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(71) Applicant: **Smart Connector AS**
4905 Tvedestrand (NO)

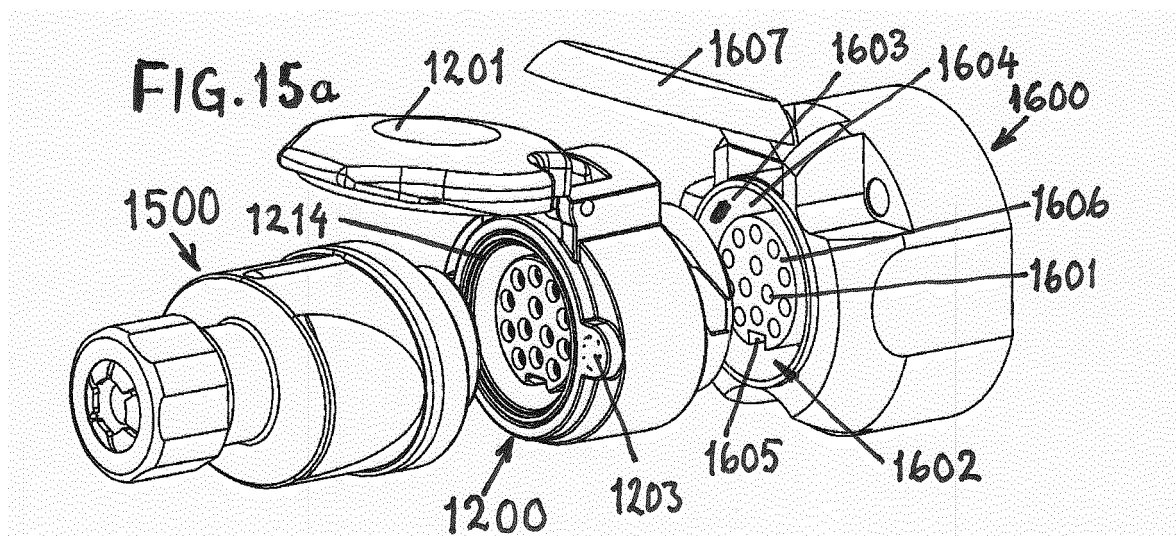
(72) Inventors:
• **ANDERSEN, Jan**
4827 Frolands (NO)
• **MARTINSEN, Gunnar Johnny**
4848 Arendal (NO)

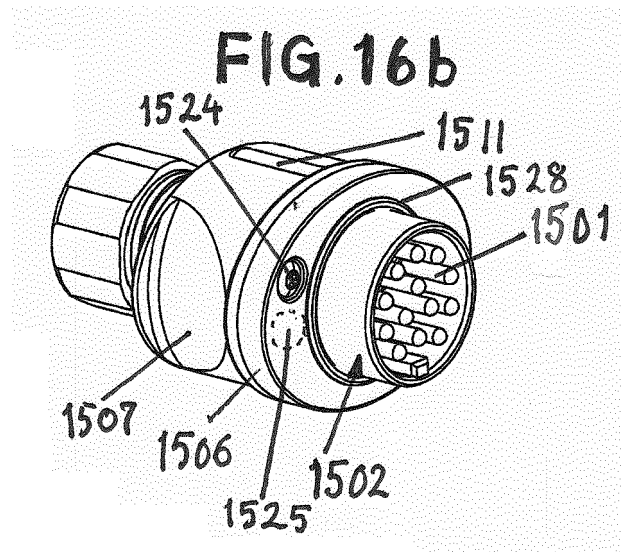
(74) Representative: **Protector IP AS**
Pilestredet 33
0166 Oslo (NO)

(54) **AN ELECTRICAL CONNECTOR SYSTEM**

(57) An electrical connector system comprising a first connector (100; 200; 300; 400; 1200; 1400) to be associated with a vehicle and a second connector (500; 1500; 1900) to be associated with a trailer for the vehicle. The first connector has an opening with an assembly of electrical sockets (102; 303; 1212; 1409), and a pair of magnets (105; 307; 1203; 1403) are located adjacent the opening (104; 306). The second connector (500; 1500; 1900) has an assembly of electrical pins (501; 1501;

1913) to engage the electrical sockets (102; 303; 1212; 1409). A pair of magnet anchors (504; 1525; 1908) is located on the second connector (500; 1500; 1900) at end regions of a largest cross-sectional dimension thereof to releasably engage the pair of magnets (105; 307; 1203; 1403) on the first connector upon joining of the first and second connectors and interaction of the pins and sockets.





Description

Background of the invention

[0001] The present invention relates to an electrical connector system, the system comprising: a first connector to be associated with a powered vehicle and second connector to be associated with a trailer attachable to the vehicle, the first connector at a female region thereof exhibiting an assembly of a plurality of sockets configured to receive and make electric contact with an assembly of a plurality of pins from a male region of the second connector, a circular space surrounding the assembly of sockets, a sleeve of circular cross-section surrounding the assembly of pins, and the sleeve configured to fit into said space.

Prior art

[0002] Commonly known connector systems, in particular for use by vehicles of weight class less than 3.500 kg are either of: the old type having 7 male/female connections therein or the newer, prior art type which is currently the most used one having 13 male/female connection.

[0003] Joining the connectors of the old type is frequently a time consuming and indeed irritating exercise, and once joining has taken place, the only way of locking the two connectors together is by using the spring-loaded lid on the first or female connector to hook onto a bead or wing on the second or male connector. Over time, such locking is not always perfect due to dirt or ice jamming the lid or the spring becoming defective by using excessive force when opening the lid.

[0004] Joining the first and second connectors of the newer, prior art type have a different challenge, as the interlocking is made using a bayonet-type of twist-locking and in addition the locking lid and bead or wing principle of the old type. Nevertheless, finding correct alignment for joining may be a challenging exercise, as the vehicle attached connector frequently is partly out of vision unless the user bends down towards the ground or road. More importantly, dirt or ice accumulating in the bayonet coupling on the second connector (male connector) may cause bayonet operation to be incomplete, to disengage, to jam or in a worst case causing the short pin to engage the track bayonet failing to engage properly. Still a further challenge is that using the newer, prior art type at frosty winter time and trying to disconnect the two connectors may prove difficult due to the bayonet coupling being blocked or jammed by ice, and removal by force causing the bayonet coupling to be damaged or destroyed.

[0005] Another well known connector system, in particular for use on heavy duty vehicles, such as a truck for towing very large trailers, is known in U.S.A. as «ez-connector trailer plug technology» made by ez-connector, inc. The system, normally offering 4 - 9 paths of electrical connection, is based on spring-loaded pins making

contact with and abutting contact faces. In a practical version, the pins are pointed or flat at the abutting end thereof. This implies that the contact force provided by the pin spring must be substantial, and the contact regions of the pin and the contact face must be of a material which is non-corrosive, such as e.g. stainless-steel, or the regions being gold-plated, in particular with the use of pointed pins. Further, the ez-connector requires for a safe electrical connection and powerful interlocking the use of heavy duty, substantially ring shaped magnets which are expensive and which also require full adult manual control prior to very abrupt and powerful magnetic interlocking, and substantial adult manual power to enable the first and second connectors to become disengaged. The technology is inter alia described in US 6,478,619 - B1.

[0006] A further magnetic coupled connector system is known from EP 2,760,089 using pointed contact pins to abut contact faces with a force provided by strong magnets. Other prior art aspects are known from WO 9326062, EP 1,148,600 and US 5,816,825, e.g. adapters for use if only parts of a novel system are present along with cooperating prior art parts.

Objects of the invention

[0007] The invention has as objects to provide a novel connector system that enables a joining operation with ease of alignment, a sufficient interlocking, and satisfactory, simple electrical connections. Further, the objects of the invention also provide for a first type of adapter operable with a female connector of the old or newer, prior art type in order to make use of benefits offered by the invention, without the need to replace a prior art female connector on the vehicle, and/or a second type of adapter operable with a female connector of the present novel type, without the need to replace the connector plug on the vehicle.

[0008] The invention also intends to offer a system which has substantial technical and operational advantages over the prior art, while providing a cost effective and technical simple solution.

Summary of the invention

[0009] In the present context, the term «first connector» is typically used for novel connector to be located on the vehicle or car side of connection, whereas the term «second connector» is typically used for a novel connector to be located on the trailer side of the connection.

[0010] According to a features of the invention, the first connector at its female region has an opening in front of said assembly of sockets, a pair of magnets being located laterally of said circular space adjacent a wall of the space opening, and a pair of magnet anchors is located laterally of the sleeve on the second connector to releasably engage the pair of magnets upon joining of the male and

female regions and interaction of the pins and sockets, as defined in attached claim 1.

[0011] Further embodiments of the invention appear from the attached sub-claims.

[0012] The features and embodiments of the invention are disclosed in more detail in the detailed description with reference to the attached drawings showing non-limiting examples and presentations of the invention.

[0013] It will be appreciated that design appearances of the various parts of the system may be adjusted without departing from the scope of the invention. Figs. 15a through 26 exhibit modifications of some of the embodiments in Figs. 1a through 5g, and Figs. 9a through 14.

Brief description of the drawings

[0014]

Figs. 1a - 1d illustrate in perspective views the novel system for use to connect with a female connector of a newer, prior art type located on a vehicle, Figs. 1a and 1b showing the playing items in exploded view and Figs. 1c and 1d showing the playing items when interconnected.

Figs. 2a - 2d refer to the illustrations on Figs. 1a and 1b, Fig. 2a showing a side view, Fig. 2b showing a horizontal cross-section through the playing items, Fig. 2c showing a view from above, and Fig. 2d showing a vertical cross-section through the playing items.

Figs. 2e - 2h refer to the illustrations on Figs. 1c and 1d, Fig. 2e showing a side view, Fig. 2f showing a horizontal cross-section through the playing items, Fig. 2g showing a view from above, and Fig. 2h showing a vertical cross-section through the playing items.

Figs. 3a - 3e illustrate the second or male connector of the invention, Fig. 3a showing a front perspective view from one side, Fig. 3b showing a front perspective view from the other side, Fig. 3c showing a side view from said one side, Fig. 3d showing a view from above, and Fig. 3e showing a front view.

Figs. 4a - 4e illustrate the first connector of the invention when configured as an adapter, Fig. 4a showing a front perspective view from one side, Fig. 4b showing a front perspective view from the other side, Fig. 4c showing a side view from said other side, Fig. 4d showing a view from above, and Fig. 4e showing a front view.

Figs. 5a and 5b illustrate the first connector of the invention when configured as a female connector to be installed on a vehicle, Fig. 5c illustrates the second connector of the invention to be joined with the

first connector of Figs. 5a and 5b, and Fig. 5d, 5f and 5g illustrate the first and second connectors as shown on Figs. 5a, 5b and 5c when interconnected, Fig. 5f showing a horizontal cross-section and Fig. 5g showing a vertical cross-section.

Fig. 6a is a perspective view of a plug to seal the first connector Figs. 5a and 5b when not in use, Fig. 6b illustrates how a second connector, when not in use, can be located in a docking device, and Fig. 6c illustrates the plug in the docking device when the first and second connectors are interconnected and the plug is idle.

Figs. 7a - 7e further illustrate the plug of Fig. 6a in rear perspective view, front perspective view, front view, side view and view from above, respectively.

Fig. 8a shows the plug of Fig. 6a and Figs. 7a - 7e and the first connector configured as an adapter as inter alia shown on Figs. 4a - 4e, and Fig. 8b shows the plug sealing the female end of the adapter when the adapter is not connected to the second connector.

Figs. 9a - 9f illustrate the first connector in adapter configuration with a sealing lid used when the adapter is not connected to the second connector, Fig. 9a showing a perspective view of the second connector with lid in open position, Fig. 9b showing a perspective view of the second connector with lid in open position and seen from a different viewing angle, Fig. 9c showing a perspective view of the second connector with lid in closing position, Fig. 9d showing an end view with lid in closing position, Fig. 9e showing a side view with lid in closing position, and Fig. 9f showing an male end view from axially opposite position of the view in Fig. 9d.

Fig. 10 is an exploded perspective view from one end of the second connector.

Fig. 11 is an exploded perspective view from one end of the first connector in its adapter configuration.

Fig. 12a is an exploded perspective view from one end of the first connector in its configuration of a female connector for permanent installation on a vehicle and with a sealing lid for sealing a female inlet on the connector, Figs. 12b and 12c are front and rear perspective views of the first connector with lid in closed state, Fig. 12d is a vertical cross-section through the first connector, and Fig. 12e is a front view of the first connector with the lid in closed state.

Fig. 13 illustrates the first connector shown on Figs. 12a - 12e interconnected with second connector.

Fig. 14 illustrates how the first connector shown on inter alia Figs. 5a - 5c and 12a - 12d can be modified to provide improved guidance when connecting the second connector onto the first connector.

Figs. 15a, 15b and 15c illustrate in exploded, perspective view, in side view, and in horizontal cross-sectional view, respectively, as seen from left to right a novel male-type second connector to be attached to a trailer, a novel first connector configured as a first type of adapter, and a vehicle associated socket of the newer, prior art type, and Figs. 15d and 15e are front and rear perspective views from above of the novel first connector being an adapter.

Figs. 16a, 16b and 16c illustrate in rear and front perspective views, and in front end view, respectively, the novel male second connector.

Figs. 17 and 18 exhibit cross-sectional views XVII-XVII and XVIII-XVIII, respectively on Fig. 16c.

Figs. 19a, 19b, 19c, 19d and 19e illustrate in rear perspective view from above, front perspective view from below, front perspective view from above, rear view, and front view, respectively, the novel first connector configured as vehicle associated socket connector, all figures except Fig. 19c showing that first connector with its movable lid in opened posture.

Figs. 20 and 21 exhibit cross-sectional views XX-XX and XXI-XXI on Fig. 19e.

Figs. 22a, 22b and 22c illustrate in rear perspective view, in front perspective view and front end view, respectively, a novel second connector configured as a second type of adapter.

Figs. 23 and 24 exhibit cross-sections XXIII-XXIII and XXIV-XXIV, respectively, as shown on Fig. 22c.

Fig. 25 is a perspective view from above of an assembly of the novel male type of second connector and the novel type of first connector being the first type adapter.

Fig. 26 is a perspective view from above, as seen from left to right, an interconnected assembly of a prior art trailer male connector having bayonet coupling configuration, the second connector being a second type of adapter, the first connector being the first type of adapter and a prior art vehicle associated female connector.

Detailed description

[0015] The invention provides an electrical connector system comprising a first connector 100; 200; 300; 400

to be associated with a powered vehicle (not shown) and second connector 500 to be associated with a trailer (not shown) attachable to the vehicle.

[0016] In one aspect, the first connector is an adapter 100; 200 to enable connection between the second connector 500 and a prior art third, female connector 600 located on a vehicle.

[0017] In another aspect, the first connector 300; 400 is a female connector to be located on a vehicle, the second connector 500 to be directly connectable to the first connector 300; 400.

[0018] As the adapter 100; 200 aspect of the invention may be of a particular interest to vehicle owners or suppliers currently using the prior art third connector 600 on vehicles owned or sold, this aspect of the invention will as a start be explained with reference to Figs. 1a - 4e.

[0019] Differences between the adapter 200 and the adapter 100 will be explained with reference to Figs. 9a - 9f. Further, differences between the first connector 400 and the first connector 300 will be explained with reference to Figs. 12a - 12c. Accordingly, it will be appreciated that the first connector 200 will have the same features as explained for the first connector 100, except for some minor differences to be pointed out later. Thus, the first connector 100 will be explained in more detail than for the first connector 200. Further, it will be appreciated that the first connector 400 will have the same features as explained for the first connector 300, except for the differences to be pointed out later. Thus, the first connector 300 will be explained in more detail than for the first connector 400.

[0020] The first connector 100, configured as an adapter, exhibits at a female region 101 thereof an assembly 102 of a plurality of sockets configured to receive and make electrical contact with an assembly 501 of a plurality of pins from a male region 502 of the second connector 500. A circular space 103 surrounds the assembly 102 of sockets, and a sleeve 503 of circular cross-section surrounds the assembly 501 of pins. The sleeve 503 is configured to fit into said space 103 when the second connector 500 is caused to be interconnected or joined with the female region 101 of the first connector 100.

[0021] It is noted from e.g Fig. 2b that the first connector 100 at its female region 101 has an opening 104 in front of said assembly 102 of sockets. A pair of magnets 105 are located laterally of said space 103 and adjacent a wall 106 of the opening 104. The magnets could be strong neodymium magnets or other types suitable for the intents and purposes of the invention. Further, a pair of magnet anchors 504 is located laterally of the sleeve 503 on the second connector 500 to releasably engage the pair of magnets 105 upon joining of the male 502 and female 101 regions and interaction of assemblies of pins 501 and sockets 102. The magnet anchors 504 located on the second connector 500 are each suitably constituted by a head on a screw 505 for joining body parts 506, 507 of second connector. In order to properly interact with the magnets 105, the screws 505 should be of

suitable anchor material, e.g. a ferromagnetic material, and the head surface should flat and suitably have surface matching a flat contact surface on the magnets **105**. If necessary to prevent corrosion or rust on the screw head, a thin surface coating may be applied thereon.

[0022] As shown e.g. on Figs. **1a**, **1b**, **2b**, **2d**, **3e** and **4e**, a rear region of the sleeve **503** is terminated by a surrounding collar **508**. The collar **508** has a circumference **508'** of substantially elliptical or oval configuration. Further, the anchors **504** are located at end regions of a greater axis of the collar configuration **508**. More specifically, the anchors **504** are located adjacent to cut-outs **509** in the collar **508**, and the cut-outs are configured to at least partly guide the magnets **105** into contact with the anchors **504** upon joining of the male region and female regions **502**; **101**. The wall **106** of the female opening **104** of the first connector **100** has an inner wall face **106'** exhibiting an elliptical or oval cross-sectional configuration and dimensioned to fit around the collar **508** of the second connector **500** upon joining of the male and female regions **502**; **101** of the second and first connectors **500**; **100**, respectively.

[0023] As shown on Figs. **3e** and **4e** the sleeve **503** has on its inner wall a bead **510** configured to engage a recess **107** on a body **102'** housing the assembly **102** of sockets. Further, alignment joining marks **108**; **511** are located on the outside of both the first and second connectors **100**; **500**, respectively. The marks **108**; **511** may serve finger-touch guides as an additional alignment aid in particular when performing the joining in the dark. However, the elliptical or oval cross-sectional matching configurations of the circumference **508'** of the collar and the inner wall face **106'** will make the joining operation of the first and second connectors **100**; **500** more precise and targeted, without any need for time-consuming twisting and turning of a connector plug into a connector socket on a vehicle, as experienced with prior art connectors having circular cross-sections. The recess **107** and the bead **510** will further assist in accurate homing of the assembly **501** of pins into the assembly **102** of sockets. Furthermore, the elliptical or oval configurations enable at end regions of the larger axis thereof on the connector **100**, i.e. adjacent the inner wall face **106'**, to suitably locate the magnets **105** which can be housed in magnet sockets **105'**. This approach enables to obtain a compact structure of both the first and second connectors **100**; **500**, and with both exhibiting a characteristic elliptical or oval cross-section over at least 1/3 of their axial length.

[0024] Another end of the first connector **100** axially opposite its female region **102** has a male region **109** which is equipped with an equal plurality of pins **110**. The male region **109** of the first connector **100** is configured with its pins **110** to engage sockets **601** of a female region **602** on the third and prior art connector **600** upon joining of the first and third connectors **100**; **600**. The sockets **601** are to be electrically connected to power supplies on the vehicle (not shown).

[0025] Another end of the second connector **500** axially

opposite its male region **502** serves as an outlet for wired electrical connection from the pins of the assembly **501** to electrical equipment on a trailer (not shown). Thus, the first connector **100** serves as an adapter between the third (prior art) and the second connectors **600**; **500**.

[0026] In order to effectively connect the first connector **100** into engagement with the third connector **600**, there is provided in a conventional way on the prior art connector **600** a set of bayonet-coupling like engagement studs **603** on the inside of a wall **604** of the third connector **600**. The male region **109** of the first connector **100** has a sleeve **111** surrounding the pins, an outer wall of the sleeve **111** having a set of bayonet-coupling-like grooves **112** engagable with the studs **603** to mechanically and releasably lock the first and third connectors **100**; **600** to each other through mutual twist action. Normally, three studs **603**, separated by **120°**, are used, and correspondingly three grooves **112** are provided, the grooves **112** having inlets **112'** for the respective studs **603** (see Fig. **9f**).

[0027] A stud **113** on an inner wall of the sleeve **112** is configured to fit into a conventional groove **605** on a body **606** supporting the sockets **601**.

[0028] It is noted the the first connector **100** has radial wing member **114**. When the first connector **100** with its male region **109** engages the female region **602** of the third connector **600**, a tiltable lid **607** will lie over a top of the wing member **114**, thereby preventing the sleeve **112** accidentally to rotate relative to the the third connector **600** and its studs **604**.

[0029] As shown on Figs. **8a** and **8b** the opening **104** at the female region **101** of the first connector **100** is configured to receive a sealing plug **700** in order to seal the opening **104** when the first connector **100**, being attached to third connector **600**, is idle, i.e. with its female region **101** not in engagement with the male region **502** of the second connector **500**. A more detailed illustration of the plug is shown on Fig. **7a - 7e**. The plug **700** has a main body **701** provided at one axial end with a handgrip or knob **602**. The main body **701**, as clearly seen from Fig. **7c**, has an elliptical or oval circumference. Further, the plug **700** has a portion **707** having elliptical or oval circumference and adapted to match a cross-section of the opening **104**; **306** on the first connector **100**; **300**. In order to provide proper sealing against intrusion of dust or humidity into the closed cavity created by the opening **104** and the plug **700**, the plug **700** is suitably provided with one or two gaskets, suitably O-rings **703**. Further, the plug **700** has a male end region **704** also with substantially elliptical or oval circumferential configuration, and with a pair of indentations **705** or recesses located at ends of a larger axis of said configuration. A pair of magnet anchors **706** are located at said indentations or recesses **705**, the pair of magnet anchors **706** to releasably engage the pair of magnets **105** on the first connector **100**; **300**. Thereby, the plug **700** is properly held in installed position on the first connector **100** even upon driving the vehicle on a bumpy road, and is only releas-

able from the first connector **100** by using a specific pulling hand force on the handgrip **702**. The magnet anchors **706** are suitably of a same type as the magnet anchors **504**, the screw part thereof attaching the the male end region **704** to the main body **701** of the plug **700**.

[0030] If the first connector **100** is modified as shown on Figs. **9a - 9f** to yield a first connector **200** also to serve as an adapter, it is swiftly noted that all structural details are the same as for the first connector **100**, the only difference being that the connector has a tiltable lid **201** which is hinge connected to the top of the wall **106** via bracket **202**. The lid **201** has an elliptical or oval configuration, as seen from Fig. **9d**. The bracket **202** forming a hinge connection with the lid **201** may be provided with a spring (not shown) or a dead centre mechanism (not shown) to enable the lid **201**, when closing the opening **104**, to firmly close against the end edge **106"** of the wall **106** with its rear edge portion **201'**. The rear edge portion **201'** may have associated therewith a gasket (not shown), e.g. of an O-ring type or of a softer plastics material than the remainder of the lid **201**, i.e. if the lid being of a two-component plastics material. As an alternative, the end edge portion **201'** may be a track or a recess into which e.g. 1 - 2 mm of an axially directed part of the end edge **106"** of the wall **106** may come to rest upon closure of the lid **201**.

[0031] Some further structural details of the first connector **100; 200** in the «adapter» version will now be described with further reference to Fig. **11**.

[0032] It is noted that that in addition to the sockets **102** and the pins **110**, the female region **101** has at an end, being axially opposite the front of the opening **104**, a cylindrical part **115** which is to engage with a sleeve **116** being configured to be substantially inside a section **119** of the first connector **100; 200** which also embodies the male region **109** of the connector. The sockets **102** will lie radially inside the part **115**, and the pins **110** each being integral with the sockets **102** will lie radially inside a part **116'** of the sleeve **116** to form part of the male region **109**. Sealing O-rings **117** and **118** are also provided.

[0033] Also, some further structural details of the second connector **500** will now be explained with further reference to Fig. **10**, as well as Fig. **5f** and **5g**.

[0034] As mentioned above, the body parts **506** and **507** are interconnected by means of the screws **505** which also with their heads **504** may serve as magnet anchors. Gaskets **512, 513**, such as e.g. O-rings, are suitably provided, one gasket **512** in a groove **514** on the body part **506**, and the other gasket **513** at a joint between the body parts **506** and **507**, as shown on Figs. **1a, 1b, 2a, 3q, and 10**. Both gaskets will serve to provide a satisfactory seal against the inside wall **106'** of the first connector **100; 200** when the male region **502** enters the opening **104** of the female region **101** of the first connector **100; 200**.

[0035] A multiwire cable (not shown) is insertable into the second connector **500** via a cable inlet opening **515**

of an end cap **516** which has internal threads **516'** to engage threads **517** on the body part **507**. Cable guide clamps **518** can be provided. Further, to further prevent the cable from accidentally being pulled out from the second connector **500**, but in particular to prevent moist into the interior **521** of the connector along the cable, a cable seal clamp member **519** is provided, suitably of a resilient material such as e.g. rubber. Upon turning the cap **516** relative to the body part **507** through interaction of the threads **516', 517**, the clamp member **519** will be compressed and change its shape to cause clamping of the cable (not shown) and provide a seal against an entry wall **520** bordering the interior **521** of the body part **507**. As indicated on Fig. **10** to the left, a rear, sleeved end **522** of each pin **501** is connectable to a wire (not shown) of a cable (not shown) fitting into that end and attachable by a screw **523** in a manner known per se, although other ways of attaching may be conceivable.

[0036] Another embodiment of the first connector is the one denoted by reference numeral **300; 400** on the drawings, the first connector **300; 400** in this version not being an adapter like the one denoted by reference numerals **100; 200**. In fact, the first connector **300; 400** is configured as a novel female type connector to be installed on a vehicle (not shown) and to be interconnected with the novel male type connector **500** described above. The connector **300** is shown on Figs. **5a - 5c** and further shown on Figs. **5e - 5g** interconnected with the second connector **500** as inter alia shown on Figs. **3a - 3e, 5d and 6b**. The connector **400**, being only a modest modification of the connector **300**, is shown in more detail on Figs. **12a - 12e**. With reference to Figs. **5a - 5c**, the connector **300** has a female region **301** connectable to a rear attachment region **302**. The connector **300** has an assembly of electrical sockets **303** which face openings **304** in a rear section **305** of the female region **301**. The female region **301** has an opening **306** of elliptical or oval contour, configured to receive the male region **502** and its collar **508**, as well as the magnet anchors **504**, the magnet anchors **504** upon full engagement of the connectors **500** and **300** engaging a pair of magnets **307** located in magnet sockets **307'** adjacent an inside **308'** of the wall **308** defining the opening **306**. The sockets **303** have a rear sleeved end **303'** into which a respective wire (not shown) of a supply cable (not shown) can be entered and firmly clamped to the end **303'** by means of a screw **309**. Other ways of securing the respective wires may be a consideration. A joining or alignment mark **310** is located a top of the wall **308** to align with mark **511**. The groove **311** is present to receive the bead **510**. A circular space **314** surrounding the assembly of the sockets **303** is configured to accommodate the sleeve **503** on the second connector **500**. A plurality of holes **312** for attachment bolts (not shown) to attach the connector **300** to the vehicle are provided. A groove **313** provides entry to the hole **312**.

[0037] When there is no second connector **500** connected to the first connector **300**, the opening **306** may be closed by use of the plug **700** in a similar way as

explained for the first connector **100**, i.e. with the magnet anchors **706** engaging the magnets **307** in order to keep the plug **700** in position on the connector, even when driving the vehicle (not shown) over a bumpy road face.

[0038] Fig. **6b** shows a docking station **800** with a wall **801** of elliptical or oval cross-section and a pair of magnets **802** at ends of the longer axis of the cross-section. The station **800** can be bolted onto a trailer (not shown) via a bolt hole **801**. When the connector **500** is not connected to the first connector **100**; **200** (the adapter); **300**; **400** (on the vehicle), it can and should be placed for safe-keeping in the docking station **800**, and with its magnet anchors **504** to engage the docking station magnets **802**.

[0039] Alternatively, if the connectors **500** and **300** are interconnected, then the plug **700** should be placed for safe-keeping in the docking station **800**, as shown on Fig. **6c**, the anchors **706** in this case engaging the magnets **802**.

[0040] The major difference between the connectors **400** and **300** is the provision of a rotary lid **401** having elliptical or oval circumference as more clearly seen on Fig. **12e**. The lid **401** is attached to the top of the wall **308** via a bracket **402**. A hinge mechanism between the lid **401** and the bracket **402** may be spring loaded (not shown) or have a dead centre function (not shown) in order to make certain that the lid **401** in closed state firmly abuts against the front edge of the wall **308** to prevent intrusion of dust or moist into the opening **306** and the interior of the connector **400**. The lid **401** may on its rear side facing the opening **306** be provided with a gasket (not shown), e.g. of O-ring type, or a plastics material softer than that of the lid and integral with the lid **401**.

[0041] In the described embodiments of the connectors **100** - **600** it is noted that the number of pins and sockets to be interconnected is 13, which is currently the most used standard in Europe. However, it will be appreciated that such a number should not be construed as a limitation of the scope of the invention, and that the number could be lower or higher.

[0042] In the event that the novel connector **500** is to be used with a prior art female connector of the old type having no bayonet coupling, but merely a plug-in and with lid-locking, the male end of the adapter type **100**; **200** of connector could be modified to fit into the prior art female connector, however the adapter in this case having separate sockets **102** which are not integral with the reduced number (usually 7) of pins on the male region, but which are electrically connect as required to provide a 7-to-13 pins adapter. The old 7 pin version sometimes has in the female connector a mixture of sockets and a few pins. An alternative to provide a novel 7-13 pins adapter would be to use a prior art 7-13 pins adapter in interaction with the novel 13-13 pins adapter.

[0043] In order to clearly show and remind a vehicle user that the connector **500** is connected to the adapter **100**; **200** or to the first or female connector **300**; **400**, it could be provided with a distinctive signalling colour, e.g. yellow and/or red, or it could exhibit fluorescence. Simi-

larly, the plug **700** and/or the docking station **800** could be provided with a distinctive signalling colour, e.g. yellow and/or red, or exhibit fluorescent properties, to serve as a proper placement reminder when fitted onto the adapter **100** or the connector **300**. Further, if the connector **500** or the plug **700** is not in operative use, the distinctive colour or fluorescence will be a reminder to place it in the docking station **800**.

[0044] It is well known that it is generally difficult to position and docket the trailer connected second connector or male plug **500** into the first connector or female connector **300**; **400** on the vehicle when it is pitch dark outside, or the first connector is at least partly under the rearmost part of the vehicle and difficult to see without kneeling down with the head close to the ground. In addition, there is the risk of having clothes soiled. In order in the darkness to provide an aid for a vehicle user worrying, from experience, about the operation of finding the location for joining the first and second connectors **300**; **400** and **500**, the first connector **300**; **400** is provided with a LED **315** which directs light through a passage **316** towards the female opening **306** and the sockets **303**. Thereby, the vehicle user will more clearly see where to enter the second connector **500** into the first connector **300**; **400**. The LED **315** may e.g. receive power from terminals linked to the red rear lights on the vehicle or the vehicle numberplate lights, although other power connections could be used. The LED-light may have any suitable colour, and power is suitably delivered to the LED via a voltage drop resistor if appropriate.

[0045] If the first connector is the adapter **100**; **200**, it will be appreciated that the adapter could be modified to include a LED-light receiving power from a pair of pins making contact with sockets in an old-type third connector **600**.

[0046] Further, if the first connector **300**; **400** is provided with the lid **401**, the lid could be made from a translucent or transparent material, in order to see the location of the first connector **400** when light from the LED **315** passes through the lid **401**. Similarly, if the first connector **300** is to be closed by the sealing plug **700** when not in use, that plug **700** could at least partly be made from a transparent or translucent material in order to identify its location on the vehicle when at least some light from the LED **315** passes through.

[0047] In connection with the description of Figs. **15a** - **26** there is used four digits in each of the reference numerals, the last three digits thereof referring to corresponding reference numerals having same array of three digits as indicated on Figs. **1a** - **5g** and Figs. **9a** - **14**, and thus being related to the first and second connectors as regards their main functions, respectively, and structural details or parts on the connectors exhibiting same or similar functions, respectively.

[0048] It should be observed that any last three digits being **203** and above, **403** and above, **524** and above, **608** and above, respectively, have no matches to 3 digit reference numerals on Figs. **1a** - **5g** and **9a** - **14**.

[0049] Further, with reference to a novel second connector shown on Figs. 22a - 24 and 26 there is described how such a connector, serving as an adapter, is attachable to a prior art prior art trailer-connected male connector configured with a bayonet type of mechanical coupling, and said second connector not shown on Figs. 1a - 14.

[0050] The first connector 1200 differs from the first connectors 100; 200 in that the magnets 105 are not located inside an oval opening 104 adjacent inside 106' of an oval wall 106 of the opening 104. Instead, the magnets 1203 are located laterally of an opening 1204 and with mutually spacing exceeding the width of the opening 1204 at the mouth thereof, as clearly seen on Figs. 15c and 15d, where the magnets are located at a front region of the first connector 1200 having a housing 1207 of oval configuration and the magnets 1203 located at end region of the oval or elliptical configuration. The magnets 1203 are at their outwardly facing surface rust-protected by a thin wall 1205 of plastics at a forward end of a pocket 1206 of the housing 1207 storing the magnet 1203. The wall 1205 is integral with the material of the housing 1207.

[0051] At a rear end, the first connector 1200 is configured with a sleeve 1208 having bayonet type engagement grooves 1209. Electrical contact pins 1210 to engage an assembly of electrical sockets 1602 are provided, and a stud 1211 is configured to engage the groove 1605. Similarly, the front end of the first connector 1200 has an assembly of electrical sockets 1212 to engage electrical contact pins 1501 at the male region 1502 of the second connector 1500 exhibiting a sleeve 1503. Further, associated with the assembly of sockets 1212 is also present a groove 1213 to interact with a bead or stud 1510 on the second connector 1500.

[0052] In order to leave the lid 1201 firmly closed when the first connector 1200 is not in use, the lid is preferably spring-loaded. Further, suitably the mouth of the opening 1204 may be provided with a gasket 1214.

[0053] The second connector 1500 is illustrated on Figs. 16a, 16b and 16c in rear and front perspective views, and in front end view, respectively. Further, Figs. 17 and 18 exhibit cross-sectional views XVII-XVII and XVIII-XVIII, respectively, on Fig. 16c.

[0054] It will be noted that the second connector 1500 differs in some aspects from the second connector embodiment 500. When viewing Figs. 16b, 16c, 17 and 18, it is noted that screws 1524 joining front and rear body parts 1506 and 1507 are not given same multi-function as the screws 504. It will be recalled that in the embodiment shown on Figs. 3a - 3e, the screws 504 also served as magnet anchors for the magnets 105; 307. However, on Fig. 16c it is noted that the screws 1524 are located at an angle to longest axis of the oval or elliptical cross-section of the body part 1506. Instead, a pair of magnets 1525 are housed in pockets 1526 of the front body part 1506 and located at the end regions of the longest axis of the oval or elliptical cross-section of the body part 1506. The front surface of each magnet 1525 is rust-protected

by a thin wall 1527 of plastics at an end of the pocket and integral with a plastics material of the body part 1506.

[0055] It will be appreciated that replacing the screws 504 by magnets 1525 to serve as magnet anchors on the second connector may improve magnetic attraction and reduce risk of rust or corrosion on the anchor surfaces.

[0056] At the front of the male region 1502, surrounding its axially rearmost location, is present a gasket 1528, suitably of O-ring type.

[0057] Electric cable (not shown) can be entered through a cable inlet opening 1515, and the rear end of the body part 1507 has external threads 1517 which engage internal threads on an end cap 1516. Rotating the cap 1516 about the threads 1517 will clamp the cable to the body part 1507 in a conventional manner.

[0058] A modified embodiment of the first connector 400 is shown as the first connector 1400 on Figs. 19a, 19b, 19c, 19d and 19e which illustrate in rear perspective view from above, front perspective view from below, front perspective view from above, rear view, and front view, respectively, this novel first connector 1400 configured as vehicle or car associated socket connector, all figures of Fig. 19 except Fig. 19c showing that first connector with its movable lid 1401 in opened posture, and rotary attached to a bracket 1402 on the housing 1403 of the first connector 1400. Figs. 20 and 21 exhibit cross-sectional views XX-XX and XXI-XXI, respectively on Fig. 19e.

[0059] The first connector 1400 differs from the first connectors 300; 400 in that the magnets 307 are not located inside an oval opening 306 adjacent inside 308' of an oval wall 308 of the opening 306. Instead, magnets 1403 are located laterally of an opening 1404 and with mutually spacing exceeding the width of the opening 1404 at the mouth thereof, as clearly seen on Figs. 19e and 20, where the magnets are located at a front region of the first connector 1400 having a housing 1405 of semi-oval or semi-elliptical configuration at the front part 1406 thereof and the magnets 1403 located at a front end region of the semi-oval or semi-elliptical configuration at a region of greatest mutual distance thereat. The magnets 1403 are at their outwardly facing surface rust-protected by a thin wall 1407 of plastics at a forward end of a pocket 1408 of the housing 1405 storing the magnet 1403. The wall 1407 is integral with the plastics material of the housing 1405.

[0060] It is noted from studying the opening 1404 on Figs. 19b, 20 and 21 that it is shallow and continues into an annular space 1404' which surrounds an assembly of electrical sockets 1409 to receive an assembly of electrical pins from the second connector. A groove 1410 is provided, associated with the assembly of sockets 1409, to interact with a bead or stud on the second connector. Figs. 19a and 19d are rear views of the first connector 1400. There is shown 13 inlet holes 1411 for cable wires to enter through to be connected to wire terminals on each electrical socket in a conventional manner. There are provided holes 1412 for bolts in order to attach the

first connector **1400** to the vehicle or car in a conventional manner.

[0061] In order to leave the lid **1401** firmly closed when the first connector **1400** is not in use, the lid is preferably spring-loaded. Further, suitably the mouth of the opening **1404** may be provided with a gasket **1413**.

[0062] In a situation when the trailer is fitted with a prior art electrical plug connector **2000** (see Fig. **26**) configured for a bayonet type of mechanical coupling, and the owner of the trailer does not want to replace the connector, a second connector **1900** of a second adapter type is provided by the invention. The prior art connector **2000** is fitted with an engagement member **2001** to engage with and support the lid **1607** is in opened posture, i.e. when the connector **2000** is connected to the prior art socket connector **600**; **1600**, both exhibiting means for mechanical bayonet type of coupling.

[0063] Figs. **22a**, **22b** and **22c** illustrate in rear perspective view, in front perspective view and front end view, respectively, a novel second connector **1900** configured as a second type of adapter. Further, Figs. **23** and **24** exhibit cross-sections **XXIII-XXIII** and **XXIV-XXIV**, respectively, as shown on Fig. **22c**.

[0064] The second connector **1900** has a rear part **1901** and a front part **1902**. The rear part has a stud **1903** to engage with bayonet type coupling grooves (not shown) on the prior art trailer male connector **2000**. An assembly of electrical sockets **1904** is provided in opening **1905** which encircles the assembly of sockets. Associated with the body of the assembly of sockets is an engagement groove **1906** to engage a bead or stud (not shown) on the prior art trailer connector adjacent its assembly of electrical connection pins (not shown) thereon.

[0065] On Fig. **22c** it is noted that screws **1907** to join the two part **1901** and **1902** are located at an angle to longest axis of the oval or elliptical crosssection of the body part **1902**. A pair of magnets **1908** are housed in pockets **1909** of the front body part **1902** and located at the end regions of the longest axis of the oval or elliptical crosssection of the body part **1902**. The front surface of each magnet **1903** is rust-protected by a thin wall **1910** of plastics at an end of the pocket **1909** and integral with a plastics material of the body part **1902**. The front body part **1902** of the second connector **1900** has a male region **1911** with a sleeve **1912** surrounding an assembly of electrical contact pins **1913**. At an axially rearmost location of the sleeve **1912**, it is surrounded by a gasket **1914**. An alignment mark **1915** is provided on the top of the second connector **1900**.

[0066] Fig. **25** is a perspective view from above of an assembly of the novel male type of second connector **1500** and the novel type of first connector **1200** being the first type adapter. This illustrates the situation when the prior art female connector **1600** is still located on the vehicle or car and the novel second connector **1500** has been instalked on the trailer. This triggers the use of the first connector **1200** in order to interconnect the second connector **1500** to the prior art connector **1600**.

[0067] Fig. **26** presents a situation when the owner the vehicle or car, as well as the trailer has not yet installed the novel first connector **1400** (female connector) and the novel second connector **1500**. In such a situation, there will be the need of the first connector **1200**, constituting a first type of adapter, to be attached to the prior art female connector **1600**, and the second connector **1900**, constituting a second type of adapter, to be attached to the prior art male connector **2000**. Such assembly of structural connectors is shown on Fig. **26**, which is a perspective view from above, as seen from left to right, the assembly of the prior art trailer plug/ male connector **2000** having bayonet coupling configuration, the second connector **1900** being the second type of adapter, the first connector **1200** being the first type of adapter, and the prior art vehicle associated female type connector **1600**.

Claims

1. An electric connector system comprising: a first connector (**100**; **200**; **300**; **400**; **1200**; **1400**) to be associated with a powered vehicle and second connector (**500**; **1500**; **1900**) to be associated with a trailer attachable to the vehicle, the first connector (**100**; **200**; **300**; **400**; **1200**; **1400**) at a female region thereof exhibiting an assembly of a plurality of sockets (**102**; **303**; **1212**; **1409**) configured to receive and make electric contact with an assembly of a plurality of pins (**501**; **1501**; **1913**) from a male region (**502**; **1502**; **1911**) of the second connector (**500**; **1500**; **1900**), a circular space (**103**; **314**; **1204**; **1404**, **1404'**) surrounding the assembly of sockets (**102**; **303**; **1212**; **1409**), a sleeve (**503**; **1502**; **1912**) of circular cross-section surrounding the assembly of pins (**501**; **1501**; **1913**), and the sleeve (**503**; **1502**; **1912**) configured to fit into said space (**103**; **314**; **1204**; **1404**, **1404'**),

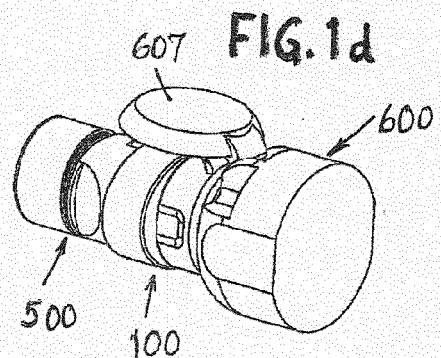
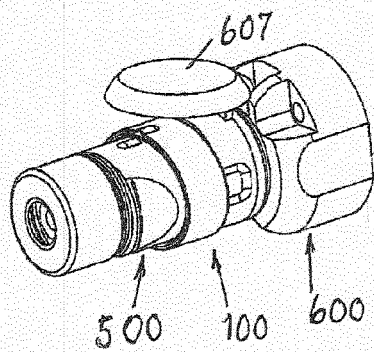
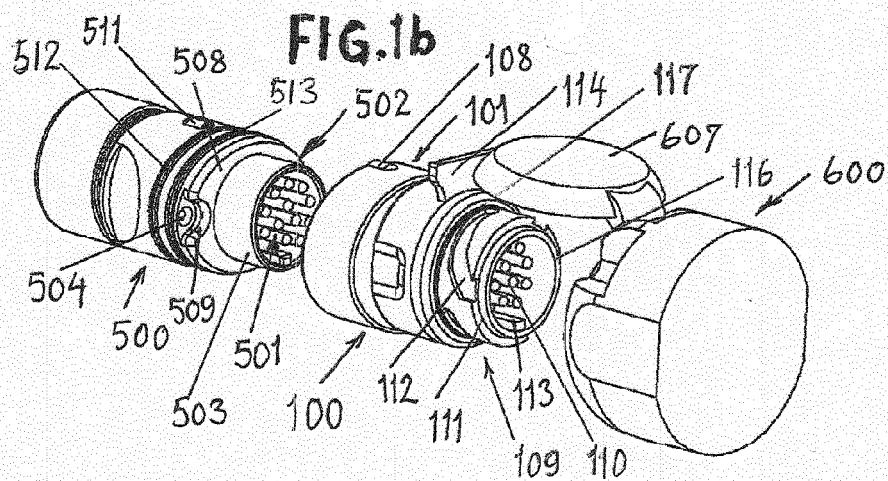
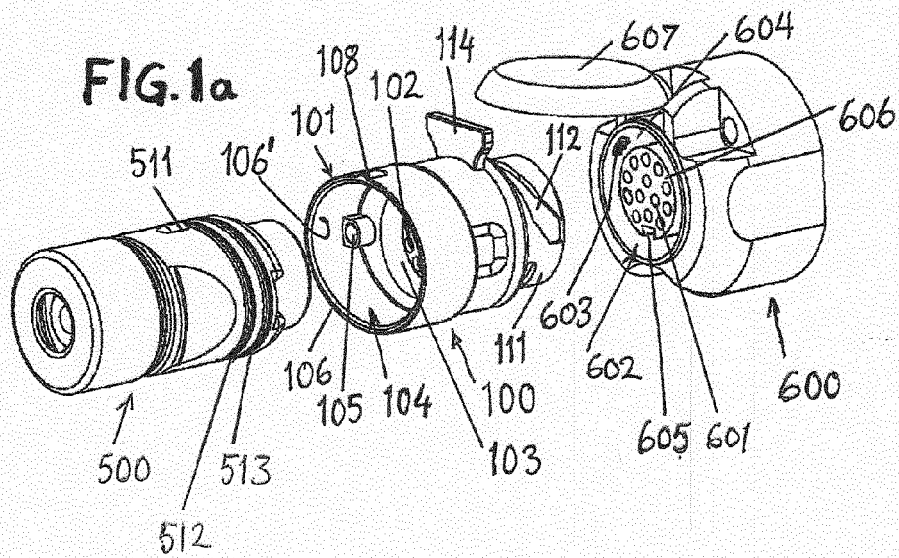
wherein the first connector (**100**; **200**; **300**; **400**; **1200**; **1400**) at its female region has an opening (**104**; **306**; **1204**; **1404**) in front of said assembly of sockets (**102**; **303**; **1212**; **1409**), a pair of magnets (**105**; **307**; **1203**; **1403**) being located laterally of said space (**103**; **314**; **1212**; **1409**) and adjacent the opening (**104**; **306**; **1204**; **1404**), wherein a pair of magnet anchors (**504**; **1525**; **1908**) is located laterally of the sleeve (**503**; **1502**; **1912**) on the second connector (**500**; **1500**; **1900**) to releasably engage the pair of magnets (**105**; **307**; **1203**; **1403**) on the first connector (**100**; **200**; **300**; **400**; **1200**; **1400**) upon joining of the male and female regions and interaction of the pins and sockets, wherein a rear region of the sleeve (**503**; **1502**; **1912**) is terminated by a surrounding collar (**508**; **1506**; **1902**), and wherein the anchors (**504**; **1525**; **1908**) are lo-

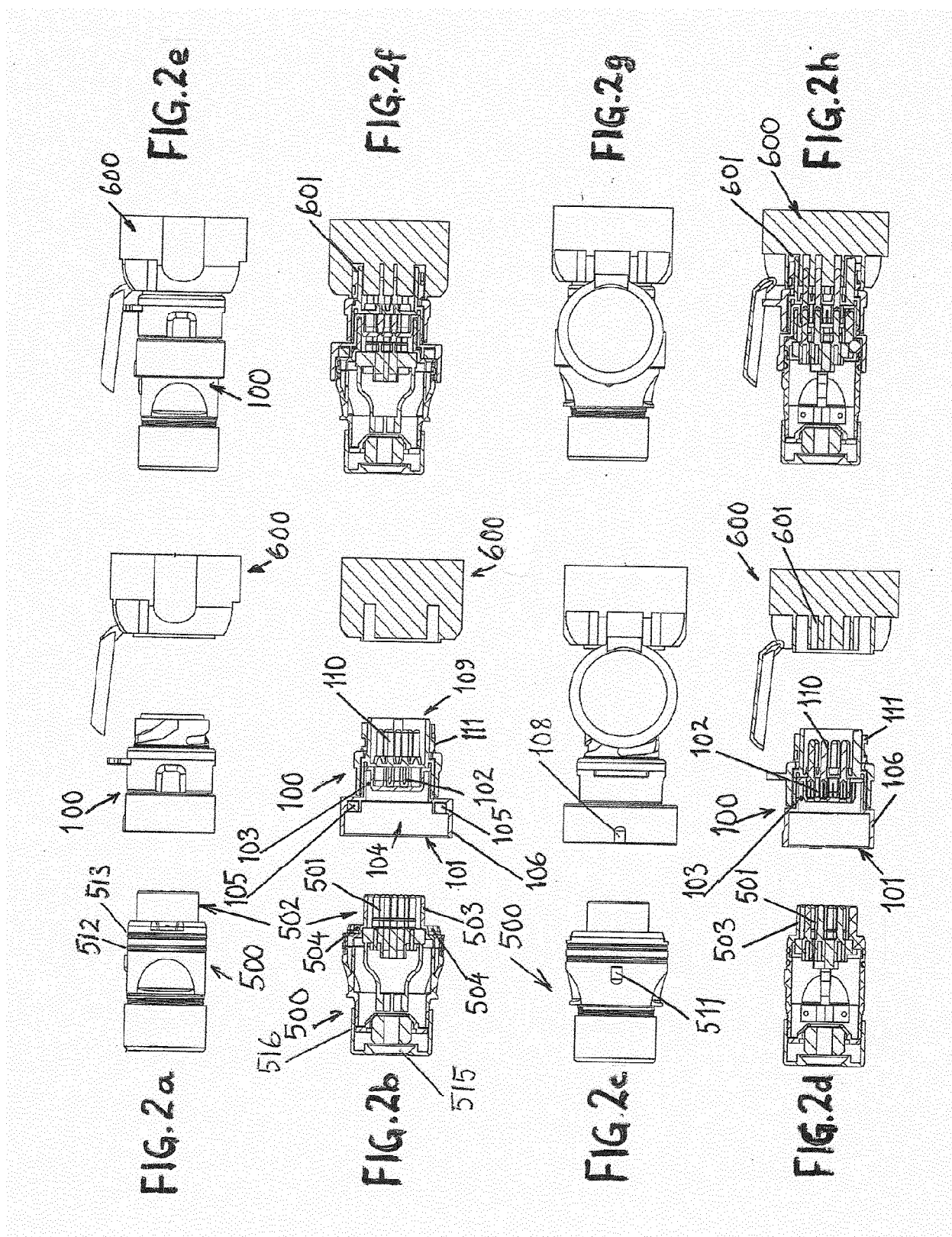
cated at end regions of a largest cross-sectional dimension of the collar (508; 1506; 1902) configuration.

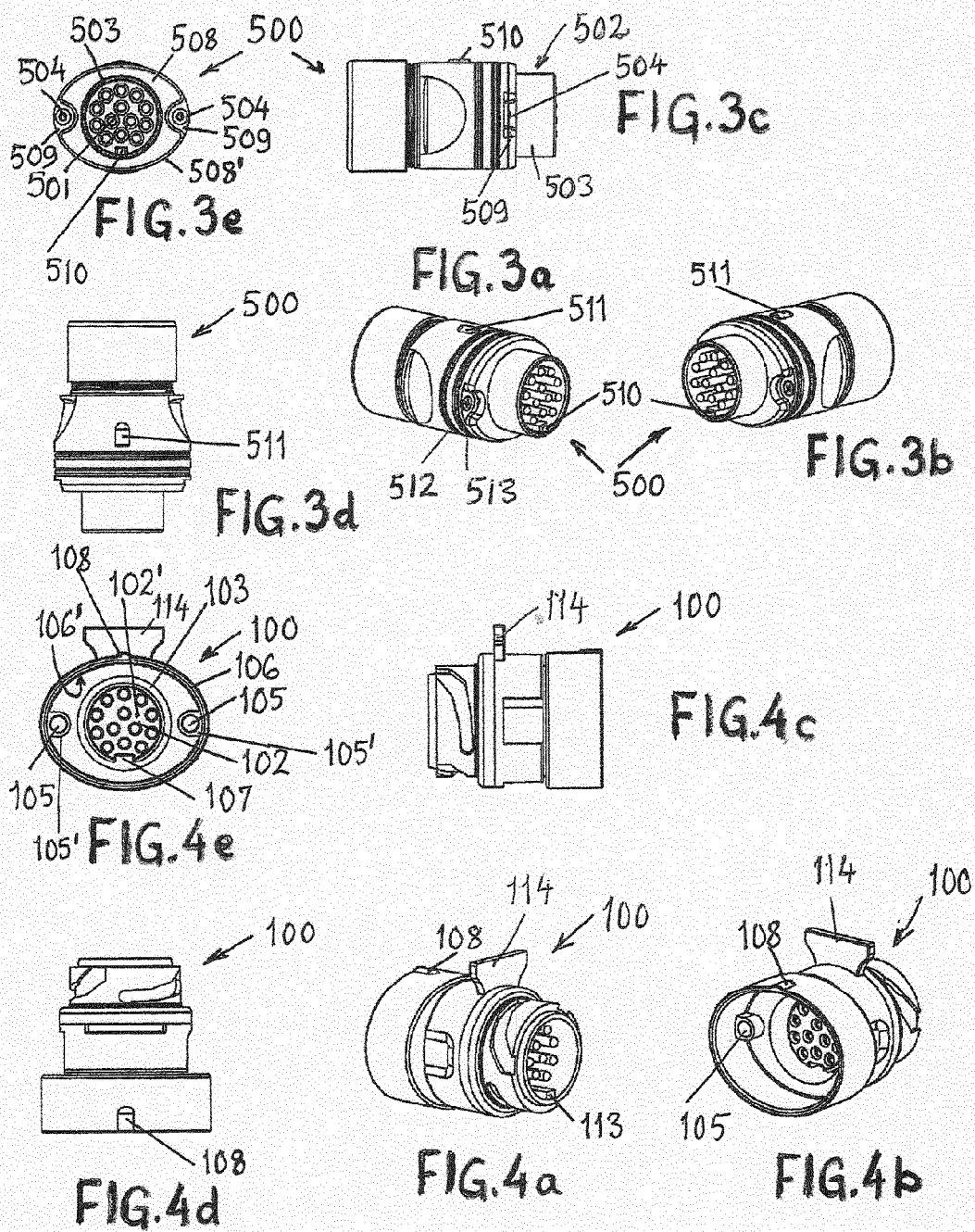
2. The system of claim 1, **wherein** the surrounding collar (508; 1506; 1902) has a circumference of substantially elliptical or oval configuration, and **wherein** the anchors (504; 1525; 1908) are located at end regions of a greater axis of the elliptical or oval configuration. 10
3. The system of claim 1 or 2, **wherein** alignment mating marks (108; 310; 511; 1511; 1915) are located on the outside of both the first and second connectors (100; 200; 300; 400; 500; 1200; 1400; 1500; 1900). 15
4. The system of claim 1, 2 or 3, further comprising a third connector (600; 1600) with a female end (602; 1602) exhibiting a plurality of electric sockets (601; 1601) electrically connected to power supplies on the vehicle, **wherein** another end of the first connector (100; 200; 1200) axially opposite its female region has a male region which is equipped with an equal plurality of pins (110; 1210), the male region of the first connector (100; 200; 1200) being configured with its pins (110; 1210) to engage the sockets (601; 1601) on the third connector (600; 1600) upon joining of the first (100; 200; 1200) and third (600; 1600) connectors. 20
5. The system of claim 4, **wherein** the second connector (500; 1500; 1900) is with its male region (502; 1502; 1911) configured to interconnect with the female region of the first connector (100; 200; 1200), the first connector (100; 200; 1200) serving as an electrical adapter between the third (600; 1600) and the second (500; 1500; 1900) connectors. 25
6. The system on any one of claims 1 - 5, **wherein** the first connector (100; 200; 1200) serving as an adapter of a first type is at its rear male connector side exhibiting a bayonet-coupling member. 30
7. The system of any one of claims 1 - 6, **wherein** the second connector (1900) serving as an adapter of a second type is at its rear female connector side exhibiting a bayonet-coupling member. 35
8. The system of any one of claims 1 - 7, **wherein** the magnets (1203; 1403) on the first connector (1200; 1400) are located in a pocket (1209; 1408) on a front member (1207; 1406), a front of the magnets being covered by a wall (1205; 1407) of the pocket (1209; 1408). 40
9. The system of any one of claims 1 - 8, **wherein** the magnet anchors (1525; 1908) on the second connector (1500; 1900) are magnets which are located 45

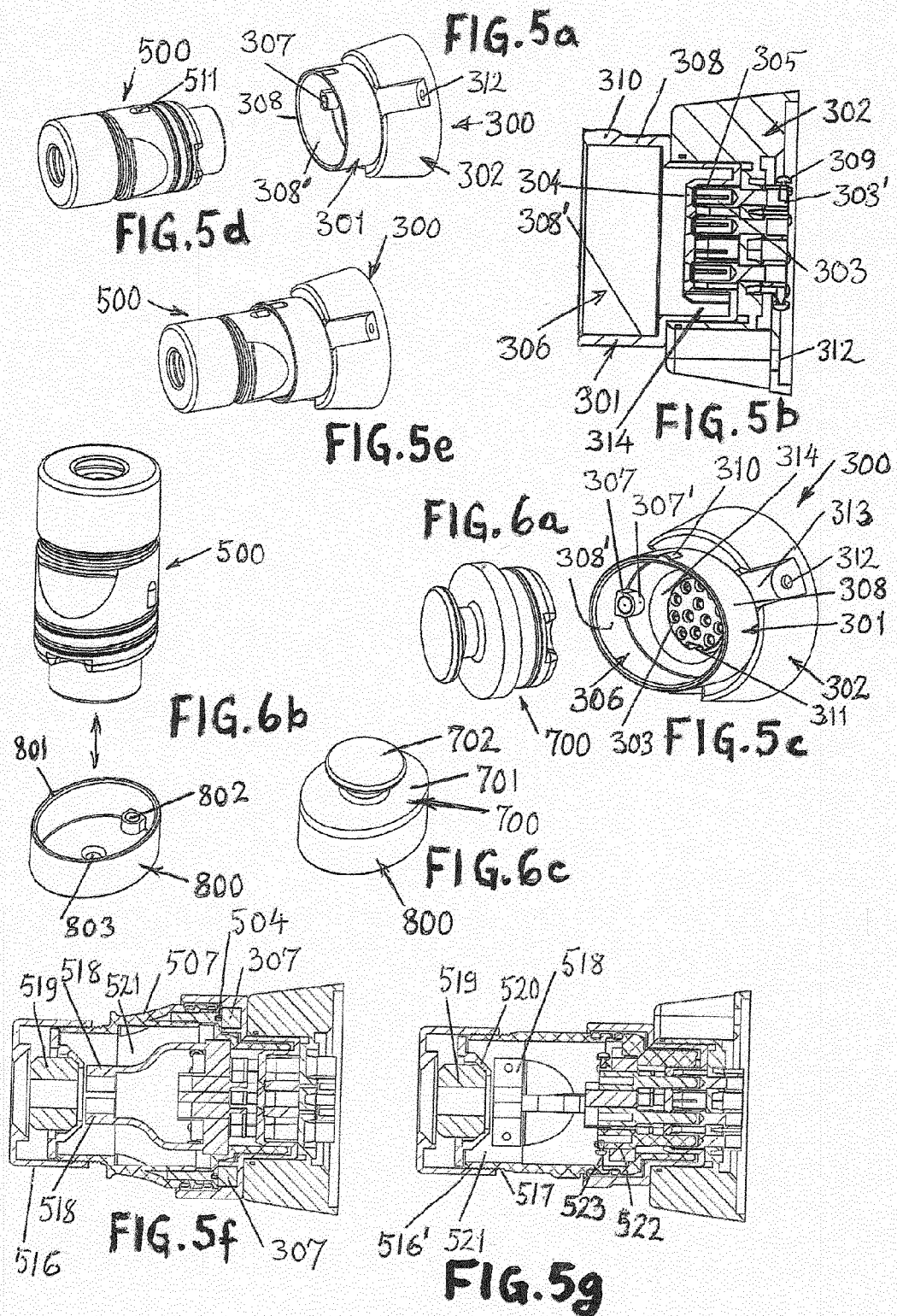
in a pocket (1526; 1909) on a front member (1207; 1902), a front of the magnets being covered by a wall (1527; 1910) of the pocket (1526; 1909).

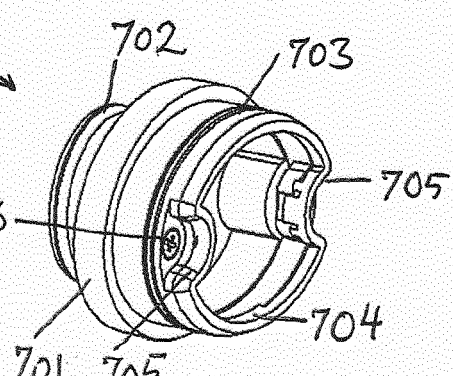
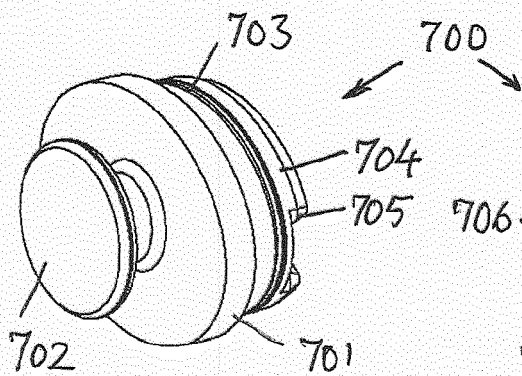
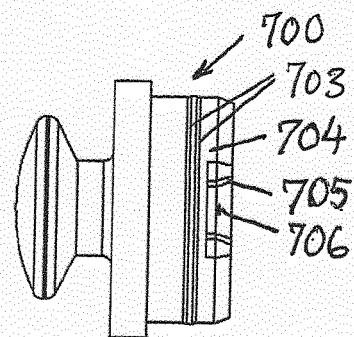
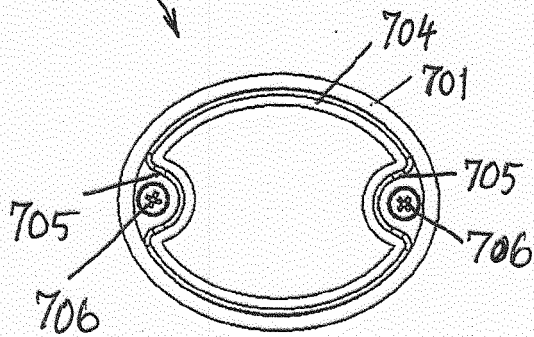
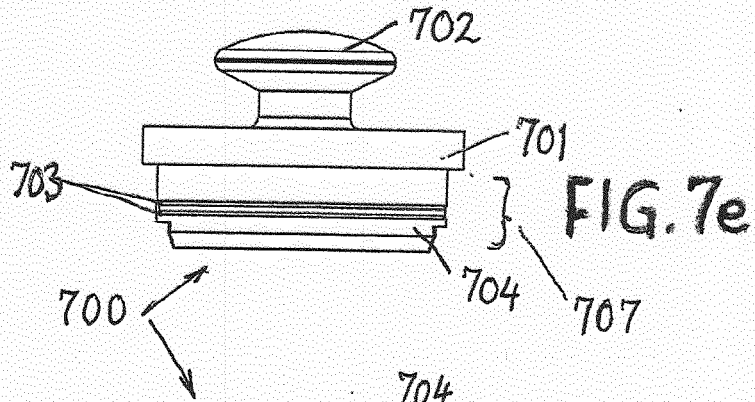
10. The system of any one of claims 1 - 8, **wherein** the magnet anchors (504) located on the second connector (500) are each constituted by a customized head on a screw which joins body parts (506, 507) of second connector (500). 50
11. The system of any one of claims 1 - 10, **comprising** a docking device (800) for the second connector (500; 1500; 1900) when it is not connected to the first connector (200; 1200; 400; 1400), **wherein** the docking device has a wall (801) with an inside thereof of elliptical or oval cross-section, **wherein** a pair of magnets (802) is provided adjacent the inside of the wall, the docking device (800) being configured to receive the male region (502; 1502; 1902) of the second connector (500; 1500; 1900) and its collar (508; 1508). 55
12. The system of any one of claims 1 -11, **wherein** at least one of: the second connector (500; 1500; 1900) and the docking station (800) has a distinctive signalling colour, e.g. yellow, red or combination thereof, or being fluorescent.
13. The system of any one of claims 1 -12, **wherein** the first connector (300; 400) is provided with a LED (315) which directs light through a passage (316) towards the female region (301) opening (306) and the assembly of sockets (303).











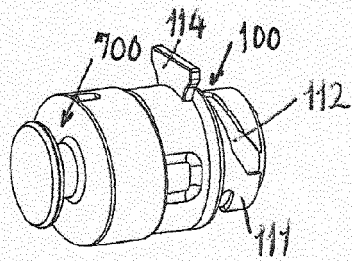


FIG. 8b

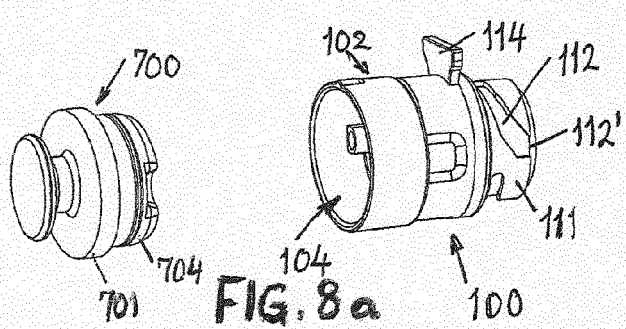


FIG. 8a

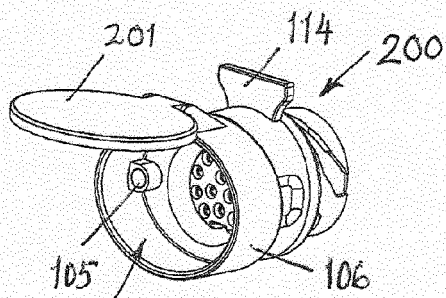


FIG. 9a

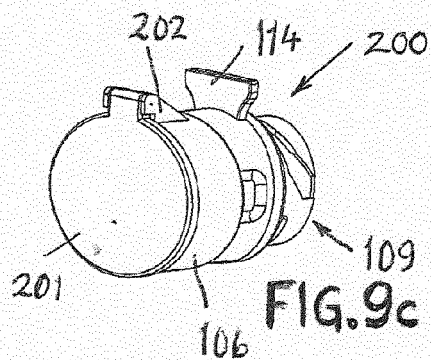


FIG. 9c

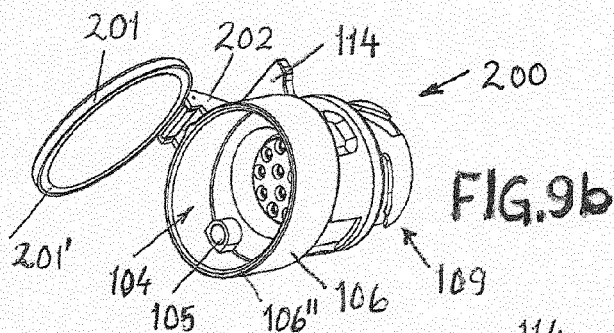


FIG. 9b

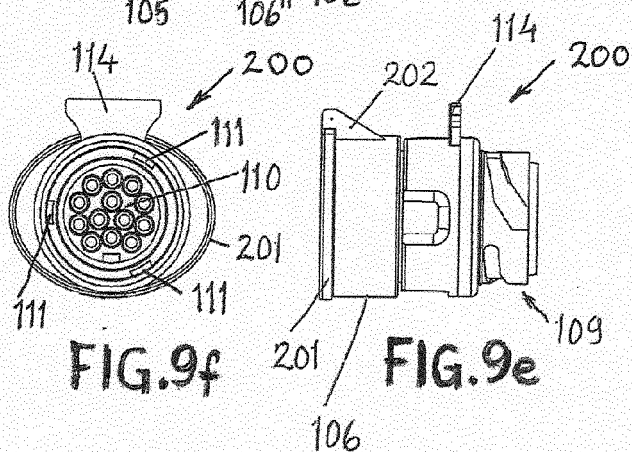


FIG. 9f

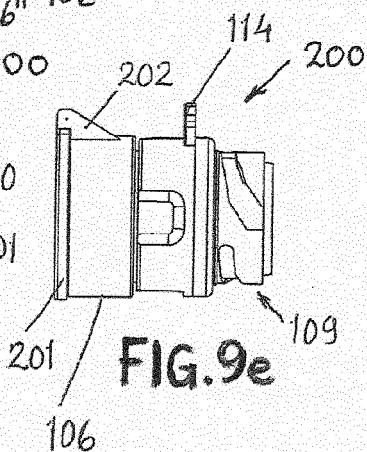


FIG. 9e

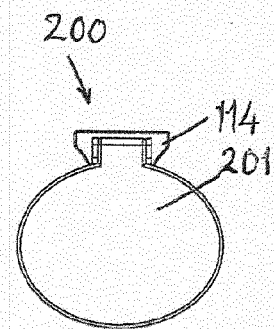
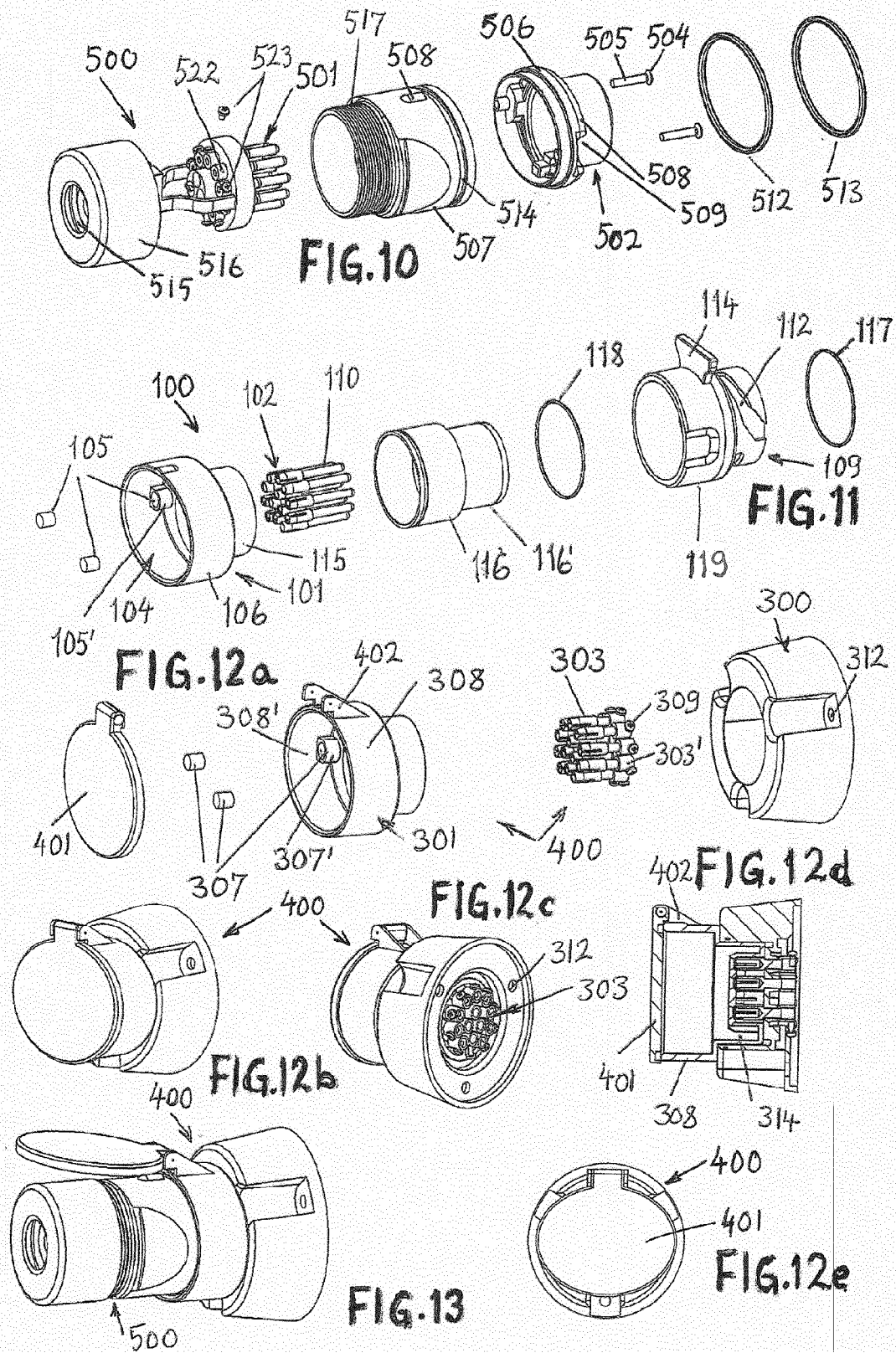
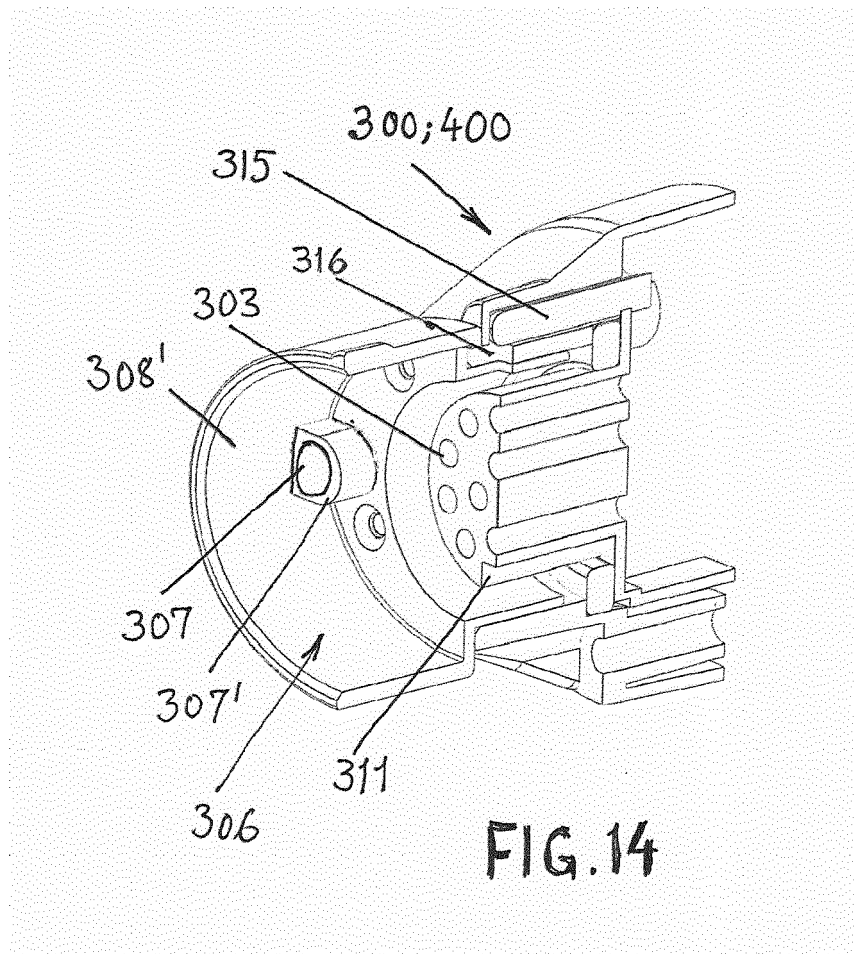
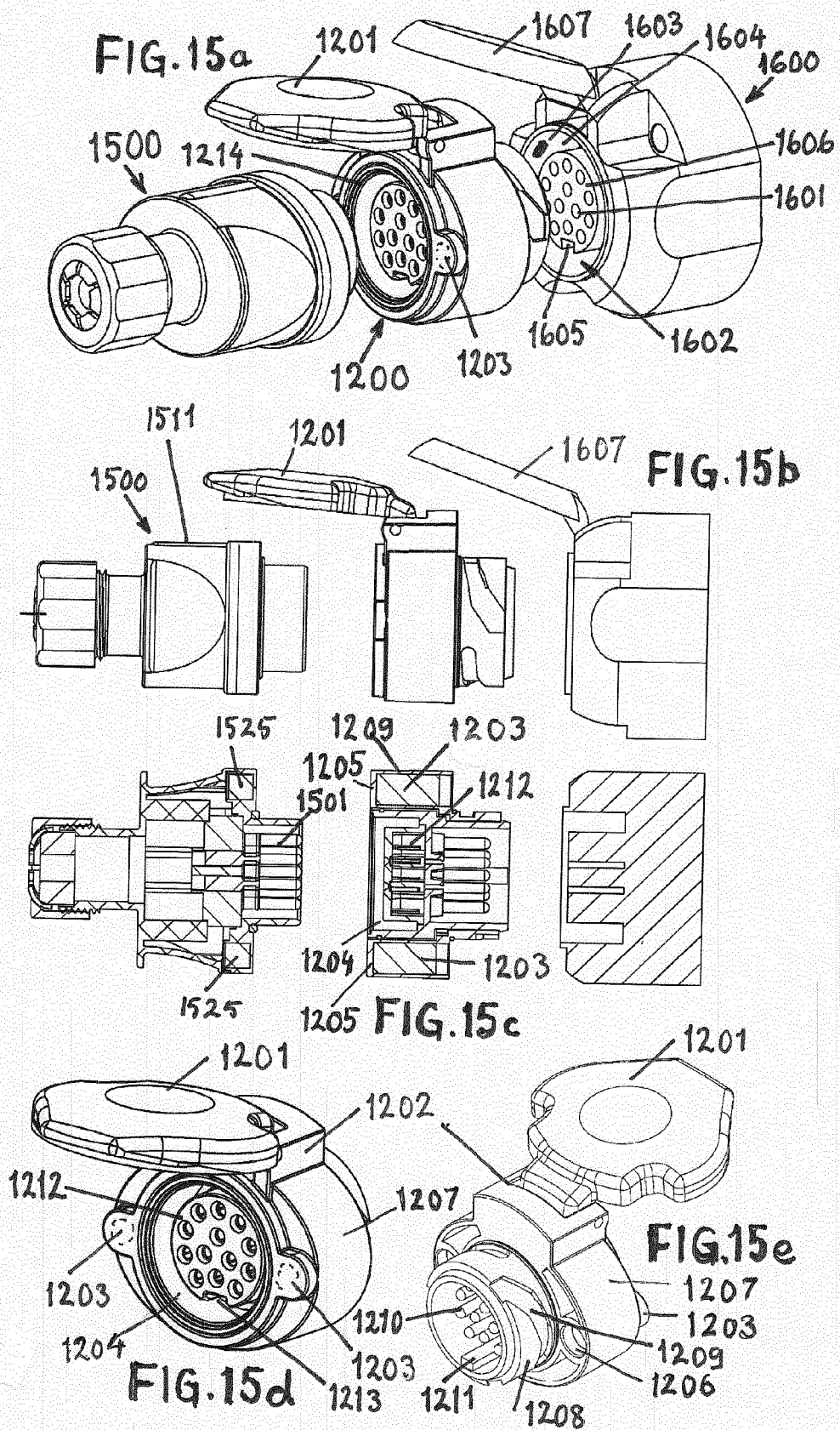
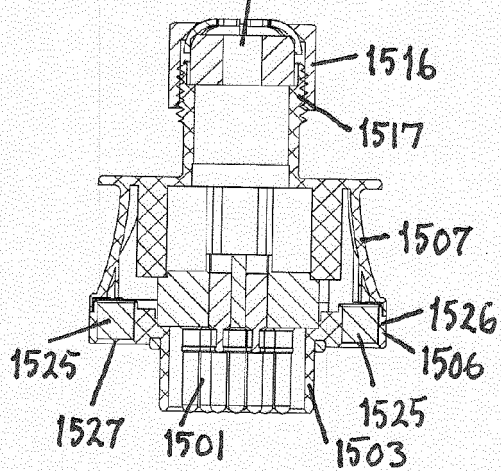
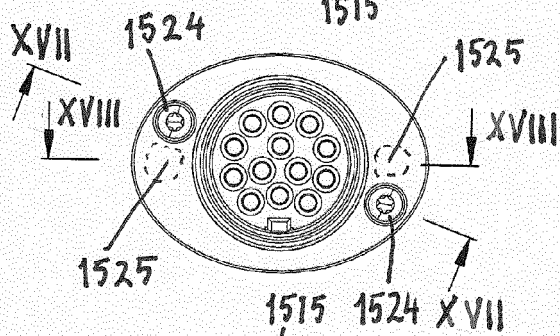
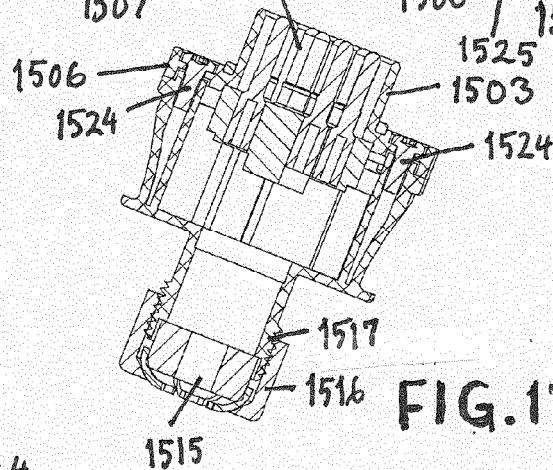
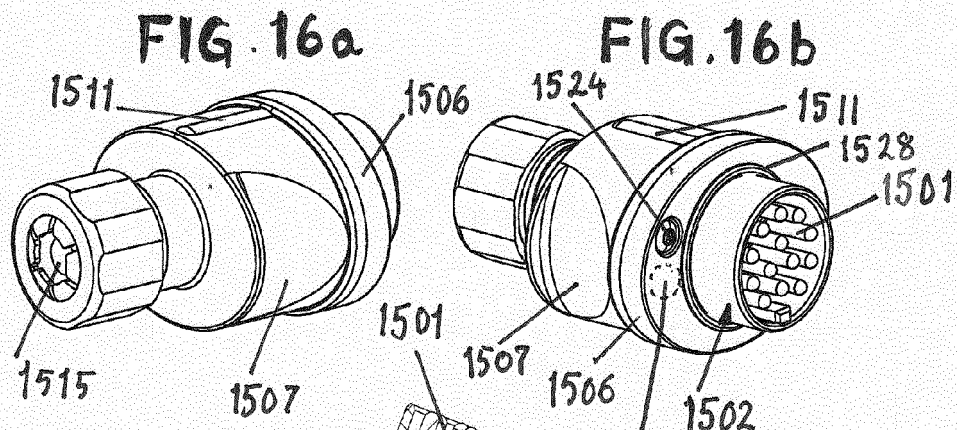


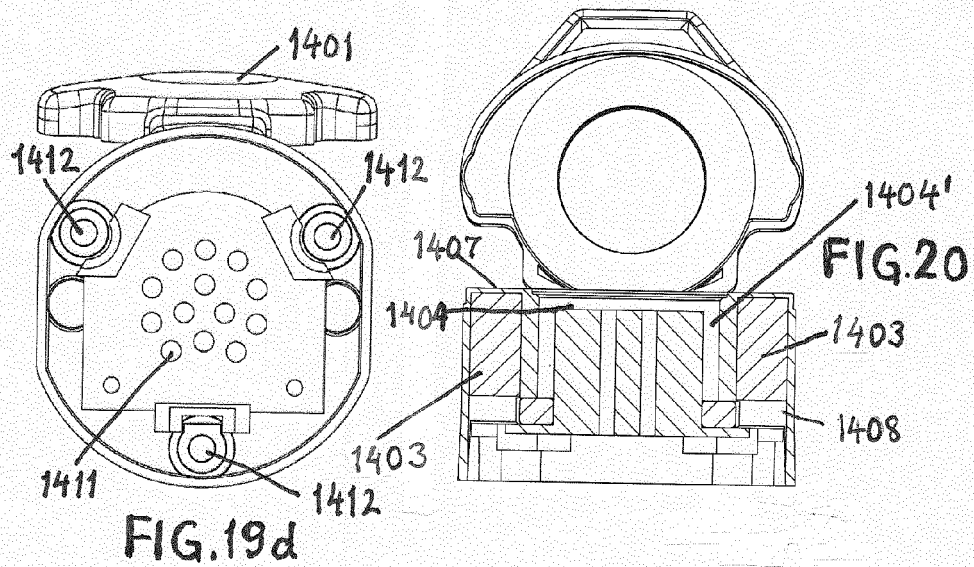
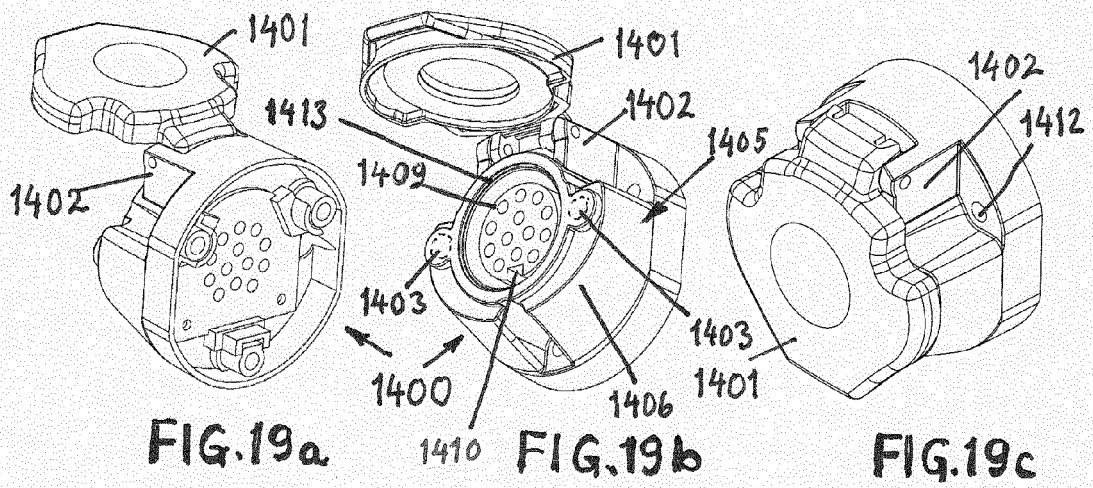
FIG. 9d



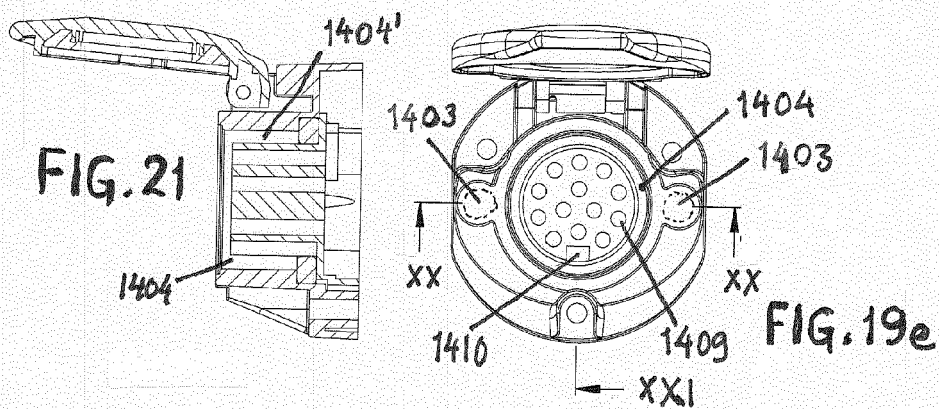


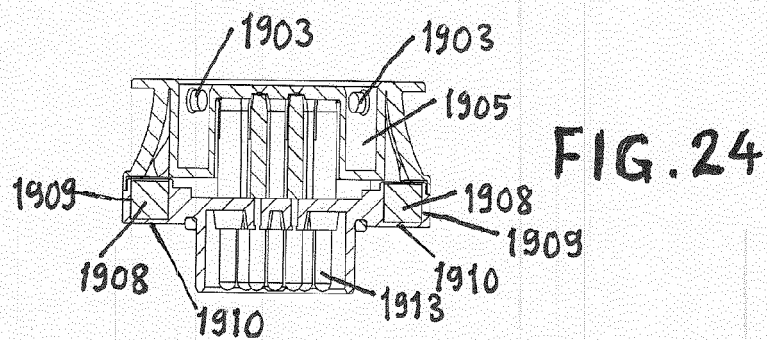
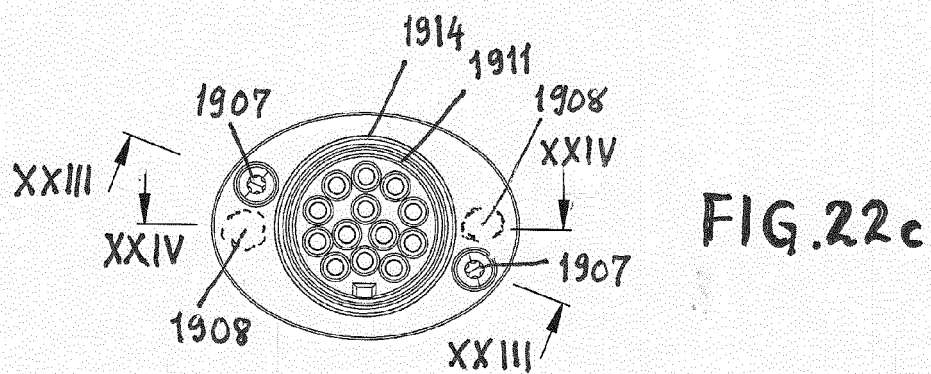
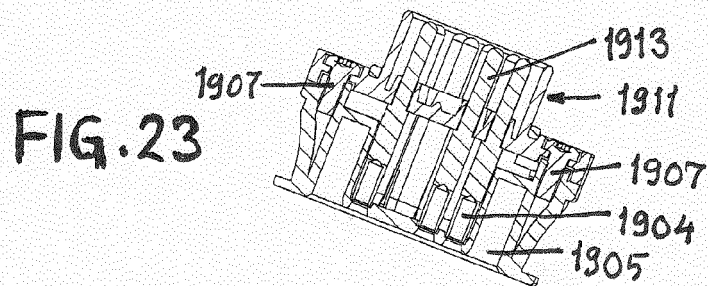
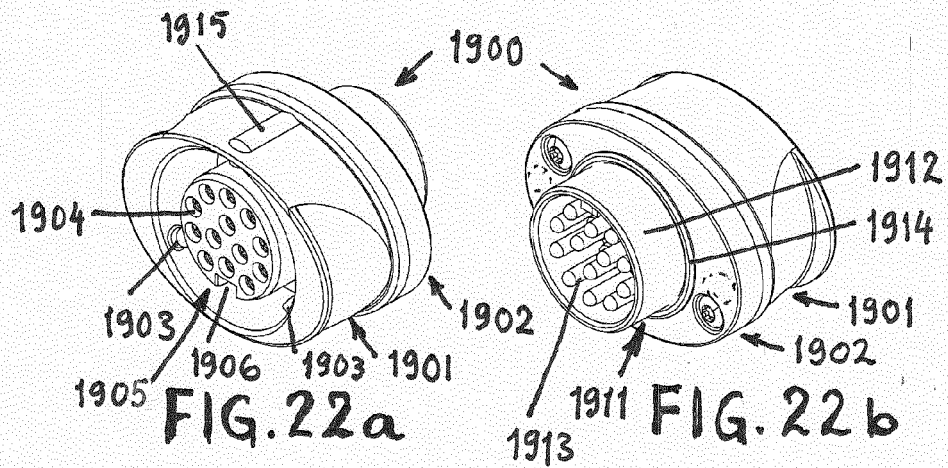


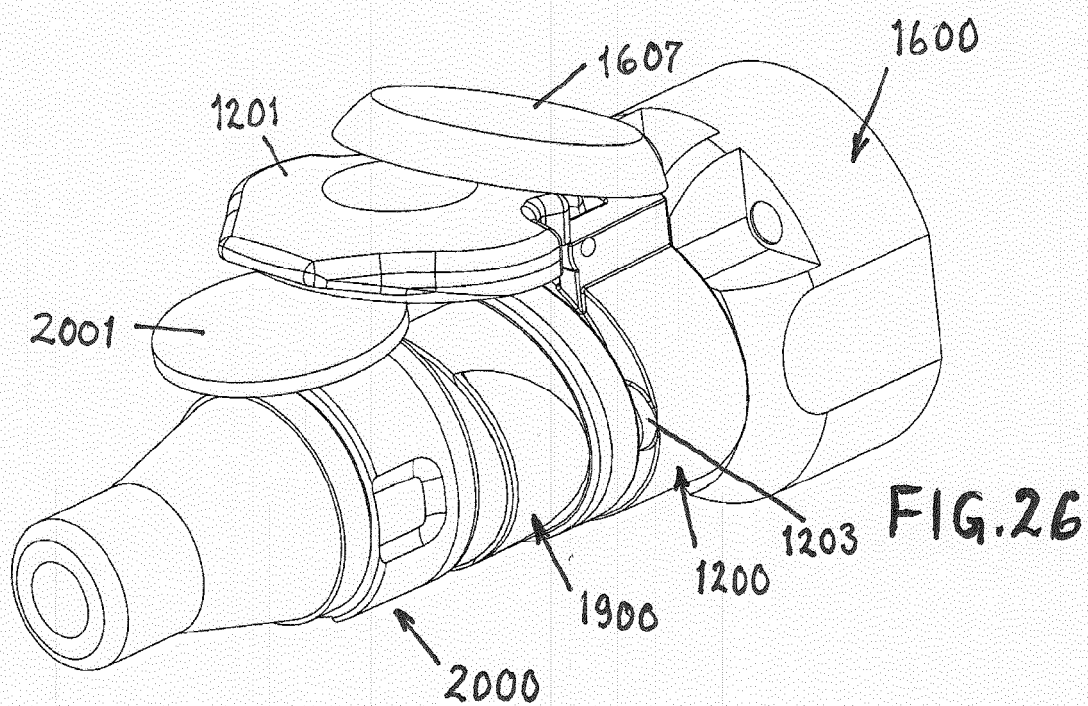
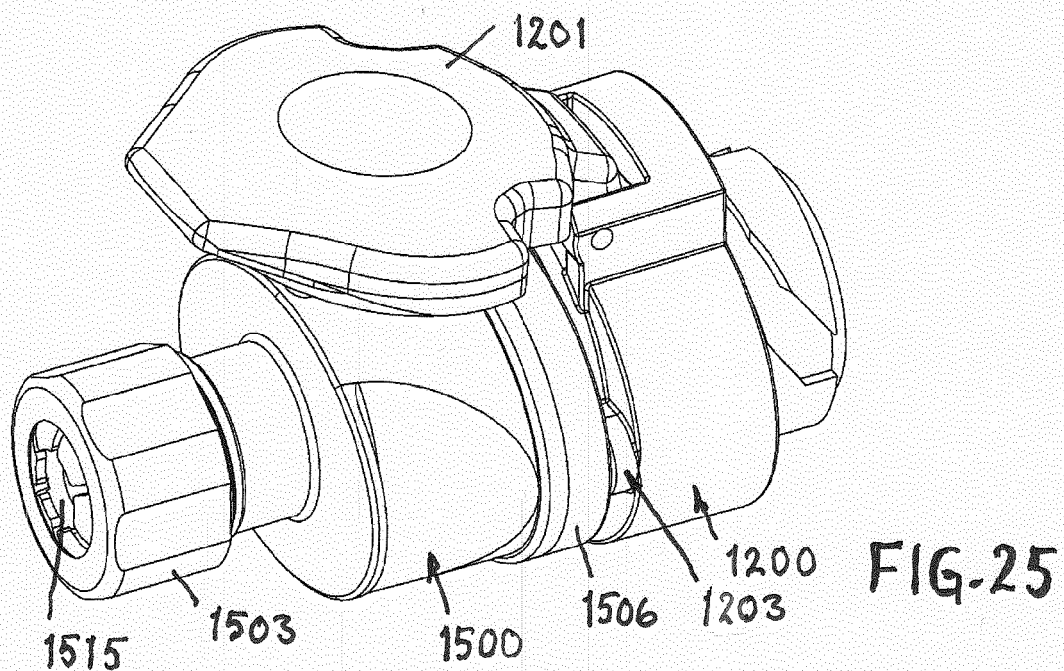




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