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IMPROVED TELEVISION SIGNAL INPUT FILTER

This invention concerns an input filter located between the television signal source and radio frequency signal processing circuits in a television receiver.

5           Television receivers often include an input  
bandpass filter located between the television signal  
input of the receiver and the radio frequency (RF) signal  
processing stage of the receiver. The RF stage commonly  
includes frequency selection, amplifier and mixer stages  
10   which produce intermediate frequency (IF) output signals  
as known. The input filter prevents unwanted broadcast  
signal frequencies outside of the television frequency  
band, e.g., communications frequencies such as used by  
police, fire and citizens band broadcast and receiving  
15   systems, from reaching and interfering with the RF  
circuits of the television receiver. The input filter  
also serves to prevent signal components associated with  
locally generated video IF and sound IF signal frequencies  
from interfering with the input television signals to be  
20   processed by the RF stage.

          An input filter of the type described above is  
used, for example, in the CTC-121 color television  
receiver manufactured by the Consumer Electronics Division  
of RCA Corporation, Indianapolis, Indiana, USA and is  
25   illustrated in FIGURE 18 of the 1982 Color Television  
Basic Service Data bulletin for the CTC-121 receiver.  
In that example the input filter includes a pair of  
parallel resonant inductor-capacitor trap networks,  
respectively tuned to the 41.25 MHz sound IF frequency and  
30   to the 45.75 MHz video IF frequency, connected in series  
between the VHF television signal input of the receiver  
and a transformer which couples filter output signals to  
the RF stage of the receiver. This filter exhibits an  
unwanted resonance at approximately 300 MHz due to  
35   interaction between the inductive primary winding of the  
coupling transformer and capacitances associated with the  
filter network. The unwanted resonance can lead to

undesirable image frequencies and image distortion, and is eliminated by means of a frequency selective network in addition to the input filter.

5 An input filter in accordance with the principles of the present invention desirably can be designed not to exhibit such an unwanted resonance, which requires additional circuitry to eliminate, and can offer a very good attenuation characteristic with an economical, uncomplicated circuit topology.

10 The disclosed filter includes series resonant input and output sections shunting the signal path between the television signal source and RF signal processing stages. In a preferred embodiment of the invention, the input section is tuned to form a trap at  
15 the video IF frequency, and the output section is tuned to resonate at a frequency other than the sound IF frequency, below the band of television signal frequencies to be processed by the RF stage.

The following description of the accompanying drawing relates to an embodiment of the invention designed for incorporation in a television receiver operating according to United States  
20 standards. In the drawing:

FIGURE 1 shows a portion of the VHF input section of a television receiver including an input filter in accordance with the principles of the present invention; and

25 FIGURE 2 illustrates an amplitude-versus-frequency response attributable to the filter shown in FIGURE 1.

In FIGURE 1, an input filter circuit 10 in accordance with the present invention receives input VHF television signals from a source 15. Source 15 may be an  
30 antenna for receiving broadcast television signals, or a source of cable television signals. In either case, more than one television receiver may be supplied with signals from source 15.

Filter 10 includes a series resonant  
35 inductor-capacitor network L1, C1 shunting the signal path and resonant at the 45.75 MHz video IF frequency. Network

L1, C1, forms a video IF trap to prevent video IF components generated by an RF stage 30 from interfering with television signals supplied by source 15.

5 An intermediate filter section including series capacitors C2 and C3 in the signal path and an inductor L2 shunting the signal path serves as a high pass filter, with the value of inductor L2 being chosen to establish the corner frequency of such high pass filter.

10 High pass filtered signals from network C2, C3, L2 are coupled to an output section of filter 10 including a series resonant inductor-capacitor network L4, C4 shunting the signal path. After filtering by network L4, C4 the television signal is coupled to an inductive primary winding 20a of a coupling transformer 20, having a  
15 secondary winding 20b from which the television signal is coupled to RF stage 30. Capacitor C6 is coupled from the interconnection point of primary winding 20a and secondary winding 20b of transformer 20 to a point of reference potential. Transformer 20 primarily serves as an  
20 impedance transformation device for matching the relatively low impedance television input (e.g., 75 ohm or 300 ohm) to higher input impedance of RF stage 30. By way of example, Primary winding 20a of transformer 20 exhibits an inductance of approximately 110 nanohenrys, secondary  
25 winding 20b exhibits an inductance of approximately 650 nanohenrys, and transformer 20 exhibits a coupling coefficient of approximately 0.7, while the inductors L1, L2 and L4 are approximately 400 nanohenrys, 200 nanohenrys and 600 nanohenrys, respectively, and are set  
30 to final values during manufacturing alignment of the receiver.

RF stage 30 includes frequency selection, amplifier and mixer stages for producing IF output signals which are afterwards coupled to detector circuits and  
35 other utilization circuits of the receiver. The video and sound IF signals produced by RF stage 30 can be undesirably coupled to source 15 via receiver chassis connections, e.g., chassis loops, and can interfere with

and distort the television signals normally provided by source 15 to be processed by RF stage 30. When source 15 is a small portable receiving antenna attached to the receiver, for example, the IF signals conducted via the receiver chassis can be both radiated and received by such antenna as a distorted television signal. Filter 10 significantly attenuates the interfering IF components so that RF stage 30 receives only the television signal that it is intended to process.

The topology of filter 10, wherein input resonant section (trap) L1, C1 and output resonant section (trap) L4, C4 are series resonant and in shunt with the signal path, results in the elimination of the unwanted 300 MHz resonance experienced with an input filter of the type having parallel resonant, series connected trap sections as mentioned previously in connection with the CTC-121 television receiver.

In one configuration of filter 10, input section L1, C1 is tuned to resonate at the 41.25 MHz sound IF frequency, and output section L4, C4 is tuned to resonate at the 45.75 MHz video IF frequency. This configuration results in an unwanted resonance at approximately 34 MHz, near the 41.25 MHz sound IF frequency, primarily due to interaction between the inductance of transformer primary winding 20a and the capacitive element of the output section. This configuration exhibits good attenuation of signal frequencies below 46 MHz i.e., below the low VHF band and encompassing the unwanted video and sound IF frequencies as well as the unwanted 27 MHz citizens band (CB) frequency.

A better attenuation characteristic was found to result, however, when input section L1, C1 is arranged to resonate at the 45.75 MHz video IF frequency, and the values of output section inductor L4 and capacitor C4 are selected to resonate at a frequency which nullifies the aforementioned 34 MHz resonance between primary winding 20a and capacitive element C4 of the output section. This

has been found to occur when capacitor C4 and inductor L4 resonate at about 30 MHz in one example.

FIGURE 2 illustrates an amplitude-versus-frequency response which is related to that of the latter configuration of filter 10. The response of FIGURE 2 was measured at the mixer stage within RF stage 30, and reflects that fact that additional frequency selective networks are included between the output of transformer 20 and the mixer stage. However, it is noted that the shape of the response shown in FIGURE 2 is primarily determined by the latter configuration of filter 10. The additional frequency selective networks add only a few additional db. of attenuation to the response otherwise determined by filter 10. The attenuation characteristic of filter 10 particularly below about 46 MHz is primarily determined by the input and output sections of filter 10.

FIGURE 2 illustrates the amplitude-versus-frequency response with respect to channel 2 of the low VHF band. The peak response of FIGURE 2 between 55.25 MHz and 58.83 MHz encompasses the channel 2 frequency band. As seen from FIGURE 2, signal frequencies below 46 MHz, including the video IF frequency (45.75 MHz), the sound IF frequency (41.25 MHz), and the citizens band frequency (27 MHz) are greatly attenuated relative to the channel 2 band. The response of filter 10 is especially important relative to the low VHF band, and the channel 2 band in particular, due to the proximity of these frequency bands to the video and sound IF frequencies.

The last-mentioned configuration of filter 10 exhibits a very good attenuation characteristic of the 41.25 MHz sound IF frequency even though a sound IF trap is not specifically provided for. In this regard it is noted that filter 10 was found to exhibit a better attenuation characteristic by having the output section resonate at a frequency lower than the sound IF frequency.

The intermediate, high pass section of filter 10 comprising elements C2, C3 and L2 exhibits a cut-off

frequency of approximately 48 MHz, i.e., below the channel 2 frequency band at the beginning of the low VHF band.

5     X An input filter in accordance with the principles of the present invention can be used with respect to high VHF band and UHF band television frequencies in addition to low VHF band frequencies, depending upon the needs of a given receiver as relating to the amount of unwanted IF signal "feedback" via chassis loops, for example.

Claims:

1. In a television signal processing system,  
apparatus comprising:  
5       a source of television signals;  
         a radio frequency signal processing stage for  
producing intermediate television signal frequencies; and  
         a bandpass filter responsive to said television  
signals for providing filtered television signals to said  
10   radio frequency processing stage via a signal path  
including a transformer having input primary and output  
secondary windings which couple output signals from said  
bandpass filter to said radio frequency processing stage,  
said filter comprising  
15       an input section comprising a series resonant  
circuit shunting said signal path; and  
         an output section comprising a series resonant  
circuit shunting said signal path.
- 20       2. Apparatus according to Claim 1, wherein  
         one of said input and output sections is  
resonant at the video intermediate frequency to form a  
trap at said video intermediate frequency; and  
         the other of said input and output sections is  
25   resonant at a frequency other than the sound intermediate  
frequency, below the band of television signal frequencies  
to be processed by said radio frequency stage.
- 30       3. Apparatus according to Claim 2, wherein  
         said one of said sections is said input section,  
and said other of said sections is said output section.



4. Apparatus according to any preceding claim wherein:  
said input section comprises the series resonant  
combination of an inductance and a capacitance;  
said output section comprises the series  
5 resonant combination of an inductance and a capacitance;  
and  
said input section is coupled to said output  
section via an intermediate filter section.

10 5. Apparatus according to Claim 4, wherein  
said intermediate filter section is a high pass  
filter.

15 6. Apparatus according to Claim 5, wherein  
said intermediate section comprises first and  
second capacitances connected in series in said signal  
path between said input and output sections, and an  
inductance shunting a point between said first and second  
capacitances.

20 7. In a television signal processing system,  
apparatus substantially as hereinbefore described with  
reference to the accompanying drawing.

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