April 22, 1952 C. J. MILLER 2,594,055

ANTENNA COUPLING SYSTEM

Filed June 29, 1949

Fig. 1.

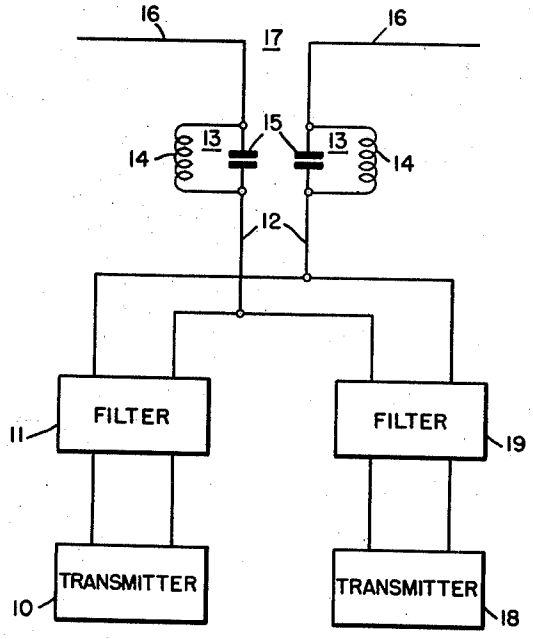
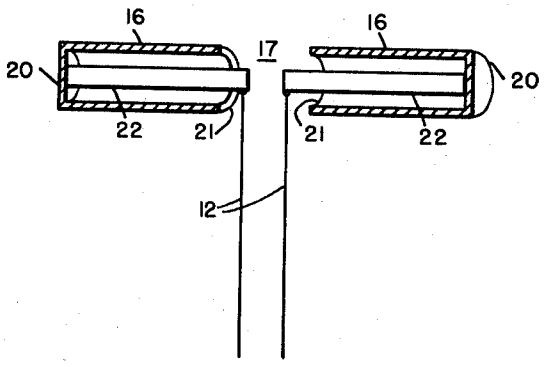


Fig. 2.



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ANTENNA COUPLING SYSTEM

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This invention relates to antenna systems, and it has as an object the provision of an antenna system which can be used efficiently at two different frequencies.

Ordinarily where two carrier waves having different frequencies are transmitted from one location, it is customary, for efficient operation, to use a separate antenna system for each frequency. While so-called band antenna systems have been designed for use with different frequencies, in such systems the impedances of the antennas have been matched by circuits connected in shunt to the antennas, for matching the impedances of their associated transmission lines at the different frequencies for preventing reflection losses and the formation of standing waves on the lines. For many duties such a broad-band system is not as suitable for the efficient transmission of two frequencies as separate antenna systems matched to the two frequencies. It has also been proposed to use a single antenna for the transmission of several frequencies, and to manually adjust the physical length of the antenna so as to match the different frequencies. While such antennas are more efficient than those used in broad-band antenna systems, their complications and their inability to handle efficiently, the simultaneous transmission of two frequencies, prevents their use for many duties.

This invention provides for the efficient use of a single antenna with two different frequencies. The antenna is a dipole, the length of which is such that it is resonant at a frequency midway between the two frequencies with which it is to be used. A parallel tuned circuit which also is resonant at the frequency to which the dipole is resonant, is placed in series with each of the two transmission lines connected to the dipole. At the higher of the two frequencies, the reactance of the dipole will be inductive, and the reactance of the tuned circuits will be capacitive, the total reactance being zero. At the lower of the two frequencies, the reactance of the dipole will be capacitive, and the reactance of the tuned circuits will be inductive, the total reactance being zero. Thus the antenna is matched to each of the two frequencies.

A feature of the invention is that it provides an antenna which can be efficiently used simultaneuously with two different frequencies.

Another object of the invention is to provide an antenna for use with two frequencies and having zero reactance at each frequency.

Another object of the invention is to provide

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an antenna which can be efficiently used simultaneously with two frequencies.

The invention will now be described with reference to the drawing, of which:

Figure 1 is a circuit schematic illustrating one embodiment of this invention having parallel tuned circuits in series with the transmission lines connected to a dipole antenna, and

Fig. 2 is a projected view, in section, of a dipole antenna having short-circuited, quarter-wave sections of transmission lines as coaxial inner conductors, and which form parallel tuned circuits in series with the antenna and the transmission lines.

Referring now to Fig. 1, the lower frequency transmitter 10 which operates at, for example, a carrier frequency of 100 mc. is connected through the filter 11 to the transmission lines 12. The transmission lines are connected through the parallel-tuned circuits 13 consisting of the inductors 14 shunted by the capacitors 15, to the quarter-wave arms 16 of the half-wave, dipole antenna 17.

The higher frequency transmitter 18 which operates at, for example, a carrier frequency of 150 mc., is connected through the filter 19 to the transmission lines 12.

The filters 11 and 19 are band pass filters which pass only the frequencies of the carriers and their sidebands, of the transmitters 10 and 18 respectively.

The dipole antenna 17 is cut to resonate at a frequency of 125 mc. which is approximately midway between the carrier frequencies of the two transmitters. The parallel tuned circuits 13 are also tuned to resonate at the mid-frequency of 125 mc., and for accomplishing this, the inductors 14 may each have an inductance of .02 microhenry, and the capacitors 15 each may have a capacity of 80 micromicrofarads.

In operation, at the higher carrier frequency of the transmitter 18, the reactance of the dipole antenna will be inductive, and the reactance of the parallel-tuned circuits 13 will be correspondingly capacitive whereby the total reactance is zero. At the lower carrier frequency of the transmitter 10, the reactance of the dipole antenna will be capacitive, and the reactance of the parallel-tuned circuits 13 will be correspondingly inductive whereby the total reactance will be zero. Thus the single antenna offers zero reactance at the carrier frequency of both transmitters, and is equally effective at both frequencies.

The two transmitters can be operated simulta-

neously without interaction or, of course, can be operated alternately.

There is no broad-band effect except that inherent in the physical size of the dipole. A dipole having a large cross-sectional diameter will be broader banded than one having a smaller diameter.

Fig. 2 of the drawing illustrates a conventional dipole construction which may be used in the practice of this invention, the dipole including the parallel-tuned circuits **13** illustrated by Fig. 1. The quarter-wave, dipole arms **16** are tubular, and are closed at their outer ends **20** and are open at their inner ends **21**. The coaxial inner conductors **22** are shorted at their outer ends to the outer ends **20** of the dipole, and are connected at their inner ends to the transmission lines **12**. The radiating surface of the antenna is the outer surface of the dipole, and the parallel resonant circuits corresponding to the circuits **13** of Fig. 1, are formed by the proper sizing and spacing of the opposing outer surfaces of the inner conductors **22** and the inner surfaces of the dipole arms **16**.

While the invention has been described in connection with radio transmitters, it can also be used with radio receivers.

I claim as my invention:

1. An antenna system for use with two radio frequency sources having different frequencies, comprising a dipole antenna resonant at a frequency midway between said frequencies, a pair of transmission lines for connecting said frequency sources to said antenna, and means forming parallel-tuned circuits in series with said transmission lines and said antenna, said circuits being resonant at said midway frequency.

2. An antenna system as claimed in claim 1 in which the dipole arms are coaxial conductors shorted at their outer ends and are connected to the transmission lines by inner conductors, and in which the parallel-tuned circuits are formed by the opposed outer surfaces of the inner conductors and the inner surfaces of the dipole arms.

3. An antenna system as claimed in claim 1 in which the parallel-tuned circuits are shunt connected inductors and capacitors connected in series with the dipole arms and the transmission lines.

4. In combination with two radio units tuned to different frequencies, a dipole antenna resonant at a frequency midway between said frequencies, a pair of transmission lines connected to said units, and means providing parallel-tuned circuits resonant at said midway frequency, connected in series with said lines and the arms of said antenna.

5. In combination with two radio transmitters having different carrier frequencies, a dipole antenna resonant at a frequency midway between said frequencies, a pair of transmission lines connected to said transmitters, and means providing parallel-tuned circuits resonant at said midway frequency connected in series with said lines and the arms of said antenna.

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