(12) **UK Patent Application** (19) **GB** (11) **2 171 869 A**

(21) Application No **8604836**

(22) Date of filing **27 Feb 1986**

(30) Priority data
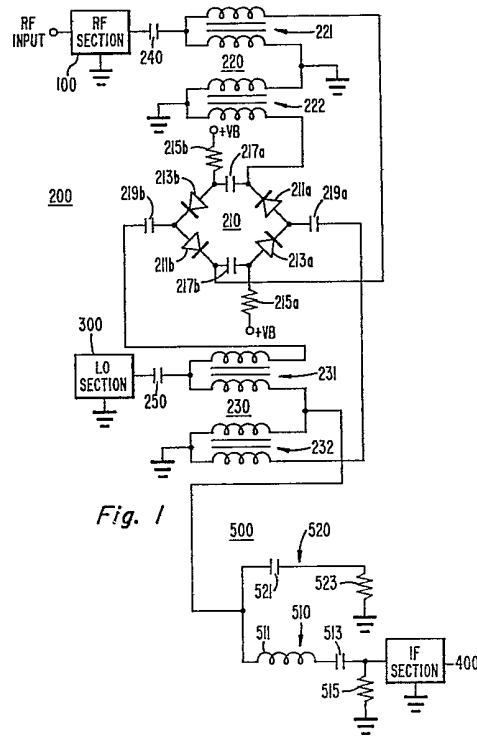
(31) **705499** (32) **28 Feb 1985** (33) **US**

(71) Applicants
RCA Corporation (USA—Delaware)
201 Washington Road, Princeton, New Jersey 08540,
United States of America

(72) Inventor:
Timothy Wayne Price

(74) Agent and/or Address for Service
R. W. Pratt, c/o RCA International Limited, Norfolk House,
31 St. James's Square, London SW1Y 4JR

(51) INT CL^4
H04B 1/26   H03H 7/00

(52) Domestic classification
(Edition H)
H3Q DRS
H3F 1M2 2A 3P
H3U 10BX QF QM
U1S 2206 H3Q H3U

(56) Documents cited
None

(58) Field of search
H3Q H3F H3T H3U
Selected US specifications from IPC sub-classes H03D H03H
H04B H04N

(54) **Tuner for R.F. receiver**

(57) The output of a doubly-balanced mixer (210) of a tuner of e.g. a television is terminated by a network (500) which exhibits the characteristic impedance of the mixer for both the sum and difference frequency components. The difference frequency component termination (510) comprises an inductor (511) and a capacitor (513) connected as a series-tuned circuit and a resistive element (515) connected in series between the output of the mixer and signal ground. The inductor and capacitor are selected resonate at a frequency in the passband of the IF section and the resistive element is selected to exhibit the characteristic impedance of the mixer. The sum frequency component termination (520) comprises a capacitor (521) and a resistive element (523) connected in series between the output of the mixer and signal ground. The capacitor is selected to exhibit negligible impedance just below the lowest frequency of the sum frequency component and the resistive element is selected to exhibit the characteristic impedance of the mixer.
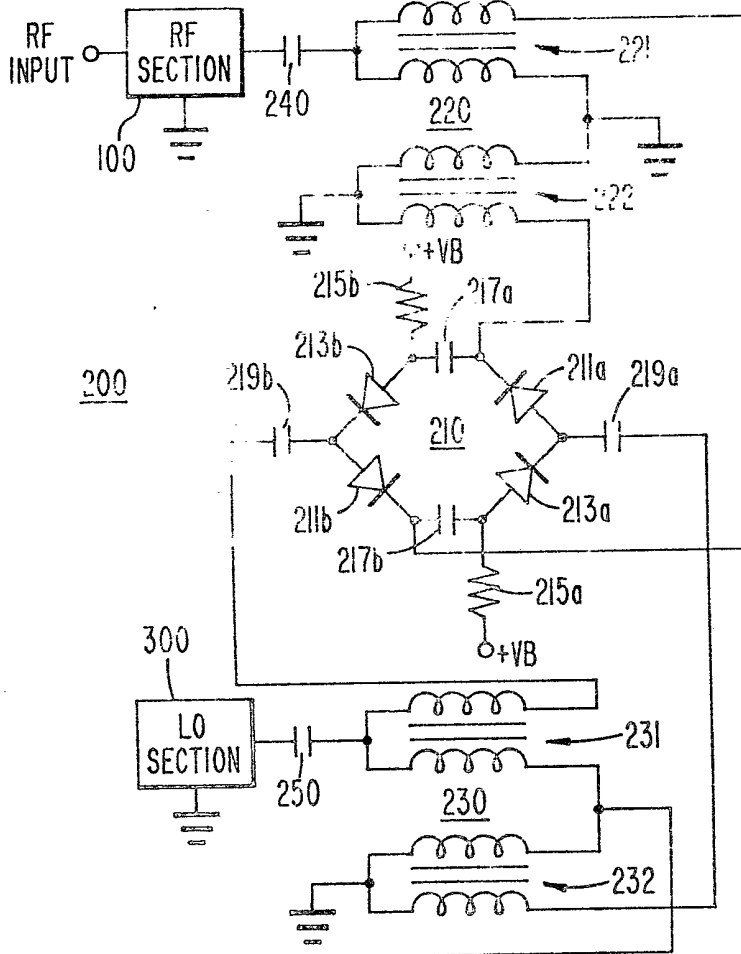
Fig. 1

GB 2 171 869 A

RF
INPUT o— | RF SECTION |

240

221

220

222

+VB

215b

217a

213b

211a 219a

219b

210

200

211b

213a

217b

215a

o +VB

300

LO SECTION

250

231

230

232

Fig. 1

Fig. 1b

Z

R0

f
155MHz

100

400

500

520

521

523

510

511

513

IF SECTION

515

Fig. 1a

Z

R0

f
44MHz
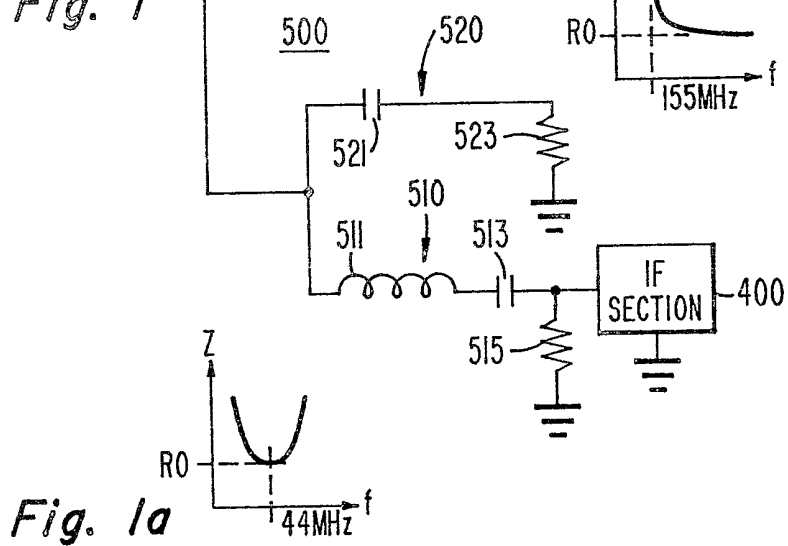
SPECIFICATION

Tuner for a receiver

5   The present invention relates to a tuner for a
receiver and concerns a termination arrangement for
a mixer of the tuner.
    An illustrative example of the invention comprises a
doubly balanced mixer to which reference is made
10 herein after by way of example.
    It is desirable to use a doubly-balanced mixer in a
television tuner because of its properties of inhibiting
the input signals from reaching the output and of
inhibiting the generation of unwanted frequency
15 components. These properties are due to the balanced
configuration of a doubly-balanced mixer.
    When receiving single ended input signals (i.e.,
input signals which are referenced to signal ground), a
balun for converting a single ended signal to a double
20 ended or differential input signal is provided for each
input signal. The output signal of the mixer is usually
taken from one of the two baluns. It is desirable to
terminate the output of the mixer with the characteris-
tic impedance of the balun in the frequency range of
25 the output signal of the mixer to prevent impedance
mismatches which would tend to produce distortion
causing unwanted frequency components. More spe-
cifically, since the output signal of a mixer contains
both sum and difference frequency components, it is
30 desirable to provide a termination network which
inhibits the characteristic impedance of the balun for
both the sum and difference frequency components.
Generally, this requires a relatively complex and
therefore expensive network.
35   It is herein recognized that for use in a tuner of a
television receiver, in which the sum and difference
frequency components are very far apart in frequency
and the local oscillator is tuned to provide a difference
frequency component is the same for each channel,
40 i.e., always in the nominal IF frequency range, the
termination network for a doubly-balanced mixer can
have a very simple configuration. Specifically, in
accordance with the invention, the termination net-
work simply includes a capacitor and a resistance
45 element having a value substantially equal to the
characteristic impedance of the mixer connected in
series between the output of the mixer and signal
ground for the sum frequency component and an
inductor, capacitor and a resistance element having a
50 value substantially equal to the characteristic impe-
dance of the mixer connected in series between the
output of the mixer and signal ground for the
difference frequency component.
    The invention will be described in greater detail with
55 reference to the accompanying drawing in which:
    FIGURE 1 shows the schematic of a preferred
embodiment of the present invention; and
    FIGURES 1a and 1b show graphical representations
of impedance characteristics useful in understanding
60 the embodiment shown in FIGURE 1.
    In FIGURE 1 there is shown a television tuner for
tuning VHF broadcast and cable channels and UHF
broadcast channels. By way of example, for use in the
United States, the tuner is capable of tuning channels
65 for which the RF picture carrier and local oscillator

frequencies are specified in the following table.

BAND	RF RANGE (MHz)	LO RANGE (MHz)
B1	55.25 − 83.25	101–129
B2	91.25 − 151.25	137–197
B3	157.25 − 265.25	203–311
B4	271.25 − 463.25	317–509
B5	471.25 − 801.25	517–847

    It will be appreciated that: band B1 corresponds to
75 channels of the low VHF broadcast band (i.e., channels
2-6); band B2 corresponds to channels in a lower
portion of the midband cable band; band B3 corres-
ponds to channels in the remaining portion of the
midband cable band, channels in the high VHF
80 broadcast band (i.e., channels 7-13) and channels in
the lower portion of the superband cable band; band
B4 corresponds to channels in the remaining portion
of the superband cable band and channels in the
hyperband cable band; and band B5 corresponds to
85 channels in the UHF broadcast band (i.e., channels
14-69).
    The RF signals received at respective VHF and UHF
inputs are coupled to an FR section 100 where the RF
signal corresponding to the selected channel is
90 selected and coupled to a mixer. A local oscillator
signal having a frequency corresponding to the
selected channel produced by a local oscillator section
300 is also coupled to mixer 200. Mixer 200 combines
the selected RF signal and the local oscillator signal to
95 produce an output signal having sum and difference
frequency components. The output signal of mixer
200 is coupled to an IF section 400. The frequency of
the local oscillator signal for each channel is control-
led so that the difference frequency component is in
100 the passband of IF section 400 which, for example, in
the United States is approximately between 41 and 46
MHz and has sound and picture carrier frequencies at
41.25 MHz and 45.75 MHz, respectively. The conven-
tional tuning control portion of the tuner for controll-
105 ing the tuning of RF section 100 and local oscillator
section 300 in the various bands is not shown.
    Mixer 200 is a doubly-balanced mixer including a
diode bridge 210 as the mixing element and baluns
220 and 230 for converting the single ended RF and
110 local oscillator signals to respective pairs of differen-
tial signals for application to respective pairs of
opposite corners of diode ridge 210. Each of baluns
220 and 230 includes two pairs of bifilar wires (221 and
222 and 231 and 232, respectively) wound around a
115 ferrite core and connected in conventional fashion as
shown to provide a 1/4 impedance transformatiion
between the unbalanced (single ended) input and the
balanced (double ended) output. RF section 100 is AC
coupled to balun 220 through a capacitor 240. Local
120 oscillator section 300 is AC coupled to balun 230
through capacitor 250. The output signal of mixer 200
is coupled from balun 230 to IF section 400 through
termination network 500, to be described in greater
detail below.
125   Bias current for diodes 211a and 213a of diode
bridge 210 is provided from a source of positive
voltage +VB through a resistor 215a. The return for
the bias current is provided by balun 220. Bias current
for diodes 211b and 213b of diode bridge 210 is
130 provided through resistor 215b in corresponding

fashion. It has been found desirable to bias the diodes in or near saturation for more linear mixer operation.

DC blocking capacitors 217a and 217b, which have negligible impedance in the frequency range of mixer
5 210, are coupled between diodes 211a and 213b and diodes 211b and 213a, respectively, to DC isolate the two bias current paths. More specifically, capacitor 217a prevents the bias current of diodes 211a and 213a from influencing the bias current of diodes 211b and
10 213b and also prevents the DC voltage developed at the junction of resistor 215b and diode 213b from being "shorted" to ground through the relatively low DC impedance of winding 222 of balun 220. Capacitor 217b serves in a corresponding manner to capacitor
15 217a. DC blocking capacitors 219a and 219b, also with negligible impedance in the frequency range of mixer 200, prevent the DC voltages at the junction of diodes 211a and 213a and at the junction of diodes 211b and 213b from being "shorted" to ground through the
20 windings of balun 230.

For optimum operation of doubly-balanced mixer 200 to provide an output signal substantially free of unwanted frequency components, it is desirable that baluns 220 and 230 be terminated in impedance
25 matching those presented by the balun at its inputs and outputs. Thus, if baluns 220 and 230 have a given characteristic impedance for the unbalanced con- figuration, e.g., 50 ohms, it is desirable that RF section 100 and local oscillator section 300 connected to the
30 unbalanced inputs of baluns 220 and 230, respective- ly, exhibit output impedances substantially equal to the unbalanced characteristics impedance, e.g., 50 ohms, and that diode bridge 210 connected to the balanced output of baluns 220 and 230 exhibits an
35 input impedance substantially equal to four times the unbalanced characteristic impedance, e.g., 200 ohms. The latter is achievable to a good approximation since a typical diode bridge exhibits an input impedance of approximately 200 ohms. For the same reasons as
40 stated above, since the output of mixer 200 is unbalanced, it is desirable that it be terminated in an impedance substantially equal to the unbalanced characteristic impedance of balun 230 throughout the frequency range of the output signal of mixer 200 for
45 both the sum and difference frequency components. This is the purpose of termination network 500.

Termination network 500 includes a difference frequency termination portion 510, coupled between the output of mixer 200 and IF section 400 and a sum
50 signal termination portion 520.

Since the difference frequency component of the output signal of mixer 200 is the same for each channel, i.e., it is always within the passband of IF section 400 due to the tuning of local oscillator section
55 300, difference frequency component termination portion 510 simply includes a series tuned circuit, consisting of an inductor 511 and a capacitor 513 resonant at a frequency substantially equal to the center frequency, e.g., 44 MHz, of the passband of IF
60 section 400, and a resistor 515 having a resistance (RO) substantially equal to the unbalanced character- istic impedance of balun 230 connected in series between the output of mixer 200 and signal ground. The input of IF section 400 is connected to the junction
65 of the tuned circuit and resistor 515. This arrangement

exhibits the impedance characteristic shown in FI- GURE 1a. It is noted that resistor 515 may comprise the input impedance of IF section 400. The series tuned circuit not only establishes (together with resistor 515)
70 the desired termination for the difference frequency component, but also prevents the sum and other unwanted frequency components from reaching IF section 400.

Since the lowest sum frequency component of the
75 output signal mixer 200 is approximately 155 MHz, i.e., the sum of the frequency of the lowest sideband component of the RF picture carrier and the frequency of the local oscillator signal for channel 2, and that is more than 99 MHz from the highest sideband compo-
80 nent of the IF picture carrier, sum frequency compo- nent termination portion 520 simply includes a capacitor 521 and a resistor 523 having a resitance (RO) substantially equal to the unbalanced character- istic impedance of balun 230 connected in series
85 between the output of mixer 200 and signal ground. Capacitor 521 is selected to isolate resistance 523 from difference frequency component termination portion 510 for frequencies below the lowest sum frequency and to have insignificant impedance at frequencies
90 above the lowest sum frequency so as to provide the impedance characteristic shown in FIGURE 1b.

It will be appreciated that modifications can be made to the preferred embodiment. For example, the order of resistor 521 and capacitor 523 in sum
95 frequency component termination portion 520 may be interchanged. Furthermore, if the input impedance of IF section 400 is very high, the input of IF section 400 may be directly coupled to the output of mixer 200 instead of the junction of the tuned circuit and resistor
100 515 of difference frequency component termination portion 510. In the latter case the order of the elements in difference frequency component termination por- tion 510 is not important, however, the filtering provided by the tuned circuit in the configuration
105 shown no longer exists. Furthermore, if the use of a single resistive termination element is desired, resis- tor 523 may be eliminated and capacitor 521 may then be connected in parallel with the series connection of inductor 511 and capacitor 513. These and other
110 modifications are contemplated to be within the scope of the present invention defined by the following claims.

CLAIMS

1.   A tuner for a receiver comprising:
115   an input for receiving RF signals corresponding to various channels;

RF means for selecting the RF signal corresponding to a selected channel;

local oscillator means for generating a local oscilla-
120 tor signal having a frequency corresponding to the selected channel;

mixer means for combining said selected RF signal and said local oscillator signal to produce an output signal at an output having sum and difference
125 frequency components;

IF means having an input coupled to the output of said mixer means and having a predetermined passband;

said local oscillator signal being controlled so that
130 said difference frequency component is within said

passband;
    sum fequency component termination means cou-
pled to said output of said mixer means for terminat-
ing said output of said mixer substantially in its
5 characteristic impedance including a capacitor and a
resistance element connected in series between said
output of said mixer and a point of reference potential,
said resistance element having a resistance value
substantially equal to that of said characteristic
10 impedance of said mixer, said capacitance having a
value such that it has a negligible impedance in the
frequency range between the highest frequency of
said difference frequency component and the lowest
frequency of said sum frequency component; and
15   difference frequency component termination
means for terminating said output of said mixer
substantially in its characteristic impedance including
an inductor and a capacitor and a resistance element
coupled in series between said output of said mixer
20 and said point of reference potential, said resistance
element having a resistance value substantially equal
to that of said characteristic impedance of said mixer,
said inductor, capacitor and resistance element
formed a tuned circuit having a resonance at a
25 frequency within said passband of said IF means.
    2.   The tuner recited in Claim 1, wherein:
    said RF means, said local oscillator means and said
IF means are adapted for tuning television signals.
    3.   The tuner recited in Claim 1
30   said inductor and said capacitor of said difference
frequency component terminating means are con-
nected in series between said output of said mixer
means and said input of said IF means.
    4.   The tuner recited in claim 1, 2 or 3 wherein:
35   said capacitor of said sum frequency component
terminating means has a value such that it has
negligible impedance just below the lowest frequency
of said sum frequency component.
    5.   The tuner recited in any impeding claim, where-
40 in the said resistance element is common to both the
sum and difference frequency component termination
means.
    6.   The tuner recited in Claim 3, wherein:
    said resistance element of said difference frequency
45 component terminating means comprises the input
impedance of said IF means.
    7.   The tuner recited in any preceding claim,
wherein:
    said mixer is a doubly-balanced mixer.
50   8.   A tuner for a receiver substantially as hereinbe-
fore described with reference to Figure 1.