

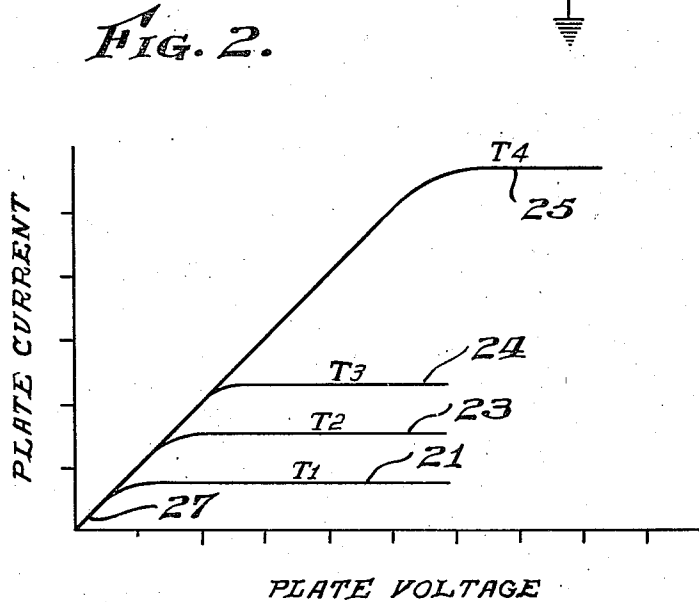
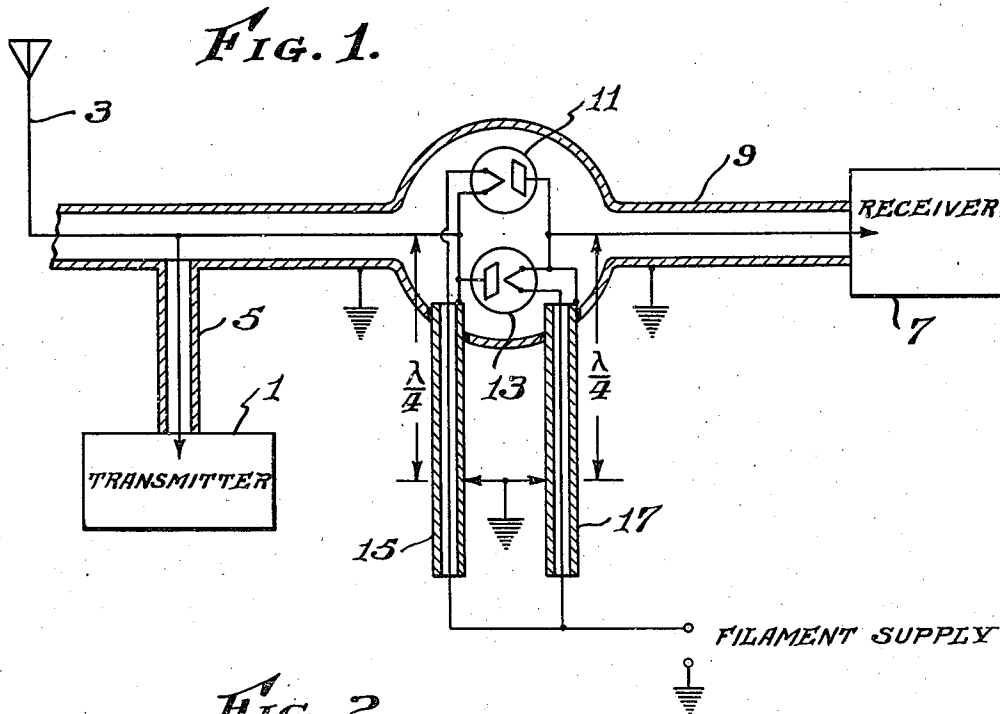
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DUPLEX RADIO SYSTEM

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DUPLEX RADIO SYSTEM

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This invention relates to improvements in duplex radio systems and particularly to a system having a common antenna for transmitting pulse signals and for receiving the pulse signals after reflection.

Radio pulse echo systems, having a common antenna for transmitting and receiving, have been described. Such systems generally depend upon transmission lines having critical lengths and critical impedances. At the instant of transmission the antenna represents a proper load for the transmitter; at the same instant the transmission line to the receiver presents a high impedance to the transmitter currents. After the radiation of the outgoing pulse, the line to the receiver becomes a suitable path for the received echo signals, and the transmission line to the transmitter becomes a high impedance to the echo signals.

While such systems are entirely satisfactory for low and medium power operation, they become difficult to operate at higher powers. For example, for peak powers in excess of approximately 10 kilowatts, the first thermionic tube of the receiver may not only overload but may be actually destroyed by the transmitted pulse which is applied through the high impedance path to the receiver. As the peak power increases, the difficulties of protecting the receiver increase with systems of the character described.

It is an object of the instant invention to provide improved means for operating a pulse echo system from a common antenna. Another object is to provide improved means for the duplex operation of a radio pulse transmitter and radio pulse receiver on a common antenna. An additional object is to provide the receiver of a duplex pulse echo system with a limiter fed from a high impedance source.

The invention will be described by referring to the accompanying drawing, in which Figure 1 is a schematic diagram of a preferred embodiment of the invention; and Figure 2 is a graph illustrating the operation of a limiter-rectifier.

Referring to Fig. 1, a transmitter 1 is connected to an antenna 3, or other load circuit, by a transmission line 5. A receiver 7 is also connected to the antenna 3 by means of a second transmission line 9. A pair of limiter-rectifiers 11, 13 are interposed in the second transmission line between the antenna and the receiver. The rectifiers, preferably of the thermionic type, are connected so that their respective cathodes are connected to their respective anodes to provide a circuit which will transmit substantially equally both

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positive and negative half cycles of the applied high frequency current. The cathodes are energized through concentric lines 15, 17. The concentric lines are each grounded at quarter wave lengths, or odd numbers of quarter wave lengths, of the carrier frequency currents of the pulses. The quarter wave lines present high impedances from the rectifiers to ground, and thus minimize the currents which would otherwise tend to flow to ground.

In the arrangement shown, the diameter of the second transmission line has been increased to house the rectifiers without crowding. In practice, since the rectifiers are preferably made very small to minimize their capacity, they may be included within the line without increasing its cross-section. In the event that the cross-section of the line is increased, any change in its characteristic impedance should be taken into account in designing the system. Furthermore, the effect of the rectifier load on the transmitter line 5 and the antenna 3 should not be overlooked in matching the line to the load.

The system operates as follows: When the transmitter pulse is applied to the line 5 and antenna 3, currents will also flow in the line 9 to the receiver. The current to the receiver will be limited by the rectifier characteristic which is illustrated in Fig. 2. It should be understood that the limiting characteristic of any one of the several curves 21, 23, etc., may be obtained by adjusting the filament or cathode temperature. Since the peak power of the outgoing pulses is many times that of the echo signal, the rectified current from the outgoing pulses will be limited to a predetermined value, but the echo signals will operate over the straight line portion 27 of the curve. The echo signal currents will therefore be transmitted without distortion and with negligible attenuation to the receiver. It should be understood that in pulse echo operation the outgoing pulse is only transmitted for a brief time during the operating cycle and the echoes are received during the balance of the cycle, so that for all practical purposes the operation may be described as duplex.

Thus the invention has been described as a duplex system in which a common antenna is used for transmitting pulses of radio frequency energy and receiving the pulses after reflection. The effect of the high peak power of the transmitter on the receiver is minimized by inserting between the antenna and the receiver a full wave limiter-rectifier. The rectifier limits the flow of transmitter currents to the receiver, and passes

the echo currents to the receiver without distortion and with negligible attenuation. While known rectifiers of other than the thermionic type may be used for thermionic rectifiers, means are provided for supplying the rectifier cathodes with energy over a path presenting a high impedance to the signaling currents.

I claim as my invention:

1. A duplex radio system including in combination a load circuit, a transmitter, a receiver having an input circuit, a transmission line connecting said load circuit to said transmitter, a second transmission line connecting said load circuit to said receiver input circuit, and a limiter-rectifier connected serially in one side of said transmission line connecting said receiver input circuit and said load circuit to limit the energy transferred from said transmitter through said transmission line to said receiver.

2. A duplex radio system including in combination an antenna, a transmitter, a receiver having an input circuit, a transmission line connecting said antenna to said transmitter, a second transmission line connecting said antenna to said receiver input circuit, and a full wave limiter-rectifier connected serially in one side of said transmission line connecting said receiver input circuit and said antenna to limit the energy transferred from said transmitter through said transmission line to said receiver.

3. A duplex radio system including in combination a load circuit, a radio pulse transmitter, a radio pulse receiver having an input circuit, a transmission line connecting said load circuit to said transmitter, a second transmission line connecting said load circuit to said receiver input circuit, and a limiter-rectifier connected serially in one side of said transmission line connecting said receiver input circuit and said load circuit to limit the pulse energy transferred from the transmitter through said transmission line to said receiver.

4. A duplex radio system including in combination an antenna, a radio pulse transmitter, a

radio pulse receiver having an input circuit, a transmission line connecting said antenna to said transmitter, a second transmission line connecting said antenna to said receiver input circuit, and a full wave limiter-rectifier connected serially in one side of said transmission line connecting said receiver input circuit and said antenna to limit the pulse energy transferred from the transmitter through said transmission line to said receiver.

5. A duplex radio system including in combination a load circuit, a radio pulse transmitter, a radio pulse receiver, a transmission line connecting said transmitter to said load circuit, a second transmission line connecting said receiver to said load circuit, a limiter-rectifier interposed between said receiver and load circuit, and a pair of quarter wave transmission lines for supplying current to said rectifier over a path representing a high impedance to said pulses.

6. A duplex radio system including in combination an antenna, a radio pulse transmitter, a radio pulse receiver, a transmission line connecting said transmitter to said antenna, a second transmission line connecting said receiver to said antenna, a full wave limiter-rectifier interposed between said receiver and antenna, and a pair of quarter wave transmission lines for supplying current to said rectifier over a path representing a high impedance to antenna currents.

7. A duplex radio system including in combination an antenna, a radio pulse transmitter, a radio pulse receiver, a transmission line connecting said transmitter to said antenna, a second transmission line connecting said receiver to said antenna, a full wave limiter-rectifier interposed between said receiver and antenna, a pair of transmission lines for supplying current to said rectifier, and means grounding said pair of lines at a length corresponding to an odd number of quarter wave lengths of the carrier frequency of said pulses so that a high impedance is offered between said rectifier and ground.

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