March 10, 1970 J. G. OPRYSKO 3,500,253

UHF DIRECTIONAL MIXER

Filed Jan. 23, 1968 2 Sheets-Sheet 1

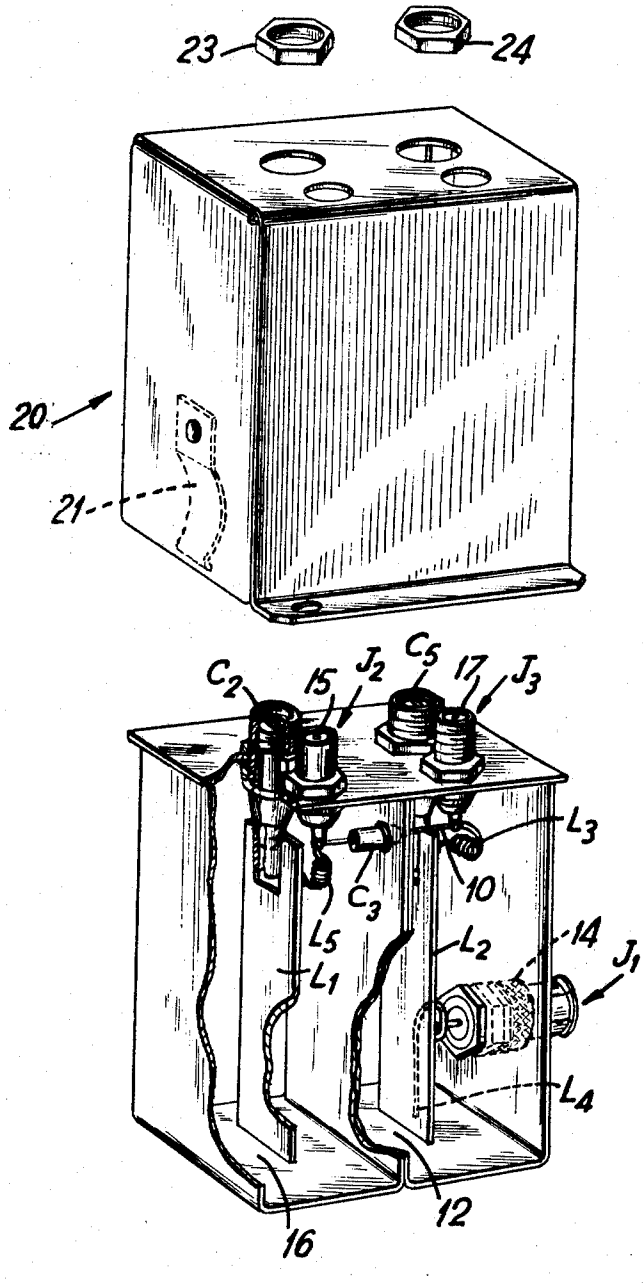


FIG. 1

INVENTOR.
JOSEPH G. OPRYSKO

BY

Hopgood & Calimafde
ATTORNEYS

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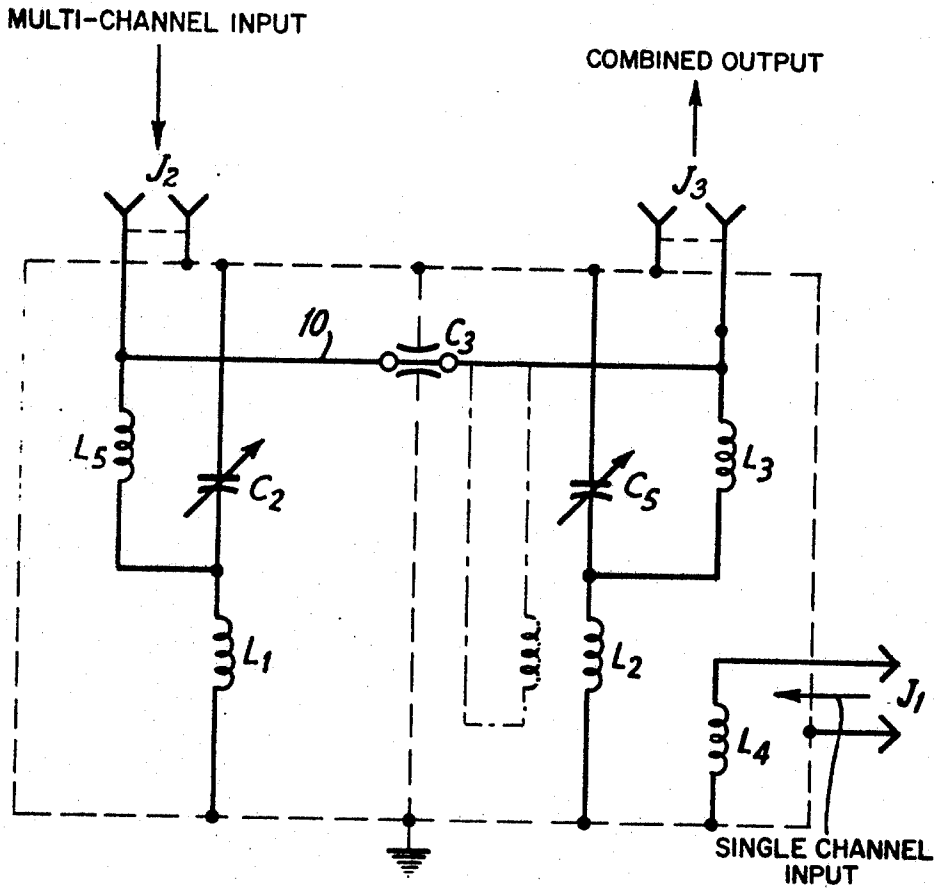


FIG. 2

INVENTOR.
JOSEPH G. OPRYSKO

BY

Hopgood & Calimafde
ATTORNEYS

United States Patent Office 3,500,253
Patented Mar. 10, 1970

3,500,253

UHF DIRECTIONAL MIXER

Joseph G. Oprysko, Philadelphia, Pa., assignor to Jerrold Electronics Corporation

Filed Jan. 23, 1968, Ser. No. 699,817
Int. Cl. H01p 5/12
U.S. Cl. 333—9 6 Claims

ABSTRACT OF THE DISCLOSURE

A two-cavity type network tunable over the UHF TV band for coupling a 6 mHz. wide UHF channel with other UHF TV signals. The first cavity which includes a resonant LC circuit tuned to reject the specific 6 mHz. signal, is fed with the other UHF signals to be mixed. The second cavity comprises an LC network tuned to band-pass the specific 6 mHz. signal and is fed with that signal. The first and second cavities are connected by a short piece of transmission line and the output signal is taken from the second cavity.

BACKGROUND OF THE INVENTION

Conventional mixers for UHF frequencies include a variety of types whose attributes generally reflect the particular function for which they were designed. With the advent of community antenna television systems (CATV systems) there has existed a demand for a mixer capable of mixing a predetermined channel frequency having a 6 mHz. wide signal into a coaxial line carrying other UHF TV signals. To date, no unit has satisfactorily fulfilled this function and simultaneously met the desirable qualities of being easily adjustable as to the channel frequency being coupled (single tuned); stable in impedance matching characteristics regardless of adjustment; and has the requisite ruggedness of CATV type devices.

It is also desirable to provide an arrangement wherein means are provided to guard against the possibility of the inserted channel (to be mixed in with the remaining UHF signals) also appearing inadvertently on the other input.

It is the object of this invention to achieve the foregoing with a device which is simple and economical to manufacture.

SUMMARY OF THE INVENTION

Briefly, the invention is predictated upon the concept of a pair of intercoupled microwave cavities, one of which includes a band-reject pole (at the specific frequency to be mixed) and is fed with a group of UHF TV signals; and the other of which includes a band-pass pole at the same frequency, and is fed with a signal at that frequency. Directional coupler action is provided by the incidental magnetic coupling introduced by the arrangement for cavity-to-cavity coupling.

The above mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will best be understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, the description of which follows.

DESCRIPTION OF SEVERAL VIEWS OF THE DRAWING

FIG. 1 is an exploded perspective illustration of one embodiment of the invention, and

FIG. 2 is a schematic of the equivalent circuit of the embodiment shown in FIG. 1.

DETAILED DESCRIPTION OF THE DRAWING

In the description of the invention which follows, reference shall be made simultaneously to FIGS. 1 and 2. In these figures, similar reference characters are employed to designate similar elements.

The signals with which the invention is concerned consist of a group of signals, including a plurality of UHF TV channels, generally available over a first coaxial line, and a single channel to be injected into the group and available over a second coaxial line. The latter single channel signal, generally 6 mHz. wide, is fed to one microwave cavity **12**, through push-on fitting **14** of input J_1. The signal is launched in the cavity by means of length L_4. The group of UHF TV signals are applied to another cavity **16**, through an input J_2 which includes coaxial connector **15**. The output, as will be explained, is available at J_3 via coaxial connector **17**.

As shown in the exploded perspective, the entire assembly is completely shielded in housing **20** having a resilient finger **21** for grounding and for rigidly maintaining the cavity exterior relative to the housing. Further mechanical support is provided by hexagonal nuts **23** and **24** on the adjustable capacitor studs C_2 and C_5.

The cavities are coupled directly between input J_2 and output J_3 by through line **10** and compensating capacitor C_3.

Cavity **12** includes a tuned band-pass pole at the frequency of the channel injected at input J_1. The tuned pole is provided by inductance L_2 in series with adjustable capacitor C_5. Inductance L_3 employs its own distributed capacity to provide a resistive cavity coupling element in series with transmission line **10**; the combination forming a shunt arm with element C_5. Cavity **16** includes a band-reject pole similarly provided by inductance L_1 in series with adjustable capacitor C_2 and for a corresponding purpose further includes resonator L_5.

The specific 6 mHz. wide channel signal injected via input J_1 meets the described band-pass filter L_2, C_5 tuned to this incoming channel frequency and it accordingly passes with low attenuation to output J_3. At this juncture, it bears mentioning that the pass and reject poles have sufficient bandwidth and the skirt characteristics are such that the entire 6 mHz. signal may be considered as a whole.

The remaining UHF signals to be mixed which are injected into the other cavity via input J_2 meet a band-reject pole at the frequency of signal being applied to input J_1. Accordingly, signals on input J_2 will be passed except where they correspond in frequency to the signal being applied to the input J_1. Consequently, unwanted out-of-phase signals which may appear on the antenna or through an amplifier coupled to J_2 will not be mixed with those appearing over J_1. Further, due to the band-reject pole, the signal appearing on input J_1 will not appear on input J_2 via the cavity coupling line **10** from J_1 to J_2.

Transmission line **10** does, however, carry the signal from J_2 to output J_3, and since J_3 also includes the magnetically coupled signal of input J_1, the desired mixing action is achieved.

Any number of channels may be be mixed by merely providing a number of devices of the invention equivalent to the number of channels to be singularly mixed and iterating the circuits in tandem. Since the cavities are tuned to the same frequency, one for band-reject, and one for band-pass, the cavities may be termed—single tuned.

By employing the described arrangement, no incoming channels appear on another incoming line, yet both incoming signals appear on the outgoing line. Capacitors

C_2 and C_5 are tunable to the desired frequency of the input J_1. In addition, inductances L_3 and L_5, which are air core inductances of predetermined number of turns, may be manually adjusted by slight shifts in their position and spacing to precisely provide the desired reject and pass poles. Inductance L_4 is adjusted for coupling into cavity **12** with the proper loading for the minimum loss in band width.

Directional coupler action is provided by the incidental magnetic coupling of through line **10** connecting the cavities. In particular, this magnetic coupling is provided by the length of line in the right hand cavity which is shown slightly longer (exposed) than in the left hand cavity. This line length magnetically couples, as shown in phantom on the equivalent circuit, to inductance L_2 and at the frequency of the cavity produces a current coupling opposite to the voltage coupling from J_3 and results in a partial cancellation of signal between J_2 and J_3 creating a mismatch which enhances the filtering provided by the trap pole L_1, C_2.

The foregoing arrangement has the unique advantage of providing the conventional low loss of a directional coupler in the paths between J_2, J_3 and J_1, J_3 with the desirable attributes of band-pass, band-reject filtering which normally give much greater attenuation.

The following are exemplary parameters for a circuit according to the invention which is tunable over the UHF TV frequency range.

Cavity **12** and **14** dimensions—5.08×6.67×2.54 cm.
L_1 and L_2—1.74×3.08 cm.
L_4 (effective)—2 cm.
L_5—5 turns No. 26, ⅛ diameter
L_3—10 turns No. 26, ⅛ diameter
C_2 and C_5—.75–9.5 pf.

While the principles of the invention have been described in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the score of the invention as set forth in the object thereof and in the accompanying claims.

What is claimed is:

1. A UHF mixer comprising:
a first microwave cavity;
coupling means for feeding an input signal into said first cavity;

coupling means for extracting an output signal from said first cavity;
a second microwave cavity;
means for feeding a second input signal to said second cavity;
means for tuning said second cavity to reject a minor band embracing the input to said first cavity;
means for tuning said first cavity to pass said minor band; and
means for coupling signals between said first and second microwave cavities, including a transmission line coupling said means for feeding a second input signal to the second cavity with said output signal coupling means in said first cavity.

2. The UHF mixer claimed in claim **1** wherein said line includes a magnetic coupling component providing directional coupler action at the frequency of the cavities.

3. The UHF mixer claimed in claim **1** wherein said means for tuning said first and second cavities comprises an inductance and capacitance in series.

4. The UHF mixer claimed in claim **3** wherein the capacitances in each of said cavities is adjustable.

5. The UHF mixer claimed in claim **4** wherein the inductance in series with said adjustable capacitance in said first cavity comprises a linear element within said cavity and wherein the input coupling means in said cavity includes a linear element running in parallel therewith for a predetermined distance.

6. The UHF mixer claimed in claim **1**, wherein said first and second microwave cavities have a common wall, and wherein said transmission line includes a wire passing through said common wall.

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H. K. SAALBACH, Primary Examiner
M. NUSSBAUM, Assistant Examiner
U.S. Cl. X.R.
333—11, 73, 76