

Claims

[Claim 1]

A connector assembly (1) for fiber optic cable (C), characterized by comprising:

- a main body (100) having, on an outer part thereof, a first thread section (101), a nut section (102), and a second thread section (103), and on an inner part thereof, a first tubular section (104), a conical section (106), and a second tubular section (107);
- a fixing nut (200) for fixing the main body (100) to a base plate (P) of a fiber optic connection box;
- an extension nut (600);
- a lock nut (400);
- an insert (700) comprising a main tubular body (701), a second tubular body (702) adjacent the main tubular body (701), and a plurality of elastically deformable flexible fingers (703) projecting from the second tubular body (702); and
- a cable seal (800);

wherein the cable seal (800) is snap fitted in an inner circumferential cavity (706) formed in the second tubular body (702) of insert (700) thus forming a sub-assembly (700-800);

wherein the main body (100) further comprises a plurality of longitudinal channels (105) formed in a surface of the first tubular section (104), and the insert (700) further comprises a plurality of longitudinal protrusions (704) formed in an outer surface of the main tubular body (701), such that the longitudinal protrusions (704) are received in the longitudinal channels (105) of main body (100) to guide introduction of insert (700) into the main body (100) and at least partially prevent rotation of insert (700) relative the main body (100) when the extension nut (600) is screwed on the main body (100);

wherein the sub-assembly (700-800) is introduced at least partially in the main body (100) such that the fingers (703) of insert (700) protrude from the main body (100) when the insert (700) is mounted butt up inside the main body (100);

wherein the extension nut (600) is partially screwed in the main body (100) thus forming a hollow inner space into which the plurality of flexible fingers (703) is at least partially received to a position in which at least a distal end of the plurality of flexible fingers (703) contacts with a portion of the inner cavity of the extension nut (600); and

wherein a further screwing of the extension nut (600) in the main body (100) causes a radially inwardly deformation of the plurality of flexible fingers (703) and of the seal (800) thus providing a first seal and stress-absorption area to an outer surface of the cable (C) installed in the connector assembly (1).

[Claim 2] The connector assembly according to claim 1, characterized in that the lock nut (400) is screwed in the extension nut (600) for closing the connector assembly (1).

[Claim 3] The connector assembly according to claim 1, characterized in that the extension nut (600) comprises:

- on an outer part thereof, a tubular section (601), a nut section (602), and a thread section (603), and
- on an inner part thereof, a thread section (604), a first conical section (605), a first tubular section (606), a second conical section (607) and a second tubular section (608).

[Claim 4] The connector assembly according to claim 1, characterized by further comprising a ferrule (500) having a center tubular section (501), two slope sections (502) adjacent to each end of the center tubular section (501), and a through bore (503), wherein the ferrule (500) is installed in a hollow inner space formed between the extension nut (600) and lock nut (400) for generating a second seal and stress-absorption area to the cable (C).

[Claim 5] The connector assembly according to claim 1, characterized in that the main body (100) further comprises an inner circumferential recess (108), and an annular recess (109) in a back face of the nut section (102).

[Claim 6] The connector assembly according to claim 5, characterized by further comprising an O-ring (300) for generating a seal between the nut section (102) and a front surface of the base plate (P) when tightening the fixing nut (200) in the main body (100).

[Claim 7] The connector assembly according to claim 6, characterized in that the O-ring (300) is received at least partially in the annular recess (109) of main body (100) to generate the seal between the nut section (102) and the base plate (P).

[Claim 8] The connector assembly according to claim 1, characterized in that each finger (703) comprises a base portion (703a) and a gripping portion (703b), and the gripping portions (703b) of the flexible fingers (703) are formed projecting radially inwardly at an angle (α) such that

adjacent gripping portions (703b) are brought into contact with one another when they deformed radially inwardly due to tightening of the extension nut (600) in the main body (100).

[Claim 9] The connector assembly according to claim 1, characterized in that the insert (700) further comprises a plurality of circumferential protrusions (705) spaced apart from each other, which are formed in an outer surface of the tubular main body (701) to reinforce the main tubular body (701).

[Claim 10] The connector assembly according to claim 1, characterized in that the plurality of flexible fingers (703) are spaced apart by gaps (703c).

[Claim 11] The connector assembly according to claim 1, characterized in that at least one of the main body (100), fixing nut (200), lock nut (400) and extension nut (600) is made of metal.

[Claim 12] The connector assembly according to claim 11, characterized in that the metal is selected from the group consisting of: steel, bronze, brass, in particular tin plated brass, and aluminium.

[Claim 13] The connector assembly according to claim 1, characterized in that at least one of the main body (100), fixing nut (200), lock nut (400), extension nut (600) and insert (700) is made from a plastic material.

[Claim 14] The connector assembly according to claim 13, characterized in that the plastic material is made of, or comprises, nylon.

[Claim 15] The connector assembly according to claim 6, characterized in that at least one of the O-ring (300), ferrule (500) and cable seal (800) is made of a rubber-based material, in particular Buna-N, or a silicone-based material.

[Claim 16] A method of forming a connector assembly (1) in a base plate (P) of a fiber optic connection box, characterized by comprising the steps of:
a) providing a main body (100) having:
on an outer part thereof, a first thread section (101), a nut section (102), and a second thread section (103), and
on an inner part thereof, a first tubular section (104) having a plurality of longitudinal channels (105), a conical section (106), and a second tubular section (107);
b) providing a fixing nut (200);
c) fixing the main body (100) in an opening of the base plate (P) by means of the fixing nut (200);
d) providing a lock nut (400);
e) providing an extension nut (600);

f) providing an insert (700) comprising:
a main tubular body (701) having a plurality of longitudinal protrusions (704) formed on its outer surface, a second tubular body (702) adjacent the main tubular body (701), and a plurality of elastically deformable flexible fingers (703) projecting project from the second tubular body (702);
g) providing a cable seal (800);
h) mounting the cable seal (800) in an inner circumferential cavity (706) formed in the second tubular body (702) of insert (700) thereby forming a sub-assembly (700-800);
i) positioning in sequence from a distal end towards a proximal end of the fiber optic cable (C) the lock nut (400), the extension nut (600) and the sub-assembly (700-800);
j) passing the distal end of the cable (C) through the main body (100) to a position where a substantial portion of the distal end of cable (C) protrudes from the base plate (P) and main body (100);
k) introducing the sub-assembly (700-800) in the main body (100) with the longitudinal protrusions (704) of insert (700) being guided in the longitudinal channels (105) of main body (100) to a position where the plurality of fingers (703) is adjacent to and protrude from the main body (100);
l) screwing the extension nut (600) in the main body (100) to a position in which a radially inwardly deformation is caused to the plurality of flexible fingers (703) and seal (800) while the insert (700) is prevented from rotating relative the main body (100) during screwing of the extension nut (600) in the main body (100), thus producing a first seal and stress-absorption area to an outer surface of cable (C);
m) screwing the lock nut (400) in the extension nut (600) to close the connector assembly (1).

[Claim 17] The method according to claim 16, characterized by further comprising, before step (c), positioning an O-ring (300) between the main body (100) and a front surface of base plate (P) to generate a seal between them.

[Claim 18] The method according to claim 16, characterized by further comprising, after step (d) and before step (e), providing an elastically deformable ferrule (500).

[Claim 19] The method according to claim 18, characterized by further comprising, in step (i), positioning the ferrule (500) between the lock nut (400) and

the extension nut (600).

[Claim 20] The method according to claim 19, characterized by further comprising, before step (m), partially inserting the ferrule (500) in the extension nut (600).

[Claim 21] The method according to claim 20, characterized by further comprising screwing the lock nut (400) in the extension nut (600) such that the ferrule (500) is accommodated inside a hollow inner space formed at least partially by the lock nut (400) and the extension nut (600); wherein the ferrule (500) is elastically deformed in said inner space, thus producing a second seal and stress-absorption area to the fiber optic cable (C).

[Claim 22] The method according to claim 21, characterized by further comprising causing a further screwing of the lock nut (400) in the extension nut (600) to a position in which the ferrule (500) is so deformed that it partially protrudes from the lock nut (400) thus ensuring a tight seal.

PCTNOTIFICACION DE RECEPCIÓN DE
COPIA DE REGISTRO

(Regla 24.2(a) del PCT)

De la OFICINA INTERNACIONAL

Para:

GONZALEZ ROSSI, Alejandro Gabriel
Av. Tecamachalco 14-7 PH
Col. Lomas de Chapultepec
Ciudad de México, 11010
MÉXICO

Fecha de envío (día/mes/año): 14 octubre 2016 (14.10.2016)	NOTIFICACION IMPORTANTE
Referencia del expediente del solicitante o agente 200087-16PCT	No. de solicitud internacional PCT/IB2016/056109

Por este medio el solicitante es **notificado** que la Oficina Internacional ha recibido la copia de registro de la solicitud internacional como se detalla a continuación.

Nombre(s) del (de los) solicitante(s) y País(es) para los cuales ellos son solicitantes:

PEREZ DAVILA, William (todos los Países designados)

Fecha de presentación internacional: **12 octubre 2016 (12.10.2016)**

Fecha(s) de prioridad reclamada(s): **03 noviembre 2015 (03.11.2015)**

Fecha de recepción de la copia de registro por la Oficina Internacional: **14 octubre 2016 (14.10.2016)**

Lista de Oficinas designadas:

AP: BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW

EA: AM, AZ, BY, KG, KZ, RU, TJ, TM

EP: AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR

OA: BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG

Nacional: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW

ATENCIÓN: El solicitante deberá verificar cuidadosamente los datos que aparecen en esta Notificación. En caso de cualquier discrepancia entre estos datos y las indicaciones en la solicitud internacional, el solicitante deberá informar inmediatamente a la Oficina Internacional.

Además, se llama la atención del solicitante a:

- tiempos límites para entrada en la fase nacional (véase www.wipo.int/pct/en/texts/time_limits.html and *Guía del Solicitante del PCT*, Fase Nacional, especialmente los Capítulos 3 y 4)
- requerimientos con respecto a documentos de prioridad (si aplican) (véase *Guía del Solicitante del PCT*, Fase Internacional, párrafo 5.070)

Una copia de esta notificación está siendo enviada a la Oficina receptora y a la Autoridad de Búsqueda Internacional.

La Oficina Internacional de OMPI 34, chemin des Colombettes 1211 Ginebra 20, Suiza	Oficial autorizado Vivet Jean-Marc Correo-e ro.ib@wipo.int Teléfono No. +4122 338 9895
Fax No. +41 22 910 06 10	

From the INTERNATIONAL BUREAU

PCTNOTIFICATION OF RECEIPT OF
RECORD COPY

(PCT Rule 24.2(a))

To:

GONZALEZ ROSSI, Alejandro Gabriel
Av. Tecamachalco 14-7 PH
Col. Lomas de Chapultepec
Mexico City, 11010
MEXIQUE

Date of mailing (<i>day/month/year</i>) 14 October 2016 (14.10.2016)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 200087-16PCT	International application No. PCT/IB2016/056109

The applicant is hereby **notified** that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

PEREZ DAVILA, William (all designated States)

International filing date:

12 October 2016 (12.10.2016)

Priority date(s) claimed:

03 November 2015 (03.11.2015)

Date of receipt of the record copy by the International Bureau:

14 October 2016 (14.10.2016)

List of designated Offices:

AP: BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW

EA: AM, AZ, BY, KG, KZ, RU, TJ, TM

EP: AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR

OA: BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG

National: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW

ATTENTION: The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau. **In addition, the applicant's attention is drawn to:**

- time limits for entry into the national phase (see www.wipo.int/pct/en/texts/time_limits.html and *PCT Applicant's Guide*, National Phase, especially Chapters 3 and 4)
- requirements regarding priority documents (if applicable) (see *PCT Applicant's Guide*, International Phase, paragraph 5.070)

A copy of this notification is being sent to the receiving Office and to the International Searching Authority.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Vivet Jean-Marc e-mail ro.ib@wipo.int Telephone No. +4122 338 9895
Facsimile No. +41 22 910 06 10	

PCT REQUEST

Print Out (Original in Electronic Form)

0	For receiving Office use only	
0-1	International Application No.	PCT/IB2016/056109
0-2	International Filing Date	12 October 2016 (12.10.2016)
0-3	Name of receiving Office and "PCT International Application"	RO/IB
0-4	Form PCT/RO/101 PCT Request	
0-4-1	Prepared Using	ePCT-Filing Version 3.3.011 MT/FOP 20151028/0.20.5.24
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	International Bureau of the World Intellectual Property Organization (RO/IB)
0-7	Applicant's or agent's file reference	200087-16PCT
I	Title of Invention	CONNECTOR ASSEMBLY FOR FIBER OPTIC CABLES HAVING ABSORPTION OF INNER STRESSES AND INNER SEALING FOR MOUNTING IN A FIBER OPTIC CONNECTION BOX
II	Applicant	
II-1	This person is	Applicant and inventor
II-2	Applicant for	All designated States
II-4	Name (LAST, First)	PEREZ DAVILA, William
II-5	Address	Av. Plutarco Elias Calles N° 1035 Col. Miravalle Del. Benito Juarez 03580 Mexico City Mexico
II-6	State of nationality	US
II-7	State of residence	MX
II-10	e-mail	wilupls@aol.com
II-10(a)	E-mail authorization The receiving Office, the International Searching Authority, the International Bureau and the International Preliminary Examining Authority are authorized to use this e-mail address, if the Office or Authority so wishes, to send notifications issued in respect of this international application:	exclusively in electronic form (no paper notifications will be sent)

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IV-1	Agent or common representative; or address for correspondence The person identified below is hereby/ has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	Agent
IV-1-1	Name (LAST, First)	GONZALEZ ROSSI, Alejandro Gabriel
IV-1-2	Address	Av. Tecamachalco 14-7 PH Col. Lomas de Chapultepec 11010 Mexico City Mexico
IV-1-3	Telephone No.	525552028204
IV-1-4	Facsimile No.	525555407927
IV-1-5	e-mail	info@gonzalezrossi.com
IV-1-5(a))	E-mail authorization The receiving Office, the International Searching Authority, the International Bureau and the International Preliminary Examining Authority are authorized to use this e-mail address, if the Office or Authority so wishes, to send notifications issued in respect of this international application:	exclusively in electronic form (no paper notifications will be sent)
IV-2	Additional agent(s)	additional agent(s) with same address as first named agent
IV-2-1	Name(s)	GALICIA RODRIGUEZ, Josue
V	DESIGNATIONS	
V-1	The filing of this request constitutes under Rule 4.9(a), the designation of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.	
VI-1	Priority claim of earlier national application	
VI-1-1	Filing date	03 November 2015 (03.11.2015)
VI-1-2	Number	MX/a/2015/015305
VI-1-3	Country or Member of WTO	MX
VI-2	Incorporation by reference : where an element of the international application referred to in Article 11(1)(iii)(d) or (e) or a part of the description, claims or drawings referred to in Rule 20.5(a) is not otherwise contained in this international application but is completely contained in an earlier application whose priority is claimed on the date on which one or more elements referred to in Article 11(1)(iii) were first received by the receiving Office, that element or part is, subject to confirmation under Rule 20.6, incorporated by reference in this international application for the purposes of Rule 20.6.	

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VII-1	International Searching Authority Chosen	United States Patent and Trademark Office (USPTO) (ISA/US)	
VIII	Declarations	Number of declarations	
VIII-1	Declaration as to the identity of the inventor	—	
VIII-2	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	—	
VIII-3	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	—	
VIII-4	Declaration of inventorship (only for the purposes of the designation of the United States of America)	—	
VIII-5	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	—	
IX	Check list	Number of sheets	Electronic file(s) attached
IX-1	Request (including declaration sheets)	4	✓
IX-2	Description	20	✓
IX-3	Claims	4	✓
IX-4	Abstract	1	✓
IX-5	Drawings	16	✓
IX-7	TOTAL	45	
	Accompanying Items	Paper document(s) attached	Electronic file(s) attached
IX-8	Fee calculation sheet	—	✓
IX-10	Original general power of attorney	—	✓
IX-20	Figure of the drawings which should accompany the abstract	44	
IX-21	Language of filing of the international application	English	
X-1	Signature of applicant, agent or common representative	/William PEREZ DAVILA/	
X-1-1	Name (LAST, First)	PEREZ DAVILA, William	
X-1-3	Capacity (if such capacity is not obvious from reading the request)		
X-2	Signature of applicant, agent or common representative	/Alejandro Gonzalez Rossi/	
X-2-1	Name (LAST, First)	GONZALEZ ROSSI, Alejandro Gabriel	
X-2-3	Capacity (if such capacity is not obvious from reading the request)	Agent	

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X-3	Signature of applicant, agent or common representative	/Josue Galicia Rodriguez/
X-3-1	Name (LAST, First)	GALICIA RODRIGUEZ, Josue
X-3-3	Capacity (if such capacity is not obvious from reading the request)	Agent

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10-1	Date of actual receipt of the purported international application	12 October 2016 (12.10.2016)
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/US
10-6	Transmittal of search copy delayed until search fee is paid	

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11-1	Date of receipt of the record copy by the International Bureau	
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From the INTERNATIONAL BUREAU

PCTNOTIFICATION CONCERNING SUBMISSION,
OBTENTION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

GONZALEZ ROSSI, Alejandro Gabriel
Av. Tecamachalco 14-7 PH
Col. Lomas de Chapultepec
Mexico City, 11010
MEXIQUE

Date of mailing (day/month/year) 16 December 2016 (16.12.2016)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 200087-16PCT	
International application No. PCT/IB2016/056109	
International publication date (day/month/year) Not yet published	
	International filing date (day/month/year) 12 October 2016 (12.10.2016)
	Priority date (day/month/year) 03 November 2015 (03.11.2015)
Applicant PEREZ DAVILA, William	

The applicant is hereby notified of the date of receipt (or of obtaining by the International Bureau) of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to the date of receipt, **the priority document concerned was submitted or transmitted to or obtained by the International Bureau in compliance with Rule 17.1(a), (b) or (b-bis)**. This Form replaces any previously issued notification concerning submission, transmittal or obtaining of priority documents.

Priority datePriority application No.Country or regional Office
or PCT receiving OfficeDate of receipt
of priority document

03 November 2015 (03.11.2015)

MX/a/2015/015305

MX

28 November 2016 (28.11.2016)

The letters "NR" denote a priority document which, on the date of mailing of this Form, had not yet been received or obtained by the International Bureau in compliance with Rule 17.1(a), (b) or (b-bis). Where the applicant has failed to either submit, request to prepare and transmit, or to request the International Bureau to obtain the priority document within the applicable time limit under that Rule, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

An asterisk "*" next to a date of receipt, denotes a priority document submitted or transmitted to or obtained by the International Bureau but not in compliance with Rule 17.1(a), (b) or (b-bis) (the priority document was received after the time limit prescribed in Rule 17.1(a); the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b) or the request to the International Bureau to obtain the priority document was made after the applicable time limit under Rule 17.1(b-bis)). Even though the priority document was not furnished in compliance with Rule 17.1(a), (b) or (b-bis), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Cécile Chatel e-mail ro.ib@wipo.int Telephone No. +41 22 338 92 22
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(51) International Patent Classification:

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F16L 37/00 (2006.01) *H02G 3/22* (2006.01)
F16L 41/14 (2006.01) *H02G 15/007* (2006.01)
H02G 3/06 (2006.01)

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3 November 2015 (03.11.2015)

MX

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(74) Agents: GONZALEZ ROSSI, Alejandro Gabriel et al.;
 Av. Tecamachalco 14-7 PH, Col. Lomas de Chapultepec,
 Mexico City, 11010 (MX).

(81) Designated States (unless otherwise indicated, for every
 kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
 BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM,
 DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
 HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
 KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,
 MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
 OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
 SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
 TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
 ZW.

(84) Designated States (unless otherwise indicated, for every
 kind of regional protection available): ARIPO (BW, GH,
 GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ,
 TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU,
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 LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
 SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
 GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

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(54) Title: CONNECTOR ASSEMBLY FOR FIBER OPTIC CABLES HAVING ABSORPTION OF INNER STRESSES AND INNER SEALING FOR MOUNTING IN A FIBER OPTIC CONNECTION BOX

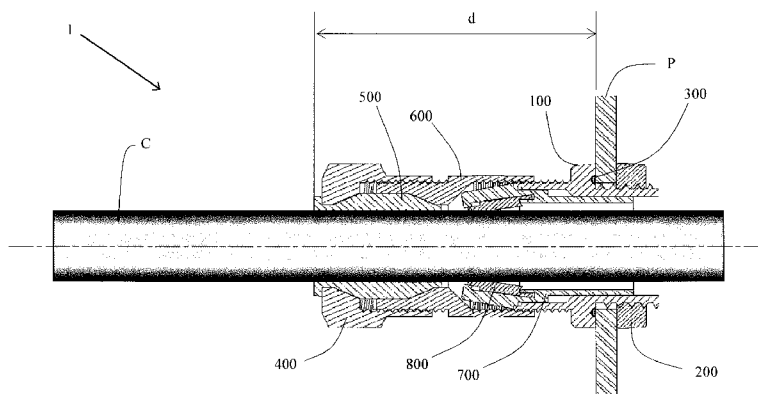


FIG. 44

(57) Abstract: A connector assembly for fiber optic cable is provided, which is able to be mounted in a fiber optic connection box and which is particularly useful for absorbing inner stresses generated on the fiber optic cable and simultaneously producing improved sealing between the connector assembly and said cable. Connector assembly comprises a main body and a fixing nut by means of which said main body is installed in a base plate of the connection box. Optionally, connector assembly further comprises an O-ring mounted between the main body and the base plate. Connector assembly further comprises a sub-assembly formed by an insert and a seal; an extension nut which is designed to cause deformation onto the sub-assembly thus providing a first seal and stress-absorption zone; a lock nut; and a ferrule; wherein the ferrule is installed between, and is deformed by, the main body and the lock nut such that a second stress-absorption and sealing zone is produced.

**CONNECTOR ASSEMBLY FOR FIBER OPTIC CABLES HAVING
ABSORPTION OF INNER STRESSES AND INNER SEALING FOR MOUNTING
IN A FIBER OPTIC CONNECTION BOX**

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TECHNICAL FIELD

The present invention generally relates to a connector assembly for cables, in particular for fiber optic cables, which can be mounted in fiber optic connection boxes, in particular vertical or horizontal type for aerial mounting, underground, wall or pole mounting, and wherein the connector assembly is adapted to absorb and/or release inner stresses exerted on the fiber optic cable while simultaneously ensures sealing between the connector assembly and the fiber optic cable, as well as between the connector assembly and the fiber optic connection box.

PRIOR ART

Fiber optic connection boxes, also referred to as junction boxes, are known by the skilled person for their use in aerial installations, wall, pole or duct mounting. Such connection boxes can be installed as terminal boxes, bypass nodes, network end points and so. Such connection boxes are commonly manufactured in plastic materials by injection molding, and are designed to endure environmental conditions such as rain, corrosion, extreme heat and cold, in such a way that inner components of the connection box remain isolated from the outside.

There are different kinds of connection boxes depending on the specific use and type of mounting, for example vertical type or horizontal type, cap-type, etc. which are known by the skilled person.

Generally speaking, a cap-type connection box comprises a base with an O-ring, a base with a cable holding system, a back plate (also referred to as base plate), a plurality of trays for connection and bypass of fiber optic cables, a cover or dome that is mounted on the base with O-ring in order to close hermetically the connection box, and several passages, ducts and bypass connectors.

A cap-type connection box mentioned above is known, for example, from the International Patent Application WO2012/155359A1, which discloses a connection box having a base, a dome or cover, and a plurality of ducts for fiber optic cables for bypassing fiber optic cables. As it can be seen in Fig. 7 of said document, ducts are tubes protruding from the base to allow passage of the fiber optic cables.

Another cap-type connection box similar to the one mentioned above is known

from the Mexican Patent application MX/a/2013/000227, which discloses a connection box having, among other elements, an end surface and several cylindrical hollow tubes for passage of the fiber optic cables.

Connection boxes of the prior art described above suffer from many drawbacks and troubles, just to mention a few: they do not guarantee a tight seal of the connection box, are difficult to handle, and hinder the passage of the fiber optic cable through the tube or cylindrical duct; in addition the cable installed in said tubes or cylindrical ducts is subject to inner damage and breakage at the free end of the cable because there is no absorption or dissipation of the inner stresses generated in the cable since the tube or duct which the cable passes through is a rigid element that is formed as a molded or extruded part of the base of the connection box.

In the state of the art, improvements to this type of connection boxes are also known. For instance, an improvement to a connection box, in particular to the tubes or ducts for connection of the cables thereof, is known from the Chinese Patent CN201637902U, which discloses, among other elements, a connection box including a base, a plurality of access tubes for fiber optic cable which are mounted in the base, and a lock nut. In further detail it can be observed that an access tube comprises a threaded section in each of its ends as well as a flange intermediate to both threaded sections, so that a threaded section passes through the base and is fixed with a fixing nut, and the other threaded section is used for screwing in the lock nut once the cable is passed through. According to an embodiment of this prior art document, it can also be provided a washer and a seal between the tube and nut to produce a sealing to the fiber optic cable. According to a second embodiment, it is provided a nut which has a ring protruding from said nut in order to produce a seal to the fiber optic cable. Whatever the case is, it is produced a seal between the tube and lock nut assembly to the fiber optic cable in the outer section of the connection box while facilitating assembly and disassembly of the cable through the tube and base.

Nevertheless, despite these improvements in the assembly of the tube in the base and the sealing to the fiber optic cable, there are numerous deficiencies both in the assembly of the access tube as in the sealing to the fiber optic cable, and there are also drawbacks in functioning of the connection box once installed, such as deficient sealing to the fiber optic cable which affects air tightness of the connection box, internal damage in the fiber optic cable because there is no absorption or dissipation of inner stresses unavoidable when the connection box is in use, breakage of the fiber optic cable at the free

end protruding from the lock nut, among others.

As a consequence of the above, other kind of problems arise such as the need for inspection and frequent replacement of the sealing materials and, in the worst case, of the fiber optic cables; presence of humidity and/or dirt is detected inside the connection box; it is requested the use of multiple complex tools for assembly and disassembly of the connection box and its components, as well as the need to install further sealing elements such as shrinkable sleeves, which increases installation costs; at least two technicians are needed for carrying out assembly of the components of the connection box and it is further requested high level skills of the technicians.

On the other hand, in the state of the art, attempts to solve the problem of absorbing inner stresses produced in the fiber optic cable are also known.

For instance, from the Chinese Patent CN202977875U it is known a connector assembly comprising, among other elements, a connector having a threaded end section, on which a nut is screwed. Connector assembly further comprises a tubular seal and a crimping ring which comprises a crimping block at the end thereof. Crimping ring has a plurality of notches which are able to engage with protrusions provided in the threaded section to prevent rotation once the connector assembly is closed.

Similarly, it is known in the state of the art to provide a connector assembly in which a threaded section is provided, at its end engaging with the lock nut of the assembly, with a plurality of resilient blades which bend over the cable such that they can absorb vibrations and, possibly, inner stresses of the cable. Connector assemblies having these features are known, for example, from patent documents US2013/0183848A1, US2014/0065873A1 and CN203036139U.

Another solution to the problem of absorbing inner stresses in the fiber optic cable is known, for example, from patent US3796504, which discloses a collar having four teeth and a circumferential edge, wherein the teeth bend in direction towards the cable to absorb vibrations of the cable whereas the edge produces a seal to the outer surface of the cable.

Once again, despite the attempts for improving connector assemblies, drawbacks and disadvantages still exist because the elements used for absorbing inner stresses of the fiber optic cable on the one hand, only absorb a minor amount of the inner stresses since there is poor contact with the cable surface and, on the other hand, they do not guarantee fluid tight seal. Indeed, in the state of the art it is known that provision of elements for absorbing inner stresses impairs sealing capacity of the connector assembly and vice versa.

BRIEF DESCRIPTION OF THE INVENTION

In view of the deficiencies and disadvantages present in the state of the art, it is a first object of the present invention to overcome the drawbacks and problems related to the absorption of inner stresses while simultaneously ensuring a tight seal of a connector assembly for fiber optic cables.

A further object of the present invention is to provide a connector assembly that is easy to manufacture, easy to assemble and disassemble in a base of a fiber optic connection box.

A further object of the invention is to provide a method of assembling a connector for fiber optic cable of easy execution and that secures a tight seal of the connector assembly as well as absorption of inner stresses generated on the fiber optic cable.

To solve the deficiencies and disadvantages of the prior art and to give solution to the objects of the invention, it is proposed a connector assembly for fiber optic cables in which, firstly, the distance between the base plate of the connection box and free end of the cable lying outside the connector assembly is increased in order to reduce likelihood of damage and breakage of said free end and, secondly, means for sealing and absorption of inner stresses generated on the fiber optic cable when the latter passes through the connector assembly are provided.

In this way, a first component of the connector assembly of the present invention consists in a main body comprising, on its outer side, a first thread section, a second thread section and a nut section intermediate to said first and second thread sections. Main body further comprises, on its inner side, a cavity formed by a first tubular section, a conical section adjacent the first tubular section, a second tubular section adjacent the conical section, and a circumferential recess formed in the second tubular section. Advantageously, main body further comprises a recess in the form of a circumferential notch which is formed in a back face of the nut section, wherein said annular recess faces a front face of a base plate of the fiber optic connection box when the main body is mounted on the base plate.

In addition, advantageously, the first inner tubular section of the main body is provided with a plurality of grooves or channels extending at least partially along the length of the first tubular section.

In addition, advantageously, a ring-shaped seal (also known as O-ring) can be provided which is mounted on the main body, and is at least partially accommodated in the annular recess such that said ring-shaped seal provides a seal to the front face of the base

plate of the connection box.

A second component of the connector assembly consists in a fixing nut comprising an inner thread section which can be screwed in the first outer thread section of the main body to fasten said main body to the base plate.

5 As previously mentioned, main body is formed with a cavity which is also adapted to at least partially allow insertion of a third component of the connector assembly which consists in a sub-assembly comprising an insert and a cable seal. This insert and seal sub-assembly is able and is designed, on the one hand, to absorb inner stresses exerted on a cable passing through the same and, on the other hand, to simultaneously generate a tight
10 seal to the surface of said cable.

According to the above, insert is manufactured from a plastic material, in particular a plastic made of, or that comprises, nylon. In addition, plastic insert is manufactured making use of injection molding techniques.

On the other hand, cable seal is manufactured from a rubber-based material, in
15 particular Buna-N, or a silicone-based material. Such a cable seal is manufactured making use of compression-molding techniques.

The insert according to the invention is designed in such a manner that it comprises a main tubular body, a second tubular body adjacent the main tubular body and which includes an inner circumferential cavity, as well as a plurality of fingers which are flexible
20 and elastically deformable; said fingers protrude from the second tubular body in a longitudinal direction of the insert. In addition, advantageously the main tubular body is provided with a plurality of longitudinal and circumferential projections which respectively serve for guiding insertion of the insert into the main body and prevent relative rotation of the insert with respect to the main body, and on the other hand to increase structural
25 strength of the insert, in particular of the main tubular body.

The second tubular body of the insert is designed in such a manner that it has the shape of an annular circumferential body projecting from the main tubular body and thereby having an outer diameter greater than the outer diameter of the main tubular body.

In addition, the flexible fingers of the insert are designed such that they comprise a
30 base portion adjoining the second tubular body and a gripping portion projecting radially inwardly at an angle relative the longitudinal axis of the insert. Such flexible fingers are further arranged in a polar symmetrical pattern in the circumference of the second tubular body, and spaced apart by gaps such that application of a radial compressive force on the fingers causes a radial deformation inwardly in such a way that the fingers overlap to one

another maintaining a cylindrical shape between the gripping portions of the fingers.

On the other hand, cable seal is designed in such a way that it comprises a tubular body having an outer circumferential recess on one of its ends, and an inner circumferential recess on the other end.

5 Thus, cable seal can be snap-fitted in a hollow inner space essentially formed by the plurality of fingers and inner circumferential cavity of the insert, such that the part comprising the inner circumferential recess of cable seal is at least partially accommodated in the inner circumferential cavity of the insert, and the part comprising the outer circumferential recess of the cable seal at least partially contacts with the gripping portion
10 of the flexible fingers of the insert.

In this manner, the radially inwardly deformation caused to the plurality of flexible fingers likewise causes radially inwardly deformation of, at least, the part having the outer circumferential recess and a portion of the tubular body of the cable seal thus creating a fluid-tight seal to the surface of a fiber optic cable passing through the insert and seal sub-
15 assembly.

Connector assembly of the present invention further comprises a fourth component which consists in an extension nut comprising, on its outer side, a tubular section, a nut section arranged approximately intermediate in the tubular section, and a thread section. In addition, extension nut is designed in such a way that it defines, in its inner side, a cavity
20 formed by a thread section, a first conical section adjacent the thread section, a first tubular section adjacent the first conical section, a second conical section adjacent the first tubular section, and a second tubular section adjacent the second conical section.

According to the present invention, inner thread section of the extension nut can be screwed in the second outer thread section of the main body, advantageously with the insert and cable seal sub-assembly at least partially introduced in the main body. In addition, inner cavity of the extension nut is designed in such a way that it is able to cause radially inwardly deformation (as previously discussed) of at least a portion of the insert and cable seal sub-assembly when said extension nut is screwed in the main body as mentioned above.

30 In this way, there is provided a first area of the connector assembly which is able to absorb inner stresses and to produce a sealing to the fiber optic cable.

Connector assembly according to the present invention further comprises a fifth component which consists in a lock nut comprising, on its outer side, a tubular section and a nut section adjacent the tubular section. In addition, lock nut is designed in such a way

that it defines an inner cavity formed by a thread section, a conical section adjacent the thread section, and a cylindrical section adjacent the conical section. Inner thread section of the lock nut can be screwed in the outer thread section of the extension nut for closing the connector assembly.

5 Advantageously, according to a preferred embodiment of the invention, inner thread section of the lock nut can be screwed alternatively in the second outer thread section of main body. To this end, it is necessary to dispense with the extension nut; to put it another words, lock nut replaces the extension nut. However, design of inner cavity of the lock nut is also able to cause radially inwardly deformation of the insert and cable seal
10 sub-assembly needed to absorb inner stresses and to produce the sealing to the fiber optic cable, as discussed above.

 Connector assembly, according to a preferred embodiment, further comprises a sixth component which consists in an elastically deformable ferrule, which can be mounted in a hollow space formed between the extension nut and lock nut. Ferrule is designed in
15 such a way that it comprises a center tubular section or body and two slope end sections or bodies each adjacent to each end of the center tubular section or body, and an inner bore passing through the center and end sections or bodies with an even diameter, that is to say in the form of a cylindrical body.

 In addition, said ferrule, when introduced in the hollow space formed between the
20 extension nut and lock nut, is able to at least partially absorb vibrations as well as tension stresses and shear stresses exerted on the fiber optic cable when the latter is in use, thus reducing damage to the cable.

 Furthermore, advantageously, ferrule is made from an elastically deformable material such that it is able to produce a seal in the hollow space formed between the
25 extension nut and lock nut to the fiber optic cable. To this end, ferrule is manufactured from a silicone based material, in particular manufactured by compression molding.

 Advantageously, at least one of the main body, fixing nut, extension nut and lock nut is manufactured from a metal material, in particular a metal selected from the group comprising steel, bronze, brass, in particular tin plated brass, and aluminium. These
30 components are manufactured preferably through automated machining processes, though it is conceivable to employ techniques such as die casting. Alternatively, these components may be manufactured from a plastic material comprising, or made of, nylon, and manufactured through injection molding techniques.

 In accordance with the above, there is provided a second area of the connector

assembly that is able to absorb inner stresses and to produce a sealing to the fiber optic cable, which improves both the tight seal and the absorption of inner stresses generated on the cable.

As it can be appreciated, connector assembly according to the present invention, once installed with a fiber optic cable passing therethrough, increases the distance between the base plate of the connection box and the free end of the fiber optic cable lying outside the connector assembly, such that the stress spot is transferred and/or distributed in a more stable inner area of the connector assembly. In addition, the provision of the ferrule and insert and cable seal sub-assembly allows ensuring a reliable fluid tight seal given that there are two sealing areas between the components of the connector assembly and the fiber optic cable.

The present invention also provides a method of forming a connector assembly in a base plate of a fiber optic connection box, wherein the method comprises the steps of:

- providing a main body;
- providing a fixing nut;
- fixing the main body through an opening in the base plate by means of the fixing nut;
- providing a sub-assembly comprising an insert and a cable seal, wherein the cable seal is mounted at least partially inside the insert;
- at least partially introducing the insert and cable seal sub-assembly in a cavity of the main body;
- providing an extension nut;
- providing a lock nut;
- positioning in sequence, from a distal end of the fiber optic cable in a direction towards the proximal end thereof, the lock nut and the extension nut;
- passing the distal end of the cable through the main body to a position in which a substantial portion of the distal end of the cable protrudes from the base plate and main body;
- sliding the insert and cable seal sub-assembly on the cable until at least partially introducing said sub-assembly in the main body;
- screwing in the extension nut to the main body; and
- screwing in the lock nut to the extension nut.

Advantageously, according to a preferred embodiment, the method further comprises providing an elastically deformable ferrule, which is mounted on the fiber optic

cable after mounting of the lock nut and before mounting the extension nut. In addition, the method further comprises sliding the ferrule to be at least partially introduced in the extension nut such that the ferrule is deformed when the lock nut is screwed in the extension nut, thus forming a fluid tight seal to the fiber optic cable.

5 Advantageously, according to a preferred embodiment, the method further comprises providing an O-ring, which is mounted between the main body and the base plate in order to form an annular seal therebetween.

 Consequently, according to the present invention, there is provided a method of forming a connector assembly that ensures, on the one hand, absorption of inner stresses
10 and, on the other hand, tight seal between the connector assembly and a fiber optic cable installed therethrough.

 Further objects and their solutions will be apparent to those skilled in the art on the basis of the reading the present specification with the aid of the enclosed drawings which show in an illustrative, non limitative manner details and features of embodiments of the
15 present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

- Figure 1 is a side view of the connector assembly according to the present invention mounted in a base plate.
- 20 Figure 2 is a side-perspective view of the connector assembly shown in Figure 1.
- Figure 3 is a front-perspective view of the connector assembly shown in Figure 1.
- Figure 4 is a back-perspective view of the connector assembly shown in Figure 1.
- Figure 5 is a front-perspective view of the connector assembly according to the present invention where the base plate and fiber optic cable have been
25 omitted.
- Figure 6 is a back-perspective view of the connector assembly according to the present invention where the base plate and fiber optic cable have been omitted.
- Figure 7 is a top-perspective view of the main body of the connector assembly according to the present invention.
30 Figure 8 is a back-perspective view of the main body of the connector assembly according to the present invention.
- Figure 9 is top view of the main body of the connector assembly according to the present invention.

- Figure 10 is a cross-sectional view of the main body shown in Figure 9.
- Figure 11 is a top-perspective view of the fixing nut of the connector assembly according to the present invention.
- Figure 12 is a front view of the fixing nut shown in Figure 11.
- 5 Figure 13 is a side view of the fixing nut shown in Figure 11.
- Figure 14 is a cross-sectional view of the fixing nut shown in Figure 13.
- Figure 15 is a perspective view of the O-ring of the connector assembly according to the present invention.
- Figure 16 is a front-perspective view of the extension nut of the connector assembly according to the present invention.
- 10 Figure 17 is a back-perspective view of the extension nut of the connector assembly according to the present invention.
- Figure 18 is a top view of the extension nut shown in Figure 16.
- Figure 19 is a cross-sectional view of the extension nut shown in Figure 18.
- 15 Figure 20 is a front-perspective view of the insert of the connector assembly according to the present invention.
- Figure 21 is a back-perspective view of the insert of the connector assembly according to the present invention.
- Figure 22 is a top view of the insert shown in Figure 20.
- 20 Figure 23 is a cross-sectional view of the insert shown in Figure 22.
- Figure 24 is a front view of the insert of the connector assembly according to the present invention.
- Figure 25 is a back-perspective view of the cable seal according to the present invention.
- 25 Figure 26 is a front-perspective view of the cable seal of the connector assembly according to the present invention.
- Figure 27 is a top view of the cable seal shown in Figure 25.
- Figure 28 is a cross-sectional view of the cable seal shown in Figure 27.
- Figure 29 is a front-perspective view of the insert and cable seal sub-assembly of the connector assembly according to the present invention.
- 30 Figure 30 is a cross-sectional view, in perspective, of the sub-assembly shown in Figure 29.
- Figure 31 is a front view of the sub-assembly in cross-section shown in Figure 30.
- Figure 32 is a top-perspective view of the lock nut of the connector assembly

according to the present invention.

Figure 33 is a back-perspective view of the external lock nut shown in Figure 32.

Figure 34 is a front-perspective view of the external lock nut shown in Figure 32.

Figure 35 is a top view of the external lock nut shown in Figure 32.

5 Figure 36 is a cross-sectional view of the external lock nut shown in Figure 35.

Figure 37 is a top-perspective view of the ferrule of the connector assembly according to the present invention.

Figure 38 is a top view of the ferrule shown in Figure 37.

Figure 39 is a cross-sectional view of the ferrule shown in Figure 38.

10 Figure 40 is a side-perspective view of a first stage of assembly of the connector assembly in a base plate of a connection box for fiber optic cables according to the present invention.

Figure 41 is a cross-sectional view of a second stage of assembly of the connector assembly according to the present invention.

15 Figure 42 is a cross-sectional view of a third stage of assembly of the connector assembly according to the present invention.

Figure 43 is a cross-sectional view of a fourth stage of assembly of the connector assembly according to the present invention.

20 Figure 44 is a cross-sectional view of a fifth stage of assembly of the connector assembly according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

As shown in the drawings, reference numeral 1 designates a connector assembly for a fiber optic cable C, wherein the connector assembly 1 can be mounted on a base plate P of a fiber optic connection box.

25 In Figures 1 to 4 there is shown the connector assembly 1 mounted on the base plate P (represented only partially for the sake of simplicity) of the fiber optic connection box, wherein a fiber optic cable C is installed through the connector assembly 1 and base plate P.

30 In these Figures 1-4, connector assembly 1 is shown in an assembled or closed state with the elements visible to an observer, where reference numeral 100 designates a main body, reference numeral 200 designates a fixing nut, reference numeral 300 designates an O-ring, reference numeral 400 designates a lock nut, and reference numeral 600 designates an extension nut, which are described in further detail below. In addition, as it can be observed in Figures 1 and 2, for example, a distal end of cable C protrudes from both the

base plate P and the fixing nut 200 (i.e. at the right side of the drawing), while a proximal end of cable C protrudes from the lock nut 400 (i.e. at the left side of the drawing).

Figures 5 and 6 show the connector assembly 1, in accordance with Figures 1 to 4, with the difference in the fiber optic cable C and the base plate P have been omitted for clarity purposes. It can be seen that connector assembly 1 defines a hollow space through which the fiber optic cable C is able to pass.

With reference now to Figures 7 to 10, details of main body 100 according to the present invention are shown. Main body 100 comprises, on its outer side, a first outer thread section 101, a nut section 102, and a second outer thread section 103, wherein the nut section 102 is arranged intermediate to the first and second thread sections 101 and 103; and further comprises, on its inner side, a cavity (configured similar to a through-hole) formed by a first tubular section 104, a conical section 106, a second tubular section 107, and a circumferential recess 108.

As it can be seen for example in Figure 10, conical section 106 is arranged intermediate and adjacent the first tubular section 104 on the one hand, and the second tubular section 107 on the other hand, such that a diameter of the first tubular section 104 is substantially smaller than a diameter of the second tubular section 107. Likewise, circumferential recess 108, which is formed in the second tubular section 107 and adjacent an end of the main body 100, has a diameter greater than the second tubular section 107.

In Figures 8 and 10 it can be seen that the main body 100 further comprises an annular recess 109 in a back face of the thread section 102 that faces a front face of the base plate P (see for example Figures 1 to 3). Such annular recess 109 has the function of accommodating a sealing element to produce a seal to a surface of said base plate P, as described herein below.

In addition, as it can be seen in Figures 8 and 10, the first inner tubular section 104 is provided with a plurality of longitudinal grooves or channels 105 extending longitudinally, at most, as much as the length of said first inner tubular section 104. Particularly, as observed in Figure 8, longitudinal channels 105 are arranged in an even number, for instance there are provided 6 longitudinal channels, and in a symmetrical pattern around the circumference of said first tubular section 104.

In relation now to Figures 11 to 14, there is shown a fixing nut 200, which comprises an inner thread 201. Said inner thread 201 can be screwed in the first outer thread section 101 of main body 100 for fixing said main body 100 in the base plate P.

Figure 15 shows an O-ring 300 which, according to a preferred embodiment of the

invention, can be mounted on the main body 100 such that it is at least partially received in the annular recess 109 thereby providing a seal to a front face of the base plate P of connection box (see for example Figures 41 to 44).

5 In relation now to Figures 16 to 19, there are shown details of the extension nut 600 according to the present invention. Extension nut 600 is designed in such a way that it comprises, on its outer part, a tubular section 601, a nut section 602 arranged approximately intermediate the tubular section 601 (see for example Figure 18), and a thread section 603, and it further comprises, on its inner part, a cavity (configured similar to a through hole) formed by a thread section 604, a first conical section 605 adjacent the
10 first thread section 604, a first tubular section 606 adjacent the first conical section 605, a second conical section 607 adjacent the first tubular section 606, and a second tubular section 608 adjacent the second conical section 607.

As it can be seen, for example in Figure 19, a diameter of the first inner tubular section 606 is substantially smaller than a diameter of the second inner tubular section 608.

15 Inner thread section 604 is able and is intended to be screwed in the second outer thread section 103 of main body 100, thus forming a hollow space into which a first sealing and stress-absorbing member can be introduced, as described below.

With reference now to Figures 20 to 24 there are shown details of an insert 700 according to the present invention, which is made in particular of a plastic material, for example made of, or that comprises, nylon. Insert 700 comprises a main tubular body 701,
20 a second tubular body 702 adjacent the main tubular body 701 and which includes an inner circumferential cavity 706, and a plurality of flexible and elastically deformable fingers 703, wherein said fingers 703 project from the second tubular body 702 in a longitudinal direction of the insert 700.

25 As it can be seen, for example in Figures 20, 21 and 22, main tubular body 701 is provided with a plurality of protrusions 704 arranged around the circumference of main tubular body 701 and extending longitudinally, at most, as much as the length of said main tubular body 701, as well as a plurality of circumferential protrusions 705 formed on said main tubular body 701 and spaced apart from each other. Said longitudinal protrusions 704
30 are formed correspondingly (that is to say in position and quantity) with the longitudinal channels 105 of main body 100 such that together they guide insertion of insert 700, particularly of main tubular body 701, into the first inner tubular section 104 of main body 100. Likewise, said longitudinal protrusions 704 are able to prevent rotation of insert 700 relative the main body 100, which is particularly advantageous when screwing the

extension nut 600 in the main body 100, as described below.

On the other hand, the circumferential protrusions 705 increase structural strength of the insert 700, in particular of the main tubular body 701, and improve fastening of the insert 700 in the main body 100 given that said circumferential protrusions 705 can be
5 adjusted tightly to the surface of the first inner tubular section 104 of main body 100.

Continuing with Figures 20 to 23, it can be seen that the second tubular body 702 is designed in the form of a circumferential annular body projecting concentrically from an end of the main tubular body 701 and has an outer diameter greater than the outer diameter of main tubular body 701. In addition, making reference to Figure 23, the second tubular
10 body 702 comprises the circumferential cavity 706 in an inner part thereof.

On the other hand, making reference to Figures 20, 23 and 24, it can be seen that the flexible fingers 703 of insert 700 are designed in such a manner comprising a base portion 703a adjoining the second tubular body 702 and a gripping portion 703b, wherein said gripping portion 703b of each finger projects extending radially inwardly at an angle α
15 with respect to a longitudinal axis of the insert when seen from the front (see Figure 24). In addition, as seen in Figure 24, said flexible fingers 703 are arranged in a symmetrical polar pattern in the circumference of the second tubular body 702 and spaced apart by respective gaps 703c, such that the application of a radial compressive force (see for example Figures 42 to 44) onto the fingers 703 causes a radially inwardly deformation of the fingers so that
20 they overlap to one another maintaining a cylindrically-shaped space between the gripping portions 703b.

As it can be seen for example in Figures 21 to 23, base portion 703a is shaped including a step 703d. Said step 703d is intended to contact the circumferential recess 108 of main body 100, such that only the flexible fingers 703 remain outside the main body
25 100 when the insert 700 is introduced butt up against said main body 100 (see for example Figures 41 to 44).

In relation now to Figures 25 to 28, there are shown details of a cable seal 800 according to the present invention, which is preferably made of a rubber-based material, in particular of Buna-N, or a silicone-based material. Cable seal 800 comprises a tubular body
30 801, which is manufactured by using compression molding techniques known in the art. Said seal 800 is formed with an outer circumferential recess 802 at one of its ends, and with an inner circumferential recess 803 at the other end.

In relation now to Figures 29 to 31, there is shown the cable seal 800 snap fitted in a hollow inner space essentially formed by the plurality of fingers 703 and the inner

circumferential cavity 706 of insert 700, in such a way that the portion comprising the inner circumferential recess 803 of cable seal 800 is at least partially accommodated inside the inner circumferential cavity 706 of insert 700 whereas the portion comprising the outer circumferential recess 802 of cable seal 800 contacts at least partially with an inner face of the gripping portion 703b of the fingers 703 of insert 700 (see for example Figure 31).

In this manner, the radially inwardly deformation caused on the plurality of flexible fingers 703 also causes radially inwardly deformation of, at least, the portion having the outer circumferential recess 802 and a portion of the tubular body 801 of cable seal 800.

In relation now to Figures 32 to 36, there are shown details of the lock nut 400 according to the present invention. Lock nut 400 comprises, on its outer part, a tubular section 401 and a nut section 402, and on its inner part it comprises a cavity (configured similar to a through hole) formed by a thread section 403, a conical section 404, and a cylindrical section 405, wherein the conical section 404 is arranged intermediate and adjacent the thread section 403 and the cylindrical section 405.

In use, said inner thread section 403 of the lock nut 400 can be screwed in the outer thread section 603 of extension nut 600 in order to close the connector assembly 1, as described below.

Alternatively, according to a preferred embodiment of the invention, inner thread section 403 can be screwed in the second outer thread section 103 of main body 100. To this end, connector assembly consists in a simplified form thereof (not shown in the drawings) which does not include the extension nut 600 but the lock nut 400 is screwed directly on the main body 100. However, this simplified form of the connector assembly is also able to produce a radially inwardly deformation of the insert 700 and cable seal 800 by means of the conical section 404 of lock nut 400 which thereby has the same or substantially the same design as the first conical section 605 of the extension nut 600 (see for example Figures 19 and 36).

In relation now to Figures 37 to 39, there are shown details of a ferrule 500, which is made of a silicone-based material, and which is manufactured preferably through compression molding. Said ferrule 500 comprises a center tubular section or body 501 and two slope end sections or bodies 502 each adjacent to each end of the center tubular section or body 501, and an inner bore 503 passing through the center 501 and end sections or bodies 502 with an even diameter, that is to say in the form of a cylindrical body.

Ferrule 500 is designed such that it can be introduced in a hollow space formed between the extension nut 600 and lock nut 400 (see Figure 43), and elastically deformed

when said lock nut 400 is screwed tightly in the extension nut 600 (see Figure 44), described below.

In Figure 40 there is shown the connector assembly 1 exploded wherein the first outer thread section 101 of main body 100 is partially passed through an opening in the base plate P and the fixing nut 200 is partially screwed in the first outer thread section 101. It is also seen that lock nut 400, ferrule 500, extension nut 600, and sub-assembly of insert 700 and cable seal 800 are mounted on the fiber optic cable C, and said cable C has been passed through main body 100 and, therefore, also through base plate P such that a distal end of the cable C protrudes from both the base plate P and the fixing nut 200.

In relation now to Figures 41 to 44, a method of forming a connector assembly 1 in a base plate P of a fiber optic connection box according to the present invention will be described.

According to the method of the present invention, the main body 100, fixing nut 200, O-ring 300, lock nut 400, ferrule 500, extension nut 600, insert 700 and cable seal 800 are provided according to the present invention. Optionally, O-ring 300 and ferrule 500 may also be provided.

Subsequently, main body 100 is fixed in the opening of the base plate P with the aid of the fixing nut 200. Optionally, O-ring 300 may be installed such that it is at least partially received in the main body 100, in particular in the annular recess 109 (see for example Figure 10), and abutting against a front face of base plate P, as described above.

In a subsequent step of the method, cable seal 800 is at least partially mounted inside the insert 700, thus forming the sub-assembly 700-800 previously described (see for example Figures 29 to 31).

Said sub-assembly 700-800, according to an embodiment of the invention, can be at least partially introduced in the cavity of main body 100. Alternatively, according to another embodiment of the invention, said sub-assembly 700-800 is introduced in main body 100 in a subsequent step as described below.

Subsequently, there are positioned in sequence, starting from a distal end of the fiber optic cable C in a direction towards a proximal end thereof, the lock nut 400 and the extension nut 600. Optionally, according to a preferred embodiment of the invention, ferrule 500 can be positioned after positioning the lock nut 400 and before positioning the extension nut 600. In addition, optionally according to an embodiment of the invention, sub-assembly 700-800 can be positioned in the cable C after positioning the extension nut 600 (this applies for the embodiment of the method in which the sub-assembly has not

been introduced in the main body 100 yet).

Then, distal end of cable C is passed through either the sub-assembly 700-800 and main body 100 fixed in the base plate P according to an embodiment of the invention or directly through the main body 100 (given that the sub-assembly 700-800 is already
5 positioned in the cable C) according to another embodiment of the invention, to a position in which a substantial portion of the distal end of said cable C protrudes from the base plate P and main body 100.

Subsequently, while maintaining the fiber optic cable C in a substantially fixed manner, according to an embodiment of the invention, sub-assembly 700-800 is slid until it
10 is at least partially introduced in the cavity of main body 100.

It can be appreciated here that, on the one hand, the sub-assembly 700-800 is guided inside the main body 100 because the longitudinal protrusions 704 follow the path defined by the longitudinal channels 105 of main body 100 and, on the other hand, it is ensured that the sub-assembly 700-800 is positioned butt up against the main body 100
15 when step 703d of insert 700 is received in the circumferential recess 108 of main body 100.

In a subsequent step of the method, extension nut 600 is screwed in the main body 100 to a position in which the first conical section 605 of extension nut 600 contacts with a distal end of insert 700, as shown in Figure 41.

Subsequently, as it can be appreciated in Figure 42, a further screwing-in of the extension nut 600 in the main body 100 is so produced as to cause a radially inwardly deformation of a portion of sub-assembly 700-800 thus creating a seal to the surface of the fiber optic cable C. It will be understood here that the sub-assembly 700-800 is kept in a substantially fixed position (that is to say hindered from rotating) and stable inside the
25 main body 100 due to the combined action of the longitudinal 704 and circumferential 705 protrusions of the insert 700.

Then, as shown in Figure 43, both the ferrule 500 and lock nut 400 are brought into proximity to the extension nut 600 such that at least a portion of the center tubular section 501 and one of the end sections 502 are at least partially introduced in the cavity of the
30 extension nut 600 such that an edge of the end section 502 contacts with the second conical section 607, and an edge of the other end section 502 contacts with conical section 404 of lock nut 400.

As it can be seen in Figure 44, lock nut 400 is screwed in the extension nut 600 thus causing deformation of the ferrule 500 in the hollow space formed by said extension nut

600 and said lock nut 400. In this way, ferrule 500 is deformed such that it at least partially protrudes out of the lock nut 400 thus ensuring a tight seal to the fiber optic cable C.

Thus, as it can be seen in Figure 44, connector assembly 1 allows to obtain a greater distance d than can be obtained with connector assemblies from the prior art. With these features, connector assembly of the present invention allows transferring and distributing the stress spot to a more stable inner zone of the connector assembly. In addition, connector assembly of the present invention presents two seal and stress-absorption areas, namely, a first seal and stress-absorption area provided by means of the insert and cable seal sub-assembly, and a second seal and stress-absorption area provided by means of the ferrule.

In the context of the present invention, terms “comprises”, “comprising”, “includes”, “including”, “has” and their conjugates should be understood as “including but not limited to”. Likewise, terms “consists of” and “consisting of” should be understood as “including and limited to”.

In addition, in the context of the present invention, the term “distal” should be understood as a position away from a technician installing the connector assembly in the base plate of the connection box, that is to say a position close to the connection box but away from the technician. Conversely, the term “proximal” should be understood as a position close to the technician installing the connector assembly, that is to say a position away from the connection box.

Likewise, it should be understood that other materials may be used for the components of the connector assembly of the present invention than those described in the present specification without departing from the spirit and scope of the invention.

Reader will appreciate that the features of the present invention described as independent or separate embodiments may also be provided in combination in a single embodiment without departing from the spirit and scope of the present invention. Conversely, features of the invention described or shown as a single embodiment for the purpose of brevity and simplicity may also be provided as independent or separate embodiments, which should be considered as included within the scope of the present disclosure.

Although the invention has been described and exemplified with the help of exemplary drawings showing embodiments of the invention, it will be understood that modifications and variations thereof will be apparent to a skilled person. Consequently, it is intended that such modifications and variations be included within the spirit and scope of

the present invention as claimed in the enclosed claims.

LIST OF REFERENCES

	1	connector assembly
5	100	main body
	101	first outer thread section
	102	nut section
	103	second outer thread section
	104	first inner tubular section
10	105	longitudinal grooves or channels
	106	conical section
	107	second inner tubular section
	108	circumferential recess
	109	annular recess
15	200	fixing nut
	201	inner thread section
	300	ring-shaped seal (O-ring)
	400	lock nut
	401	tubular section
20	402	nut section
	403	inner thread section
	404	conical section
	405	cylindrical section
	500	ferrule
25	501	center tubular section or body
	502	slope end sections or bodies
	503	through bore
	600	extension nut
	601	outer tubular section
30	602	nut section
	603	outer thread section
	604	inner thread section
	605	first conical section
	606	first inner tubular section

	607	second conical section
	608	second inner tubular section
	700	insert
	701	main tubular body
5	702	second tubular body
	703	plurality of flexible and elastically deformable fingers
	703a	base portion of finger
	703b	gripping portion of finger
	703c	gaps
10	703d	step
	704	longitudinal protrusions
	705	circumferential protrusions
	706	inner circumferential cavity
	800	cable seal
15	801	tubular body
	802	outer circumferential recess
	803	inner circumferential recess
	C	fiber optic cable
	d	distance between the base plate and a free end of cable outside the connector
20		assembly
	P	base plate
	α	angle of radial projection of the gripping portions 703b of fingers 703 relative a longitudinal axis of the insert

WHAT IS CLAIMED IS:

1. A connector assembly (1) for fiber optic cable (C), characterized by comprising:

- a main body (100);
- a fixing nut (200) for fixing the main body (100) to a base plate (P) of a fiber optic connection box;
- an extension nut (600);
- a lock nut (400);
- an insert (700) comprising a plurality of elastically deformable flexible fingers (703); and
- a cable seal (800);

wherein the cable seal (800) is snap fitted in a hollow inner space formed by the plurality of flexible fingers (703) of insert (700) thus forming a sub-assembly (700-800);

wherein the sub-assembly (700-800) is introduced at least partially in the main body (100) such that the fingers (703) of insert (700) protrude from the main body (100) when the insert (700) is mounted butt up inside the main body (100);

wherein the extension nut (600) is partially screwed in the main body (100) thus forming a hollow inner space into which the plurality of flexible fingers (703) is at least partially received to a position in which at least a distal end of the plurality of flexible fingers (703) contacts with a portion of the inner cavity of the extension nut (600); and wherein a further screwing of the extension nut (600) in the main body (100) causes a radially inwardly deformation of the plurality of flexible fingers (703) and of the seal (800) thus providing a first seal and stress-absorption area to an outer surface of the cable (C) installed in the connector assembly (1).

2. The connector assembly according to claim 1, characterized in that the lock nut (400) is screwed in the extension nut (600) for closing the connector assembly (1).

3. The connector assembly according to claim 1, characterized in that the extension nut (600) comprises:

- on an outer part thereof, a tubular section (601), a nut section (602), and a thread section (603), and
- on an inner part thereof, a thread section (604), a first conical section (605), a first tubular section (606), a second conical section (607) and a second tubular section (608).

4. The connector assembly according to any one of the preceding claims, characterized by further comprising a ferrule (500) having a center tubular section (501), two slope sections

(502) adjacent to each end of the center tubular section (501), and a through bore (503), wherein the ferrule (500) is installed in a hollow inner space formed between the extension nut (600) and lock nut (400) for generating a second seal and stress-absorption area to the cable (C).

- 5 5. The connector assembly according to any one of the preceding claims, characterized in that the main body (100) comprises:
- on an outer part thereof, a first thread section (101), a nut section (102), and a second thread section (103); and
 - on an inner part thereof, a first tubular section (104), a conical section (106), a second
- 10 tubular section (107), a circumferential recess (108), and an annular recess (109) in a back face of the nut section (102).
6. The connector assembly according to claim 5, characterized by further comprising an O-ring (300) for generating a seal between the nut section (102) and a front surface of the base plate (P) when tightening the fixing nut (200) in the main body (100).
- 15 7. The connector assembly according to claim 6, characterized in that the O-ring (300) is received at least partially in the annular recess (109) of main body (100) to generate the seal between the nut section (102) and the base plate (P).
8. The connector assembly according to claim 5, characterized in that the main body (100) further comprises a plurality of longitudinal channels (105) formed in a surface of the first
- 20 inner tubular section (104).
9. The connector assembly according to any one of the preceding claims, characterized in that the insert (700) further comprises a main tubular body (701) and a second tubular body (702) having an inner circumferential cavity (706); wherein the plurality of fingers (703) project from the second tubular body (702); wherein each finger (703) comprises a base
- 25 portion (703a) and a gripping portion (703b), and the gripping portions (703b) of the flexible fingers (703) are formed projecting radially inwardly at an angle (α) such that adjacent gripping portions (703b) are brought into contact with one another when they deformed radially inwardly due to tightening of the extension nut (600) in the main body (100).
- 30 10. The connector assembly according to claim 9, characterized in that the insert (700) further comprises a plurality of longitudinal protrusions (704) formed in a surface of the main tubular body (701).
11. The connector assembly according to claims 8 and 10, characterized in that the longitudinal protrusions (704) of insert (700) are received in the longitudinal channels

(105) of main body (100) to guide introduction and at least partially prevent rotation of insert (700) relative the main body (100).

12. The connector assembly according to claim 9, characterized in that the insert (700) further comprises a plurality of circumferential protrusions (705) spaced apart from each other, which are formed in a surface of the tubular main body (701) to reinforce the main tubular body (701).

13. The connector assembly according to claim 9, characterized in that the plurality of flexible fingers (703) are spaced apart by gaps (703c).

14. The connector assembly according to any one of the preceding claims, characterized in that at least one of the main body (100), fixing nut (200), lock nut (400) and extension nut (600) is made of metal.

15. The connector assembly according to claim 14, characterized in that the metal is selected from the group consisting of: steel, bronze, brass, in particular tin plated brass, and aluminium.

16. The connector assembly according to any one of claims 1 to 13, characterized in that at least one of the main body (100), fixing nut (200), lock nut (400), extension nut (600) and insert (700) is made from a plastic material.

17. The connector assembly according to claim 16, characterized in that the plastic material is made of, or comprises, nylon.

18. The connector assembly according to any one of the preceding claims, characterized in that at least one of the O-ring (300), ferrule (500) and cable seal (800) is made of a rubber-based material, in particular Buna-N, or a silicone-based material.

19. A method of forming a connector assembly (1) in a base plate (P) of a fiber optic connection box, characterized by comprising the steps of:

- a) providing a main body (100);
- b) providing a fixing nut (200);
- c) fixing the main body (100) in an opening of the base plate (P) by means of the fixing nut (200);
- d) providing a lock nut (400);
- e) providing an extension nut (600);
- f) providing an insert (700) comprising a plurality of elastically deformable flexible fingers (703);
- g) providing a cable seal (800);
- h) mounting the cable seal (800) in a hollow inner space formed by the plurality of

flexible fingers (703) of insert (700) thereby forming a sub-assembly (700-800);

i) positioning in sequence from a distal end towards a proximal end of the fiber optic cable (C) the lock nut (400), the extension nut (600) and the sub-assembly (700-800);

j) passing the distal end of the cable (C) through the main body (100) to a position where a substantial portion of the distal end of cable (C) protrudes from the base plate (P) and main body (100);

k) introducing the sub-assembly (700-800) in the main body (100) to a position where the plurality of fingers (703) is adjacent to and protrude from the main body (100);

l) screwing the extension nut (600) in the main body (100) to a position in which a radially inwardly deformation is caused to the plurality of flexible fingers (703) and seal (800), thus producing a first seal and stress-absorption area to an outer surface of cable (C);

m) screwing the lock nut (400) in the extension nut (600) to close the connector assembly (1).

20. The method according to claim 19, characterized by further comprising, before step (c), positioning an O-ring (300) between the main body (100) and a front surface of base plate (P) to generate a seal between them.

21. The method according to any one of claims 19 to 20, characterized by further comprising, after step (d) and before step (e), providing an elastically deformable ferrule (500).

22. The method according to claim 21, characterized by further comprising, in step (i), positioning the ferrule (500) between the lock nut (400) and the extension nut (600).

23. The method according to claim 22, characterized by further comprising, before step (m), partially inserting the ferrule (500) in the extension nut (600).

24. The method according to claim 23, characterized by further comprising screwing the lock nut (400) in the extension nut (600) such that the ferrule (500) is accommodated inside a hollow inner space formed at least partially by the lock nut (400) and the extension nut (600); wherein the ferrule (500) is elastically deformed in said inner space, thus producing a second seal and stress-absorption area to the fiber optic cable (C).

25. The method according to claim 24, characterized by further comprising causing a further screwing of the lock nut (400) in the extension nut (600) to a position in which the ferrule (500) is so deformed that it partially protrudes from the lock nut (400) thus ensuring a tight seal.

AMENDED CLAIMS

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Claims

[Claim 1]

A connector assembly (1) for fiber optic cable (C), characterized by comprising:

- a main body (100) having, on an outer part thereof, a first thread section (101), a nut section (102), and a second thread section (103), and on an inner part thereof, a first tubular section (104), a conical section (106), and a second tubular section (107);
- a fixing nut (200) for fixing the main body (100) to a base plate (P) of a fiber optic connection box;
- an extension nut (600);
- a lock nut (400);
- an insert (700) comprising a main tubular body (701), a second tubular body (702) adjacent the main tubular body (701), and a plurality of elastically deformable flexible fingers (703) projecting from the second tubular body (702); and
- a cable seal (800);

wherein the cable seal (800) is snap fitted in an inner circumferential cavity (706) formed in the second tubular body (702) of insert (700) thus forming a sub-assembly (700-800);

wherein the main body (100) further comprises a plurality of longitudinal channels (105) formed in a surface of the first tubular section (104), and the insert (700) further comprises a plurality of longitudinal protrusions (704) formed in an outer surface of the main tubular body (701), such that the longitudinal protrusions (704) are received in the longitudinal channels (105) of main body (100) to guide introduction of insert (700) into the main body (100) and at least partially prevent rotation of insert (700) relative the main body (100) when the extension nut (600) is screwed on the main body (100);

wherein the sub-assembly (700-800) is introduced at least partially in the main body (100) such that the fingers (703) of insert (700) protrude from the main body (100) when the insert (700) is mounted butt up inside the main body (100);

wherein the extension nut (600) is partially screwed in the main body (100) thus forming a hollow inner space into which the plurality of flexible fingers (703) is at least partially received to a position in which at least a distal end of the plurality of flexible fingers (703) contacts with a portion of the inner cavity of the extension nut (600); and

wherein a further screwing of the extension nut (600) in the main body (100) causes a radially inwardly deformation of the plurality of flexible fingers (703) and of the seal (800) thus providing a first seal and stress-absorption area to an outer surface of the cable (C) installed in the connector assembly (1).

[Claim 2] The connector assembly according to claim 1, characterized in that the lock nut (400) is screwed in the extension nut (600) for closing the connector assembly (1).

[Claim 3] The connector assembly according to claim 1, characterized in that the extension nut (600) comprises:

- on an outer part thereof, a tubular section (601), a nut section (602), and a thread section (603), and
- on an inner part thereof, a thread section (604), a first conical section (605), a first tubular section (606), a second conical section (607) and a second tubular section (608).

[Claim 4] The connector assembly according to claim 1, characterized by further comprising a ferrule (500) having a center tubular section (501), two slope sections (502) adjacent to each end of the center tubular section (501), and a through bore (503), wherein the ferrule (500) is installed in a hollow inner space formed between the extension nut (600) and lock nut (400) for generating a second seal and stress-absorption area to the cable (C).

[Claim 5] The connector assembly according to claim 1, characterized in that the main body (100) further comprises an inner circumferential recess (108), and an annular recess (109) in a back face of the nut section (102).

[Claim 6] The connector assembly according to claim 5, characterized by further comprising an O-ring (300) for generating a seal between the nut section (102) and a front surface of the base plate (P) when tightening the fixing nut (200) in the main body (100).

[Claim 7] The connector assembly according to claim 6, characterized in that the O-ring (300) is received at least partially in the annular recess (109) of main body (100) to generate the seal between the nut section (102) and the base plate (P).

[Claim 8] The connector assembly according to claim 1, characterized in that each finger (703) comprises a base portion (703a) and a gripping portion (703b), and the gripping portions (703b) of the flexible fingers (703) are formed projecting radially inwardly at an angle (α) such that

- adjacent gripping portions (703b) are brought into contact with one another when they deformed radially inwardly due to tightening of the extension nut (600) in the main body (100).
- [Claim 9] The connector assembly according to claim 1, characterized in that the insert (700) further comprises a plurality of circumferential protrusions (705) spaced apart from each other, which are formed in an outer surface of the tubular main body (701) to reinforce the main tubular body (701).
- [Claim 10] The connector assembly according to claim 1, characterized in that the plurality of flexible fingers (703) are spaced apart by gaps (703c).
- [Claim 11] The connector assembly according to claim 1, characterized in that at least one of the main body (100), fixing nut (200), lock nut (400) and extension nut (600) is made of metal.
- [Claim 12] The connector assembly according to claim 11, characterized in that the metal is selected from the group consisting of: steel, bronze, brass, in particular tin plated brass, and aluminium.
- [Claim 13] The connector assembly according to claim 1, characterized in that at least one of the main body (100), fixing nut (200), lock nut (400), extension nut (600) and insert (700) is made from a plastic material.
- [Claim 14] The connector assembly according to claim 13, characterized in that the plastic material is made of, or comprises, nylon.
- [Claim 15] The connector assembly according to claim 6, characterized in that at least one of the O-ring (300), ferrule (500) and cable seal (800) is made of a rubber-based material, in particular Buna-N, or a silicone-based material.
- [Claim 16] A method of forming a connector assembly (1) in a base plate (P) of a fiber optic connection box, characterized by comprising the steps of:
- a) providing a main body (100) having:
 - on an outer part thereof, a first thread section (101), a nut section (102), and a second thread section (103), and
 - on an inner part thereof, a first tubular section (104) having a plurality of longitudinal channels (105), a conical section (106), and a second tubular section (107);
 - b) providing a fixing nut (200);
 - c) fixing the main body (100) in an opening of the base plate (P) by means of the fixing nut (200);
 - d) providing a lock nut (400);
 - e) providing an extension nut (600);

f) providing an insert (700) comprising:
a main tubular body (701) having a plurality of longitudinal protrusions (704) formed on its outer surface, a second tubular body (702) adjacent the main tubular body (701), and a plurality of elastically deformable flexible fingers (703) projecting project from the second tubular body (702);
g) providing a cable seal (800);
h) mounting the cable seal (800) in an inner circumferential cavity (706) formed in the second tubular body (702) of insert (700) thereby forming a sub-assembly (700-800);
i) positioning in sequence from a distal end towards a proximal end of the fiber optic cable (C) the lock nut (400), the extension nut (600) and the sub-assembly (700-800);
j) passing the distal end of the cable (C) through the main body (100) to a position where a substantial portion of the distal end of cable (C) protrudes from the base plate (P) and main body (100);
k) introducing the sub-assembly (700-800) in the main body (100) with the longitudinal protrusions (704) of insert (700) being guided in the longitudinal channels (105) of main body (100) to a position where the plurality of fingers (703) is adjacent to and protrude from the main body (100);
l) screwing the extension nut (600) in the main body (100) to a position in which a radially inwardly deformation is caused to the plurality of flexible fingers (703) and seal (800) while the insert (700) is prevented from rotating relative the main body (100) during screwing of the extension nut (600) in the main body (100), thus producing a first seal and stress-absorption area to an outer surface of cable (C);
m) screwing the lock nut (400) in the extension nut (600) to close the connector assembly (1).

[Claim 17] The method according to claim 16, characterized by further comprising, before step (c), positioning an O-ring (300) between the main body (100) and a front surface of base plate (P) to generate a seal between them.

[Claim 18] The method according to claim 16, characterized by further comprising, after step (d) and before step (e), providing an elastically deformable ferrule (500).

[Claim 19] The method according to claim 18, characterized by further comprising, in step (i), positioning the ferrule (500) between the lock nut (400) and

- the extension nut (600).
- [Claim 20] The method according to claim 19, characterized by further comprising, before step (m), partially inserting the ferrule (500) in the extension nut (600).
- [Claim 21] The method according to claim 20, characterized by further comprising screwing the lock nut (400) in the extension nut (600) such that the ferrule (500) is accommodated inside a hollow inner space formed at least partially by the lock nut (400) and the extension nut (600); wherein the ferrule (500) is elastically deformed in said inner space, thus producing a second seal and stress-absorption area to the fiber optic cable (C).
- [Claim 22] The method according to claim 21, characterized by further comprising causing a further screwing of the lock nut (400) in the extension nut (600) to a position in which the ferrule (500) is so deformed that it partially protrudes from the lock nut (400) thus ensuring a tight seal.

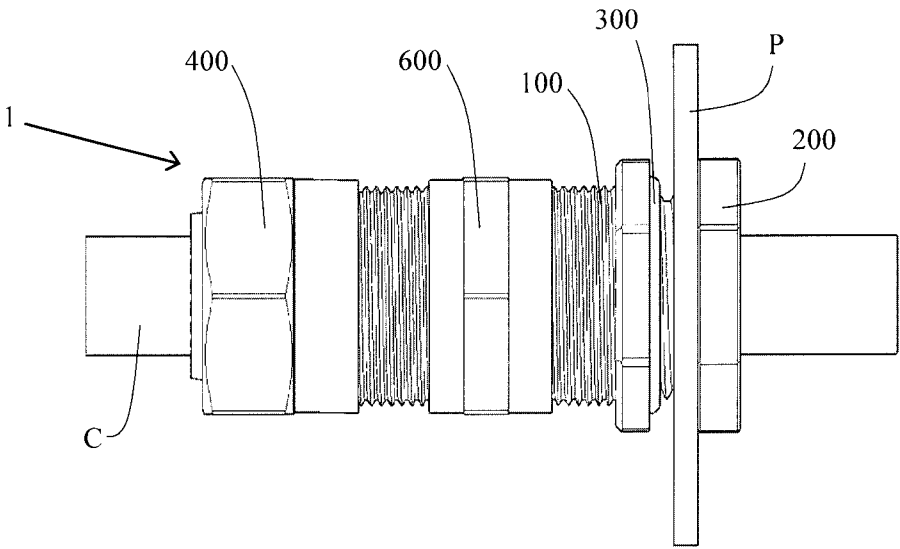


FIG. 1

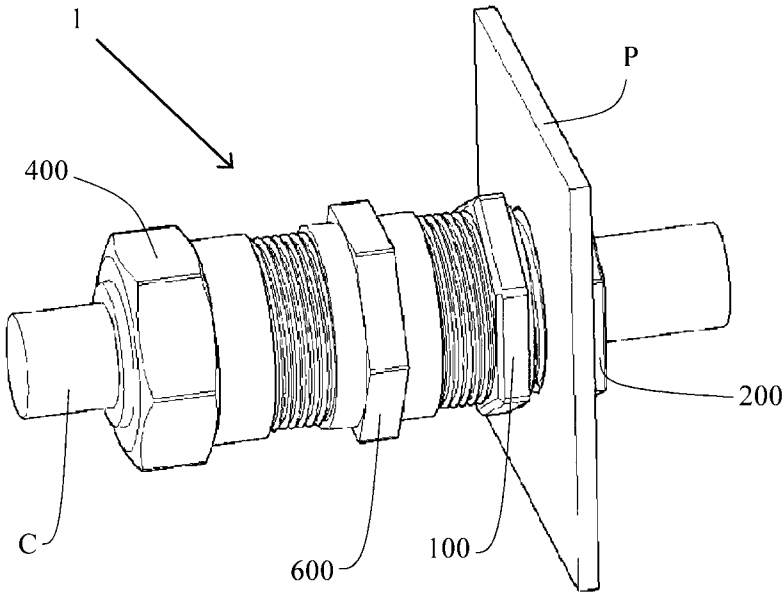


FIG. 2

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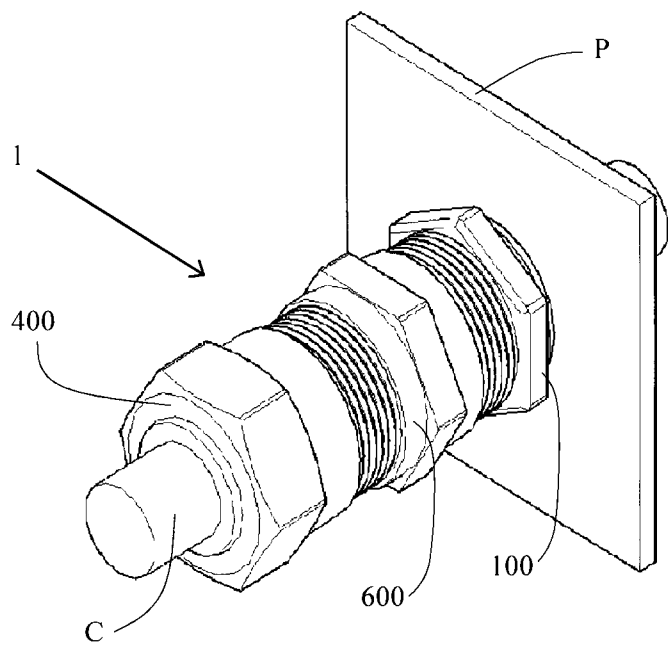


FIG. 3

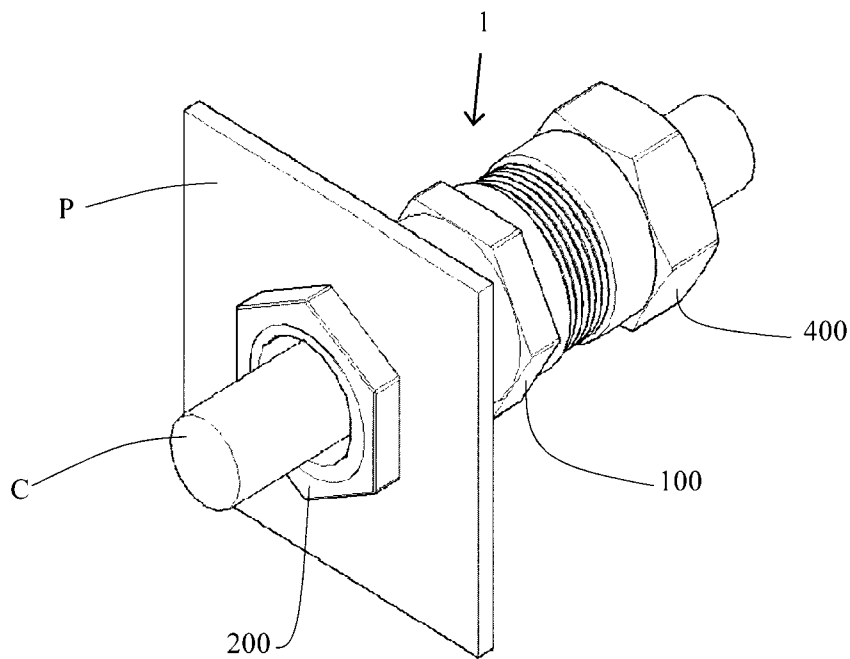


FIG. 4

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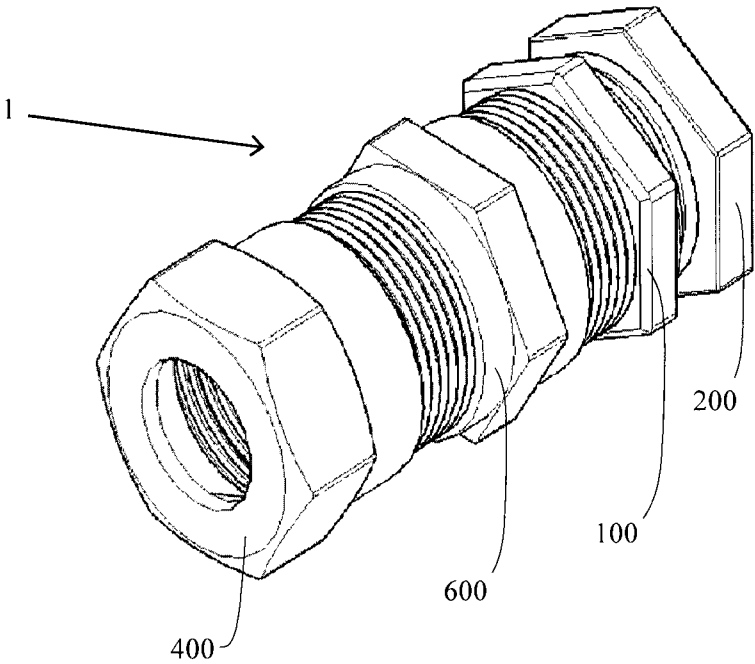


FIG. 5

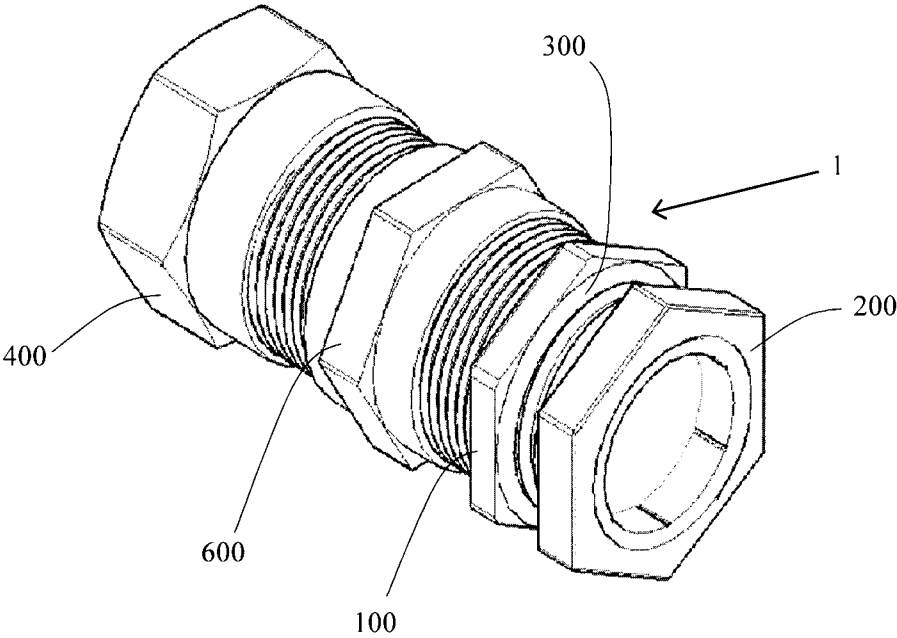


FIG. 6

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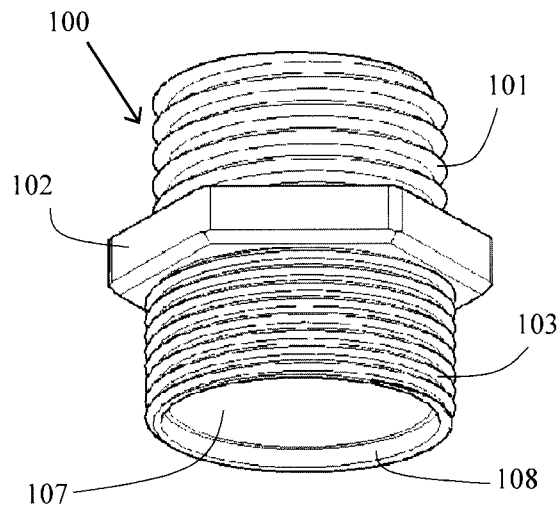


FIG. 7

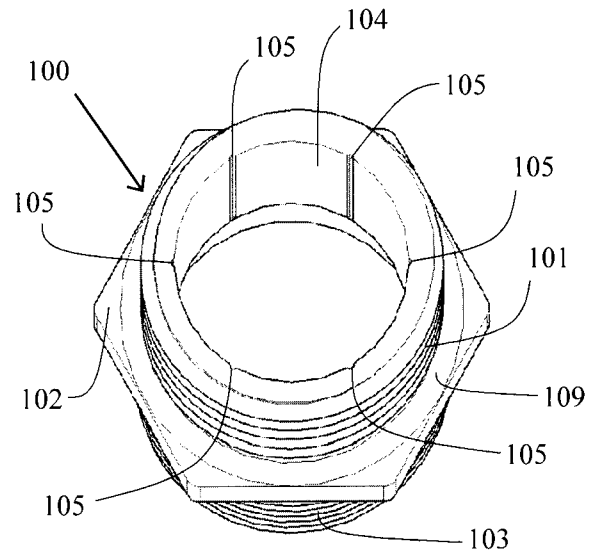


FIG. 8

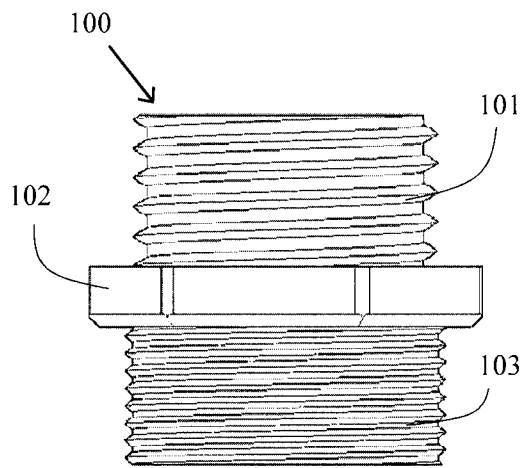


FIG. 9

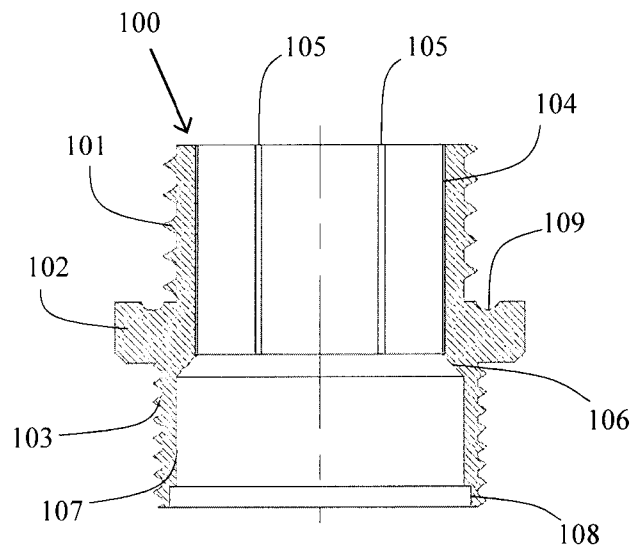


FIG. 10

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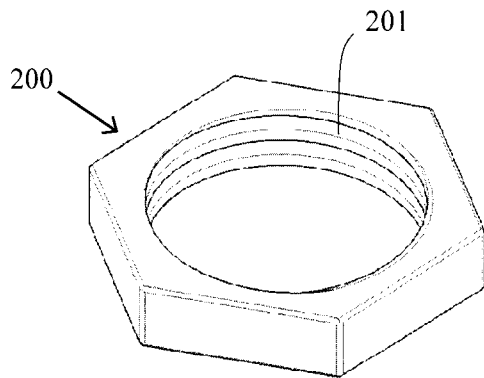


FIG. 11

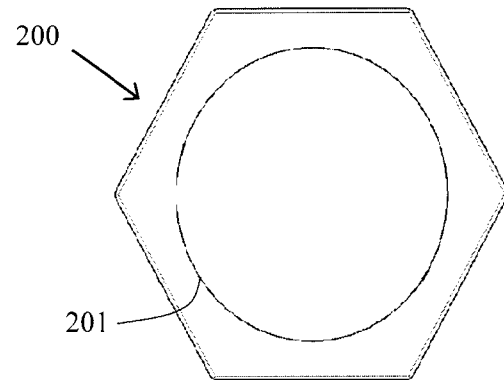


FIG. 12

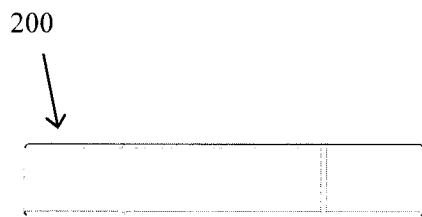


FIG. 13

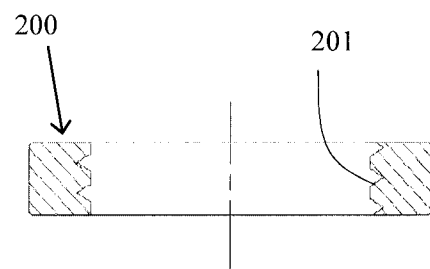


FIG. 14



FIG. 15

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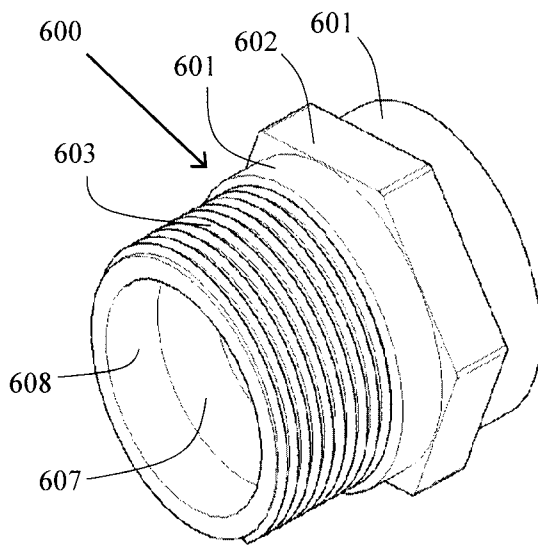


FIG. 16

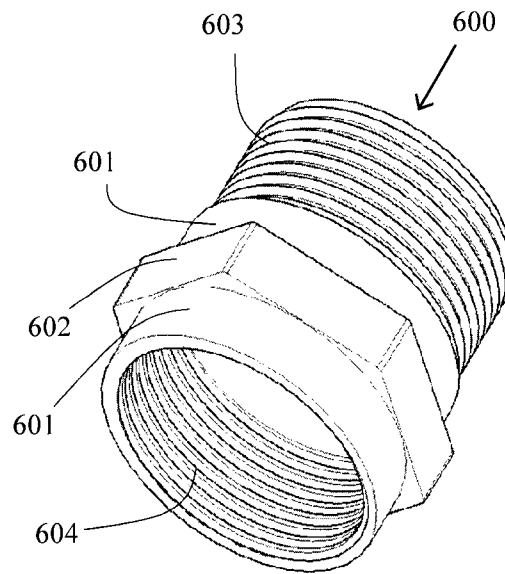


FIG. 17

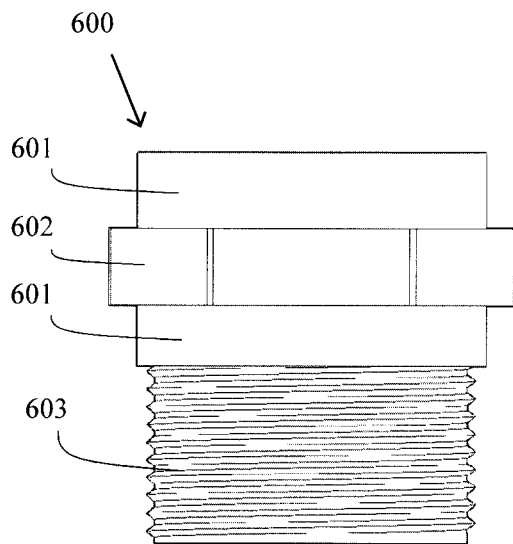


FIG. 18

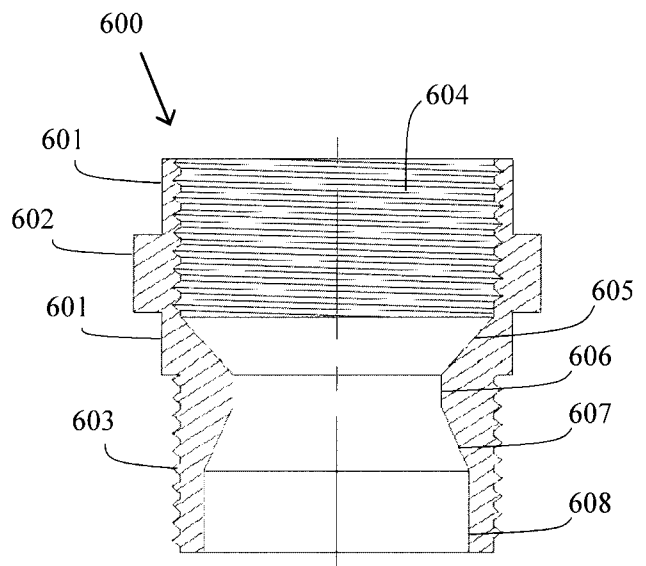


FIG. 19

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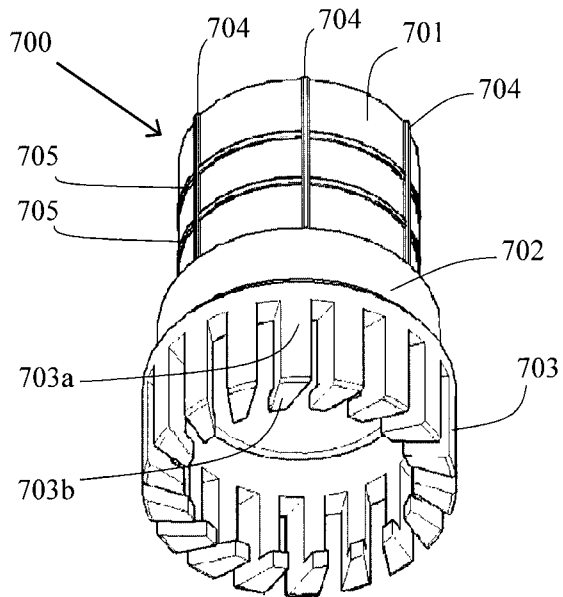


FIG. 20

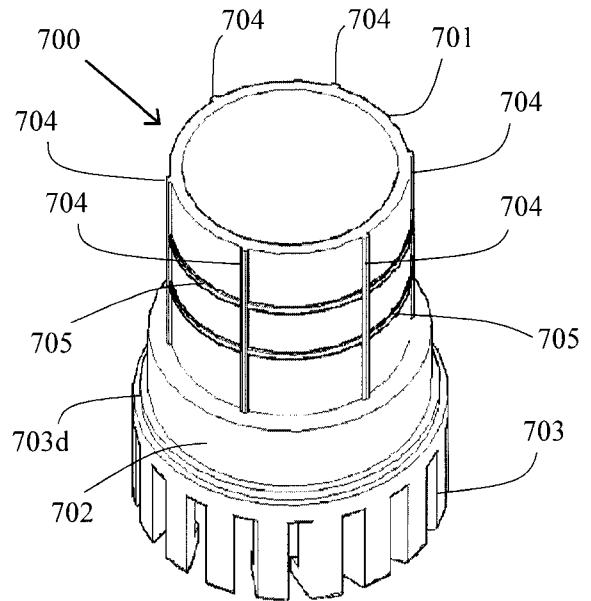


FIG. 21

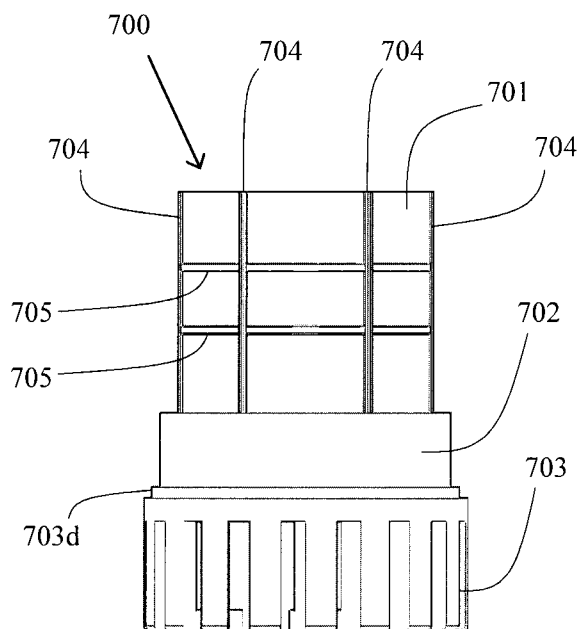


FIG. 22

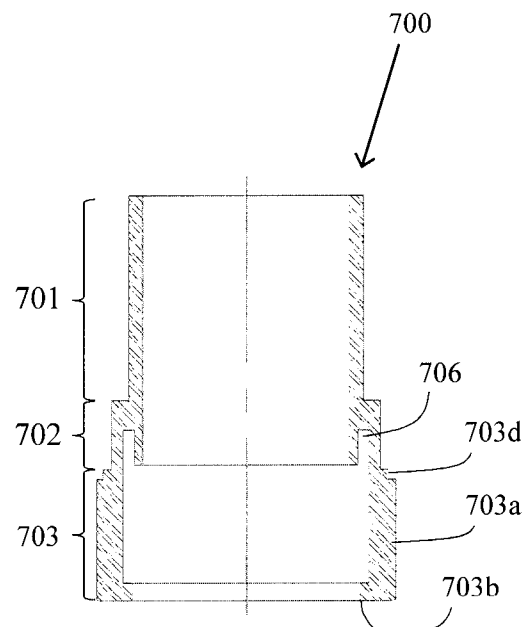


FIG. 23

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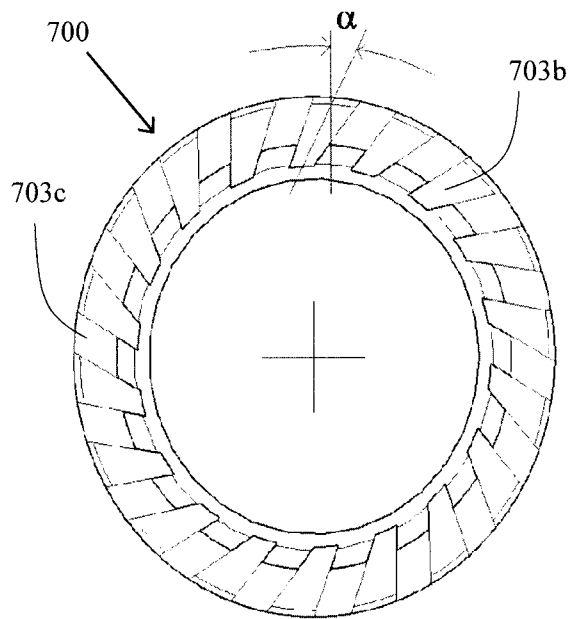


FIG. 24

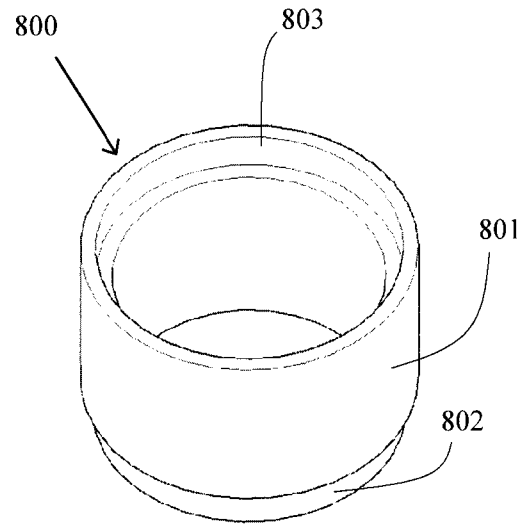


FIG. 25

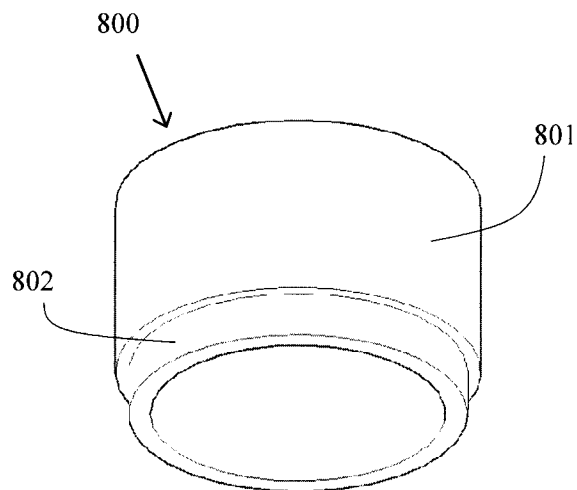


FIG. 26

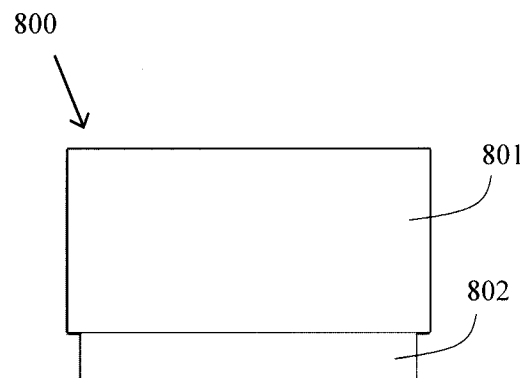


FIG. 27

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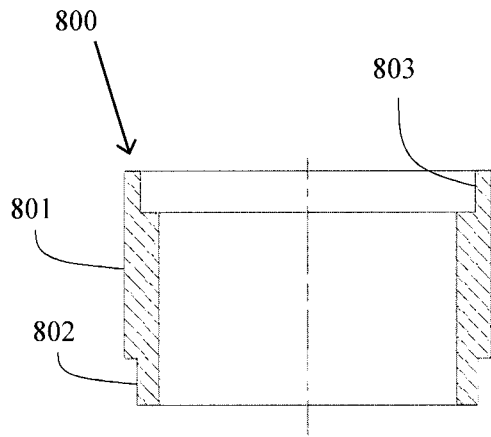


FIG. 28

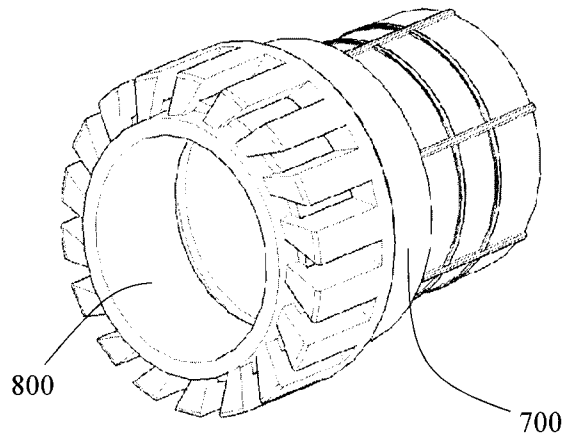


FIG. 29

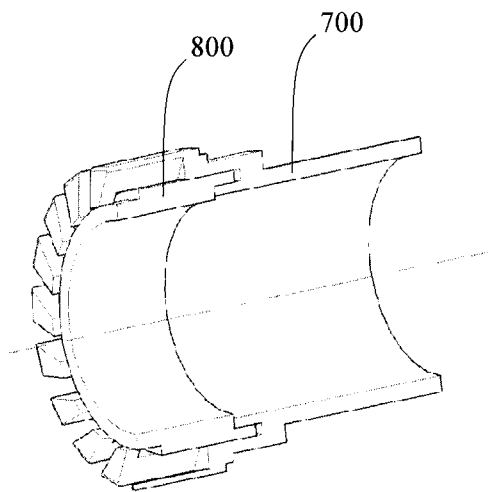


FIG. 30

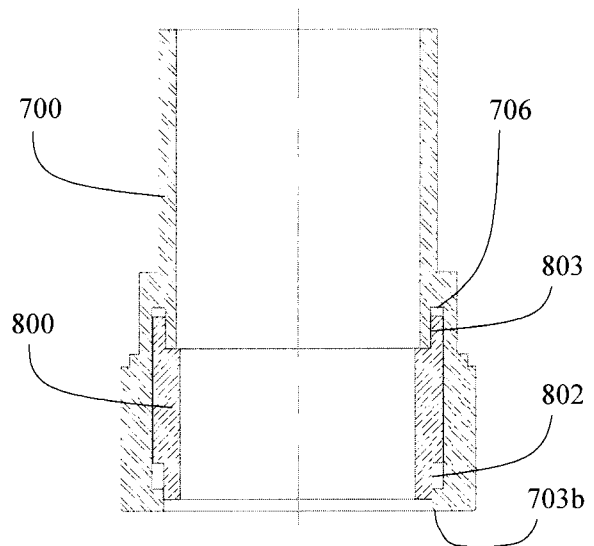


FIG. 31

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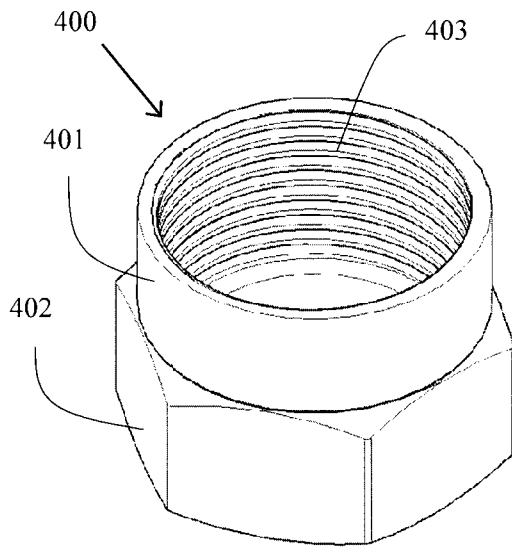


FIG. 32

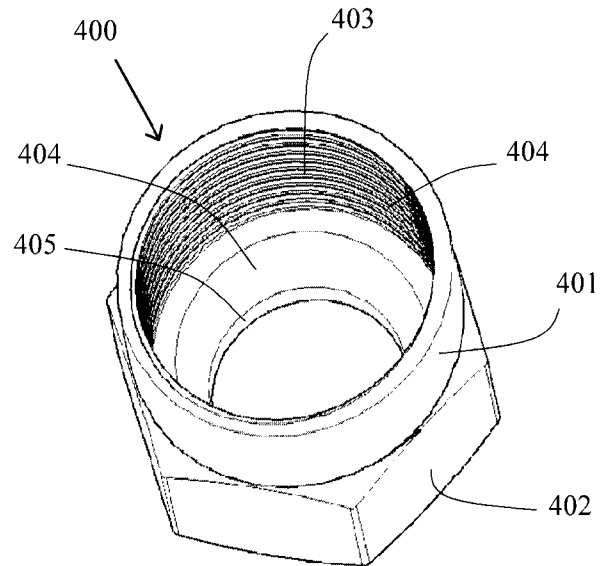


FIG. 33

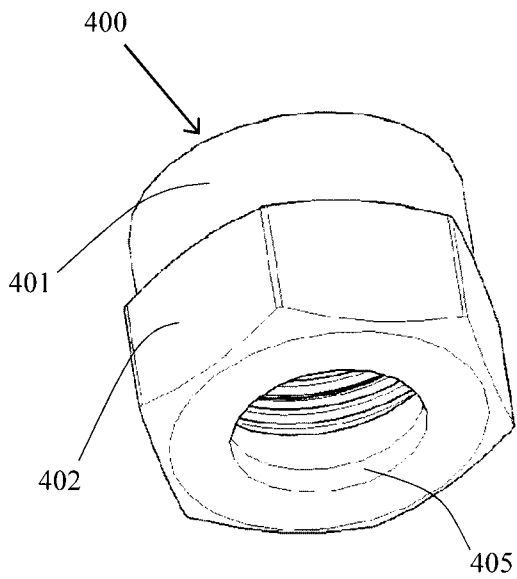


FIG. 34

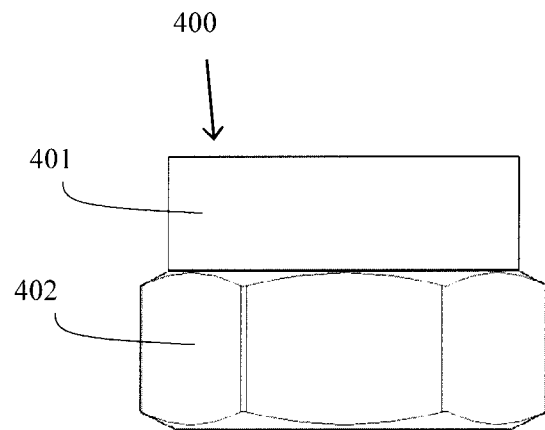


FIG. 35

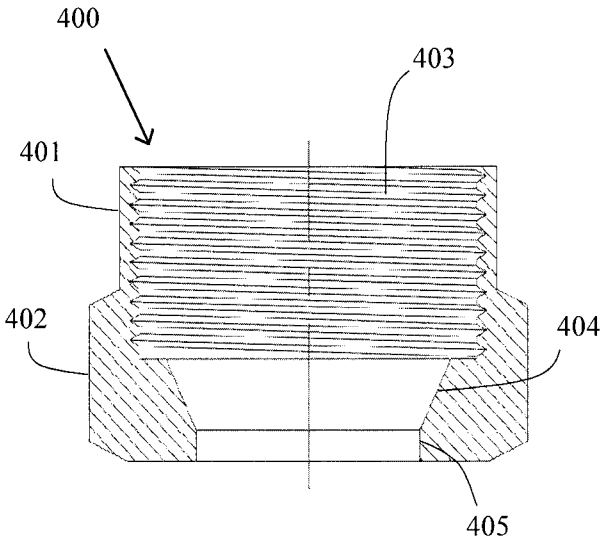


FIG. 36

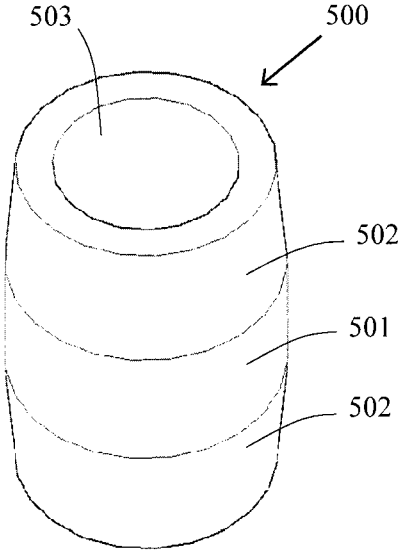


FIG. 37

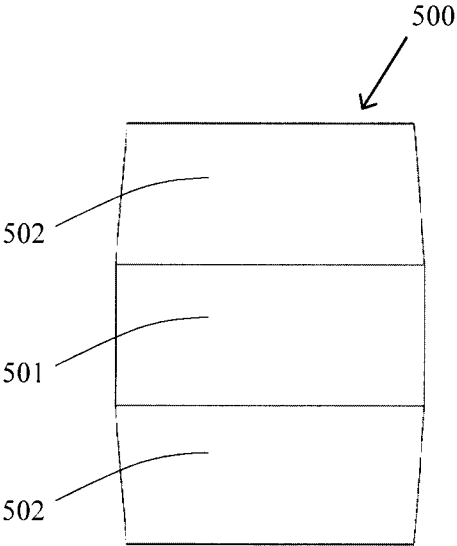


FIG. 38

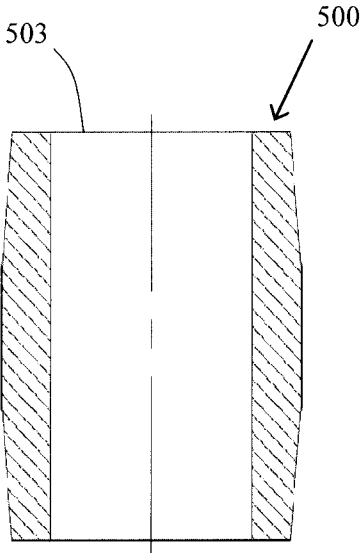


FIG. 39

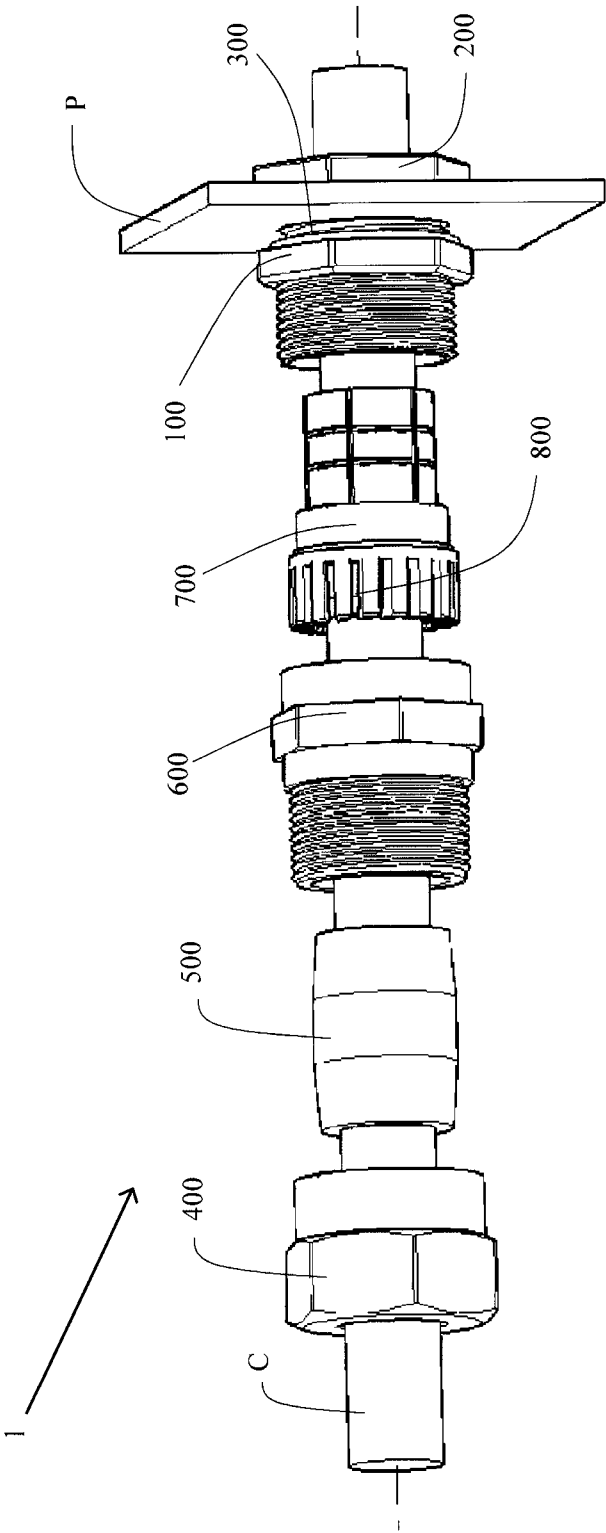


FIG. 40

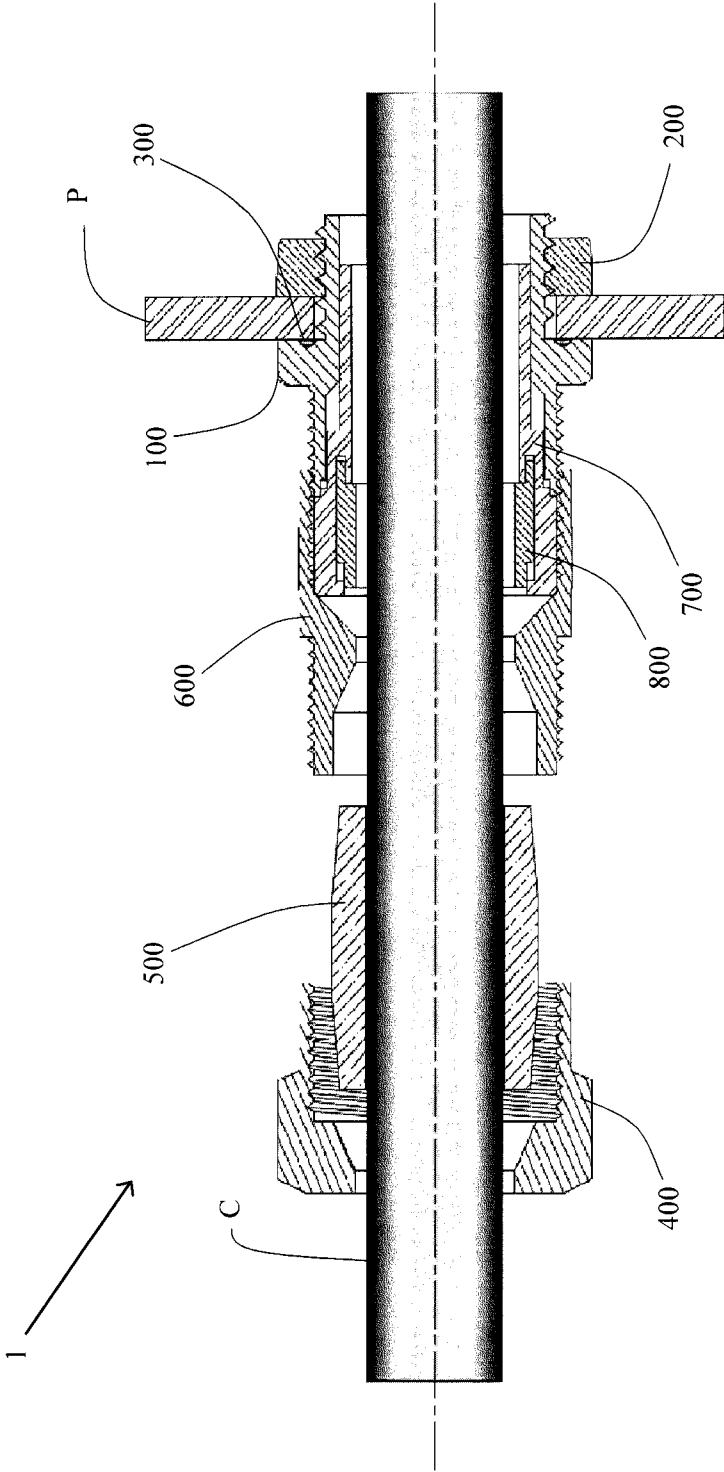


FIG. 41

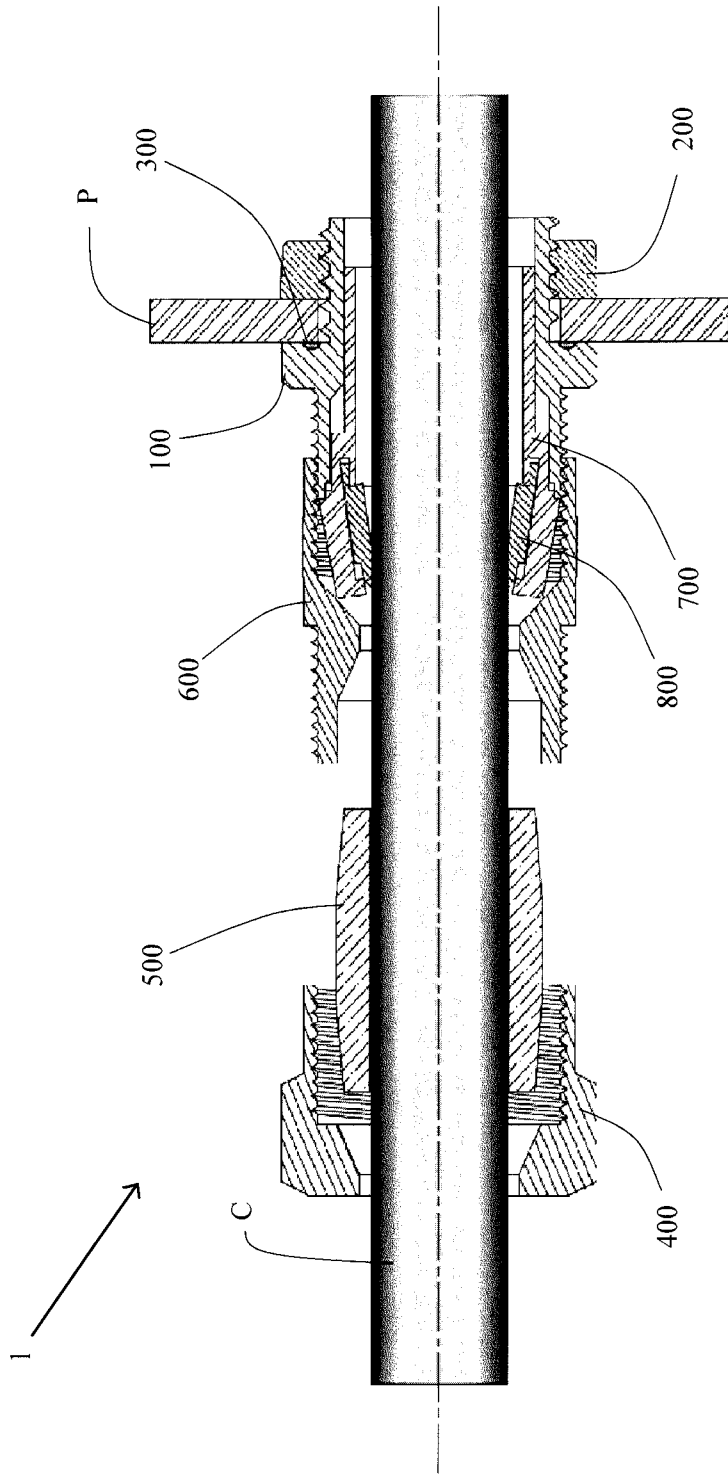


FIG. 42

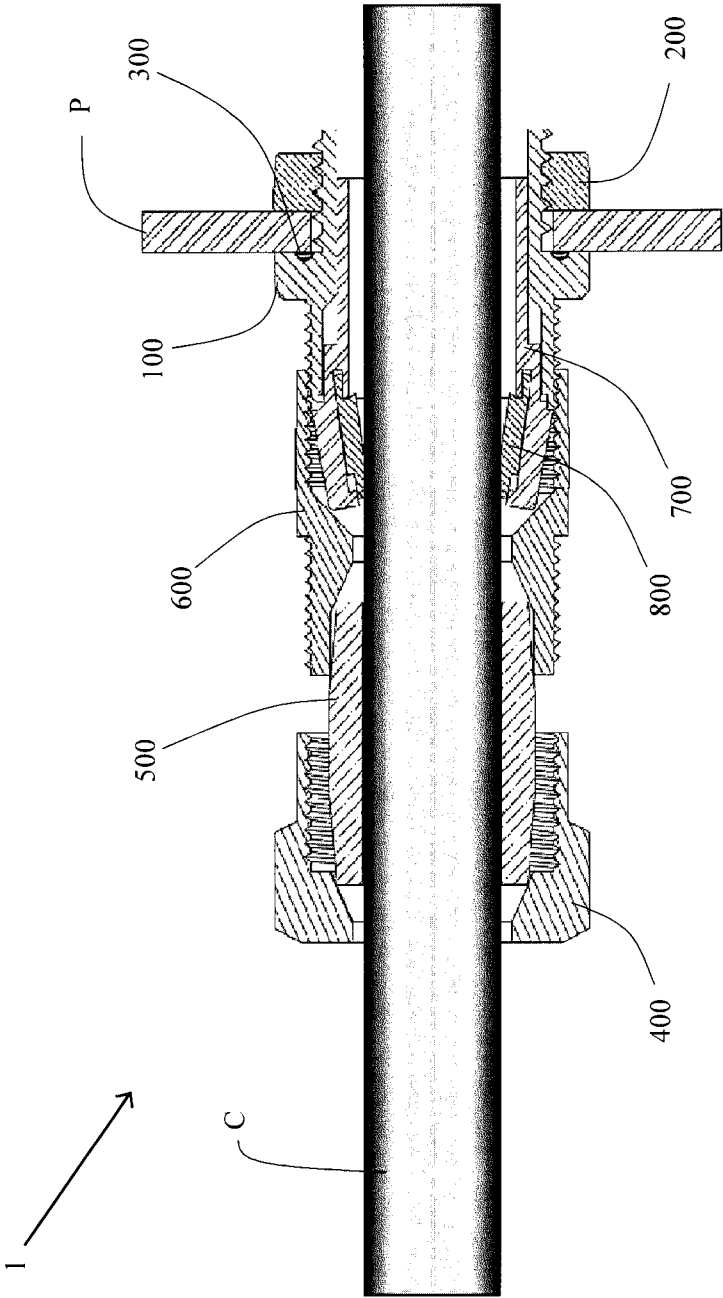


FIG. 43

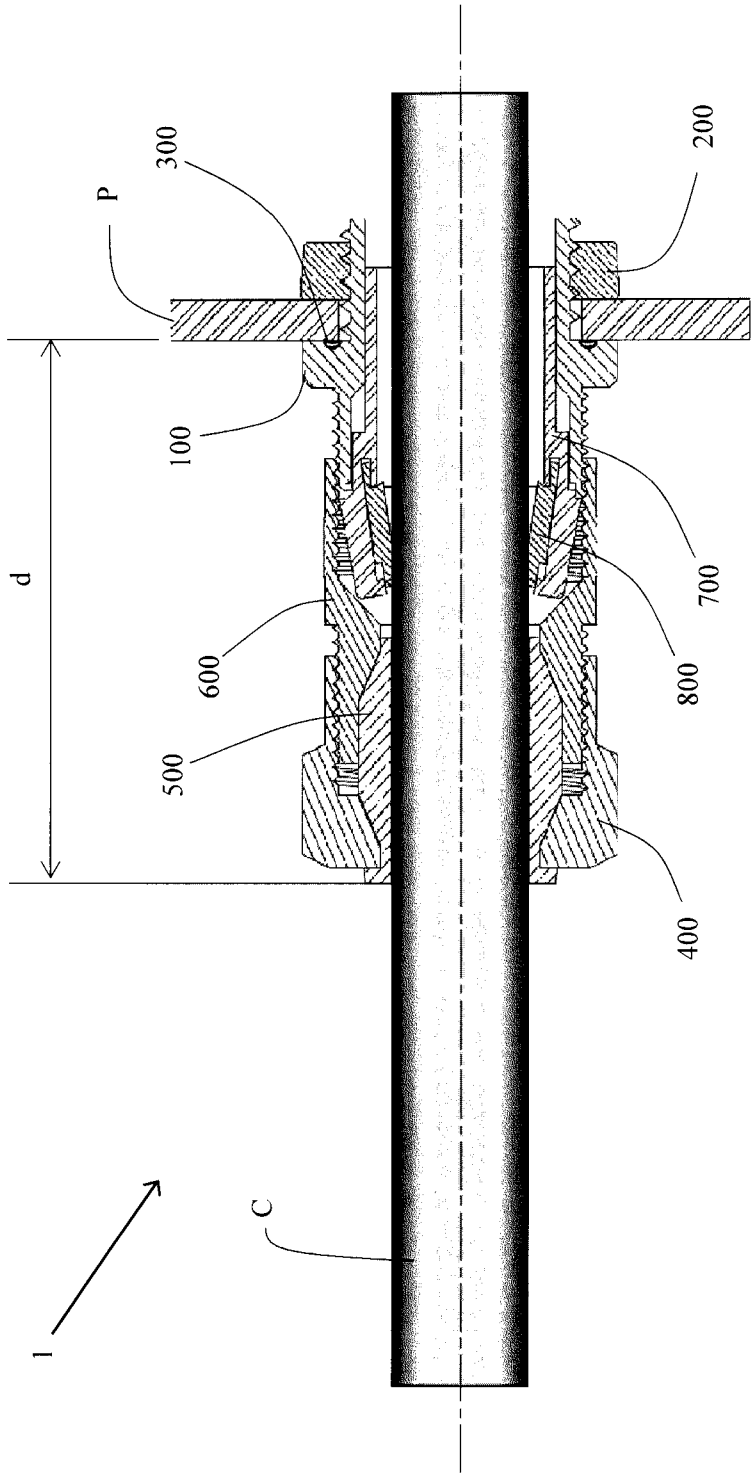


FIG. 44

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2016/056109

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H02G 15/04; F16L 37/00; F16L 41/14; H02G 3/06; H02G 3/08; H02G 3/22; H02G 15/007 (2017.01)

CPC - H02G 15/043; F16L 37/008; F16L 41/14; H02G 3/065; H02G 3/0666; H02G 15/007 (2017.01)

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 - F16L 37/00; F16L 41/14; H02G 3/06; H02G 3/08; H02G 3/22; H02G 15/007; H02G 15/04

CPC - F16L 37/008; F16L 41/14; H02G 3/065; H02G 3/0666; H02G 15/007; H02G 15/04; H02G 15/043

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

174/65R; 174/151; 174/655; 277/603; 285/123.1; 285/243; 285/322; 285/323; 403/194 (keyword delimited)

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

PatBase, Google Patents, Google Scholar, Google

Search terms used: fiber, fibre, optic, electrical, cable, wire, conduit, screw, thread, fingers, jaws, members, grippers, blades, extensions; flex, bend, deform, contract, collapse, collet, sleeve, insert, wall, panel, plate, wedge, seal, ferrule, nut

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2015/0200530 A1 (AVC INDUSTRIAL CORP.) 16 July 2015 (16.07.2015) entire document	1-4, 19-25
Y	US 4,375,011 A (GRUNAU) 22 February 1983 (22.02.1983) entire document	1-4, 19-25
Y	US 6,268,565 B1 (DAOUD) 31 July 2001 (31.07.2001) entire document	3, 4
Y	US 5,051,541 A (BAWA et al) 24 September 1991 (24.09.1991) entire document	20
A	US 4,250,348 A (KITAGAWA) 10 February 1981 (10.02.1981) entire document	1-4, 19-25

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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

"&" document member of the same patent family

Date of the actual completion of the international search

18 January 2017

Date of mailing of the international search report

03 FEB 2017

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2016/056109

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 5-18
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

PCTNOTIFICACION REFERENTE A LA
PRESENTACIÓN, OBTENCIÓN O
TRANSMISIÓN DE DOCUMENTO
DE PRIORIDAD

(Instrucciones Administrativas del PCT, Sección 411)

De la OFICINA INTERNACIONAL

Para:

GONZALEZ ROSSI, Alejandro Gabriel
Av. Tecamachalco 14-7 PH
Col. Lomas de Chapultepec
Ciudad de México, 11010
MÉXICO

Fecha de envío (día/mes/año)	16 diciembre 2016 (16.12.2016)
Referencia de expediente del solicitante o del agente:	200087-16PCT
Solicitud internacional No.	PCT/IB2016/056109
Fecha de publicación internacional (día/mes/año)	Aún no publicada
Solicitante	PEREZ DAVILA, William

NOTIFICACION IMPORTANTE

Fecha de presentación internacional (día/mes/año)

12 octubre 2016 (12.10.2016)

Fecha de prioridad (día/mes/año)

03 noviembre 2015 (03.11.2015)

Por este medio se notifica al solicitante de la fecha de recepción (o de obtención por la Oficina Internacional) del (de los) documento(s) de prioridad relacionado(s) a todas las solicitudes anteriores cuya prioridad es reclamada. A menos que se indique lo contrario por las letras “NR”, en la columna derecha o por un asterisco que aparezca junto a la fecha de recepción, **el documento de prioridad referido fue presentado o transmitido a u obtenido por la Oficina Internacional en cumplimiento de la Regla 17.1(a), (b) o (b-bis)**. Esta Forma reemplaza cualquier notificación emitida previamente referente a la presentación, transmisión u obtención de documentos de prioridad.

Fecha de prioridadNo. de solicitud de prioridadPaís u Oficina regional u
Oficina receptora
conforme al PCTFecha de recepción del documento de
prioridad

03 noviembre 2015 (03.11.2015)

MX/a/2015/015305

MX

28 noviembre 2016 (28.11.2016)

Las letras “NR” denotan un documento de prioridad el cual, en la fecha de envío de esta Forma, no había sido recibido aún u obtenido por la Oficina Internacional en cumplimiento con la Regla 17.1(a), (b) o (b-bis). Cuando el solicitante ha fallado ya sea en presentar, requerir preparar y transmitir, o requerir a la Oficina Internacional obtener el documento de prioridad dentro del tiempo límite aplicable bajo esa Regla, se llama la atención del solicitante a la Regla 17.1(c) que establece que ninguna Oficina designada puede descartar el reclamo de prioridad concerniente antes de dar al solicitante una oportunidad, después de la entrada a la fase nacional, de enviar el documento de prioridad dentro de un tiempo límite que sea razonable bajo las circunstancias.

Un asterisco “*” junto a la fecha de recepción, denota un documento de prioridad presentado o transmitido a u obtenido por la Oficina Internacional pero no en cumplimiento con la Regla 17.1(a), (b) o (b-bis) (el documento de prioridad fue recibido después del tiempo límite prescrito en la Regla 17.1(a); la petición para preparar y transmitir el documento de prioridad fue presentada ante la Oficina receptora después del tiempo límite aplicable bajo la Regla 17.1(b) o la petición a la Oficina Internacional para obtener el documento de prioridad se realizó después del tiempo límite aplicable bajo la Regla 17.1(b-bis). Aún cuando el documento de prioridad no fue presentado en cumplimiento con la Regla 17.1(a), (b) o (b-bis), la Oficina Internacional, no obstante, transmitirá una copia del documento a las Oficinas designadas, para su consideración. En caso de que dicha copia no sea aceptada por la Oficina designada como el documento de prioridad, la Regla 17.1(c) establece que ninguna Oficina designada puede descartar el reclamo de prioridad referido antes de dar al solicitante una oportunidad, después de la entrada a la fase nacional, de enviar el documento de prioridad dentro de un tiempo límite que sea razonable bajo las circunstancias.

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Oficial autorizado

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