(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 709 926 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.05.1996 Bulletin 1996/18

(51) Int Cl.[6]: **H01R 13/621**

(21) Application number: **95307674.2**

(22) Date of filing: **27.10.1995**

(84) Designated Contracting States:
DE FR GB IT

(30) Priority: **28.10.1994 US 331258**

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(54) A center jackscrew type connector system

(57) In a central jackscrew type connector system (22), a plastic module housing (28) is mated with a plastic receptacle housing, by means of a bolt (12). A metal insert, having an internally threaded metal blind axial bore is provided within the module housing (28), such that when the bolt (12) is torqued into the blind axial bore (31), a tip (73) on a threaded portion (71) of the bolt (12) engages a bottom (32) of the blind axial bore (31) prior to a flange (21) on the bolt (12) engaging the receptacle housing (50), thereby not applying the torque load to the plastic components. A crush rib is provided on the receptacle housing to bear a load applied by the flange (21) on the bolt (12) and to create a required compressive force keeping the module housing (28) and the receptacle housing snugly together. By torquing the bolt (12) to a predetermined value, the metal insert (29) is stretched relative to the bolt (12), and internal threads are deformed, thereby creating and storing strain energy. A portion of stored strain energy is recoverable, thereby providing a locking force keeping the bolt (12) within the metal insert (29).

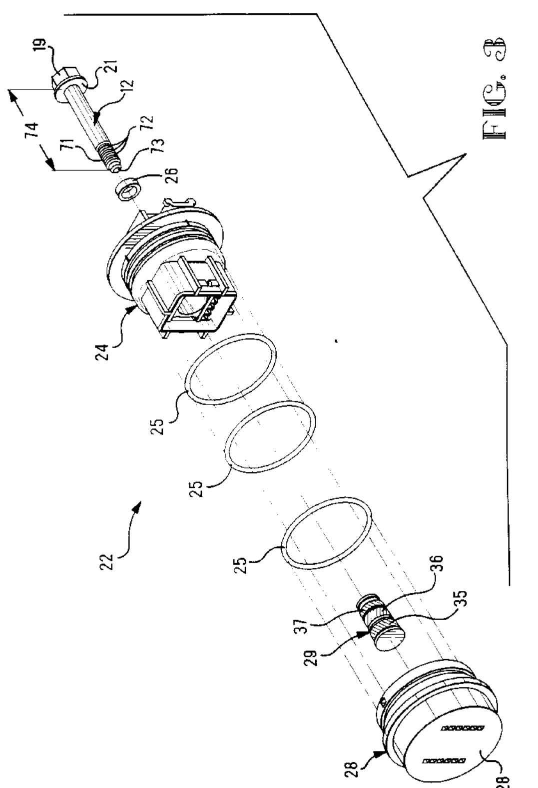

FIG. 3

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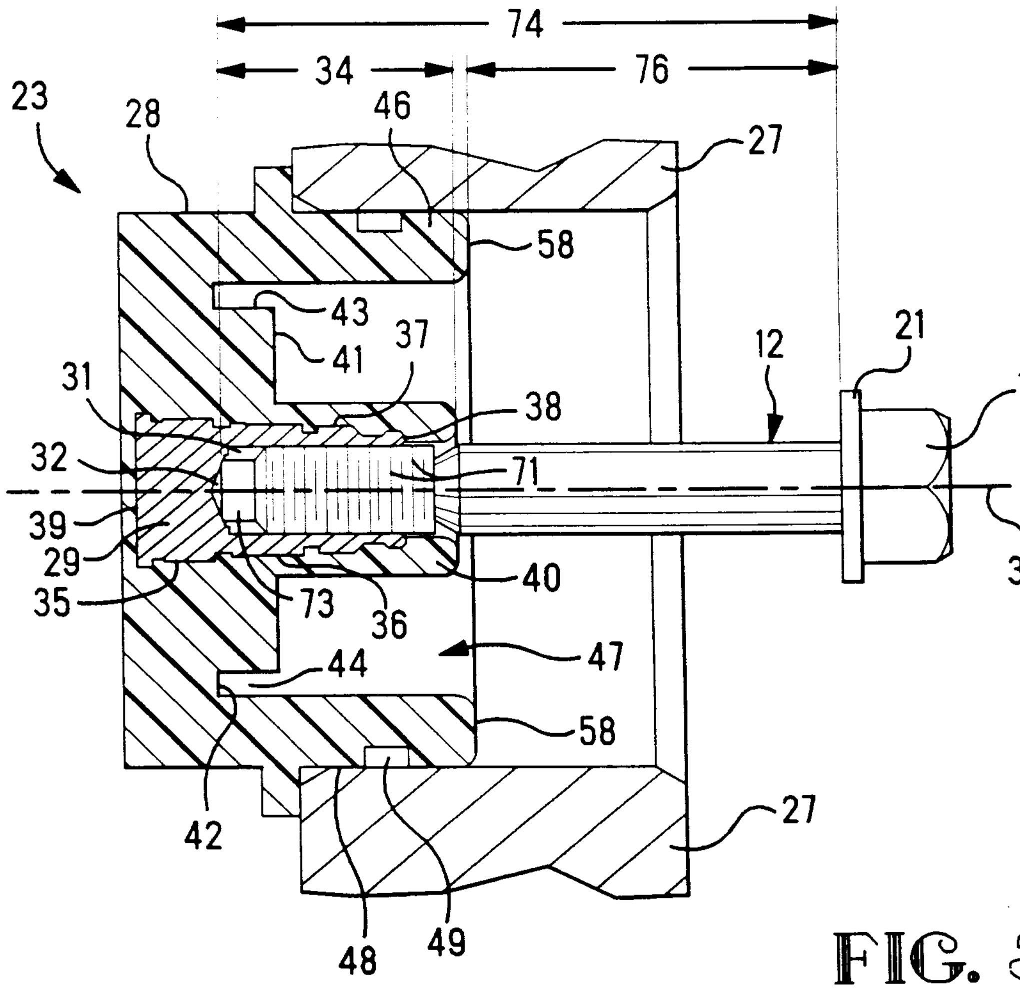
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FIG. 5

Description

The present invention relates to the field of electrical connectors, and more particularly, to center jackscrew type connectors with over torque protection and with enhanced locking performance.

Center jackscrew type connectors typically include a pair of mating plastic housings (a module housing and a receptacle housing) which are connected to each other and fastened by means of a steel bolt which has a threaded portion and a flange spaced apart from the threaded portion. The threaded portion of the bolt is threaded into a tapped metal insert installed longitudinally within the module housing until both the module housing and the receptacle housing bottom. As the bolt is over torqued, the plastic housings are placed in greater and greater compression. Referring to FIGS. 1 and 2, a module housing 10 mates with a receptacle housing 11 by means of a bolt 12. A metal insert 13 is installed within the module housing 10 to receive the threaded portion 14 of the bolt 12. The bolt 12 is threaded into the metal insert 13 until mating surface 16 of the module housing 10 and mating surface 17 of the receptacle housing 11 bottom (or engage each other). As the bolt 12 is over torqued, the module housing 10 and the receptacle housing 11 are placed in continually increasing compression until the plastic breaks. For example, a particular application in the automotive field requires a torque of 60 inch-pounds which translates into a compressive force of 1,270 pounds on the plastic housings. The excessive torque is applied by a flange 21 on the bolt 12 (FIG. 1) which engages a tower 18 on the plastic housing 11 (FIG. 2) causing the tower 18 to mushroom out, shear off or crack.

A typical remedy for overcoming this problem is to employ additional strengthening components or else use very high compressive strength plastics as a material for the housings, all of which is burdensome and costly.

Another problem associated with center jackscrew type connectors is that after exposure to time and high temperature, the plastic will creep. A preload on the bolt 12, which was generated by the plastic in compression and which prevented the bolt 12 from coming loose initially, would therefore diminish sufficiently so that the bolt 12 will come loose. As the bolt 12 vibrates, the housings 10 and 11 of the connector assembly may come apart, and thus the connector assembly will result in loss of electrical engagement. Typically, an extra metal spring washer (or "dry lock") is used in the connector assembly to prevent the bolt 12 from coming loose. Any extra elements in the connector assembly are a distinct disadvantage and require additional assembly procedures.

Therefore, it would be highly desirable to have a more cost effective and simple method for making center jackscrew type connector systems more reliable and free from quality assurance problems.

It is, therefore, an object of the present invention to provide a cost effective center jackscrew type connector assembly, wherein the plastic parts of the connector assembly are not subject to damage under excessive torque loads, thereby eliminating plastic creep problems.

It is another object of the present invention to provide a center jackscrew type connector assembly with enhanced locking performance, thereby providing a permanent mechanical connection of the parts of the connector assembly and reliable electrical engagement of electrical contacts.

It is yet another object of the present invention to provide a simple and cost-effective method for maintaining a locking force between the threads of the bolt and the internal threads of the metal insert.

According to the present invention, in a central jackscrew type connector system, a plastic receptacle housing has an engagement surface and a crush rib on the engagement surface, and a module connector includes a metal insert having an internally-threaded blind axial bore having a bottom at a predetermined depth. When the blind axial bore receives the threaded portion of the bolt, the tip of the threaded portion engages the bottom of the blind axial bore prior to a flange on the bolt engaging the engagement surface of the receptacle housing. The flange engages the crush rib, thereby applying a required compressive load to the crush rib, which serves as sacrificial plastic.

The metal-to-metal contact between the tip of the bolt and the bottom of the blind axial bore keeps the flange on the bolt at a certain distance from the engagement surface of the receptacle housing, even if a sufficient over-torque is applied to the bolt, thereby avoiding an excessive compressive load to be applied to the receptacle housing.

The threaded portion of the bolt is received into the blind axial bore by turning the bolt until the tip on the threaded portion engages the bottom of the blind axial bore. Then, the bolt is turned further to a predetermined torque. This stretches the insert axially relative to the bolt and deforms the internal threads, thereby removably locking the bolt to the insert.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which:

FIG. 1 is a longitudinal cross-sectional view of a module connector of the prior art.

FIG. 2 is a longitudinal cross-sectional view of a complementary receptacle housing of the prior art.

FIG. 3 is a perspective exploded view of a connector assembly of the present invention.

FIG. 4 is a perspective view of the module connector.

FIG. 5 is a longitudinal sectional view of the module connector taken along lines 5-5 of FIG. 4.

FIG. 6 is a perspective view of the receptacle housing.

FIG. 7 is a longitudinal sectional view of the receptacle housing taken along lines 7-7 of FIG. 6.

FIGS. 8-11 are longitudinal sectional views showing the connector assembly mating sequence.

FIGS. 12-15 show respective longitudinal enlarged sectional views of the bolt within the metal insert during the over torquing procedure.

Referring to FIGS. 3-12, the connector assembly 22 of the present invention includes a module connector 23, an upper connector subassembly 24, sealing O-rings 25, a bolt 12, and a rubber bolt grommet 26. The module connector 23 and the upper connector subassembly 24 are removably secured to each other by the bolt 12. O-rings 25 provide a sealing function where the module connector and the upper connector subassembly 24 are received in a casting 27 (for example, an automotive transmission casing) as shown more clearly in FIG. 5.

The module connector 23 includes a plastic module housing 28 and a metal insert 29 (preferably made of brass) secured within the module housing 28 along its longitudinal axis 30. As best shown in Fig. 5, the metal insert 29 has an internally threaded blind axial bore 31 having a bottom 32 and a plurality of internal threads 33. The bottom 32 is located a predetermined depth 34 within the blind axial bore 31. On its external surface, the metal insert 29 has three rings 35, 36 and 37 with external threads, thereby securing the metal insert 29 within the module housing 28. While the internal surface of the blind axial bore 31 is shaped as a right cylinder, the external surface has a gradually changing cross-section diameter, increasing in the direction from an opening 38 of the blind axial bore 31 towards the head 39 of the metal insert 29.

In the center of the module housing 28, a tower-like element 40 is provided to receive and secure a portion of the metal insert 29. A step-like element 41 is extended above a bottom 42 of the module housing 28 and extends longitudinally from the bottom 42 until the tower-like element 40. The step-like element 41 has walls 43, which form recesses 44 between an external surface of the walls 43 and an internal surface 45 of walls 46 of the module housing 28. The internal surface 45 of the walls 46 forms a box-like receptacle cavity 47, while an external surface 48 of the walls 46 is formed as a cylinder. The external surface 48 has a recess 49 for receiving one of the sealing O-rings 25 for sealing contact between the casting 27 and the module housing 28.

As shown more clearly in FIG. 7, the upper connector subassembly 24 includes a plastic receptacle housing 50 and a plurality of conductive wires (not shown) received in respective slots 51. The receptacle housing 50 includes a module side 52 and a wire side 53 connected by a main body 54. The module side 52 has walls 55 which, being of rectangular box-like shape, fit into the box-like receptacle cavity 47 of the module housing 28. On their external surface, the walls 55 have tabs 56 (FIGS. 8, 9) which are received in respective keyways 57 (FIG. 4) on internal surface 45 of the walls 46 of the module housing 28. The walls 55 extend from the main body 54 the full internal length of the module housing 28.

The main body 54 of the receptacle housing 50, being of cylindrical shape outwardly, has the same diameter as the cylindrical external surface 48 of the walls 46. This diameter is identified as a major diameter. The main body provides two recesses 61 for sealing O-rings 25.

The wire side 53 of the receptacle housing 50 has an axial tower-like element 62 having a cylindrical shape. The tower-like element 62 extends a predetermined length 63 (for example, 24.50 mm) from the mating surface 59 and has an engagement surface 64. In cross-sectional view (FIG. 7), the engagement surface 64 has a ring shape of a certain width 66. Crush rib 65 is integrally molded on the engagement surface 64. Crush rib 65 also has a cylindrical shape; however, a width 67 of the crush rib 65 is smaller than the width 66 of the engagement surface 64. The crush rib 65 extends axially from the engagement surface 64 by a certain length 68, such that an edge 69 of the crush rib 68 is spaced apart from the mating surface 59 by a predetermining length 70, for example, 25.50 mm.

Referring to FIG. 3, the bolt 12 has a threaded portion 71, having a plurality of external threads 72, the flange 21 at the head 19, and a tip 73. The tip 73 is spaced apart from the flange 21 by a predetermined distance 74.

As the module connector 23 and the upper connector subassembly 24 are being mated, the preassembled bolt 12 (inserted by its threaded portion first through a central through opening 75 and turned into the blind axial bore 31) is turned until the tip 73 hits the bottom 32 of the blind axial bore 31. Since the blind axial bore 31 has the predetermined depth 34 and the flange 21 is spaced apart from the tip 73 by the predetermined distance 74, the flange 21 is kept continuously a certain distance 76 from the mating surface 58 of the module housing 28, for example, 25.00 mm. When the tip 73 of the bolt 12 bottoms in the blind axial bore 31, the 25.00 mm distance 76 will not change regardless of torque applied to the bolt 12, due to metal-to-metal engagement of the steel tip 73 and brass bottom 32 of the blind axial bore 31. Due to chosen combination of the predetermining length 63, the predetermined length 70, the predetermined depth 34, and the predetermined distance 74, the tip 73 engages the bottom 32 simultaneously with the engagement between the mating surfaces 58, 59 and prior to the flange 21 of the bolt 12 engaging the engagement surface 64 of the tower-like element 62 on the receptacle housing 50. It will be appreciated by those skilled in the art, that due to the combination of the aforesaid predetermined dimensions, if the bolt 12 is over torqued by any required value, it will not crush or deform the plastic. The engagement surface 64 itself does not bear a torque force applied by flange 21. Rather, it is the crush rib 65, which bears the torque load applied by the flange 21, which creates compressive force on plastic module housing 28 and the receptacle housing 50. The crush rib 65 serves as sacrificial plastic material which is easily compressed and sheared off by the flange 21 of the bolt 12 in order that the module housing 28 and the receptacle housing could be held snugly together but not under the excessive compressive load.

Referring to FIGS. 8-11, showing the module housing 28 and the receptacle housing 50 in their mating sequence, tabs 56 on external surface of the walls 54 of the receptacle housing 50 engage respective keyways on the module housing 28. The major diameter of the main body 54 of the receptacle housing 50 engages the casting 27. The threads 72 of the bolt 12 engage the internal threads 33 of the blind axial bore 31, and the bolt is torqued down (O-rings 25 enter the casting 27) as the bolt 12 is turned until the tip 73 engages the bottom 32 and the mating surfaces 58 and 59 are engaged. Simultaneously, the crush rib 65 is sheared off and deformed by the flange 21 of the bolt 12. Since the receptacle housing 50 does not support the torque load generated by the bolt 12, the plastic creep problems are eliminated. This design can provide protection for plastic housings practically for any desired over torque. For example, an over torque of 60 inch-pounds, which is translated into a compressible force of above 1,270 pounds on the plastic housings 28, 50 has been achieved.

Referring to FIGS. 12-15, after the bolt 12 is turned into the blind axial bore 31 in the metal insert 29 (FIG. 12), and after the tip 73 of the bolt 12 engages the bottom 32 (FIG. 13), the mating surfaces 58 and 59 engage (FIG. 11), the bolt 12 is turned further (additional force is applied) to a predetermined torque value. This step causes a stretching of the metal insert 29 axially relative to the bolt 12 (FIGS. 14, 15). While the internal threads 33 are being deformed, the strain energy is being stored in the deformed system. A portion of the stored strain energy remains in the deformed system even after thermal cycling. This stored strain energy provides a frictional locking force between the internal threads 33 of the blind axial bore 31 and the external threads 72 of the bolt 12 and does not appreciably diminish during thermal cycling and vibration. Metal-to-metal interference of the steel bolt 12 and the brass threaded insert 29 keeps the bolt 12 from vibrating loose. The bolt 12 will not loosen and allow loss of electrical engagement between wires (not shown) and respective contact members (not shown). The steel bolt 12 may be employed in combination with the brass metal insert 29. It would also work if materials of the bolt and the metal insert were reversed, and/or the metal insert 29 would be made as the compressed member. For example, if the bolt 12 had a shoulder which bottomed on the mating face of the metal insert 29, the metal insert 29 would be compressed as the bolt 12 was turned.

Accordingly, the present invention provides a superior central jackscrew connector having a robust design, over torque protection for plastic components, reduced plastic creep problems and enhanced locking performance, thereby assuring proper mechanical and electrical engagement of all components of the connector system.

Claims

1. A central jackscrew type connector system (22) including:

   a module connector (23) and an upper connector subassembly (24) removably secured to the module connector (23) by means of a bolt (12) the bolt (12) having a threaded portion (71), a flange and a tip (73), the connector system characterized in that a receptacle housing (50) of the upper connector assembly (24) has a crush rib (65) on an engagement surface (64) the module connector (23) has a module housing (28) and a metal insert (29) secured within the module housing (28), the metal insert (29) has an internally-threaded blind axial bore (31) with a bottom (32) spaced a predetermined depth within the blind axial bore (31) the blind axial bore (31) the threaded portion (71) of the bolt (12), the tip (73) of the bolt (12) engaging the bottom (32) of the blind axial bore(31)prior to the flange (21) of the bolt (12) engaging the engagement surface (64) of the receptacle housing (50) to keep the flange (21) a certain distance from the engagement surface (64) and the flange (21) engaging the crush rib (65), thereby applying a required load to the crush rib (65).

2. The connector system (22) of claim 1, further characterized in that the module (28) housing has a first mating surface (58), wherein the receptacle housing (50) has a second mating surface (59), and wherein the first and the second mating surfaces engage each other when the tip (73) of the threaded portion (71) of the bolt (12) engages the bottom (32) of the blind axial bore (31).

3. The connector system (22) of claim 2, further characterized in that the crush rib (65) has an edge (69), wherein said edge (69) and the engagement surface (64) are axially spaced apart from the second mating surface (59) by a first and a second predetermined length, respectively, the first predetermined length being larger than the second predetermined length, and wherein a distance between the flange (21) on the bolt (12) and the first and the second mating surfaces (58,59), respectively, is larger than the second predetermined length and smaller than the first predetermined length.

4. The connector system (22) of claim 1, further char-

acterizd in that the receptacle housing (50) includes a module side (52) and a wire side (53) integrally connected by a main body (54), wherein the module side (52) includes respective walls (55), the respective walls (55) having an external surface including a plurality of tabs (56), wherein the module housing (28) provides a receptacle cavity (47), an internal surface (45) of the receptacle cavity (47) providing a plurality of keyways (57), the respective walls (55) on the module side (52) of the receptacle housing (50) being received in the receptacle cavity (47) in the module housing (28) with each of said plurality of tabs (56) being received into a respective one of said plurality of keyways (57).

5. The connector system (22) of claim 1, further characterized in that the crush rib (65), deformed by the flange (21) on the bolt (12), creates in conjunction with a preload on a threaded portion (71) of the bolt (12) a required compressive force for holding the module housing (28) and the receptacle housing (50) in an engagement.

6. In combination with first and second plastic subassemblies (23,24) wherein said first and second plastic subassemblies are removably secured to each other by means of a bolt (12), the bolt (12) having a threaded portion (71) received in the first plastic subassembly (24) and a flange (21) axially spaced from the threaded portion (12), the flange on the bolt bearing on the second plastic subassembly (24), the threaded portion 71 having a tip (73) a method for providing additional lock force holding the threaded portion (71) of the bolt (12) within the first plastic subassembly, said method characterized by the steps of:

providing a metal insert (29),
securing the metal insert (29) within the first plastic subassembly (23) along a longitudinal axis of the first plastic subassembly (23),
providing a blind axial bore (31) of a predetermined depth within the metal insert (29) the blind axial bore (31) having a bottom (32) and a plurality of internal threads (33),
receiving the threaded portion (71) of the bolt (12) into the blind axial bore (31),
turning the bolt (12) until the tip (73) on the threaded portion(71) engages the bottom (32) of the blind axial bore (31) and
turning the bolt (12) further to a predetermined torque, thereby stretching the insert (29) axially relative to the bolt (12) and deforming the internal threads (33) thereby removably locking the bolt (12) to the insert (29).

7. The method of claim 6, further characterized in that the bolt (12) is made of steel, and wherein the metal (29) insert is made of a lower strength metal.

8. The method of claim 6, further characerized in that the metal insert (29) is made of steel, and wherein the bolt (12) is made of a lower strength metal.

9. The method of claim 6, further characterized in that the metal insert (29) comprises a compressed member.

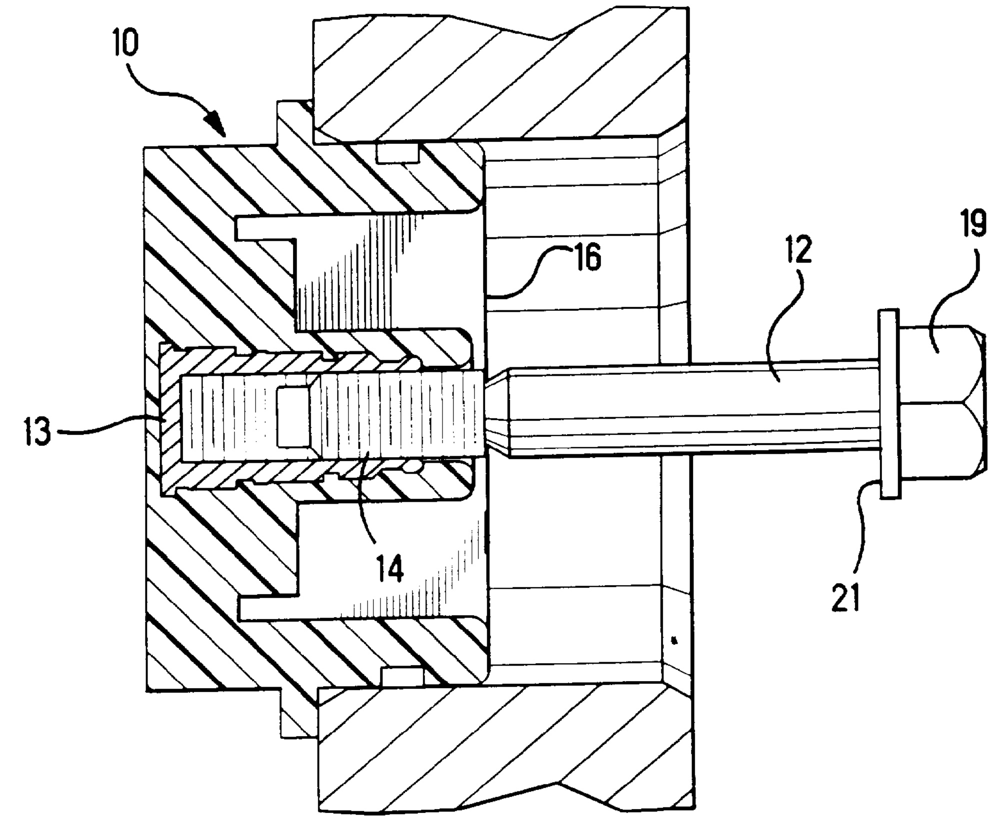

FIG. 1
Prior Art

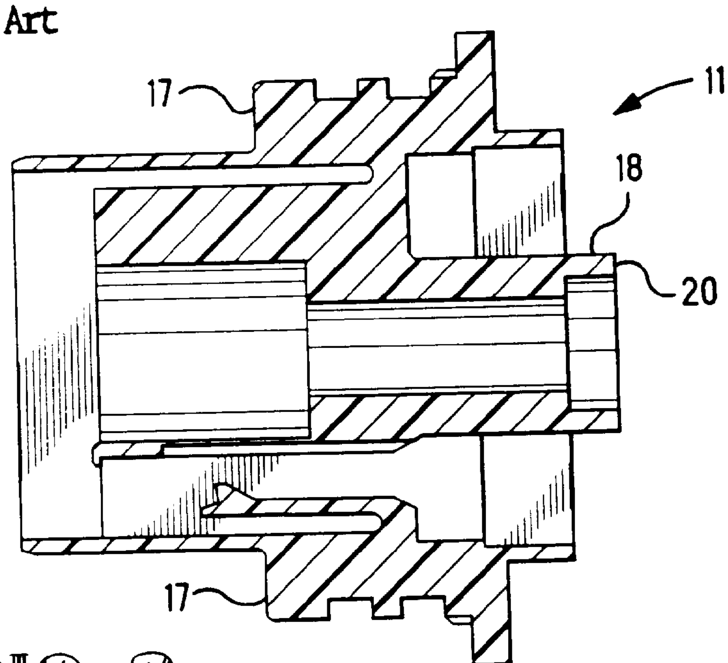

FIG. 2
Prior Art

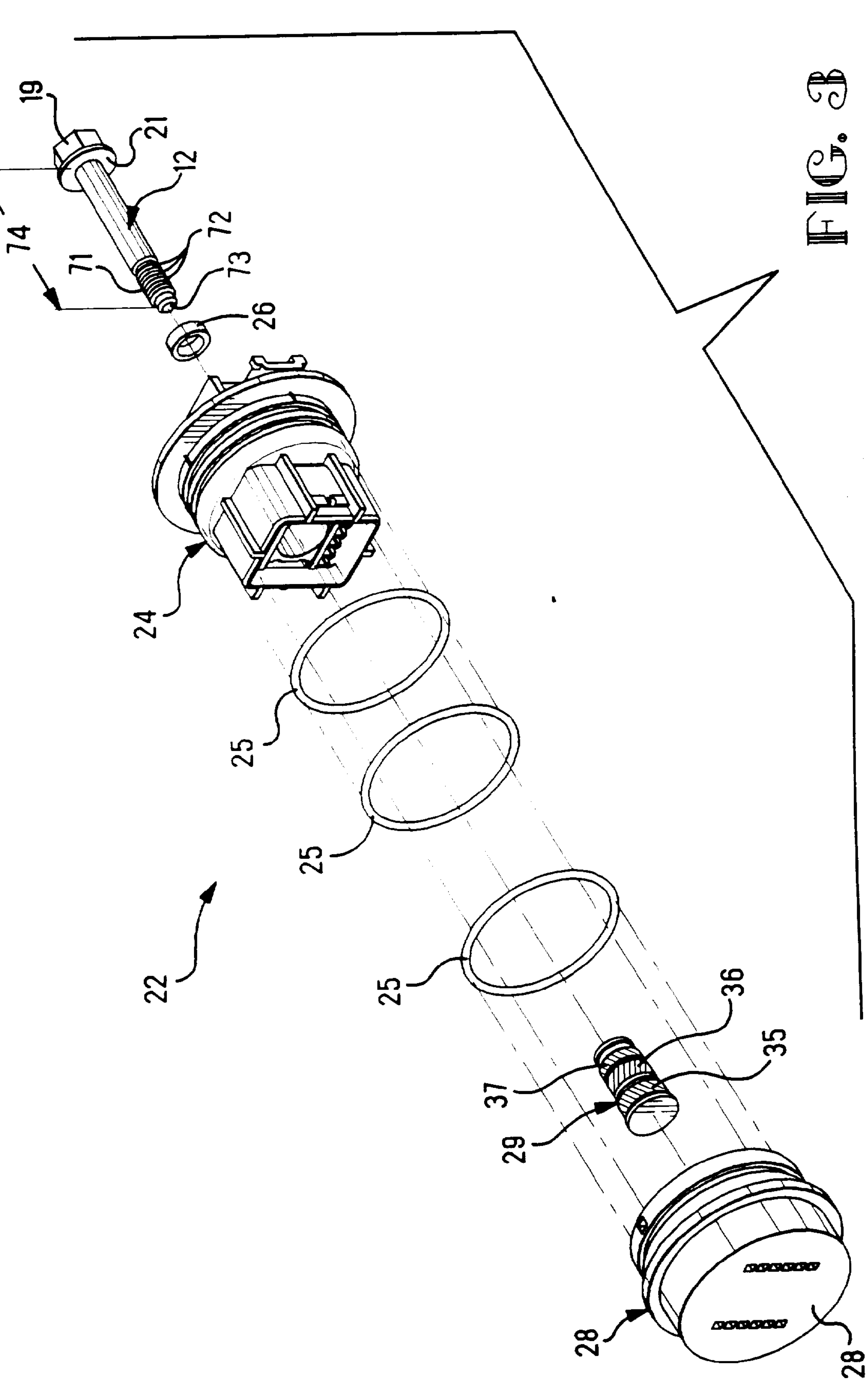

FIG. 3

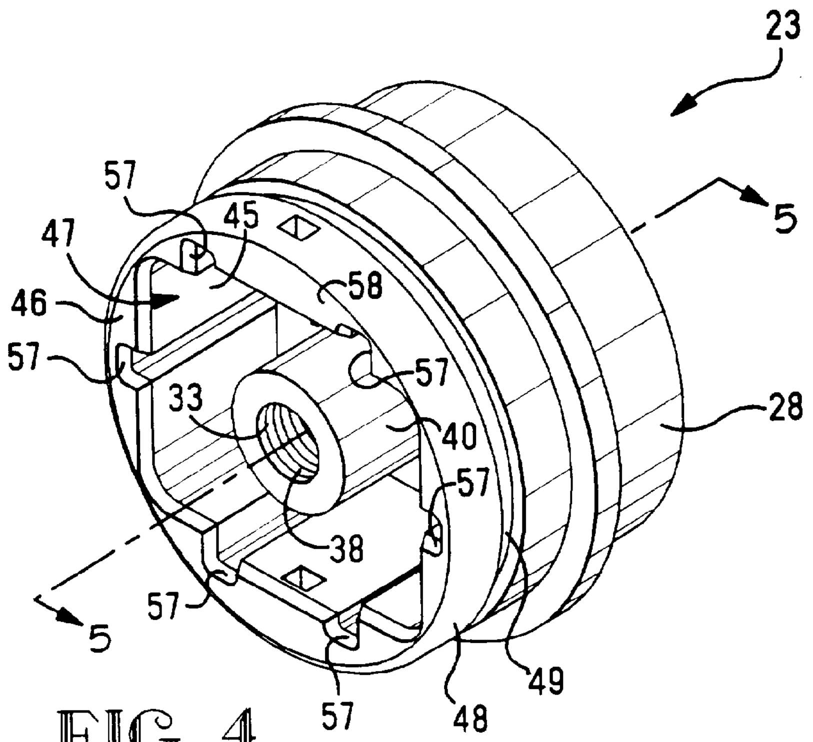
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FIG. 4

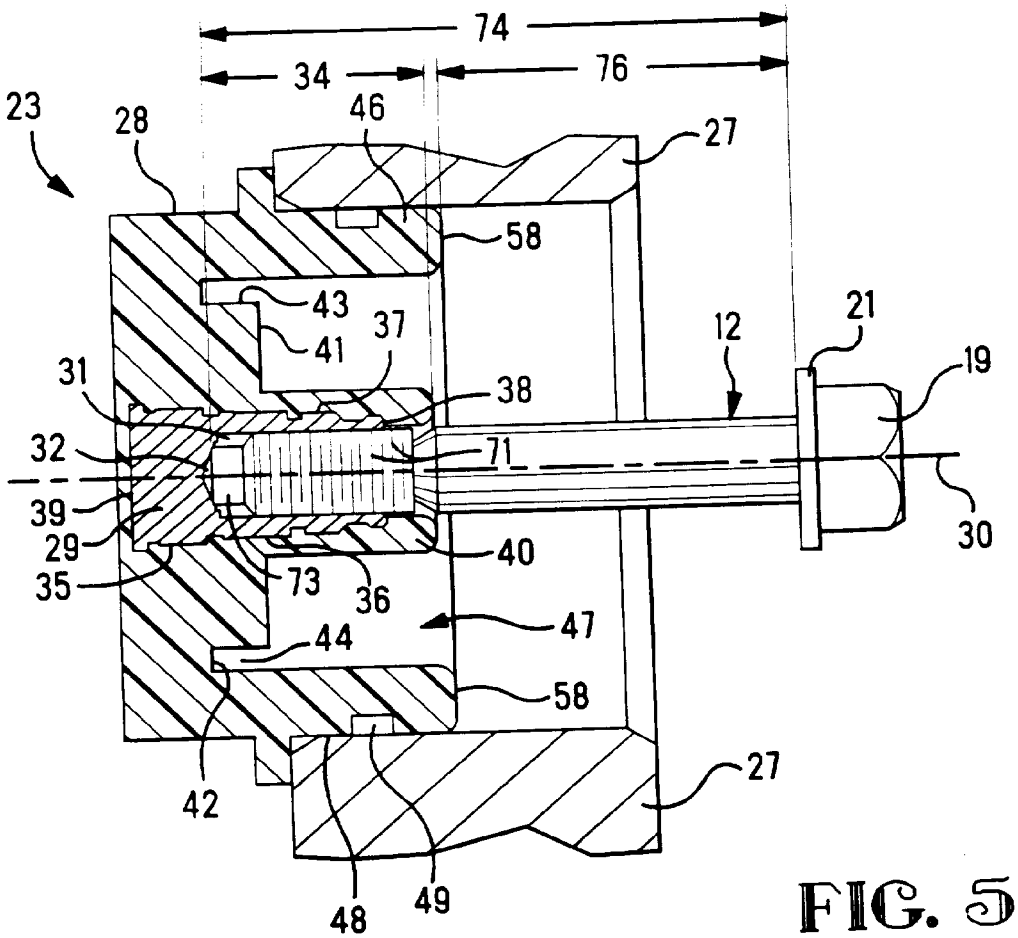
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FIG. 5

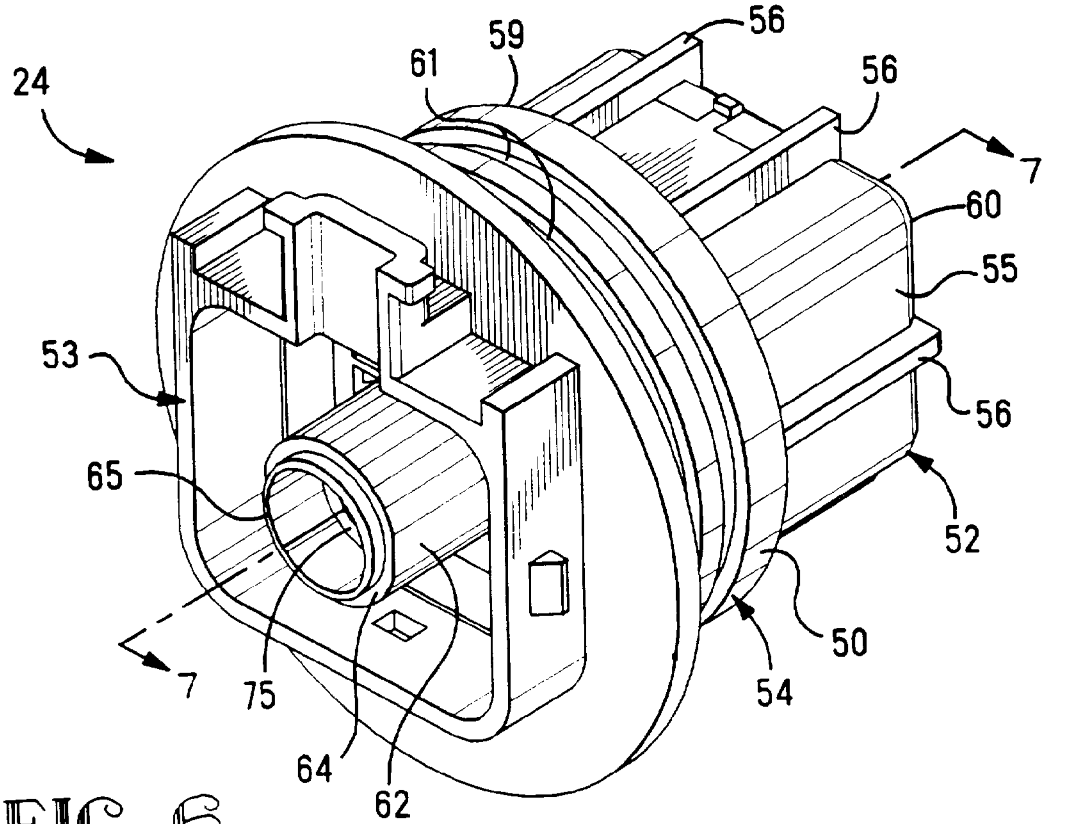
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FIG. 6

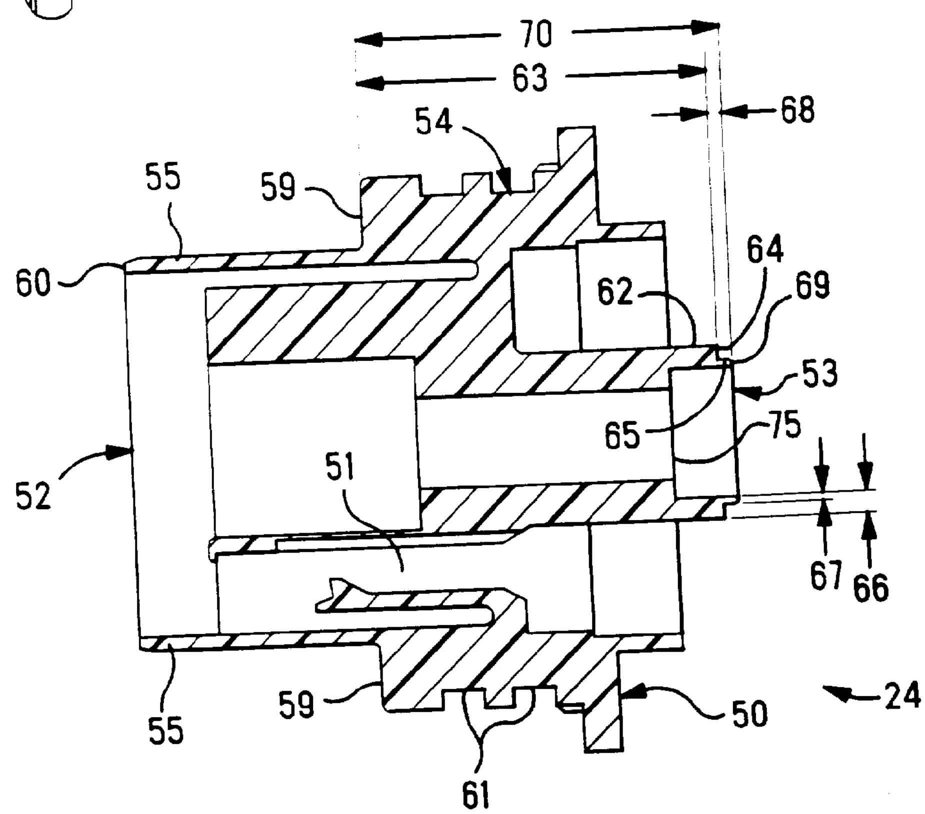
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FIG. 7

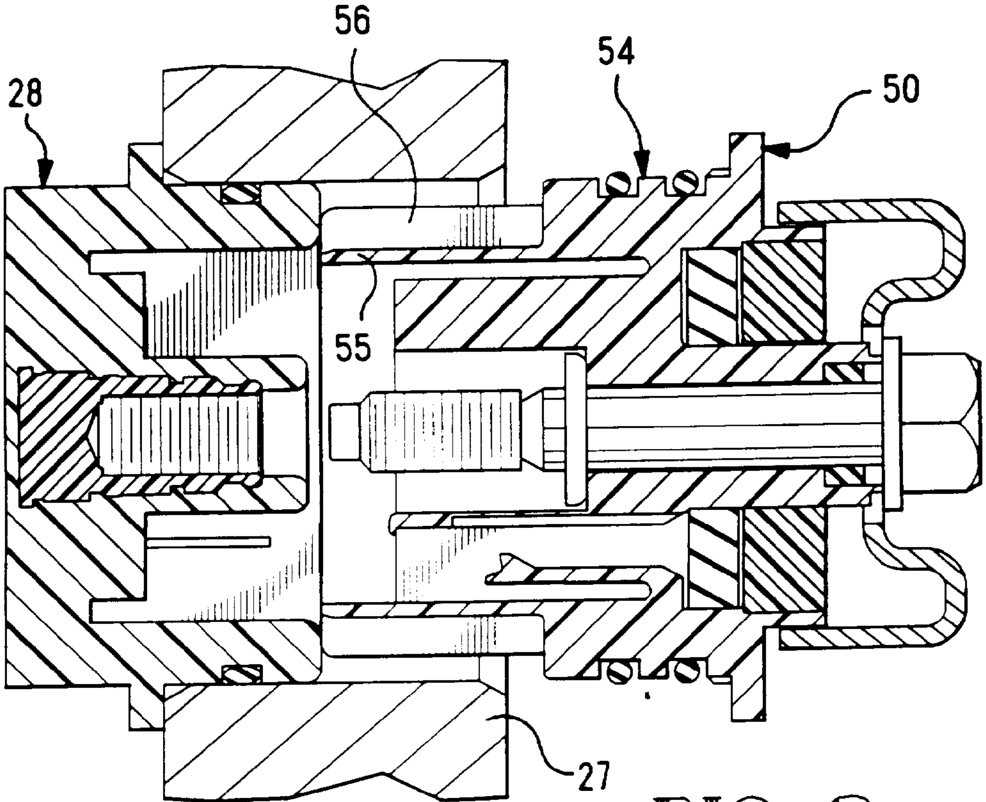

FIG. 8

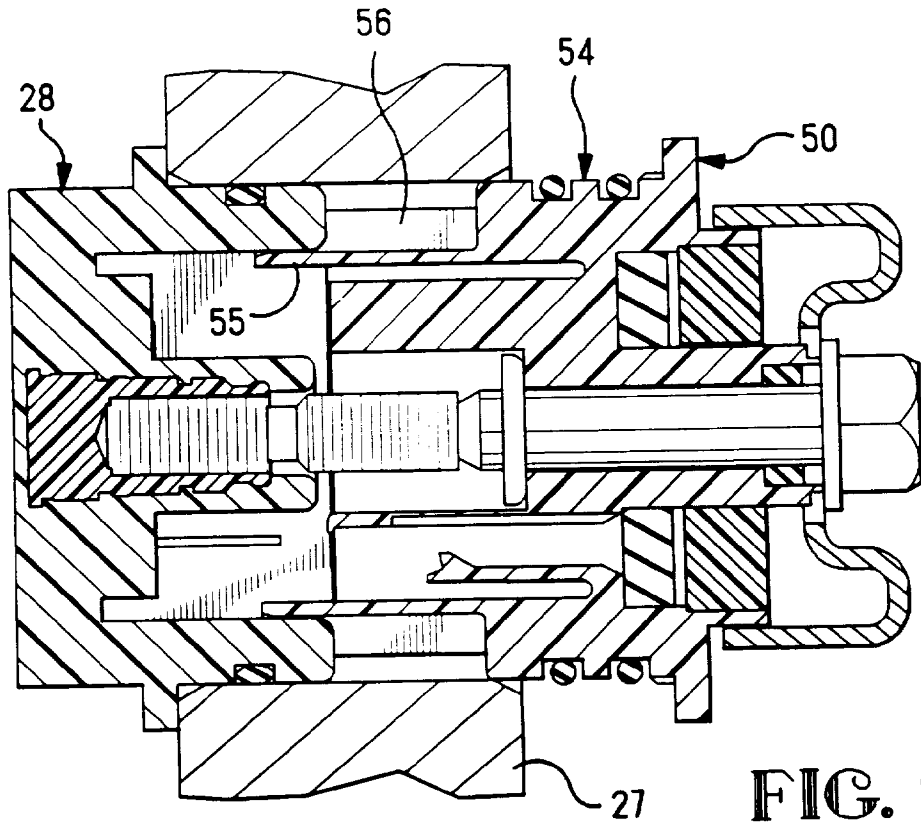

FIG. 9

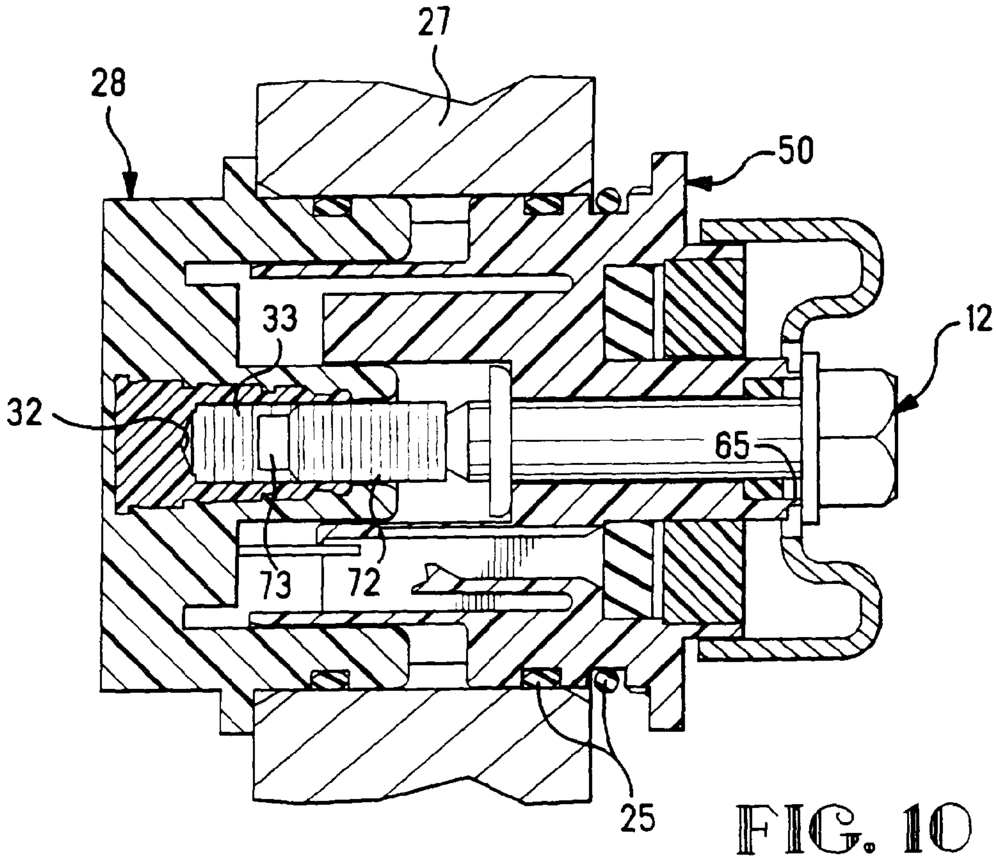

FIG. 10

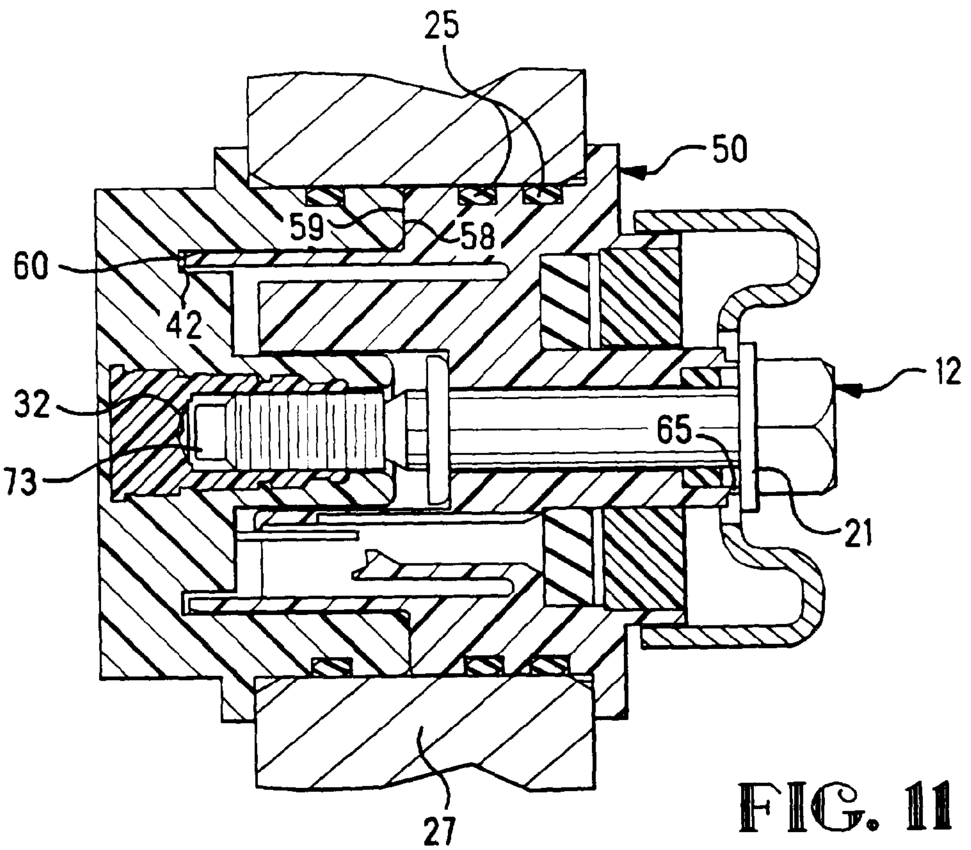

FIG. 11

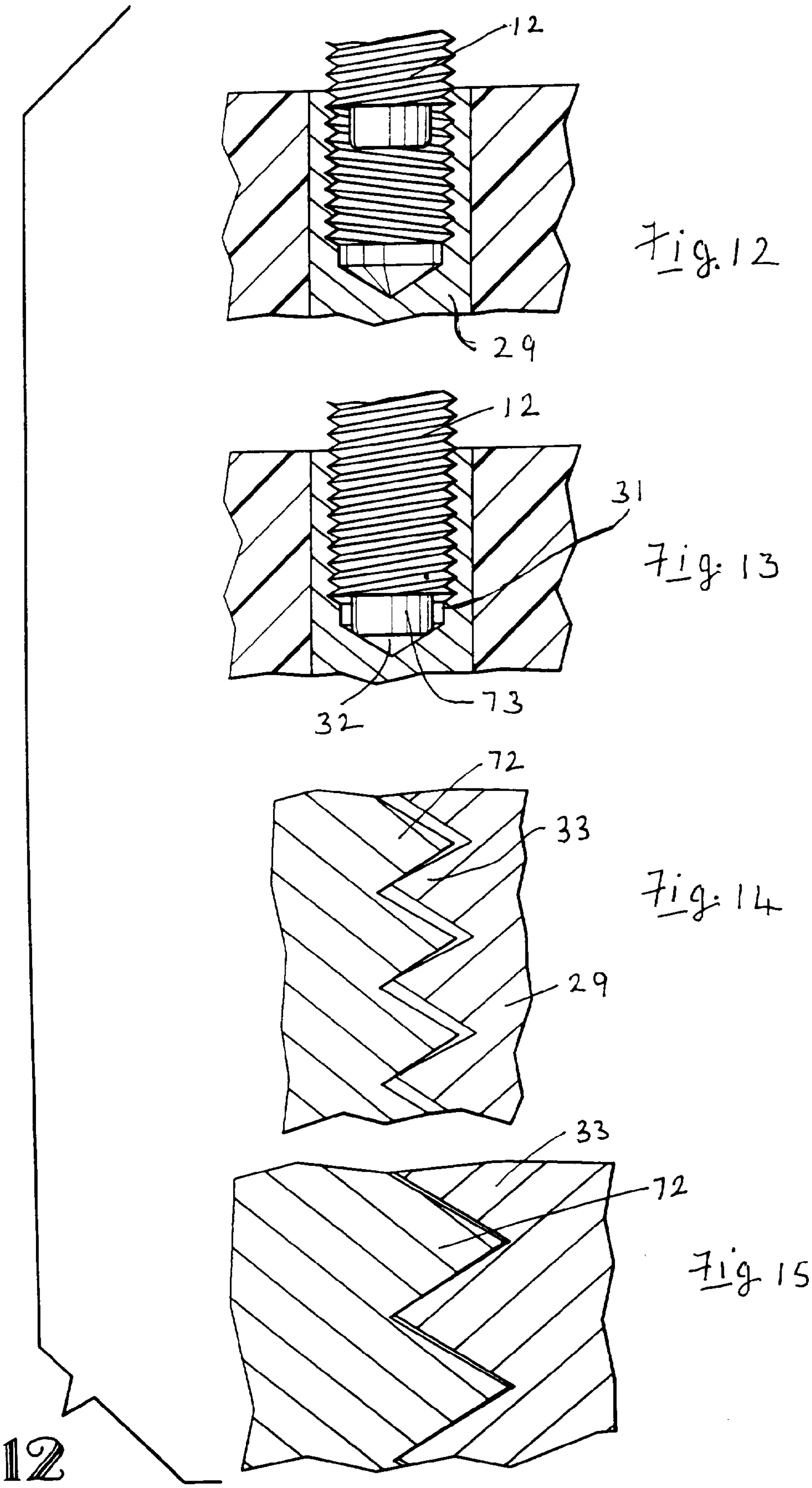

FIG. 12

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 30 7674

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	GB-A-2 272 335 (THE WHITAKER CORPORATIN) 11 May 1994 * abstract; figure 6 * ---	1,2,6	H01R13/621
A	EP-A-0 550 334 (LABINAL S.A) 7 July 1993 * abstract; figure 24 * ---	1,6	
A	US-A-5 271 689 (YAZAKI CORPORATION) 21 December 1993 * abstract; figure 3 * ---	1,6	
A	US-A-5 165 834 (YAZAKI CORPORATION) 24 November 1992 * abstract; figure 6 * -----	1,6	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
H01R
F16B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 January 1996	Waern, G

CATEGORY OF CITED DOCUMENTS

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