J. R. CARSON.

DUPLEX WIRELESS SYSTEM.

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1,188,531.

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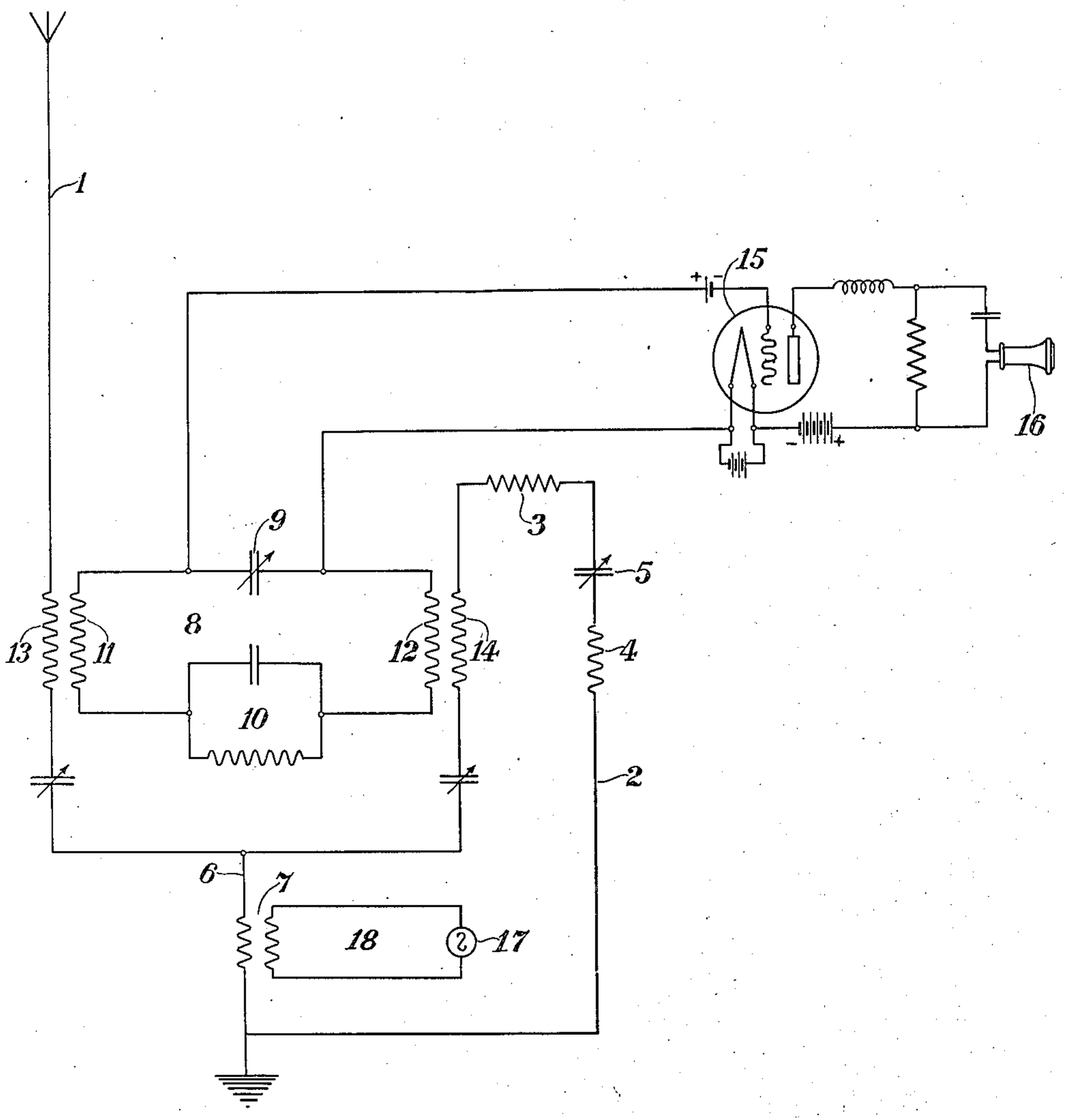

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UNITED STATES PATENT OFFICE.

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DUPLEX WIRELESS SYSTEM.

1,188,531. Specification of Letters Patent. Patented June 27, 1916.

Application filed September 27, 1915. Serial No. 52,866.

To all whom it may concern:

Be it known that I, JOHN R. CARSON, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Duplex Wireless Systems, of which the following is a specification.

This invention relates to a duplex wireless system, and more particularly to a wireless system for the simultaneous transmission and reception of signals in which different wave lengths are employed for the transmitted and received signals.

Heretofore, in actual practice, it has been customary to alternatively put the transmitting and the receiving circuit proper into operative connection with the antenna by means of a switching arrangement.

It is the object of this invention to provide a means whereby two-way or duplex communication between two wireless stations may be carried on automatically in a manner analogous to that at present obtaining in commercial telephone and duplex telegraph systems.

It is well known that, in wireless telegraphy and telephony, the magnitude of the transmitted current is enormously greater than the received current, their ratio being of the order of one million to one. This enormous ratio renders inapplicable to wireless systems, methods which are employed successfully in wire telegraph and telephone systems. The wireless system, is, however, differentiated in the following two important respects from the ordinary wire telegraph and telephone systems; first, energy is transmitted and received at definite constant frequencies or wave lengths; and, secondly, resonant tuned circuits are employed. The present invention is based on these two facts.

The requirements of a successful wireless duplex system are: first, that the system have two resonant frequencies or wave lengths, to one of which the transmitting system proper is tuned, and to the other of which the receiving system proper is tuned; and secondly, that the receiving system proper be very efficiently screened or protected from electromagnetic induction from the transmitting system. The manner in which this invention satisfies these requirements and the invention itself may best be understood by reference to the accompanying drawing which is a diagram of a system embodying this invention.

Referring to said drawing, 1 is the antenna circuit, and 2 is an auxiliary branch circuit containing a resistance 3, inductance 4, and capacity 5, by means of which the antenna branch 1, and branch 2 may be adjusted to have the same impedance at the transmission wave length. A branch 6 connects the system to ground, and contains the primary of an oscillation transformer 7, which couples the transmitting circuit 18 to the antenna system. The transmitting circuit is shown, for convenience, as energized by a high frequency generator 17.

A receiving oscillation circuit 8 contains an adjustable condenser 9 and the anti-resonant set 10. Said receiving circuit is inductively connected to the antenna by means of inductance coils 11 and 13 and to the branch 2 by means of the inductance coils 12 and 14, said coils being similar and equal. Across condenser 9 is connected the input side of a detector 15 preferably of the vacuum tube type, whose output side is operatively connected to a telephone receiver 16. It will be understood, of course, that the application of the present system is not limited to any particular type of receiving apparatus.

It is evident that the addition of the auxiliary branch circuit 2 gives the system two degrees of freedom and therefore two resonant wave lengths. One of these resonant wave lengths is employed for transmission and the other for reception of signals.

The operation of the organization shown, with regard to transmission of signals, is as follows:—The system is excited or energized by a source of high frequency energy, conventionally represented by the high frequency generator 17, through the oscillation transformer 7. Since the two branches 1 and 2 have the same impedance, the current divides equally between said two branches. The transmission current, therefore, induces equal and opposing voltage in the coils 11 and 12 which are coupled to coils 13 and 14 respectively; and, hence, if the two branches are balanced, the resultant voltage and current in the coupled receiving circuit 8 is zero. An exact balance of the two branches is difficult and indeed impracticable to obtain and maintain, and hence a slight degree of unbalance must be expected and

guarded against. The effect of an unbalance is minimized by tuning the receiving circuit 8 to the wave length of reception; wherefore, the receiving circuit offers a high impedance to currents of the transmitted wave lengths. This impedance at the transmission wave length may be made very large by including in the receiving circuit the set 10, which is adjusted to anti-resonance to the transmission wave length. The receiving circuit as a whole is tuned to the reception wave length.

It will be evident from the foregoing description that when impulses originate in branch 6, branches 1 and 2 are symmetrically related to said impulses and, since the impedances of said branches 1 and 2 are equal, equal currents flow in said branches with the result that no current flows in the receiving circuit 8. During reception of signals, the energy from the incident waves is absorbed by the antenna. The received impulses therefore originate in branch 1, and branches 1 and 2 are not symmetrical with respect to said received impulses. The currents, therefore, in branches 1 and 2, corresponding to the received signals, are not equal, and the receiving circuit 8 is not balanced with respect to said signals. Since said receiving circuit 8 is tuned to the wave length of said received signals it is strongly responsive thereto and the receiver 16 is therefore energized, independently of the fact that the system may be simultaneously radiating energy at a different wave length.

I claim:

1. A duplex wireless signaling system employing different wave lengths for the transmission and reception of signals comprising an antenna circuit, an auxiliary branch circuit having substantially the same impedance as said antenna circuit and in parallel therewith with respect to the transmission current; an oscillation circuit differentially connected to both of said circuit, said oscillation circuit having a high impedance for currents of the transmission frequency and low impedance for currents of the reception frequency, and a receiving device operatively connected to said oscillation circuit.

2. A duplex wireless telegraph or telephone system employing different wave lengths for the transmission and reception of signals comprising a branch circuit including the antenna and the primary of a coupling inductance coil, a second branch circuit, including the primary of a transmitting oscillation transformer, connecting said antenna branch to ground, and an auxiliary branch circuit connected to ground and to the common point of said two branch circuits, said auxiliary branch circuit including the primary of a coupling inductance coil and also including resistance, inductance and capacity elements so adjusted that the said auxiliary branch circuit has the same impedance as the antenna branch circuit, and a receiving circuit coupled by means of said coupling coils to both the antenna and the auxiliary branch circuits, the said receiving circuit being tuned to resonance with the wave length of the received signals while offering a relatively high impedance to the wave length of the transmitted signals.

3. A duplex wireless telegraph or telephone system employing different wave lengths for the transmission and reception of signals comprising a branch circuit including the antenna and the primary of a coupling inductance coil, a second branch circuit including the primary of a transmitting oscillation transformer, and connecting said antenna branch to ground, and an auxiliary branch circuit connected to ground and to the common point of said two branch circuits, the said auxiliary branch circuit including the primary of a coupling inductance coil and also including resistance, inductance and capacity elements so adjusted that the said auxiliary branch circuit has the same impedance as the antenna branch circuit, and a receiving circuit coupled by means of said coupling coils to both the antenna and the auxiliary branch circuits, the said receiving circuit being tuned to resonance with the wave length of the received signals and being tuned to anti-resonance with the wave length of the transmitted signals.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this 22nd day of September, 1915.

JOHN R. CARSON.

Witnesses:
FRED'K S. ROBINSON,
GEORGE E. FOLK.