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(54) Title: FIBER OPTIC FERRULE ASSEMBLY, METHOD FOR PRODUCING THE SAME

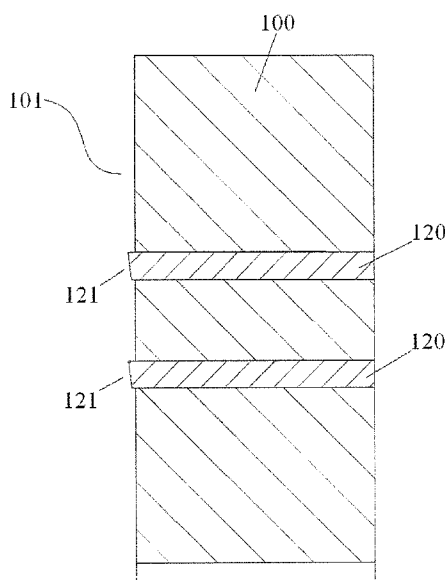


Fig.8

(57) Abstract: A fiber optic ferrule assembly, comprising: a ferrule (100) having a through hole (108); and an optical fiber (120) received in the through hole (108) of the ferrule (100), wherein an end surface (101) of the ferrule (100) is formed as a flat surface perpendicular to an optical axis of the optical fiber (120), and wherein an end surface (121) of the optical fiber (120) is formed as a flat surface or a spherical surface inclined to the optical axis of the optical fiber (120). When two ferrules are mated under a relative large spring force, it does not occur an offset error between the mated end surfaces of the two ferrules in a direction perpendicular to the optical axis of the optical fiber, so a good performance of the light transmission is achieved.



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FIBER OPTIC FERRULE ASSEMBLY, METHOD FOR PRODUCING THE SAME**CROSS-REFERENCE TO RELATED APPLICATION**

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This application claims the benefit of Chinese Patent Application No. 201310199294.0 filed on May 24, 2013 in the State Intellectual Property Office of China, the whole disclosure of which is incorporated herein by reference.

10 **BACKGROUND OF THE INVENTION****Field of the Invention**

15 The embodiments of the present invention relates to a technical field of fiber optic connector, more particularly, relates to an angle physics contact (APC) type fiber optic ferrule assembly, a fiber optic connector having the fiber optic ferrule assembly, a fiber optic connector assembly having the fiber optic connector, and a method for producing the fiber optic ferrule assembly.

20 **Description of the Related Art**

With a fiber to the home (FTTH) broadband technology having a high access speed at the user side is widely and commercially applied in the world, the number of ports for interconnecting fibers is rapidly increased. Thereby, it is necessary to provide a fiber optic
25 connector that can achieve a high density fiber optic interconnection. Since a multi fiber optic connector can achieve the high density fiber optic interconnection, persons are paying high attention to a transmission performance of the multi fiber optic connector.

In a conventional fiber optic connector, for example, in a single fiber type or a multi fiber type having a physics contact (PC) type end surface or an angle physics contact (APC)
30 type end surface, generally, an optical fiber is fixed in a through hole of a ferrule with gel so as to form a fiber optic ferrule assembly (a core component of the fiber optic connector), and then the whole end surface of the fiber optic ferrule assembly is grinded and polished so as to form the physics contact type end surface or the angle physics contact type end surface as required.

35 Fig.1 is an illustrative view of two fiber optic ferrule assemblies of a pair of

conventional APC type fiber optic connectors mated with each other.

As shown in Fig.1, the pair of fiber optic connectors comprises a first fiber optic connector having the first APC type ferrule 10 and a second fiber optic connector having the second APC type ferrule 20.

As shown in Fig.1, two end surfaces a, b of the two APC type ferrules 10, 20 each is formed as a slope surface having an angle relative to a longitudinal axis of the ferrules 10, 20. The pair of mated APC ferrules 10, 20 are held in physical contact with each other under an action of springs 11, 21. As a result, the fibers 12, 22 of the pair of ferrules 10, 20 are optically coupled with each other.

Fig.2 is an illustrative structure view of the second fiber optic connector having the APC type multi fiber ferrule 20 of Fig.1.

As shown in Fig.2, the second fiber optic connector mainly comprises the second ferrule 20, a fiber 22, a rear seat 23, a spring 21, a spring seat 24 and a housing 25. The rear end of the ferrule 20 is fixed on the rear seat 23, and the spring seat 24 is fixed on the housing 25. The spring 21 is compressed between the rear seat 23 and the spring seat 24, so as to exert an axial force on the ferrule 20 when the second ferrule 20 is abutted against the first ferrule 10.

Fig.3 is an illustrative enlarged view of the end surface b of the second ferrule assembly of Fig.2.

As shown in Fig.3, the end surface b of the second ferrule assembly is wholly grinded and polished to a slope surface having an angle relative to the longitudinal axis of the second ferrule 20.

Fig.4 is an illustrative perspective view of the mated first and second fiber optic connectors; Fig.5 is an illustrative cross section view of the mated first and second fiber optic connectors of Fig.4.

As shown in Figs.4-5, the first connector is similar to the second connector, and mainly comprises the first ferrule 10, a fiber 12, a seat 13, a spring 11, a spring seat 14 and a housing (not shown). When coupling the first and second connectors, the first and second connectors are aligned with each other by alignment guide elements 16.

As shown in Fig.5, during physically abutting the pair of ferrules 10, 20, the springs 11, 21 of the ferrules 10, 20 are compressed to exert an axial elastic force on the ferrules 10, 20, so that the ferrules 10, 20 are physically abutted against and bring into contact with each other. For APC type multi fiber optic connector, in order to achieve a good physical contact, it needs to increase the axial elastic force of the springs. However, under a large axial spring force, the pair of mated ferrules 10, 20 may be offset from each other along the angle

direction of the APC type end surfaces. As a result, as shown in Fig.5, the pair of mated ferrules 10, 20 may be offset and misplaced from each other in y-axis perpendicular to the optical axis of the fiber, causing the mated fibers 12, 22 to be offset from a normal coupling position, deteriorating the optical transmission performance of the connectors, and even causing failure of the optical interconnection of the connectors.

Fig.6 is an illustrative enlarged view of the end surfaces a, b of the pair of ferrules 10, 20 of Fig.5.

As shown in Fig.6, the first ferrule 10 is offset downward from the normal coupling position by a distance d in the y-axis under the action of the spring force, and the second ferrule 20 is offset upward from the normal coupling position by a distance d in the y-axis under the action of the spring force. If the offset distance d goes beyond an allowable range, the optical transmission performance may be deteriorated, and the optical interconnection even may be failed.

SUMMARY OF THE INVENTION

The present invention has been made to overcome or alleviate at least one aspect of the above mentioned disadvantages.

Accordingly, it is an object of the present invention to provide a fiber optic ferrule assembly, in which an end surface of a fiber is individually processed as an APC type end surface, and an end surface of a ferrule for receiving the fiber is processed as a flat surface perpendicular to an optical axis of the fiber. As a result, even a large spring force (especially for a multi fiber optic connector) is exerted on the fiber optic ferrule assembly with the above configuration, the fiber optic ferrule assembly can prevent the fibers from being offset in y-axis, improving the optical transmission performance of connectors.

According to an embodiment of an aspect of the present invention, there is provided a fiber optic ferrule assembly, comprising: a ferrule having a through hole; and an optical fiber received in the through hole of the ferrule, wherein an end surface of the ferrule is formed to be a flat surface perpendicular to an optical axis of the optical fiber, and wherein an end surface of the optical fiber is formed to be a flat surface or a spherical surface inclined to the optical axis of the optical fiber.

According to an exemplary embodiment of the present invention, the end surface of the optical fiber is positioned outward beyond the end surface of the ferrule; and wherein when two ferrules are abutted against each other, the end surface of the optical fiber in one of the two ferrules comes into physical contact with the end surface of the optical fiber in the other of the two ferrules, and the end surface of the one of the two ferrules is not in physical

contact the end surface of the other of the two ferrules.

According to another exemplary embodiment of the present invention, the end surface of the optical fiber is formed to be a flat surface inclined to the optical axis of the optical fiber; and the end surface of the optical fiber is formed to have an angle of about 45 degrees or 135 degrees relative to a horizontal plane containing the optical axis of the optical fiber.

According to another exemplary embodiment of the present invention, the end surface of the optical fiber is formed to be a flat surface inclined to the optical axis of the optical fiber; and the end surface of the optical fiber is formed to have an angle of about 45 degrees or 135 degrees relative to a vertical plane containing the optical axis of the optical fiber.

According to another exemplary embodiment of the present invention, wherein the ferrule comprises a single fiber ferrule.

According to another exemplary embodiment of the present invention, the ferrule comprises a multi fiber ferrule.

According to another exemplary embodiment of the present invention, the multi fiber ferrule is formed with alignment guide holes therein.

According to another exemplary embodiment of the present invention, the whole end surface of the multi fiber ferrule is formed to be a flat surface; or the whole end surface of the multi fiber ferrule is formed to be a ‘凸’ type of stepped surface, and a front end surface of the through hole protrudes from a front end surface of the alignment guide hole.

According to another exemplary embodiment of the present invention, the fiber optic ferrule assembly further comprising: a rear seat on which a rear end of the ferrule is fixed.

According to another exemplary embodiment of the present invention, the fiber optic ferrule assembly further comprising: a spring seat positioned behind the rear seat; and a spring positioned and compressed between the rear seat and the spring seat so as to exert an axial elastic force on the ferrule.

According to an embodiment of another aspect of the present invention, there is provided a fiber optic connector, comprising: a housing; and a fiber optic ferrule assembly according to the above embodiments. The fiber optic ferrule assembly is mounted in the housing.

According to an embodiment of a further aspect of the present invention, there is provided a fiber optic connector assembly, comprising: a first fiber optic connector; a second fiber optic connector to be coupled with the first fiber optic connector; and a fiber optic adapter for coupling the first fiber optic connector and the second fiber optic connector, wherein each of the first and second fiber optic connectors comprises a fiber optic ferrule assembly according to the above embodiments.

According to an embodiment of still another aspect of the present invention, there is provided a method for producing a fiber optic ferrule assembly, comprising steps of:

S100: providing a ferrule having an end surface formed to be a flat surface perpendicular to an axis of a through hole in the ferrule; and

5 S200: before inserting an optical fiber into the through hole of the ferrule, or after fixing the optical fiber in the through hole of the ferrule, individually processing an end surface of the optical fiber, so that the end surface of the optical fiber is formed to be a flat surface or a spherical surface inclined to an optical axis of the optical fiber.

10 According to an exemplary embodiment of the present invention, said processing the end surface of the optical fiber comprises grinding, polishing, cutting or arc discharging the end surface of the optical fiber.

According to another exemplary embodiment of the present invention, the end surface of the optical fiber is positioned outward beyond the end surface of the ferrule after the optical fiber is fixed in the through hole of the ferrule.

15 In the above various embodiments of the present invention, since the end surface of the ferrule is formed to be a flat surface perpendicular to an optical axis of the optical fiber, when two ferrules are mated under a relative large spring force, it does not occur an offset error between the mated end surfaces of the two ferrules in a direction perpendicular to the optical axis of the optical fiber, so a good performance of the light transmission is achieved.

20

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the accompanying drawings, in which:

25 Fig.1 is an illustrative view of two fiber optic ferrule assemblies of a pair of conventional APC type fiber optic connectors mated with each other;

Fig.2 is an illustrative structure view of a second fiber optic connector having the APC type multi fiber ferrule of Fig.1;

30 Fig.3 is an illustrative enlarged view of the end surface of the second ferrule assembly of Fig.2;

Fig.4 is an illustrative perspective view of the mated first and second fiber optic connectors;

Fig.5 is an illustrative cross section view of the mated first and second fiber optic connectors of Fig.4;

35 Fig.6 is an illustrative enlarged view of the end surfaces of the pair of ferrules of Fig.5;

Fig.7 is a vertical cross section view of a fiber optic connector according to a first exemplary embodiment of the present invention;

Fig.8 is an illustrative enlarged view of an end surface of a ferrule of the fiber optic connector of Fig.7;

5 Fig.9 is an illustrative perspective view of the fiber optic connector of Fig.7;

Fig.10 is an illustrative cross section view of a pair of mated fiber optic connectors;

Fig.11 is an illustrative enlarged view of end surfaces of the mated connectors of Fig.10;

10 Fig.12 is an illustrative vertical cross section view of a fiber optic connector according to a second exemplary embodiment of the present invention;

Fig.13 is an illustrative enlarged view of an end surface of a ferrule of the fiber optic connector of Fig.12;

Fig.14 is an illustrative horizontal cross section view of a fiber optic connector according to a third exemplary embodiment of the present invention;

15 Fig.15 is an illustrative enlarged view of an end surface of a ferrule of the fiber optic connector of Fig.14;

Fig.16 is an illustrative horizontal cross section view of a fiber optic connector according to a fourth exemplary embodiment of the present invention;

20 Fig.17 is an illustrative enlarged view of an end surface of a ferrule of the fiber optic connector of Fig.16; and

Fig.18 is an illustrative structure view of a pair of coupled single fiber optic ferrules according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE 25 **IVENTION**

Exemplary embodiments of the present disclosure will be described hereinafter in detail with reference to the attached drawings, wherein the like reference numerals refer to the like elements. The present disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiment set forth herein; rather, these
30 embodiments are provided so that the present disclosure will be thorough and complete, and will fully convey the concept of the disclosure to those skilled in the art.

In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced

without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

Fig.7 is a vertical cross section view of a fiber optic connector according to a first exemplary embodiment of the present invention; Fig.8 is an illustrative enlarged view of an end surface 101 of a ferrule 100 of the fiber optic connector of Fig.7; Fig.9 is an illustrative perspective view of the fiber optic connector of Fig.7.

As shown in Figs.7-9, an APC (angle physics contact) type multi fiber optic ferrule 100 capable of receiving twenty-four fibers (arranged in an array of 2×12) is taken as an example. But the present invention is not limited to the illustrated embodiment, in an alternative embodiment, the present invention also can be applied in a single fiber optic ferrule.

As shown in Figs.7-9, the fiber optic connector mainly comprises a ferrule 100, fibers 120, a rear seat 130, a spring 160, a spring seat 140 and a housing 150. A rear end of the ferrule 100 is fixed on the rear seat 130. The spring seat 140 is fixed on the housing 150. The spring 160 is compressed between the rear seat 130 and the spring seat 140, so as to exert an axial elastic force on the ferrule 100 once the ferrule 100 is coupled with a mating ferrule of a mating fiber optic connector.

As shown in Figs.7-9, twenty-four through holes (arranged in an array of 2×12) 108 are formed in the ferrule 100 of the fiber optic ferrule assembly of the fiber optic connector. The twenty-four fibers 120 are inserted into and fixed in the twenty-four through holes 108 of the ferrule 100, respectively.

As shown in Fig.8, an end surface 101 of the ferrule 100 is formed to be a flat surface perpendicular to an axis (an optical axis) of the through hole 108, and an end surface 121 of the optical fiber 120 is formed to be a slope flat surface having an angle relative to the optical axis of the optical fiber 120. But the present invention is not limited to the illustrated embodiments, for example, in another exemplary embodiment, the end surface 121 of the optical fiber 120 may be formed to be an arc surface inclined to the optical axis of the optical fiber 120, that is, a tangent line at any point of the arc surface is not perpendicular to the optical axis. In another exemplary embodiment, the end surface 121 of the optical fiber 120 may be formed to be a spherical surface inclined to the optical axis of the optical fiber 120.

In order to obtain the fiber optic ferrule assembly of Figs.7-9, in an exemplary embodiment of the present invention, before inserting the fibers 120 into the through holes 108 of the ferrule 100, the end surface 101 of the ferrule 100 is individually processed to a flat plane perpendicular to the axis (the optical axis) of the through hole 108 of the ferrule

100, and the end surface 121 of the fiber 120 is individually processed to a slope surface having an angle relative to the optical axis of the fiber 120; then the fibers 120 are inserted into the through holes 108 of the ferrule 100 and fixed in the through holes 108 with gel, respectively.

5 But the present invention is not limited to this, in another exemplary embodiment of the present invention, the end surface 121 of the fiber 120 may be individually processed to a slope flat surface having an angle relative to the optical axis of the fiber 120 after the fiber 120 is inserted into and fixed in the through holes 108 of the ferrule 100.

10 In an exemplary embodiment, the end surface 121 of the fiber 120 may be formed to the slope surface by grinding and polishing. But the present invention is not limited to this, the processing of the end surface 121 of the optical fiber 120 may comprise any one of grinding, polishing, cutting or arc discharging.

15 In an exemplary embodiment, the end surface 101 of the ferrule 100 may be formed to the flat surface by grinding and polishing. But the present invention is not limited to this, the end surface 101 of the ferrule may be formed to the flat surface by a single molding, instead of the grinding and polishing.

Fig.10 is an illustrative cross section view of a pair of mated fiber optic connectors; Fig.11 is an illustrative enlarged view of end surfaces of the mated fiber optic connectors of Fig.10.

20 As shown in Figs.10-11, the pair of mated fiber optic connectors comprises a first fiber optic connector as shown in Figs.7-9 and a second fiber optic connector similar to the first fiber optic connector. The second fiber optic connector mainly comprises a ferrule 200, fibers 220, a rear seat 230, a spring 260, a spring seat 240 and housing (not shown).

25 Also, the fiber optic ferrule assembly (comprising the ferrule 200 and fibers 220) of the second fiber optic connector is also similar to that of the first fiber optic connector. As shown in Fig.11, an end surface 201 of the ferrule 200 is formed to be a flat surface perpendicular to an axis (an optical axis) of a through hole of the ferrule 200, and an end surface 221 of the fiber 220 is formed to be a slope surface having an angle relative to the optical axis of the fiber 220.

30 In this way, in the present invention, since the end surfaces 101 and 201 of the pair of mated ferrules 100, 200 both are flat surfaces perpendicular to the optical axis, when the two ferrules 100, 200 are mated under a relative large spring force, it does not occur an offset error between the mated end surfaces 101 and 201 of the two ferrules 100, 200 in a direction perpendicular to the optical axis of the optical fiber, so it can implement a good performance
35 of the light transmission.

As shown in Fig.8 and Fig.11, after the fibers 120, 220 are fixed in the ferrules 100, 200, respectively, the end surfaces 121, 221 of the optical fibers 120, 220 are positioned outward beyond the end surfaces 101, 201 of the ferrules 100; 200, respectively. In this way, as shown in Figs.10-11, when the two ferrules 100, 200 are abutted against each other, the end surface 121 of the optical fiber 120 in the ferrule 100 comes into physical contact with the end surface 221 of the optical fiber 220 in the ferrule 200, and the end surface 101 of the ferrule 100 is not in physical contact with the end surface 201 of the ferrule 200. As a result, when the pair of fiber optic connectors are coupled together, the end surfaces 101, 201 of the two ferrules 100, 200 are not in physical contact with each other. Thereby, it can effectively prevent the end surfaces 101, 201 of the two ferrules 100, 200 from being offset and displaced in a direction perpendicular to the optical axis, improving the optical transmission performance of the fiber optic connectors.

But the present invention is not limited to the illustrated embodiments, for example, in another exemplary embodiment of the present invention, the end surface 101 of the ferrule 100 may come into physical contact with the end surface 201 of the ferrule 200 when the two ferrules 100, 200 are abutted against each other. For example, the end surface of the fiber of one of the two ferrules is provided to protrude from the end surface of the one ferrule, and the end surface of the fiber of the other of the two ferrules is provided to recess from the end surface of the other ferrule. In this case, even if the end surfaces of the two mated ferrules come into physical contact with each other, the present embodiment can prevent the end surfaces of the two ferrules from being offset and displaced in a direction perpendicular to the optical axis because the end surfaces of the two mated ferrules both are formed to be flat surface perpendicular to the optical axis, improving the optical transmission performance of connectors.

As shown in Figs.8-11, the ferrule 100 or the ferrule 200 is provided as a multi fiber ferrule having a pair of alignment guiding holes 107, and the ferrules 100 and 200 can be aligned with each other by inserting alignment guiding rods (not shown) into the alignment guiding holes 107 of the ferrules 100 and 200.

As shown in Fig.9, the whole end surface 101 of the multi fiber ferrule 100 is formed to a flat surface perpendicular to the optical axis. But the present invention is not limited to this, in another exemplary embodiment, the whole end surface 101 of the multi fiber ferrule 100 may be formed to be a '凸' type of stepped surface, and a front end surface of the through hole 108 is formed to protrude from a front end surface of the alignment guide hole 107.

In an exemplary embodiment, the end surface of the fiber is individually processed as an APC type end surface inclined to the optical axis, and the end surface of the ferrule is

processed as a flat surface perpendicular to the optical axis. The orientation of the APC type end surface of the fiber with respect to the flat surface of the ferrule can be determined as required, then inserting the fiber and fixing the fiber in the ferrule in accordance with the determined orientation.

5 As shown in Fig.8, the end surface 121 of the fiber 120 is orientated to have an angle of about 135 degrees relative to a horizontal plane containing the optical axis. That is, the end surface 121 of the fiber 120 is orientated to have an angle of 135 degrees relative to a horizontal plane containing centers of a row of through holes 108.

10 But the present invention is not limited to this, the orientation of the end surface 121 of the fiber 120 may be varied as required. For example, the end surface 121 of the fiber 120 may be orientated to have an angle larger or less than 90 degrees relative to any plane containing the optical axis.

15 Fig.12 is an illustrative vertical cross section view of a fiber optic connector according to a second exemplary embodiment of the present invention; Fig.13 is an illustrative enlarged view of an end surface of a ferrule of the fiber optic connector of Fig.12.

 The fiber optic connector of Figs.12-13 is different from the fiber optic connector of Figs.7-9 in that the end surface 121' of the fiber 120' is orientated to have an angle of about 45 degrees relative to the horizontal plane containing the optical axis.

20 Fig.14 is an illustrative horizontal cross section view of a fiber optic connector according to a third exemplary embodiment of the present invention; Fig.15 is an illustrative enlarged view of an end surface of a ferrule of the fiber optic connector of Fig.14.

 The fiber optic connector of Figs.14-15 is different from the fiber optic connector of Figs.7-9 in that the end surface 121'' of the fiber 120'' is orientated to have an angle of about 135 degrees relative to a vertical plane containing the optical axis.

25 Fig.16 is an illustrative horizontal cross section view of a fiber optic connector according to a fourth exemplary embodiment of the present invention; Fig.17 is an illustrative enlarged view of an end surface of a ferrule of the fiber optic connector of Fig.16.

30 The fiber optic connector of Figs.16-17 is different from the fiber optic connector of Figs.7-9 in that the end surface 121''' of the fiber 120''' is orientated to have an angle of 45 degrees relative to the vertical plane containing the optical axis.

 Please be noted that the present invention is not limited to the multi fiber ferrule shown in Figs.7-17, for example, as shown in Fig.18, the present invention may be adapted to a single fiber ferrule.

35 Fig.18 is an illustrative structure view of a pair of coupled single fiber optic ferrules

1000, 2000 according to an exemplary embodiment of the present invention.

As shown in Fig. 18, a pair of single fiber ferrules 1000, 2000 are inserted into an alignment pipe 3000 and coupled with each other. The end surfaces of the single fiber ferrules 1000, 2000 both are formed to flat surfaces perpendicular to the optical axes of the fibers 1200, 2200, and the end surface of the fibers 1200, 2200 both are formed to slope surfaces or spherical surfaces inclined to the optical axes of the fibers 1200, 2200.

Although it is not shown, the present invention also provides a fiber optic connector assembly comprising: a first fiber optic connector; a second fiber optic connector to be coupled with the first fiber optic connector; and a fiber optic adapter for coupling the first fiber optic connector and the second fiber optic connector. Each of the first and second fiber optic connectors comprises a fiber optic ferrule assembly according to the above embodiments.

In the present invention, when a pair of fiber optic connectors are abutted against each other, the APC end surfaces of the fibers are mated with each other under the action of the springs, avoiding the disadvantageous of wholly grinding and polishing the whole end surfaces of the fiber optic ferrules. Furthermore, the mated fibers can be aligned well, improving the optical transmission performance of connectors.

It should be appreciated for those skilled in this art that the present invention also can be adapted to a fiber optic connector having a few of fibers or a single fiber to be connected. In this case, similar to the above discussed embodiments, only the end surface of the fiber is processed to an APC type end surface as required, and it is not necessary to process the whole end surface of the whole ferrule assembly as an APC type end surface, simplifying the processing of the end surface of the fiber optic connector, and optimizing the coupling performance of the fiber optic connectors.

It should be appreciated for those skilled in this art that the above embodiments are intended to be illustrated, and not restrictive. For example, many modifications may be made to the above embodiments by those skilled in this art, and various features described in different embodiments may be freely combined with each other without conflicting in configuration or principle.

Although several exemplary embodiments have been shown and described, it would be appreciated by those skilled in the art that various changes or modifications may be made in these embodiments without departing from the principles and spirit of the disclosure, the scope of which is defined in the claims and their equivalents.

As used herein, an element recited in the singular and proceeded with the word "a" or "an" should be understood as not excluding plural of said elements or steps, unless such

exclusion is explicitly stated. Furthermore, references to "one embodiment" of the present invention are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Moreover, unless explicitly stated to the contrary, embodiments "comprising" or "having" an element or a plurality of elements
5 having a particular property may include additional such elements not having that property.

What is claimed is,

1. A fiber optic ferrule assembly, comprising:
a ferrule (100) having a through hole (108); and
5 an optical fiber (120) received in the through hole (108) of the ferrule (100),
wherein an end surface (101) of the ferrule (100) is formed as a flat surface
perpendicular to an optical axis of the optical fiber (120), and
wherein an end surface (121) of the optical fiber (120) is formed as a flat surface or a
spherical surface inclined to the optical axis of the optical fiber (120).

10 2. The fiber optic ferrule assembly according to claim 1,
wherein the end surface (121) of the optical fiber (120) is positioned outward beyond
the end surface (101) of the ferrule (100); and
wherein when two ferrules (100, 200) are abutted against each other, the end surface
15 (121) of the optical fiber (120) in one of the two ferrules (100, 200) comes into physical
contact with the end surface (221) of the optical fiber (220) in the other of the two ferrules
(100, 200), and the end surface (101) of the one of the two ferrules (100, 200) is not in
physical contact with the end surface (201) of the other of the two ferrules (100, 200).

20 3. The fiber optic ferrule assembly according to claim 1,
wherein the end surface (121) of the optical fiber (120) is formed as a flat surface
inclined to the optical axis of the optical fiber (120); and
wherein the end surface (121) of the optical fiber (120) is formed to have an angle of
about 45 degrees or 135 degrees relative to a horizontal plane containing the optical axis of
25 the optical fiber (120).

4. The fiber optic ferrule assembly according to claim 1,
wherein the end surface (121) of the optical fiber (120) is formed to be a flat surface
inclined to the optical axis of the optical fiber (120); and
30 wherein the end surface (121) of the optical fiber (120) is formed to have an angle of
about 45 degrees or 135 degrees relative to a vertical plane containing the optical axis of the
optical fiber (120).

5. The fiber optic ferrule assembly according to claim 1, wherein the ferrule (100)
35 comprises a single fiber ferrule.

6. The fiber optic ferrule assembly according to claim 1, wherein the ferrule (100) comprises a multi fiber ferrule.

5 7. The fiber optic ferrule assembly according to claim 6,
wherein the multi fiber ferrule is formed with alignment guide holes (107) therein.

8. The fiber optic ferrule assembly according to claim 7, wherein
the whole end surface (101) of the multi fiber ferrule is formed as a flat surface; or
10 the whole end surface (101) of the multi fiber ferrule is formed as a ‘凸’ type of stepped
surface, and a front end surface of the through hole (108) is formed to protrude from a front
end surface of the alignment guide hole (107).

9. The fiber optic ferrule assembly according to claim 1, further comprising:
15 a rear seat (130) on which a rear end of the ferrule (100) is fixed.

10. The fiber optic ferrule assembly according to claim 9, further comprising:
a spring seat (140) positioned behind the rear seat (130); and
a spring (160) positioned and compressed between the rear seat (130) and the spring
20 seat (140) so as to exert an axial elastic force on the ferrule (100).

11. A fiber optic connector, comprising:
a housing (150); and
a fiber optic ferrule assembly according to any one of claims 1-10,
25 wherein the fiber optic ferrule assembly is mounted in the housing (150).

12. A fiber optic connector assembly, comprising:
a first fiber optic connector;
a second fiber optic connector to be coupled with the first fiber optic connector; and
30 a fiber optic adapter for coupling the first fiber optic connector and the second fiber
optic connector,
wherein each of the first and second fiber optic connectors comprises a fiber optic
ferrule assembly according to claim 1.

35 13. A method for producing a fiber optic ferrule assembly, comprising steps of:

S100: providing a ferrule (100) having an end surface (101) formed as a flat surface perpendicular to an axis of a through hole (108) in the ferrule (100); and

S200: before inserting an optical fiber (120) into the through hole (108) of the ferrule (100), or after fixing the optical fiber (120) in the through hole (108) of the ferrule (100),

- 5 individually processing an end surface (121) of the optical fiber (120), so that the end surface (121) of the optical fiber (120) is formed as a flat surface or a spherical surface inclined to an optical axis of the optical fiber (120).

14. The method according to claim 13,

- 10 wherein said processing the end surface (121) of the optical fiber (120) comprises grinding, polishing, cutting or arc discharging the end surface (121) of the optical fiber (120).

15. The method according to claim 14,

- 15 wherein the end surface (121) of the optical fiber (120) is positioned outward beyond the end surface (101) of the ferrule (100) after the optical fiber (120) is fixed in the through hole (108) of the ferrule (100).

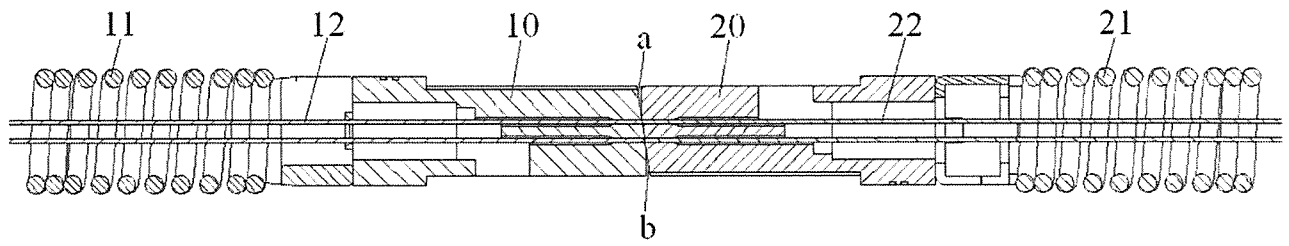


Fig.1

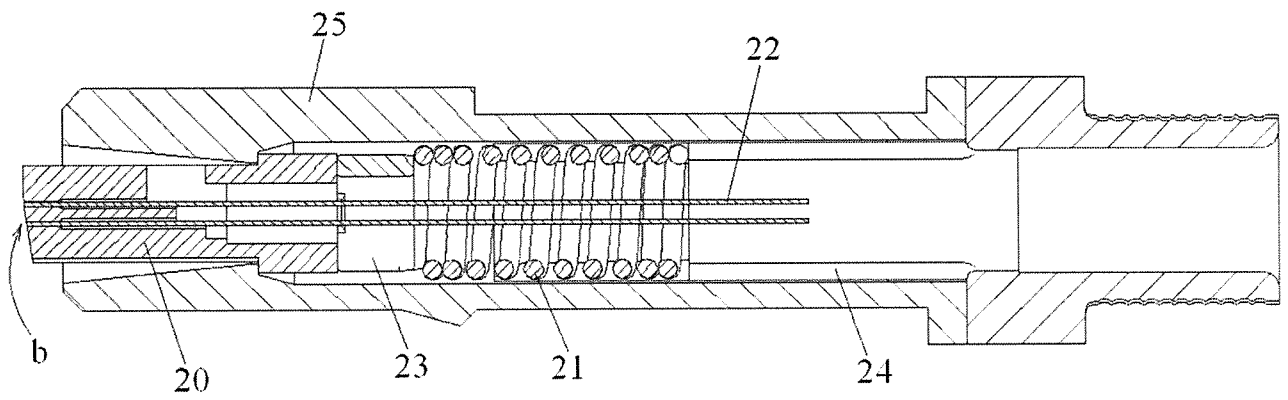


Fig.2

2/11

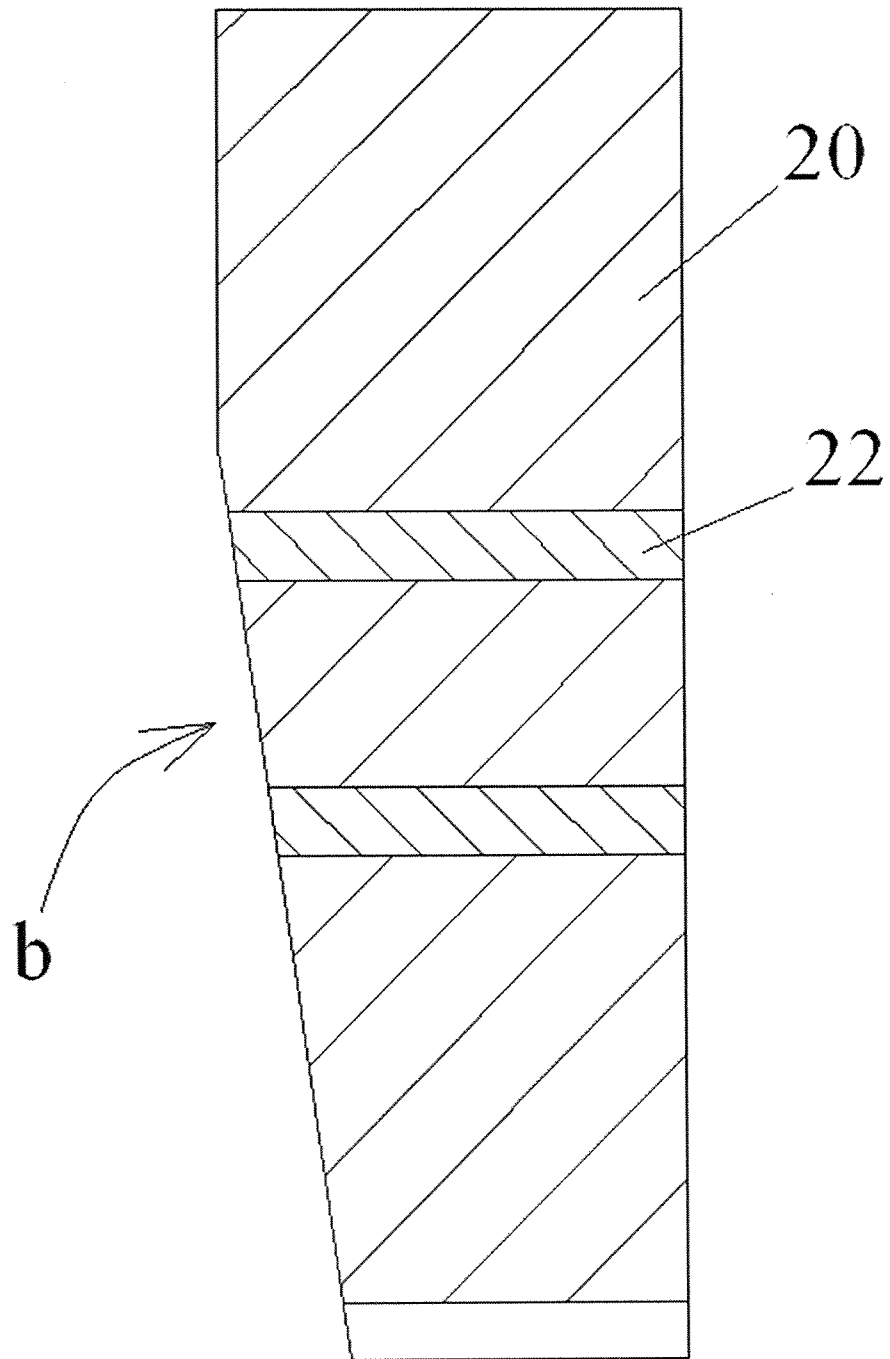


Fig.3

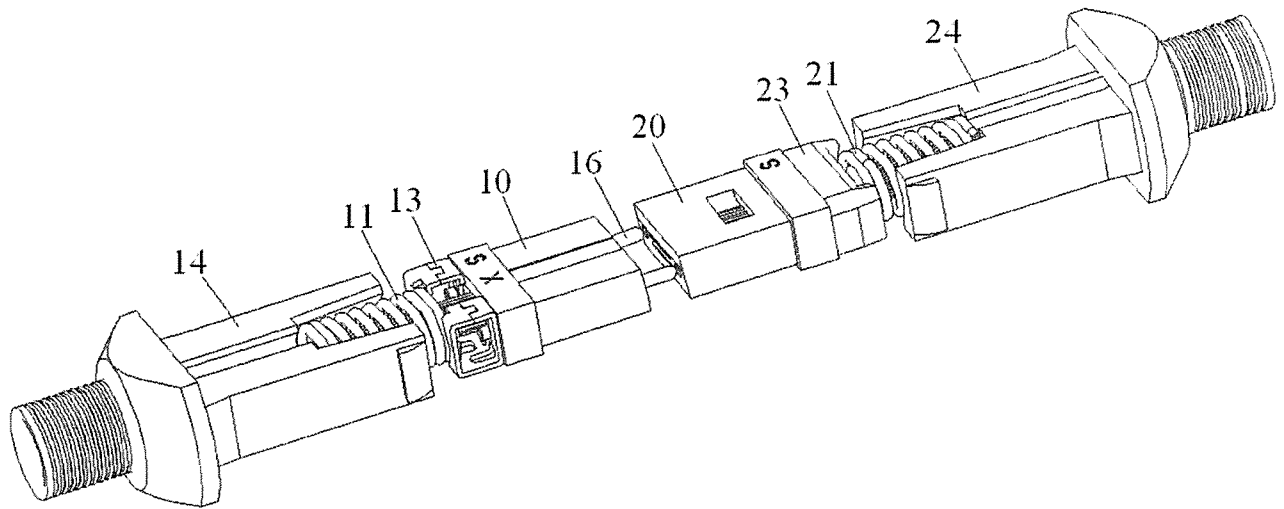


Fig.4

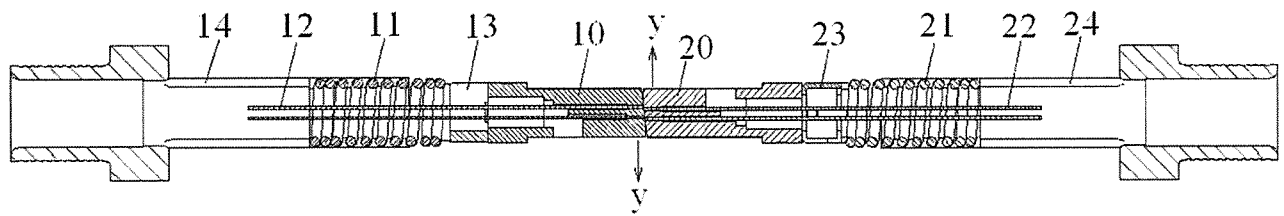


Fig.5

4/11

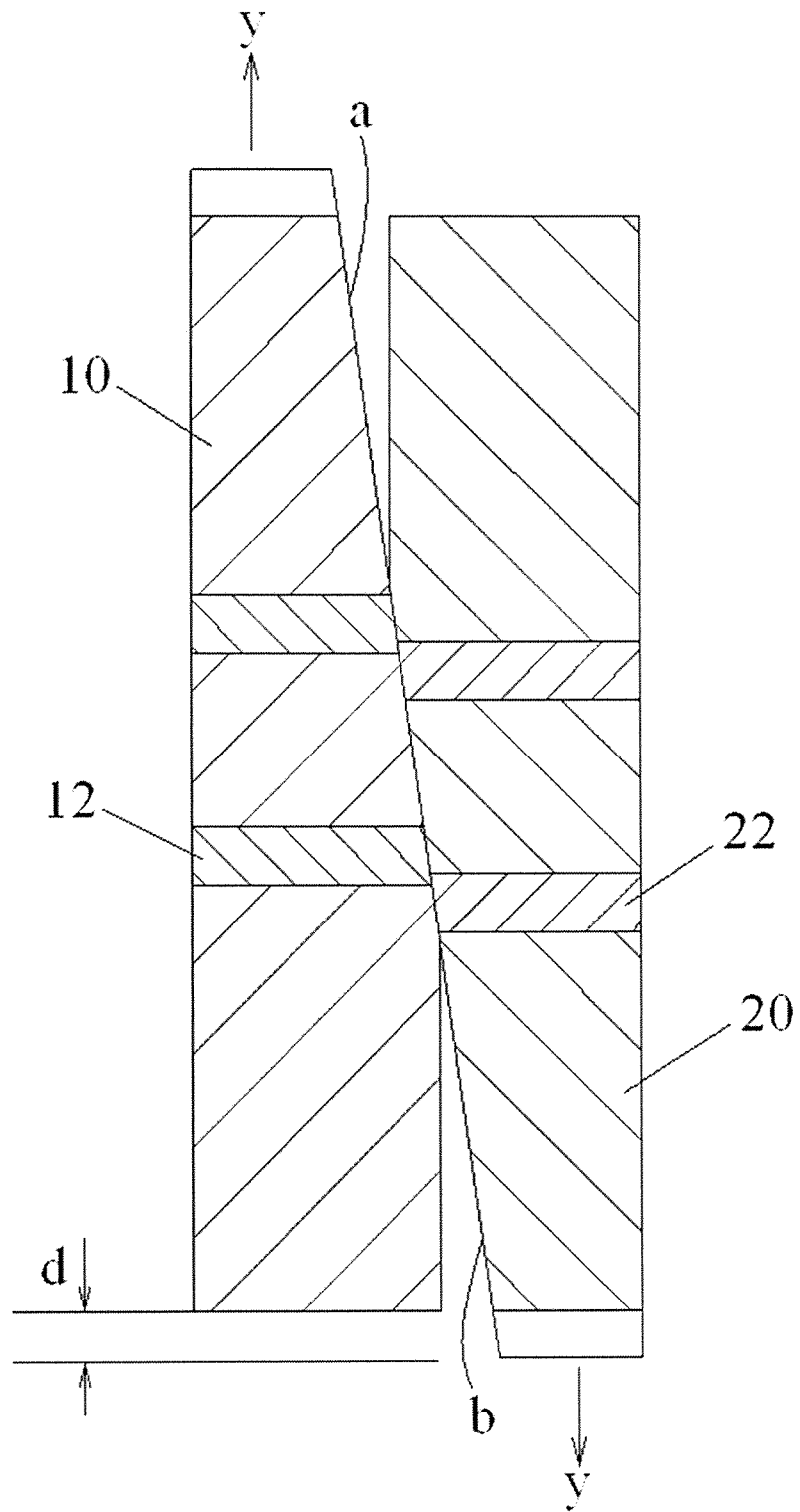


Fig.6

5/11

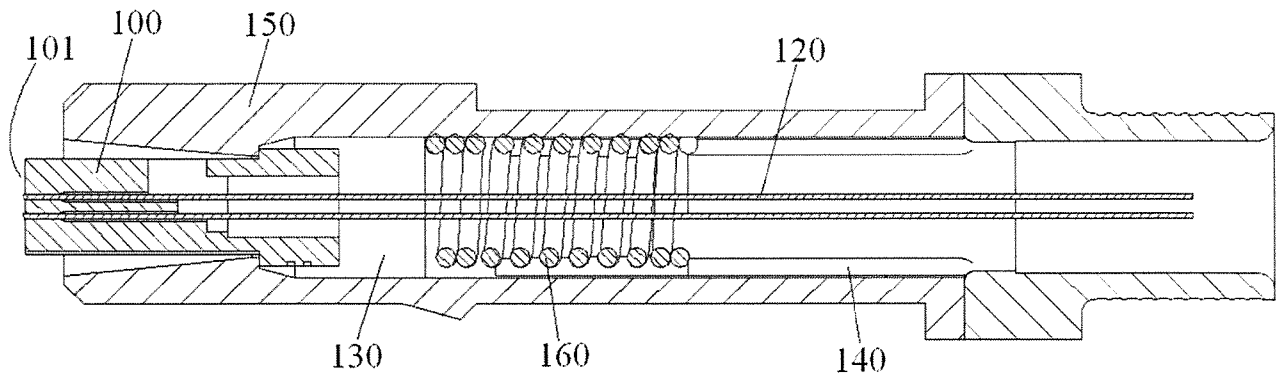


Fig.7

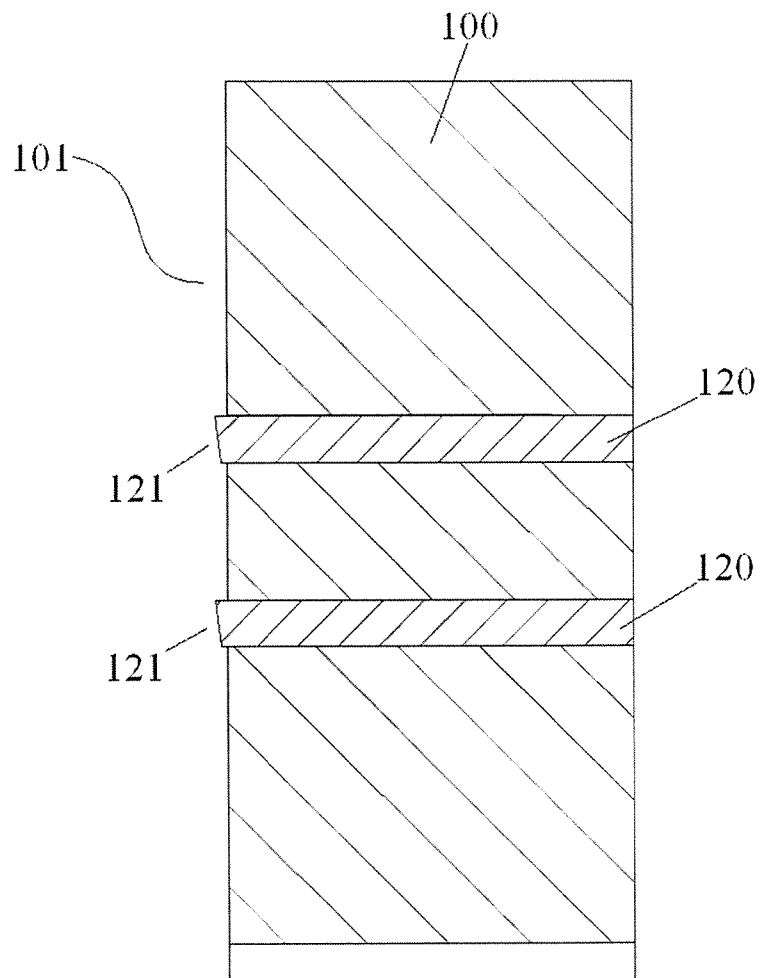


Fig.8

6/11

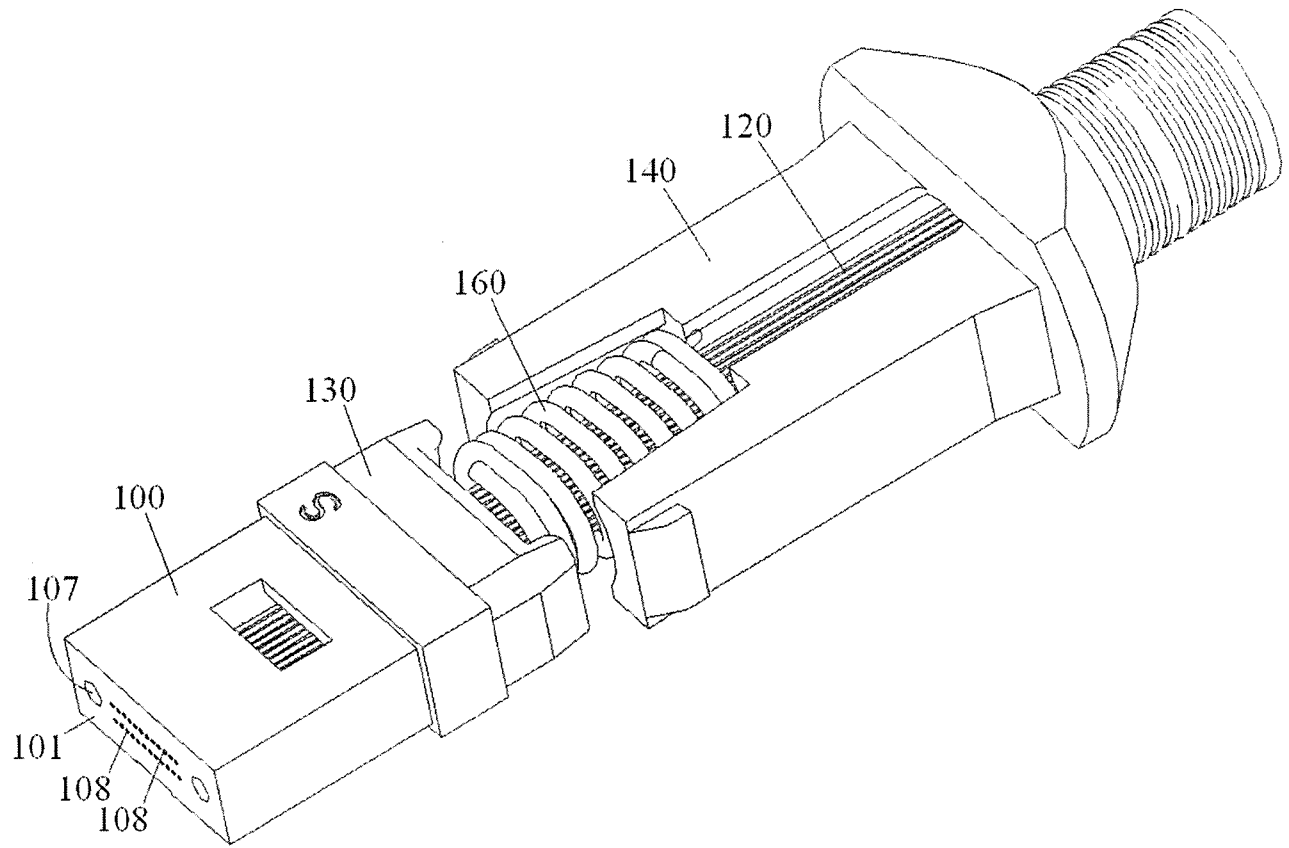


Fig.9

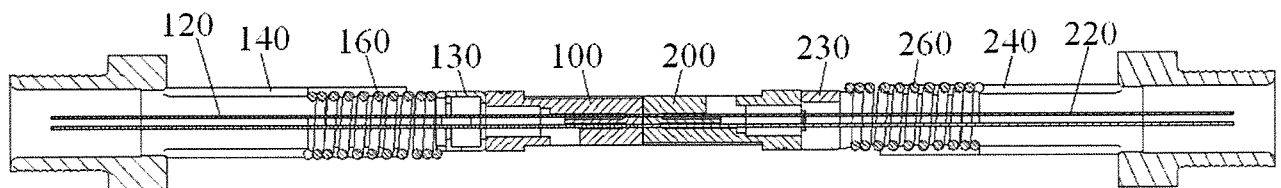


Fig.10

7/11

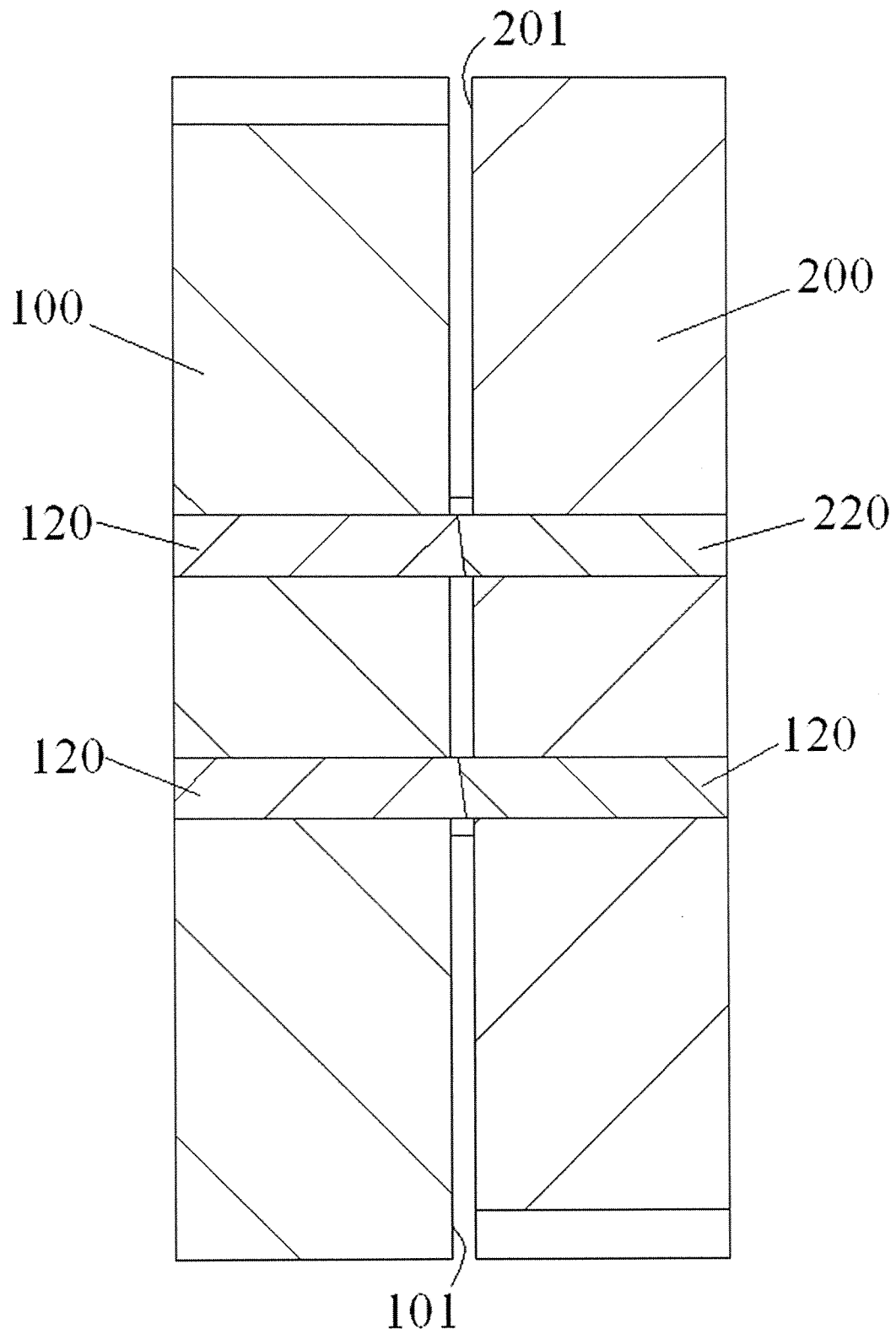
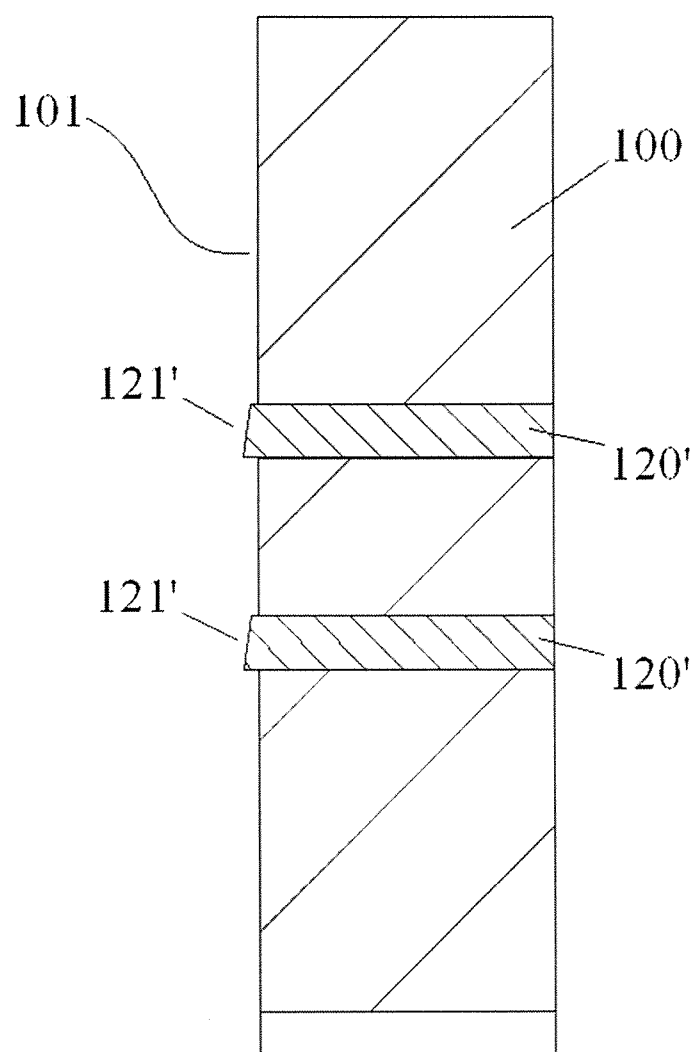
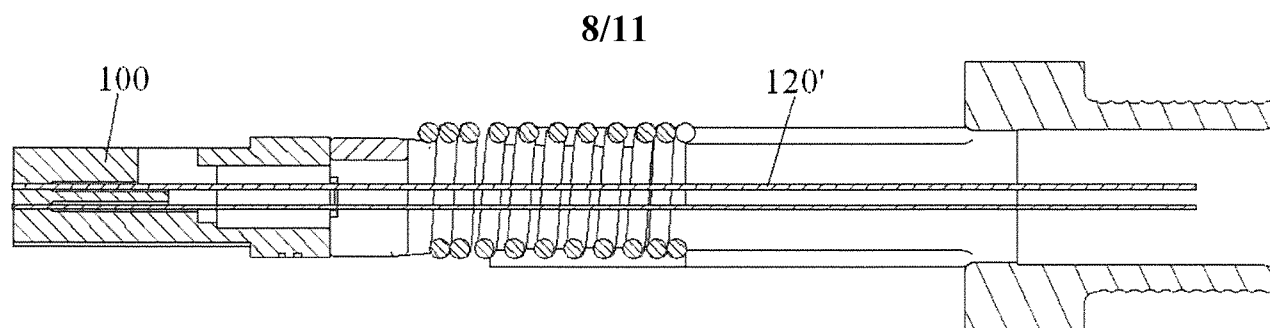


Fig.11



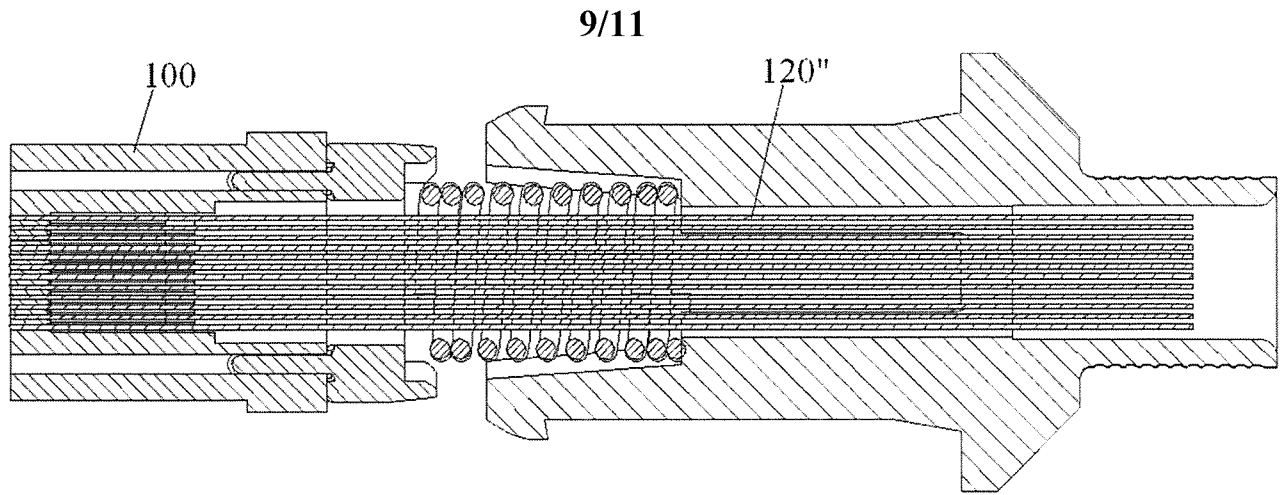


Fig.14

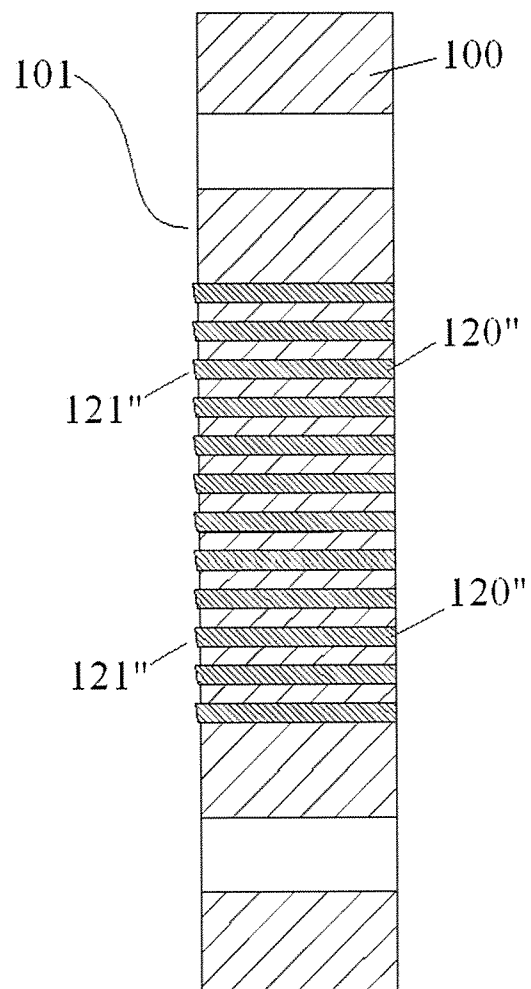


Fig.15

10/11

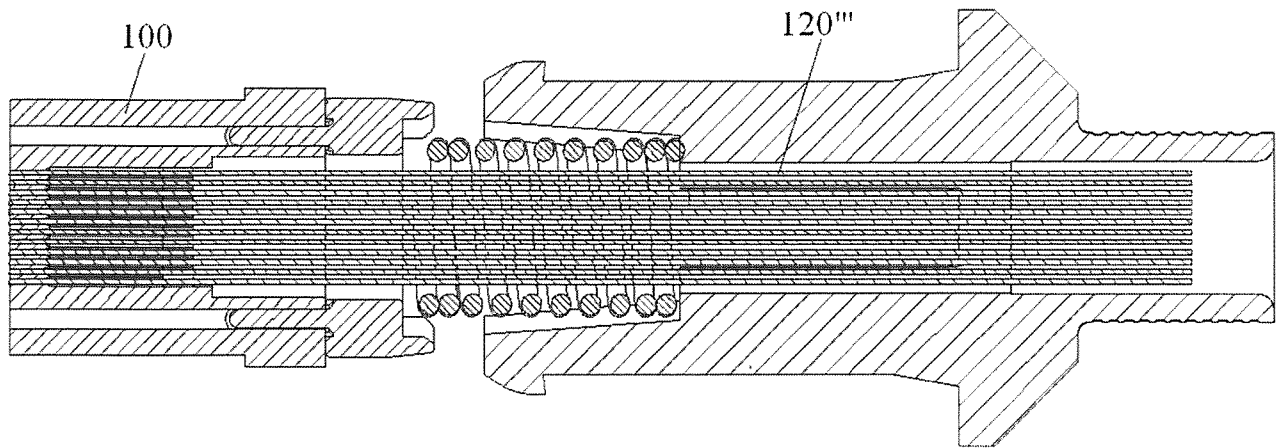


Fig.16

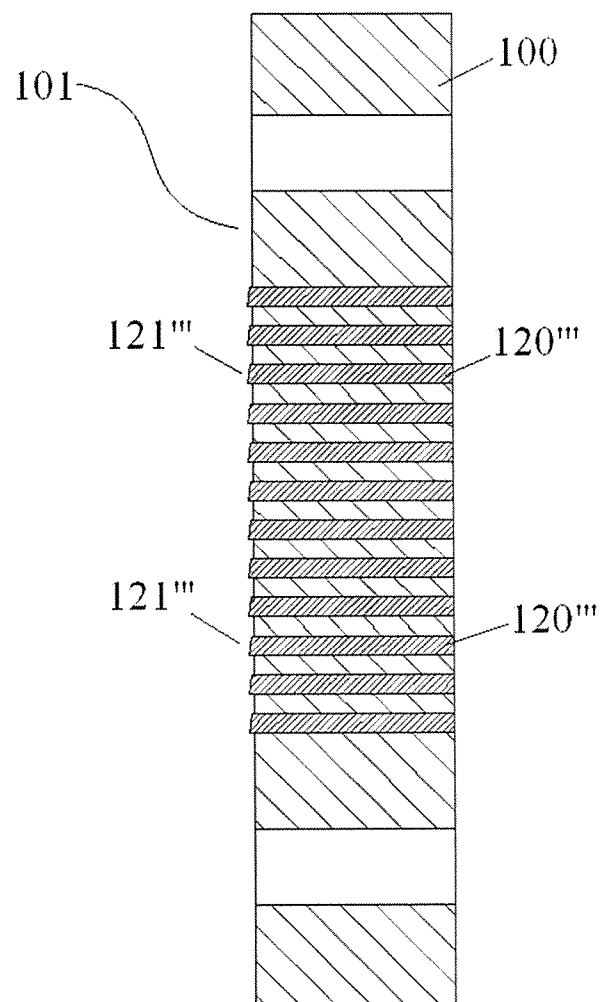


Fig.17

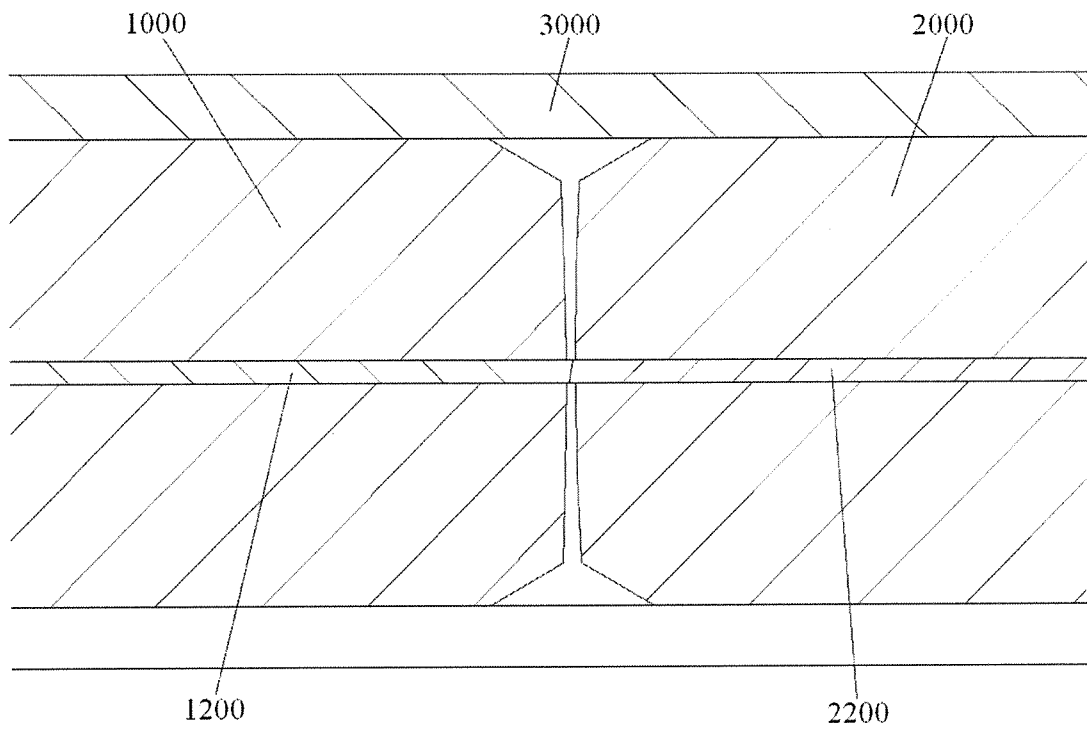


Fig.18

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/061133

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/38
ADD.

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)
G02B

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 practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2003/235374 A1 (LUTHER JAMES P [US] ET AL) 25 December 2003 (2003-12-25) abstract paragraphs [0002], [0003], [0034], [0035], [0053] figures 1,2,6B,7B,8B,9B -----	1-9, 11-15 10
X A	US 6 196 732 B1 (TAMEKUNI YOSHIKYO [JP] ET AL) 6 March 2001 (2001-03-06) column 7, line 50 - column 8, line 16 figures 16,17 -----	1,13 2-12,14, 15
Y A	EP 0 514 722 A1 (NIPPON TELEGRAPH & TELEPHONE [JP]) 25 November 1992 (1992-11-25) figures 9,24 -----	10 1-9, 11-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

16 July 2014

Date of mailing of the international search report

24/07/2014

Name and mailing address of the ISA/

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Authorized officer

Menck, Alexander

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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