



Europäisches Patentamt
European Patent Office
Office européen des brevets



Publication number:

0 460 727 A1

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: **91201166.5**

(51) Int. Cl.⁵: **H01R 13/52, H01R 43/24,
H01R 13/504, H02G 15/013**

(22) Date of filing: **15.05.91**

(30) Priority: **06.06.90 US 534586**

(43) Date of publication of application:
11.12.91 Bulletin 91/50

(84) Designated Contracting States:
BE DE FR GB IT

(71) Applicant: **GENERAL MOTORS CORPORATION**
General Motors Building 3044 West Grand
Boulevard
Detroit Michigan 48202(US)

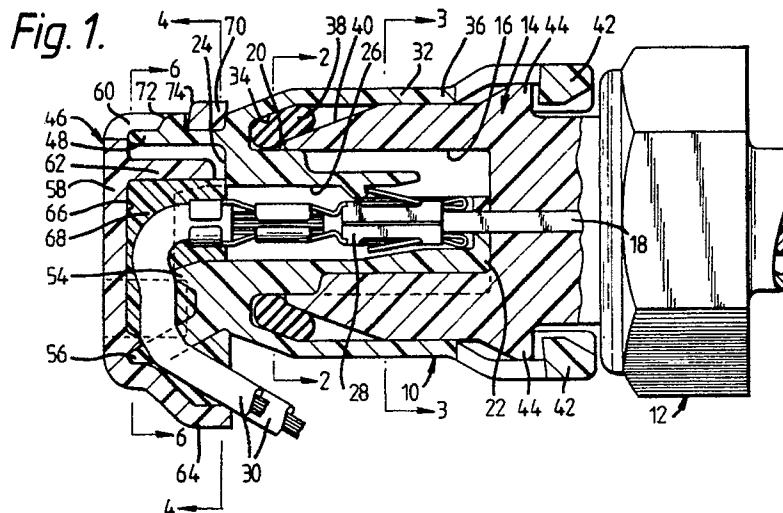
(72) Inventor: **Plyler, Robert G.**
1918 Youngstown-Kingsville Rd.
Vienna, Ohio 44473(US)
Inventor: **Senk, Joseph M.**
P.O. Box 113
Cortland, Ohio 44410(US)

(74) Representative: **Denton, Michael John et al**
Patent Section Vauxhall Motors Limited 1st
Floor Gideon House 26 Chapel Street
Luton Bedfordshire LU1 2SE(GB)

(54) **Electrical connector.**

(57) An electrical connector (10) comprising a multiple terminal connector body (20) has a sturdy and easily installed end cap (46) that is secured to the connector body (20) for sealing the cable ends (24). The end cap (46) includes a seal chamber (66) that is disposed in a common cavity (50) at the cable end (24) of the connector body (20) and contains a compliant sealing material (68) which seals the open ends of the terminal cavities (26) and encapsulates projecting ends of the electrical terminals (28) and

trailing portions of the electric cables (30). The end cap (46) is configured to maintain the integrity of the seal chamber (66), to permit the electric cables (30) to pass out of the common cavity (50) at the cable end of the connector body (20), to assure that the electrical terminals (28) are properly located in the terminal cavities (26) of the connector body (20) and to provide strain relief in cooperation with portions of the connector body (20).



EP 0 460 727 A1

This invention relates generally to electrical connectors and more specifically to electrical connectors for electrical cable that are sealed by compliant sealing material at the cable end.

Connectors of this type are already known from U.S. Patent 3,555,171, U.S. Patent 3,775,615, U.S. Patent 3,897,129, U.S. Patent 4,634,207, U.S. Patent 4,662,692 and U.S. Patent 4,875,870. While these connectors are useful in particular circumstances, each has one or more drawbacks so that it is not completely satisfactory, particularly, in the case of sealing the cable end of multiple terminal electrical connectors.

An object of this invention is to provide an improved electrical connector for electric cable.

Accordingly, an aspect of the present invention provides an electrical connector as defined in claim 1.

The invention can provide improved means for sealing the cable end of the electrical connector, for example when multiple electric terminals and cables are involved. It can also provide means for sealing the cable end of a multiple terminal electrical connector which is sturdy and easy to install.

The invention can provide an improved electrical connector having improved sealing means for sealing the cable end of the electrical connector which can relieve strain and assure that the electric terminals are properly seated in the electrical connector.

There may be provided an end cap that seals the cable end of the electrical connector as well as assures that the electric terminals are properly seated in the electrical connector. Preferably, the end cap also provides strain relief.

Advantageously, the end cap is a simple snap-on end cap.

The end cap may include a chamber containing compliant sealing material for sealing the cable end of the electrical connector. In an embodiment, the end cap comprises means for securing it to the electrical connector that do not perforate or interrupt the walls of the chamber containing compliant sealing material for sealing the cable end of the electrical connector.

The end cap may cooperate with the connector body of the electrical connector to bend the electric cables so as to provide improved strain relief.

The end cap is preferably made so as not to have perforations, interruptions, slits or the like for electric cables to exit from the chamber containing compliant sealing material for sealing the cable end of the electrical connector.

An embodiment of the present invention is described below, by way of illustration only, with reference to the accompanying drawings, in which:

Figure 1 is longitudinal section of an embodiment of electrical connector;

Figure 2 is a section taken substantially along line 2-2 of Figure 1 looking in the direction of the arrows;

Figure 3 is a section taken substantially along line 3-3 of Figure 1 looking in the direction of the arrows;

Figure 4 is a section taken substantially along line 4-4 of Figure 1 looking in the direction of the arrows;

Figure 5 is a section taken substantially along line 5-5 of Figure 4 looking in the direction of the arrows;

Figure 6 is an end view of the electrical connector (with an end cap removed) taken substantially along line 6-6 of Figure 1 looking in the direction of the arrows;

Figure 7 is a plan view showing a stage of manufacture of end caps for the electrical connector shown in Figures 1 to 6; and

Figure 8 is a vertical section of end cap taken along line 8-8 of Figure 7 looking in the direction of the arrows.

Referring now to the drawings, particularly Figure 1, an electrical connector 10 is shown connected to an electrical device 12, such as a temperature sensor, that includes a mating electrical connector 14 comprising a socket 16 and blade or pin terminals 18 that project into the socket 16.

The electrical connector 10 comprises a connector body 20 having a contact end 22, a cable end 24 and a plurality of terminal cavities 26 which extend through the connector body from the contact end 22 to the cable end 24. A plurality of electrical terminals 28 attached to electric cables 30 are disposed in respective terminal cavities 26 so that trailing portions of the electric cables 30 extend out of the terminal cavities 26 at the cable end 24 of the connector body 20. The electrical terminals 28 are properly positioned and retained in the terminal cavities 26 by a front wall at the contact end 22 of the connector body 20 and latch shoulders in the terminal cavities 26 that are engaged by latch tangs of the terminals 28, as best shown in Figure 1.

The connector body 20 further includes a shroud 32 that fits over the connector 14 when the connector body 20 is plugged into the socket 16. The shroud 32 has an inner conical portion 34 of circular cross-section and an outer oval shaped portion 36. The inner conical portion 34 supports an elastomeric O-ring 38 that has a circular section when installed. The tip of the connector 14 has an outer conical surface 40 that is at substantially the same angle as the inner surface of the inner conical portion 34. The elastomeric O-ring 38 is elastically distorted by this inner surface to seal against the outer conical surface 40 at the tip of the connector 14 when the connector body 20 is plugged

into the socket 16, as best shown in Figure 1.

The matching angles of the inner surface of conical portion 34 and conical surface 40 are preferably less than 45° so that the compression of the elastomeric O-ring 38 is less than the longitudinal travel of the connectors 10 and 12 during engagement. This compensates for connector lock over-travel and O-ring material stiffness while allowing the sealing surfaces of the connectors to be moulded in a conventional manner.

The outer oval shaped portion 36 includes inwardly directed latches 42 at its minor diameter which engage lock nibs 44 of the electrical connector 14 to lock the electrical connector 10 to the electrical device 12.

The electrical connector 10 is released and pulled out of the socket 16 in conventional manner, by squeezing the oval shaped portion 36 of the shroud 32 at its major diameter.

The electrical connector 10 includes an end cap 46 that is secured to the connector body 20 for sealing the cable end 24 of the connector body, assuring that the electric terminals 28 are properly positioned and retained in the terminal cavities 26, and providing strain relief, as is explained in detail in connection with Figures 1, 4, 5, 6, 7 and 8.

The connector body 20 has a longitudinal hood 48 at the cable end 24 that forms a common cavity 50. The common cavity 50 communicates with the terminal cavities 26 and receives protruding portions of the electric terminals 28 and trailing portions of the electric cables 30 that extend out of the terminal cavities 26. The longitudinal hood 48 is U-shaped in cross section so that the bottom of the common cavity 50 is open as best shown in Figure 6.

The connector body 20 has a partition wall 52 between each set of adjacent terminal cavities 26 that extends part-way into the common cavity 50 for isolating the protruding portions of the electrical terminals 28 from each other. The connector body 20 also has an anvil 54 beneath the terminal cavities 26 which extends part way into the common cavity 50 crosswise of the terminal cavities 26. This anvil 54 bends the trailing portions of the electric cables 30 substantially perpendicular to the terminal cavities 26 when the end cap 46 is secured to the connector body 20, as best shown in Figure 1. The connector body 20 further includes a separator 56 that is disposed below the anvil 54 for spacing the perpendicularly bent trailing portions of the electric cables 30 from each other. The separator 56 projects rearwardly and downwardly from the cable end 24 of the connector body 20 and into the open space at the bottom of the U-shaped hood 48.

The anvil 54 and the separator 56 create a channel 57 below the anvil 54 which permits each

of the trailing portions of the electric cable 30 to be completely encapsulated as explained below.

The end cap 46 comprises an end wall 58, an outer hood 60 that is integrally attached to an outer edge of the end wall 58 and an inner hood 62 that is integrally attached to the end wall 58 inwardly of the outer hood 60. The inner hood 62 is spaced from the outer hood 60 so that the longitudinal hood 48 of the connector body 20 fits between the inner and outer hoods 62 and 60 as best shown in Figures 1, 4 and 5. Thus when attached, the end cap 46 has an outer hood 60 that is disposed outside the longitudinal hood 48 of the connector body 20 and an inner hood 62 that is disposed inside the longitudinal hood 48.

The end cap 46 further includes a lip 64 that is integrally attached to a lower edge of the end wall 58 and to the lower ends of the inner and outer hoods 62 and 60. The lip 64, the inner hood 62 and the end wall 58 cooperatively form a seal chamber 66 containing a compliant sealing material 68 that seals the cable end of the electrical connector 10 when the end cap 46 is secured to the connector body 20 as best shown in Figures 1 and 5.

A preferred compliant sealing material 68 is silicone dielectric gel such as Sylgard 527 marketed by Dow Corning Corporation. This material is a two component, transparent silicone encapsulant specially designed to seal, protect and preserve electrical characteristics. The two parts of the silicone dielectric gel may be mixed in various ratios depending upon the firmness and cure rates desired.

The end cap 46 containing the compliant sealing material is secured to the hood 48 of the connector body 20 by snap-on retaining means comprising lock shoulders 70 of the end cap 46 and cooperating outwardly projecting lock nibs 72 of the longitudinal hood 48. The end cap 46 is secured to the longitudinal hood 48 simply by pressing the end cap 46 on the end of the hood 48 with thumb pressure which causes the lock nibs 72 to snap past and engage behind the lock shoulders 70. It should be noted that the lock shoulders 70 are formed as part of the outer hood 60 by molding slots in the outer hood 60 that extend from the end wall 58 up to an enlarged rim 74 of the outer hood 60. This configuration is easily moulded but more importantly, location of the lock shoulders 70 on the outer hood 60 preserves the integrity of the seal chamber 66. In other words the end cap 46 is secured to the electrical connector 10 by lock shoulders which do not perforate, interrupt or otherwise compromise the walls of the seal chamber 66 so that the flow of compliant sealing material 68 for sealing the cable end of the electrical connector 10 is controlled and contained when the end cap 46 is attached so as to avoid unnecessary loss of seal

material and/or a messy, sticky end cap. Moreover, the close proximity between the inner hood 62 of the end cap 46 and the longitudinal hood 48 of the connector body 20 forces the compliant sealing material 68 to completely fill the ends of the terminal cavities 26 and around the individual trailing ends of the cables 30 particularly in the area of the channel 57.

When the end cap 46 is secured to the connector body 20, the lip 64 is disposed below the separator 56 and spaced from the connector body 20 to permit the perpendicularly bent trailing ends of the electric cables 30 to pass out of the common cavity 50 at the cable end of the connector body 20 and the seal chamber 66. Moreover, the separator 56 and the lip 64 are configured so that they cooperate to bend the perpendicularly bent trailing portions back toward the contact end 22 of the connector body 20 as best shown in Figure 1. This reversely bent configuration of the trailing portions of the electrical cables 30 provides an excellent strain relief.

Referring now to Figure 7, the end caps 46 are preferably made of a stiff plastic material, such as Hytrel, which is a block copolymer of a glycol (soft segment) and a polyester PTB marketed by E. I. DuPont de Nemours and Company. The end caps 46 are preferably molded in strip form in which a series of end caps 46 are integrally attached to a carrier strip 76 for ease of handling during the manufacturing process. The strip is then delivered to a fill station where the seal chambers 66 are filled with compliant sealing material 68. When a sealing material such as the silicone dielectric gel Sylgard 527 is used, the two parts are mixed and poured into the seal chambers 66 in liquid form and cured in the end caps 46. The end caps 46 are then severed from the carrier strip 76 and attached to the connector body 20.

An end cap 46 having its seal chamber 66 filled with the cured sealing material 68 is shown in Figure 8. Such an end cap 46 is then simply pushed onto the end of the longitudinal hood 48 at the cable end of the connector body 20. When the end cap 46 is secured in place, the sealing material 68 closes the open ends of the terminal cavities 26 and encapsulates the end portions of the electric terminals 28 and the trailing portions of the electric cables 30 as best shown in Figures 1 and 5. It should be noted that the channel 57 between the anvil 54 and separator 56 ensures that each trailing portion of the electric cables 30 is completely surrounded and encapsulated by the sealing material 68.

The amount of sealing material 66 that is initially poured and cured in the end cap 46 is advantageously sufficient to seal the ends of the terminal cavities 26 completely and to encapsulate

the terminal ends and trailing portions of the electric cables 30 within the end cap 46. The amount of sealant is preferably such that little or no sealing material escapes out of the end cap 46 between the lip 64 and the connector body 20.

It should also be noted that the end cap 46 for sealing the cable end of the electrical connector 10 cannot be secured to the electrical connector unless the electric terminals 28 are properly seated in the terminal cavities 26 due to the necessary proximity of the end wall 58 which cooperates with the anvil 54 to bend the trailing portions of the cables 30 perpendicularly.

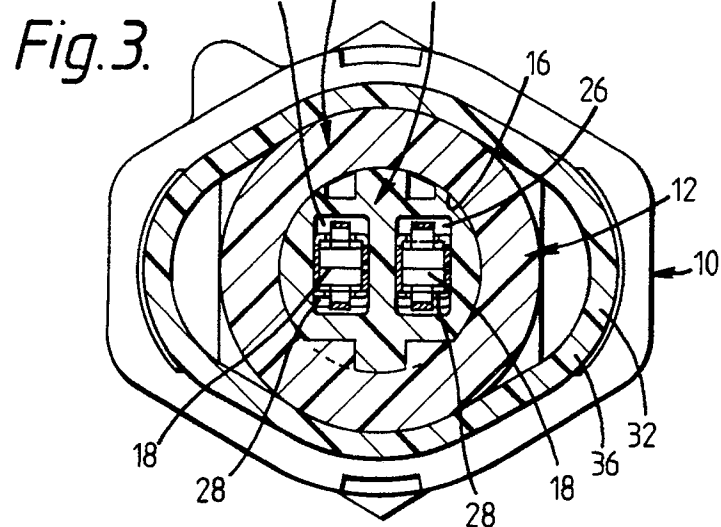
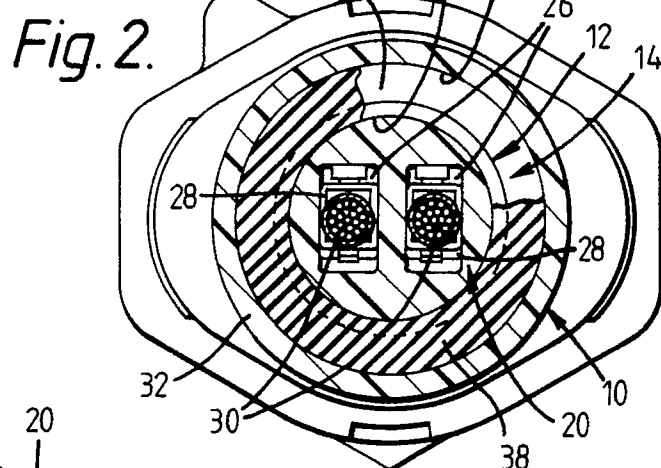
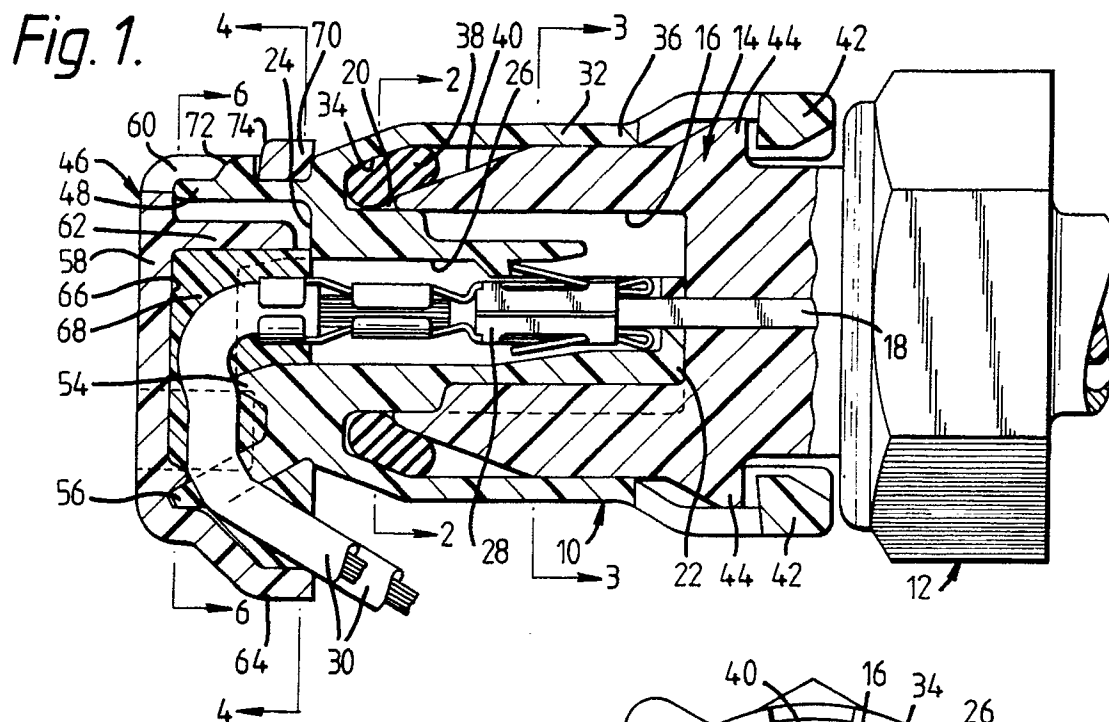
Thus the snap-on end cap 46 not only seals the cable end of the electrical connector 10 but it also assures that the electric terminals 28 are properly seated in the electrical connector as well.

Claims

1. An electrical connector comprising a connector body (20) including a cable end (24) and a plurality of terminal cavities (26) opening into a common cavity (50) at the cable end of the connector body; a plurality of electrical terminals (28) attached to electric cables (30) and disposed in respective terminal cavities (26), trailing portions of the electric cables being disposed in the common cavity; and an end cap (46) secured to the connector body for sealing the cable end of the connector body, the end cap including a first hood (62) and a lip (64) cooperatively forming a seal chamber (66) with an end wall (58) of the end cap, the seal chamber (66) communicating with the common cavity (50) of the connector body and containing a compliant sealing material (68) for sealing the cable end of the electrical connector when the end cap is secured to the connector body.
2. An electrical connector according to claim 1, wherein the lip (64) of the end cap is spaced from the connector body to permit the trailing portions of the electric cables (30) to pass out of the common cavity (50) at the cable end of the connector body.
3. An electrical connector according to claim 1 or 2, wherein the connector body comprises a separator (56) extending into the common cavity for spacing the trailing portions of the electric cables from one another, the separator (56) being disposed between the hood (62) and the lip (64).
4. An electrical connector according to claim 3, wherein the lip (64) is adapted to cooperate

with the separator (56) to bend the trailing portions of the electric cable so as to provide strain relief.

5. An electrical connector according to any one of claims 1 to 4, wherein the connector body comprises an anvil (54) extending into the common cavity (50) crosswise of the terminal cavities (26) and being adapted to bend the trailing portions of the electric cables substantially perpendicular to the terminal cavities when the end cap is secured to the connector body. 5
10
6. An electrical connector according to any preceding claim, wherein the end cap (46) comprises securing means (70) for securing the end cap to the connector body. 15
7. An electrical connector according to any preceding claim, wherein the end cap comprises an outer hood (60), the first hood (62) being disposed between the outer hood and the common cavity (50), the outer hood comprising securing means (70) for securing the end cap to the connector body. 20
25
8. An electrical connector according to claim 7, wherein the securing means (70) of the outer hood (60) is adapted to provide a snap-fit on the connector body. 30
9. An electrical connector according to any preceding claim, wherein the end wall (58) of the end cap (46) is adapted to be in close proximity to the cable end of the connector body (20) to ensure correct positioning of the electrical terminals (28). 35
10. An electrical connector according to any preceding claim, wherein the connector body comprises a partition wall (52) between each set of adjacent terminal cavities extending into the common cavity for isolating protruding portions of adjacent electrical terminals from one another. 40
45
11. An electrical connector according to any preceding claim, wherein the compliant sealing material is a gel sealant. 50
12. An electrical connector according to any preceding claim, wherein the compliant sealing material is a silicone dielectric gel adapted to be cured in the seal chamber of the end cap before the end cap is secured to the connector body. 55



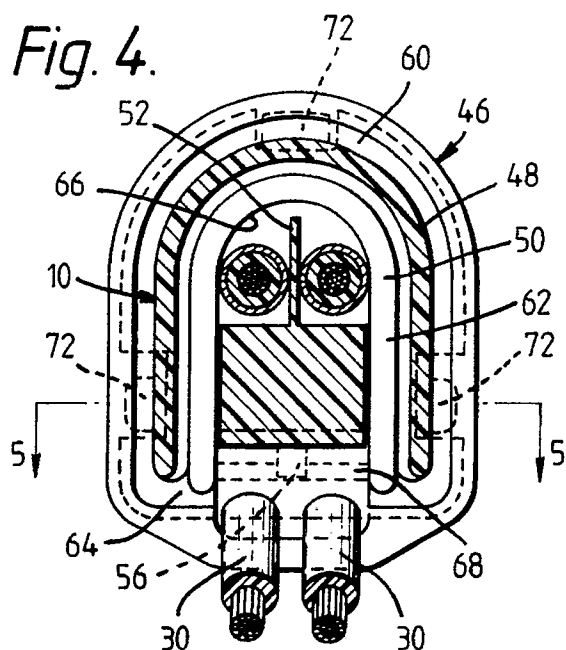


Fig. 5.

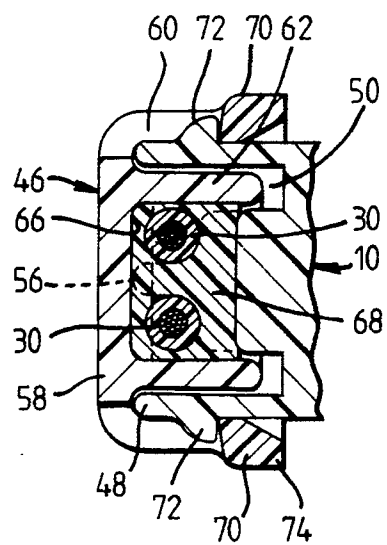


Fig. 6.

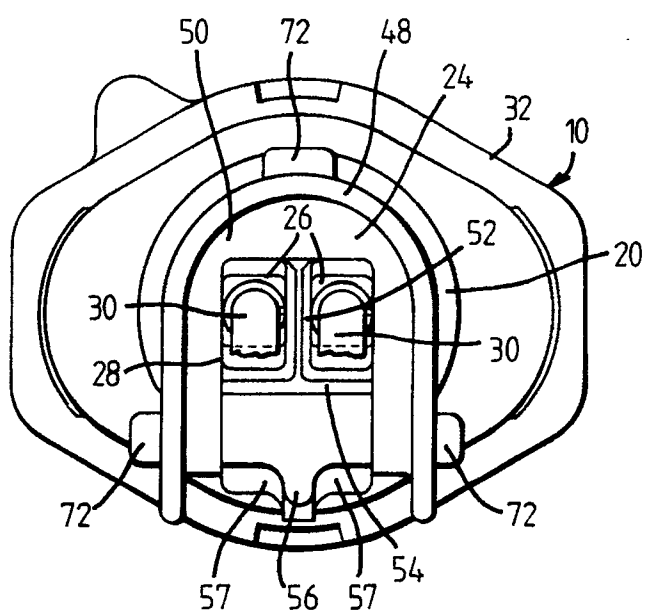


Fig. 7.

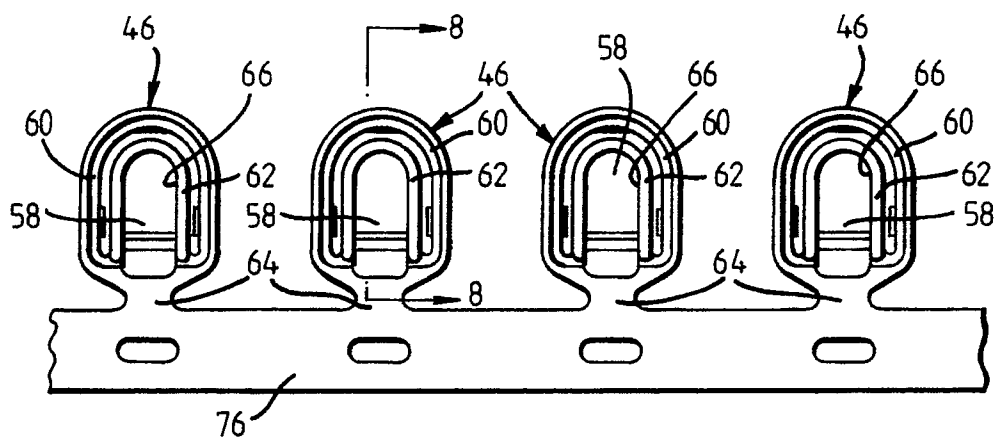
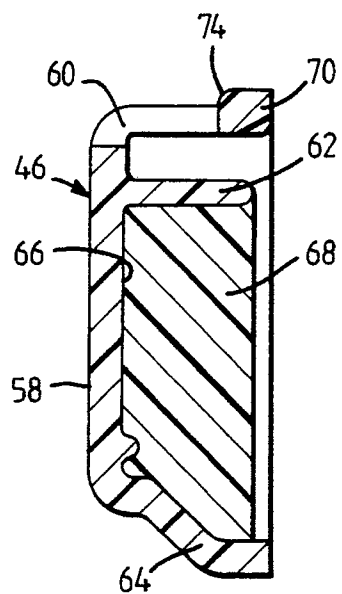


Fig. 8.





European
Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 20 1166

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.5)
A	DE-C-1 148 613 (ELASTIC STOP NUT) * figures 3,4,10,11; column 13, line 37 - column 14, line 2 * - - -	1,11,12	H 01 R 13/52 H 01 R 43/24 H 01 R 13/504 H 02 G 15/013
A	DE-A-2 930 658 (GENERAL MOTORS) * figures 1-4; page 4, line 1 - page 8, line 7 * - - -	1-9	
A	DE-C-3 623 927 (KABELMETAL) * figures 5; claim 1; column 5, lines 33-48 * - - -	1,9,11,12	
A	FR-A-1 295 369 (GARDENER) * figures 4-9; page 2, right-hand column, paragraph 4; page 4, left-hand column, paragraph 4 * - - -	1,2,6, 9-12	
A	DE-C-3 417 811 (KABELMETAL) * figure 2, column 4, line 61 - column 5, line 5 * - - - - -	1,2,9,11, 12	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H 01 R 13/00 H 01 R 43/00 H 02 G 15/00
The present search report has been drawn up for all claims			
Place of search		Date of completion of search	Examiner
Berlin		16 September 91	HAHN G
CATEGORY OF CITED DOCUMENTS			
X: particularly relevant if taken alone		E: earlier patent document, but published on, or after the filing date	
Y: particularly relevant if combined with another document of the same category		D: document cited in the application	
A: technological background		L: document cited for other reasons	
O: non-written disclosure			
P: intermediate document		&: member of the same patent family, corresponding document	
T: theory or principle underlying the invention			