

(19)



(11)

EP 2 600 465 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
28.01.2015 Bulletin 2015/05

(51) Int Cl.:
H01P 1/161 ^(2006.01)

(21) Application number: **12194728.7**

(22) Date of filing: **29.11.2012**

(54) **Orthomode transducer**

Polarisationsweiche

Transducteur orthomode

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(30) Priority: **30.11.2011 IT MI20112186**

(43) Date of publication of application:
05.06.2013 Bulletin 2013/23

(73) Proprietor: **SIAE Microelettronica S.p.A.
20093 Cologno Monzese (MI) (IT)**

(72) Inventor: **Paganuzzi, Gianluigi Maria
20093 Cologno Monzese (MI) (IT)**

(74) Representative: **Raimondi, Margherita
Dott. Ing. Prof. Alfredo Raimondi S.r.l.,
Piazzale Cadorna, 15
20123 Milano (IT)**

(56) References cited:
**EP-A2- 0 661 771 WO-A1-2008/012369
DE-A1- 19 643 896**

EP 2 600 465 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention relates to an orthomode transducer with input/output ports and input/output single-mode signals which are parallel.

[0002] It is known in the technical sector of telecommunications, in particular in that of radio relays, that there exists the need to transmit an increasingly greater amount of information/data. The constraints imposed by the physical characteristics of the transmission medium (air) and the costs of the apparatus, which must be kept low, have resulted in the development of various techniques for optimizing transmission which are able to double the amount of information transmitted via a radio relay on the same channel; one of these techniques consists in transmitting simultaneously on the same channel two signals with mutually orthogonal polarities.

[0003] This technique is implemented by means of devices with three ports commonly known as waveguide polarization transducers or orthomode transducers which are able to combine on a single channel two single-mode microwave signals SV, SH with mutually orthogonal (Vertical/Horizontal) polarization for simultaneous transmission thereof and, vice versa, separate during reception two signals of the same channel owing to the orthogonality of their polarization (V,H).

[0004] In these devices, the two input/output ports for the single separate signals are connected to two single-mode waveguides, and the third common port is connected to a third dual-mode waveguide on which the combined signals are simultaneously transmitted/received.

[0005] During transmission the two single-mode polarized signals enter the transducer through the respective single-mode port connected to a respective single-mode waveguide and both exit from the common port after being combined with mutual orthogonal polarities while passing through the transducer. During reception, on the other hand, it is possible to separate the two original single-mode signals, receiving on the common port the combined signal which, while passing through the transducer in the opposite direction, is separated into the two single-mode signals, each of these signals being conveyed towards one of the two ports connected to the two single-mode guides.

[0006] Figure 1 shows an example of a polarization transducer according to the prior art in which the ports P2, P3 are connected, by means of respective flanges F2, F3, to two single-mode waveguides with a rectangular section which are in turn connected to a central body Q which emerges in a common port PC from where the two signals SV and SH exit simultaneously with mutually orthogonal polarization.

[0007] According to this prior art the transducer is designed with the two single-mode ports P2, P3 arranged in planes which are mutually orthogonal.

[0008] In order to improve the compactness of the known transducers US 2007/0210882A1 also proposed a solution (Fig. 2) in which the two single-mode ports P2,

P3 are arranged in planes parallel to each other and orthogonal with respect to the plane of the common port PC. Although performing its function, this transducer however requires that the two single-mode signals (SV, SH) enter into the transducer with the polarizations already spatially orthogonal relative to each other and therefore the two ports P2, P3 and the two respective single-mode waveguides must have their respective rectangular sections oriented orthogonally with respect to each other (Fig. 2); this requirement, namely that the two single-mode signals should have a polarization already mutually orthogonal at the transducer input, makes it more difficult to integrate the known transducers inside waveguide apparatus designed to be connected also to other devices which require at their input single-mode signals with parallel rather than orthogonal polarization. Also known from EP 0,661,771 is a filter provided inside an orthomode transducer which has input ports of the two single-mode signals arranged in planes parallel to each other and also to the plane of a port orthogonal to the direction of propagation of the dual-mode signals.

[0009] As in the previous cases, in the case of this filter also, the particular configuration of the input ports of the single-mode signals does not allow easy incorporation in place of those devices such as directional couplers and circulators which have their branched ports generally oriented in the same manner, i.e. with rectangular sections of the single-mode guides having corresponding sides which are parallel and not orthogonal, consequently, in order to be able to use the transducers according to the prior art, in combination with or instead of one of the said devices, it is necessary to introduce single-mode waveguides between the transducer and the device/apparatus, which are able, among other things, to impart a 90° rotation to one of the two signals; although performing their function, these solutions however result in an increase in the constructional difficulties, the overall dimensions and therefore the cost of production of the apparatus.

[0010] The technical problem which is posed, therefore, is to provide an orthogonal transducer for microwave signals which, during transmission, is able to combine orthogonally single-mode signals when the polarization of the two input signals has the same spatial orientation and, vice versa, separate from a combined dual-mode signal with orthogonal polarization two single-mode output signals oriented with a mutually parallel polarization, said transducer must be able to reduce the overall dimensions, in particular in the transverse direction with respect to the direction of propagation of the dual-mode signals through the associated dual-mode output/input port of the apparatus, being also able to ensure that the connection with the said transmission/reception devices is as simple and direct as possible.

[0011] In connection with this problem it is also required that the transducer should be inexpensive to produce, simple to assemble and easily installed on radio relay antennas using normal standard means. These re-

sults are achieved according to the present invention by an orthomode transducer having the characteristic features of Claim 1.

[0012] Further details may be obtained from the following description of a non-limiting example of embodiment of the subject of the present invention provided with reference to the accompanying drawings in which:

Figs. 1,2: show perspective views of transducers according to the prior art;

Figure 3: shows a perspective view of an orthomode transducer according to the present invention;

Figure 4: shows a perspective schematic view of the waveguides inside the transducer according to the present invention;

Figure 5: shows a first, partial, functional diagram of the paths of the waveguides according to Fig. 4 and

Figure 6: shows a second, partial, functional diagram of the paths of the waveguides according to Fig. 4.

[0013] As shown in Fig. 3 and assuming solely for the sake of convenience of description and without any limitation of meaning a pair of reference axes with, respectively, a transverse direction X-X of movement of the single-mode input/output signals SV,SH, indicated in the figures by means of a dashed line and broken line, respectively, and a longitudinal direction Y-Y, orthogonal to the preceding direction, for propagation of dual-mode output/input signals with orthogonal polarization SV,SH1, an orthomode transducer according to the present invention comprises:

- a first port 10 for input/output in a direction of transverse movement X-X of a first single-mode signal SV with assigned polarization; according to a preferred embodiment said first port 10 has a rectangular section with a larger base 10a extending parallel to the longitudinal direction Y-Y and is connected (Fig. 4) to a first single-mode input/output waveguide 11 extending inside the transducer in the transverse direction X-X;
- a second port 20 for input/output in the transverse direction X-X of a second single-mode signal SH with assigned polarization; according to a preferred embodiment said second port 20 has a rectangular section with a larger base 20a extending parallel to the longitudinal direction Y-Y and is connected (Fig. 4) to a second single-mode input/output waveguide 21 extending inside the transducer in the transverse direction X-X, preferably coaxial with the first input/output waveguide 11;
- a dual-mode signal output/input port 30, the transverse section of which lies in a plane orthogonal to the longitudinal direction Y-Y of propagation of the dual-mode output/input wave Sv, SH1).

[0014] According to the invention it is envisaged that the two single-mode input/output ports 10 and 20 lie in

planes parallel to each other and simultaneously their sections in planes orthogonal to the direction X-X of movement of the signals, which in the example are rectangular, have respective larger bases 10a,20a parallel to each other and, consequently, the directions of polarization of the two input/output signals SV,SH are also parallel to each other; in addition to this, said transverse sections of the single-mode input/output ports 10,20 lie in planes orthogonal to the plane in which the transverse section of the dual-mode output/input port 30 of the transducer lies. According to a preferred embodiment, as shown, the two single-mode signal ports 10,20 are situated opposite to each other relative to the longitudinal direction Y-Y of propagation of the dual-mode wave output/input from/into the port 30 itself; although not shown, it is envisaged, however, that these ports 10,20 may be arranged on the same side relative to the longitudinal direction Y-Y. Although described with larger bases 10a,20a parallel to each other and to the longitudinal axis Y-Y it is envisaged that the bases 10a,20a themselves may be rotated through 90° so as to be arranged parallel to each other and to a third vertical direction Z-Z orthogonal to the longitudinal direction Y-Y and to the transverse direction X-X.

[0015] The dual-mode signal output/input port 30 is preferably connected to a dual-mode output/input waveguide 31 which is generally rectangular and has dimensions such as to allow inside it the simultaneous propagation of two signals SV and SH1, respectively, with orthogonal polarization which are indicated in the figures by means of a mixed dot-dash line.

[0016] In the embodiment of the example shown the dual-mode signal waveguide 31 has a square section. It is also envisaged that, if required by the different section of the upstream/downstream devices to which the transducer is to be coupled, the waveguide 31 itself may be associated with a square/circular adaptor waveguide 32 coupled to an associated output port 32a with a circular section. Moreover, with the transducer according to the invention reciprocal operation is possible, namely it is able to combine two single-mode signals SV,SH supplied from the single-mode ports 10,20 and send them simultaneously to the common port 30 with orthogonal polarization and, vice versa, to receive simultaneously at the input of the common port 30 a dual-mode signal formed by two single-mode signals SV, SH1 with mutually orthogonal polarization and separate them, sending two corresponding single-mode signals SV,SH with parallel polarization to the respective single-mode ports 10,20. Conveniently, the transducer according to the invention has at least one flange 12,22 (a pair of flanges in the example shown) which are respectively associated with the ports 10,20 so as to allow mechanical coupling of the transducer to the upstream/downstream devices from/to which the single-mode signals SV,SH are received/sent.

[0017] As shown, the two flanges 12,22 are parallel to each other and each of them has a respective opening 12a,22a with a cross-section corresponding to that of the

associated port 10,20 so that, once assembly has been performed, the openings are coaxial so as to allow the free passage of the signals.

[0018] In a preferred embodiment shown in the accompanying figures it is envisaged that the single-mode signal input/output ports 10, 20, as well as the respective flanges 12,22 associated with them, are arranged symmetrically with respect to the plane parallel to them and containing: the longitudinal direction Y-Y of propagation of the dual-mode input/output signal and the vertical direction Z-Z orthogonal to the longitudinal direction Y-Y and transverse direction X-X.

[0019] According to the invention, waveguide portions are arranged between the single-mode input/output ports 10, 20 and the common dual-mode output/input port 30, said waveguide portions being able to interact with the passing signals so as to produce the desired combination/separation effect.

[0020] In detail and as shown in Figs. 4, 5 and 6 the following are provided:

- a first single-mode portion 40 with a rectangular section in turn consisting of several waveguide portions 40a,40b with a rectangular section and different impedance and length, which is connected at one end to the first waveguide 11 for input of the first signal SV and which is able to allow the signal to pass through without modifying its polarization;
- a second single-mode portion 50 with a rectangular section in turn consisting of several waveguide portions 50a,50b,50c with a rectangular section and different impedance, length and orientation, which is connected at one end to the second waveguide 21 for input of the second signal SH and is able to allow the signal to pass through without modifying its polarization in the direction of SH1 so as to render it orthogonal to the polarization of the first signal SV;
- a combination portion 60 which is connected to the other ends 40 and 50 of the input/out waveguides for the two signals SV, SH1 which are already orthogonal to each other and inside which the combination/separation of thereof occurs; the transducer 60 is moreover preferably connected to the dual-mode waveguide 31, with a rectangular section (square in the example shown) for input/output of the dual-mode signal SV,SH1.

[0021] As shown in the cross-sectional views of Figs. 5 and 6 the dimensions of the waveguide portions are such as to ensure the propagation of the two orthogonal signals and simultaneously prevent the propagation of higher modes which would result in the guide becoming multimodal with dispersion and generation of interference.

[0022] These cross-sections show how the waveguide portion 40 has a simpler geometry since it must keep the polarization of the signal SV unchanged, while the waveguide portion 50 has a more complex shape, it being

necessary to modify the orientation of the polarity of the second signal SH, which is initially parallel to the first signal SV, so as to cause it to enter into the portion 60 for relative combination with an orientation orthogonal to the signal SV itself.

[0023] The dual-mode waveguide portion 31, in the square embodiment, owing to its intrinsic high orthogonal mode separation characteristic, may be lengthened as required without limiting the electrical performance and/or the useful bandwidth of the device, so as to allow adjustment of the length of the transducer depending on the system requirements, for example so as to adapt it to the dimensions of another device with which mechanical compatibility is required.

[0024] Owing to the way in which the waveguide portions 40 and 50 are made, the device may be kept very compact, although this involves a certain reduction in the useful operating bandwidth, which reduction in the bandwidth, however, does not prevent particularly efficient devices with practically zero loss from being obtained; for example, in the case of radio relays with a frequency greater than 7 GHz it is possible to have a relative useful bandwidth which is 10% greater; this means that entire frequency spectrum stipulated by the ITU international standards for each point-to-point radio relay band may be covered, with a distance between the parallel planes in which the ports 10 and 20 are located not greater than 1.25λ (λ = wavelength at the central frequency in the free space).

[0025] It is therefore clear that with an orthogonal microwave transducer device according to the invention, able to perform the orthogonal combination/separation of single-mode signals, it is possible to receive/emit at the input/output single-mode signals SV,SH with parallel polarization, this characteristic feature making the transducer mechanically compatible with other waveguide devices, such as directional couplers and circulators, where the branched ports are generally oriented with the same polarity, while being at the same time extremely compact.

[0026] With the architecture proposed it is thus possible to provide pin-to-pin transducer devices which are compatible with other microwave devices, namely those having the same external dimensions and mechanical interfaces which coincide, without the need for additional mechanical adaptor parts. As a result implementation is simplified, management of the spare part warehouses is made easier and therefore the costs may be kept low.

[0027] It therefore becomes possible to incorporate in the same apparatus either one of these devices (transducer, circulator, directional coupler) depending on the specific requirements.

[0028] An example of an application where this characteristic feature of the invention may be particularly advantageous is that of radio relays with a 1+1 configuration, in which two transceivers are connected to the antenna by means of a device which, depending on the desired system configuration, may be a directional coupler, a circulator or an orthogonal transducer.

[0029] Although described in connection with certain constructional forms and certain preferred examples of embodiment of the invention, it is understood that the scope of protection of the present patent is defined solely by the following claims.

Claims

1. Orthomode transducer comprising a first port (10) and a second port (20) for input/output of single-mode signals (SV,SH) and a port (30) for output/input of dual-mode signals (SV,SH1) with orthogonal relative polarization, said first single-mode port (10) and second single-mode port (20) lying in planes parallel to each other, **characterized in that** said single-mode ports (10,20) have their respective transverse section, orthogonal to the direction of movement (X-X) of the single-mode input/output signals (SV,SH), parallel to each other and perpendicular to the plane in which the port (30) orthogonal to the direction of propagation (Y-Y) of the dual-mode output/input signals (SV,SH1) lies. 10
2. Orthomode transducer according to Claim 1, **characterized in that** said first and second ports (10,20) for input/output of single-mode signals (SV,SH) are situated opposite each other relative to the longitudinal direction (Y-Y) of propagation through the port (30) for output/input of the dual-mode signals (SV,SH1). 15
3. Orthomode transducer according to Claim 2, **characterized in that** said first and second ports (10,20) for input/output of single-mode signals (SV,SH) are arranged symmetrically relative to the plane parallel thereto and containing the longitudinal direction (Y-Y) of propagation of the dual-mode signal (SV,SH1) through the output/input port (30). 20
4. Orthomode transducer according to Claim 1, **characterized in that** the larger bases (10a,20a) of the respective first (10) and second (20) single-mode input/output ports are parallel to the longitudinal direction of movement (Y-Y) of the dual-mode output/input signals (SV,SH1). 25
5. Orthomode transducer according to Claim 1, **characterized in that** the larger bases (10a,20a) of the respective first (10) and second (20) single-mode input/output ports are orthogonal to a direction orthogonal to the longitudinal direction of movement (Y-Y) of the dual-mode output/input signals (SV,SH1). 30
6. Orthomode transducer according to Claim 1, **characterized in that** the single-mode input/output signals (SV,SH) are parallel to each other. 35

7. Orthomode transducer according to Claim 1, **characterized in that** it comprises a transducer formed by a waveguide portion (60) for combining/separating the two single-mode signals (SV,SH; SV,SH1) already orthogonal to each other. 40
8. Orthomode transducer according to Claim 7, **characterized in that** it comprises a first single-mode waveguide portion (40) with a rectangular section, in turn consisting of several coaxial waveguide portions (40a,40b) with a rectangular section and different impedance and length, one end of which is connected to the first waveguide (11) for input of the first signal (SV) and the other end of which is connected to the transducer (60). 45
9. Orthomode transducer according to Claim 1, **characterized in that** it comprises a second single-mode waveguide portion (50) with a rectangular section, in turn consisting of several waveguide portions (50a,50b,50c) with a rectangular section and different impedance, length and orientation, one end of which is connected to the second waveguide (21) for input of the second single-mode signal (SH) and the other end of which is connected to the transducer (60). 50
10. Orthomode transducer according to Claim 1, **characterized in that** it comprises a dual-mode waveguide portion (31) with a square section for input/output of the dual-mode signal (SV,SH1), connected to the transducer (60). 55
11. Orthomode transducer according to Claim 1, **characterized in that** it comprises a square/circular adaptor waveguide (32) coupled to an associated adaptor (32) with a rectangular/circular section with circular output port (32a) and connected to the port (30) for output/input of the dual-mode signals.
12. Orthomode transducer according to Claim 1, **characterized in that** it covers the entire frequency spectrum stipulated by the international ITU standards for each band of point-to-point radio relays.

Patentansprüche

1. Orthomode-Transducer, umfassend: ein erstes Tor (10) und ein zweites Tor (20) für die Eingabe/Ausgabe von Monomode-Signalen (SV, SH) und ein Tor (30) zur Ausgabe/Eingabe von Dualmode-Signalen (SV, SH1) mit zueinander orthogonaler Polarisierung, wobei das erste Monomode-Tor (10) und das zweite Monomode-Tor (20) in zueinander parallelen Ebenen liegen, **dadurch gekennzeichnet, dass** die Monomode-Tore (10, 20) ihren jeweiligen Querschnitt orthogonal zur Bewegungsrichtung (X-X) der Mono-

mode-Eingangs-/Ausgangssignale (SV, SH) haben, parallel zueinander und rechtwinklig zu der Ebene, in welcher das Tor (30) orthogonal zur Ausbreitungsrichtung (Y-Y) der Dualmode-Ausgangs-/Eingangssignale (SV, SH1) liegt.

2. Orthomode-Transducer nach Anspruch 1, **dadurch gekennzeichnet, dass** das erste und das zweite Tor (10, 20) für die Eingabe/Ausgabe von Monomode-Signalen (SV, SH) in Bezug auf die Längsrichtung (Y-Y) der Fortpflanzung durch das Tor (30) für die Ausgabe/Eingabe der Dualmode-Signale (SV, SH1) einander entgegengesetzt gelegen sind.
3. Orthomode-Transducer nach Anspruch 2, **dadurch gekennzeichnet, dass** das erste und das zweite Tor (10, 20) für die Eingabe/Ausgabe von Monomode-Signalen (SV, SH) symmetrisch in Bezug auf die dazu parallele Ebene angeordnet sind und die Längsrichtung (Y-Y) der Ausbreitung des Dualmode-Signals (SV, SH1) durch das Ausgangs-/Eingangstor enthalten.
4. Orthomode-Transducer nach Anspruch 1, **dadurch gekennzeichnet, dass** die größere Basis (10a, 20a) der jeweiligen ersten (10) und zweiten (20) Monomode-Eingangs-/Ausgangstore parallel zu der Längsrichtung der Bewegung (Y-Y) der Dualmode-Ausgangs-/Eingangssignale (SV, SH1) sind.
5. Orthomode-Transducer nach Anspruch 1, **dadurch gekennzeichnet, dass** die größeren Basen (10a, 20a) der jeweiligen ersten (10) und zweiten (20) Monomode-Eingangs-/Ausgangstore orthogonal zu einer Richtung verlaufen, welche orthogonal zu der Längsrichtung der Bewegung (Y-Y) der Dualmode-Ausgangs-/Eingangssignale (SV, SH1) ist.
6. Orthomode-Transducer nach Anspruch 1, **dadurch gekennzeichnet, dass** die Monomode-Eingangs-/Ausgangssignale (SV, SH) parallel zueinander sind.
7. Orthomode-Transducer nach Anspruch 1, **dadurch gekennzeichnet, dass** er einen durch einen Wellenleiterabschnitt (60) zum Kombinieren/Separieren der beiden Monomode-Signale (SV, SH; SV, SH1), die bereits orthogonal zueinander sind, gebildeten Wandler enthält.
8. Orthomode-Transducer nach Anspruch 7, **dadurch gekennzeichnet, dass** er einen ersten Monomode-Wellenleiterabschnitt (40) mit rechteckigem Querschnitt aufweist, welcher seinerseits aus mehreren Koaxial-Wellenleiterabschnitten (40a, 40b) mit rechteckigem Querschnitt und unterschiedlicher Impedanz und Länge besteht, von denen ein Ende mit dem ersten Wellenleiter (11) verbunden ist zur Ein-

gabe des ersten Signals (SV) und das andere Ende mit dem Wandler (60) verbunden ist.

9. Orthomode-Transducer nach Anspruch 1, **dadurch gekennzeichnet, dass** er einen zweiten Monomode-Wellenleiterabschnitt (50) mit rechteckigem Querschnitt aufweist, welcher seinerseits aus mehreren Wellenleiterabschnitten (50a, 50b, 50c) mit rechteckigem Querschnitt und unterschiedlicher Impedanz, Länge und Orientierung besteht, von denen ein Ende mit dem zweiten Wellenleiter (21) zur Eingabe des zweiten Monomode-Signals (SH) verbunden ist und das andere Ende mit dem Wandler (60) verbunden ist.
10. Orthomode-Transducer nach Anspruch 1, **dadurch gekennzeichnet, dass** er einen Dualmode-Wellenleiterabschnitt (31) mit quadratischem Querschnitt zur Eingabe/Ausgabe des Dualmode-Signals (SV, SH1) aufweist, angeschlossen an den Wandler (60).
11. Orthomode-Transducer nach Anspruch 1, **dadurch gekennzeichnet, dass** er einen quadratischen/zirkularen Adapterwellenleiter (32) aufweist, der an einen zugehörigen Adapter (32) mit rechteckigem/zirkularem Querschnitt mit zirkularem Ausgangstor (32a) gekoppelt und an das Tor (30) zur Ausgabe/Eingabe der Dualmode-Signale verbunden ist.
12. Orthomode-Transducer nach Anspruch 1, **dadurch gekennzeichnet, dass** er das gesamte Frequenzspektrum abdeckt, welches durch die internationalen ITU-Normen für jedes Band von Punkt-zu-Punkt-Richtfunkverbindungen festgelegt ist.

Revendications

1. Quadruplexeur comprenant un premier port (10) et un second port (20) d'entrée/sortie de signaux monomodes (SV, SH) et un port (30) de sortie/entrée de signaux bi-modes (SV, SH1) à polarisation relative orthogonale, ledit premier port monomode (10) et ledit second port monomode (20) se trouvant dans des plans parallèles l'un à l'autre, **caractérisé en ce que** les sections transversales respectives desdits ports monomodes (10, 20) sont orthogonales à la direction de propagation (X-X) des signaux d'entrée/sortie monomodes (SV, SH), parallèles l'une à l'autre et perpendiculaires au plan dans lequel se trouve le port (30) orthogonal à la direction de propagation (Y-Y) des signaux de sortie/entrée bi-modes (SV, SH1).
2. Quadruplexeur selon la revendication 1, **caractérisé en ce que** lesdits premier et second ports (10, 20) d'entrée/sortie de signaux monomodes (SV, SH) sont situés opposés l'un à l'autre par rapport à la

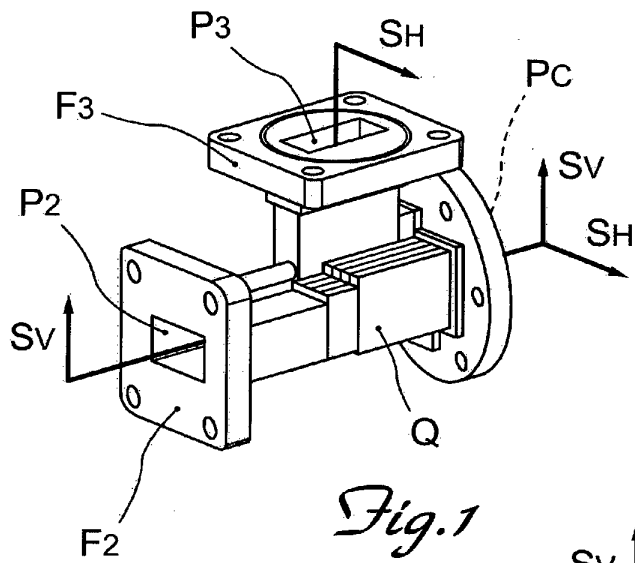
direction longitudinale (Y-Y) de propagation par le port (30) de sortie/entrée des signaux bi-modes (SV, SH1).

3. Quadruplexeur selon la revendication 2, **caractérisé en ce que** lesdits premier et second ports (10, 20) d'entrée/sortie de signaux monomodes (SV, SH) sont disposés symétriquement par rapport au plan qui leur est parallèle et contenant la direction longitudinale (Y-Y) de propagation du signal bi-mode (SV, SH1) par le port de sortie/entrée (30). 5
4. Quadruplexeur selon la revendication 1, **caractérisé en ce que** les bases plus grandes (10a, 20a) des premier (10) et second (20) ports d'entrée/sortie monomodes respectifs sont parallèles à la direction longitudinale de propagation (Y-Y) des signaux de sortie/entrée bi-modes (SV, SH1). 10
5. Quadruplexeur selon la revendication 1, **caractérisé en ce que** les bases plus grandes (10a, 20a) des premier (10) et second (20) ports d'entrée/sortie monomodes respectifs sont orthogonales à une direction orthogonale à la direction longitudinale de propagation (Y-Y) des signaux de sortie/entrée bi-modes (SV, SH1). 20
6. Quadruplexeur selon la revendication 1, **caractérisé en ce que** les signaux d'entrée/sortie monomodes (SV, SH) sont parallèles l'un à l'autre. 25
7. Quadruplexeur selon la revendication 1, **caractérisé en ce qu'il** comprend un transducteur formé par une partie guide d'onde (60) destinée à combiner/séparer les deux signaux monomodes (SV, SH ; SV, SH1) déjà orthogonaux l'un à l'autre. 30
8. Quadruplexeur selon la revendication 7, **caractérisé en ce qu'il** comprend une première partie (40) de guide d'onde monomode de section rectangulaire, constituée, à son tour, de plusieurs parties coaxiales (40a, 40b) de guide d'onde de section rectangulaire et d'impédance et de longueur différentes, dont une extrémité est connectée au premier guide d'onde (11) d'entrée du premier signal (SV) et dont l'autre extrémité est connectée au transducteur (60). 35
9. Quadruplexeur selon la revendication 1, **caractérisé en ce qu'il** comprend une seconde partie (50) de guide d'onde monomode de section rectangulaire, constituée, à son tour, de plusieurs parties (50a, 50b, 50c) de guide d'onde de section rectangulaire et d'impédance, de longueur et d'orientation différentes, dont une extrémité est connectée au second guide d'onde (21) d'entrée du second de signal monomode (SH) et dont l'autre extrémité est connectée au transducteur (60). 40

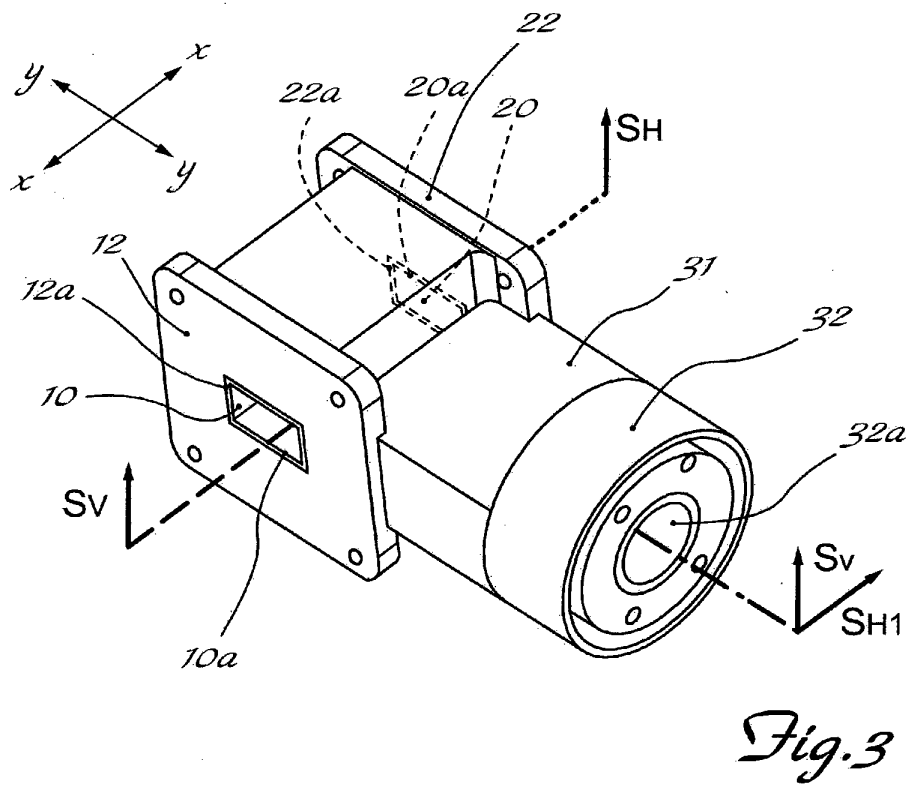
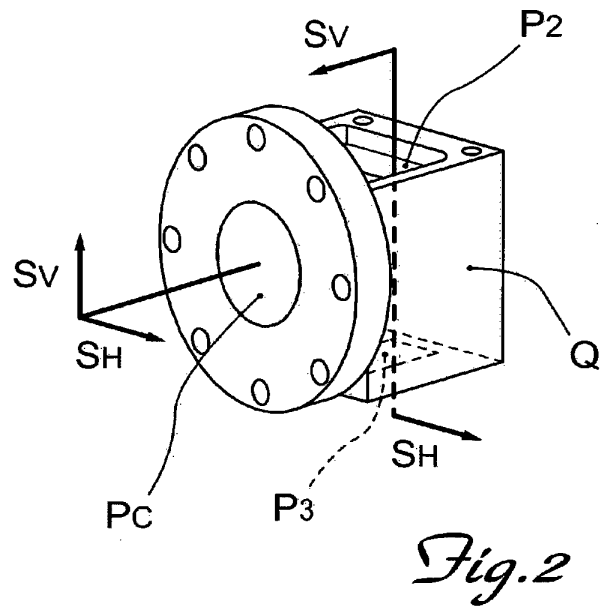
10. Quadruplexeur selon la revendication 1, **caractérisé en ce qu'il** comprend une partie (31) de guide d'onde bi-mode de section carrée d'entrée/sortie du signal bi-mode (SV, SH1) connectée au transducteur (60). 45

11. Quadruplexeur selon la revendication 1, **caractérisé en ce qu'il** comprend un guide d'onde à adaptateur carré/circulaire (32) couplé à un adaptateur associé (32) de section rectangulaire/circulaire à port de sortie circulaire (32a) et connecté au port (30) de sortie/entrée de signaux bi-modes. 50

12. Quadruplexeur selon la revendication 1, **caractérisé en ce qu'il** couvre tout le spectre de fréquence, stipulé par les normes ITU internationales, de chaque bande de relais radio point à point. 55



PRIOR ART



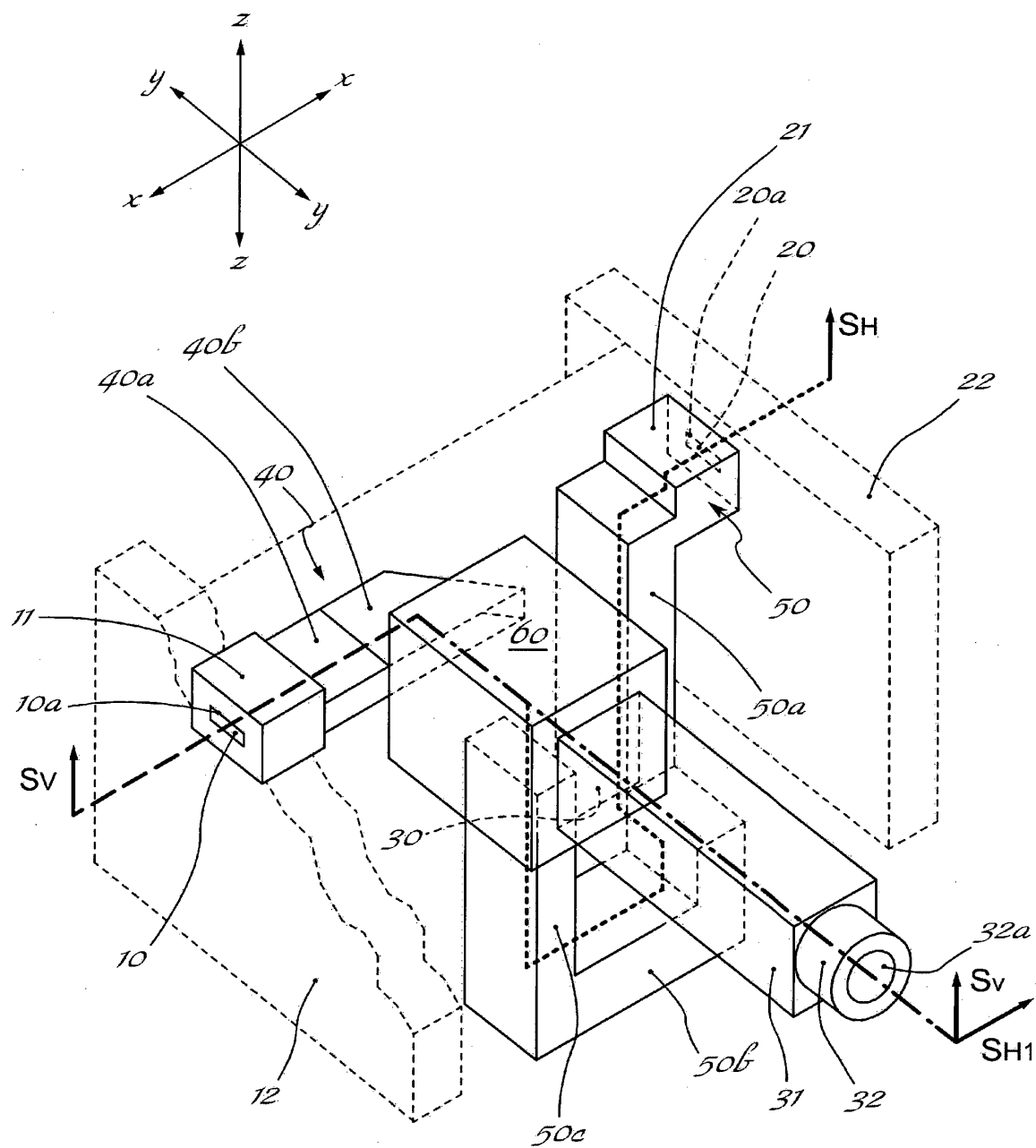
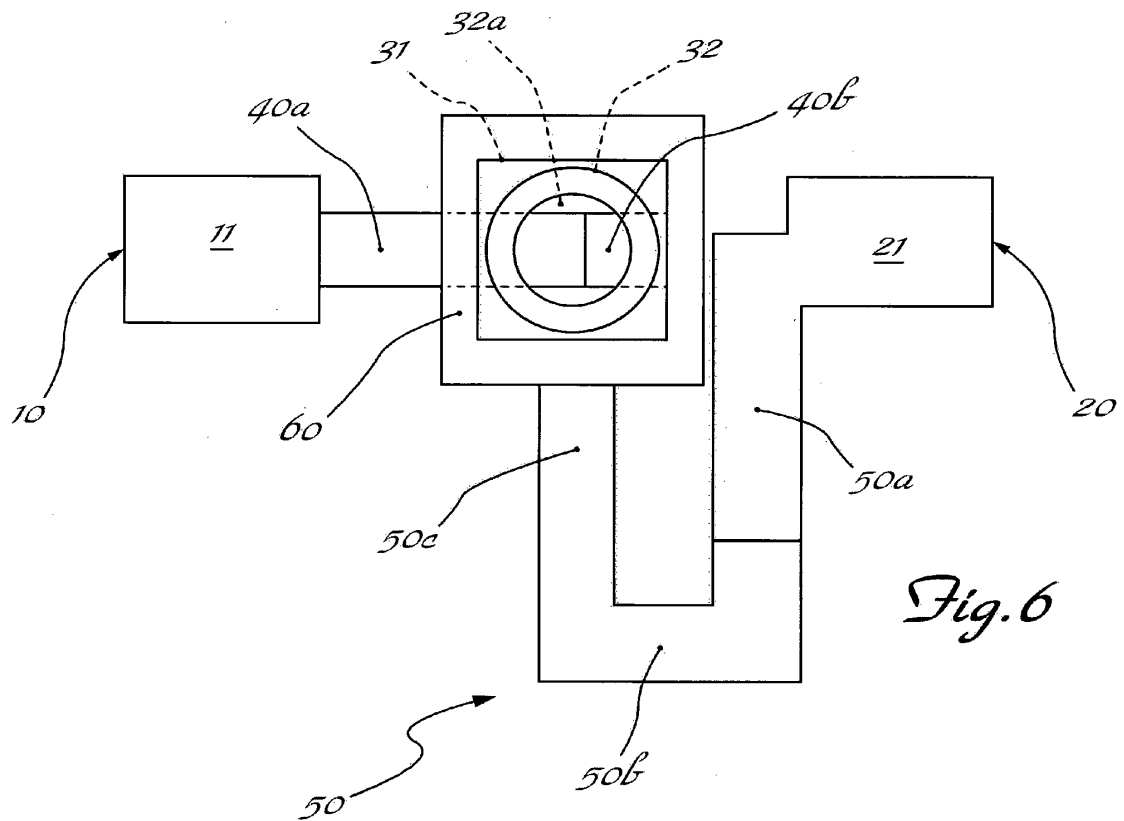
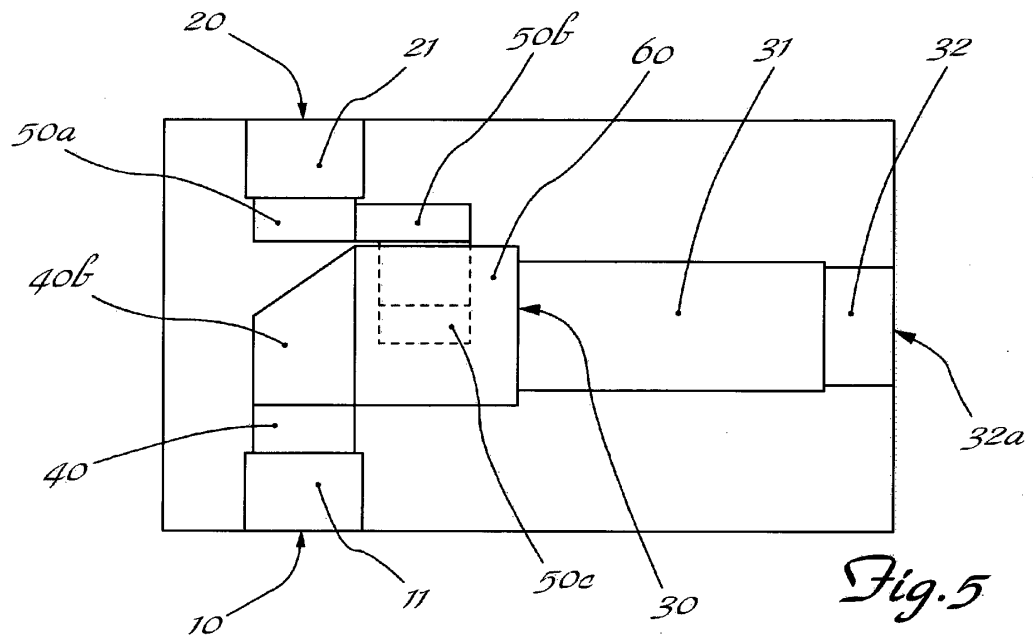


Fig.4



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20070210882 A1 [0008]
- EP 0661771 A [0008]