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(54) **Diplexer and method for manufacturing a diplexer**

(57) The invention relates to a diplexer for connecting a transmitter and a receiver with one aerial, comprising a first block half (4) with a waveguide duct half (6) and a second complementary block half (5) with a waveguide duct half (6), which block halves (4, 5) jointly form a waveguide duct. The diplexer comprises a filter with a filtering portion, which comprises electrical discharge machined poles and has a foil form, the filter (15) being arranged between the block halves (4, 5) with its filtering portion between the waveguide duct halves (6) of the block halves (4, 5).

Further the invention concerns a method for manu-

facturing a diplexer, comprising the steps of forming a first block half (4) and a second complementary block half (5) and forming a waveguide duct half (6) in each block half (4, 5). The method further comprises the step of forming a filter with a filtering portion by making the filtering portion of a foil and electrical discharge machining poles in the foil. The method also concerns the step of assembling the filter and the block halves (4, 5) so that a waveguide duct with a filtering function is obtained, and placing the filter with its filtering portion between the waveguide duct halves (6) of the block halves (4, 5).

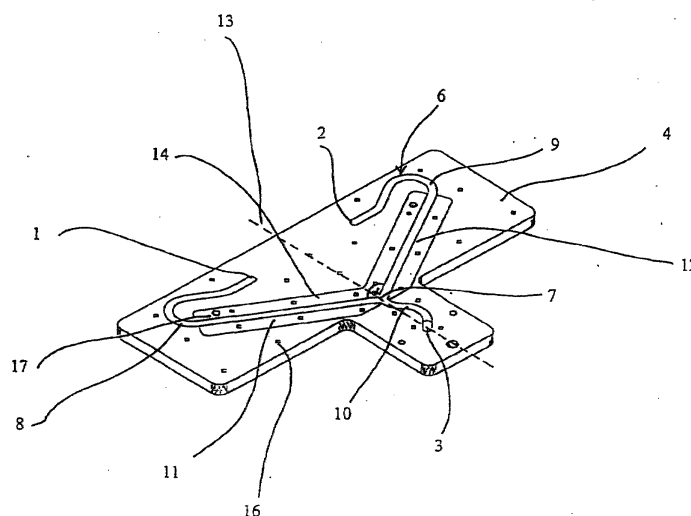


Fig. 2

Description

Field of the Invention

[0001] The present invention relates to a diplexer for connecting a transmitter and a receiver with one aerial, comprising a first block half with a waveguide duct half and a second complementary block half with a waveguide duct half, said block halves jointly forming a waveguide duct connecting a transmitter port, a receiver port and an aerial port. The invention also relates to a method for manufacturing a diplexer.

Background Art

[0002] Cordless transmission of signals which represent, for example, speech, data or image in digital or analog form often takes place via radio links. For instance, in mobile telephony, base stations are in many cases connected to each other via radio links, and for such cordless transmission of signals, a transmitter, a receiver and an aerial are required. A device is frequently used, which makes it possible to simultaneously transmit and receive signals with the same aerial, so-called full duplex.

[0003] A diplexer, which connects the transmitter and the receiver with the common aerial, is an example of such a device. Using a diplexer, it is possible to transmit signals within a certain transmitting frequency range and at the same time receive signals within another receiving frequency range. A special type of diplexer is used for transmission of signals with frequencies in the microwave range, i.e. between 10 GHz and 50 GHz.

[0004] A known diplexer for the microwave range comprises a transmitter filter and a receiver filter. The filters are formed in a common metal block which is composed of two block halves. In each block half, cavities are formed in a certain sequence, and between them material barriers are left. When the block halves are put together, a passage forms through the cavities and round the material barriers. The passage is adjusted so that only signals within given frequency ranges can pass. One portion of the passage serves as transmitter filter by only letting through signals within the transmitting frequency range and another portion of the passage serves as receiver filter by only letting through signals within the receiving frequency range. The common plane between the block halves is in this prior-art diplexer at right angles to the E plane of the waves. The diplexer also comprises a circulator which directs signals from the aerial essentially to the receiver as well as signals from the transmitter essentially to the aerial.

[0005] Diplexers are available for a plurality of different combinations of frequency ranges of the transmitter filter and the receiver filter, and there is a standard for which combinations are permissible. Diplexers of this type are made for frequencies in the microwave range between 10 GHz and 50 GHz since they would be too

large for lower frequencies and too small for higher frequencies. The microwave range is according to the standard divided into a plurality of so-called subbands and each subband is in turn divided into so-called indexes. The number of indexes varies between the different subbands but they can be as many as about 50. The transmitter filter and the receiver filter let through frequencies within a frequency range, or a frequency band, which corresponds to an index. Within a subband there is thus a diplexer in several different embodiments, so-called variants, each variant being a combination of an index of the transmitter filter and an index of the receiver filter.

[0006] A diplexer of the above type is usually also provided with a large number of trimming screws in the cavities. This is due to the fact that it has until now been impossible to exactly calculate the positioning and dimensioning of the cavities and also to make the filters with sufficiently narrow tolerances. Therefore, the filters need be finely adjusted, trimmed, with the trimming screws by the screws being unscrewed to different extents in the cavities. As a result, the signal is affected so that only the desired frequencies can pass. A problem is that this is an extensive and time-consuming procedure which involves testing by sometimes screwing in/unscrewing one or more trimming screws and sometimes measuring which frequencies pass through the filter.

[0007] Recently, however, trim-free diplexers, i.e. diplexers without trimming screws, of the above-mentioned type have become marketed. Since only very small tolerances can be permitted in design and manufacture, it is a problem that these diplexers will be relatively complicated and time-consuming to manufacture. Moreover, a large number of variants must be kept in stock, which causes additional costs, in order to make it possible to satisfy the purchasers' demands for quick deliveries.

[0008] A different basic construction of the diplexer has therefore been suggested, such as described in the article "Computer-aided design of parallel-connected millimeter-wave diplexers/multiplexers" by B. Vahldieck and B. Varailhon de la Filolie which was published in IEEE MTT-S Digest 1988. According to this prior-art technique, the diplexer is formed with an aerial duct which changes into two parallel ducts, one transmitter duct and one receiver duct. As mentioned above, the diplexer is manufactured as two block halves where each block half contains a duct half of each duct. A thin, sheet-like filter is placed between the block halves. The filter comprises a transmitter filter portion, which is placed between the duct halves of the transmitter duct and a receiver filter portion, which is placed between the duct halves of the receiver duct. The filter portions are formed with rectangular holes whose shape determines the frequency properties of the filter portions. This prior-art diplexer has the advantage that a certain formation of variants can be achieved with the filter so that a

diplexer block can be used for at least a few different transmitter and receiver frequencies.

[0009] Unfortunately, the latter diplexer type suffers from the fact that it cannot be used for higher frequencies, but close to 20 GHz at most. For higher frequencies, the frequency accuracy of the filter is insufficient. This is due to the fact that the etched holes cannot be made with sufficient accuracy of measurements.

Summary of the Invention

[0010] In view of that stated above, an object of the invention is to provide a diplexer without trimming screws which can be manufactured in a less time-consuming and more cost-efficient manner than known diplexers, which is easy to adjust to different variants and which is usable for the entire frequency band for microwaves defined above.

[0011] This object is achieved by means of a diplexer of the type mentioned by way of introduction and a method for manufacturing a diplexer of the type mentioned by way of introduction, which have been given the features that are defined in claims 1 and 8. Preferred embodiments are evident from the dependent claims.

[0012] The method for manufacturing a diplexer according to the invention is characterised by the steps of

forming a filter with a filtering portion by making the filtering portion of a foil and electrical discharge machining poles in the foil; and
assembling the filter and the block halves so that a waveguide duct with a filtering function is obtained, said waveguide duct connecting the transmitter port and the receiver port with the aerial port, and placing the filter with its filtering portion between the waveguide duct halves of the block halves.

[0013] By means of this method, a diplexer is provided which is characterised by a filter with a filtering portion in the form of a foil, the filter being arranged between the block halves with its filtering portion between the waveguide duct halves of the block halves.

[0014] The term "foil" relates to a thin sheet, preferably of metal. By the expression "something has a foil form" is meant that something is formed as a thin sheet, preferably a thin sheet of metal.

[0015] The invention makes it possible for the filtering portion to be made separately from the block halves, which is advantageous since different manufacturing methods and materials can be used for the block halves and the filtering portion.

[0016] According to the invention, identical block halves with identical waveguide duct halves can also be used for all variants within a subband. The variants are formed by a filter with a filtering portion which lets through the desired frequency band being arranged between the waveguide duct halves of the block halves. By means of long-term planning it is possible to produce

and keep in stock a large number of identical first block halves and a large number of identical second, complementary block halves. Only after an order has been received, it is determined which variants are to be formed and the desired filters are put together, which are also kept in stock or which have been manufactured after receipt of the order, with the block halves. This simplifies keeping in stock and planning to a considerable extent, which has a positive effect on the costs.

[0017] The component of the diplexer which causes the filtering, i.e. the filtering portion, has a foil form. Many experiments in manufacturing filtering portions precisely from foil have failed owing to the difficulty of forming a sufficiently exact filtering portion. For instance, experiments have been made using etched foils, which, however, do not have narrower tolerances than ± 0.02 mm. This is not sufficient but the tolerance requirements placed on a filtering portion in a trim-free diplexer amount to at least ± 0.01 mm. According to the invention, such narrow tolerances are achieved by the filtering portion being formed by poles being electrical discharge machined in the foil. With an electrical discharge machining (EDM) process, tolerances of ± 0.002 mm are achieved.

[0018] According to a preferred embodiment of the invention, the poles are made by wire EDM.

[0019] Preferably the poles consist of rectangular electrical discharge machined holes in the filtering portion. These have such a dimension and are placed in such a sequence that only signals within a certain frequency range can pass through the filtering portion when it is mounted in a trim-free diplexer according to the invention.

[0020] One more advantage of the filtering portion having a foil form and of electrical discharge machining the poles in the foil is that a plurality of filtering portions can be manufactured at the same time. A plurality of foils are placed one upon the other and in all foils the poles are made by EDM or wire EDM simultaneously.

The electrical discharge machining of the foil thus is an exact, quick and cost-efficient method of manufacturing the filtering portion.

[0021] It is preferred for the entire filter to have a foil form, but also other configurations are feasible. For instance, the filter may comprise a holding portion for a filtering portion of a foil form. If the entire filter is of a foil form, the filter can be punched from a foil, after which the poles are electrical discharge machined to form the filtering portion. However, it is possible also to electrical discharge machine the outer contour of the filter. Both the punching process and the EDM process allow manufacture of a plurality of filters at the same time. This also means that the filter need not be kept in stock in large quantities since they can easily and rapidly be manufactured as soon as an order is received. It is, however, also possible to keep filters in stock at significantly lower costs than before since they take up a considerably smaller space than complete diplexers with the fil-

ters made of the material. This configuration thus further simplifies planning of deliveries and stock keeping, thus causing reduced costs.

[0022] A preferred embodiment of the method for manufacturing a trim-free diplexer, i.e. a diplexer without trimming screws, according to the invention also comprises the steps of

optimising the waveguide duct and the filter for transmission within a given frequency range; and generating data for the design of the waveguide duct and the filter.

[0023] By making an accurate optimisation, by using, for example, a simulator program for a computer, such as a program marketed under the name Hfss, of the components of the trim-free diplexer, an optimal design can be achieved and the properties of the diplexer can be predicted in a more reliable way. If the result of the optimisation is then used to generate exact data for the manufacture, exemption from trimming can be guaranteed more easily.

[0024] According to the invention, the waveguide duct comprises a junction point and a transmitter duct which extends from the transmitter port, a receiver duct which extends from the receiver port and an aerial duct which extends from the aerial port which join each other at the junction point. Preferably this junction point is also optimised.

[0025] In such an optimised design of the junction point, the angle is essentially 120° between the transmitter duct and the receiver duct, between the receiver duct and the aerial duct and between the aerial duct and the transmitter duct. By essentially is meant angles in a given but very limited range round 120 degrees. It has been found that the reflection of signals from the transmitter port towards the aerial port and of signals from the aerial port towards the receiver port will be extremely good in this design. The function is even so excellent that a circulator, i.e. the component directing signals from the aerial essentially to the receiver as well as signals from the receiver essentially towards the aerial, can be excluded. Apart from this being a component which is relatively expensive to construct, it is of course advantageous to handle as few component as possible during mounting.

[0026] A great gain of this symmetric 120 degrees geometry is that the band width of the diplexer will be great, significantly greater than that of the known diplexers described above. This makes the gain of a foil filter still greater. With a single design of the block halves an extensive formation of variants can be achieved with only different designs of the foil filter. Experiments have shown that a diplexer block can cover in any case approximately 20% of the bandwidth of the subband. This is in clear contrast to the situation up till now, where a plurality of diplexer blocks of different designs are necessary to cover the corresponding bandwidth. The gains

as regards production, stock-keeping and costs etc. are obvious.

[0027] However, the junction point 7 can also have a design other than that described above. It may also be a T junction, or a conventional circulator can be used. Nevertheless, the design described above is preferred.

[0028] In a particularly preferred embodiment of the invention, at least a portion of the transmitter duct is mirrored relative to at least a portion of the receiver duct along an axis extending through the junction point. This symmetric design is advantageous in manufacturing and mounting.

[0029] In connection with this embodiment, it is preferred for the filtering portion of the filter to extend maximally over the mirrored portions of the transmitter duct and the receiver duct and for the filter to be reversible. This reduces the number of filters that must be available to make it possible to manufacture all different variants by half. This additionally simplifies planning and stock-keeping, which of course has a positive effect on the costs.

[0030] According to one embodiment of the invention, the waveguide duct half is milled in a block half. However, it has also been found possible to cast the waveguide duct half together with the block half. It has been found that sufficient tolerances are achieved for the waveguide duct half in casting since according to the invention the filtering function is present in a separate filter. On the other hand, as described above the tolerance requirements as regards the filter are high. Conventional diplexers thus cannot be cast so as to achieve sufficient accuracy as regards the cavities which constitute the actual filter in such diplexers. According to the invention, a large number of identical block halves can be manufactured, and then casting is a convenient and rational manufacturing method.

Brief Description of the Drawings

[0031] A preferred embodiment of the invention will now be described in more detail with reference to the accompanying schematic drawings, in which

Fig. 1 is a perspective view of a trim-free diplexer according to the invention;

Fig. 2 shows a first block half seen from the common plane between the same and a second complementary block half;

Fig. 3 shows a filter in a view parallel with the common plane; and

Fig. 4 shows a flow chart of the method for manufacturing a trim-free diplexer according to the invention.

Description of a Preferred Embodiment

[0032] Fig. 1 shows a trim-free diplexer according to the invention when it has been assembled and is ready

for use. The diplexer connects a transmitter port 1 and a receiver port 2 with one aerial 3 and comprises a first block half 4 and a second complementary block half 5.

[0033] Fig. 2 shows a first block half 4 with a waveguide duct half 6 which preferably is semicircular in cross-section. The waveguide duct half 6 can be milled in the block half 4 or cast together with the block half 4. However, a person skilled in the art realises that the cross-section can also have any convenient curve form or be rectangular. The waveguide duct half 6 comprises a junction point 7 and a transmitter duct half 8 which extends from the transmitter port 1, a receiver duct half 9 which extends from the receiver port 2 and an aerial duct half 10 which extends from the aerial port 3, which join each other at the junction point 7. In this preferred embodiment, the angle α between the transmitter duct half 8 and the receiver duct half 9, between the receiver duct half 9 and the aerial duct half 10 and between the aerial duct half 10 and the transmitter duct half 8 is 120° at the junction point 7. A portion 11 of the transmitter duct half 8 is mirrored relative to a portion 12 of the receiver duct half 9 along an axis 13 which extends through the junction point 7 and divides the angle α into two equal angles of 60° . In an area round these mirrored portions 11, 12 there is a depression 14, which is also mirrored along the same axis 13 and intended for a filter 15.

[0034] In the block half 4 there are a plurality of screw holes 16 which are distributed across the block half 4, inter alia also in the depression 14. A person skilled in the art realises that the number and location of the screw holes 16 is not important and can be varied arbitrarily as long as it is possible to screw together the complementary block halves 4, 5 and the filter 15 so that a sufficiently strong joint is formed. In the block half 4 there are also a number of somewhat larger guide pin recesses 17 which are also distributed across the block half 4, inter alia also in the depression 14. A person skilled in the art realises that also the number and location of the guide pin recesses 17 is not important as long as exact positioning of the filter and the complementary block half is ensured.

[0035] The block halves 4, 5 are made of aluminium and have a surface coating of yellow chromate as protection against corrosion.

[0036] The second complementary block half 5 will not be explained in more detail since in every essential respect it corresponds to the block half 4 described above.

[0037] The filter 15 is shown in Fig. 3. It is in the form of a foil and has an outer contour corresponding to the depression 14 in the block halves. The filter comprises a transmitter filter 18 and a receiver filter 19 which are arranged at an angle α of 120° to which other and whose outer contours are mirrored. In a filtering portion of the filter 15, poles in the form of rectangular, electrical discharge machined recesses 21 are formed. Moreover the filter comprises screw holes 16 and guide pin recesses

17 which correspond to those in the block halves 4, 5. The filter 15 can be arranged in the depression 14 with one or the other of its two main sides facing the block half 4, i.e. the filter 15 is reversible. This means that the transmitter filter 18 changes to constitute the receiver filter 19 and vice versa when the filter is used oriented in the direction opposite to that shown in Fig. 3.

[0038] As mentioned above, the number and location of the screw holes 16 and the guide pin recesses 17 is not crucial to the invention, but it is most important that the guide pin recesses 17 in the filter 15 and in the block halves 4, 5 match each other since the tolerances for positioning the filter 15 between the block halves 4, 5 are narrow. Moreover, the screw holes 16 and the guide pin recesses 17 which are formed in the depression 14 must be arranged in a mirrored manner along the axis 13 since the filter 15 would otherwise not be reversible.

[0039] The filter 15 is in the form of a foil, is made of copper or beryllium copper and has a surface coating of chromate or chemical gold. The surface coating is intended to prevent galvanic currents between the filter 15 and the block halves 4, 5. It is essential for the material of the filter to have low resistivity.

[0040] Below follows a detailed description of the method for manufacturing a trim-free diplexer according to the invention by means of Fig. 4 which shows a flow chart of the method. In step 101, the design of the diplexer as regards transmission within a frequency range is optimised. This is carried out by optimising the form of a waveguide duct 6' which connects a transmitter port 1 and a receiver port 8 with one aerial port 3. It is a requirement that the waveguide duct 6' comprise a junction point 7 and a transmitter duct 8' extending from the transmitter port 1, a receiver duct 9' extending from the receiver port 2 and an aerial duct 10' extending from the aerial port 3, which join each other at the junction point 7. A further condition is that a portion 11' of the transmitter duct 7 be mirrored relative to a portion 12' of the receiver waveguide duct 9' along an axis 13 extending through the junction point 7. In this preferred embodiment, a waveguide duct 6' which is circular in cross-section is optimised, but also other cross-sections are conceivable. In addition to the extent of the waveguide duct 6', also the depth dimension, i.e. the diameter, of the waveguide duct 6' is particularly important in optimising.

[0041] Moreover, a filter 15 is optimised by a filtering portion of the filter 15 being optimised, in which case it is a requirement that the filtering portion maximally cover the mirrored portions 11', 12' of the transmitter duct 8' and the receiver duct 9'. This takes place by optimising the location and the dimensions of the poles in the form of rectangular recesses 21 in the filtering portion. The extent of the recesses in the direction of the ducts 8', 9' and their location along the mirrored portions 11', 12' of the ducts 8', 9' are particularly critical.

[0042] In step 102, the junction point 7 in the waveguide duct 6' is optimised as regards reflection of signals from the transmitter port 1 towards the aerial port

3 and as regards reflection of signals from the aerial port 3 towards the receiver port 2.

[0043] Optimising takes place preferably by means of electromagnetic simulator programs. In step 103, the exact data for the mechanical processing of block halves 4, 5 is generated, in which the waveguide duct 6' is to be formed, and of the filter 15, such as data for CAD/CAM equipment.

[0044] In step 104, the complementary block halves 4, 5 are cut out from a large plate of aluminium, and in step 105 a waveguide duct half 6, a depression 14 for the filter 15 and a junction point 7 in each block half 4, 5 are milled. Milling takes place, for example, in an NC machine controlled by the CAD/CAM equipment in accordance with the accurately generated data. In step 106, screw holes 16 and guide pin recesses 17 are drilled in the block halves 4, 5.

[0045] The filter 15 is punched from a foil of copper or beryllium copper in step 108. It is possible to punch through up to 500 foils at the same time. In step 109, a filtering portion is formed by poles in the form of rectangular recesses 21 being made by wire EDM in the punched-out filter 15, and also in this case it is possible to perform wire EDM through a large number of filters 15 simultaneously. The wire EDM machine is also controlled by the CAD/CAM equipment in accordance with the accurately generated data. The filter 15 is also formed with guide pin recesses 17 and screw holes 16 by, for example, wire EDM or drilling.

[0046] In connection with the forming of guide pin recesses 17 and screw holes 16, it is, as mentioned above, important for the guide pin recesses 17 in the filter 15 and in the complementary block halves 4, 5 to match each other since the tolerances for the subsequent positioning of the filter 15 between the block halves 4, 5 are narrow. Moreover, the screw holes 16 and the guide pin recesses 17 which are formed in the depression 14 must be arranged in a mirrored manner along the axis 13 since otherwise the filter would not be reversible.

[0047] Before the diplexer is assembled, the complementary block halves 4, 5 are finished with yellow chromate in step 107 to prevent corrosion, and the filter with chromate or chemical gold in step 110 to prevent galvanic currents between the filter 15 and the block halves 4, 5.

[0048] Finally, the filter 15 and the complementary block halves 4, 5 are assembled in step 111. First, guide pins are arranged in guide pin recesses 17 in one block half 5. Subsequently the filter 15 is passed over the guide pins, its filtering portion being positioned over the waveguide duct half 6 of the block half 4. Then the second complementary block half 5 is passed over the guide pins and arranged against the block half 4. Thus the filter 15 is arranged between the block halves 4, 5 in such manner that the filtering portion is located between the waveguide duct halves 6 of the block halves 4, 5, whereby a waveguide duct 6' with a filtering func-

tion is formed. Finally, screws are inserted in the screw holes 16 and the block halves 4, 5 are screwed together. Now the diplexer is ready for use without first needing to be trimmed.

[0049] When manufacturing a trim-free diplexer according to the invention it is, of course, also possible to manufacture the block halves 4, 5 and different filters 15 separately and at different points of time for subsequent mounting.

[0050] A person skilled in the art understands that the embodiment described above can be varied in many different ways within the scope of the invention as defined in the claims.

[0051] The filter 15 thus need not necessarily be recessed in the block halves 4, 5. Also the outer contour of the filter 15 can differ from that described above; for instance it may have an outer contour corresponding to that of the block halves 4, 5. Since the foil, however, is expensive this is a more costly design.

[0052] The mutual positioning in the block halves 4, 5 and the filter 15 need not take place by means of guide pins and guide pin recesses 17 but can take place in some other convenient fashion, for instance by means of supporting ribs.

[0053] The block halves 4, 5 can be made of a non-metallic material, e.g. plastic, and be provided with a conductive coating.

[0054] The block halves 4, 5 can be connected with each other in some other manner than by means of a screw joint, for instance by means of welding or gluing.

Claims

1. A diplexer for connecting a transmitter and a receiver with one aerial, comprising a first block half (4) with a waveguide duct half (6) and a second complementary block half (5) with a waveguide duct half, said block halves jointly forming a waveguide duct (6') connecting a transmitter port (1), a receiver port (2) and an aerial port (3), **characterised**

by a filter (15) with a filtering portion, which comprises electrical discharge machined poles (21) and has a foil form, the filter (15) being arranged between the block halves (4, 5) with its filtering portion between the waveguide duct halves (6) of the block halves (4, 5); and

in that the waveguide duct (6') comprises a junction point (7) and a transmitter duct (8') which extends from the transmitter port (1), a receiver duct (9') which extends from the receiver port (2) and an aerial duct (10') which extends from the aerial port (3) which join each other at the junction point (7), at least a portion (11) of the transmitter duct (8') being mirrored relative to at least a portion (12) of the receiver duct (9') along an axis (13) extending through

the junction point (7).

2. A diplexer as claimed in claim 1, **characterised in that** the filtering portion of the filter (15) maximally extends over the mirrored portions (11, 12) of the transmitter duct (8') and the receiver duct (9'), and that the filter (15) is reversible. 5
3. A diplexer as claimed in claim 1 or 2, **characterised in that** angle (α) between the transmitter duct (8') and the receiver duct (9'), between the receiver duct (9') and the aerial duct (10') and between the aerial duct (10') and the transmitter duct (8') is essentially 120° at the junction point (7). 10
4. A diplexer as claimed in any one of claims 1-3, **characterised in that** the block halves (4, 5) have a depression (14) for the filter (15). 15
5. A diplexer as claimed in any one of claims 1-4, **characterised in that** the filtering portion has rectangular, electrical discharge machined poles (21). 20
6. A diplexer as claimed in any one of claims 1-5, **characterised in that** the block halves (4, 5) are made of aluminium and have a surface coating of yellow chromate. 25
7. A diplexer as claimed in any one of claims 1-6, **characterised in that** the filter (15) has a foil form and is made of copper or beryllium copper and has a surface coating of chromate or chemical gold. 30
8. A method for manufacturing a diplexer for connecting a transmitter and a receiver with one aerial, comprising the steps of forming a first block half (4) and a second complementary block half (5), forming in each block half (4, 5) a waveguide duct half (6) and forming a transmitter port (1), a receiver port (2) and an aerial port (3) in the block halves (4, 5), **characterised by** the steps of 40

forming a filter (15) with a filtering portion by making the filtering portion of a foil and electrical discharge machining poles (21) in the foil; and 45

assembling the filter (15) and the block halves (4, 5) so that a waveguide duct (6') with a filtering function is obtained, said waveguide duct (6') connecting the transmitter port (1) and the receiver port (2) with the aerial port (3), and placing the filter (15) with its filtering portion between the waveguide duct halves (6) of the block halves (4, 5). 50
9. A method as claimed in claim 8, **characterised in that** the step of electrical discharge machining poles (21) comprises the step of making the poles 55

by wire EDM.

10. A method as claimed in claim 8 or 9, **characterised in that** the step of forming a filter (15) comprises the step of punching the filter (15) from a foil.
11. A method as claimed in any one of claims 8-10, **characterised by** the steps of

optimising the waveguide duct (6') and the filter for transmission within a given frequency range; and 10

generating data for the design of the waveguide duct (6') and the filter (15). 15
12. A method as claimed in claim 11, **characterised in that** the step of optimising the waveguide duct (6') and the filter (15) comprises the step of optimising the dimensions and the placing of poles (21) in the filtering portion. 20
13. A method as claimed in any one of claims 8-12, **characterised by** the step of optimising a junction point (7) in the waveguide duct (6') for reflecting signals from the transmitter port (1) towards the aerial port (3) and for reflecting signals from the aerial port (3) towards the receiver port (2). 25
14. A method as claimed in any one of claims 8-13, **characterised in that** the step of forming in each block half (4, 5) a waveguide duct half (6) comprises the step of milling the waveguide duct half (6). 30
15. A method as claimed in any one of claims 8-14, **characterised in that** the step of assembling the filter (15) and the complementary block halves (4, 5) comprises the steps of

placing guide pins in guide pin recesses (17) in the block half (4) ; 35

passing the filter (15) over the guide pins and placing the filter (15) on the block half (4) ; 40

passing the complementary block half (4, 5) over the guide pins (17) and placing the complementary block half (5) on the filter (15) and/or the block half (4); and 45

connecting the complementary block halves (4, 5) with each other. 50

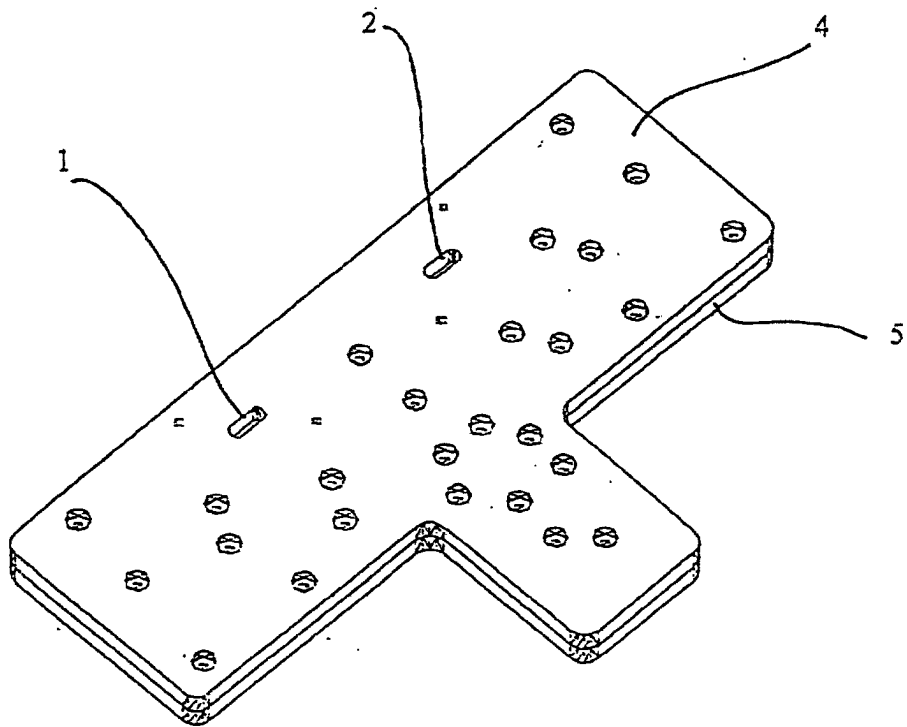


Fig. 1

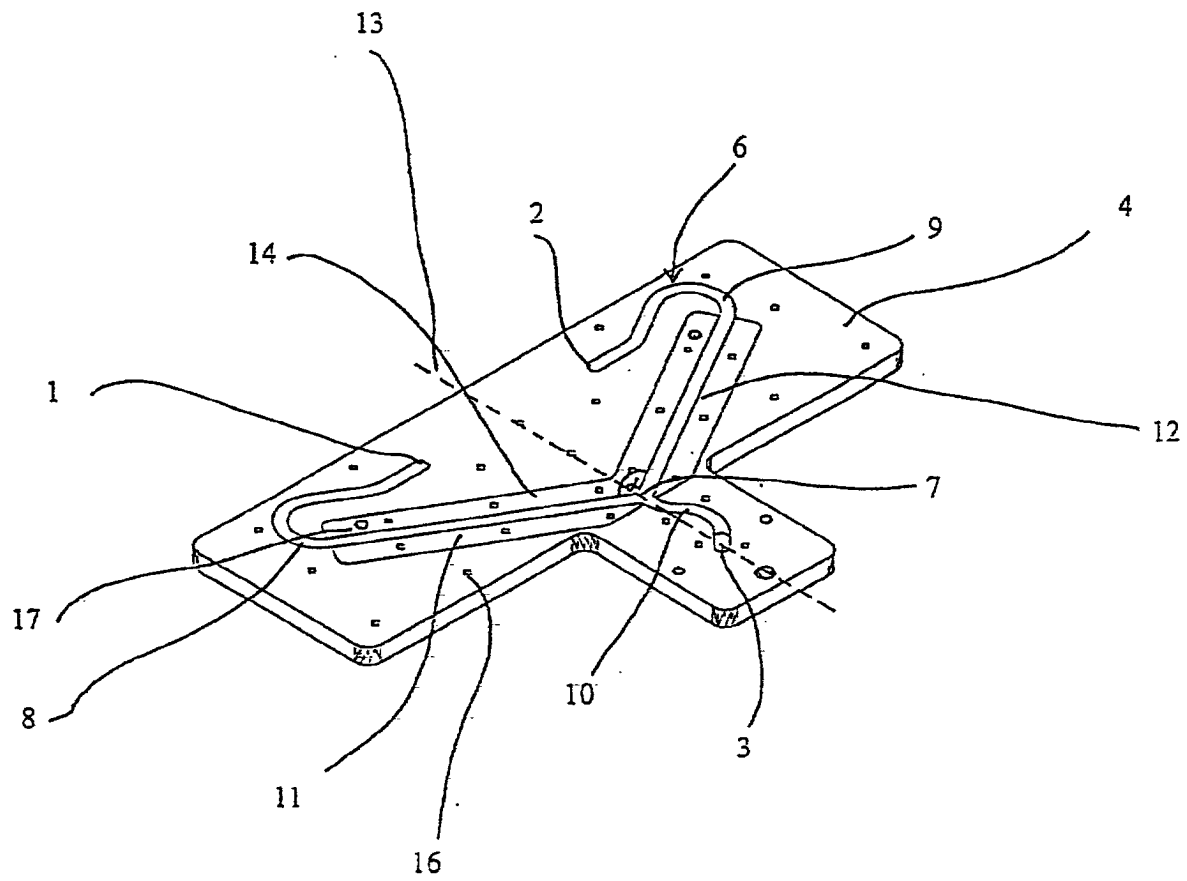


Fig. 2

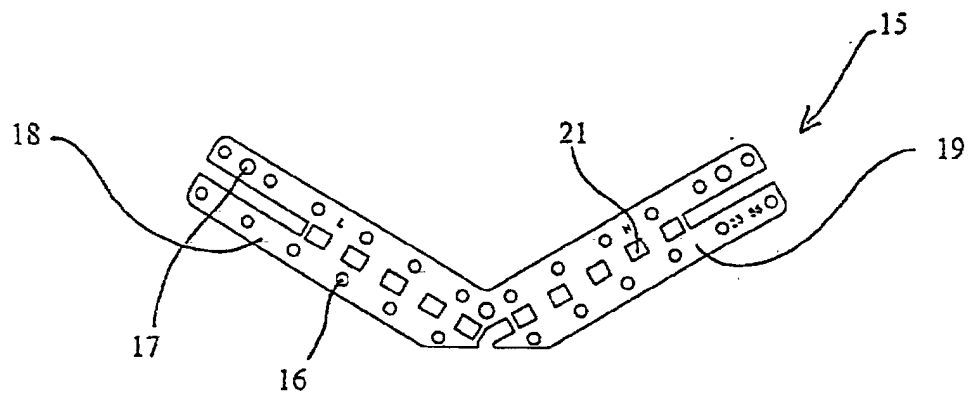


Fig. 3

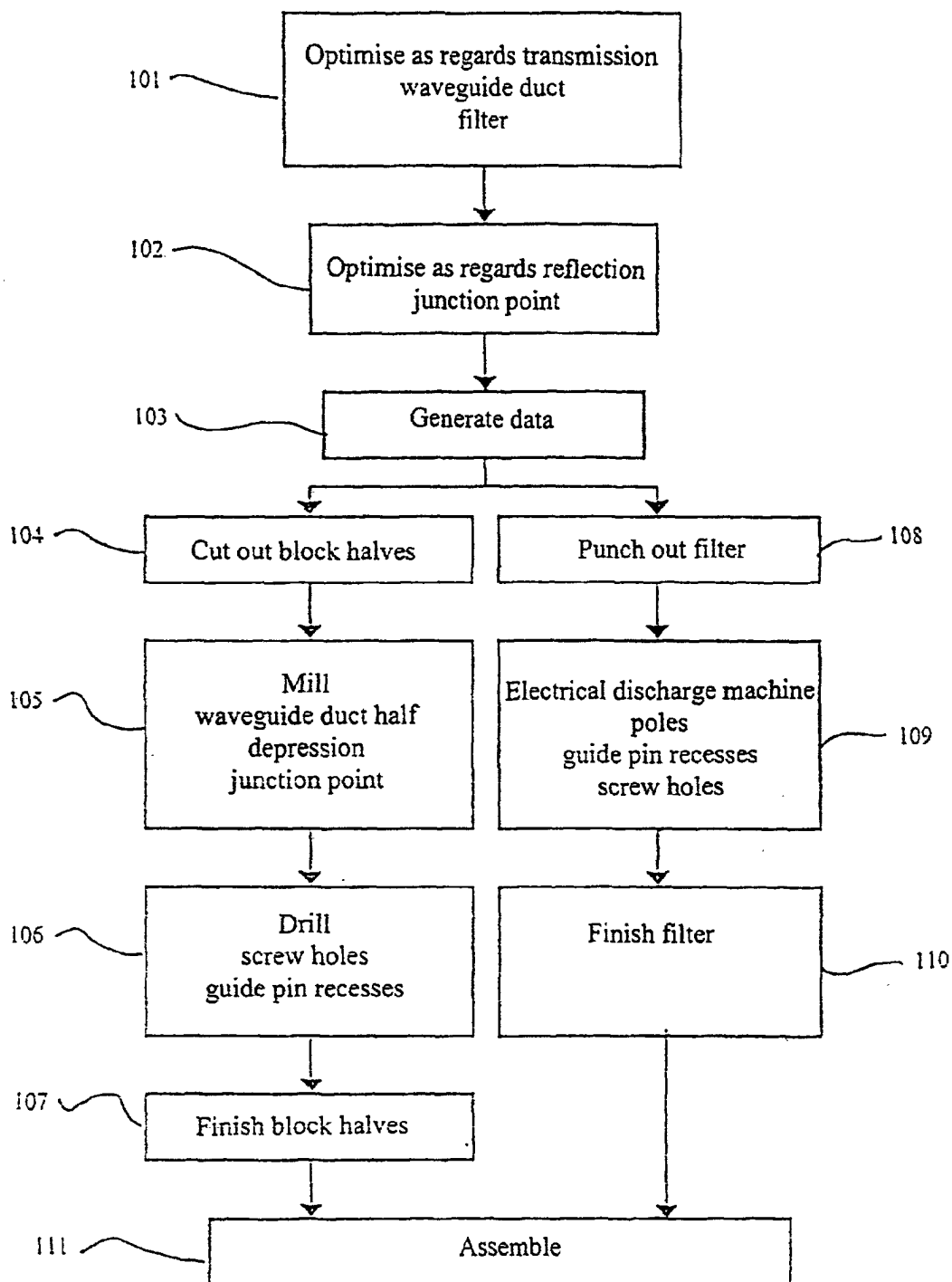


Fig. 4