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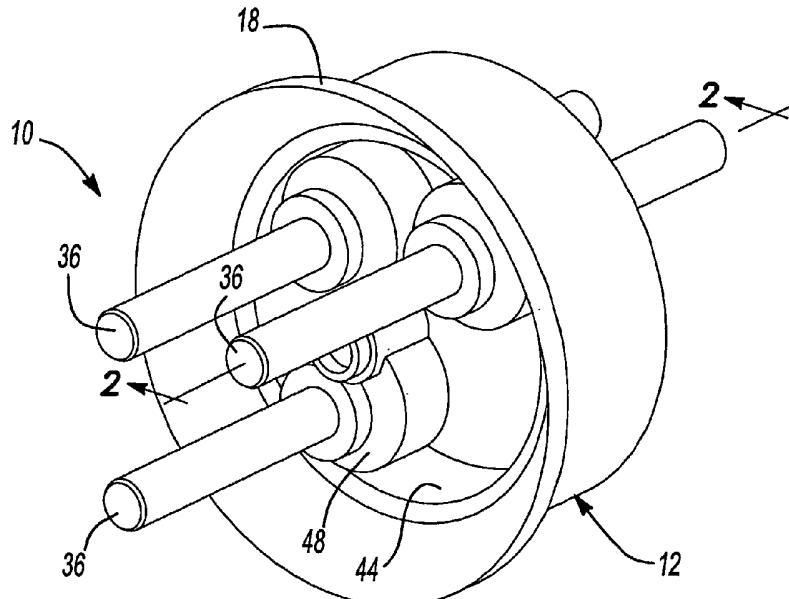
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(54) Title: HERMETIC TERMINAL ASSEMBLY



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(57) Abstract: A hermetic or semi-hermetic terminal assembly having a cup-shaped body portion with a generally flat bottom wall and at least one opening in the bottom wall defined by an annular lip extending into the cup. One current conducting pin extends through each opening and beyond the lip on both ends of the body portion, the inner end of the pin being on the dish side of the cup-shaped body portion, and the outer end on the outer side of the body. A resilient plastic material is molded into place within the body portion to bond the pin to an inside surface of the lip with a hermetic seal. The plastic extends beyond the face of the body portion and bonds to the pin to provide the desired air path between the respective pins and each other and/or the face of the body portion.



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— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ,

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HERMETIC TERMINAL ASSEMBLY

FIELD OF THE INVENTION

[0001] The present invention relates to electric terminals, and more particularly to terminals of the type which include one or more conductor pins which project through and are secured to a metallic body portion by a hermetic seal for disposing the ends of the conductor pins on opposite sides of the body portion.

BACKGROUND OF THE INVENTION

[0002] Hermetically sealed electric terminals provide an airtight electrical terminal for use in conjunction with hermetically sealed devices where leakage into or from such devices, by way of the terminals, is effectively precluded. For hermetically sealed electric terminals to function safely and effectively for its intended purpose, the terminals require that their conductor pins be electrically insulated from and hermetically sealed to the body portion through which they pass and that an optimum air path be established and thereafter maintained between adjacent portions of the pins and opposite sides of the body.

[0003] In a conventional hermetic terminal assembly, exemplified by U.S. Pat. No. 3,160,460 to Wyzenbeek, a straight, current carrying pin is fixed in place within a lip defining a hole in the terminal body by a fusible glass-to-metal seal. A resilient insulator is bonded to the face of the body beyond the extent of the glass-to-metal seal. The insulator includes outwardly projecting portions bonded to the conductor pins which define a predetermined air path between adjacent portions of the pins and the body member. Such a hermetic terminal construction has been the standard in the industry for four decades.

[0004] The primary object of the present invention is to provide a hermetic terminal assembly having conductor pins that are rigidly and hermetically secured to the body portion entirely by a resilient plastic which possesses the requisite materials properties, such as dielectric, moisture resistance, resistance to chemical breakdown, to provide for a hermetic seal. In addition to providing a hermetic seal between the conductor pins and the body, the same resilient plastic is bonded to the conductor pins to provide the desired air path between the pins and the face of the body portion.

[0005] Another object of the present invention is to provide such a terminal that is simple and economical to manufacture, such as by plastic injection molding.

SUMMARY OF THE INVENTION

5 **[0006]** The present invention provides a hermetic terminal assembly having a cup-shaped body portion with a generally flat bottom wall and at least one opening in the bottom wall defined by an annular lip. A current conducting terminal pin extends through each opening and beyond the lip on both ends of the body portion, the inner end of the terminal pin being on the dish side of the 10 cup-shaped body portion, and the outer end of the terminal pin extending through and to the outer side of the body portion. A resilient plastic resin material is molded into place within the body portion and interlocks with the body portion and the terminal pins to fixedly secure the terminal pins in position relative to the body portion. The plastic resin material forms a hermetic seal 15 between the terminal pin and the body portion. In addition, the plastic extends beyond the face of the body portion and covers the pin to provide the desired air path between the respective pins and each other and/or the face of the body portion.

20 **[0007]** In alternate embodiments of the present invention, the terminal pins include shank portions with varying surface configurations that are intended to enhance the bonding of the plastic resin to the terminal pin and improve the hermeticity of the seal. The terminal pins may also include fuse portions that are intended to open in response to predetermined current loads seen at the terminal pins.

25 **[0008]** Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

30 **BRIEF DESCRIPTION OF THE DRAWINGS**

[0009] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0010] FIG. 1 is a perspective view of a hermetic terminal assembly;

[0011] FIG. 2 is a cross-sectional side view of a first embodiment of the hermetic terminal assembly of the present invention;

[0012] FIG. 3 is a cross-sectional perspective view of the hermetic terminal assembly of FIG. 2;

5 **[0013]** FIG. 4 is a cross-sectional side view of a second embodiment of the hermetic terminal assembly of the present invention;

[0014] FIG. 5 is a cross-sectional perspective view of the hermetic terminal assembly of FIG. 4;

10 **[0015]** FIG. 6 is a cross-sectional side view of a third embodiment of the hermetic terminal assembly of the present invention; and

[0016] FIG. 7 is a cross-sectional perspective view of the hermetic terminal assembly of FIG. 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] The following description of the preferred embodiment(s) is 15 merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0018] Referring now to the drawings FIGs. 1, 2 and 3, a hermetic terminal assembly 10 having a generally cup-shaped body portion 12 with a generally flat bottom 14 and side wall 16 with an outwardly flaring rim 18. The 20 bottom 14 of the body portion 12 has a dish-side interior surface 22, an outside surface 24, and a plurality of openings 26. The openings 26 are each defined by an annular lip 28 with an inside wall surface 30, a free edge 32 on the dish side, and a radius 34 on the outside.

[0019] A current carrying terminal pin 36 with an outer end 38 and an 25 inner end 40 may be fitted with a conventional terminal tab (not shown). The current carrying pin 36 is sealed within the opening 26 by a dielectric plastic resin material 44 that is molded directly into the body portion 12, which bonds to the body portion 12 and terminal pin 36. As molded, the plastic resin 44 creates a seal 46 that is an airtight hermetic seal between the terminal pin 36 30 and the body portion 12 such that leakage through the assembly 10, by way of the terminal pins 36, is prevented.

[0020] In a preferred embodiment, the plastic resin 44 is molded in and around the body portion 12 on each side of the bottom 14. The plastic resin 44 thereby covers both the dish-side surface 22 and the outside surface

24 of the bottom wall 20 and is mechanically interlocked with the body portion 12. The plastic resin provides an dielectric oversurface that covers the inside and outside of the terminal 10 body portion 12. Additionally, the plastic resin 44 may also include a sleeve portion 47 that bonds to and covers a portion of 5 the terminal pin 36 projecting out of the body portion 12 to the outer end 38 of the to define the air path between the respective terminal pins 36 and/or the body portion 12, as desired.

[0021] On the dish-side, interior surface 22 of the body portion 12, the molded plastic resin 44 forms a plurality of neck portions 48 each of which 10 is adjacent to, and surrounds, the annular lip 28 defining an opening 26 in the bottom wall 20 of the body portion 12. Each neck portion 48 extends along its respective terminal pin 36 toward the inner end 40 for about a quarter to a third of the distance that the terminal pin 36 protrudes from the dish-side surface 22 of the terminal 10 body portion 12. In addition to providing a dielectric 15 oversurface, the neck portions 48 increase the length of the hermetic seal 46 and better fixes the terminal pins 36 in place.

[0022] Each terminal pin 36 has a shank portion 50 which passes through the terminal 10 body portion 12. The plastic resin 44 fills the space between the inside wall 30 and the shank portion 50 of the terminal pin 36 to 20 create the hermetic seal 46 and to bond the terminal pin 36 to the terminal 10 body portion 12. Included in the shank portion 50 of the terminal pin 36 is a fuse section 52 which is encompassed by the seal 46 so as to be internal to the terminal 10 body portion 12. The fuse section 52 has a necked down diameter from the remainder of the terminal pin 36. The fuse section 52 is intended to 25 open at currents in excess of a predetermined current-carrying capacity. Alternatively, the terminal pin 36 may be configured with a fuse that is external to the terminal 10 body portion 12, such as a terminal pin that is disclosed in U.S. Patent no. 5,017,740 to Honkomp et al., which is hereby incorporated into this disclosure by reference.

[0023] The plastic resin 44, molded to create the hermetic seal 46, must possess the appropriate electrical and mechanical properties that are required for the application and operating environment in which the hermetic terminal assembly will be utilized. Typical minimum engineering material requirements may include:

Physical Property	Requirement
Hydrostatic Pressure	2250 psi
Hermeticity	1×10^{-7} cc/sec He
Dielectric Voltage	Minimum 2500 V with < 0.5mA leakage
Insulation Resistance	>10,000 MΩ at 500 Vdc
Operating Temperature	150 °F to 300 °F
Operating Environment	Mineral oil or refrigerant

[0024] A plastic resin that is suitable for use with the present invention is a moldable plastic resin which can provide the dielectric oversurface and hermetic seal 46 as disclosed. One such moldable plastic resin is polyphenyl sulfide (PPS), which is known under the tradename RYTON. In addition, other moldable plastic resins that possess the necessary electrical and mechanical properties may also be used, including liquid crystalline polymer compositions (LCPs). An example of one such material is available commercially from DuPont under the tradename Zenite®.

[0025] Further, there may be applications for the terminal assembly 10 of the present invention having less demanding operational or performance requirements, where a fully hermetic seal may not be necessary, and a less-than-airtight, semi-hermetic seal or even non-hermetic seal is all that is required. It is fully contemplated that a terminal assembly 10 of the present invention may be applicable for use in such applications. Additional moldable plastic resins that may be suitable for use with this invention in such applications are polypropylenes, thermoplastic polyolefins, and polyvinylchlorides like Bakelite®.

[0026] The terminal pin 36 is manufactured from an electrically conductive material, such as solid copper or steel. Alternatively, a bimetallic, copper core wire, having high electrical conductivity and possessing good hermetic bond characteristics with the plastic resin 44 may also be utilized.

[0027] Referring now to FIGs. 3 and 4, a second embodiment of the hermetic terminal assembly 10' of the present invention is illustrated. Elements

and features common to both the first and second embodiments shown in the Figures are identified with like reference numerals.

[0028] Included in the shank portion 50' of the terminal pin 36' is a section 54 having a scuffed surface 56 of increased surface roughness. Such a surface may be achieved by mechanical means, such as sanding or grit blasting the terminal pin 36' or by other similar processes, or by chemical means. The scuffed surface 56 is included in terminal pin 36' to create an increased surface area over which the plastic resin 44' may contact and mechanically engage the terminal pin 36' to increase the strength of the bond with the plastic resin 44' and improve the hermeticity of the seal 46'. Although not shown in FIGs. 3 and 4, the terminal pin 36' may also incorporate a fuse section, similar to that disclosed above. Such a fuse section could also include a scuffed surface 56.

[0029] Additionally, as described above, the plastic resin 44' may also cover a portion of the projecting outer end 38' of the terminal pin 36' to define the air path between the respective terminal pins 36' and/or the body portion 12', as desired.

[0030] Yet another embodiment of the hermetic terminal assembly 10" of the present invention is shown in FIGs. 5 and 6. In this third embodiment, the terminal 10" has a generally cup-shaped body portion 12" with a side wall 16" having an outwardly flaring rim 18". The body portion does not have a generally continuous, closed bottom, but instead has only an inwardly extending peripheral lip 58 which extends from the side wall 16" at the end opposite the rim 18". The plastic resin 44" is molded in and around the peripheral lip 58 and is thereby mechanically interlocked with the body portion 12". As with those embodiments described above, the plastic resin 44" may also be molded over a portion of the projecting outer end 38" of the terminal pin 36" to define the air path between the respective terminal pins 36' and/or the body portion 12", as desired.

[0031] The terminal pin 36" of the third embodiment of the present invention may also differ from the terminal pins 36 and 36' disclosed above. As shown in FIG. 5, the shank portion 50" of the terminal pin 36" is a section 54 forming a threaded surface 56". Similar to that described above, the threaded surface 56" is included in terminal pin 36" to increase the surface area of the

terminal pin 36" over which the plastic resin 44" may contact and mechanically engage the terminal pin 36". The increased area of engagement correspondingly increases the strength of the bond between the terminal pin 36" and the plastic resin 44" and improves the hermeticity of the seal 46".

5 Again, the terminal pin 36" may also incorporate a fuse section, similar to that disclosed with respect to FIGs. 1 and 2 above. Such a fuse section could also include a threaded surface 56'.

[0032] Of course, any of the features of the body portions 12, 12', 12" or terminal pins 36, 36', 36" may be combined in various ways to create a 10 hermetic terminal assembly within the contemplation of the present invention.

[0033] While the invention has been disclosed and described in its presently preferred form(s), it is understood that the invention is capable of modification without departing from the spirit and scope of the invention as set forth in the appended claims.

CLAIMS

What is claimed is:

1. A terminal assembly comprising:
 - a metallic body, the body having a bottom portion comprising an interior surface, an exterior surface, and at least one opening;
 - a current conducting pin extending longitudinally through the opening in the bottom portion; and
 - a dielectric plastic resin covering at least portions of each of the interior surface and the opening of the bottom portion of the body, the plastic resin bonding to both the body and the pin and providing a seal of at least about 1×10^{-6} atm cc/sec between the pin and the opening in the bottom portion through which the pin is extending.
2. The terminal assembly of claim 1, wherein the plastic resin is molded in situ.
- 15 3. The terminal assembly of claim 1, wherein an adhesive is interposed between the plastic resin and the body.
4. The terminal assembly of claim 3, wherein an adhesive is interposed between the plastic resin and the pin.
5. The terminal assembly of claim 1, wherein the plastic resin is prefabricated and bonded to the metallic body and the pin with an adhesive.
- 20 6. The terminal assembly of claim 5, wherein the adhesive is an electrically insulating epoxy.
7. A hermetic terminal assembly comprising:
 - a metallic body, the body having a bottom portion, the bottom portion comprising an interior surface, an exterior surface and at least one opening having a wall;
 - a current-conducting pin extending longitudinally through the opening;
 - 25 a prefabricated dielectric retainer receiving the pin and covering at least a portion of the interior surface and surrounding at least a portion of the wall; and
 - 30 a dielectric epoxy bonding to the body, the retainer and the pin, and providing a seal between the pin and the opening in the bottom portion through which the pin is extending.

8. The terminal assembly of claim 7, wherein the exterior surface of the bottom portion includes a countersunk portion sealed with the epoxy.

9. The terminal assembly of claim 8, wherein the retainer includes an annular countersunk portion sealed with the epoxy.

5 10. The terminal assembly of claim 9, wherein the retainer includes a cavity communicating with the countersunk portion and sealed with the epoxy through the interior surface of the bottom portion.

11. The terminal assembly of claim 7, further including an adhesive on the interior surface of the body.

10 12. The terminal assembly of claim 7, further including an adhesive on the exterior surface of the body.

13. The terminal assembly of claim 7, wherein the retainer is formed from a plastic resin.

14. The terminal assembly of claim 7, wherein the retainer is formed 15 from a ceramic.

15. The terminal assembly of claim 9, wherein the countersunk portion receives at least a portion of the wall of the body.

16. A hermetic terminal assembly comprising:
a metallic body, the body having a bottom portion, the bottom 20 portion comprising an interior surface, an exterior surface and at least one opening having a wall;

a current-conducting pin extending longitudinally through the opening; and

25 a dielectric epoxy bonding to the interior and exterior surfaces of the body and the pin through the opening of the bottom portion, and providing a seal of at least about 1×10^{-6} atm cc/sec between the pin, the opening and the wall of the opening.

17. The terminal assembly of claim 16, further comprising a retainer placed over the pin and under the interior surface of the body.

30 18. The terminal assembly of claim 17, wherein the retainer includes an annular countersunk portion sealed with the epoxy.

19. The terminal assembly of claim 18, wherein the retainer includes a cavity communicating with the countersunk portion and sealed with the epoxy.

20. The terminal assembly of claim 16, wherein the body includes an annular countersunk portion sealed with the epoxy.

21. The terminal assembly of claim 17, further comprising an adhesive over at least a portion of the exterior surface of the body.

5 22. The terminal assembly of claim 17, further comprising an adhesive over at least a portion of the interior surface of the body.

23. The terminal assembly of claim 1, wherein the plastic resin is selected from the group consisting of polyphenyl sulfide, liquid crystalline polymers, polypropylenes, thermoplastic polyolefins, and polyvinylchlorides.

10 24. The terminal assembly of claim 1, wherein the plastic resin is epoxy.

25. A method for making a hermetic terminal assembly, the method comprising:

placing a terminal pin in a retainer;

15 placing a first epoxy ring over the pin and over the retainer;

placing a metallic body having a pin hole over the pin, the retainer and the first epoxy ring;

placing a second epoxy ring over the pin and over the body; and curing the first and second epoxy rings to provide a seal between

20 the pin and the pin hole of the body.

26. The method of claim 23, wherein curing includes heating the epoxy rings to cross link the epoxy.

27. The method of claim 24, wherein the retainer includes a cavity receiving epoxy overflow bonding the retainer to the body.

25 28. The method of claim 25, wherein the retainer includes a countersunk portion receiving the first ring, the countersunk portion communicating with the cavity.

29. The method of claim 23, further comprising supporting the pin on an assembly board.

30 30. The method of claim 23 further comprising coating the body with an adhesive.

31. A method for making a hermetic terminal assembly, the method comprising:

providing a terminal pin;

- placing a first epoxy ring over the pin;
- placing a metallic body having a pin hole over the pin and the first epoxy ring;
- placing a second epoxy ring over the pin and over the body; and
- 5 curing the first and second epoxy rings to provide a seal between the pin and the pin hole of the body.

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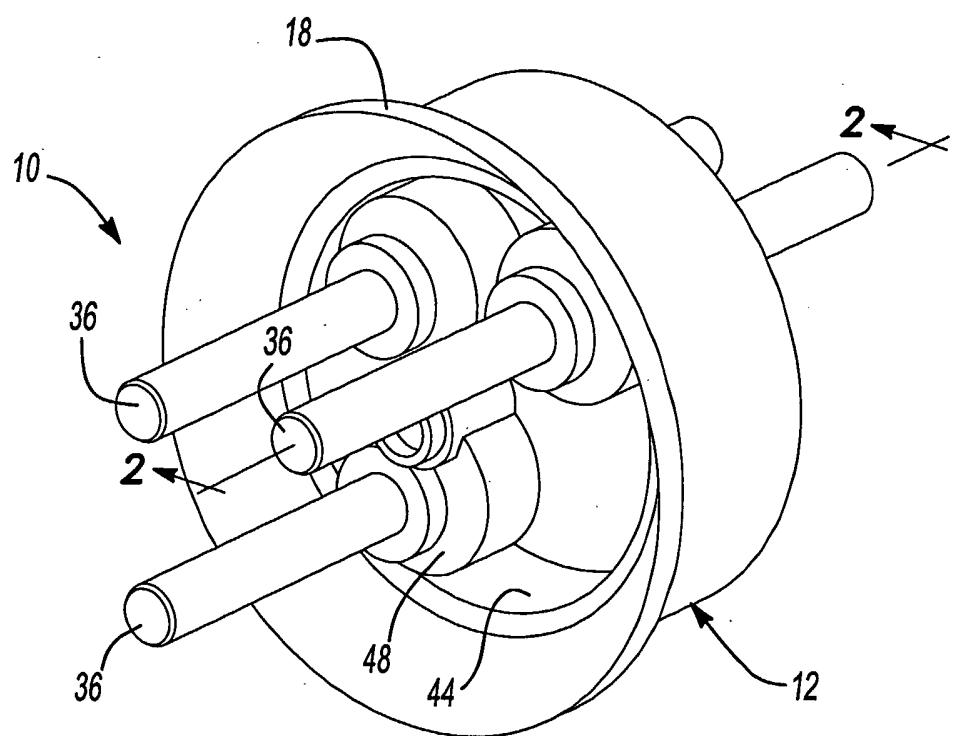


Fig-1

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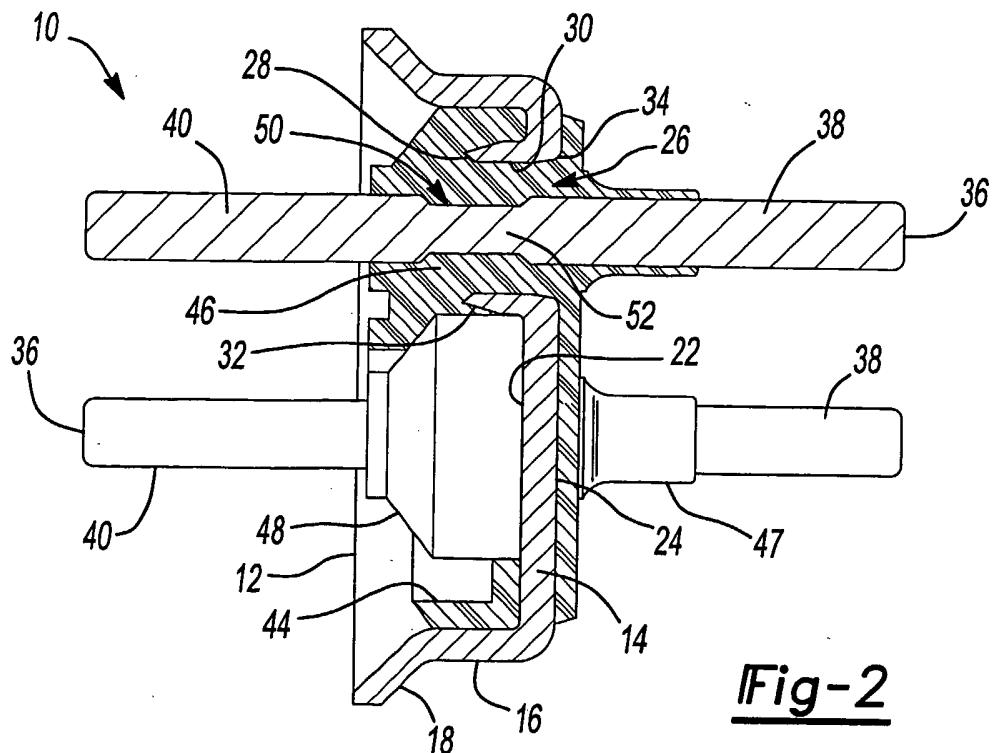


Fig-2

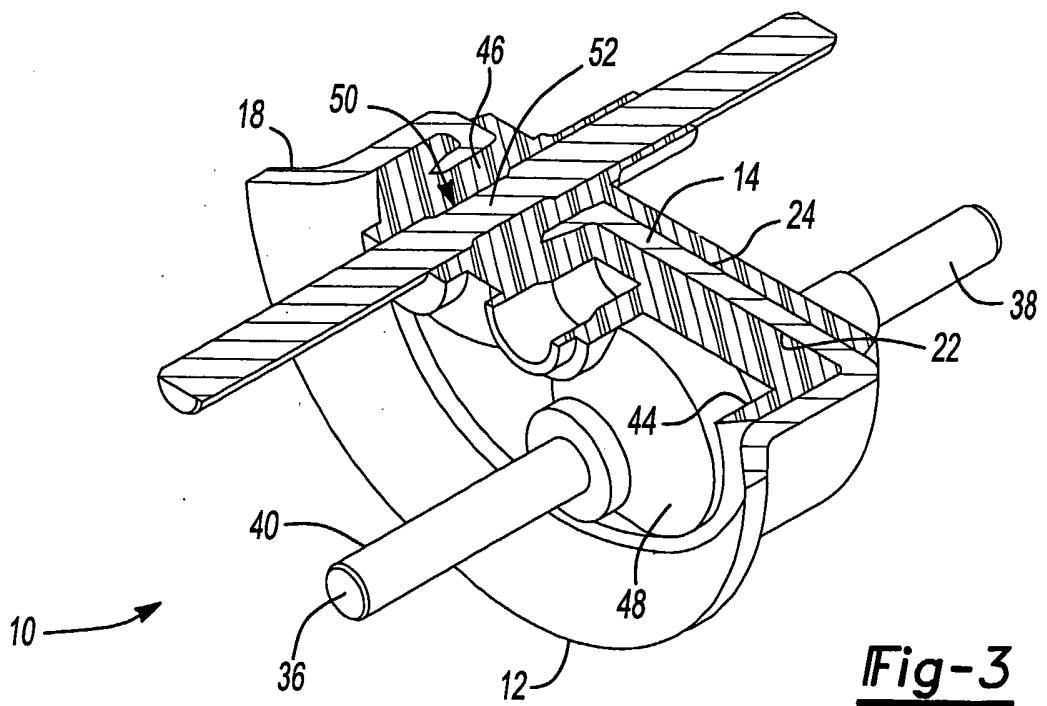


Fig-3

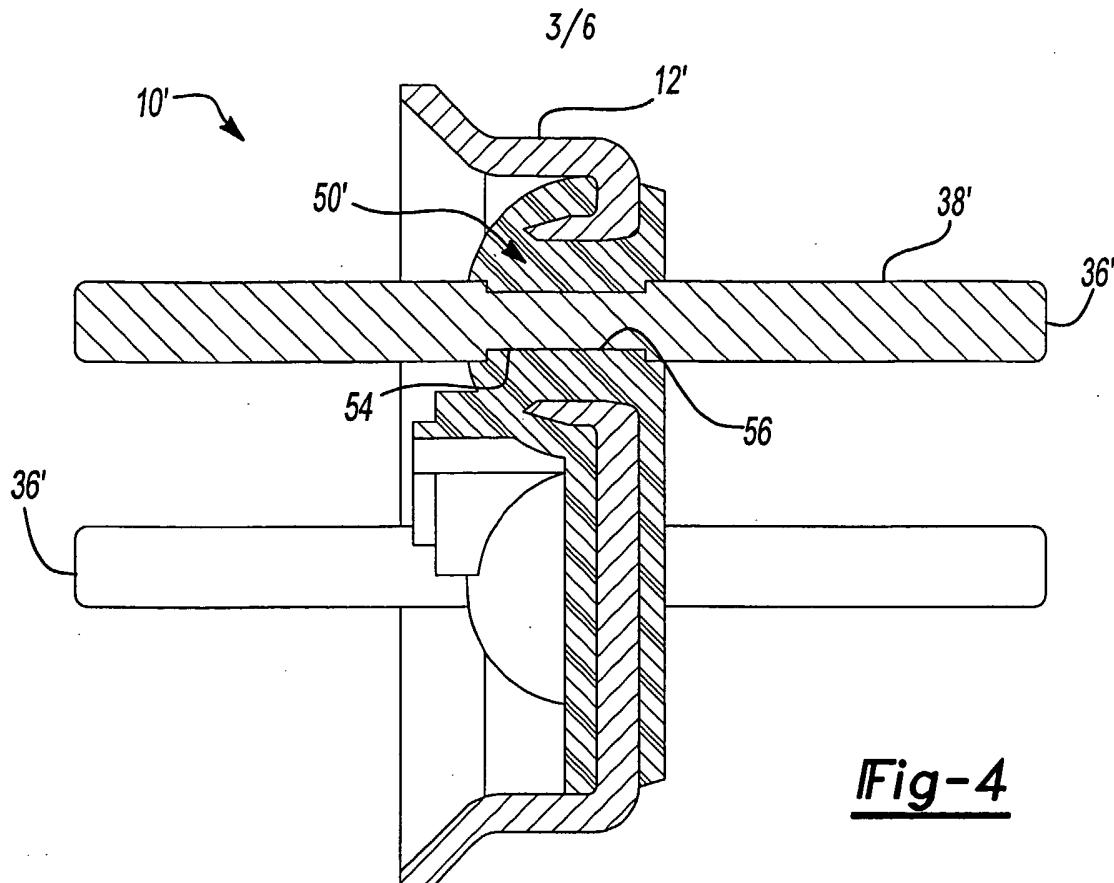


Fig-4

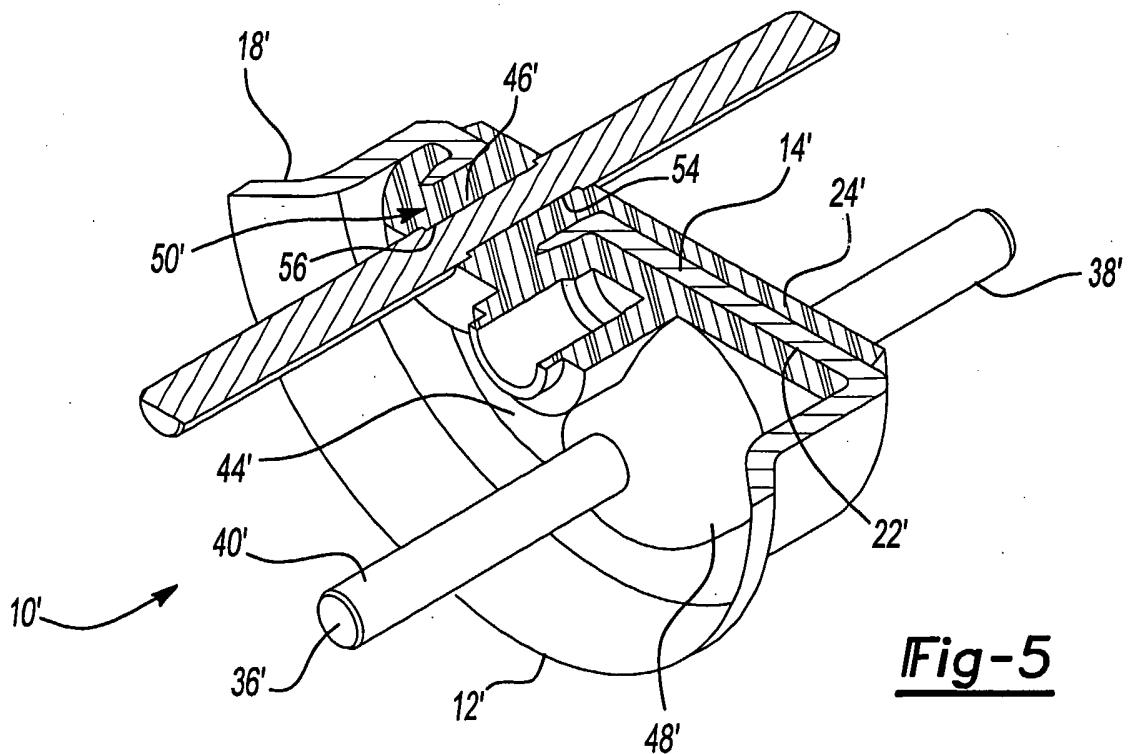


Fig-5

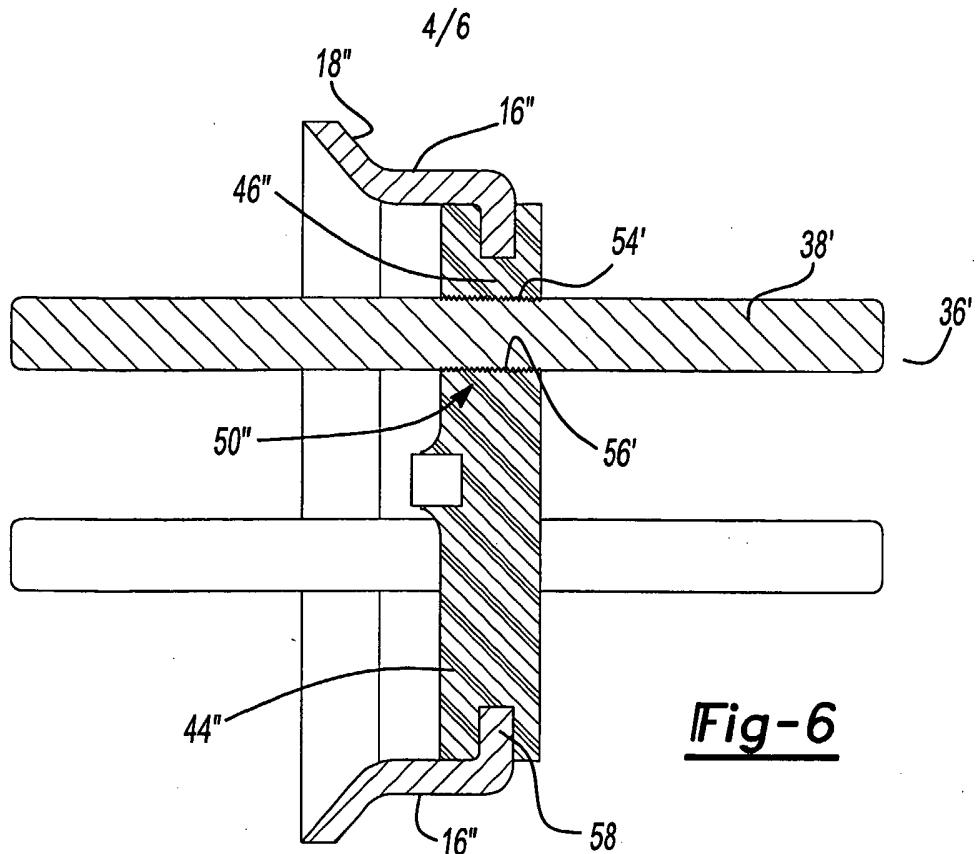


Fig-6

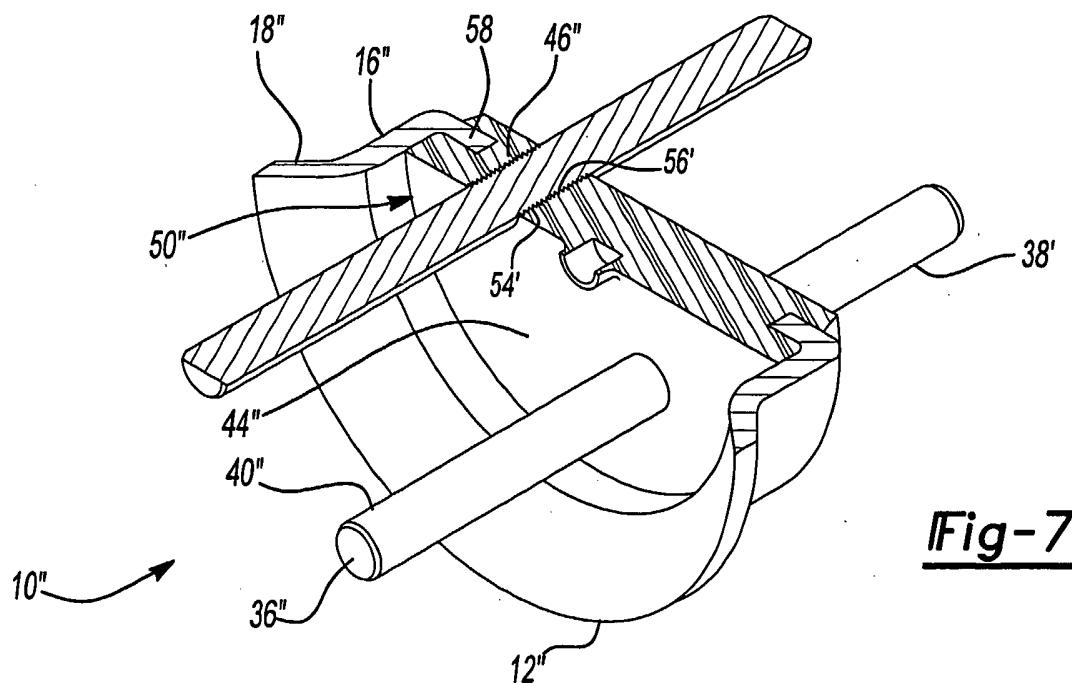
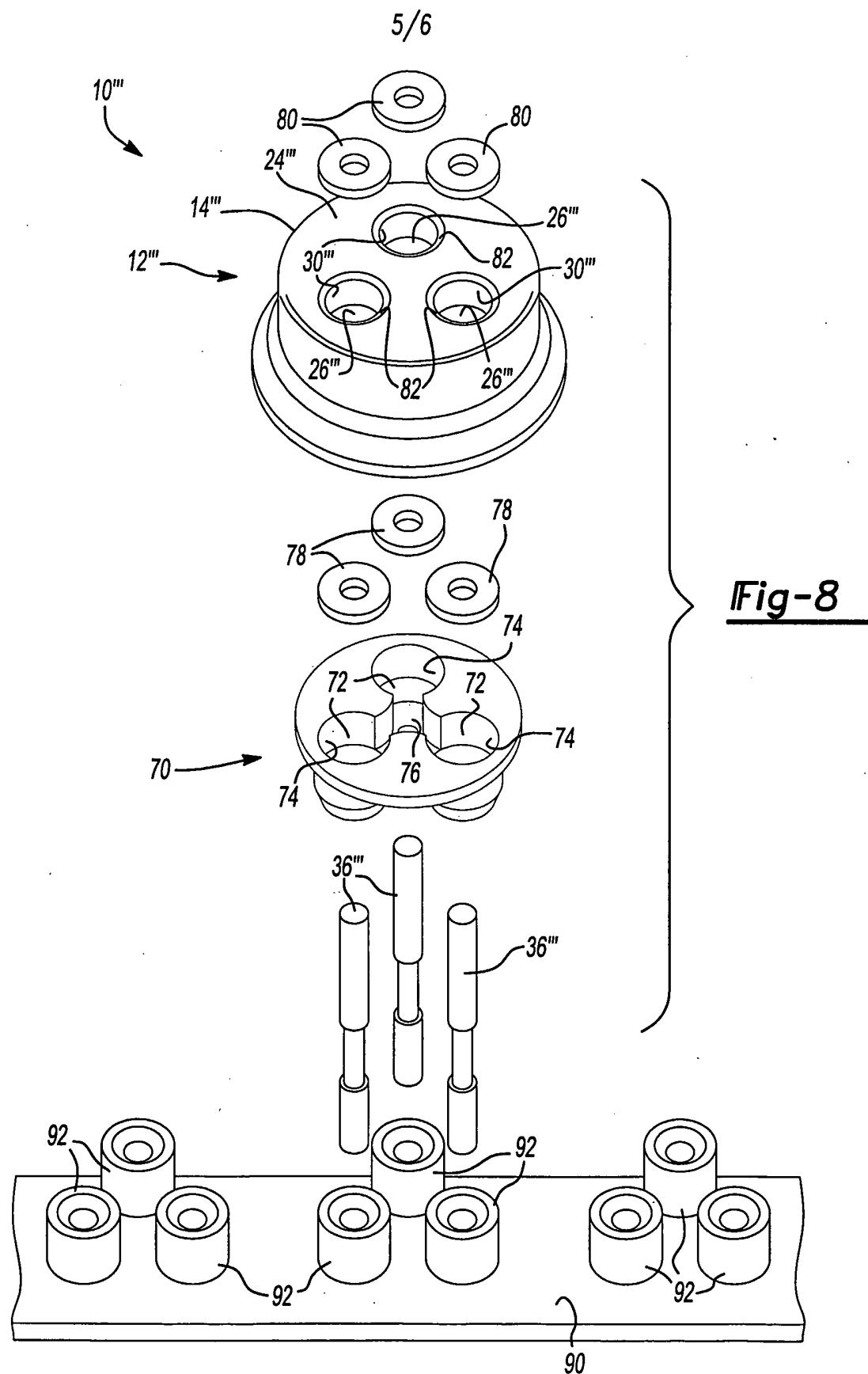


Fig-7



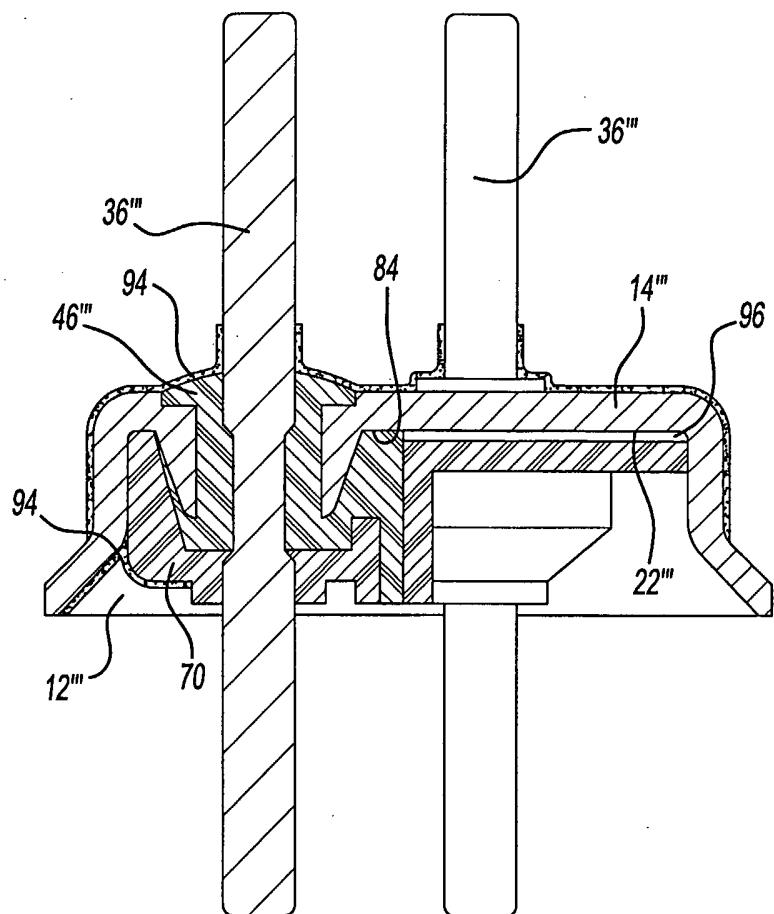


Fig-9

INTERNATIONAL SEARCH REPORT

on Application No
PCT/US2004/023996A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01B17/30 H01R13/533

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01B H01T H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	column 1, line 35 - line 50 column 3, line 31 - column 4, line 8 column 5, line 21 - line 30 figures 4-6 -----	5,6,28, 29
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Y	column 2, line 66 - column 3, line 20; figure 1 -----	28
		-/-

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

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- *A* document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search

11 November 2004

Date of mailing of the international search report

19/11/2004

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/023996

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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