Sept. 2, 1969 B. B. SCOTT ET AL 3,465,344

SINGLE ANTENNA DUAL FREQUENCY BAND SIGNAL COUPLING SYSTEM

Filed Jan. 26, 1967

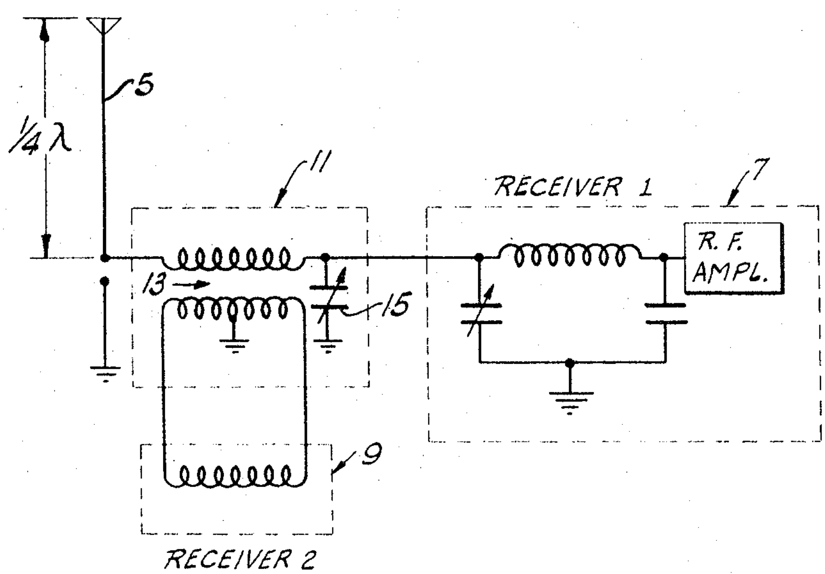

Fig. 1

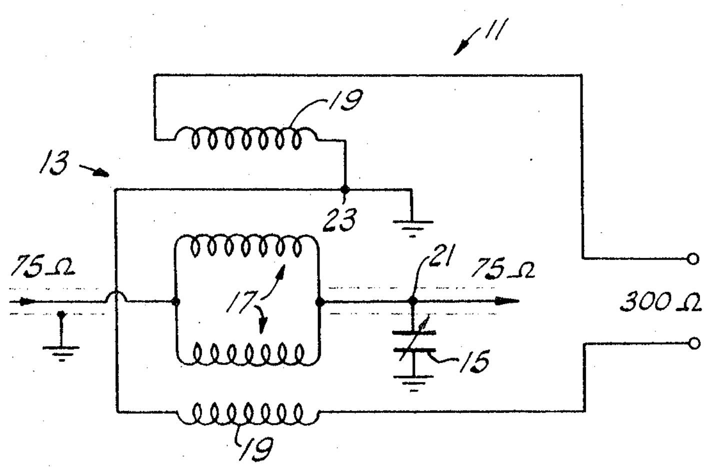

Fig. 2

INVENTORS
BENTON B. SCOTT &
THOMAS L. TAYLOR
BY
Robert E. Strauss
ATTORNEY

United States Patent Office 3,465,344
Patented Sept. 2, 1969

3,465,344

SINGLE ANTENNA DUAL FREQUENCY BAND SIGNAL COUPLING SYSTEM

Benton Boyd Scott and Thomas Lester Taylor, Batavia, N.Y., assignors to Sylvania Electric Products Inc., a corporation of Delaware

Filed Jan. 26, 1967, Ser. No. 611,984
Int. Cl. H01q 1/50
U.S. Cl. 343—852 8 Claims

ABSTRACT OF THE DISCLOSURE

A system for coupling a pair of receivers individually responsive to one of a pair of spaced frequency band signals to a single antenna tuned to provide signals at both frequency bands. A maximum transfer of signal from the antenna to each of the receivers is effected without deleterious effect upon the capabilities of the other receiving system.

Background of the invention

It is a common practice to match what might be termed the output impedance of an antenna to the input impedance of a receiver to effect a maximum transfer of signals. For example, an ordinary automobile "whip" antenna is normally considered to have an output impedance which may be depicted as a capacitor of relatively low value at the broadcast band of frequencies (550–1500 kc.). Also the usual automobile receiver is is manufactured to include a tunable capacitive-inductive network which may be adjusted such that the output impedance of the antenna and the input impedance of the receiver are matched whereupon the above-mentioned maximum transfer or signal from antenna to receiver is effected.

Also, numerous coupling means are available for matching an antenna having an output impedance of one value and a receiver having an input impedance of a greatly different value. For example, there are numerous types of balun (balanced to unbalanced) matching means available whereby an antenna having an output impedance in the vicinity of 75-ohms may be readily matched to a receiver having an input impedance of about 300-ohms such as a television receiver for instance.

However, a problem arises when a system is desired which utilizes a single antenna to provide signals at one band of frequencies for one receiver and signals at a spaced and different band of frequencies for another receiver. Referring to the above-mentioned specific examples, it has been found that an ordinary automobile receiver having an input impedance adjusted to match the impedance of an antenna for broadcast band frequencies will tend to substantially short-circuit signals of the VHF frequency band for instance. Similarly, a television receiver which normally has an input impedance in the form of a matching transformer having a few turns will tend to substantially short-circuit signals of the broadcast band. Thus, the mere coupling of two receivers responsive to signals of different frequency bands to a single antenna is deleterious to the operation of both receivers.

Objects and summary of the invention

It is an object of the present invention to provide an enhanced system for coupling a pair of receivers responsive to signals of different frequency bands to a single antenna. Another object of the present invention is to provide a system utilizing a single antenna and effecting a maximum transfer of signals at spaced frequency bands to individual receivers responsive to separate ones of the frequency band signals.

Briefly, these and other objects are achieved in one aspect of the invention by a system which includes a single antenna capable of providing signals at spaced frequency bands, a first receiver responsive to signals of one frequency band, a second receiver responsive to signals of another frequency band, and a network coupling means for connecting both receivers to the single antenna such that a maximum signal is applied to each receiver at the frequency band to which the receiver is responsive. Also, this maximum signal transfer is effected without deleterious effect upon the signal response capabilities of either receiver.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 diagrammatically illustrates one particular system for coupling a pair of receivers responsive to signals of different frequency bands to a single antenna; and

FIG. 2 is a schematic illustration of the coupling network of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In order to provide a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, the following description is to be considered in conjunction with the above-mentioned drawing and the appended claims. Also, the following description will be directed to the above-mentioned examples of typical receivers for purposes of clarity and understanding but the invention is in no way to be construed as limited thereto.

Referring to FIG. 1, the system includes a single antenna 5, a first or radio receiver 7, a second or television receiver 9, and a coupling network 11. The antenna 5 is of the ordinary "whip" type commonly used on automobiles and capable of providing a signal at a relatively low frequency band such as the broadcast band. Also, the antenna 5 has an alterable length and may be adjusted to quarter-wave length resonance for a relatively high frequency band such as the VHF frequencies common to television. Moreover, it has been found that the output impedance of the antenna 5 is a reasonably stable value of about 75-ohms for both the relatively low and the relatively high band of frequencies.

The first receiver 7 is of the ordinary AM type commonly utilized in automobiles and includes any one of a variety of adjustable capacitive-inductive signal input networks. This input network usually includes an alterable capacitor whereby the input impedance of the receiver 7 is adjusted to match the output impedance of the antenna 5 in order to effect a maximum transfer of signals of the broadcast band from the antenna 5 to the receiver 7.

The second receiver 9 is an ordinary television receiver having a signal input network which normally consists of a transformer winding having a few turns of wire. This input network is usually constructed to provide a relatively high input impedance of about 300-ohms for signals in the VHF band.

At this point it should perhaps be noted that the above-mentioned adjustable capacitive means of the first receiver **7** would tend to substantially short-circuit signals of the VHF band of frequencies. Similarly, the transformer input winding of the second receiver **9** would tend to substantially short-circuit signals of the broadcast band. Thus, direct coupling of both the first and second receivers **7** and **9** to a single antenna **5** would be deleterious to the signal reception obtainable from both receivers, **7** and **9** respectively.

To overcome the above problems, a coupling network **11** is provided for connecting both the first receiver **7** and the second receiver **9** to the single antenna **5**. The coupling network preferably includes a balun **13** and a capacitive means **15**. The balun **13**, which is more clearly illustrated in FIG. 2, includes a first pair of transmission lines **17** in parallel connection and a second pair of transmission lines **19** inductively coupled to the first pair of transmission lines **17**.

The first pair of transmission lines **17** is characterized by an unbalanced input impedance of about 75-ohms in this instance which matches the output impedance of and is connected to the antenna **5**. Similarly, the first pair of transmission lines **17** has an unbalanced output impedance of about 75-ohms which matches the input impedance of the first receiver **7** and is connected thereto.

Preferably, but not necessarily, a capacitive means **15** couples the junction **21** of the first pair of transmission lines **17** and the first receiver **7** to circuit ground. This capacitive means **15** is usually in the form of an alterable capacitor having a value in the range of about 5 to 80 picofarads which is usually less than the range of the value of the alterable capacitor of the adjustable capacitive-inductive signal input network of the receiver **7**. Thus, the capacitor of the capacitive-inductive signal input network of the receiver **7** may be adjusted to a minimum with all further adjustment means provided by the capacitive means **15**. In this manner, the system is independent of the variations in the receiver **7** although it is obvious that the capacitive means **15** may be eliminated so long as the receiver **7** includes a signal input network which has capacity sufficient to substantially short-circuit signals of the VHF frequency band.

The second pair of transmission lines **19** is inductively coupled to the first pair of transmission lines **17**. A junction **23** is connected to circuit ground with the opposite end of the second pair of transmission lines **19** having a substantially balanced output impedance in the order of about 300-ohms. The output, having an impedance of about 300-ohms, is coupled to the input network of the second receiver **9** which also has a compatible impedance of about 300-ohms.

Additionally, it should be noted that the balun **13** is preferably of the bifilar wound binocular type having a capacity between windings in the range of about 5 to 15 picofarads. Thus, stray capacitive losses are maintained at a relatively low value and minimal size adjustable capacitors may be utilized whereby space is conserved and cost is reduced.

The operation of the system is relatively straight forward in that the antenna **5** is preferably adjusted in length to provide quarter-wave resonance at the relatively high or VHF band of frequencies. Also, it should perhaps be noted that this adjustment in length is not particularly critical and, in most presently available automobile antenna systems, merely amounts to extending the antenna to a maximum length.

Following the adjustable capacitance of the inductive-capacitive input network of the first receiver **7** is altered to provide an impedance which matches the output impedance of the first pair of transmission lines **17** which is substantially the same as the output impedance of the antenna **5**. Alternatively, the above-described capacitance adjustment is provided by altering the capacitor **15** should the input network of the first receiver **7** fail to include an adjustable capacitor.

Thus, a relatively low frequency or broadcast band of signals is coupled from the antenna **5** to the first receiver **7** via the first pair of transmission lines **17**. Moreover, this first pair of transmission lines **17** presents a negligible impedance to signals in the broadcast band thereby permitting a maximum transfer of signals to the first receiver **7** in the frequency band to which the first receiver **7** is responsive.

Further, a relatively high frequency or VHF band of signals available at the antenna **5** is transferred to the second receiver **9** via the first pair of transmission lines **17** and the inductively coupled second pair of transmission lines **19**. Since the capacitor of the inductive-capacitive input network of the first receiver **7** or, in the absence of such a network, the adjustable capacitor **15** appears substantially as a very low impedance to ground in so far as the VHF band of signals is concerned, the first and second pair of transmission lines **17** and **19**, respectively, provide a maximum transfer of signals from the antenna **5** to the second receiver **9** at the frequency band to which the receiver **9** is responsive.

Thus, there has been provided a unique system utilizing a single antenna to provide signals of spaced frequency bands to a pair of receivers responsive to opposite ones of the spaced frequency band signals. The system is simple and inexpensive and provides a maximum transfer of signals without deleterious effect upon the response capabilities of either receiver system. Also, it may be noted that the first pair of transmission lines presents a relatively high impedance in so far as ignition type noise is concerned which greatly enhances the operation of the first receiver. Moreover, the fact that a preferred embodiment of the invention has been shown and described makes it obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined by the appended claims.

We claim:

1. A spaced dual frequency band coupling system utilizing a single antenna comprising in combination:

- a single antenna for intercepting first and second spaced frequency band signals;
- a first receiver responsive to signals of said first frequency band;
- a second receiver responsive to signals of said second frequency band; and
- means for coupling said first and second receivers to said antenna, said means including a first pair of parallel connected transmission lines coupling said first receiver to said antenna and a second pair of transmission lines inductively coupled to said first pair of transmission lines with one end of each of said second pair of transmission lines connected to circuit ground and the opposite end of each of said second pair of transmission lines coupled to said second receiver.

2. The coupling system of claim **1** including adjustable capacitive means coupling the junction of said first pair of transmission lines and said first receiver to circuit ground.

3. The coupling system of claim **1** wherein said first and second pairs of transmission lines are in the form of a balun.

4. The coupling system of claim **1** wherein said first and second pairs of transmission lines are in the form of a bifilar wound binocular-type balun.

5. The coupling system of claim **1** wherein said signals of said first frequency band are broadcast band frequency signals and said signals of said second frequency band are VHF signals.

6. The coupling system of claim 2 wherein said adjustable capacitive means has a range of about 5 to 80 picofarads.

7. The coupling system of claim 3 wherein said balun has an unbalanced input impedance of about 75-ohms for said first and second bands of frequencies, and unbalanced output impedance of about 75-ohms for said first band of frequencies, and a balanced output impedance of about 300-ohms for said second band of frequencies.

8. The coupling system of claim 3 wherein said balun has a capacity between windings in the range of about 5 to 15 picofarads.

References Cited

UNITED STATES PATENTS

3,217,275 11/1965 Duncan et al. -------- 333—76

ELI LIEBERMAN, Primary Examiner

U.S. Cl. X.R.

343—858; 333—25