

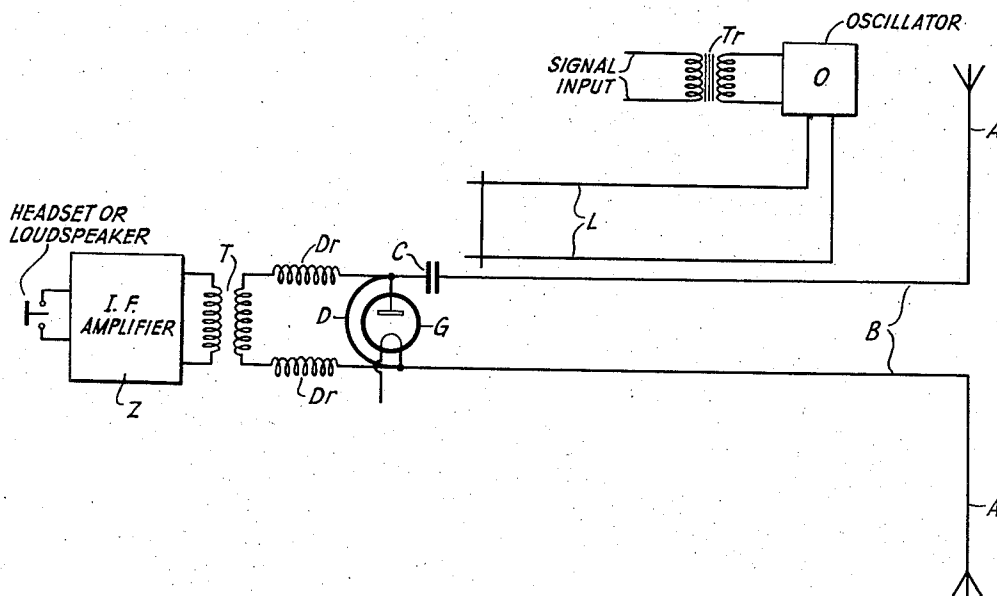
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ARRANGEMENT FOR DUPLEX OPERATION

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ARRANGEMENT FOR DUPLEX OPERATION

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It is known in the prior art that duplex communication on two different waves is feasible by causing, at both stations, the incoming signal wave to form with the radiated wave an intermediate frequency or beat frequency.

In the present invention an arrangement is concerned and hereinafter disclosed which is predicated upon the same principle, but which by virtue of the use of decimeter or midget waves, according to the invention, and of the features associated therewith, offers special merits both as regards construction and circuit organization.

According to the invention, in a duplex-operation installation utilizing an intermediate or beat frequency obtained by the beating together of the incoming wave and the sending wave, decimeter waves are employed in such a way that a diode rectifier is used for producing the beat or mixing action, while the capacitance of the said rectifier constitutes the capacity of the oscillation circuit of the receiver system. According to another feature of the invention, an energy feeder line is interposed between the receiver oscillation circuit and the antenna, the oscillator which serves to generate the outgoing wave being in coupling relation with the said feeder line (energy lead).

The invention shall now be described in more detail by reference to the single figure of the accompanying drawing.

A denotes an antenna which, for example, may comprise several dipoles so that the action thereof in reference to radiations will be bi-directional. From the antenna a double wire lead B is brought to the rectifier G. Parallel to the rectifier is mounted a wire loop D which, acting as an inductance together with the diode capacitance, constitutes the oscillation circuit of the receiver. It has been discovered that the said wire loop may be omitted without any incidental impairment of the performance. By the provision of two choke-coils Dr, Dr, the decimeter waves are kept away from the intermediate frequency amplifier Z. Inasmuch as the intermediate frequency potential at the diode G is low because of the low diode resistance, this potential may be stepped up in transformer T. The diode heating voltage is applied by way of choke coils (not shown). Condenser C only serves to block the way of the intermediate frequency energy to the antenna. Its capacitive reactance is chosen so low that it will not play any part as far as the decimeter waves are concerned.

lead B is the oscillator inductance L, being in the form of a tuned Lecher wire line. In practice, the said Lecher wire system is disposed at close proximity and parallel to the energy feeder line. The oscillator O comprises a self-oscillatory tube, say a magnetron, which is voice-modulated by the way of transformer Tr.

The intermediate frequency part of the circuit is schematically indicated at Z, and is tuned to the difference between the outgoing and incoming signal frequencies, and serves to amplify and rectify the intermediate frequency energy. What is only essential is that the amplifier should be designed to handle a very wide frequency band, inasmuch as the intermediate frequency is subject to fluctuations because of inevitable instability of the oscillator wave.

Let us assume, as an example, that the outgoing and the incoming signal frequencies are 1500 and 1503 megacycles (about 20 cm.) so that the difference or beat between them is 3 megacycles (100 m. wave). If the oscillator then has an instability factor of 1×10^{-3} , the beat frequency will present fluctuations around 1.5 megacycles. Under practical working conditions, a band-width of 1 megacycle suffices, when the beat frequency is 3 megacycles.

The numerical example hereinbefore cited shows, moreover, that the two signal waves of 1500 and 1503 megacycles differ only by 2 mils (.2 of one percent) from each other; in other words, that when the antenna and the oscillation circuit of the receiver are tuned to one wave, they will be sharply tuned also to the respective other wave. This is a very valuable and essential merit inherent in the arrangement of this invention as contrasted with the earlier art. It will be understood that if duplex traffic is carried on upon longer waves, the difference between the waves expressed in terms of percent, will grow increasingly greater seeing that the intermediate frequency can not be diminished at will, in fact, that it must always lie above the highest voice frequency to be transmitted. The result is that detuning of the aerial and the oscillation circuit in reference to one of the waves must be accepted as inevitable (and this tends to impair the performance and efficiency of the scheme), otherwise the antenna and the oscillation circuits will have to be tuned to different natural frequencies by suitable resonant circuits. These difficulties are obviated in the arrangement of the invention here disclosed. As a result the circuit organization used therein becomes simple and inexpensive.

Connected or coupled with the energy feeder

Now, in what follows the operation of the arrangement shall be described. In the Lecher wire line L which is tuned to the sending or outgoing signal frequency, waves are produced which are transferred to the energy feeder lead B. Part of the oscillations is to be fed to the diode G in order to be beaten therein with the incoming signal waves, though by far the largest part of the generated energy is to be radiated out through the aerial.

The relationship between the radiated and the rectified energy (i. e., radiation resistance of the antenna and the rectifier resistance) may be calculated from the ratio of the two terminal resistances (impedances) of the energy lead. In order that so far as the energy to be transmitted is concerned, there may be no reflection point in the aerial, the energy feeder lead B must be matched; in other words, the characteristic impedance of the feeder B must be like that of the antenna. Feeder B is matched to antenna A, but a considerable mismatch is arranged to occur at the diode. Hence energy fed into feeder B from L goes mostly outward to the antenna as radiation, the energy reaching the diode being mostly reflected and preferably reflected in such phase as to reinforce the waves traveling to antenna A. Of course, this means that for receiving purposes the energy is not most efficiently absorbed by the diode but this drawback is tolerable in view of the use of high frequency amplification and the other merits of the arrangement. The unmatched impedance of the diode oscillatory circuit, which for the resonance frequency is equal to the internal impedance of the diode, governs the portion or fraction of the oscillator energy which will be fed to the rectifier. In order that the entire balance of the said energy may be radiated, care will have to be taken so that the oscillations which are reflected at the diode will be fed in phase with the oscillations coming from the generator, to the antenna. This is effected by an exact regulation of the length of the energy feeder line. In the presence of perfect coincidence of phases, it will be seen that the reflected and the direct waves will boost one another and will be radiated conjointly.

To be sure, part of the incoming waves will be reflected also at the diode. Moreover, since the diode impedance is comparatively low compared to the anti-resonant impedance of the terminals of the energy feeder, and the sensitiveness of the arrangement is made comparatively great because of the fact that the beat reception principle is used, this loss in reception may be readily tolerated in the light of the other valuable operating advantages inhering in the scheme.

The diode oscillation circuit itself need not be tuned throughout a wide wave band seeing that its resonance curve is extremely broad because of the internal diode resistance. If it is tuned on the average to 20 cm. wavelength, it will be understood that a change to a 19 cm. or a 21 cm. wave will not entail any practical effects. But this means a frequency range of around 140 megacycles inside which from 30 to 40 duplex equipments with intermediate frequencies of 3 megacycles may be received without any special tuning of the receiver oscillation circuit. This wide wave band is one of the advantages of the invention which, however, has become utilisable in practice only since the adoption of the decimeter waves.

The arrangement as hereinbefore disclosed

may be perfectly accommodated with batteries, intermediate frequency amplifiers, and, if desired, an audio frequency amplifier, etc., inside a shielded case of reduced dimensions, with the aerial being mounted outside the shielding means, preferably on the box itself. To operate the equipment, only one knob need be used for tuning and other purposes. If necessary, also, the coupling between the energy feeder line and the oscillator could be made variable, say by pivoting the oscillator inductance so as to be positioned at greater or less proximity, though this in most instances will be superfluous. On connecting the arrangement, first a buzzer or the like could be used to modulate the outgoing signal wave. In the headset the buzzer note of the installation will be heard only when the correspondent station has been accurately tuned, for it will be only then that an intermediate frequency modulated by the buzzer sound will be formed. But as soon as the buzzer sound becomes audible, the microphone may be connected, whereupon conversation may be started.

What is claimed is:

1. An ultra short wave duplex communication system for the transmission and reception of waves below one meter, including a radiating element for radiating extremely short waves, a transmitting oscillator, a signal input circuit coupled to said oscillator for modulating the oscillations generated thereby, a tuned circuit coupled to the output of said oscillator, said tuned circuit, in turn, being coupled to said radiating element, and a receiving circuit including an intermediate frequency amplifier also coupled to said radiating element, said receiving circuit comprising an oscillatory circuit tuned to the oscillator and received frequencies, said intermediate frequency amplifier functioning to receive a frequency substantially equal to the difference between the frequency of said oscillator and the frequency of the incoming signals received by said radiating element, said last oscillatory circuit comprising a diode rectifier whose interelectrode capacitance constitutes the capacity of said oscillatory circuit, and means located between said intermediate frequency amplifier and said last oscillatory circuit for preventing the passage of waves having the frequency of said incoming signals or of said oscillator to said amplifier.

2. An ultra short wave duplex communication system for the transmission and reception of waves below one meter, including a radiating element for radiating extremely short waves, a continuously operating transmitting oscillator generating waves below one meter, a signal input circuit coupled to said oscillator for modulating the oscillations generated thereby, an output circuit for said oscillator comprising a tuned Lecher wire system, a receiving system including an intermediate frequency producing oscillation detector and an intermediate frequency amplifier connected to said oscillation-detector, a parallel-wire feeder line extending between said oscillation-detector and said radiating element, said output circuit for said transmitting oscillator being electromagnetically coupled to said feeder line, said oscillation detector comprising a diode coupled across said feeder line, the interelectrode capacitance of said diode forming the capacitance of an oscillatory circuit tuned to the oscillator and received frequencies.

3. An ultra short wave duplex communication system for the transmission and reception of waves below one meter, including a radiating

element for radiating extremely short waves, a continuously operating transmitting oscillator generating waves below one meter, a signal input circuit coupled to said oscillator for modulating the oscillations generated thereby, an output circuit for said oscillator comprising a tuned Lecher wire system, a receiving system including an intermediate frequency producing oscillation detector and an intermediate frequency amplifier connected to said oscillation detector, a parallel-wire feeder line extending between said oscillation detector and said radiating element, said output circuit for said transmitting oscillator being electromagnetically coupled to said feeder line, said oscillation detector comprising a diode coupled across said feeder line, the interelectrode capacitance of said diode forming the capacitance of an oscillatory circuit tuned to the transmitting and received frequencies, said parallel-wire feeder line having such length and dimensions that the impedance at the terminals thereof, which are coupled to said radiating element, matches the surge impedance of said radiating element, and the waves reflected at the terminals of said line which are connected to said detector will be in phase with the waves of transmitting oscillator frequency which travel toward said radiating element.

4. An ultra short wave duplex communication system for the transmission and reception of waves below one meter, including a radiating element for radiating extremely short waves, a continuously operating transmitting oscillator generating waves below one meter, a signal in-

put circuit coupled to said oscillator for modulating the oscillations generated thereby, an output circuit for said oscillator comprising a tuned Lecher wire system, a receiving system including an intermediate frequency producing oscillation detector and an intermediate frequency amplifier connected to said oscillation detector, a parallel-wire feeder line extending between said oscillation detector and said radiating element, said output circuit for said transmitting oscillator being electromagnetically coupled to said feeder line, said oscillation detector comprising a diode coupled across said feeder line, the interelectrode capacitance of said diode forming the capacitance of an oscillatory circuit tuned to the transmitting frequency, said oscillatory circuit being also tuned to receive an incoming wave below one meter, which incoming wave has a frequency differing by less than one percent from the oscillation frequency of said transmitting oscillator.

5. An ultra short wave communication system for the transmission and reception of waves below one meter, comprising an oscillatory circuit for resonating the received wave, and a local oscillator for producing both the wave to be transmitted and the mixing wave, said oscillatory circuit having a diode rectifier for mixing the received wave and the wave generated by said local oscillator to produce the intermediate frequency wave, the capacitance of said diode forming the capacitance of said oscillatory circuit.

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