Jan. 6, 1953 P. I. RICHARDS 2,624,801

TUNABLE BAND-PASS COAXIAL FILTER

Filed Jan. 3, 1946

FIG. 1

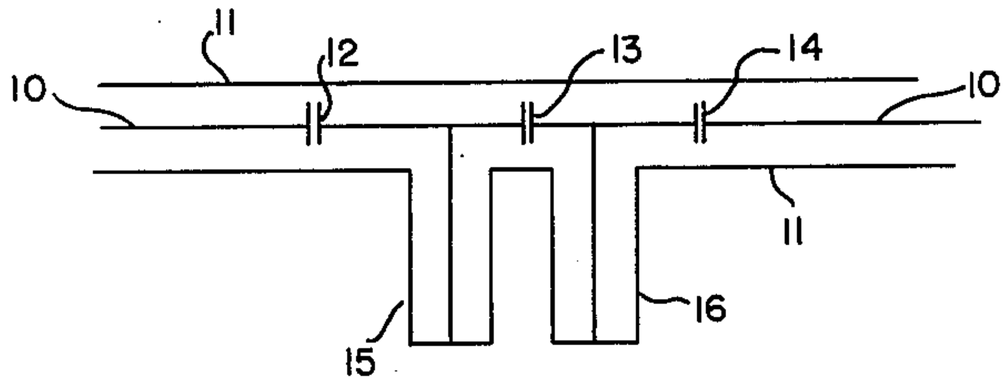


FIG. 2

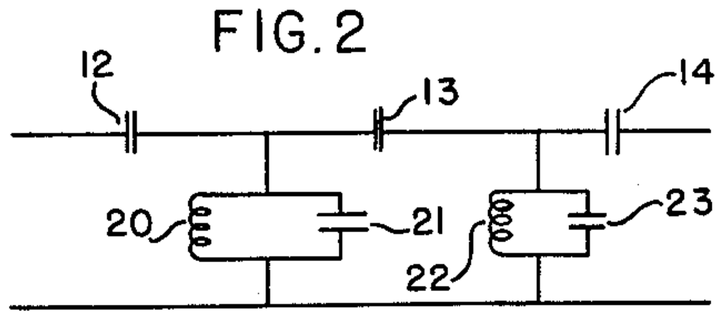
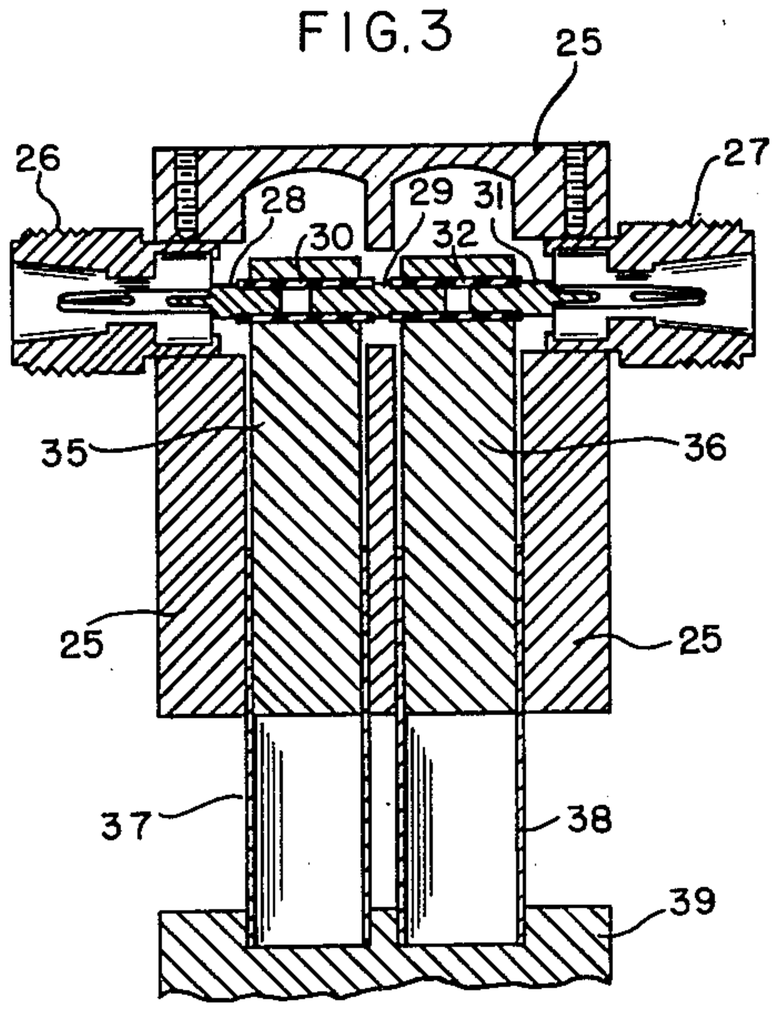


FIG. 3



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TUNABLE BAND-PASS COAXIAL FILTER

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3 Claims. (Cl. 178—44)

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This invention relates to electrical devices and particularly to band-pass filters.

In the use of band-pass filters, particularly at high radio frequencies, it is desirable that the mid-frequency of the pass band be readily adjustable over a wide frequency range. An object of the present invention is to provide a novel band-pass coaxial filter having an adjustable mid-frequency.

For a better understanding of the invention together with other objects, features and advantages thereof, reference is had to the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a diagrammatic representation of a coaxial filter of the type contemplated by the present invention;

Fig. 2 is a schematic illustration of an electrical network analogous to the arrangement shown in Fig. 1; and

Fig. 3 is a cross-sectional view of a proposed filter assembly embodying the invention.

Referring to Fig. 1 which shows a representative band-pass coaxial filter as contemplated by the invention, a coaxial transmission line consisting of a center conductor 10 and outer cylindrical conductor 11 is provided with three series-connected condensers 12, 13 and 14 and two shunt stubs 15 and 16. This filter structure is analogous to the lumped-constant band-pass filter shown in Fig. 2, wherein the parallel combination of an inductance 20 and condenser 21 replaces the shunt stub 15 while the parallel combination of inductance 22 and condenser 23 replaces the shunt stub 16 in Fig. 1. Each of the stubs 15 and 16 is one-quarter wave length long at the upper cutoff frequency of the pass band and its characteristic impedance is determined by the desired lower cutoff frequency. The capacities of the condensers 12, 13 and 14 are determined by the desired characteristic impedance of the filter at a particular point in the pass band.

Referring now to Fig. 3 which illustrates the construction of a filter unit in accordance with the present invention, the entire filter is mounted in a metal block 25, preferably of brass, which serves as the outer conductor for the various coaxial sections. The block 25 can be formed of two or more pieces to facilitate construction thereof if desired. Coaxial connectors 26 and 27 are mounted on the block at the opposite extremities of a hole bored transversely through the block 25. A short metal plug 28, soldered or otherwise secured to the center prong of the connector 26, extends into the bore and terminates in spaced relation to another short metal plug 29. An insulating sleeve 30 of dielectric material such as polystyrene encloses the plugs 28 and 29 and maintains them in the relative position as shown. A third metal plug 31 is secured to the center prong of the connector 27 and terminates in spaced relation to the plug 29. An insulating sleeve 32 similar to the sleeve 30 encloses the plugs 29 and 31.

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The center conductors of the coaxial stubs as 15 and 16, Fig. 1, are afforded by metal cylinders 35 and 36, Fig. 3, which are positioned in suitable holes bored lengthwise into the block 25 from one end thereof and communicating with the transverse bore through this block. The conducting bodies 35 and 36 are provided with suitable transverse openings in which the sleeves 30 and 32 are fitted. This arrangement, in effect, is equivalent to that of Fig. 1 comprising the three series condensers 12, 13, and 14, the respective junctions of which are connected to the center conductors of the shunt stubs 15 and 16. The conductors 35 and 36, Fig. 3, are spaced from the surrounding block 25 to form the desired concentric transmission line resonators. To enable the lengths of the concentric transmission line resonators to be adjusted, a pair of tubular metal plungers 37 and 38 is provided. Each plunger as 37 or 38 comprises a cylindrical shell having a sliding fit between the conductor 35 or 36 and the block 25. The plungers 37 and 38 are mechanically interconnected by a metal strap 39 or the like. The entire plunger assembly may be moved in or out to adjust the length of the concentric transmission resonators. This serves to vary the mid-frequency of the filter pass band.

While there has been described what is at present considered to be the preferred embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention.

The invention claimed is:

1. A band-pass coaxial filter comprising a conducting block forming an outer conductor of the coaxial filter, said block having two lengthwise bores and a communicating transverse bore, coaxial line connectors mounted on said block at opposite ends of said transverse bore, two conducting cylinders one disposed in each of said lengthwise bores to afford concentric transmission line resonators, each of said cylinders having a transverse opening axially aligned with the transverse bore in said block, two metal plugs ex-

tending respectively from the center conductors of said connectors into the openings in said conducting cylinders, a third metal plug extending between said cylinders and terminating in spaced relation to said first two plugs, first and second insulating sleeves respectively enclosing said first and third plugs and said second and third plugs, said sleeves being fitted within the openings in said cylinders and affording capacitive coupling between said two resonators and respectively between said connectors and said resonators, and tubular plungers respectively disposed within said lengthwise bores and fitted around said cylinders for adjusting the effective lengths of said resonators.

2. A band-pass coaxial filter comprising a conducting block forming an outer conductor of the coaxial filter, said block having a lengthwise bore and a communicating transverse bore therein, coaxial line connectors mounted on said block at opposite ends of said transverse bore, a conducting cylinder disposed in said lengthwise bore to afford a concentric transmission line resonator, said cylinder having a transverse opening therein axially aligned with said transverse bore, a rigid member consisting of alternately arranged conducting and dielectric pieces disposed in said transverse bore and interconnecting the center conductors of said connectors, said member passing through the opening in said cylinder and serving to retain said cylinder against movement thereof, and a tubular plunger disposed in said lengthwise bore and having sliding electrical contact with said cylinder and said block for adjusting the effective length of said resonator.

3. A tunable band pass filter comprising a co-

axial structure having an inner conductor comprising a plurality of axially aligned, spaced, metal plugs coupled to each other for electromagnetic energy transfer therebetween, and an outer conductive member spaced from said plugs, input and output coaxial line connectors at each end of said outer conductive member, the end plugs of said plurality of plugs being respectively connected to the inner conductors of said connectors and said outer conductor to the outer conductors of said connectors, two sections of coaxial transmission line arranged side by side and perpendicularly with respect to the axis of said plurality of plugs, the outer conductors of said coaxial transmission line sections being electrically connected to said outer conductive member of said coaxial structure and the inner conductors of said coaxial transmission line section both being capacitively coupled to the center plug of said plurality of metal plugs and each being capacitively coupled to different end plugs of said plurality of metal plugs, and mechanically interconnected tuning plungers for simultaneously adjusting the effective lengths of said coaxial transmission line sections.

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