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(54) Pluggable and lockable monopole connector

(57) A monopole electrical connector (4) for interconnecting a conductor such as a cable to a structure for ground or power connection, comprises a receptacle portion mountable over a stud (8) having transverse locking protrusions (13). A locking ring (32) is resiliently and rotatably assembled to the connector housing (14), and comprises a camming slot (52) engaging the locking studs (13) of the mating connector (6). The oblique camming portion (52) of the camming slot ensures that unless complete coupling of the connectors has occurred, the connectors are biased to an uncoupled and electrically disconnected state. In the fully coupled state, a transverse locking portion (54) of the camming slot (50) engages the locking protrusions (13) of the mating connector thereby securely locking the connectors together.

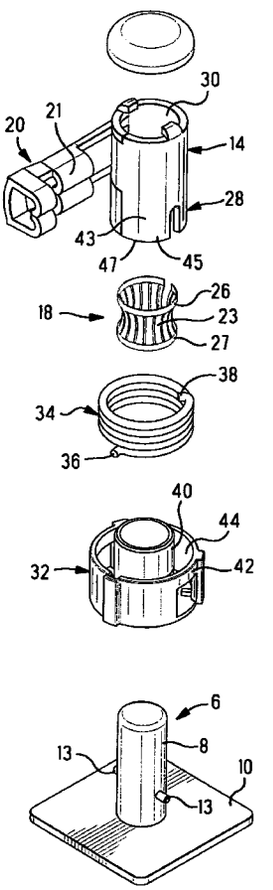

FIG. 2

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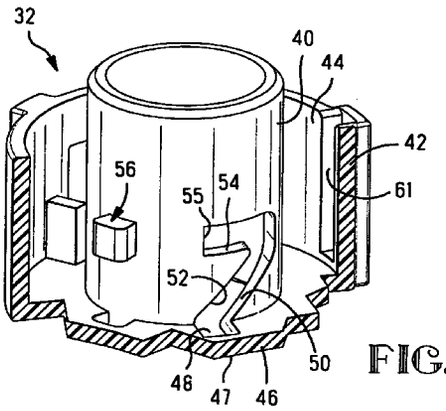

FIG. 4

Description

[0001] This invention relates to a pluggable electrical connector with a lacking mechanism, for example a receptacle connector pluggable on a monopole complementary power connection.

[0002] In many industries it is common to connect earth or ground cable connections to conductive structures by crimping a cable to a ring tongue terminal and bolting it to the structure. Monopole connections of this sort are also used for connection to power supplies, for example for connection to power supply points in an automobile. It is common to find connection points in various structures comprising threaded bolts which are welded or otherwise attached to the structure, over which the ring tongue terminal is inserted and connected by tightening a nut thereagainst. Threaded connections have a number of disadvantages. One disadvantage is that the contact pressure between the terminal and structure is difficult to adjust in view of the tolerance in frictional forces of threaded connections, affecting the clamping force of the nut when a specified torque is applied. When subject to vibration, or thermal stresses, relaxation of the contact pressure, or loosening of the threaded connection may occur. In an automobile, where connections are subject to vibration and thermal stresses, bolted connections for ground or power connections are problematic. A further disadvantage of threaded connections, is the cost of assembly, the placing of the ring tongue terminal and tightening of the nut being manual. Threaded connections are not suitable for multipole connections, and if both power and ground are to be connected by a single cable or unit, two terminals separately bolted to the structure are required.

[0003] It would be advantageous to provide a more versatile connection system that can be used for monopole or multiple connections. It would be advantageous to provide a secure connection even when subject to vibration and thermal cycles. It would be desirable to enable rapid and secure connection.

[0004] Objects of this invention have been achieved by providing the connector assembly according to claim 1. Disclosed herein in an electrical connector comprising a connection section for connection to a conductor such as a cable, a contact section for pluggable connection to a complementary connector, and a locking mechanism for securing the connectors in the coupled position, wherein the locking mechanism comprises a locking element movable relative to the contact section in a direction transverse to a plugging direction of the connectors, the locking element engaged by a spring member biasing the locking element towards a rest position corresponding to a position taken by the locking element when the connectors are fully coupled and locked by the locking element, the locking element comprising a camming slot or stud coupleable with a complementary camming stud or slot of the mating connector, the camming slot having an oblique transition portion adapted to move the locking element transversely against the bias of the spring during coupling of the connectors, the camming slot comprising a locking portion extending from the transition portion and adapted to allow the locking element to resiliently bias to the locked position when the connector are fully coupled, the connector further comprising a guide element cooperating with a complementary guide element of the mating connector during coupling, the guide elements adapted to guide the contact section and complementary connector in the plugging direction whilst the locking element is resiliently transversely moved during coupling. Advantageously, the connector can thus be plugged rapidly to the mating connector whereby the locking element is resiliently biased into the locked position transverse to the mating direction for a secure and rapid coupling.

[0005] The locking element may be ring-shaped and rotatably movable about the contact section. The guide element may be in the form of a protrusion or slot extending in the mating direction to prevent relative movement between the mating section and complementary connector in the transverse direction during plugging, the guide elements providing the reactive support force countering the spring force of the locking element. The locking element may be provided with the camming slot, and the mating connector with the camming stud cooperating therewith, the locking element having an entry cutout at a mating face thereof for receiving and guiding the camming studs into the camming slot thereof. The camming studs of the mating connector may advantageously also perform the function of guide elements received in the guiding slot in the mating section of the connector. The mating section of the connector may be formed by a stamped and formed sheet metal part integrally connected to the connection section where the connector is a monopole connector for plugging to a mating connector in the form of a stud for ground or power supply. The mating section may further comprise transverse guiding portions coupleable with complementary transverse guiding portions of the locking element in order to guide the locking element in transverse movement relative to the mating section, the guiding elements comprising a protrusion or slot on the locking element received in a complementary slot or protrusion in the mating section. The transverse guiding elements may extend in a transverse direction that is substantially perpendicular to the connector mating direction. The locking portion of the camming slot of the locking element may extend substantially orthogonally to the mating direction such that a secure retention of the connector to the complementary connector is ensured. Due to the oblique transitional slot and resilient biasing of the locking element, connectors which are incompletely coupled are biased to the fully uncoupled position. The connectors are thus prohibited from remaining in an incomplete coupled position that may subsequently uncouple during operation.

[0006] Other advantageous aspect of the invention are set forth in the claims, or will be apparent from the following description and drawings.

figure 1 is a perspective view of a connector assembly according to this invention, shown in the uncoupled state;
figure 2 is an exploded perspective view of the connector assembly;
figure 3 is a perspective of a housing or mating end connection section of the receptacle connector according to this invention;
figure 4 is a perspective partial cross sectional view of a locking element of the receptacle connector;
figure 5 is a perspective view viewed towards a mating face of the locking element;
figure 6 is a side view of the connectors in an initial coupling position, with the locking element partially cut away for clarity;
figure 7 is a view in the direction of arrow 7 of figure 6;
figure 8 is a view similar to figure 6 but with the connectors in an almost fully coupled position, just prior to the fully coupled and secure state;
figure 9 is a view in the direction of arrow 9 of figure 8;
figure 10 is a view similar to figure 9 of the connectors in the fully coupled and locked position;
figure 11 is a view in the direction of arrow 11 of figure 10;
figure 12 is a cross sectional view through the connector assembly in the initial coupling position;
figure 13 is a cross sectional view similar to figure 12 showing the connectors in the fully coupled position.

[0007] Referring to figures 1 and 2, a connector assembly 2 comprises a connector 4 and a complementary or mating connector 6 for pluggable coupling with the connector 4. The connector 6 is in this embodiment a monopole connector in the form of a cylindrical conductive stud 8 extending from a conductive base plate 10 that can be welded or otherwise fixed to a conductive structure, or for connection to a conductor such as a cable for ground or power connection. The connector assembly 2 in this embodiment is thus for monopole applications such as ground or power connections in an automobile for example. The complementary connector 6 further comprises a locking element 12 in the form of an elastic pin inserted transversely to the coupling direction M in a bore traversing the cylindrical stud 8 proximate the base 10. A pair of ends 13 of the locking element 12 thus project through opposite sides of the mating connector 6 and act as camming and locking elements.

[0008] The receptacle connector 4 comprises a housing or body 14, a locking mechanism 16, a contact section 18, and a connection section 20. In this embodiment, as the connector is for single pole applications, the body or housing 14 is conductive, and is stamped and formed from sheet metal integrally with the connection section 20 which in this embodiment comprises a crimping barrel 21 for crimping to a cable conductor. The body could also be made of an insulative housing receiving a plurality of contacts therein for plugging connection to a plurality of contacts of a complementary connector comprising a housing and a complementary plurality of terminals.

[0009] In monopole applications, it is advantageous to integrally form the body 14 with the connection section 20 in view reducing number of parts and the costs of manufacture. In addition, the contact section 18 mounted within the body 14 can be electrically connected to the body 14. It is also possible to provide a contact section stamped integrally from the body 14 that engages the complementary stud 8. The separate contact section 18 however can be made of a material with greater elasticity than the connection section material, and in this embodiment is in the form of an approximately cylindrical part having a plurality of contact arms 23 extending in the mating direction M arranged around the circumference of the contact section and having inwardly bowed contacts (see figure 13) that resiliently bias against the contact surface 25 of the cylindrical stud 8. The ring support sections 26, 27 at the top and bottom of the contact section 18 support the contact arms 23 that extend therebetween, and also provide mechanical and electrical connection with the conductive body 14 as best seen in figure 13.

[0010] The connector 4 has a mating section 28 comprising a cavity 30 for receiving the contact section 18 therein, the mating section formed by the housing 14 for pluggable connection to the mating section of the complementary connector 6. The locking mechanism 16 is mounted to the housing 14 and forms part of the mating section 28, the locking mechanism comprising a locking element 32 and a spring member 34. As the housing 14 is substantially cylindrical, the locking element 32 is substantially in the form of a ring rotatably movably mounted on the housing 14. The spring member 34 has an attachment portion in the form of an end protrusion 36 that attaches to the locking element, and a second attachment portion in the form of a further end protrusion 38 that attaches to the housing 14, such that the locking member 32 is resiliently movable in a transverse direction with respect to the connector housing 14. In this particular embodiment, as the locking element is rotatably mounted on the housing 14, the spring member 34 acts in torsion and produces a torque spring bias between he locking element and the housing. It is also possible to provide a locking member 32 that is movable in a direction transverse T to the mating direction M, and preferably perpendicularly to the mating direction M, in a linear or non circular motion whilst nevertheless providing the secure locking effect according to this invention. In this particular embodiment, however, a rotational

movement of the locking element and provision of the torsion spring 34 provides a simple and reliable solution.

[0011] Referring to figures 3 and 4 in conjunction with figure 2, the locking element and assembly thereof to the housing 14 will be explained in more detail. The locking element in this embodiment is moulded from a plastic or similar mouldable material and comprises an inner substantially cylindrical wall 40 that is inserted into the housing cavity 30, and an outer wall 42 spaced from the inner wall 40 with a gap 44, the outer wall 42 positioned outside of an external surface 43 of the housing 14. A mating-end wall portion 45 of the housing 14 is thus received in the gap 44 of the locking element. A mating face wall 46 interconnects the inner and outer walls 40, 42 proximate a mating end 47 of the connector. The mating face wall 46 is provided with entry portions in the form of cutouts 48 adapted to receive the camming studs or projections 13 of the mating connector 6 therethrough into a camming slot 50 formed in the inner wall 40.

[0012] As best seen in figures 6-11, the camming protrusions 13 and camming slot 50 thus form complementary means that interengage to resiliently bias the locking element during coupling in the mating direction, transversely to the mating direction, and at full coupling bias the locking element to the fully locked position thereby securing the connectors in the fully coupled position. Whilst in this embodiment the camming slot 50 is advantageously provided on the moulded locking element and can thus be easily shaped at low cost, it is nevertheless possible to provide the camming groove on the complementary connector 6 and the camming protrusion on the locking element. This would for example be cost effective where the connector 6 comprises a insulative housing with camming grooves moulded therein. In the present embodiment, the monopole conductor 8 is preferably maintained as simple as possible for cost reasons, and view of exposure of the stud 8 when mounted to a structure or the like, whereby it is more advantageous to keep the stud 8 as simple as possible and provide the complicated functional features on the locking element that is removably pluggable to the structure. The camming slot 50 in the locking element comprises an oblique transition portion 52 that may for example have a substantially helical shape, extending from the entry portion 48, the camming slot 50 further comprising a locking portion 54 extending transversely to the mating direction M and preferably orthogonally thereto, the locking portion having an end 55 defining a rest position against which the complementary camming protrusion 13 abuts in the fully coupled position. The locking portion 54 may also be provided with a slight recess directed towards the mating end 47 in order to ensure that even under conditions of vibration and application of an uncoupling force on the connector 6, the locking element 32 remains resiliently biased against the complementary locking protrusions. The locking element further comprises a transverse guide element 56 that engages with a complementary guide member 57 (see figure 3) of the housing 14 in order to guide the transverse movement T of the locking element with respect to the housing 14, whilst retaining the locking element to the housing 14 in the mating direction M. In this embodiment the guide members constitute a guide protrusion 56 protruding from the inner wall 40 of the locking element and received in a slot 57 extending transversely across the body 14 from an assembly entry portion 58 to an end 59. The entry portion 58 extends in the mating direction M to a spring attachment extension or cutout 60 in which the inwardly directed attachment portion 38 (see figure 2) of the spring 34 projects, such that the spring attachment portion 38 is retained to the housing 14 in the transverse direction (T).

[0013] The connector housing 14 further comprises a mating direction guide member 62 in the form of a slot extending from the mating end 47 of the housing 14, in the mating direction to an end 63 for receiving complementary guide portions of the mating connector 6 therein. The complementary guide portions are in this embodiment advantageously formed by the camming protrusions or locking elements 13, such that the connectors 4, 6 are polarised and guided with respect to each other during coupling whilst the locking element is transversely resiliently biased. The guiding and polarising of the connectors may however be performed by other guide means, or by providing complementary non-symmetrical shapes of the connectors such that only specific orientations are permitted with respect to each other. In the present monopole embodiment, it is however advantageous to utilise the locking and camming protrusions 13 also for guiding of the connectors in the mating direction, taking account of the torque or force applied by the spring 34.

[0014] As shown in figure 6, the camming or locking protrusion 13 is inserted through the locking element entry portion 48 and abuts the oblique angled transitional camming surface of the transitional camming portion 52 and simultaneously enters the connector body guide slot 62. During further plugging of the connectors together, the locking element is transversely biased n opposition to he spring force of the spring member which is wound to provide spring torsion on the locking element until the fully coupled position is reached and the locking element resiliently rotates from the extreme transitional state shown in figure 8 and figure 9, to the fully coupled locked or rest position shown in figure 10 and figure 11, where the locking protrusion 13 abuts against the rest surface 54 of the camming slot locking portion 54. The transverse locking surface 53 of the locking portion 54 thus securely retains the connectors in a locked fully coupled position. If coupling is incomplete, the resilient bias of the oblique camming surface 52 against the complementary protrusion 13 will cause the connectors to move to the initial coupling position

shown in figures 6 and 12, whereby as best seen in figure 12 the contact section 18 is electrically disconnected from the mating contact section 8. Incorrect coupling is thus detected at an early stage and inadvertent disconnection during operation is avoided.

[0015] Advantageously therefore, particularly simple and rapid coupling connection, in particular for monopole power or ground connections between a cable conductor and a structure is thus provided.

Claims

1. A electrical connector (4) comprising a connection section (20) for connection to a conductor such as a cable, a contact section (8) for pluggable connection to a complementary connector (6), and a locking mechanism (16) for securing the connectors in the coupled position, wherein the locking mechanism comprises a locking element (32) movable relative to the contact section in a direction transverse (T) to a plugging or mating direction (M) of the connectors, the locking element engaged by a spring member (34) biasing the locking element towards a rest position corresponding to a position taken by the locking element when the connectors are fully coupled and locked by the locking element, the locking element comprising a camming slot (50) or protrusion coupleable with a complementary camming protrusion (13) or slot of the mating connector, the camming slot (50) having an oblique transition portion (52) adapted to move the locking element transversely against the bias of the spring member during coupling of the connectors, the camming slot (50) comprising a locking portion (54) extending from the transition portion (52) and adapted to allow the locking element (32) to resiliently bias to the locked position when the connectors are fully coupled, the connector further comprising a mating direction guide element (62) cooperating with a complementary guide element (13) of the mating connector during coupling, the guide elements (62,13) adapted to guide the contact section and complementary connector in the plugging direction (M) whilst the locking element (32) is resiliently transversely moved during coupling.

2. The connector of claim 1 wherein the connector comprises a body or housing (14) within which the contact section is provided, the body extending to a mating face (47) and having a cavity (30) for receiving the mating connector therein through the mating face (47).

3. The connector of claim 2 wherein the body is stamped and formed from sheet metal.

4. The connector of claim 2 or 3 wherein the body is integrally formed with the connection section (21) which is adapted for electrical connection to a cable, for example by crimping.

5. The connector of any one of claims 2-4 wherein the body has an approximately cylindrical shape extending in the mating direction (M).

6. The connector of any one of the preceding claims wherein the locking element (32) is moulded from plastic or similar mouldable material, and is provided with the camming slot (50) receiving the locking protrusion (13) of the mating connector.

7. The connector of claim (6) wherein the locking element comprises an inner wall (40) received within a cavity (30) of a body or housing (14) of the connector, the inner wall provided with the camming slot (50).

8. The connector of claim 6 or 7 wherein the locking element comprises an outer wall (42) separated from an inner wall (40) by a gap (44) within which a mating end section (45) of the housing or body (14) is received.

9. The connector of any one of the preceding claims wherein the mating direction guide element (62) is cut out of the body or housing (14) extending from the mating face (47) of the connector.

10. The connector of any one of the preceding claims wherein the locking element has a mating face wall (46) extending between inner and outer walls (40,42) mountable adjacent the body or housing (14) of the connector, the mating face wall (46) provided with entry portions (46) in the form of cutouts for receiving the complementary camming protrusions (13) therethrough into the camming slot (50).

11. The connector of any one of the preceding claims wherein the spring member (34) is substantially in the form of a coil receivable around a body or housing (14) of the connector and enclosed by an outer wall (42) of the locking element (32), which is approximately in the shape of a ring.

12. An electrical connector assembly comprising the connector of any one of the preceding claims and the mating connector (6), wherein the mating connector is approximately in the form of a cylindrical stud (8).

13. The assembly of the preceding claim wherein a pin (12) inserted into a transverse bore of the contact stud (8) provides the camming protrusion or protrusions (13) on one or opposite sides respectively of the contact stud (8) for engagement in the camming slot or slots (50) of the locking element (32).

14. The assembly of either of the two preceding claims wherein the camming protrusions (13) also serve as the complementary guide element (62) of the connector body or housing (40).

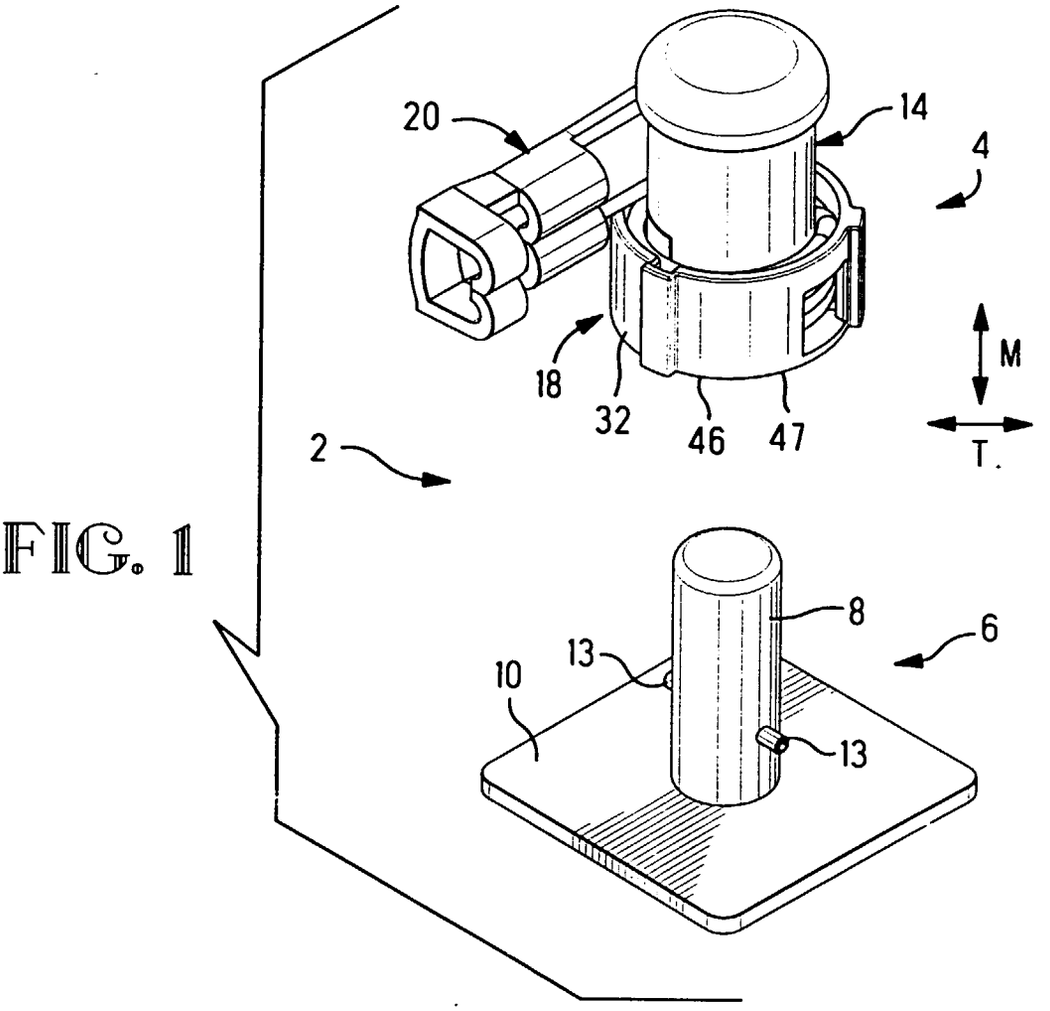

FIG. 1

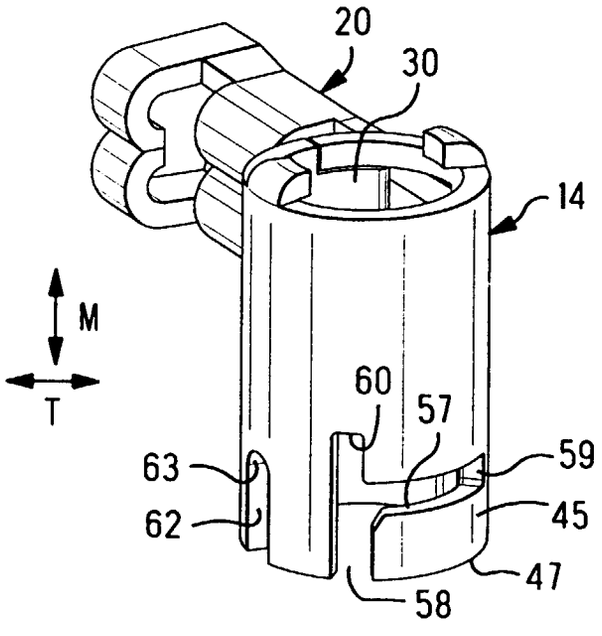

FIG. 3

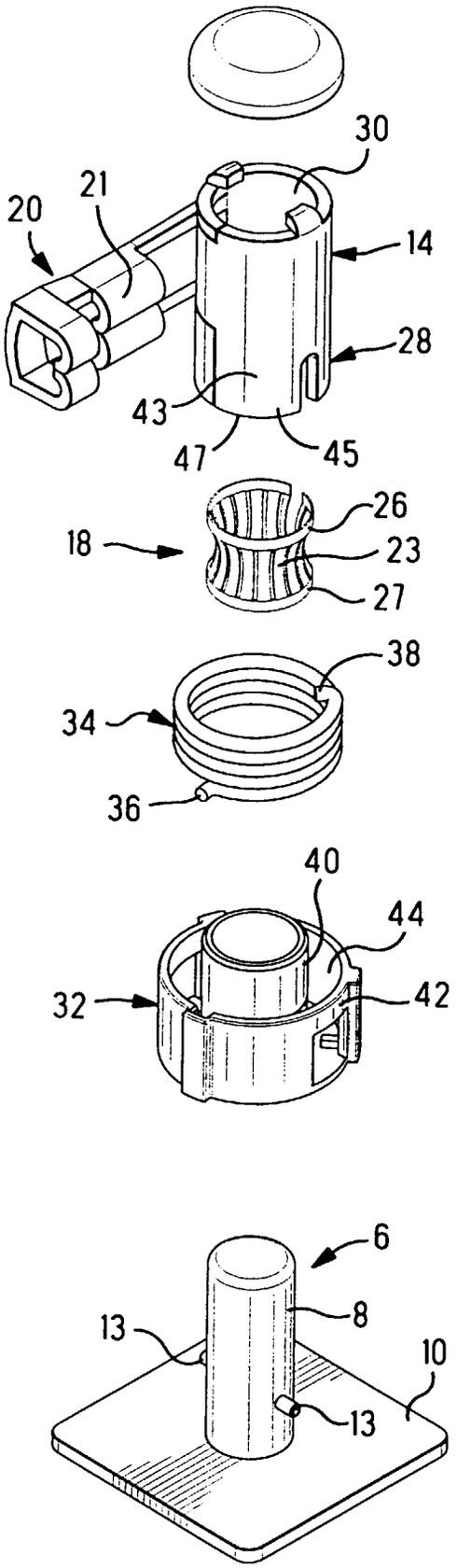

FIG. 2

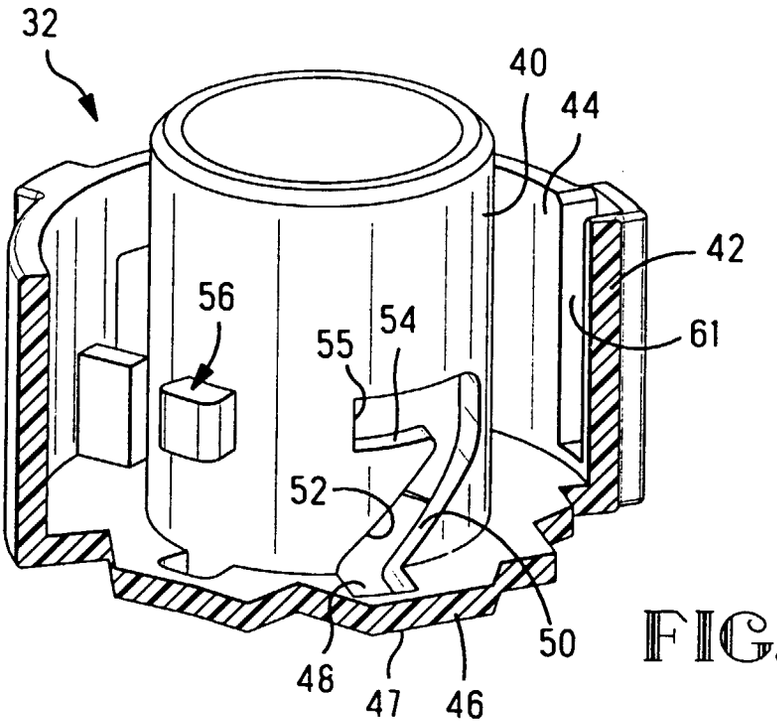

FIG. 4

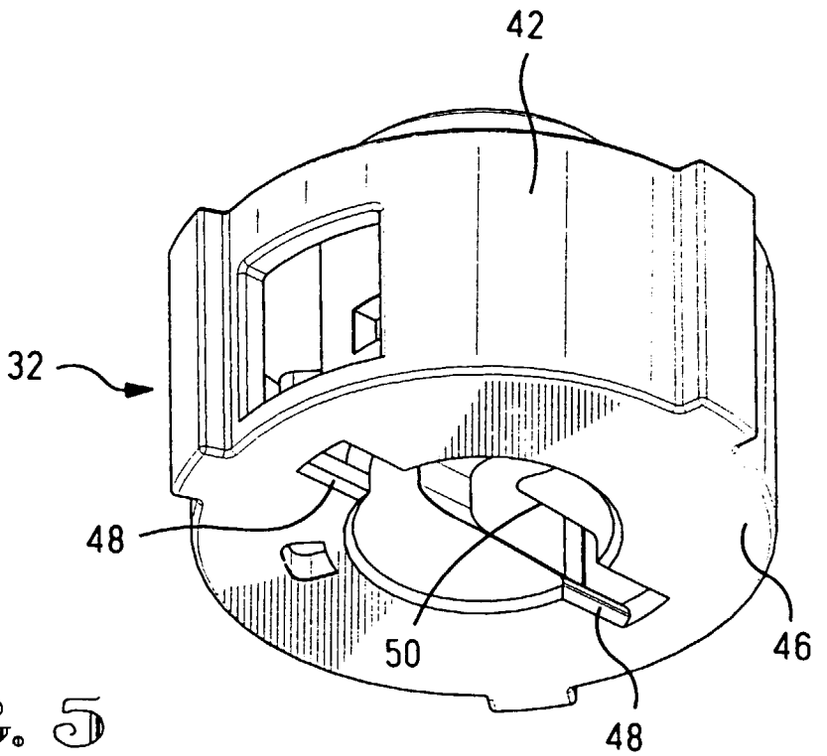

FIG. 5

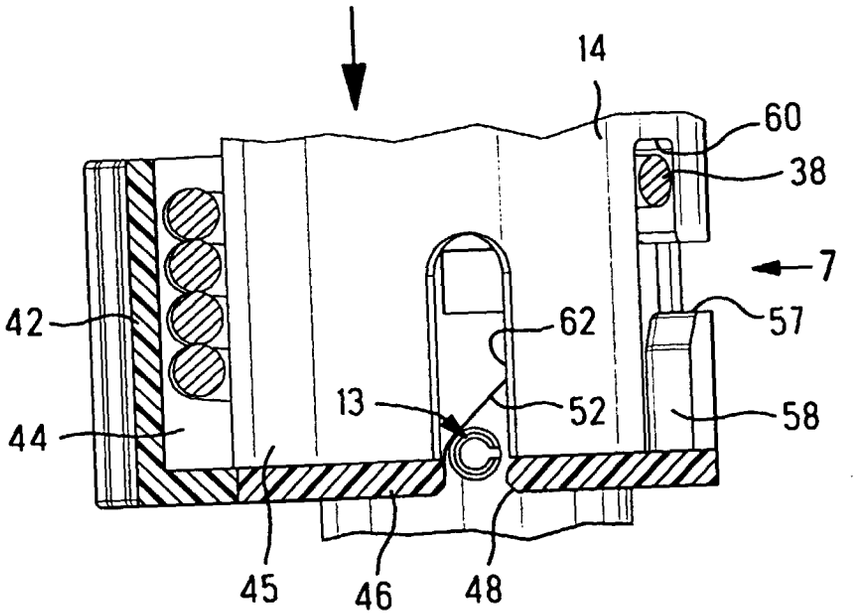

FIG. 6

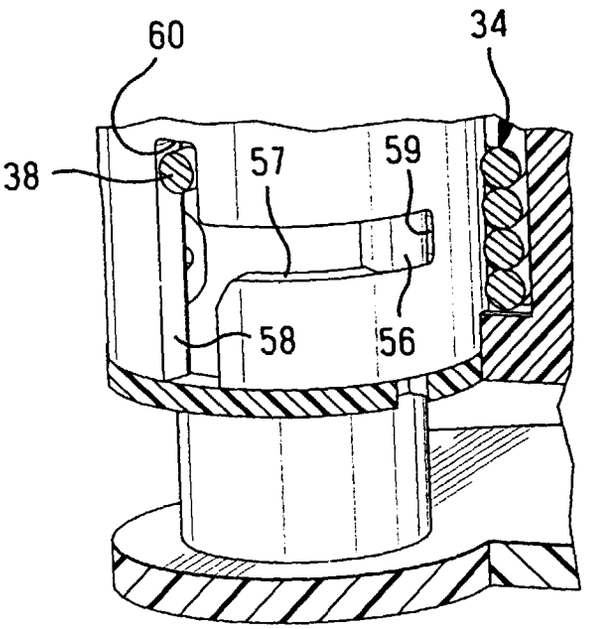

FIG. 7

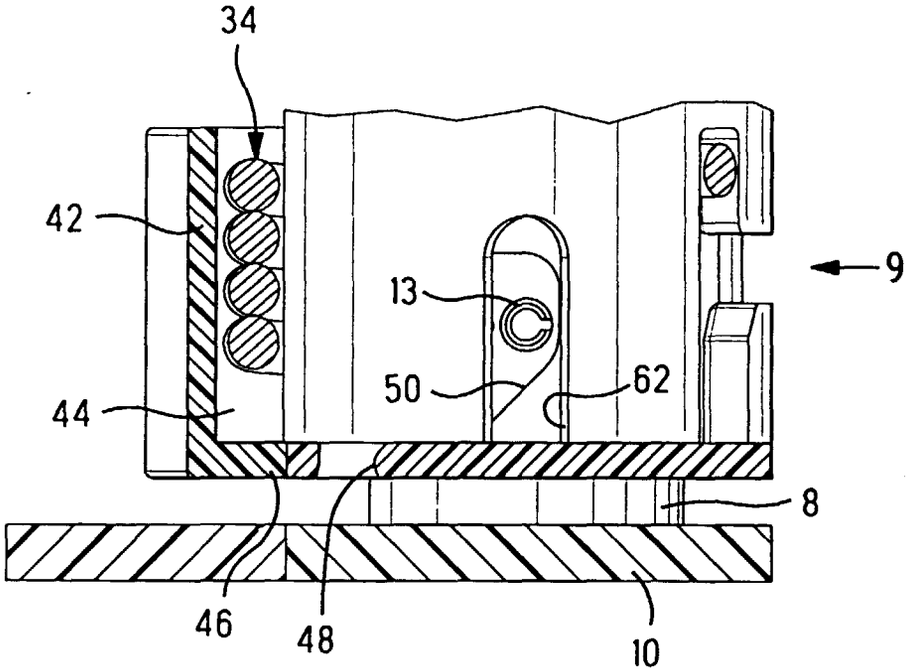

FIG. 8

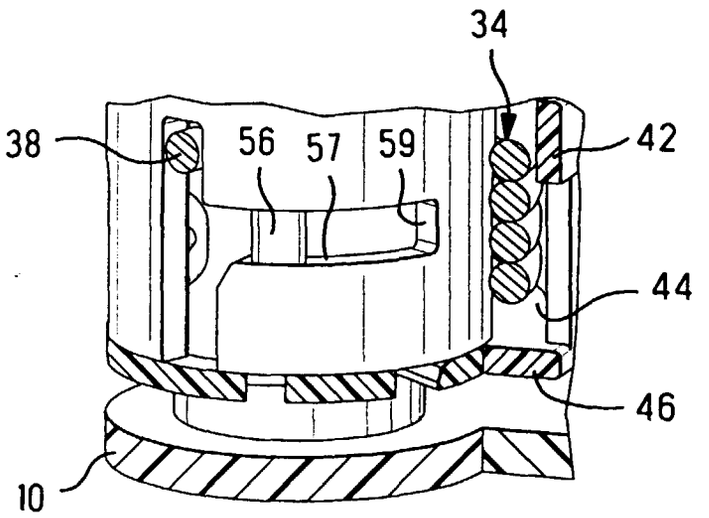

FIG. 9

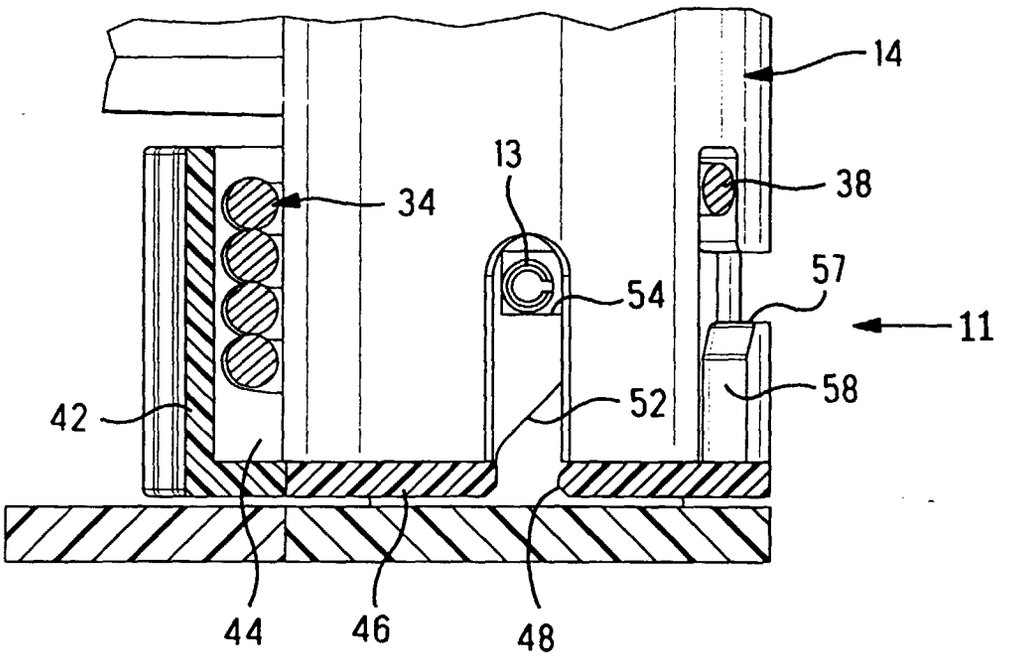

FIG. 10

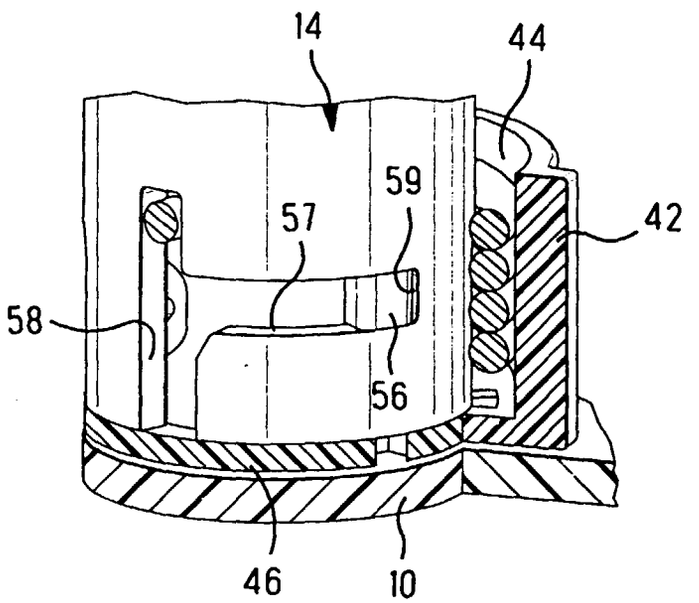

FIG. 11

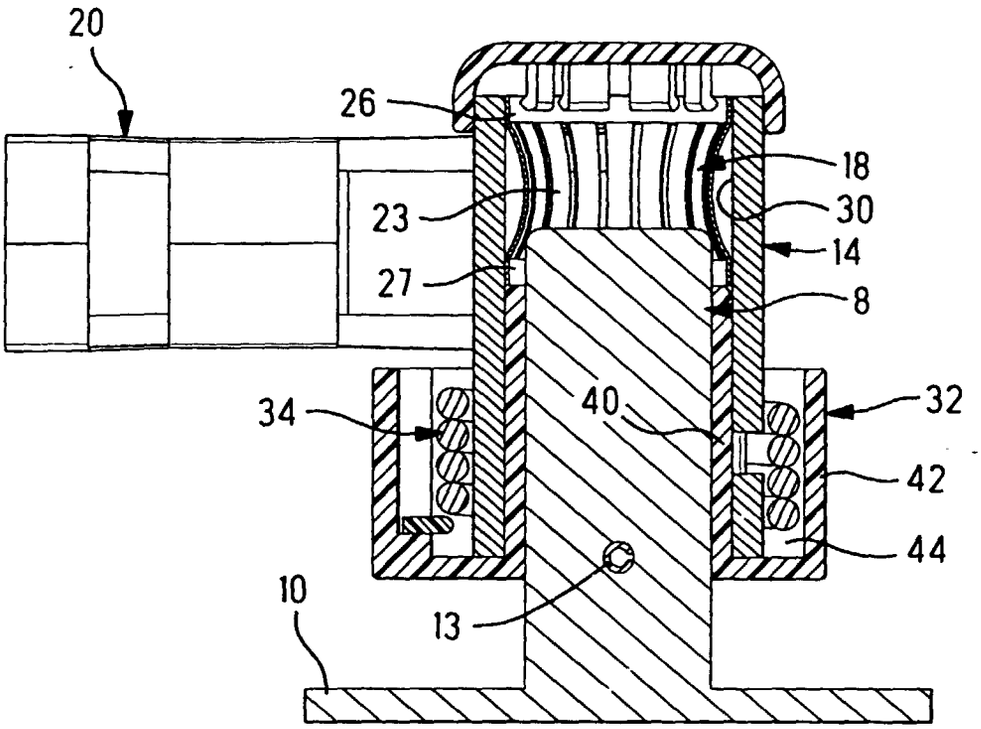

FIG. 12

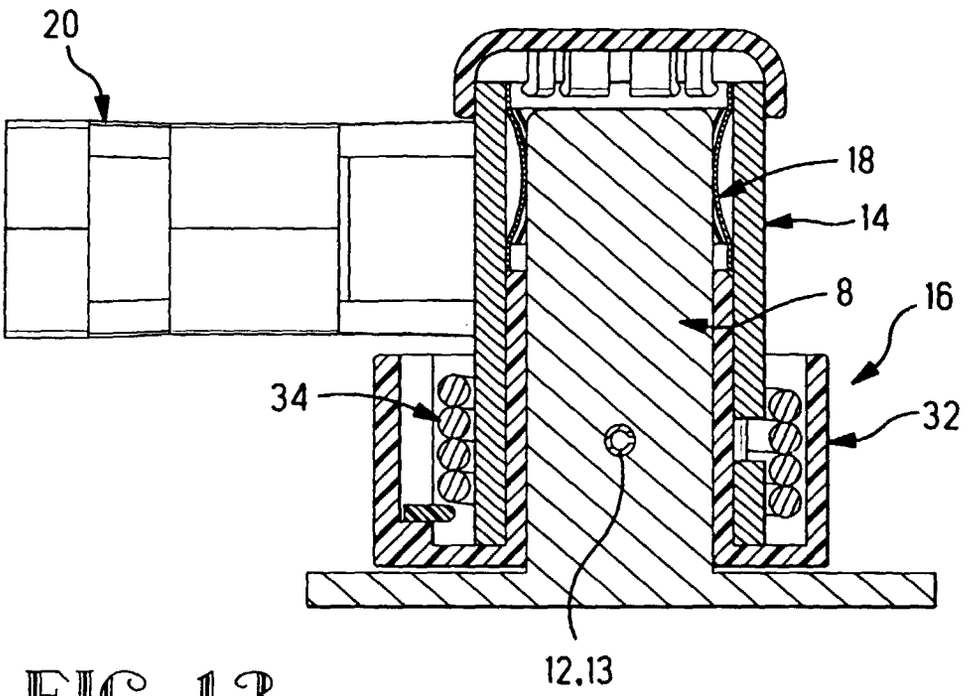

FIG. 13

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 10 4344

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.6) H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	1 July 1999	Serrano Funcia, J

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 10 4344

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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