

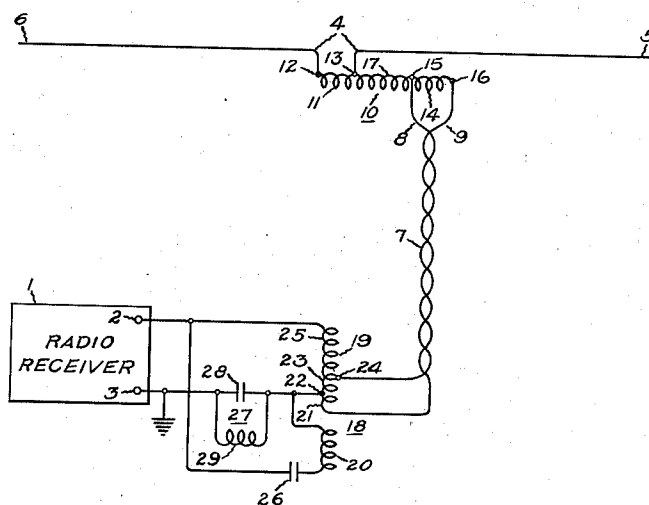
May 10, 1938.

R. B. DOME

2,117,154

ALL-WAVE ANTENNA AND COUPLER SYSTEM

Filed Aug. 27, 1937



Inventor:
Robert B. Dome,
by *Harry E. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

2,117,154

ALL-WAVE ANTENNA AND COUPLER
SYSTEMRobert B. Dome, Bridgeport, Conn., assignor to
General Electric Company, a corporation of
New York

Application August 27, 1937, Serial No. 161,247

5 Claims. (Cl. 250—33)

My invention relates to radio receiving systems adapted for both long and short wave reception, and particularly to antenna and coupling arrangements for such systems wherein noise picked up by the transmission line extending between the antenna and the receiver is reduced in both the long wave and the short wave bands. The object of the invention is to provide an improved and simplified antenna and coupler arrangement of this character.

It has been proposed heretofore to provide an antenna and coupler arrangement for all-wave radio receiving systems comprising a dipole antenna, a transmission line connecting the antenna to the receiver, and a transformer arranged at the antenna in such manner that short wave currents, which cause opposite ends of the antenna to oscillate in opposite phase, produce circulating currents in the transmission line or currents which flow down one conductor of the line and up the other conductor, and that long wave currents, which cause the antenna to oscillate as a whole with respect to ground, also produce circulating currents in the transmission line. A transformer is then provided at the receiver end of the transmission line having a grounded midtap in a winding connected across the end of the line, so that substantially only the circulating currents produce an effect in the receiver, the currents such as noise currents, picked up by the two transmission line conductors in phase, producing no effect in the output of the latter transformer and therefore no effect in the receiver.

In accordance with my present invention a simplified and efficient system of the above character is provided wherein autotransformers are employed both to couple the antenna to the transmission line and to couple the transmission line to the receiver, and capacitors heretofore employed in the coupling means between the antenna and the transmission line are eliminated.

It is a further feature of my invention that a circuit, anti-resonant at a predetermined frequency in the short wave range at which dipole operation is less efficient than T antenna operation, is provided whereby the midtap on the transformer connecting the transmission line to the receiver is not grounded, the antenna system then oscillating at this predetermined frequency, as a whole.

The novel features which are considered to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organ-

ization and method of operation together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing, which is a diagrammatic representation of an all-wave radio receiving system in which my invention has been embodied.

In the drawing, the single figure represents a radio receiving system or like system including a load device such as a radio receiver 1 of the all-wave type having input terminals 2 and 3. The numeral 4 designates an antenna which may be, for example, a conventional doublet or dipole having oppositely extending tops 5 and 6. A transmission line or lead-in 7 is provided preferably of the type comprising a twisted pair of conductors 8 and 9, or two conductors closely adjacent to each other throughout their length.

To couple the antenna 4 to the transmission line 7, I provide a single winding or autotransformer 10 comprising a section 11 at one extremity thereof connected at taps 12 and 13 respectively to the inner ends of the antenna tops 5 and 6, a section 14 at the opposite or outer extremity of the autotransformer connected at taps 15 and 16 respectively to the upper ends of the conductors 8 and 9 of transmission line 7, and an intermediate section 17 between taps 13 and 15. The winding or autotransformer 10 is of the tight coupling type.

To couple the transmission line 7 to the receiver 1, I provide a transformer 18 comprising a single winding or autotransformer 19 of the tight coupling type and a winding 20 tightly coupled thereto. The primary 21 of autotransformer winding 19 is connected at its opposite extremities to the lower ends of the transmission line conductors 8 and 9 and is provided with a midtap 22. The secondary of autotransformer winding 19 includes that section 23 of primary 21 which extends between the midtap 22 and the connection point 24 of one of the line conductors, as 8, and a section 25 extending from connection point 24 to the upper extremity of the autotransformer winding 19, which is connected to the antenna terminal 2 of the radio receiver 1. One terminal of winding 20 is connected to midtap 22, and connections including a condenser 26, having a high impedance for oscillations in the long wave bands and a low impedance for oscillation in the short wave bands, are provided between the other terminal of winding 20 and antenna terminal 2. The capacitor 26 can often be advantageously chosen to resonate with the secondary 20 in the high frequency band to

improve reception. The other receiver terminal 3 is grounded, and connections including a circuit 27, constituted by a capacitance 28 and an inductance 29 and tuned to a predetermined relatively high frequency, are provided between the grounded terminal 3 and the midtap 22 of primary 21.

In operation, when the all-wave receiver 1 is adjusted for reception over a high frequency band other than that to which circuit 27 is tuned as will be explained more fully hereinafter, the antenna 4 operates as a dipole, currents circulating therein, from one top portion to the other, through the autotransformer section 11 functioning as a primary to induce currents in section 14 which functions as a secondary. Currents from secondary section 14 circulate in the transmission line 7 and in the primary 21 of transformer 18 thereby inducing currents in secondary 20 from which the currents are supplied to receiver antenna terminal 2 and ground terminal 3 through condenser 26 which is of negligibly low impedance for the high frequency, and through circuit 27, which is of low impedance for all frequencies except its predetermined frequency. Secondary 20 and condenser 26, forming a series circuit across the receiver terminals, have, preferably, such characteristics that this series circuit resonates at about seven megacycles, which causes reception in the six and the nine and five-tenths megacycle bands to be better than would be the case if the capacity of condenser 26 were chosen merely to provide high impedance in the low frequency bands and low impedance in the high frequency bands. Any noise or other currents picked up by the conductors 8 and 9 of the transmission line 7 tend to flow in the same phase through the opposite halves of primary 21, the midtap 22 of which is grounded through circuit 27, and are thus substantially canceled out.

When the receiver 1 is adjusted for reception over the broadcast or other low frequency bands, the impedance of the sections 11, 14 and 17 of antenna coupling coil or autotransformer 10 and the primary 21 of autotransformer 19 being relatively low at these low frequencies, currents oscillate freely in the circuit including the two antenna wires or tops 5 and 6 functioning as a single antenna, windings 11, 17 and 14 of transformer 10, transmission line conductors 8 and 9 operating in parallel, winding 21 of autotransformer 19, circuit 27, and ground. In autotransformer 10 the oscillating currents in winding section 17 functioning as a primary induce currents in winding section 14 functioning as a secondary. The currents in section 14 then circulate in the opposite conductors 8 and 9 of transmission line 7 and in the primary 21 of autotransformer 19. Corresponding currents are then induced in sections 23 and 25 constituting the low frequency secondary which is connected across the receiver terminals through the circuit 27 in the connections between receiver grounded terminal 3 and the tap 21 of transformer 19, the latter circuit 27 being of negligibly low impedance for currents of the broadcast and other low frequency bands. As in the case of operation on the high frequency band, noise or other currents picked up by the transmission line tend to flow in the same phase through the opposite halves of primary 21 having grounded midtap 22, and are canceled out as before.

It has been found that while operation of the antenna as a dipole as hereinabove explained

insures satisfactory reception over the greater part of the short wave bands, signal response at the receiver tends to fall off perceptibly at about four megacycles. I have found that the signal response may be brought up to satisfactory strength by the provision of the circuit 27 which is tuned to that high frequency, in the present case approximately four megacycles, at which the lessened signal response is otherwise obtained. In operation of the system at this latter frequency, the transformer 18 is virtually disconnected from ground by the high impedance of tuned circuit 27 in the connections between midtap 22 and the grounded terminal 3 of receiver 1. The antenna system as a whole, constituted by the antenna proper or horizontal wires 4 and the down-lead 7, then operates as a usual T antenna to supply currents at the predetermined frequency through the antenna terminal 2 to the receiver 1. Thus, while the resulting T antenna operation at four megacycles due to the action of the tuned circuit 27 does not provide for noise reduction at the frequency of four megacycles, the desirable result is obtained that the signal response throughout the short wave bands is caused to be maintained substantially uniform at a satisfactorily high level.

The radio receiver system in accordance with my invention has been described hereinabove in connection with a single radio receiver 1 of the all-wave type. It will be readily understood, however, that the system is easily adaptable to reception of the short wave and long wave signals respectively by different receivers supplied from the same antenna 4 and transmission line 7.

My invention has been described herein in a particular embodiment for purposes of illustration. It is to be understood, however, that the invention is susceptible of various changes and modifications and that by the appended claims I intend to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a dipole antenna, radio apparatus adapted to receive long and short waves, a transmission line adapted to have long and short wave currents circulating therein, means to couple said antenna to said transmission line for long and short wave currents, said means being constituted by a single winding, said winding having a section connected across the inner extremities of said antenna, a section connected across the upper extremities of said transmission line, and a section between said two sections, and means to couple said transmission line to said radio apparatus for both long and short wave currents circulating in said transmission line and supplied thereto through said winding.

2. In combination, a dipole antenna, a radio receiver adapted to receive long and short waves, a transmission line arranged to have long and short wave currents circulating therein, means constituted by an autotransformer to couple said antenna to said transmission line, and means to couple said transmission line to said radio receiver comprising an autotransformer having a primary connected at its midtap to the grounded terminal of said receiver and a secondary connected across the antenna terminal of said receiver and said grounded terminal, said second-named coupling means further comprising a secondary in inductive relation with said primary and connected across said terminals through a

condenser having a high impedance for long waves and a low impedance for short waves.

3. In combination, a dipole antenna, a radio receiver adapted to receive long and short waves, a transmission line adapted to have long and short wave currents circulating therein, means to couple said antenna to said transmission line for long and short waves, means to couple said transmission line to said receiver for long and short waves comprising a transformer having a primary connected at its midtap to the grounded terminal of said receiver and a secondary connected across the antenna terminal of said receiver and said grounded terminal through a condenser having a high impedance for long waves and a low impedance for short waves, and a circuit tuned to a predetermined high frequency in the connections between said midtap and said grounded terminal, whereby said antenna and said transmission line operate together as a T antenna at said predetermined frequency.

4. In combination, a dipole antenna, an all-wave radio receiver, a transmission line adapted to have long and short wave currents circulating therein, means constituted by an autotransformer to couple said antenna to said line, said autotransformer having two sections connected respectively across the inner extremities of said antenna and the upper extremities of said line and a section between said two sections, and means to couple

said receiver to said line comprising an autotransformer having a primary connected at its midtap to the grounded terminal of said receiver, a secondary connected across the antenna terminal and the grounded terminal of said receiver, and another secondary in inductive relation with said primary and connected across said terminals through a condenser, whereby long and short wave currents circulating in said line are supplied respectively to said receiver through said first-named and said second-named secondaries.

5. In combination, a dipole antenna, a radio receiver adapted to receive long and short waves, a transmission line arranged to have long and short wave currents circulating therein, means to couple said antenna to said line, and means to couple said line to said receiver comprising an autotransformer having a primary connected at its midtap to the grounded terminal of said receiver and a secondary connected across the antenna terminal of said receiver and said grounded terminal, said second-named means further comprising a series circuit connected across said terminal including a secondary in inductive relation with said primary and a condenser, said condenser having such capacity that said series circuit resonates at a predetermined frequency in the short wave range.

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