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(54) Input coupling adjustment arrangement for radio frequency filters

(57) An arrangement for adjustably coupling a radio frequency input port to a resonator element of the filter. The arrangement comprises a resilient conductor (19) which extends from the input port (15) into the electric field of a resonator element (2). The remote end of the resilient conductor resiliently abuts the point (20) of an adjustment screw (20a). Operating the screw moves the resilient conductor in relation to the electric field and alters the capacitive coupling between the input port and the resonator element for fine tuning the impedance match of the input to the filter.

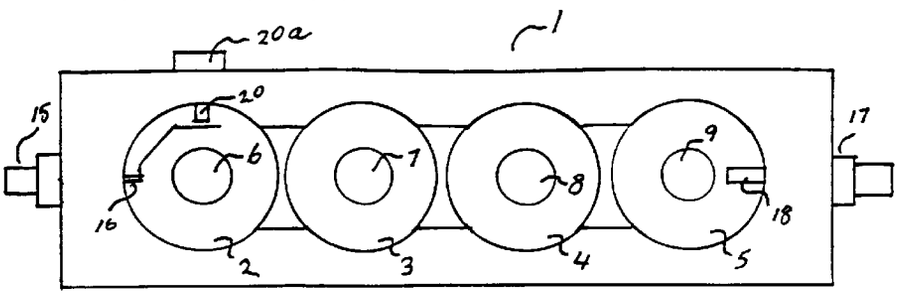


Fig 1

EP 0 817 301 A1

Description

This invention relates to radio frequency bandpass filters that incorporate resonator elements, and in particular to an adjustable coupling arrangement for adjustably coupling the filter's input means to the filter's first resonator element to obtain optimum impedance matching between elements of the input means and elements of the bandpass filter for maximum transfer of energy.

It is known, for example from US Pat. No. 5,389,903, to couple the input means of a bandpass filter of the aforementioned type to a first co-axial resonator element via a loop of wire. One end of the loop is connected to the filters input terminal within the filter housing; the other end of the loop is connected to an internal surface of the housing. The loop inductively couples the filter's input terminal to the first resonator element.

Such a known coupling arrangement provides good coupling properties. However it is difficult to finely adjust the impedance matching particularly for filters requiring tuning over a wide range of frequencies.

In such cases adjustment may be obtained by bending the loop with a probe inserted through an aperture in the filter housing to displace the loop in relation to the adjacent resonator element, or deforms it. Using this method, fine adjustment is difficult, particularly if the area in which the loop is located is too small to allow a safe bending action, as there is a likelihood of mechanical damage during the adjustment process.

It is an object of the present invention to provide an improved coupling arrangement for coupling a bandpass filter's input means to the filter's first resonator element.

According to the invention, there is provided a radio frequency filter comprising a housing means containing at least one resonator element, an input port means and at least one output port means, said filter further including an arrangement for adjustably coupling said input port means to at least one resonator element, said arrangement comprising an elongated resilient conductor element of a predetermined dimension arranged to capacitively couple said input port means to said at least one resonator element's electric field zone, wherein said resilient conductor element is arranged to cooperate with lever means of electrical insulating material that can be manually activated by a connected actuating means mounted externally on a wall of said housing means, to move said resilient conductive element thereby adjusting capacitive coupling between said input port means and said resonator element's electric field.

The electrical properties of the coupling arrangement according to the invention are generally equivalent to, and in some cases better than those of loop coupling, while avoiding the inherent disadvantages of loop coupling.

In order that the invention may be readily carried into effect, embodiments thereof will now be described in relation to the accompanying drawings, in which:

Figure 1 shows a top view of the mechanical structure of a bandpass filter incorporating the adjustable coupling arrangement of the present invention.

Figure 2 shows a cross-sectional view of the mechanical structure shown in Figure 1.

Figure 3 shows a top view of the mechanical structure of a diplexer filter incorporating the adjustable coupling arrangement of the present invention.

Figure 4 shows a side view of a conductive element of the coupling arrangement shown in Figure 3.

Referring to Figures 1 -2 , the radio frequency bandpass filter 1 comprises a rectangular block of conductive material in which are formed four aperture coupled co-axial resonators (2, 3, 4 and 5) of predetermined dimensions, each comprising a resonator rod (6, 7, 8 and 9) within a cavity having a side wall 10, a bottom wall 11, and a top wall (not shown); the latter wall being formed by a removable plate common to all cavities. Adjacent resonators are coupled by an aperture 12, 13 and 14 in the side wall.

An input port 15 comprising a conductor 16 which extends into resonator 2 to couple the input port to the filter. An output port 17 comprises a conductor 18 which extends into resonator 5 to couple the filter to the output port.

From the end of conductor 16 there extends a flat resilient conductor 19 which is provided with a bend intermediate its length such that its free end resiliently abuts the point 20 of an adjustment screw 20a which extends into resonator 2. The shaft and point of screw 20 are made of suitable electrical insulating material such as, for example, aluminium oxide.

Resilient conductor 19 acts electrically like a transmission line and its end section couples input port 15 to the electric field of resonator 2.

Optimum coupling is obtained by operating screw 20 to move conductor 19 in relation to resonator rod 6, and using a return loss measurement means or any other known means for measuring the reflection factor to find optimum impedance match over a given bandwidth.

Referring to Figures 3-4, the high frequency diplexer 21 comprises a rectangular block of conductive material in which is formed a high bandpass filter A and a low bandpass filter B. Each filter comprises four aperture coupled co-axial resonators of predetermined dimensions. The resonators are similar to those described above in relation to Figures 1 and 2. The diplexer 21 includes a single input port 22 comprising a conductor 23 which extends into a passage 24 connect-

ing the first resonator of filter A to the first resonator of filter B, and two output ports 25 and 26. Output port 25 comprises a conductor 27 which extends into the last resonator of filter A, and output port 26 comprises a conductor 28 which extends into the last resonator of filter B.

Conductor 23 of input port 22 is connected to a flat elongated resilient conductor 29 at a point intermediate the length of the conductor. The length of the conductor is such that each end thereof resiliently abuts the point of a respective adjustment screw 30 and 31, adjustment screw 30 extending into the first resonator of filter A and adjustment screw 31 extending out the first resonator of filter B. The shaft and point of adjustment screws 30 and 31 are made of suitable electrical insulating material such as, for example, aluminium oxide.

Optimum coupling of the input port to filters A and B is obtained by operating screws 30 and 31 to move the ends of conductor 29 in relation to the resonator rods of the first resonators, and using a return loss measurement means or any other known means for measuring the reflection factor to locate optimum impedance match between elements connected to the input port and filters A and B.

Claims

1. A radio frequency filter comprising a housing means containing at least one resonator element, an input port means and at least one output port means, said filter further including an arrangement for adjustably coupling said input port means to at least one resonator element, said arrangement comprising an elongated resilient conductor element of a predetermined dimension arranged to capacitively couple said input port means to said at least one resonator element's electric field zone, wherein said resilient conductor element is arranged to cooperate with lever means of electrical insulating material that can be manually activated by a connected actuating means mounted externally in a wall of said housing means, to move said resilient conductive element thereby adjusting capacitive coupling between said input port means and said resonator element's electric field.

2. A radio frequency filter as claimed in claim 1, wherein said resilient conductor extends from a part of the input port means such that the resilient conductor's free end resiliently abuts said lever means.

3. A radio frequency filter as claimed in claim 1 or 2, wherein said actuating means is a screw whose point forms the said lever means.

4. A radio frequency filter as claimed in any one of the preceding claim, wherein said at least one resonator element is a co-axial resonator.

5. A radio frequency filter as claimed in claim 4, comprising a plurality of the co-axial resonators.

6. A radio frequency filter comprising a housing means containing a first array of coupled resonator elements and an adjoining second array of coupled resonator elements, an input port means common to both arrays and respective output port means for each array, said filter further including an arrangement for adjustably coupling said input port means to a first resonator element in each array, said arrangement comprising an elongated resilient conductor extending from a part of said input port means to a first resonator elements' electric field zone, each end portion of said resilient conductor resiliently abutting the point of a respective adjustment screw of a electrical insulating material mounted in a wall of said housing and whose screw heads are outside said housing, whereby co-operation of respective screws moves associated end portions of said resilient conductor thereby adjusting capacitive coupling between said input port means and an associated resonator elements electric field.

7. A radio frequency filter as claimed in any one of the preceding claims, wherein said electrical insulating material is aluminium oxide.

8. A radio frequency filter substantially as herein described with reference to Figures 1 - 4 of the accompanying drawings.

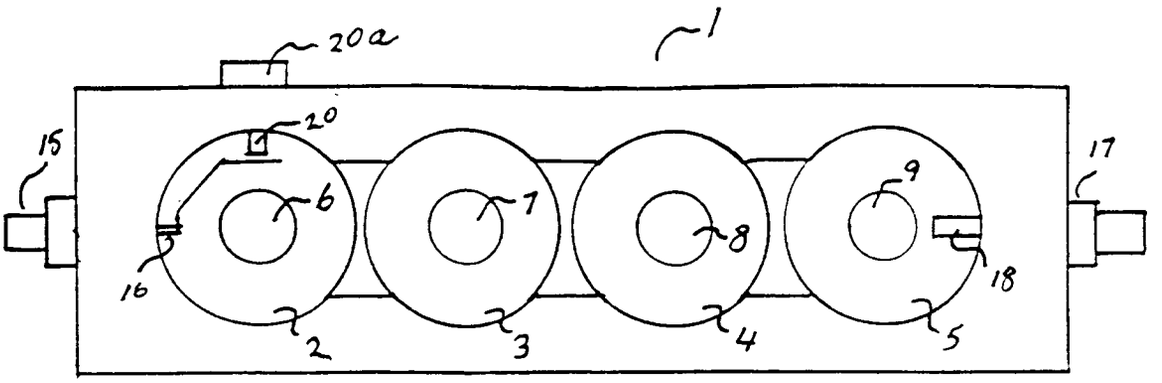


Fig 1

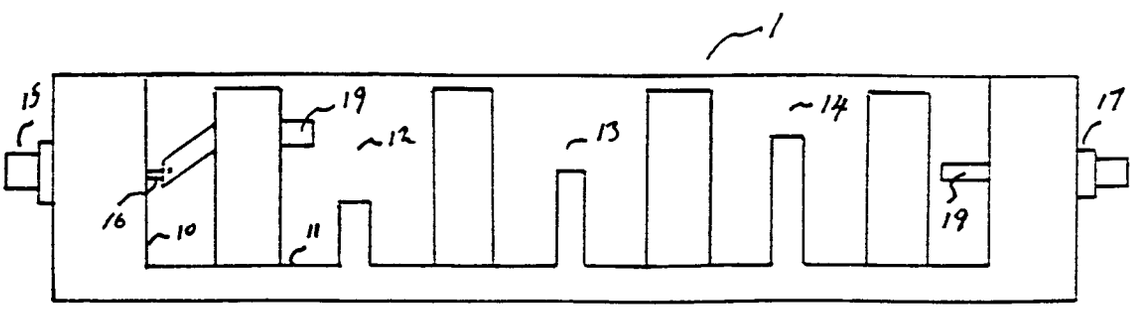


Fig 2

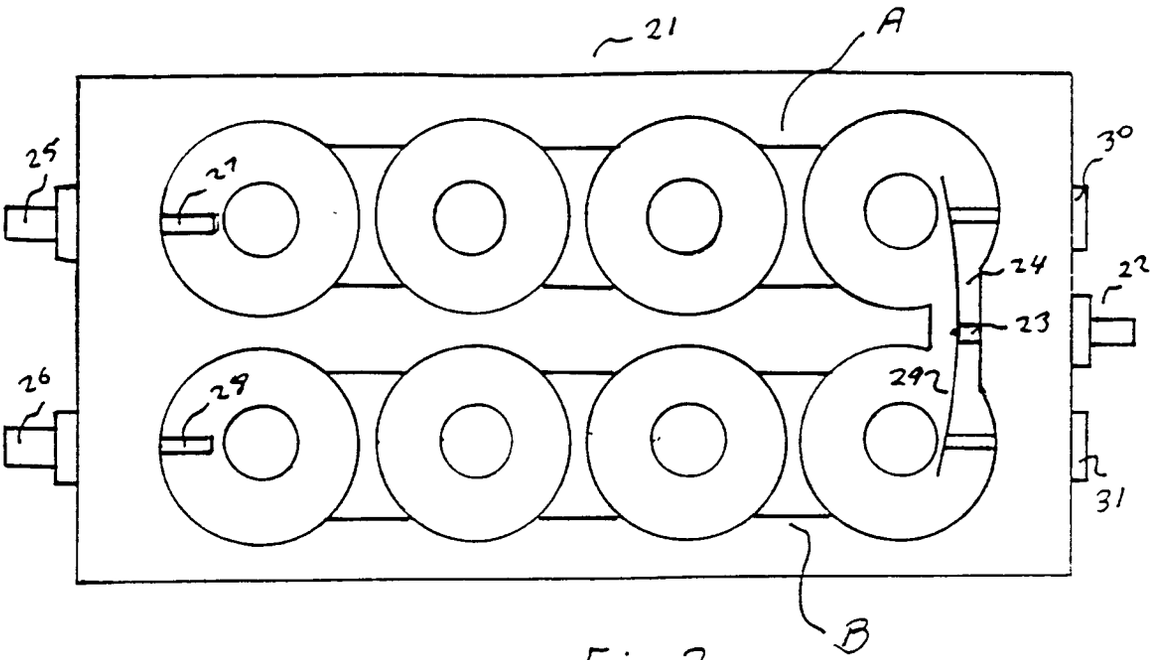


Fig 3

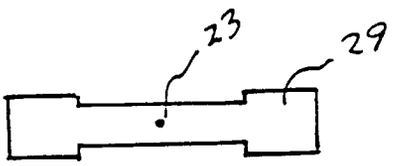


Fig 4

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EUROPEAN SEARCH REPORT

Application Number
EP 97 11 0682

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	GB 849 490 A (THE GENERAL ELECTRIC COMPANY LIMITED) 28 September 1960 * page 2, line 83 - line 99; figure 2 *	1-4,8 6	H01P1/205 H01P5/04
Y	DE 30 28 925 A (SIEMENS AG) 11 February 1982 * the whole document *	6	
X	K. PICHLER ET AL.: "VIERKREIS-UHF-BANDFILTER YH AF 1010" SIEMENS-BAUTEILE-INFORMATIONEN, vol. 6, no. 6, December 1968, MÜNCHEN, pages 200-201, XP002042875 * page 200, right-hand column, line 1 - line 45; figure 1 *	1-5,8	
A	WO 96 02073 A (COMMUNAUTE EUROPEENNE) 25 January 1996 * page 4, line 13 - page 5, line 9; figure 2 *	1-3,6,8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	DE 40 05 230 A (ROBERT BOSCH GMBH) 22 August 1991 * column 3, line 37 - column 4, line 6; figure 1 *	1,6	H01P
A	EP 0 334 270 A (ALCATEL THOMSON FAISCEAUX HERTZIENS) 27 September 1989 * column 3, line 20 - line 23; figure 1 *	1,6	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 October 1997	Den Otter, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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