and a rear housing member 407. The lens member 404 may be configured to be pre-assembled to the circuit board 406 by a connecting structure 405 at a suitable distance for focusing on the imaging element 403 that may be contained on the circuit board 406. The connecting

structure 205 may be any suitable structure, such as, for example, a cylinder that is glued to both the circuit board 406 and the lens member 404.

[00102] The circuit board 406 with the lens member 404 mounted thereto is mounted to internally threaded apertures 408 that are provided on
5 supports 410 that may be molded directly in the vehicle panel 402 for receiving threaded circuit board mounting fasteners 411. The supports 410 may be sized so that when the circuit board 406 is mounted thereon the lens member 404 lies approximately flush with the outside surface shown at 412 of the vehicle panel 402. To facilitate assembly of the camera 400 into the
10 vehicle panel 402, some of the supports 410 may not include internally threaded apertures, and thus serve only as spacers. In the embodiment of the vehicle panel 402 shown in Figure 25, two of the supports, shown at 410a, include the apertures 208, and two of the supports, shown at 410b, do not include apertures.

[00103] Referring again to Figure 25, after mounting the circuit board 406 to the vehicle panel 402, a rear housing member 407 may be connected to a wall structure 414 that is molded directly into the vehicle panel 402. The connection of the rear housing member 407 may be by any suitable means, such as by adhesive. The rear housing member 407 thus protects the circuit
15 board 406 and other camera components from contaminants that could damage those components.
20

[00104] The vehicle panel 202 may be any suitable vehicle panel, such as a liftgate handle or panel, a tailgate handle or panel, a spoiler or a lightbar.

[00105] A seal member 216 may be provided between the lens member 204 and the vehicle panel 202 to inhibit the pass through of contaminants
25 from outside the vehicle panel 152 to potentially damage the camera 150.

[00106] Reference is made to Figure 27, which shows a set of male, front and female, rear electrical connectors 500 and 502 respectively that can be used in place of the electrical connectors 90 and 96 respectively in the

embodiment shown in Figures 9-11. The male electrical connector 500 may be a simple pin that is molded into and extends downwardly from the rear housing member 84, and may be similar in shape to the rear electrical connector 25 in the embodiment shown in Figures 1-7. The female electrical connector 502 is provided in the female electrical connector housing 504 (Figure 28) that is fixedly mounted to the circuit board 88 (Figure 9). Preferably, the housing 504 (Figure 28) is divided into individual chambers 506 for each electrical connector 502 to ensure that the connectors 502 do not bend in an unexpected way that drives two adjacent connectors 502 to contact one another, during insertion of the pins 500 therein. Each individual female electrical connector 502 is permitted to flex individually in a first direction shown by arrow 508 to accommodate an imperfectly positioned male connector 500. Furthermore, each individual electrical connector 502 has a width in a second direction shown by arrow 510, which is perpendicular to the first direction. The width of the female connectors 502 is selected to be sufficiently wide to accommodate a selected amount of tolerance in the positions of the individual male connectors 500. Thus, the female connectors 502 which are associated with the circuit board 88 (and thus with the front housing member 82, shown in Figure 9) can accommodate a selected amount of tolerance in the two directions 508 and 510 that relate to the alignment between the male connectors 500 which are associated with the rear housing member 84.

[00107] To permit the bending in the first direction 508, the female connector 502 includes a resilient flexure member 512 (Figure 27), which permits the pin capture head, shown at 513 to move as needed to accommodate tolerance in the pin 500 in the first direction. The pin capture head 513 may be made up of a pair of chevron shaped arms 514 and 516 that are integrally connected to each other through a body plate 517. The arms 514 and 516 are resiliently flexible relative to the body plate 517. The arms 514 and 516 are preferably positioned less than the thickness of the pins 500

apart, so that at least one of the arms 514 and 516 is ensured to remain in contact with a pin 500 inserted into the female connector 502. The chevron shaped arms 514 and 516 also provide lead-in for the pins 500 to promote the sliding of the pins 500 into female connector 502.

5 **[00108]** The above described connecting structure between the first and second connectors 500 and 502 permits the housing members 84 and 86 to mount together in an aligned way, similar to how they mount together in Figure 11, while reducing the potential for failure of the connectors 90 and 96 that would result from any misalignment between them.

10 **[00109]** The camera in accordance with an embodiment of the present invention need not be mounted at the rear of a vehicle or as a rearview camera. The camera may be mounted anywhere suitable about the vehicle, and may be mounted on the side of the vehicle or the front of the vehicle, for example. In such alternative installations, the camera could face the front or
15 side of the vehicle, or may, for example, face the rear of the vehicle while being mounted on the side of the vehicle (eg. for blind-spot monitoring for the vehicle).

20 **[00110]** While the above description constitutes a plurality of embodiments of the present invention, it will be appreciated that the present invention is susceptible to further modification and change without departing from the fair meaning of the accompanying claims.

CLAIMS:

1. A camera for mounting on a vehicle, comprising:
 - 5 a front housing member;
 - a lens member mounted to the front housing member;
 - an imaging element that is positioned to receive images from the lens member;
 - a circuit board mounted to the front housing member, wherein the circuit
 - 10 board is configured to send to another component signals relating to images received by the imaging element, wherein the circuit board has at least one front electrical connector thereon; and
 - a rear housing member, wherein the rear housing member has at least one rear electrical connector extending therefrom, wherein the at least one
 - 15 rear electrical connector is electrically connected to the at least one front electrical connector, wherein the rear housing member has a rear alignment structure that aligns the rear electrical connector with respect to the at least one front electrical connector, wherein the rear housing member and the front housing member are unaligned with respect to each other, and wherein the
 - 20 rear housing member mates with the front housing member to define a camera interior, wherein the imaging element, the circuit board, the at least one front electrical connector and the at least one rear electrical connector are positioned in the camera interior.
- 25 2. A camera as claimed in claim 1, wherein the at least one rear electrical connector is at least one conductive pin and wherein the at least one front electrical connector is a female electrical connector.

3. A camera as claimed in claim 2, wherein the at least one conductive pin is the rear alignment structure.
4. A camera as claimed in claim 2, wherein the at least one female electrical connector is positioned in a female electrical connector housing, and wherein the rear alignment structure includes a sleeve that snugly receives the female electrical connector housing.
5. A camera as claimed in claim 4, wherein the sleeve is integral with the rear housing member.
6. A camera as claimed in claim 1, wherein the at least one rear electrical connector is integral with the rear housing member.
7. A camera as claimed in claim 6, Wherein the at least one rear electrical connector is insert molded into the rear housing member.
8. A camera as claimed in claim 1, wherein the front and rear housing members are sealingly joined together.
9. A camera as claimed in claim 1, wherein the front housing member has a front housing member interior surface that has a front housing member coating of electrically conductive material thereon, and wherein one of the at least one front electrical connector is in electrical communication with the front housing member coating and is electrically connectable to ground.
10. A camera as claimed in claim 9, wherein the circuit board is mounted to the front housing with an electrically conductive circuit board fastener that is in electrical communication with the front housing member coating.

11. A camera as claimed in claim 10, wherein the rear housing member has a rear housing member interior surface that has a rear housing member coating thereon, and wherein one of the at least one rear electrical connector is in communication with the rear housing member coating and is electrically
5 connectable to ground.

12. A camera as claimed in claim 11, wherein the said one of the at least one rear electrical connector is in communication with the said one of the at least one front electrical connector.

10

13. A camera for mounting on a vehicle, comprising:
a front housing member;
a lens member mounted to the front housing member;
an imaging element that is positioned to receive images from the lens
15 member;

a circuit board mounted to the front housing member, wherein the circuit board is configured to send to another component signals relating to images received by the imaging element, wherein the circuit board has at least one front electrical connector thereon; and

20 a rear housing member, wherein the rear housing member has at least one rear electrical connector extending therefrom, wherein the at least one rear electrical connector is electrically connected to the at least one front electrical connector, wherein the rear housing member has a rear alignment structure that aligns the rear electrical connector with respect to the at least
25 one front electrical connector, wherein the rear housing member mates with the front housing member generally along a plane so that the rear housing member and front housing member are unaligned with respect to each other and wherein the rear housing member and the front housing member together define a camera interior, wherein the imaging element, the circuit board, the at

least one front electrical connector and the at least one rear electrical connector are positioned in the camera interior.

14. A method of assembling a camera for a vehicle, comprising:

- 5 (a) mounting a lens member, an imaging element and a circuit board to a front housing member, wherein the imaging element is positioned to receive images from the lens member, wherein the circuit board is configured to send to another component signals relating to images received by the imaging element, wherein the circuit board has at least one front
10 electrical connector thereon;
- (b) providing a rear housing member with at least one rear electrical connector thereon;
- (c) aligning the rear electrical connector with respect to the at least one front electrical connector;
- 15 (d) forming at least one connection between the at least one rear electrical connector and the at least one front electrical connector; and
- (e) joining the front and rear housing members together to define a camera interior in which the circuit board, the at least one front electrical connector and the at least one rear electrical connector are positioned,
20 without aligning the front and rear housing members with respect to one another.

15. A method as claimed in claim 14, wherein said at least one front electrical connector includes at least one female electrical connector, and said
25 at least one rear electrical connector includes at least one conductive pin.

16. A method as claimed in claim 15, wherein the at least one female electrical connector is positioned in a female electrical connector housing, and wherein the rear housing member further includes a sleeve that is sized to
30 snugly receive the female electrical connector housing, wherein the method

further comprises inserting the female electrical connector housing in the sleeve.

17. A method as claimed in claim 15, wherein step (d) includes inserting the
5 at least one conductive pin into the at least one female electrical connector.

18. A method as claimed in claim 14, wherein the front housing member
has a front housing member interior surface that has a front housing member
coating of electrically conductive material thereon, and wherein the method
10 includes electrically connecting the circuit board with the front housing
member coating, and electrically connecting one of the at least one front
electrical connector with the front housing member coating.

19. A method as claimed in claim 18, wherein the rear housing member has
15 a rear housing member interior surface that has a rear housing member
coating thereon, and wherein one of the at least one rear electrical connector
is in communication with the rear housing member coating.

20. A method as claimed in claim 14, wherein step (e) includes sealingly
20 joining the front and rear housing members.

21. A camera for mounting on a vehicle, comprising:
a front housing member having a front housing member interior surface
that has a front housing member coating of electrically conductive material
25 thereon;
a lens member mounted to the front housing member;
an imaging element that is positioned to receive images from the lens
member;
a circuit board mounted to the front housing member, wherein the circuit
30 board is configured to send to another component signals relating to images

received by the imaging element, wherein the circuit board is mounted to the front housing member, wherein the circuit board has at least one front electrical connector thereon, wherein one of the at least one front connector is in electrical communication with the front housing member coating and is
5 electrically connectable to ground; and

a rear housing member having at least one rear electrical connector thereon, wherein the at least one rear electrical connector is connected to the at least one front electrical connector.

10 22. A camera as claimed in claim 21, wherein the circuit board is mounted to the front housing member with an electrically conductive circuit board fastener that is in electrical communication with the front housing member coating.

15 23. A camera as claimed in claim 22, wherein the rear housing member has a rear housing member interior surface that has a rear housing member coating thereon, and wherein one of the at least one rear electrical connector is in communication with the rear housing member coating and is electrically connectable to ground.

20

24. A camera as claimed in claim 23, wherein the said one of the at least one rear electrical connector is in communication with the said one of the at least one front electrical connector.

25 25. A camera for mounting on a vehicle, comprising:
a front housing member;
a lens member mounted to the front housing member;
an imaging element that is positioned to receive images from the lens member;

a circuit board mounted to the front housing member, wherein the circuit board is configured to send to another component signals relating to images received by the imaging element, wherein the circuit board has at least one front electrical connector thereon; and

- 5 a rear housing member, wherein the rear housing member has at least one rear electrical connector extending therefrom, wherein the at least one rear electrical connector is electrically connected to the at least one front electrical connector, and wherein the at least one rear electrical connector and the at least one front electrical connector are urged together by at least
- 10 one biasing member, wherein the rear housing member and the front housing member are aligned with respect to each other, and wherein the rear housing member mates with the front housing member to define a camera interior, wherein the imaging element, the circuit board, the at least one front electrical connector and the at least one rear electrical connector are positioned in the
- 15 camera interior.

26. A camera as claimed in claim 25, wherein each front electrical connector has a rear end and each rear electrical connector has a front end, wherein the front and rear ends engage each other with a force that is
- 20 substantially perpendicular to the front and rear ends.

27. A camera as claimed in claim 25, wherein each front electrical connector has a bend therein that is one of the at least one biasing member.

- 25 28. A camera as claimed in claim 25, wherein each front electrical connector has a rear end and each rear electrical connector has a front end, wherein the rear end and the front end are sized to permit a selected amount of misalignment therebetween while maintaining an electrical connection therebetween.

30

29. A camera for mounting on a vehicle panel having a thickness, comprising:

a front housing member;

a lens member that extends along a camera axis, wherein the lens
5 member is mounted to the front housing member;

an imaging element that is positioned to receive images from the lens
member;

a circuit board mounted to the front housing member, wherein the circuit
board is configured to send to another component signals relating to images
10 received by the imaging element;

a rear housing member that is connectable to the front housing member
to define a camera interior in which the circuit board and imaging element are
positioned; and

a camera-associated locking structure connected to at least one of the
15 front housing member, the lens member and the rear housing member,
wherein the camera-associated locking structure is engageable with a vehicle
panel-associated locking structure on the vehicle panel, wherein the camera-
associated locking structure is rotatable between an unlocked position
wherein the camera-associated locking structure is disengaged from the
20 vehicle panel-associated locking structure and a locked position wherein the
camera-associated locking structure is engaged with the vehicle panel-
associated locking structure to prevent axial movement of the camera relative
to the vehicle panel, wherein one of the camera-associated and vehicle panel-
associated locking structures includes a first locking surface and a second
25 locking surface that generally axially face each other, and wherein the other of
the camera-associated and vehicle panel-associated locking structures
includes a third locking surface and a fourth locking surface that generally
axially face away from each other.

30. A camera as claimed in claim 29, wherein the camera-associated locking structure includes the first and second locking surfaces, wherein one of the first and second locking surfaces is sized to pass through a camera-associated locking surface pass-through in the vehicle panel, and to
5 subsequently be rotatable to bring the camera-associated locking structure to the locking position.

31. A camera as claimed in claim 30, wherein the first locking surface faces rearwardly and the second locking surface faces forwardly.
10

32. A camera as claimed in claim 30, wherein the vehicle panel includes an inside surface and an outside surface and has a thickness and wherein the third and fourth locking surfaces are on the inside and outside surfaces of the vehicle panel, and wherein the first and second locking surfaces are spaced
15 axially by a spacing that is related to the thickness of the vehicle panel.

33. A camera as claimed in claim 29, further comprising a first detent element on the camera-associated locking structure and a second detent element on the vehicle panel-associated locking structure that is configured to
20 engage the first detent element to hold the camera-associated locking structure in the locking position.

34. A camera as claimed in claim 29, wherein the vehicle panel includes an inside surface and an outside surface and wherein the vehicle panel-associated locking structure extends from the inside surface, and wherein the
25 third and fourth locking surfaces are on the vehicle panel-associated locking structure.

35. A camera as claimed in claim 29, wherein the camera-associated
30 locking structure includes a plurality of first locking surfaces.

36. A camera as claimed in claim 29, wherein the camera-associated locking structure is connected to the front housing member.
- 5 37. A combination of a camera and a vehicle panel, comprising:
a vehicle panel having a vehicle panel-associated locking structure; and
a camera, including:
A front housing member;
a lens member mounted to the front housing member;
10 an imaging element that is positioned to receive images from the lens member;
a circuit board mounted to the front housing member, wherein the circuit board is configured to send to another component signals relating to images received by the imaging element;
15 a rear housing member that is connectable to the front housing member to define a camera interior in which the circuit board and imaging element are positioned; and
a camera-associated locking structure connected to at least one of the front housing member, the lens member and the rear housing member,
20 wherein the camera-associated locking structure is engageable with the vehicle panel-associated locking structure, wherein the camera-associated locking structure is rotatable between an unlocked position wherein the camera-associated locking structure is disengaged from the vehicle panel-associated locking structure and a locked position wherein the camera-associated locking structure is engaged with the vehicle panel-associated locking structure to prevent axial movement of the camera relative to the vehicle panel, wherein one of the camera-associated and vehicle panel-associated locking structures includes a first locking surface and a second locking surface that generally axially face each other, and wherein the other of
25 the camera-associated and vehicle panel-associated locking structures
30 the camera-associated and vehicle panel-associated locking structures

includes a third locking surface and a fourth locking surface that generally axially face away from each other.

38. A combination of a camera and a vehicle panel, comprising:

5 A vehicle panel; and

A camera including a lens member and a circuit board, wherein the lens member is fixedly connected with respect to the circuit board, wherein the circuit board is mounted to the vehicle panel.

10 39. A combination as claimed in claim 38, wherein the vehicle panel has an outside surface, and further includes a plurality of supports that are configured to hold the circuit board at a selected position such that the lens member is substantially flush with the outside surface.

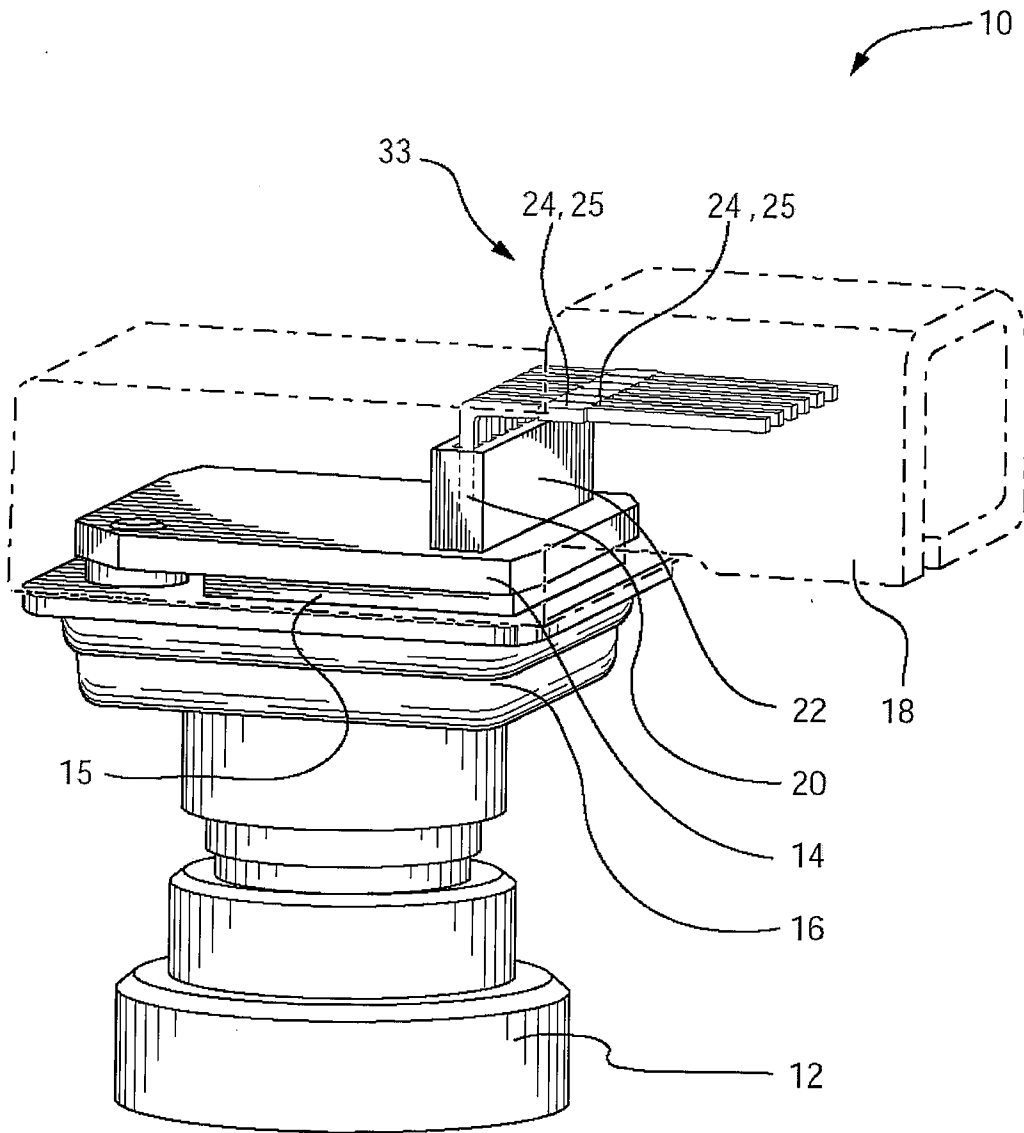


FIG. 1

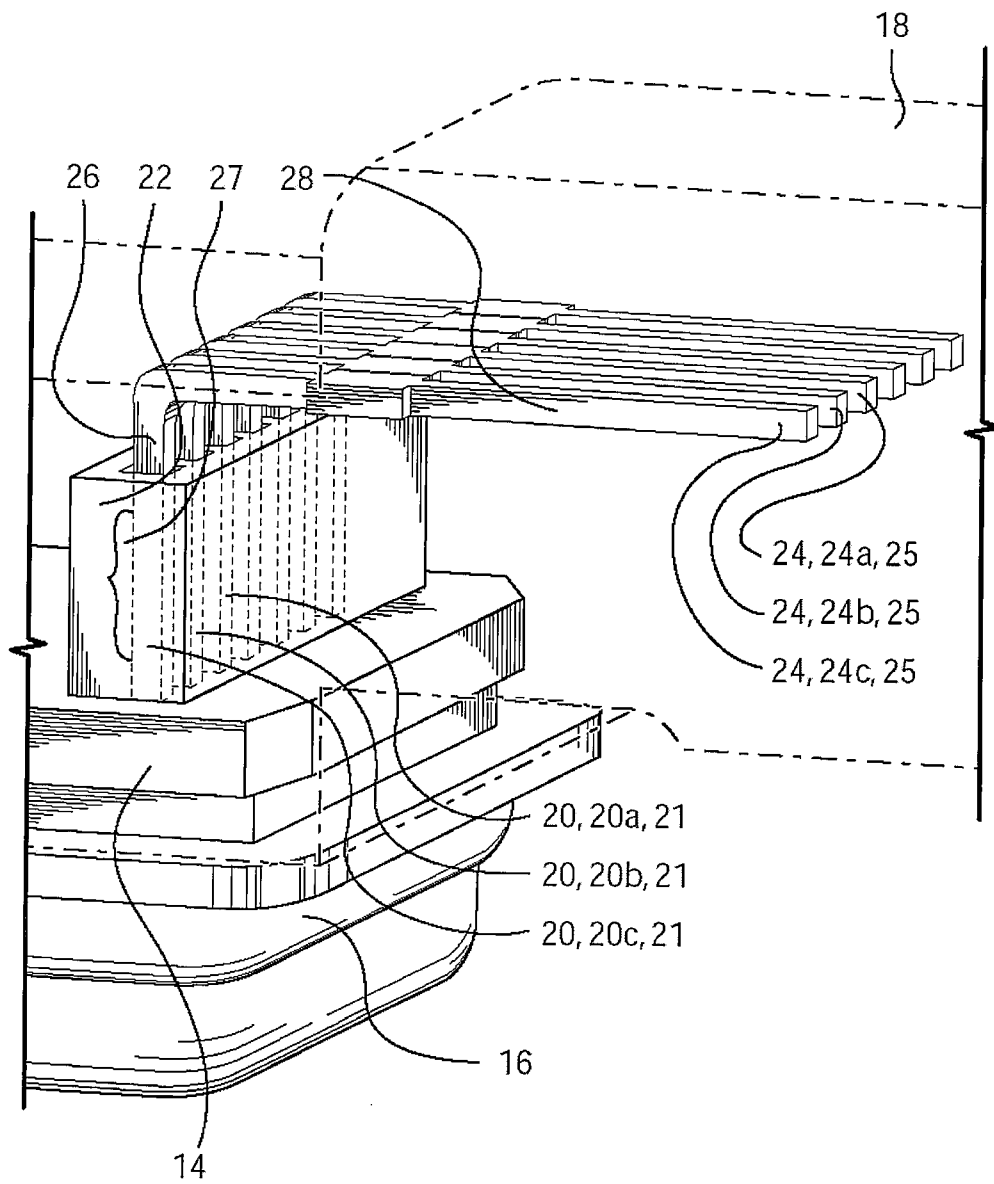


FIG. 2

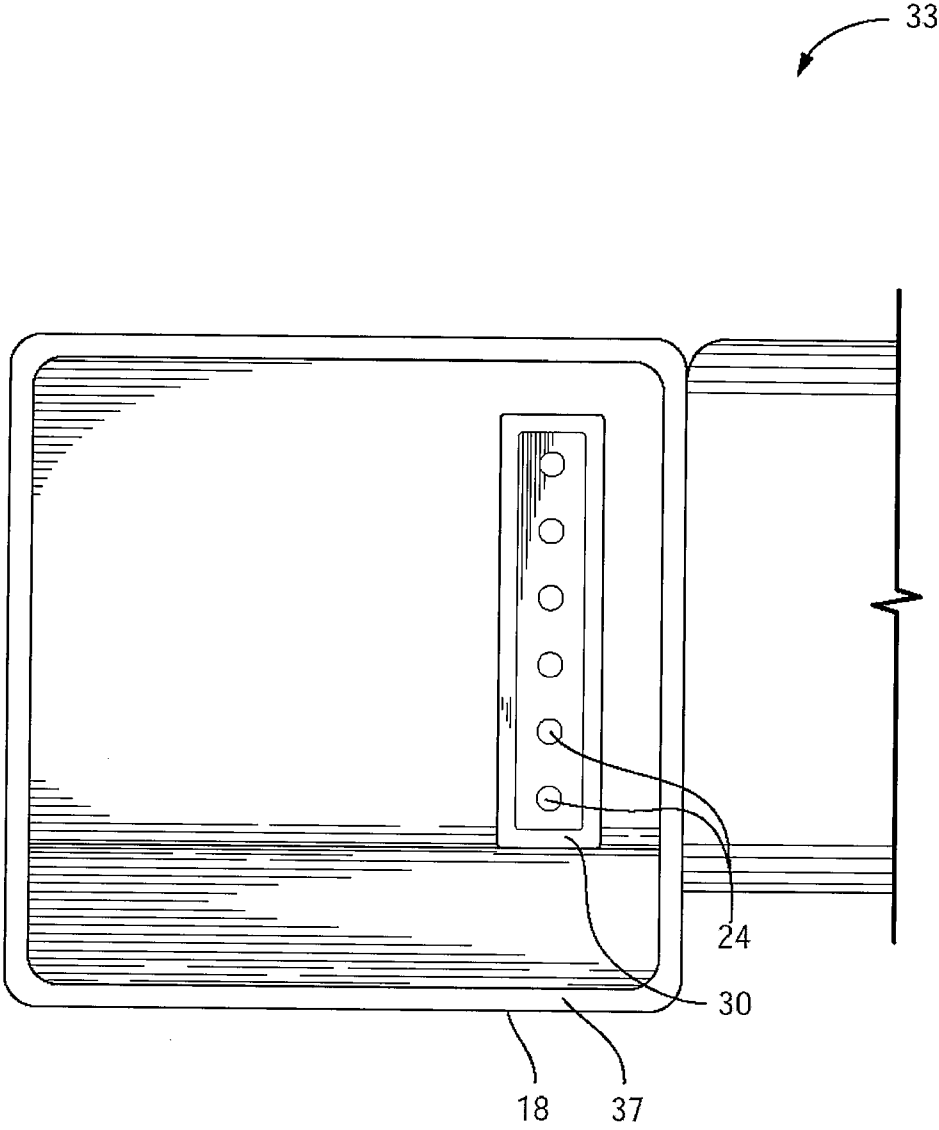


FIG. 3

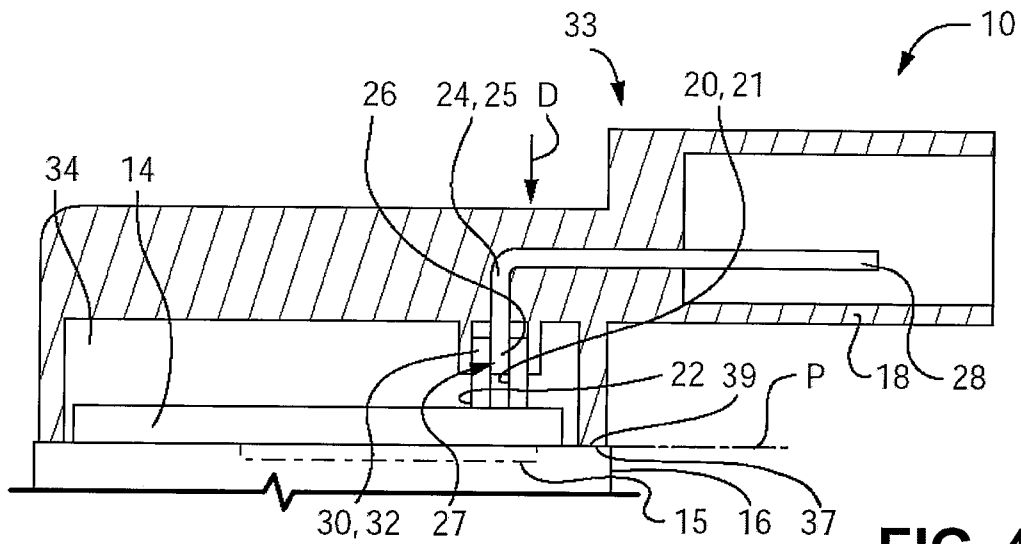


FIG. 4

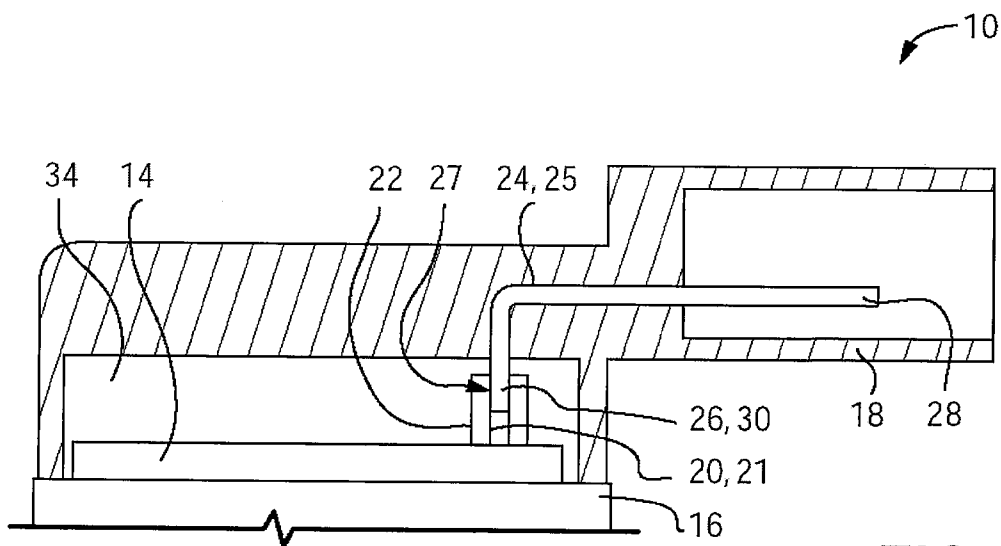


FIG. 5

5/20

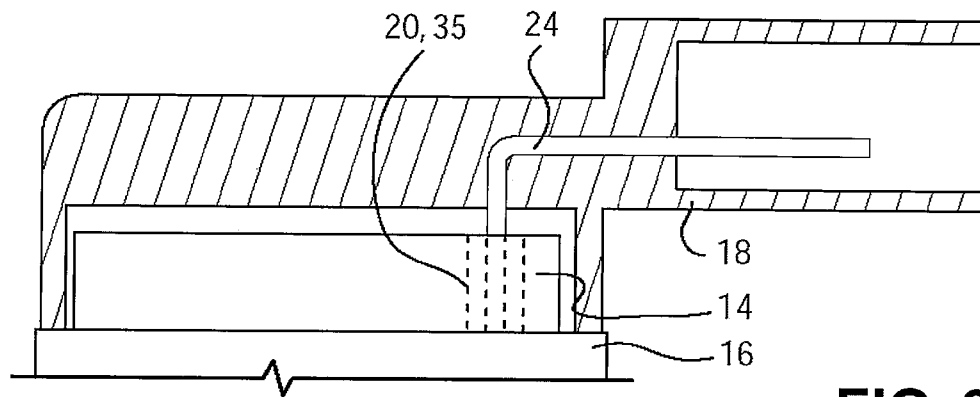


FIG. 6

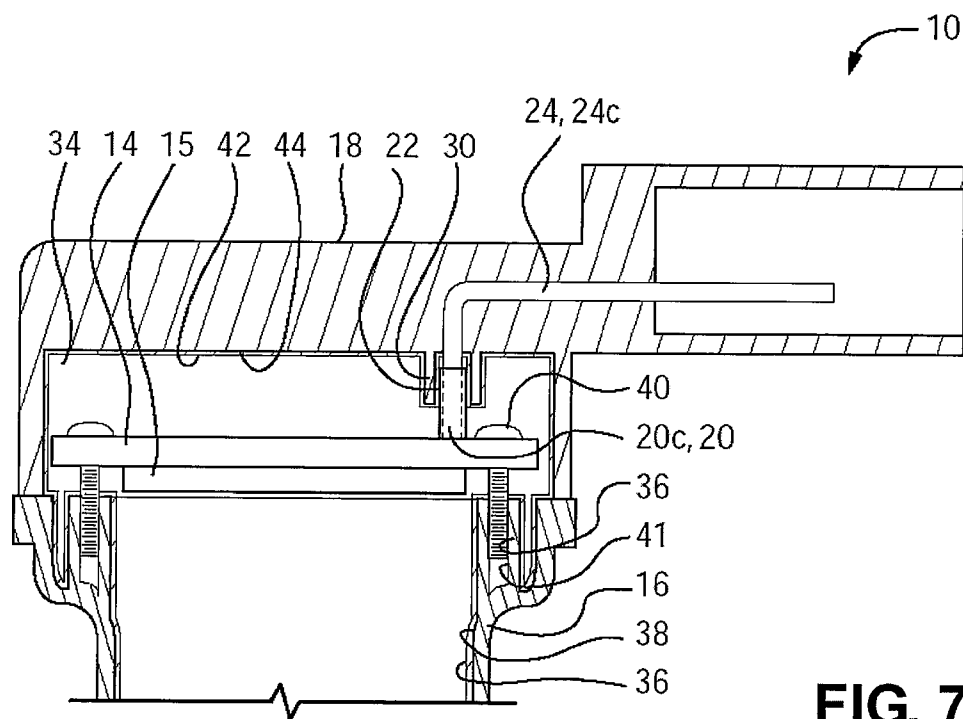


FIG. 7

6/20

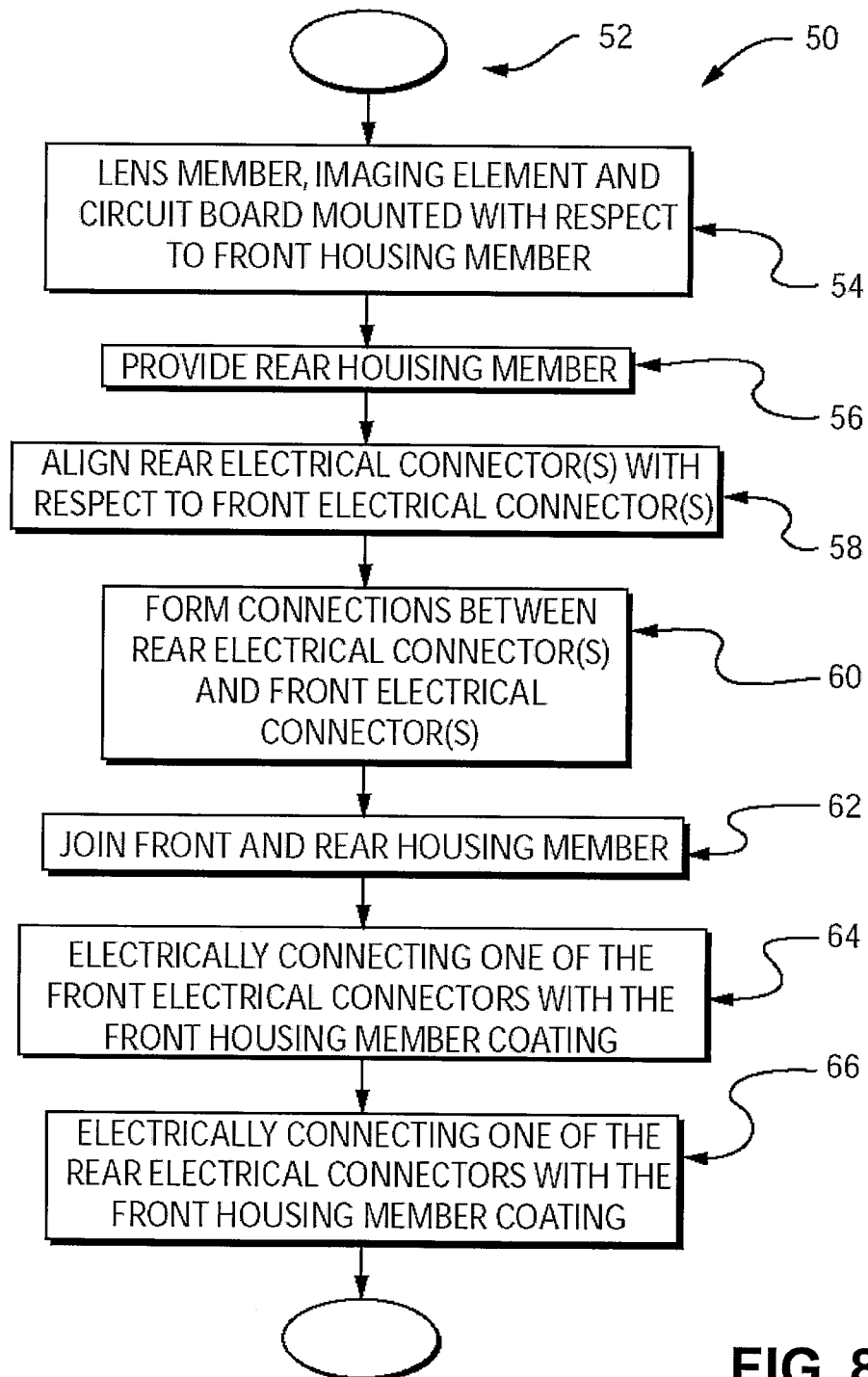


FIG. 8

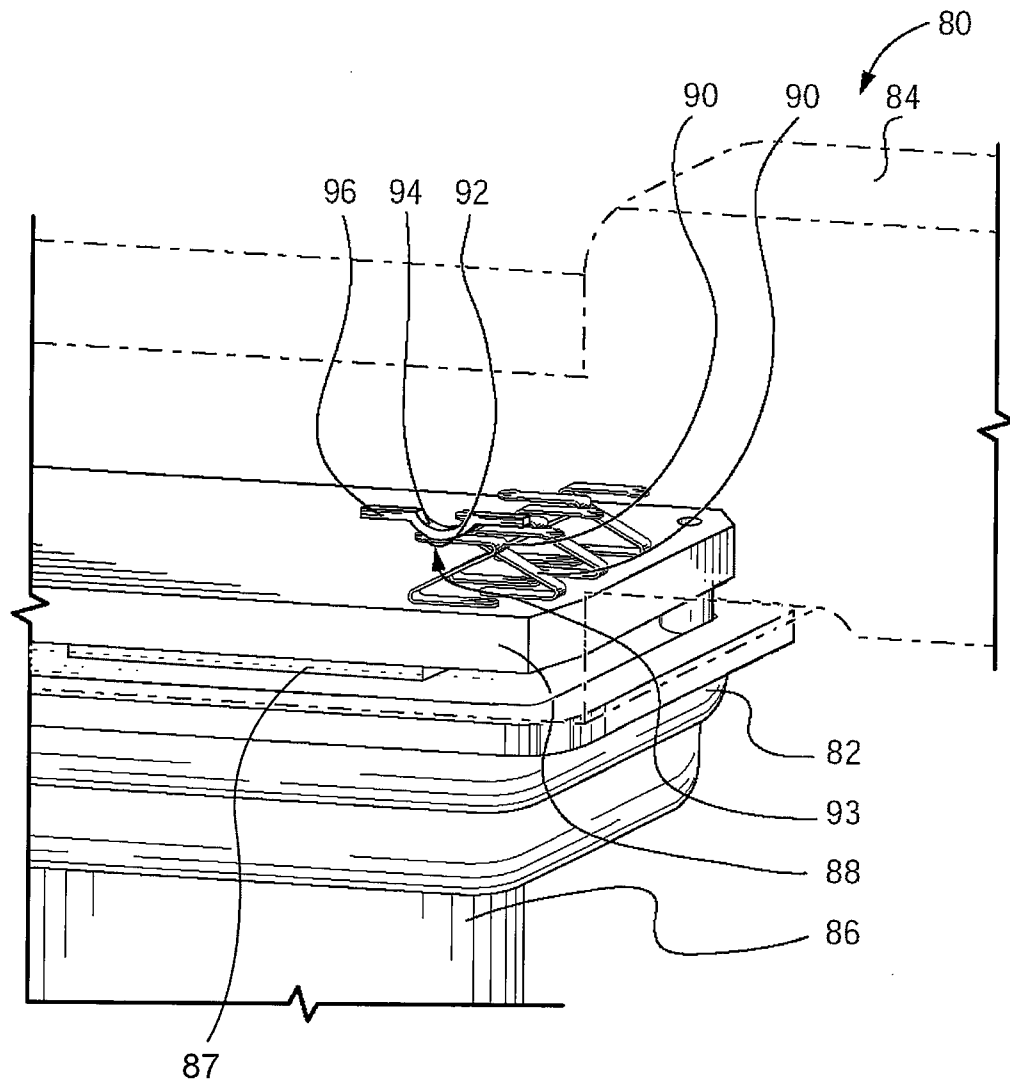


FIG. 9

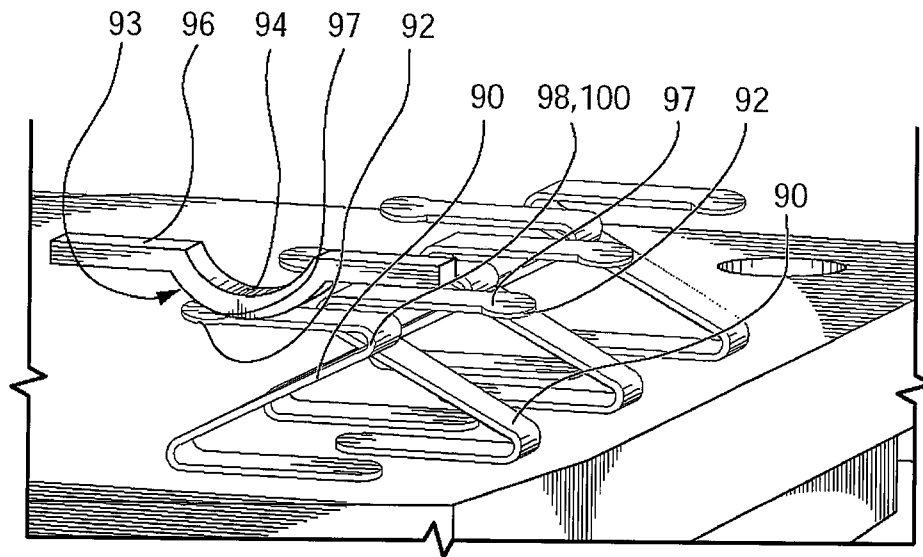


FIG. 10

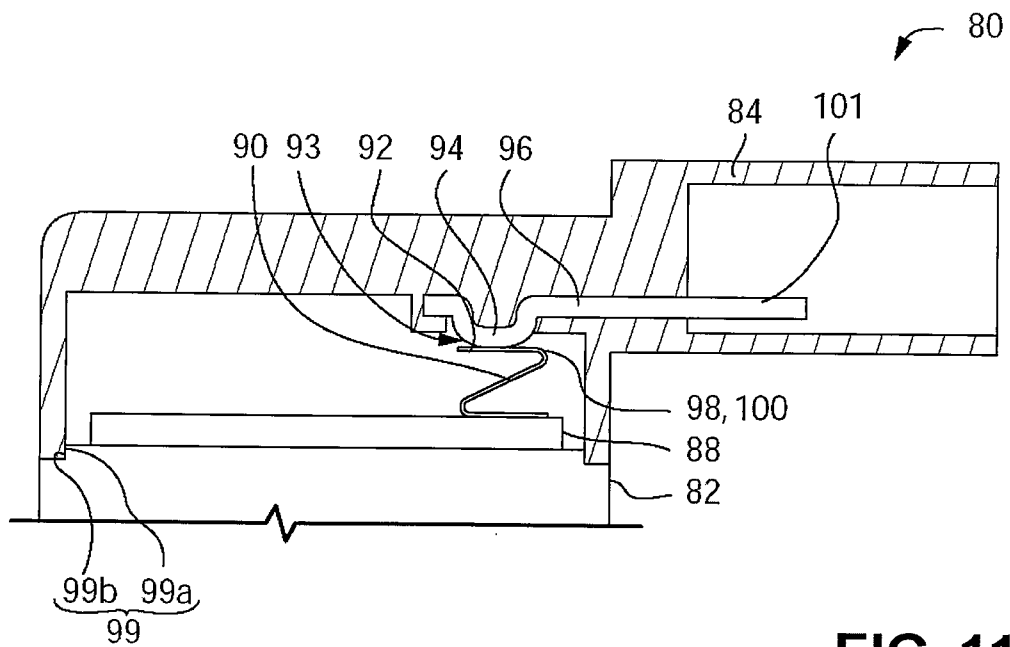


FIG. 11

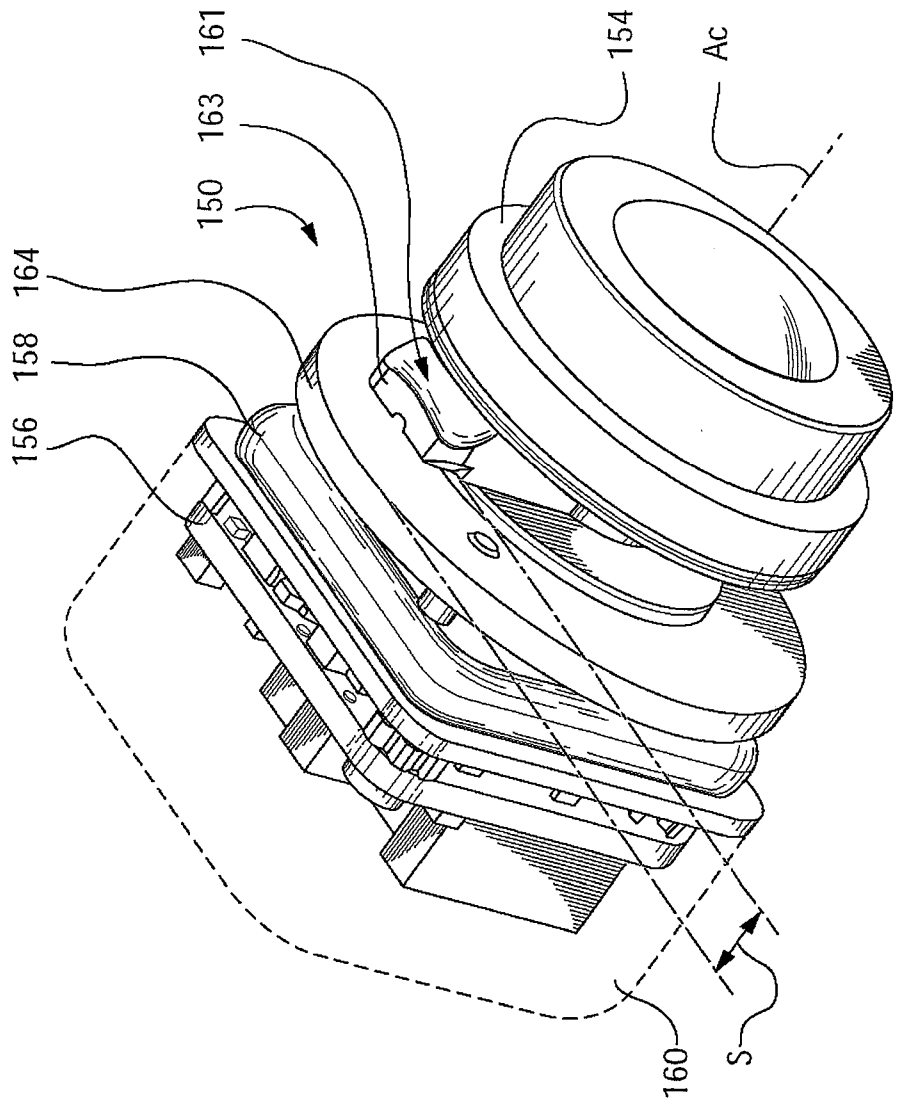


FIG. 12

10/20

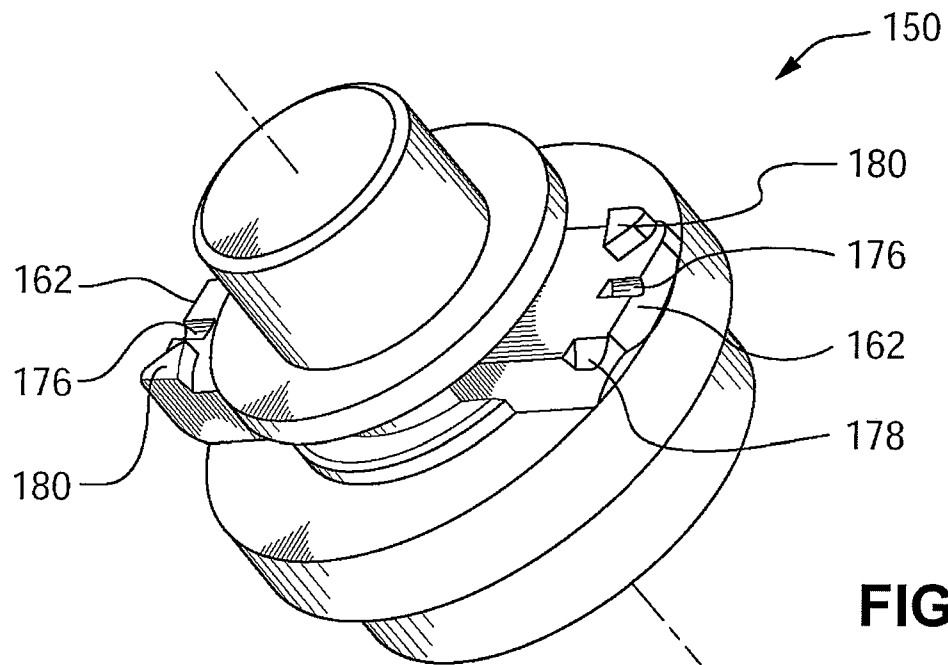


FIG. 13

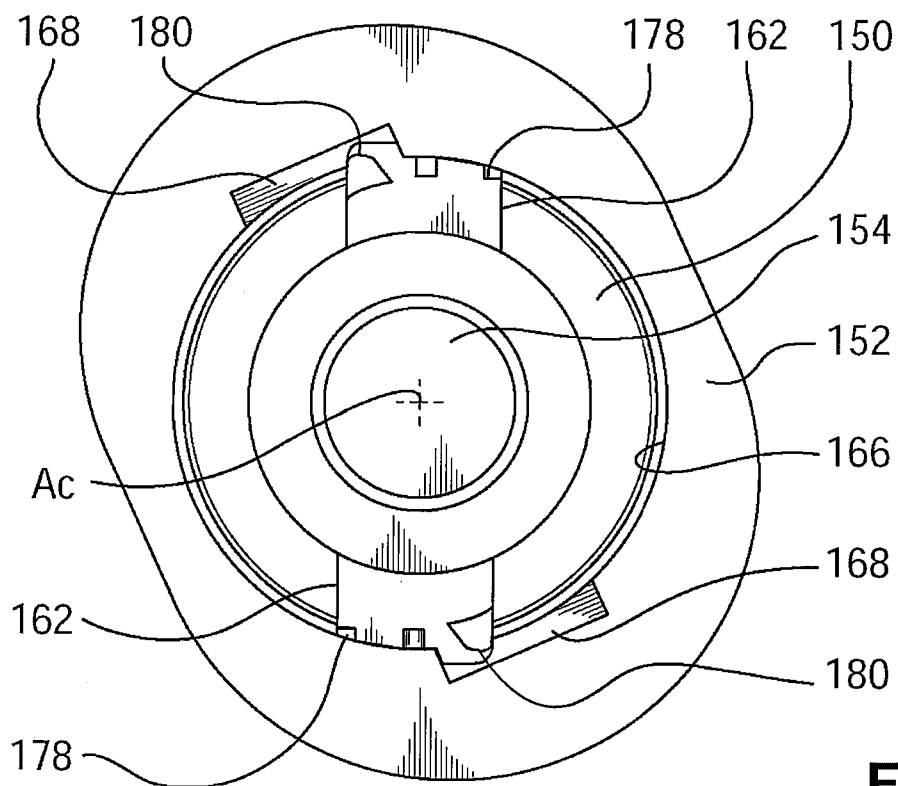


FIG. 14

12/20

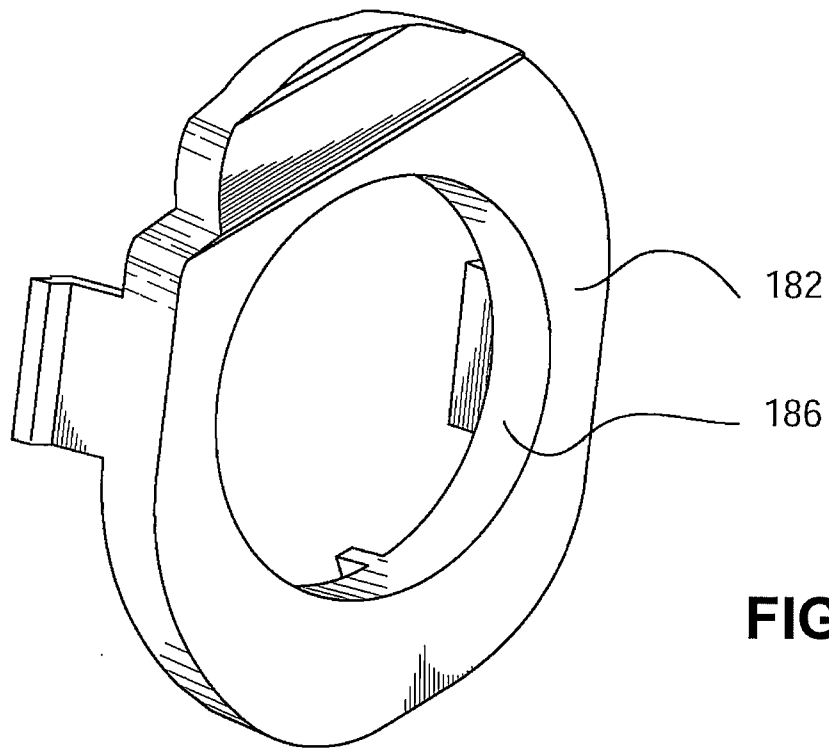


FIG. 16

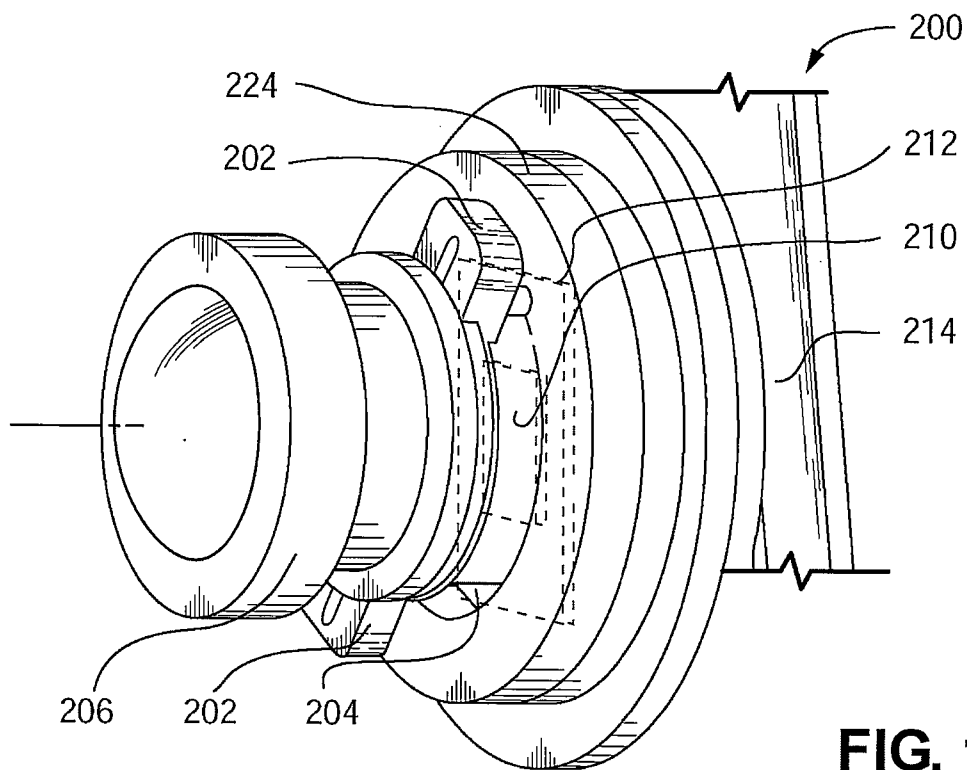


FIG. 17

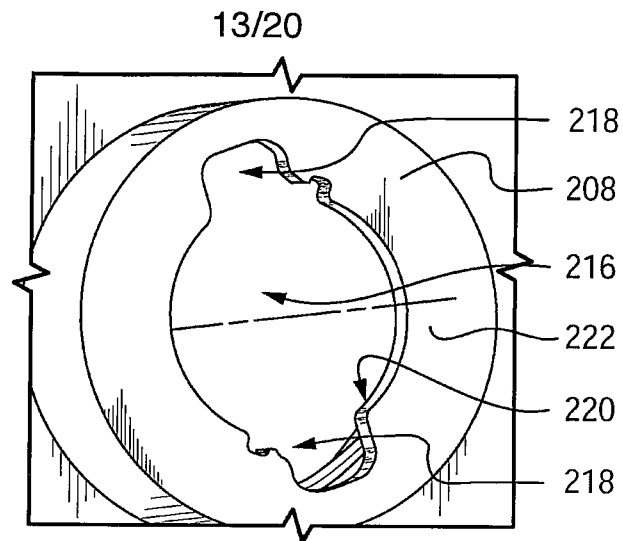


FIG. 18

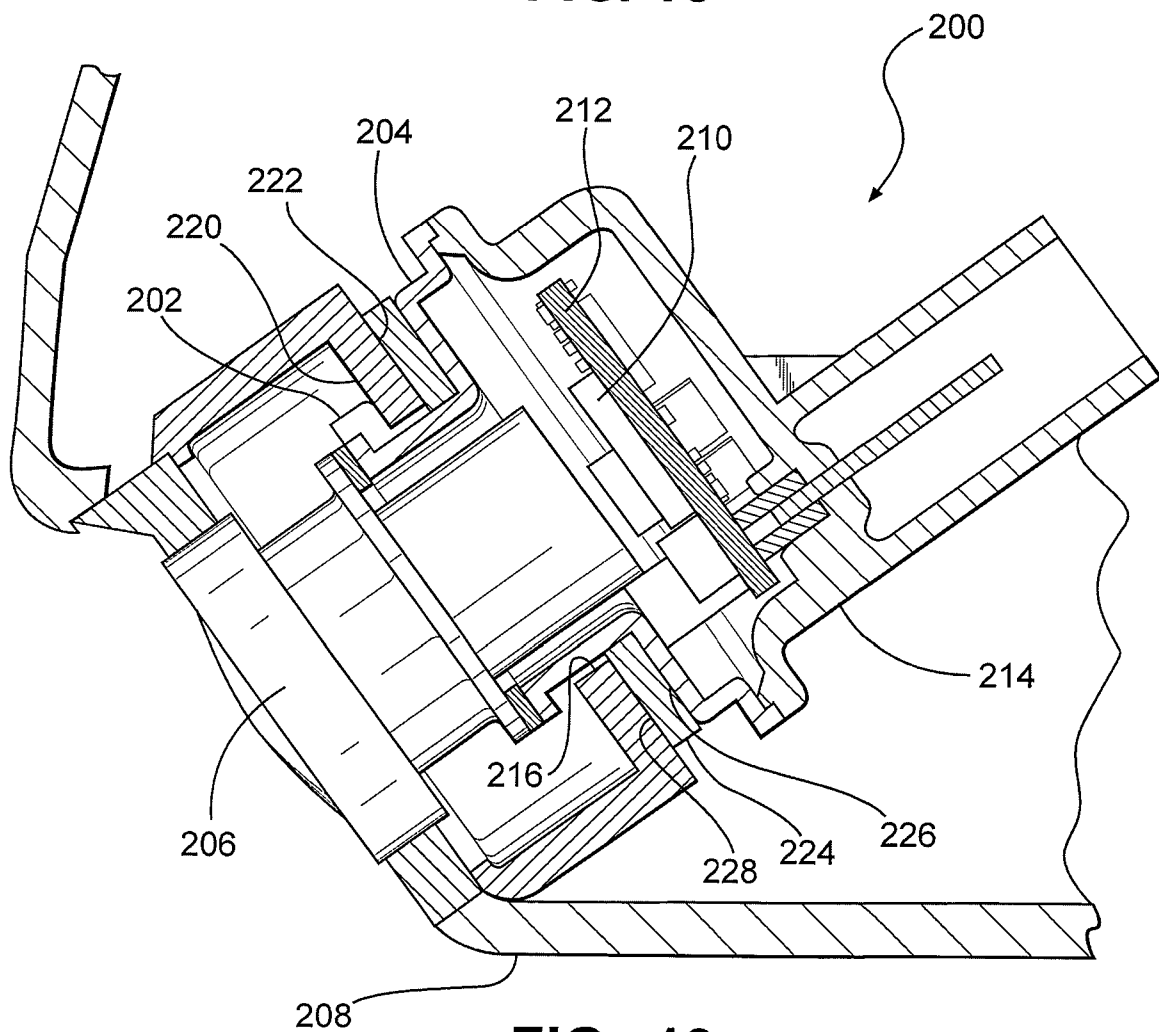
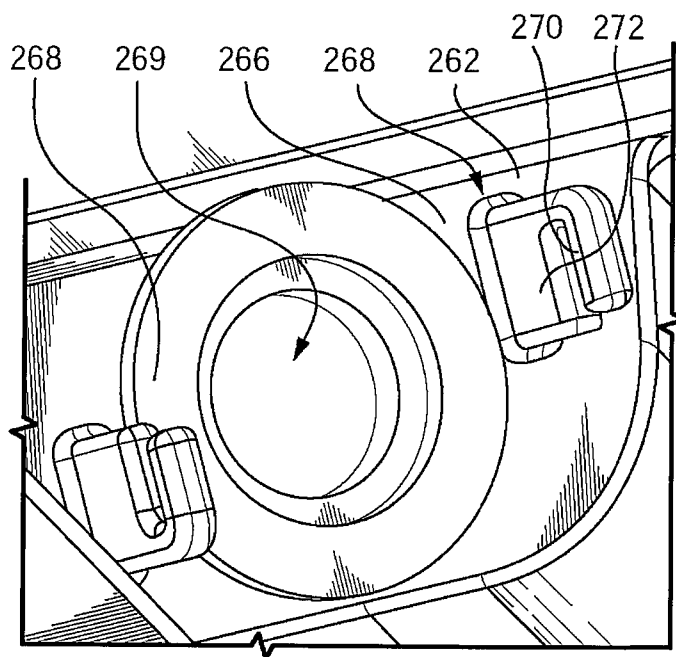
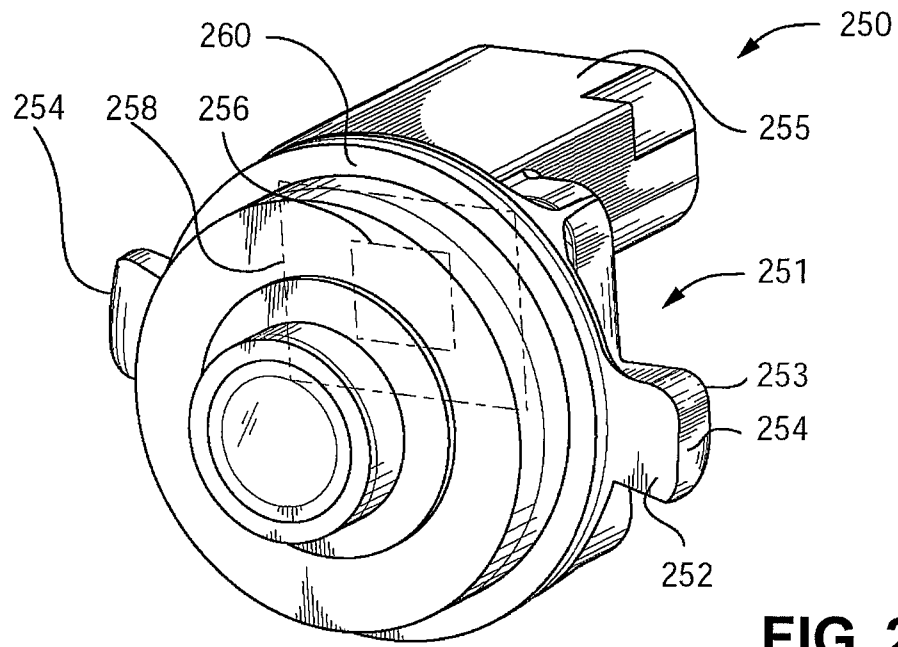


FIG. 19

14/20



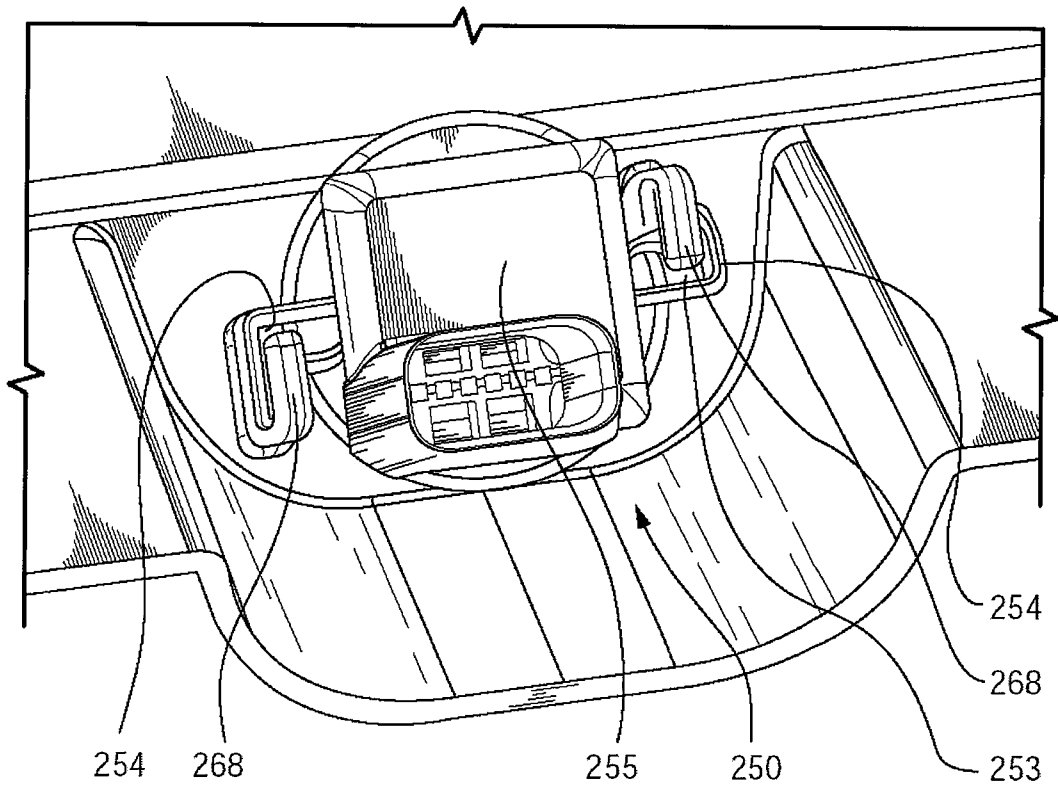


FIG. 22

16/20

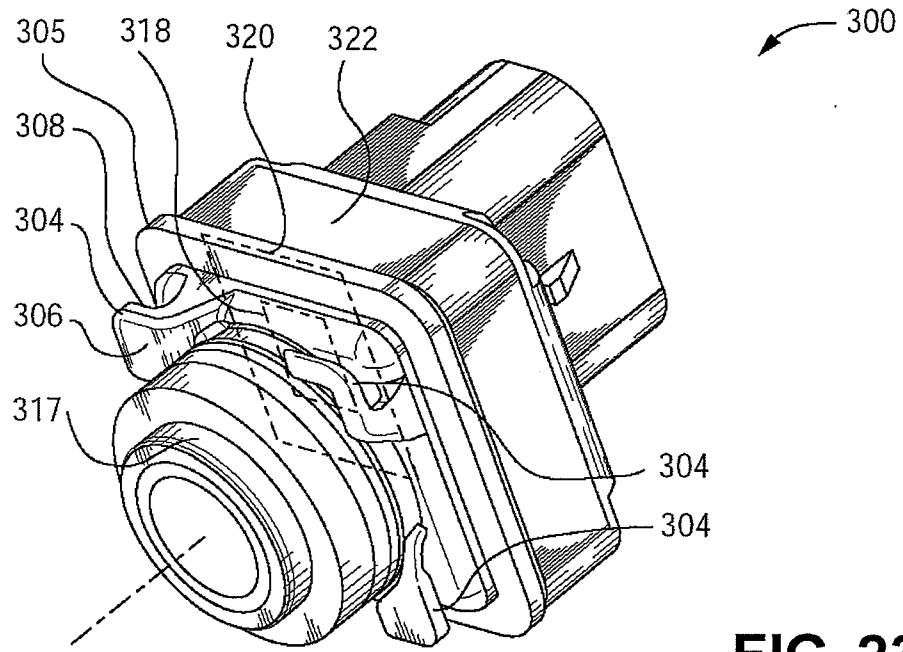


FIG. 23

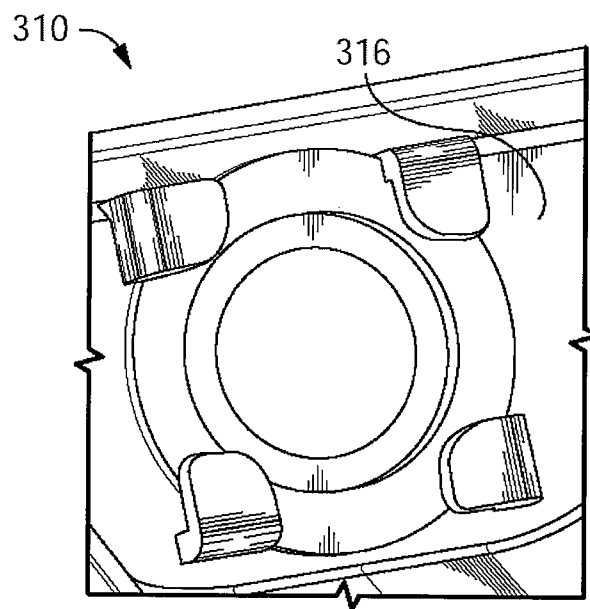


FIG. 24

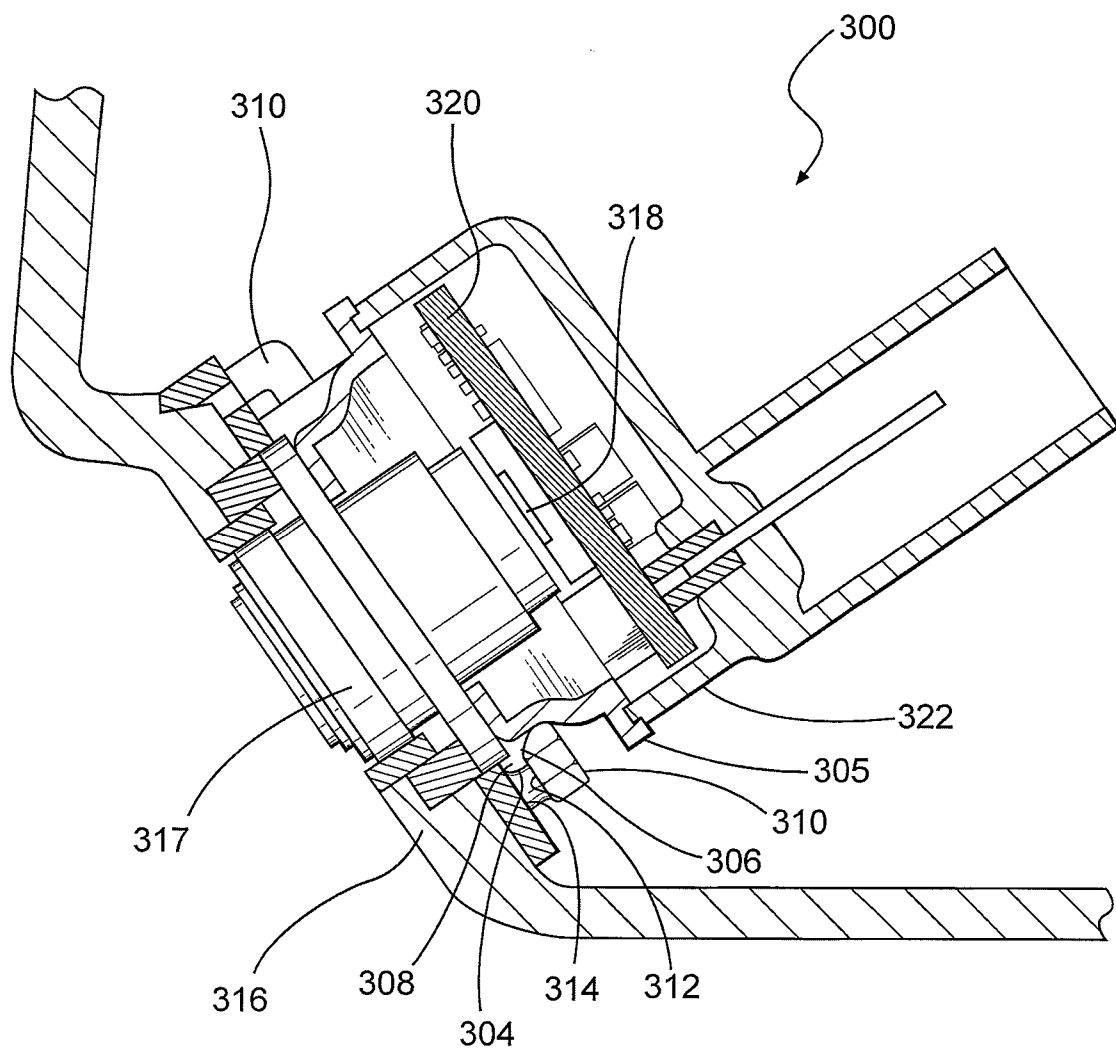


FIG. 24A

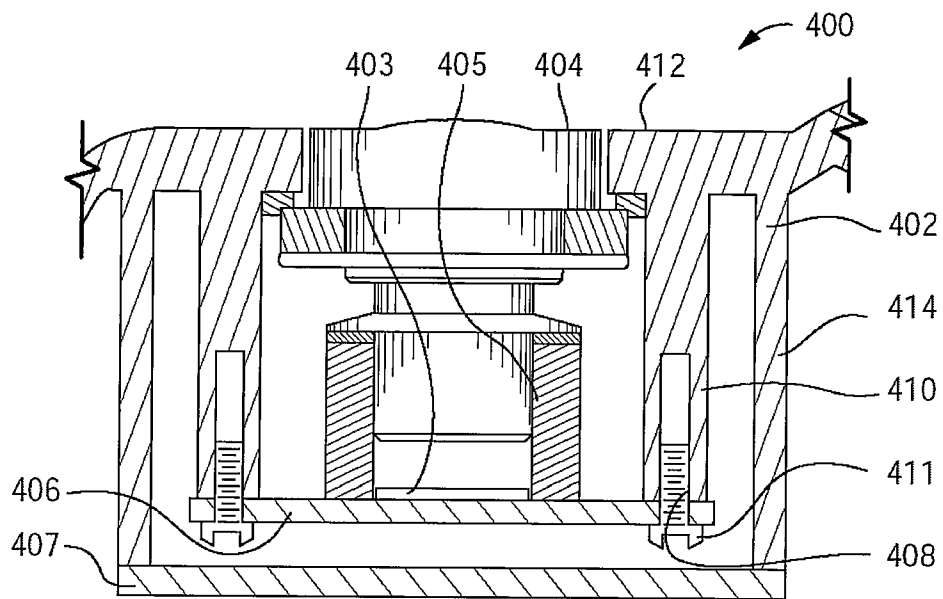


FIG. 25

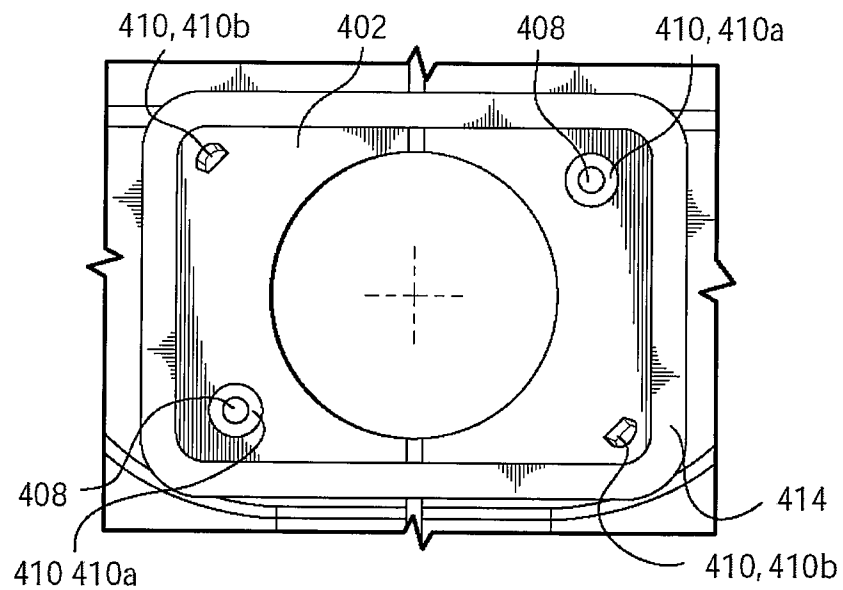


FIG. 26

19/19

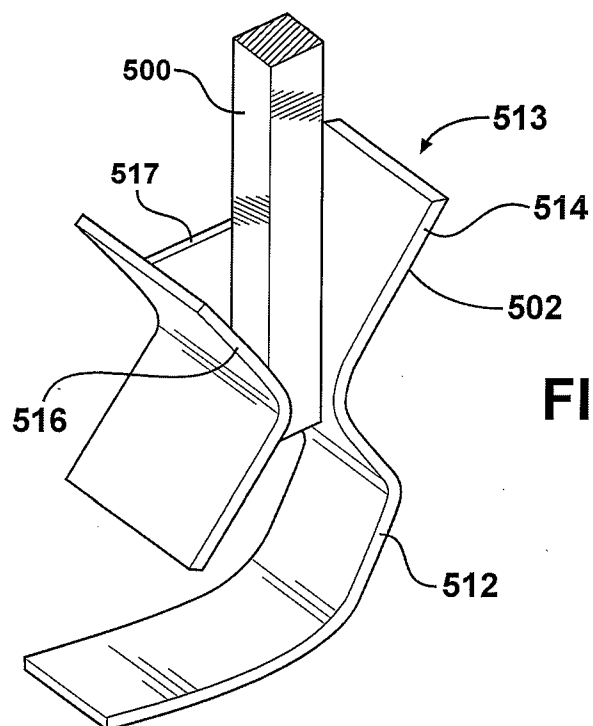


FIG. 27

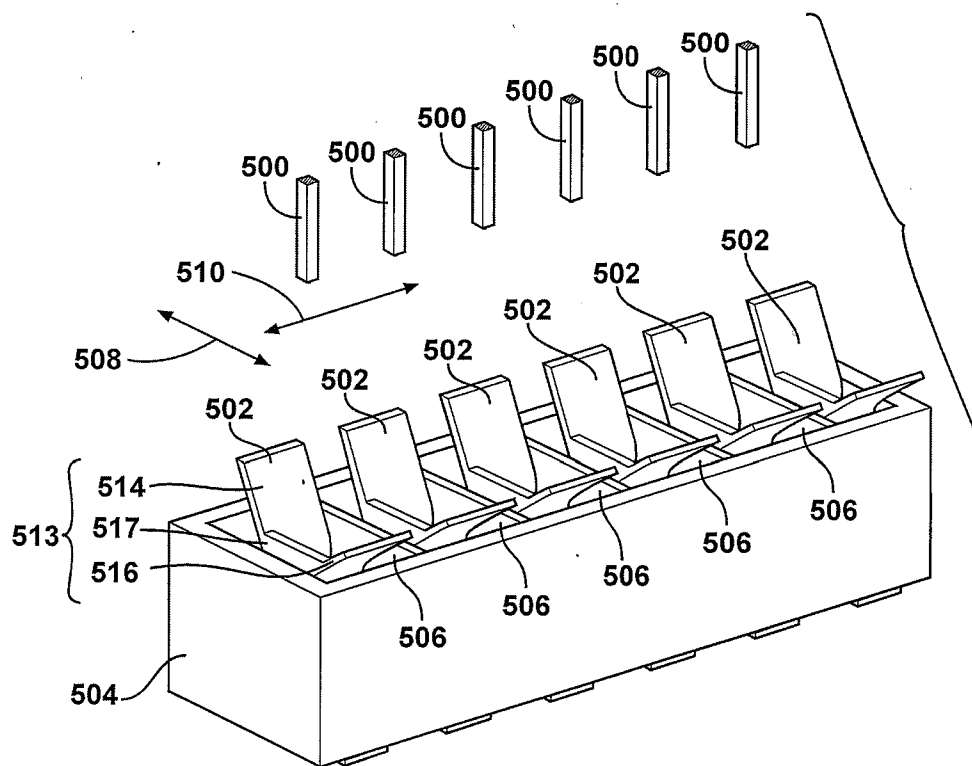


FIG. 28

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2010/023475

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H04N 5/225 (2010.01)

USPC - 348/373

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - H04N 5/225; H04N 9/04 (2010.01)

USPC - 348/373, 207.99, E5.024, E5.025, E5.026

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)

USPTO EAST System (US, USPG-PUB, EPO, DERWENT)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2003/0198467 A1 (CONSTABLE) 23 October 2003 (23.10.2003) entire document	1-20
Y	WO 2007/053404 A2 (GEBAUER et al) 10 May 2007 (10.05.2007) entire document	1-20
A	US 2006/0171704 A1 (BINGLE et al) 03 August 2006 (03.08.2006) figures 3-17E; paragraphs [0070-0072]; [0077-0082, 0090]	1-20
A	US 2009/0003811 A1 (BEREND et al) 01 January 2009 (01.01.2009) entire document	1-20

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


* 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

28 May 2010

Date of mailing of the international search report

10 JUN 2010

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2010/023475

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 extra 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 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.:
1-20

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.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2010/023475

Continuation of Box III.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-20, drawn to a camera and method for mounting on a vehicle comprising a rear housing member which has an alignment structure that aligns a rear electrical connector with respect to a front electrical connector, wherein the rear housing member and the front housing member are unaligned with each other.

Group II, claims 21-24, drawn to a camera for mounting on a vehicle comprising a front housing member coating of electrically conductive material.

Group III, claims 25-28, drawn to a camera for mounting on a vehicle comprising a biasing member which urges together a rear and front electrical connector wherein the rear housing member and the front housing member are aligned with each other.

Group IV, claims 29-37, drawn to a camera for mounting on a vehicle panel having a thickness, comprising a camera associated locking structure engageable with a vehicle panel associated locking structure on a vehicle panel, wherein the camera associated locking structure is rotatable between locked and unlocked positions.

Group V, claims 38-39, drawn to a combination of a camera and a vehicle panel, comprising a lens fixedly connected with respect to a circuit board, wherein the circuit board is mounted to the vehicle panel.

The inventions listed as Groups I, II, III, IV and V do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: an alignment structure that aligns a rear electrical connector with respect to a front electrical connector, wherein the rear housing member and the front housing member are unaligned with each other as claimed therein is not present in the invention of Groups II, III, IV or V. The special technical feature of the Group II invention: a front housing member coating of electrically conductive material as claimed therein is not present in the invention of Groups I, III, IV or V. The special technical feature of the Group III invention: a biasing member which urges together a rear and front electrical connector wherein the rear housing member and the front housing member are aligned with each other as claimed therein is not present in the invention of Groups I, II, IV or V. The special technical feature of the Group IV invention: a camera associated locking structure engageable with a vehicle panel associated locking structure on a vehicle panel, wherein the camera associated locking structure is rotatable between locked and unlocked positions as claimed therein is not present in the invention of Groups I, II, III or V. The special technical feature of the Group V invention: a combination of a camera and a vehicle panel, comprising a lens fixedly connected with respect to a circuit board, wherein the circuit board is mounted to the vehicle panel as claimed therein is not present in the invention of Groups I, II, III or IV.

Groups I, II, III, IV and V lack unity of invention because even though the inventions of these groups require the technical feature of mounting a camera within a vehicle, the camera having a housing comprising a front and rear housing, a circuit board, a connector, a lens, an imaging element, the circuit board mounted to the front housing member, this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of US 2006/0171704 A1 (BINGLE et al) 03 August 2006 (03.08.2006) figures 3-17E; paragraphs [0070-0072]; [0077-0082, 0090].

Groups I, II, and III lack unity of invention because even though the inventions of these groups require the technical feature of a vehicle camera having a front connector in a front housing and a rear connector in a rear housing, this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of WO 2007/053404 A2 (GEBAUER et al) 10 May 2007 (10.05.2007) page 7, paragraph [0037]; figures 4-11.

Since none of the special technical features of the Group I, II, III, IV or V inventions are found in more than one of the inventions, unity of invention is lacking.