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Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) Flange adapted to form a waveguide interconnection

(57) A flange (13) for waveguide interconnection fixed to a waveguide (10), characterised by being composed of two parts, namely a radially shaped more internal part (14) of conductive material which surrounds said waveguide, and a radially shaped more external part (15) of rigid plastic material filled with conductive powders.

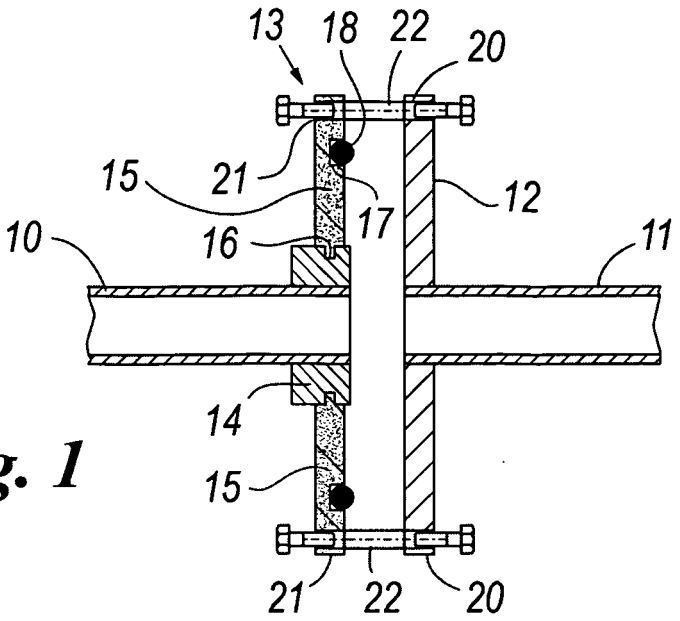

Fig. 1

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Description

[0001] The present invention relates to a flange adapted to form a waveguide interconnection and a method for reducing the corrosion of said interconnection.

[0002] In telecommunication and similar equipment installations, appliances and antennas have to be connected together, either directly or via waveguide lines.

[0003] The materials in direct mutual contact must present high electrochemical compatibility to prevent rapid joint degradation due to corrosion.

[0004] The waveguide flanges are generally made of brass (or copper alloys), whereas the appliance or antenna flanges are frequently made of aluminium for weight and cost reasons.

[0005] The problem of electrochemical compatibility hence arises when coupling different metals together, as this can lead to corrosion problems to the extent of causing joint blockage under unfavourable ambient conditions.

[0006] In particular, for joints of quick connect type which enable an appliance to be quickly installed or replaced (for example if faulty), corrosion can lead to jam of the parts, making quick flange separation impossible.

[0007] A basic requirement of microwave interconnection is therefore good electrical conductivity along the microwave path, hence electrically insulating protections or passivations which interrupt this electrical continuity are unacceptable.

[0008] Systems for corrosion reduction by interposing rubber/elastic elements also filled with conductive material are known. See for example DE 28 27 676, FR 2 537 786, US 3,620,873.

[0009] An object of the present invention is to provide a waveguide interconnection in which corrosion of the parts is prevented, while maintaining the electrical conductivity of the microwave path unaltered.

[0010] Another object is to provide a waveguide interconnection which is of simple construction.

[0011] These and other objects are attained according to the present invention by a flange for waveguide interconnection fixed to a waveguide, characterised by being composed of two parts, namely a radially shaped more internal part of conductive material which surrounds said waveguide, and a radially shaped more external part of rigid plastic material filled with conductive powders. These objects are also attained by a method for reducing the corrosion of flanges used in microwave interconnections between a first waveguide comprising at a first end thereof a first flange, and a second waveguide comprising at an end thereof a second flange, **characterised in that** said first flange is formed in accordance with claim 1.

[0012] Further characteristics of the invention are described in the dependent claims.

[0013] The more external part of the flange formed of rigid plastic material interrupts the galvanic circuit between the different metals of the two coupled flanges. At the same time, the conductive powders ensure high absorbent power at microwave frequency to prevent undesirable radiation from the joint.

[0014] The characteristics and advantages of the present invention will be apparent from the following detailed description of one embodiment thereof, illustrated by way of non-limiting example in the accompanying drawings, in which:

Figure 1 is a schematic section through a flange for waveguide interconnection according to the present invention coupled to a second flange of normal type, shown with the flanges close together but not connected;

Figure 2 is a schematic section through a flange for waveguide interconnection of quick connect type, coupled to a counter flange, shown with the flanges close together but not connected, in accordance with the present invention;

Figure 3 is a schematic section through a flange for separating two waveguide parts of the present invention, by means of an insert obtained by combining two opposing flanges 13 of Figure 1, shown with the flanges close together but not connected, in accordance with the present invention.

[0015] With reference to the accompanying figures, a waveguide joint according to the present invention comprises a first waveguide section 10 to be joined to a second waveguide section 11.

[0016] A flange 12 of traditional type is applied to the second section 11.

[0017] A flange 13 is applied to the first section 10. The flange 13 is composed of a radial (coaxial) more internal part 14, relative to the waveguide channel region, and a radial (coaxial) more external plastic part 15, relative to the mechanical fixing region between the flanges, all forming a single block.

[0018] The internal part 14 consists of a (circular or rectangular) ring preferably of the same material as the waveguide welded to it. Externally to this, on its lateral surface, it comprises a profile discontinuity, for example a recess 16, to strengthen the mechanical connection between the metal internal part 14 and the external plastic part 15 of the flange.

[0019] Preferably, the internal part 14 projects by about 5‰ of the maximum flange dimension (about 0.1 mm) from the outer surface of the external plastic part 15. The shape of the ring 14 is preferably circular, but other shapes are possible, depending on the type of flange and the shape of the waveguide 10.

[0020] Preferably, the waveguide 10 penetrates completely into the internal part 14, and is welded to ensure greater mechanical strength, however it could also be merely brought into contact therewith and welded, or brazed or bonded.

[0021] Alternatively, the internal part 14 could be dispensed with and the external plastic part 15 be bonded directly onto the waveguide 10. The presence of the in-

ternal part 14 facilitates fixing of the external plastic part 15 to the waveguide 10.

[0022] The external plastic part 15 is formed from a high density rigid polymer of polyamide type to which conductive powders are added during moulding, for example carbon or metal grains, in a percentage of 10-20% on the weight of the flange plastic part.

[0023] The final shape of the flange is given by the external plastic part 15, including therein all the standard IEC, EIA and other shapes, and proprietary shapes designed for special applications.

[0024] The addition of powders or grains of conductive material, to improve the microwave screening effect, gives this structure a level of microwave energy absorption such as to prevent undesirable spurious radiations, to hence enable the waveguide joint to conform to the electromagnetic compatibility specifications (ECM) required by international standards. In other words, the external plastic part 15 behaves as a short circuit for radiofrequency signals while with direct current behave as a high impedance.

[0025] The construction of these flanges comprises a first step in which the waveguide 10 is fixed to the internal part 14 by welding or brazing or bonding, and a second step in which the external plastic part 15 is co-moulded (by injection moulding), to generate the flange shape.

[0026] As an alternative to co-moulding, the flange can be formed with the external plastic part 15 superposed on the internal part 14 and maintained in position by suitable screws.

[0027] The outer surface of the external plastic part 15, which comes into contact with the outer surface of the flange 12, comprises a radial recess 17 positioned in proximity to that outer edge thereof more distant from waveguide 10. A seal gasket 18 of O-ring type is positioned into the radial recess 17 so that it slightly projects therefrom.

[0028] The flanges 12 and 13, in proximity to those outer edges thereof more distant from waveguide 10, and external to the annular recess 17, present holes 20 and 21 respectively, preferably four or six in number, to receive respective bolts 22 for clamping the flanges 12 and 13 together.

[0029] The holes 20 and 21 are formed such as to enable the apertures of the waveguides 10 and 11 to be aligned.

[0030] The joint between the waveguide 10 and the waveguide 11 is made by bringing the flanges 12 and 13 together such that the internal part 14 abuts against the facing conductive surface of the flange 12. The nuts of the bolts 22 are then tightened.

[0031] The clamping takes place such that the seal gasket 17 is regularly squeezed by the joint's internal flanges 12 and 13 to ensure a tight seal.

[0032] According to the present invention the flange 12, for example of aluminium, and the internal part 14, for example of brass, are in tight mutual contact but within a sealed region by virtue of the gasket 17, hence as there is no electrolyte the galvanic triangle does not close and corrosion cannot take place. Outside the internal part 14, the plastic part 15 interrupts the galvanic circuit and the corrosion process cannot be activated.

[0033] The present solution can be applied to any flange for microwaves having frequencies for example between 4 GHz and 40 GHz.

[0034] Another waveguide interconnection system according to the present invention is of the quick connect type, comprising a first waveguide section 10 to be joined to a second waveguide section 11.

[0035] A flange 30 is applied to the final part of the first section 10 and a flange 31 is applied to the initial part of the second section 11.

[0036] The flange 30 comprises an external plastic part 32 formed of plastic material filled with powder or grains of conductive material, it being of substantially cylindrical shape (but any other shape such as conical, elliptical or pyramidal could be used), and having at its base (towards the waveguide 10) a step on the cylindrical part to form the plastic structure 33, which is of L cross-section to fix the flange 30 to the appliance 37 (partly shown). The step structure 33 is preferably of square shape, but could also be circular, with four or more holes 34 for fixing screws.

[0037] The outer surface of the plastic part 32 comprises an annular slot positioned in proximity to that outer edge more distant from the waveguide 10. This slot houses a seal gasket 35 of O-ring type, projecting slightly from it.

[0038] The external plastic part 32 and the plastic structure 33 form a cavity 36 in which stiffening ribs (not shown) can be inserted.

[0039] Coaxially with and internal to the external plastic part 32 there is a radial internal part 40, preferably of the same material as the waveguide (for example brass), comprising on its outside, in its lateral surface, a recess 41 for increasing the mechanical holding between the internal part 40 and the external plastic part 32.

[0040] Preferably, the internal part 40 projects by about 5‰ of the maximum flange dimension from the outer surface of the external plastic part 32.

[0041] The shape of the internal part 40 is preferably circular, but other shapes are possible, depending on the shape of the waveguide 10.

[0042] Preferably, the waveguide 10 penetrates completely into the internal part 40, and is welded to ensure greater security of fixing, however it could also be merely brought into contact therewith and welded.

[0043] The external plastic part 32 is formed from a high density rigid polymer of polyamide type to which carbon powder is added in a percentage of 10-20% on its total weight.

[0044] The flange 30 is fixed to the structure of an appliance 37 (shown partly) constructed of any material, by screws positioned through the four or more holes 34. In that region of the appliance 37 facing the structure 33 a seal gasket 38 of O-ring type is positioned projecting slightly therefrom, to maintain the appliance tightness.

[0045] The shape of the flange 30 is such as to be precisely housed within the self-centring seat of the flange 31. This latter comprises a circular inner structure 42, normally of aluminium, coaxial to the waveguide 11, which is bounded by a circular projecting rim 43.

[0046] The radius of the structure 42 bounded by the rim 43 is substantially equal to the radius of the external part 32 of the flange 30, with tolerances such as to achieve virtually perfect alignment on the waveguides.

[0047] In an alternative embodiment, a waveguide interconnection system of the present invention comprises a first waveguide section 10 to be joined to a second waveguide section 11, the two sections having galvanically incompatible materials.

[0048] Flanges 50 and 51 of traditional type are applied to the sections 10 and 11.

[0049] According to the present invention, an insert 52 is provided for positioning between the flanges 50 and 51, which are galvanically incompatible.

[0050] The insert 52 is formed from two flanges constructed as previously described and joined together to form an insert. It comprises an external plastic body formed from a high density rigid polymer of polyamide type to which carbon powder or grains are added in a percentage of 10-20% on its total weight.

[0051] Centrally in a position corresponding to the guides 10 and 11 a waveguide section 53 is positioned, on which one or more profile irregularities 54 and 55 are provided to increase the mechanical holding of the co-moulded block. The outer surfaces (towards the flanges 50 and 51) of the body 52 each comprise an annular slot positioned in proximity to that outer edge more distant from the waveguide 10. This slot houses a seal gasket 56 of O-ring type, projecting slightly from it. This seals the joint and prevents water from reaching the galvanically incompatible metals, hence opening the galvanic triangle, to prevent corrosion.

[0052] The flanges 50 and 51, in proximity to their more external edge, present holes 57, preferably four or six in number, to receive respective bolts 58 for clamping the flanges 50 and 51 together.

[0053] To prevent an electrical direct current closure bridge formed by the fixing screws within the body 52, mutually insulated threaded metal bushes are provided in proximity to the more external edge external to the gaskets 56, into which the bolts 58 are screwed.

[0054] By virtue of the present invention, the body of plastic filled with conductive powder interrupts the galvanic circuit responsible for corrosion, hence preventing electrolyte from forming the galvanic pair. Filing the material with conductive powder within the stated range means that this material is virtually insulating towards direct current components, while acting as a good absorber for microwave components, hence enabling the waveguide joint to operate correctly.

[0055] The dimensions of the flanges and the plastic bodies filled with conductive material can be chosen at will according to requirements and to the state of the art.

Claims

1. A flange for waveguide interconnection fixed to a waveguide (10), **characterised by** being composed of two parts, namely a radially shaped more internal part (14) of conductive material which surrounds said waveguide, and a radially shaped more external part (15) of rigid plastic material filled with conductive powders.

2. A flange as claimed in claim 1, **characterised in that** said more external part (15) comprises frontally an annular recess (17) provided for the insertion of a seal gasket (18).

3. A flange as claimed in claim 1, **characterised in that** said conductive powder comprises carbon powder or metal granules in a percentage between 10% and 20%.

4. A flange as claimed in claim 1, **characterised in that** said more internal part (14) of said flange is formed of metal.

5. A flange as claimed in claim 1, **characterised in that** the end of said waveguide (10) is connected to said more internal part (14) of said flange.

6. A flange as claimed in claim 5, **characterised in that** said more internal part (14) of said flange projects beyond said plastic body.

7. A flange as claimed in claim 2, **characterised in that** said flange (13) comprises means (20, 22) for its fixing to another flange (12) and positioned external to the seat of the seal gasket (18).

8. A method for reducing the corrosion of flanges used in microwave interconnections between a first waveguide (10) comprising at an end thereof a first flange (14, 15), and a second waveguide (11) comprising at an end thereof a second flange (12), **characterised in that** said first flange (14, 15) is formed in accordance with claim 1.

Amended claims in accordance with Rule 137(2) EPC.

1. A flange (13) for waveguide interconnection fixed to a waveguide (10), being composed of two parts, namely a radially shaped more internal part (14) of conductive material which surrounds said waveguide, and a radially shaped more external part (15) of rigid plastic material filled with conductive powders; **characterized in that** said internal part (14) and said external part (15) are coaxial to said waveguide; and said external part (15) surrounds

said internal part (14).

2. A flange as claimed in claim 1, **characterised in that** said more external part (15) comprises frontally an annular recess (17) provided for the insertion of a seal gasket (18).

3. A flange as claimed in claim 1, **characterised in that** said conductive powder comprises carbon powder or metal granules in a percentage between 10% and 20%, on the weight of said rigid plastic part (15).

4. A flange as claimed in claim 1, **characterised in that** said more internal part (14) of said flange is formed of metal.

5. A flange as claimed in claim 1, **characterised in that** the end of said waveguide (10) is connected to said more internal part (14) of said flange.

6. A flange as claimed in claim 5, **characterised in that** said more internal part (14) of said flange projects beyond from the outer surface of said more external part (15).

7. A flange as claimed in claim 2, **characterised in that** said flange (13) comprises means (20, 22) for its fixing to another flange (12) positioned on said external part (15) far from said internal part (14) and external to the annular recess (17).

8. A method for reducing the corrosion of flanges used in microwave interconnections between a first waveguide (10) comprising at an end thereof a first flange (14, 15), and a second waveguide (11) comprising at an end thereof a second flange (12), **characterised in that** said first flange (14, 15) is formed in accordance with claim 1.

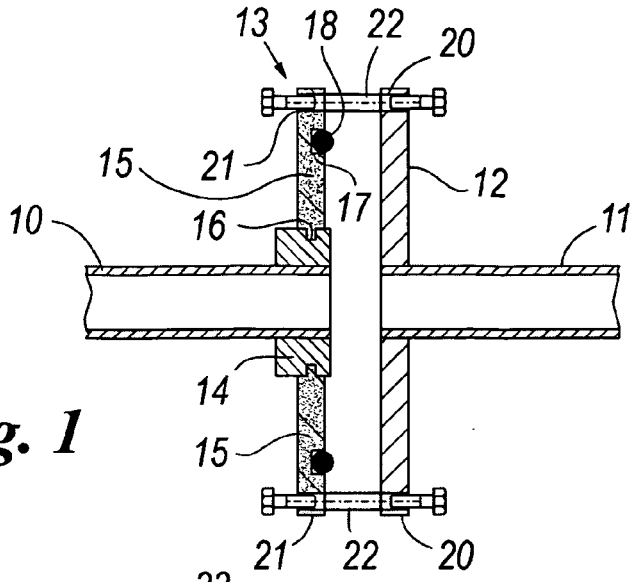

Fig. 1

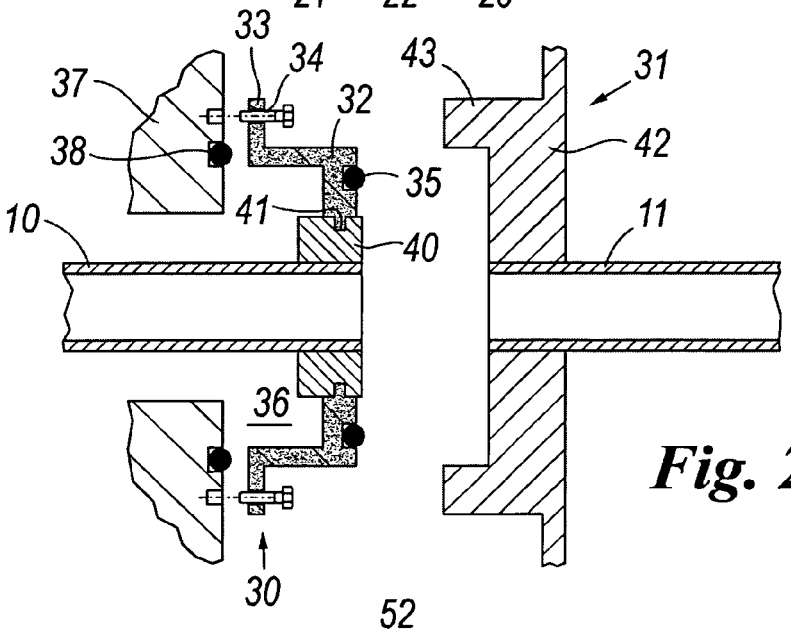

Fig. 2

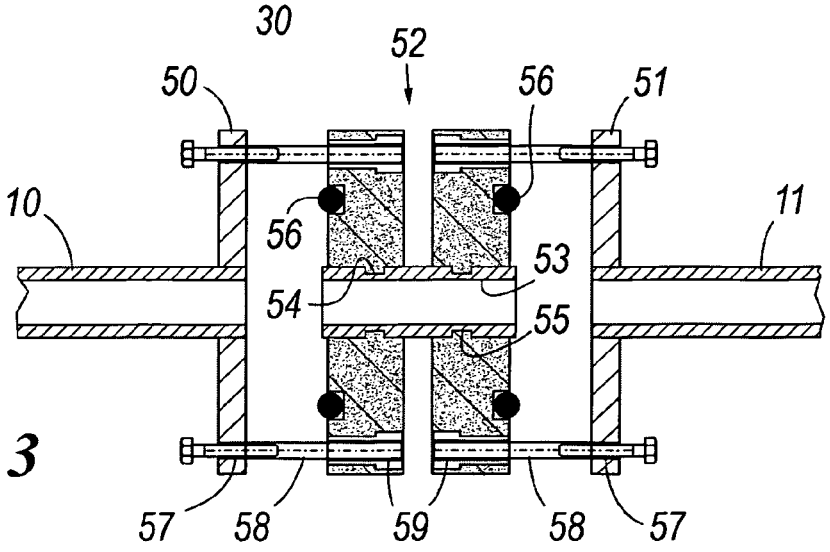

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 10 00 9779

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 December 2010	Kaleve, Abraham

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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