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(54) **MULTIPLE AXIS CONNECTION SYSTEM**

MEHRACHSIGES VERBINDUNGSSYSTEM

SYSTEME DE CONNEXION A AXES MULTIPLES

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(56) References cited:
**EP-A- 0 374 918 EP-A- 0 415 489
GB-A- 2 218 277 US-A- 3 569 909
US-A- 5 788 522**

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Description

Field of the Invention

[0001] This invention relates to a connection system for a component, such as a sensor, which provides a restraining force on the component in three orthogonal directions, while centering the component in its mount and reducing vibration levels.

Background of the Invention

[0002] Many machines and other devices utilize a number of smaller components to carry out tasks essential to the operation of the overall device. These components are typically mounted on a housing of the device or on the device itself. Designers of all types of equipment are faced with similar constraints regarding the layout and arrangement of components. These constraints include size, weight, alignment, vibration, assembly, access, and serviceability.

[0003] Existing mounting arrangements have included screws and heat stakes for securing components in place, rubber mounts for reducing vibration, and additional parts to ensure the proper alignment and centering of components with respect to the overall device.

[0004] Known mounting arrangements have proven to be inadequate in several regards. External mounting hardware takes up valuable space and increases the weight of components. Mounts may wear out prematurely and lead to component failure. Fixed mounting arrangements make components difficult to access and remove, in some cases rendering the parts unserviceable. Lastly, additional external mounting hardware increases the time for assembly and disassembly, leading to higher equipment costs.

[0005] There is a need for a component mounting system that provides the required retention, centering, and vibration damping of the component, yet is lightweight and easy to engage and disengage.

[0006] Document EP-A-0 415 489 discloses a system according to the preamble of claim 1.

Summary of the Invention

[0007] The invention is defined in claims 1 and 10.

[0008] The claimed invention provides an integral component connection system that restrains the component in three orthogonal directions, centers the component in its mounting location, and preferably absorbs vibration. The inventive connection system further preferably provides an audible or visible indication when the component is connected. Further, the connection system of the present invention is preferably lightweight and easy to disengage, allowing for quick removal of the component for replacement or repair.

[0009] The claimed invention provides a system for connecting a male member to a female member, the male

and female members being relatively displaceable substantially along an axis lying in a plane. The system comprises a pair of first projections each extending parallel to the plane and each having a first end spaced from a second end, each first end being fixed to a first one of the male and female members, and each second end being resiliently movable with respect to the first member, each second end including a first one of a cavity feature and a protrusion feature; and a pair of grooves in a second one of the male and female members, each groove extending parallel to the axis and receiving a respective one of the pair of first projections, and each groove including a second one of the cavity feature and the protrusion feature, the second feature cooperatively engaging the first feature such that the first member is centered about the axis with respect to the second member and such that the first member is retained along the axis with respect to the second member. The claimed invention also provides a system for connecting a male member to a female member, the male and female members being relatively displaceable substantially along an axis lying in a plane. The system comprises a pair of first projections each extending parallel to the plane and each having a first end spaced from a second end, each first end being fixed to a first one of the male and female members, and each second end being resiliently movable with respect to the first member to preferably absorb relative vibration between the male and female members; a pair of grooves in a second one of the male and female members, each groove extending parallel to the axis and receiving a respective one of the pair of first projections; preferably a tip formed on each second end and an aperture extending from each groove through the second member, each tip tapering from a first size at least as large as its corresponding aperture to a second size smaller than the corresponding aperture, and each tip cooperatively engaging its corresponding aperture such that the first member is centered about the axis with respect to the second member and such that the first member is retained along the axis with respect to the second member; each tip being visible in its corresponding aperture when the first member is retained along the axis with respect to the second member and a pair of second projections fixed to the first member and extending parallel to the plane, each second projection having at least two faces slidably engaging corresponding surfaces in each groove to prevent relative displacement of the first and second members perpendicular to the plane.

[0010] The claimed invention also provides a method of connecting a male member to a female member, the male and female members being relatively displaceable substantially along an axis lying in a plane. The method comprises providing a first one of the male and female members with a pair of first projections each extending parallel to the plane and each having a first end spaced from a second end, each first end being fixed to the first member, and each second end being resiliently movable with respect to the first member, each second end includ-

ing a first one of a cavity feature and a protrusion feature; providing a second one of the male and female members with a pair of grooves, each groove extending parallel to the axis and receiving a respective one of the pair of first projections, and each groove including a second one of the cavity feature and the protrusion feature; aligning the male member with respect to the female member along the axis such that each groove will receive a respective one of the pair of first projections; and relatively displacing the male member with respect to the female member until the second feature cooperatively engages the first feature such that the first member is centered about the axis with respect to the second member, the first member is retained along the axis with respect to the second member, and relative vibration between the first and second members is absorbed.

Brief Description of the Drawings

[0011] The accompanying drawings illustrate presently preferred embodiments of the invention and, together with the general description given above and the detailed description given below, serve to explain features of the invention.

Figure 1 is a top view of a component having the connection features according to the claimed invention.

Figure 2 is a side view of a component having the connection features according to the claimed invention.

Figure 3 is a top view of a component secured by the connection system according to the claimed invention.

Figure 4 shows the connection system according to the claimed invention utilized in an automotive assembly.

Detailed Description of the Preferred Embodiments

[0012] Figures 1-3 illustrate a component incorporating the connection system according to the claimed invention. As shown, the inventive connection system utilizes two different types of projections 10 on the component 20 which interact with a retention surface 30 to removably secure the component 20 in place. In one embodiment, the projections 10 are formed unitarily with the component housing 22. Alternatively, a projection assembly can be formed separately and added on to an existing component. In a further embodiment, the retention surface 30 comprises a pair of grooves 32, each formed with a channel 34 adapted to engage the projections 10. Alternatively, the retention surface 30 can comprise discrete channel sections.

[0013] Figures 1 and 2 illustrate a component with projections 10 of the present invention unitarily formed with a housing. The component 20 shown is a pressure sensor 26 for an automotive exhaust gas recirculation (EGR)

system module 40. It is understood, however, that the connection system according to the claimed invention could be utilized on a range of components of varying size and shape. Further, the inventive system could be made of a variety of materials, provided that the materials exhibited the requisite properties, such as weight, strength, and flexibility. As shown, a pair of first and second projections 12,14 are disposed on the component housing 22 in a substantially planar arrangement. The projections are arranged symmetrically about an axis A of the component 20, with the first projections 12 spaced from the second projections 14 along the axis A. While the invention is described as using pairs of projections 10, it is envisioned that its advantages could be achieved with a single first and second projection 12,14.

[0014] The first projections 12 have a generally elongated shape, with a first end 122 secured to the component housing 22 and a second end 124 slightly offset from the housing 22. These projections 12 are resilient, so that if they are pressed towards the housing 22, they will be resiliently flex away from the housing 22. The second projections 14 may be generally rectangular in shape and are secured to the housing 22 along their length, making them essentially rigid.

[0015] Figure 3 shows the component 20 secured with the connection system according to the claimed invention. The retention surface 30 in the illustrated embodiment comprises a pair of grooves 32, each having a C-shaped channel 34 along the length of an inner surface. The projections 12,14 and the channels 34 are dimensioned so that the projections 12,14 slidably fit closely within the channels 34. Relative motion between the projections 12,14 and the grooves 32 is limited to sliding motion along the length of the channels 34. Each groove 32 has an aperture 36 for engaging a respective second end 124 of a first projection 12. The apertures 36 are located on the grooves 32 at a position corresponding to the mounting position of the component 20. The features of the grooves 32 are clearly shown in Figure 4, which shows the sensor 26 mounted on an automotive EGR system module (ESM) 40.

[0016] The operation of the connection system will be described with reference to Figures 3 and 4. First, the component 20 to be mounted (in the illustrated example, a sensor 26) is oriented so that the first and second projections 12,14 are aligned with the channel 34 in each groove 32. The component 20 is then displaced along the axis in the connecting direction. As the first projections 12 enter the respective channels 34, the second ends 124 of those projections 12 are forced inwardly. A tip, or angled section, 126 on each second end 124 eases the entry of the second ends 124 into the respective channels 34. Within the channels 34, the first projections 12 exert an outward biasing force on the grooves 32. As the component 20 is advanced further, the second projections 14 enter the channels 34.

[0017] The component 20 is displaced until it has reached the desired mounting position. As the mounting

position is reached, the second ends 124 of the first projections 12 snap outwardly into the apertures 36 in the respective grooves 32. The snap provides an audible indication that the component 20 is securely fixed. Further, the appearance of the second ends 124 of the projections 12 in the notches 36 provides a visual indication that the component 20 is in place.

[0018] Once the component 20 is in place, the first and second projections 12,14 interact with the grooves 32 to provide a locking force on the component 20 in three orthogonal directions. The first projections 12 restrain movement along the axial direction by interacting with the apertures 36 in the grooves 32. The second projections 14 restrain movement in two opposite directions perpendicular to the plane (which includes the axis A) of the component 20. The restraining forces on the second projections 14 are generated by the interaction of the projections 14 with at least two contact surfaces of each channel 34.

[0019] The resiliency of the first projections 12 provides the inventive connection system with several additional advantages. Because the spring force of each of the first projections 12 is approximately equal, the projections 12 act to maintain the component 20 in a centered position between the grooves 32. This self-centering feature greatly simplifies installation. Further, due to their flexibility, the first projections 12 serve to reduce the vibration levels encountered by the component 20. Lower vibration levels contribute significantly to a longer operational life for most components.

[0020] Lastly, the connection system of the present invention allows for quick removal of components. To remove a component 20, the second ends 124 of the first projections 12 are pressed into the apertures 36 on each groove 32 while the component 20 is pulled in a direction opposite to the mounting direction. Once the first projections 12 have cleared the apertures 36, the first and second projections 12,14 can slide along the channels 34 until the component 20 is removed. Easy mounting and removal facilitates assembly of a device, as well as repair and replacement of individual components.

[0021] While the invention has been disclosed with reference to certain preferred embodiments, numerous modifications, alterations, and changes to the described embodiments are possible without departing from the scope of the invention, as defined in the appended claims. Accordingly, it is intended that the invention not be limited to the described embodiments, but that it have the full scope defined by the language of the following claims.

Claims

1. A system for connecting a male member (20) to a female member (30), the male and female members being relatively displaceable substantially along an axis (A) lying in a plane, the system comprising:

a pair of first projections (12) each extending parallel to the plane and each having a first end (122) spaced from a second end (124), each first end being fixed to a first one of the male and female members, and each second end being resiliently movable with respect to the first member, each second end including a first one of a cavity feature (36) and a protrusion feature (126); and

a pair of grooves (32) in a second one of the male and female members, each groove extending parallel to the axis and made to receive a respective one of the pair of first projections, and each groove including a second one of the cavity feature and the protrusion feature, the second feature made to cooperatively engage the first feature such that the first member is centered about the axis with respect to the second member and such that the first member is retained along the axis with respect to the second member; **characterised in that**

at least one second projection fixed is to the first member and extends parallel to the plane, each second projection having at least two faces slidably engaging the second member; and at least one of the grooves including at least two surfaces confronting respective ones of the at least two faces and preventing relative displacement of the first and second members perpendicular to the plane.

2. The system according to claim 1, wherein there are a pair of the second projections, each of the second projections slidably engaging respective faces of corresponding one of the pair of grooves.
3. The system according to claim 2, wherein the pair of first projections, the pair of grooves, and the pair of second projections commonly lie in the plane.
4. The system according to claim 1, wherein each second projection is substantially rigidly fixed to the first member.
5. The system according to claim 1, wherein each groove includes a generally C-shaped channel opening toward the axis.
6. The system according to claim 1, wherein each second end being resiliently movable absorbs relative vibration between the first and second members.
7. The system according to claim 1, wherein the cavity feature includes an aperture extending from each groove through the second member and the protrusion feature includes a tip of each second end.
8. The system according to claim 7, wherein the tip of

each second end is visible in the aperture of each groove when the first member is retained along the axis with respect to the second member.

9. The system according to claim 7, wherein the tip of each second end tapers from a first size at least as large as its corresponding aperture to a second size smaller than the corresponding aperture.

10. A method of connecting a male member to a female member, the male and female members being relatively displaceable substantially along an axis lying in a plane, the method comprising;

providing a first one of the male and female members with a pair of first projections each extending parallel to the plane and each having a first end spaced from a second end, each first end being fixed to the first member, and each second end being resiliently movable with respect to the first member, each second end including a first one of a cavity feature and a protrusion feature;

providing a second one of the male and female members with a pair of grooves, each groove extending parallel to the axis and receiving a respective one of the pair of first projections, and each groove including a second one of the cavity feature and the protrusion feature;

aligning the male member with respect to the female member along the axis such that each groove will receive one of the pair of first projections; and

relatively displacing the male member with respect to the female member until the second feature cooperatively engages the first feature such that

the first member is centered about the axis with respect to the second member, the first member is retained along the axis with respect to the second member, and relative vibration between the first and second members is absorbed, and providing the first member with a pair of second projections extending parallel to the plane, each second projection having at least two faces confronting the second member;

wherein relatively displacing includes the at least two faces one of the projections slidingly engaging respective surfaces of the groove such that the first and second members are prevented from relative displacement perpendicular to the plane.

11. The method according to claim 9, wherein the protrusion feature is visible in the cavity feature when

the first member is retained along the axis with respect to the second member.

5 Patentansprüche

1. System zum Verbinden eines inneren Elements (20) mit einem äußeren Element (30), wobei das innere und das äußere Element relativ zueinander im Wesentlichen entlang einer in einer Ebene liegenden Achse (A) verschiebbar sind, wobei das System umfasst:

ein Paar erste Fortsätze (12), welche sich jeweils parallel zu der Ebene erstrecken und jeweils ein erstes Ende (122) in einem Abstand von einem zweiten Ende (124) aufweisen, wobei jedes erste Ende an einem ersten der inneren bzw. äußeren Elemente befestigt ist und jedes zweite Ende federnd in Bezug auf das erste Element beweglich ist, jedes zweite Ende einen ersten Hohlraumbestandteil (36) und einen Fortsatzbestandteil (126) umfasst; und

ein Paar Nuten (32) in einem zweiten inneren Element und einem zweiten äußeren Element, wobei sich jede Nut parallel zur Achse erstreckt und so ausgelegt ist, dass sie einen entsprechenden Fortsatz des Paares erster Fortsätze aufnimmt, und wobei jede Nut einen zweiten Hohlraumbestandteil bzw. Fortsatzbestandteil umfasst, wobei der zweite Bestandteil so ausgelegt ist, dass er in mitwirkender Weise in den ersten Bestandteil greift, so dass das erste Element in Bezug auf das zweite Element um die Achse herum zentriert wird und das erste Element in Bezug auf das zweite Element entlang der Achse zurückgehalten wird, **dadurch gekennzeichnet, dass**

wenigstens ein zweiter Fortsatz am ersten Element befestigt ist und sich parallel zu der Ebene erstreckt, wobei jeder zweite Fortsatz wenigstens zwei Außenflächen aufweist, welche gleitend in das zweite Element greifen; und wobei wenigstens eine der Nuten wenigstens zwei Oberflächen umfasst, welche den entsprechenden wenigstens zwei Außenflächen zugewandt sind und ein relatives Verschieben der ersten und zweiten Elemente senkrecht zu der Ebene verhindern.

2. System nach Anspruch 1, wobei es ein Paar der zweiten Fortsätze gibt, wobei jeder der zweiten Fortsätze gleitend in jeweilige Außenflächen einer entsprechenden Nut des Nutenpaares greift.

3. System nach Anspruch 2, wobei das Paar erster Fortsätze, das Paar Nuten und das Paar zweiter Fortsätze gemeinsam in der Ebene liegen.

4. System nach Anspruch 1, wobei jeder zweite Fortsatz im Wesentlichen steif am ersten Element befestigt ist.
5. System nach Anspruch 1, wobei jede Nut einen allgemein C-förmigen Kanal umfasst, welcher sich zur Achse hin öffnet. 5
6. System nach Anspruch 1, wobei jedes zweite Ende, welches federnd beweglich ist, relative Schwingungen zwischen dem ersten und dem zweiten Element absorbiert. 10
7. System nach Anspruch 1, wobei der Hohlraumbestandteil eine Öffnung umfasst, welche sich von jeder Nut durch das zweite Element erstreckt, und der Fortsatzbestandteil eine Spitze jedes zweiten Endes umfasst. 15
8. System nach Anspruch 7, wobei die Spitze jedes zweiten Endes in der Öffnung jeder Nut sichtbar ist, wenn das erste Element in Bezug auf das zweite Element entlang der Achse zurückgehalten wird. 20
9. System nach Anspruch 7, wobei die Spitze jedes zweiten Endes sich von einer ersten Größe, die wenigstens so groß ist wie die ihr entsprechende Öffnung, zu einer zweiten Größe verjüngt, die kleiner als die entsprechende Öffnung ist. 25
10. Verfahren zum Verbinden eines inneren Elements mit einem äußeren Element, wobei das innere und das äußere Element im Wesentlichen entlang einer in einer Ebene liegenden Achse relativ verschiebbar sind, wobei das Verfahren umfasst: 30

Ausstatten eines ersten inneren Elements und eines ersten äußeren Elements mit einem Paar erster Fortsätze, welche sich jeweils parallel zu der Ebene erstrecken und jeweils ein erstes Ende in einem Abstand von einem zweiten Ende aufweisen, wobei jedes erste Ende an dem ersten Element befestigt ist und jedes zweite Ende federnd in Bezug auf das erste Element beweglich ist, wobei jedes zweite Ende einen ersten Hohlraumbestandteil und einen ersten Fortsatzbestandteil umfasst; 45

Ausstatten eines zweiten inneren Elements und eines zweiten äußeren Elements mit einem Paar Nuten, wobei sich jede Nut parallel zu der Achse erstreckt und einen entsprechenden Fortsatz des Paares erster Fortsätze aufnimmt, und wobei jede Nut einen zweiten Hohlraumbestandteil und einen zweiten Fortsatzbestandteil umfasst; 50

Fluchten des inneren Elements in Bezug auf das äußere Element entlang der Achse, so dass jede Nut einen Fortsatz des Paares erster Fortsätze 55

aufnimmt; und
Verschieben des inneren Elements in Bezug auf das äußere Element, bis der zweite Bestandteil in mitwirkender Weise in den ersten Bestandteil greift, in der Weise, dass

das erste Element in Bezug auf das zweite Element um die Achse herum zentriert wird, das erste Element in Bezug auf das zweite Element entlang der Achse zurückgehalten wird, und
relative Schwingungen zwischen dem ersten und dem zweiten Element absorbiert werden, und
Ausstatten des ersten Elements mit einem Paar zweiter Fortsätze, welche sich parallel zu der Ebene erstrecken,

wobei jeder zweite Fortsatz wenigstens zwei Außenflächen aufweist, welche dem zweiten Element zugewandt sind;

wobei relatives Verschieben umfasst, dass die wenigstens zwei Außenflächen eines der Fortsätze gleitend in jeweilige Oberflächen der Nut greifen, so dass das erste und das zweite Element an einem relativen Verschieben senkrecht zur Ebene gehindert werden.

11. Verfahren nach Anspruch 9, wobei der Fortsatzbestandteil in der Öffnung des Hohlraumbestandteils sichtbar ist, wenn das erste Element entlang der Achse in Bezug auf das zweite Element zurückgehalten wird. 35

Revendications

1. Système permettant de connecter un organe mâle (20) à un organe femelle (30), les organes mâle et femelle étant relativement mobiles sensiblement le long d'un axe (A) s'étendant dans un plan, le système comprenant : 40

une paire de premières saillies (12) s'étendant chacune parallèlement au plan et ayant chacune une première extrémité (122) espacée d'une seconde extrémité (124), chaque première extrémité étant fixée à un premier organe parmi les organes mâle et femelle et chaque seconde extrémité étant mobile de manière résiliente par rapport au premier organe, chaque seconde extrémité comprenant un premier élément parmi un élément formant cavité (36) et un élément formant saillie (126) ; et
une paire de rainures (32) dans un second organe parmi les organes mâle et femelle, chaque rainure s'étendant parallèlement à l'axe et étant

- conçue pour recevoir une saillie respective de la paire de premières saillies et chaque rainure comprenant un second élément parmi l'élément formant cavité et l'élément formant saillie, le second élément étant conçu pour se solidariser par coopération avec le premier élément d'une manière telle que le premier organe est centré autour de l'axe par rapport au second organe et telle que le premier organe est maintenu le long de l'axe par rapport au second organe ; **caractérisé en ce que** au moins une seconde saillie est fixée au premier organe et s'étend parallèlement au plan, chaque seconde saillie ayant au moins deux faces se solidarissant par coulissement avec le second organe ; et au moins une des rainures comprend au moins deux surfaces en vis-à-vis des faces respectives des au moins deux faces et empêche un déplacement relatif des premier et second organes perpendiculairement au plan.
2. Système selon la revendication 1, dans lequel il existe une paire de secondes saillies, chacune des secondes saillies se solidarissant par coulissement avec les faces respectives d'une rainure correspondante de la paire de rainures. 25
 3. Système selon la revendication 2, dans lequel la paire de premières saillies, la paire de rainures et la paire de secondes saillies s'étendent communément dans le plan. 30
 4. Système selon la revendication 1, dans lequel chaque seconde saillie est fixée de manière sensiblement rigide au premier organe. 35
 5. Système selon la revendication 1, dans lequel chaque rainure comprend un profil globalement en forme de C s'ouvrant vers l'axe. 40
 6. Système selon la revendication 1, dans lequel chaque seconde extrémité mobile de manière résiliente absorbe une vibration relative entre les premier et second organes. 45
 7. Système selon la revendication 1, dans lequel l'élément formant cavité comprend une ouverture s'étendant depuis chaque rainure à travers le second organe et l'élément formant saillie comprend une pointe de chaque seconde extrémité. 50
 8. Système selon la revendication 7, dans lequel la pointe de chaque seconde extrémité est visible dans l'ouverture de chaque rainure quand le premier organe est maintenu le long de l'axe par rapport au second organe. 55
 9. Système selon la revendication 7, dans lequel la pointe de chaque seconde extrémité se rétrécit depuis une première taille au moins aussi grande que son ouverture correspondante jusqu'à une seconde taille inférieure à l'ouverture correspondante. 5
 10. Procédé permettant de connecter un organe mâle à un organe femelle, les organes mâle et femelle étant relativement mobiles sensiblement le long d'un axe s'étendant dans un plan, le procédé comprenant les étapes consistant à ;
 - doter un premier organe parmi les organes mâle et femelle d'une paire de premières saillies s'étendant chacune parallèlement au plan et ayant chacune une première extrémité espacée d'une seconde extrémité, chaque première extrémité étant fixée au premier organe et chaque seconde extrémité étant mobile de manière résiliente par rapport au premier organe, chaque seconde extrémité comprenant un premier élément parmi un élément formant cavité et un élément formant saillie ;
 - doter un second organe parmi les organes mâle et femelle d'une paire de rainures, chaque rainure s'étendant parallèlement à l'axe et recevant une saillie respective de la paire de premières saillies et chaque rainure comprenant un second élément parmi l'élément formant cavité et l'élément formant saillie ;
 - aligner l'organe mâle par rapport à l'organe femelle le long de l'axe d'une manière telle que chaque rainure recevra une saillie de la paire de premières saillies ; et
 - déplacer relativement l'organe mâle par rapport à l'organe femelle jusqu'à ce que le second élément se solidarise par coopération avec le premier élément d'une manière telle que
 - le premier organe est centré autour de l'axe par rapport au second organe,
 - le premier organe est maintenu le long de l'axe par rapport au second organe, et
 - une vibration relative entre les premier et second organes est absorbée, et
 - doter le premier organe d'une paire de secondes saillies s'étendant parallèlement au plan, chaque seconde saillie ayant au moins deux faces en face du second organe ;
 - dans lequel l'étape de déplacement relatif consiste en ce que les au moins deux faces d'une des saillies se solidarissent par coulissement avec des surfaces respectives de la rainure d'une manière telle que les premier et second organes ne peuvent pas effectuer de déplacement relatif perpendiculairement au plan.

- 11.** Procédé selon la revendication 10, dans lequel l'élément formant saillie est visible dans l'élément formant cavité quand le premier organe est maintenu le long de l'axe par rapport au second organe.

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FIG. 1

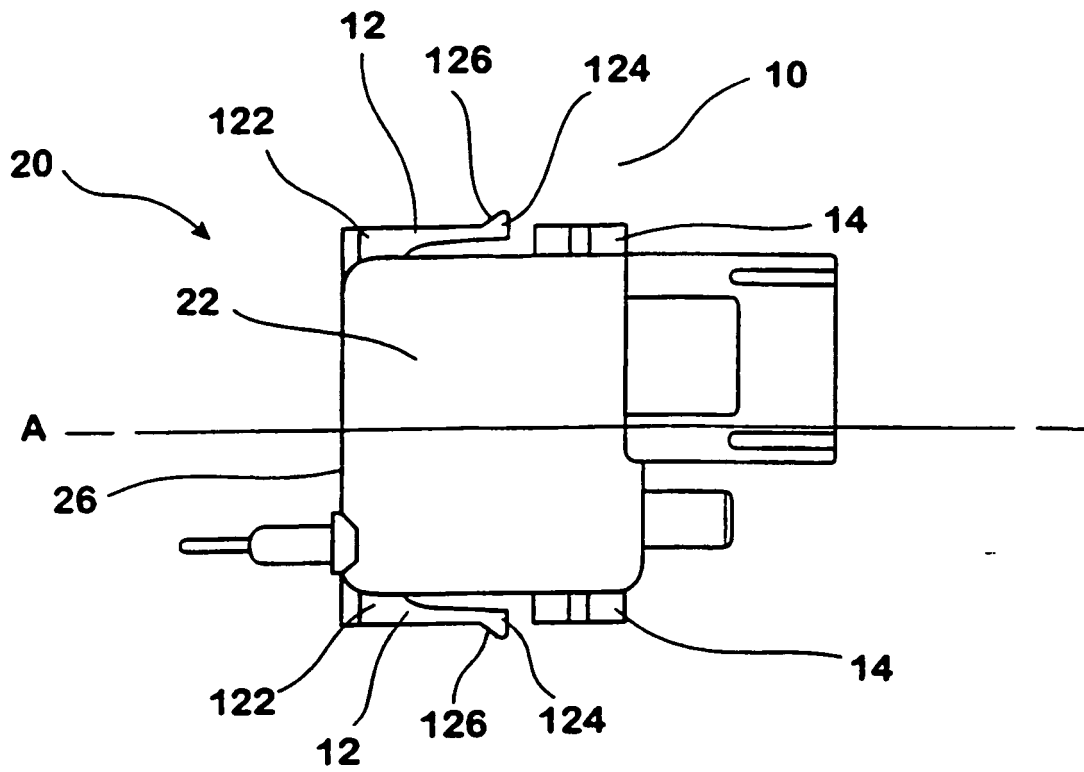


FIG. 2

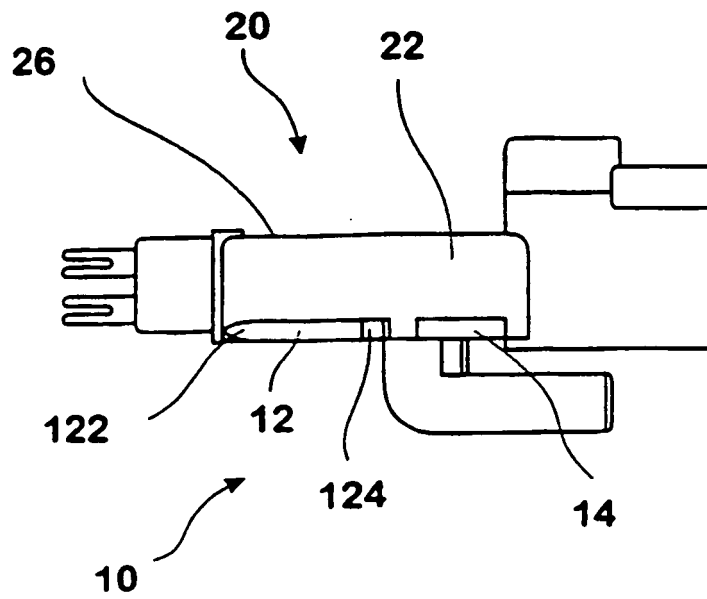


FIG. 3

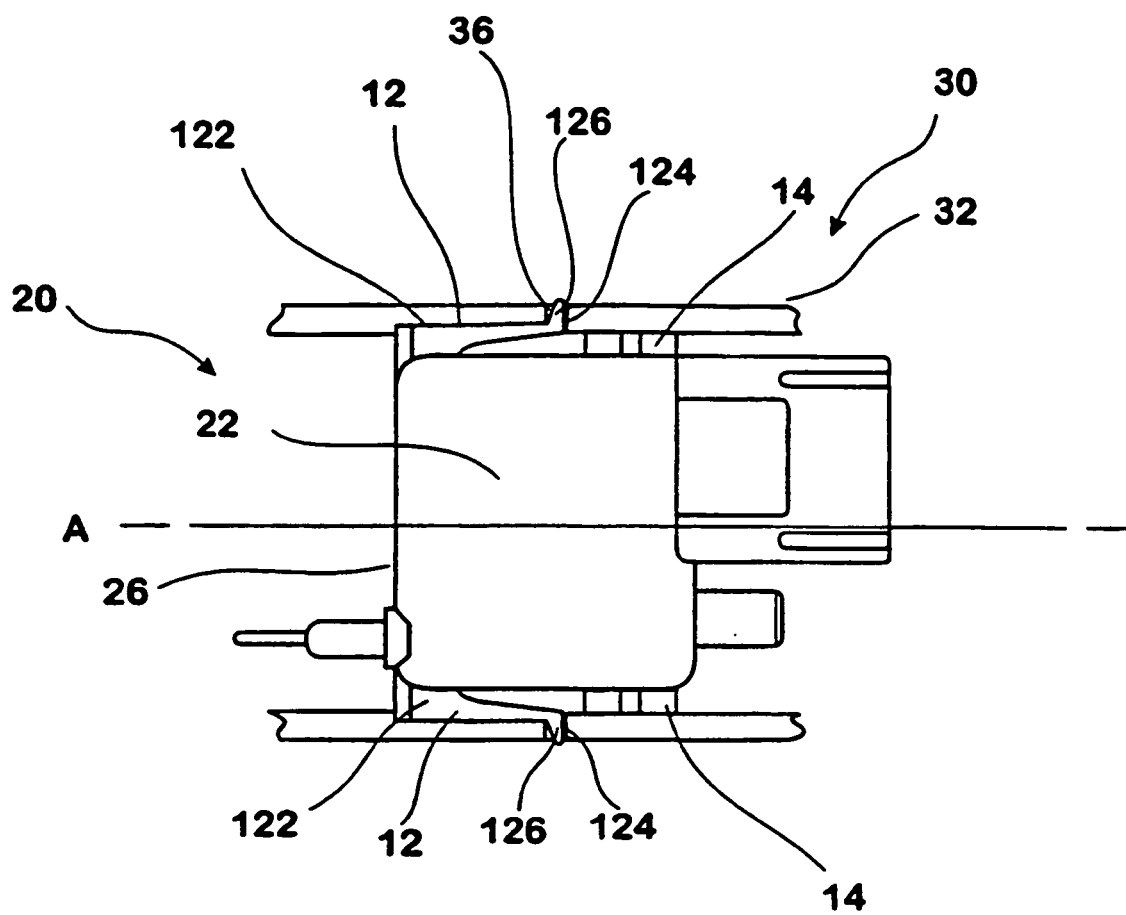
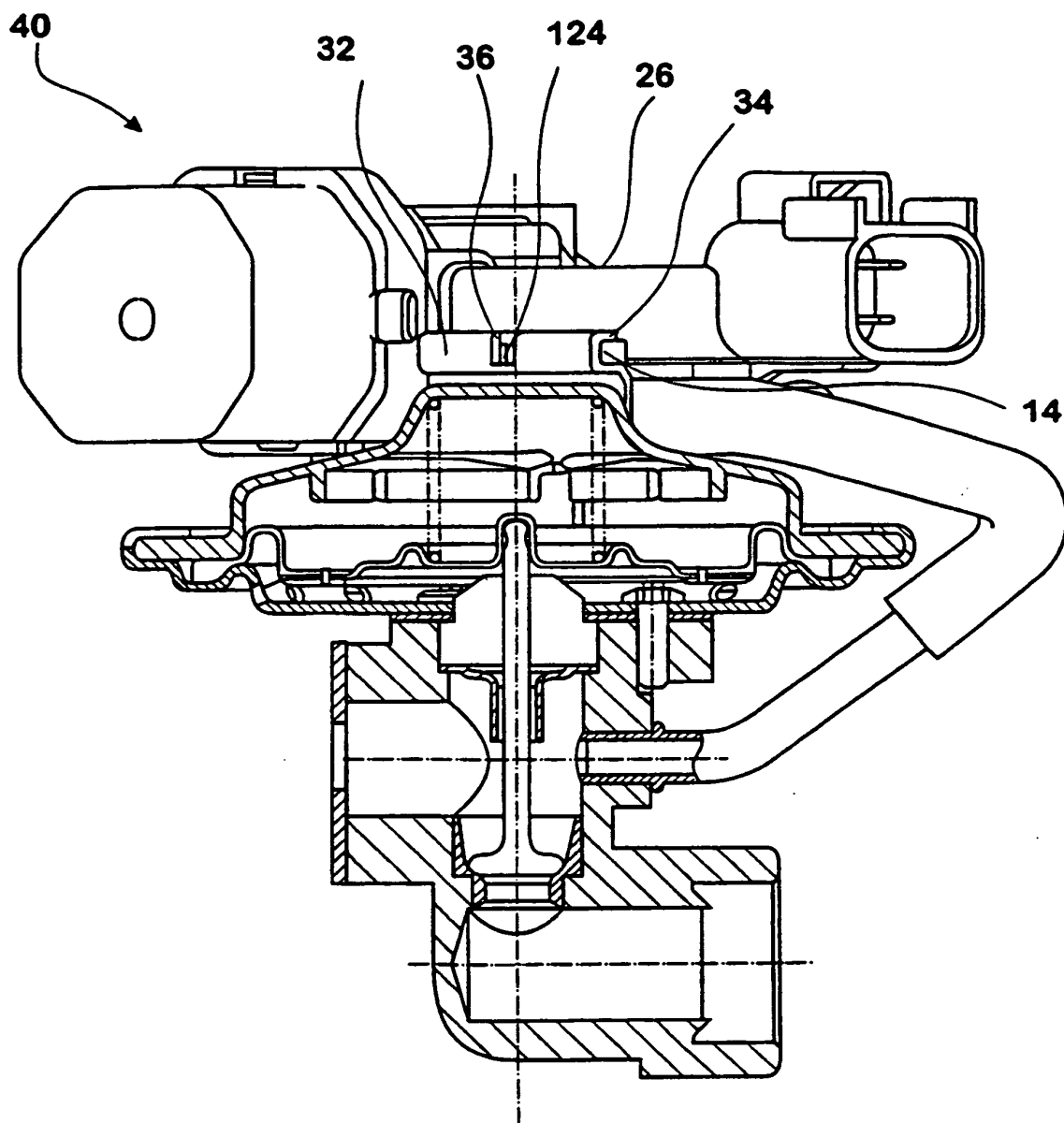


FIG. 4



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0415489 A [0006]