

[54] **VEHICLE-MOUNTED ANTENNA AND COUPLING CIRCUIT THEREFOR**
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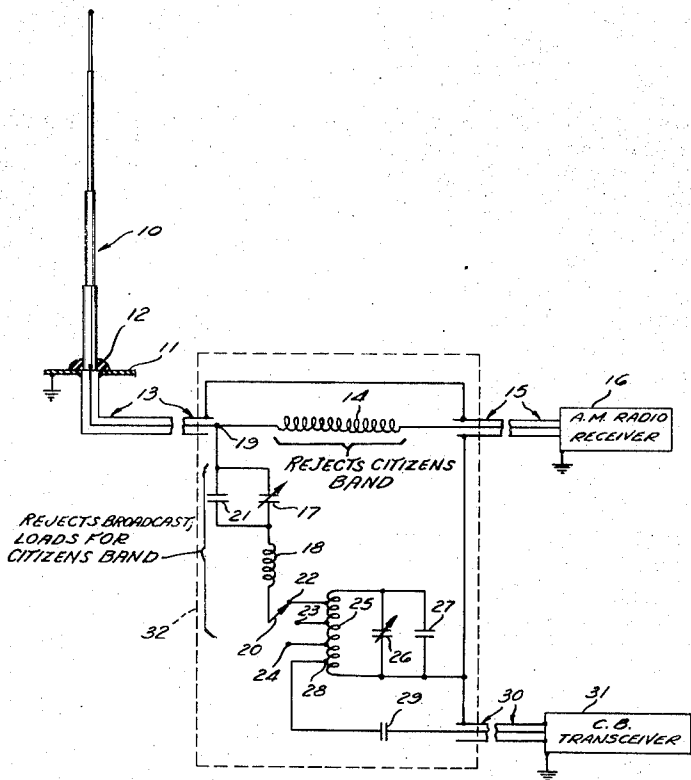
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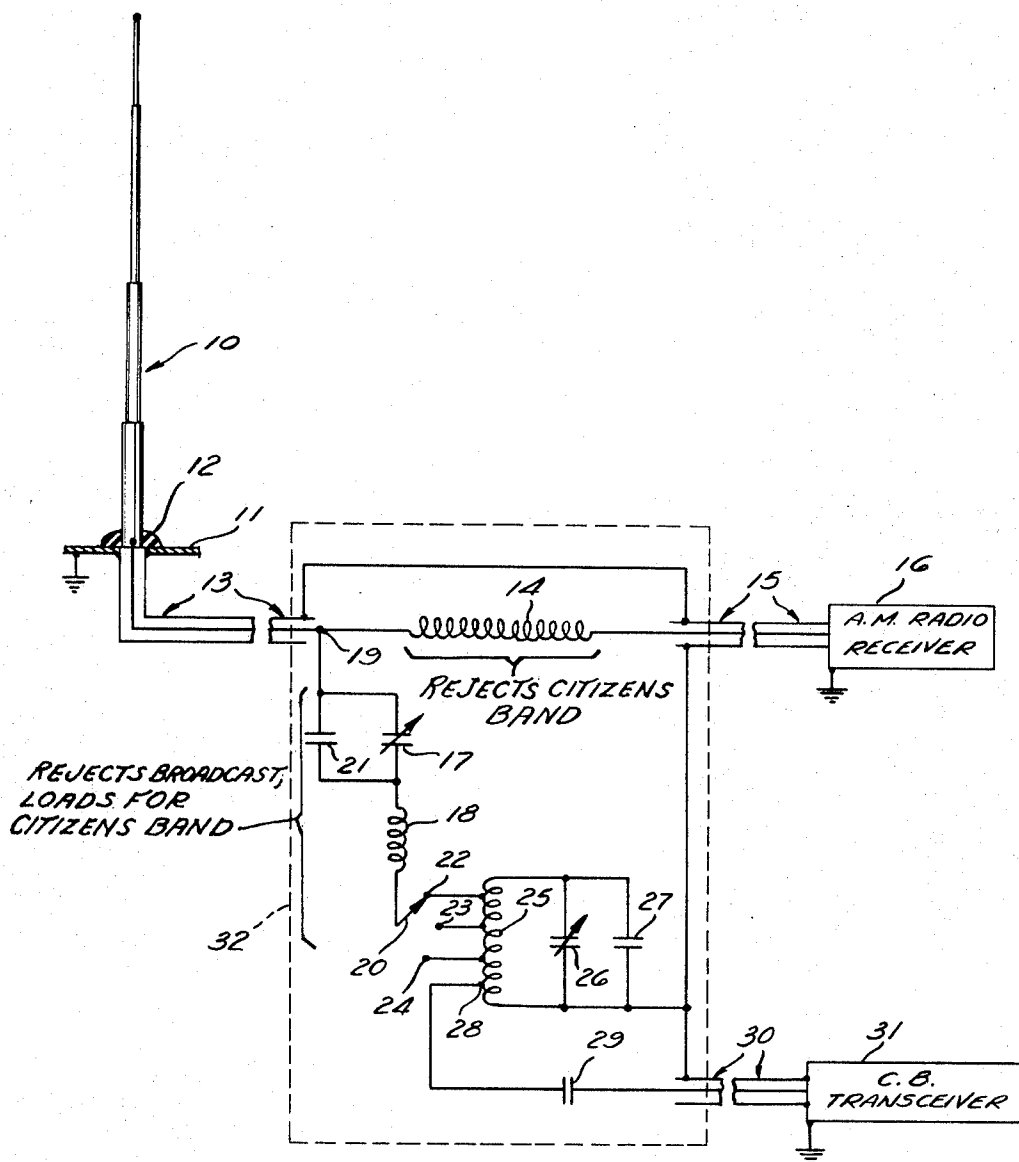
[57] **ABSTRACT**

Vehicle-mounted antenna system having a novel coupling circuit connected between the end of an antenna lead-in cable away from the latter's connection to a conventional standard broadcast antenna and a standard broadcast (A.M.) radio receiver and citizens band communications equipment. This coupling circuit:

1. passes standard broadcast signals to the standard broadcast receiver and blocks incoming citizens band signals from this receiver;
2. passes citizens band signals and blocks standard broadcast signals between the antenna and the citizens band communications equipment;
3. increases the effective electrical length of the antenna for efficient transmission and reception of citizens band signals; and
4. impedance matches the antenna lead-in cable to the citizens band communications equipment.

15 Claims, 1 Drawing Figure





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VEHICLE-MOUNTED ANTENNA AND COUPLING CIRCUIT THEREFOR

This invention relates to a vehicle-mounted antenna system and to a coupling circuit therein for enabling a standard broadcast radio receiver antenna on a vehicle, such as an automobile, to be used also for citizens band communications equipment on the vehicle.

Citizens band transceivers have come into use for emergency signaling by vehicle drivers, particularly drivers of automobiles who may want to use the citizens band transmitter to call for assistance on the highway in case of an accident or breakdown of the automobile. Previously, the vehicle-mounted antennas for citizens band transceivers have been of two different types: (1) an antenna designed specifically for the citizens band transceiver and entirely separate from the antenna for the standard broadcast radio receiver on the vehicle; and (2) an antenna specially designed both to receive standard broadcast radio programs, within the standard broadcast frequency range from 550 to 1,600 kilocycles per second, and to transmit and/or receive messages in the citizens band, within the frequency range from 26.965 to 27.255 megacycles per second. In either case, the use of the conventional standard broadcast radio receiver antenna on the vehicle for citizens band signaling was considered to be unfeasible.

The present invention is directed to a novel vehicle-mounted antenna system and to a novel coupling circuit therein in which a conventional standard broadcast radio antenna on the vehicle, such as an automobile, may be used also for citizens band signaling when desired, as well as to perform its usual function of receiving standard broadcast radio programs, thereby avoiding the expense of providing either an additional special antenna for citizens band signaling or a specially designed dual purpose antenna.

Accordingly, it is an object of this invention to provide a novel and improved vehicle-mounted antenna system in which a conventional standard broadcast radio receiver antenna may be used for citizens band signaling.

Another object of this invention is to provide a novel and improved coupling circuit for connection to a conventional standard broadcast antenna on a vehicle to enable that antenna to be used for citizens band signaling.

Further objects and advantages of this invention will be apparent from the following detailed description of certain presently-preferred embodiments which are described with reference to the single FIGURE of the accompanying drawing, which illustrates the invention schematically.

Referring to the drawing, reference numeral 10 designates a conventional vertically extending automobile antenna for receiving commercial A.M. radio programs within the standard broadcast frequency range from 550 to 1,600 kc. The antenna has the usual telescopically arranged sections which enable its physical length to be selectively adjusted. The antenna is mounted on the car body 11 by any suitable insulation support, shown schematically at 12. For standard broadcast radio reception the antenna is connected to a conventional coaxial antenna lead-in cable 13, which has an impedance of about 125 ohms. The inner conductor of this cable is connected to the antenna at its lower end, and its outer conductor or sheath is grounded to the car body 11.

The opposite end of the inner conductor of the antenna lead-in cable 13 is connected at junction point 19 to one end of a choke coil 14, and the opposite end of this coil is connected through a similar cable 15 to the input of a conventional standard broadcast radio receiver 16 in the automobile. The outer conductors of cables 13 and 15 are connected conductively to each other.

The conventional automobile radio antenna, even when extended to its maximum length, is much shorter than one-quarter wavelength of signals within the standard broadcast radio band and therefore it does not closely approach a resonant condition. Consequently, it is inherently inefficient at these signal frequencies, but the usual standard broadcast signal strength is so great that a highly efficient receiving antenna is not required, it being more important from the practical standpoint to keep the physical length of the antenna from exceeding a reasonable limit.

However, for broadcasting or receiving signals in the citizens band between 26.965 and 27.255 mc the conventional automobile antenna for receiving standard broadcast programs is so inefficient that it was considered impractical heretofore for transmitting and/or receiving such signals at the much lower power levels of citizens band transmission.

In accordance with a principal aspect of the present invention, this difficulty is overcome by providing a coupling circuit for the conventional automobile radio antenna which increases the effective electrical length of the antenna to a value at or closely approaching resonance for signals in the citizens band, so that the efficiency of the antenna is increased enough to enable the successful transmission and/or reception of relatively low power citizens band signals.

Referring to the drawing, in the particular embodiment shown, this coupling circuit comprises a series L-C circuit including a condenser 17 and an inductance coil 18 connected in series with each other between the junction point 19 and an adjustable switch contact 20. Junction point 19 is at the end of the antenna lead-in cable 13 remote from the antenna 10. Condenser 17 in this series L-C circuit is adjustable, and to facilitate its adjustability an additional fixed condenser 21 is connected across condenser 17. In this series L-C circuit, condensers 17 and 21 constitute a "first condenser means" and coil 18 is a first "first coil."

The adjustable switch contact 20 may be positioned selectively to engage any one of three fixed contacts 22, 23 and 24 which are connected to different points along the length of a second inductance coil 25, whose lower end in the drawing is connected to the outer conductor of a coaxial cable 30. An adjustable condenser 26 is connected across coil 25, and to facilitate its adjustment another condenser 27 is connected across condenser 26. Coil 25 and condensers 26 and 27 constitute a parallel L-C circuit in which coil 25 is the "second coil" and condensers 26, 27 are a "second condenser means."

Coil 25 has an additional tap 28, located above its lower end in the drawing and below the taps 22-24, which is connected through a blocking condenser 29 to one end of the inner conductor of cable 30. The opposite end of this inner conductor is connected to a conventional citizens band transceiver 31, which is adapted to either transmit or receive signals in the

citizens band and which may have a "push-to-talk" microphone switch. The outer conductor or sheath of cable 30 is connected conductively to the outer conductors of cables 13 and 15, and preferably is connected directly to the frame of transceiver 31 which is grounded to the vehicle body. Both cable 30 and transceiver 31 have a characteristic impedance of about 50 ohms which, it will be noted, is substantially lower than the impedance of the antenna lead-in cable 13.

The entire coupling circuit preferably is enclosed within a protective container 32, which may be of metal or a suitable non-metallic material and may be grounded to the vehicle body or not.

In the operation of this circuit, the series L-C circuit components 17, 18, 21 act as a filter to reject the incoming standard broadcast radio signals from the citizens band transceiver 31, while passing the citizens band signals to or from the transceiver 31 without substantial attenuation. In addition, however, the inductive reactance of coil 18 adds to the effective electrical length of the antenna 10 for citizens band signals, so that its effective electrical length is at or sufficiently close to $\frac{1}{4}$ wavelength for efficient transmission or reception of citizens band signals. Coil 18 has this loading effect on the antenna even though they are separated by the antenna lead-in cable 13. Normally, this cable 13 has a low capacitive reactance and sufficient inductive reactance that it will present an inductive reactance to the citizens band signals and to this extent it will also increase the effective electrical length of the antenna slightly. However, it is coil 18 which provides the principal loading on the antenna.

Coil 25 in the parallel L-C circuit 25, 26, 27 matches the 50 ohm impedance of the citizens band transceiver 31 and its cable 30 to the substantially higher impedance of the antenna lead-in cable 13. Coil 25 functions as a step-up transformer, the magnitude of the step-up being determined by which tap 22, 23 or 24 is engaged by the adjustable switch contact 20. When the antenna 10 is extended to its full height (for example, about 56 inches), the movable switch contact 20 is connected to the uppermost tap 22 on coil 25. When the antenna is retracted to its minimum length (for example, about 22 inches), contact 20 is connected to the lower tap 24. The third tap may be used when the antenna is partially retracted to a position about mid-way between these extremes.

The blocking capacitor 29 prevents de-tuning of this step-up transformer from the 50-ohm transceiver cable 30.

If desired, the lower end of coil 18 in the series L-C circuit may have a fixed connection to the upper end of coil 25 in the parallel L-C circuit, in which case the antenna 10 should be kept fully extended at all times for the most efficient transmission and reception of citizens band signals.

Further simplification may be achieved by making the condensers 17 and 26 fixed, instead of adjustable, for specific applications on a known vehicle having cables of known lengths. Except in such cases, these condensers preferably should be adjustable to permit precise tuning after the system is installed on the vehicle.

The function of choke coil 14 is to act as a filter which rejects the incoming or outgoing citizens band

signals from the standard broadcast radio receiver 16, while permitting incoming standard broadcast program signals to be received without excessive attenuation.

From the foregoing description it will be apparent that the present coupling circuit in the complete embodiment shown performs the functions of increasing the effective electrical length of the antenna for efficient transmission and reception of citizens band signals, matching the antenna lead-in cable to the citizens band communications equipment, and passing separately the citizens band signals and the incoming standard broadcast signals between the antenna and the respective receiving and/or transmitting equipment on the vehicle.

While a presently-preferred embodiment of this invention has been described in detail and illustrated schematically in the accompanying drawing, and certain simplifications of the present coupling circuit have been referred to, it is to be understood that this invention is susceptible of other embodiments which differ in detail from the disclosed embodiments and that various refinements and omissions differing from the disclosed embodiments may be adopted without, however, departing from the spirit and scope of the present invention.

I claim:

1. A coupling circuit for connecting citizens band communications equipment to a vehicle-mounted antenna having a length substantially less than $\frac{1}{4}$ wavelength for citizens band signals and provided with an antenna lead-in cable, said coupling circuit comprising filter circuit means for connection between said communications equipment and said cable and effective to reject incoming standard broadcast signals, said filter circuit means having sufficient inductive reactance to increase substantially the effective electrical length of the antenna for efficient transmission or reception of citizens band signals.

2. A coupling circuit according to claim 1, wherein said filter circuit means comprises first condenser means and a first coil connected in series with each other.

3. A coupling circuit for connecting citizens band communications equipment to a vehicle-mounted antenna having a length substantially less than one-quarter wavelength for citizens band signals and provided with an antenna lead-in cable having an impedance substantially greater than that of said communications equipment, said coupling circuit comprising filter circuit means for connection at one end to the antenna lead-in cable and effective to reject incoming standard broadcast signals and to pass signals in the citizens band, said filter circuit means having sufficient inductive reactance therein to increase substantially the effective electrical length of the antenna for efficient transmission or reception of signals in the citizens band, and impedance matching means including a step-up transformer connected to the opposite end of said filter circuit means for matching the impedance of said communications equipment to that of the antenna lead-in cable.

4. A coupling circuit for connecting citizens band communications equipment to a vehicle-mounted antenna having a length substantially less than one-quarter wavelength for citizens band signals and pro-

vided with an antenna lead-in cable having an impedance substantially greater than that of said communications equipment, said coupling circuit comprising filter circuit means for connection at one end thereof to the antenna lead-in cable away from the antenna and operative to reject standard broadcast signals and to pass citizens band signals, said filter circuit means having sufficient inductive reactance to increase substantially the effective electrical length of the antenna for efficient transmission or reception of signals in the citizens band, impedance matching means connected at one end thereof to the opposite end of said filter circuit means and including a step-up transformer to match the impedance of said communications equipment to that of the antenna lead-in cable, and a blocking condenser connected to the opposite end of said impedance matching means.

5. A coupling circuit for connecting citizens band communications equipment to a vehicle-mounted antenna having a length substantially less than one-quarter wavelength for citizens band signals and provided with an antenna lead-in cable having an impedance substantially greater than that of said communications equipment, said coupling circuit comprising:

a series L-C circuit for connection at one end thereof to the antenna lead-in cable remote from the antenna, said series L-C circuit having series-connected first condenser means and a first coil, said first coil having an inductive reactance sufficient to increase substantially the effective electrical length of the antenna for efficient transmission or reception of signals in the citizens band, said series L-C circuit constituting a rejection filter for rejecting incoming standard broadcast radio signals and for passing citizens band signals;

and a parallel L-C circuit connected to the opposite end of said series L-C circuit and comprising parallel-connected second condenser means and a second coil, said second coil having one terminal thereon grounded and another terminal thereon connected to said series L-C circuit and a tap intermediate said terminals for connection to said communications equipment, said second coil providing a step-up transformer for matching the impedance of the communications equipment to that of the antenna lead-in cable.

6. A coupling circuit for connecting both a standard broadcast radio receiver and citizens band communications equipment to the lead-in cable of a vehicle-mounted antenna having a length substantially less than $\frac{1}{4}$ wavelength for citizens band signals, said coupling circuit comprising first filter circuit means for connection between the antenna lead-in cable and the citizens band communications equipment and effective to reject incoming standard broadcast radio signals and to pass signals in the citizens band, said first filter circuit means having sufficient inductive reactance to increase substantially the effective electrical length of the antenna for efficient transmission or reception of citizens band signals, and second filter means for connection between the antenna lead-in cable and the standard broadcast radio receiver and effective to reject citizens band signals and to pass standard broadcast radio signals, said first and second filter means being in parallel to each other for connection to said antenna lead-in

cable, whereby, upon connection of a citizen band set (receiver, transmitter, or transceiver) and a standard broadcast set to said first and second filter means, respectively, each set will be operational.

7. A coupling circuit for connecting both a standard broadcast radio receiver and citizens band communications equipment to a vehicle-mounted antenna having a length substantially less than $\frac{1}{4}$ wavelength for citizens band signals and having a lead-in cable with an impedance substantially greater than that of said communications equipment, said coupling circuit comprising first filter circuit means for connection at one end to the antenna lead-in cable and effective to reject incoming standard broadcast radio signals and to pass signals in the citizens band, said first filter circuit means having sufficient inductive reactance to increase substantially the effective electrical length of the antenna for efficient transmission or reception of citizens band signals, impedance matching means connected to the opposite end of said first filter circuit means and operative to match the impedance of said communications equipment to that of the antenna lead-in cable, and second filter means for connection between the antenna lead-in cable and the standard broadcast radio receiver and effective to reject citizens band signals and to pass standard broadcast radio signals, said first and second filter means being in parallel to each other for connection to said antenna lead-in cable, whereby, upon connection of a citizen band set (receiver, transmitter, or transceiver) and a standard broadcast set to said first and second filter means, respectively, each set will be operational.

8. A coupling circuit for connecting both a standard broadcast radio receiver and citizens band communications equipment to a vehicle-mounted antenna having a length substantially less than one-quarter wavelength for citizens band signals and provided with a lead-in cable having an impedance substantially greater than that of said equipment, said coupling circuit comprising first filter circuit means for connection at one end to the antenna lead-in cable away from the antenna and effective to reject incoming standard broadcast radio signals and to pass signals in the citizens band, said first filter circuit means having sufficient inductive reactance to increase substantially the effective electrical length of the antenna for efficient transmission or reception of citizens band signals, impedance matching means including a step-up transformer connected to the opposite end of said first filter circuit means and operative to match the impedance of said citizens band communications equipment to that of the antenna lead-in cable, and second filter means for connection between the antenna lead-in cable and the standard broadcast radio receiver and effective to reject citizens band signals and to pass standard broadcast radio signals, said first and second filter means being in parallel to each other for connection to said antenna lead-in cable, whereby, upon connection of a citizen band set (receiver, transmitter, or transceiver) and a standard broadcast set to said first and second filter means, respectively, each set will be operational.

9. A coupling circuit for connecting both a standard broadcast radio receiver and citizens band communications equipment to a vehicle-mounted antenna having a length substantially less than $\frac{1}{4}$ wavelength for citizens

band signals and provided with a lead-in cable having an impedance substantially greater than that of said communications equipment, said coupling circuit comprising:

a series L-C circuit for connection at one end thereof to the antenna lead-in cable remote from the antenna, said series L-C circuit having series-connected first condenser means and a first coil, said first coil having an inductive reactance sufficient to increase substantially the effective electrical length of the antenna for efficient transmission or reception of signals in the citizens band, said series L-C circuit constituting a rejection filter for rejecting incoming standard broadcast radio signals and for passing citizens band signals;

a parallel L-C circuit connected at one end thereof to the opposite end of said series L-C circuit and comprising parallel connected second condenser means and a second coil, said second coil having one terminal thereon grounded and, another terminal thereon connected to said series L-C circuit and a tap intermediate said terminals for connection to the citizens band communications equipment, said second coil providing a step-up transformer for matching the impedance of said communications equipment to that of the antenna lead-in cable;

a blocking condenser connected to said intermediate tap and adapted to be connected to said communications equipment;

and a choke coil for connection between the antenna lead-in cable and the standard broadcast radio receiver and effective to reject citizens band signals and to pass standard broadcast radio signals.

10. An antenna system comprising a vehicle-mounted antenna having a length substantially less than $\frac{1}{4}$ wavelength for citizens band signals, an antenna lead-in cable connected to said antenna, and a coupling circuit comprising filter circuit means for connection to said cable away from the antenna and effective to reject incoming standard broadcast signals and to pass citizens band signals, said filter circuit means having sufficient inductive reactance to increase substantially the effective electrical length of the antenna for efficient transmission or reception of citizens band signals.

11. An antenna system for citizens band communications equipment comprising a vehicle-mounted antenna having a length substantially less than $\frac{1}{4}$ wavelength for citizens band signals, an antenna lead-in cable having an impedance substantially different from that of said communications equipment, and a coupling circuit comprising filter circuit means connected at one end to the antenna lead-in cable remote from the antenna and effective to reject incoming standard broadcast radio signals and to pass citizens band signals, said filter circuit means having sufficient inductive reactance to increase substantially the effective electrical length of the antenna for efficient transmission or reception of signals in the citizens band, and impedance matching means connected to the opposite end of said filter circuit means to match the impedance of said communications equipment to that of the antenna lead-in cable.

12. An antenna system for both a standard broadcast radio receiver and citizens band communications

equipment comprising a vehicle-mounted antenna having a length substantially less than $\frac{1}{4}$ wavelength for citizens band signals, an antenna lead-in cable connected to the antenna, and a coupling circuit comprising first filter circuit means connected to the antenna lead-in cable away from the antenna and effective to reject incoming standard broadcast radio signals and to pass signals in the citizens band, said first filter circuit means having sufficient inductive reactance to increase substantially the effective electrical length of the antenna for efficient transmission or reception of citizens band signals, and second filter means connected to the antenna lead-in cable away from the antenna and effective to reject citizens band signals and to pass standard broadcast radio signals.

13. An antenna system for both a standard broadcast radio receiver and citizens band communications equipment comprising a vehicle-mounted antenna having a length substantially less than $\frac{1}{4}$ wavelength for citizens band signals, an antenna lead-in cable connected to said antenna and having an impedance substantially greater than that of said communications equipment, and a coupling circuit comprising first filter circuit means connected at one end to the antenna lead-in cable remote from the antenna and effective to reject incoming standard broadcast radio signals and to pass signals in the citizens band, said first filter circuit means having sufficient inductive reactance to increase substantially the effective electrical length of the antenna for efficient transmission or reception of citizens band signals, impedance matching means connected to the opposite end of said first filter circuit means to match the impedance of said communications equipment to that of the antenna lead-in cable, and second filter means connected to the antenna lead-in cable remote from the antenna and effective to reject citizens band signals and to pass standard broadcast radio signals.

14. In combination on a vehicle,
a standard broadcast radio receiver;
citizens band communications equipment;
a vehicle-mounted antenna having a length substantially less than $\frac{1}{4}$ wavelength for citizens band signals;

an antenna lead-in cable connected to the antenna and having an impedance substantially greater than that of said communications equipment;

first filter circuit means connected at one end to the antenna lead-in cable remote from the antenna and effective to reject incoming standard broadcast radio signals and to pass signals in the citizens band, said first filter circuit means having sufficient inductive reactance to increase substantially the effective electrical length of the antenna for efficient transmission or reception of citizens band signals;

impedance matching means connected between the opposite end of said first filter circuit means and said communications equipment to match the latter's impedance to that of the antenna lead-in cable;

and second filter means connected between the antenna lead-in cable and said standard broadcast radio receiver and effective to reject citizens band signals and to pass standard broadcast radio signals.

15. In combination on a vehicle,
a standard broadcast radio receiver;
citizens band communications equipment;
a vehicle-mounted antenna having a length substan-
tially less than $\frac{1}{4}$ wavelength for citizens band 5
signals;
an antenna lead-in cable connected to the antenna
and having an impedance substantially greater
than that of said communications equipment;
a series L-C circuit connected at one end thereof to 10
the antenna lead-in cable remote from the anten-
na, said series L-C circuit having series-connected
first condenser means and a first coil, said first coil
having an inductive reactance sufficient to in-
crease substantially the effective electrical length 15
of the antenna for efficient transmission or recep-
tion of signals in the citizens band, said series L-C
circuit constituting a rejection filter for rejecting
incoming standard broadcast radio signals and for
passing citizens band signals; 20

a parallel L-C circuit connected at one end thereof to
the opposite end of said series L-C circuit and
comprising parallel connected second condenser
means and a second coil, said second coil having
one terminal thereon grounded and another ter-
minal thereon connected to said series L-C circuit
and a tap intermediate said terminals for connec-
tion to the citizens band communications equip-
ment, said second coil providing a step-up trans-
former for matching the impedance of said com-
munications equipment to that of the antenna
lead-in cable;
a blocking condenser connected between said inter-
mediate tap and said communications equipment;
and a choke coil connected between the antenna
lead-in cable and the standard broadcast radio
receiver and effective to reject citizens band
signals.

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