

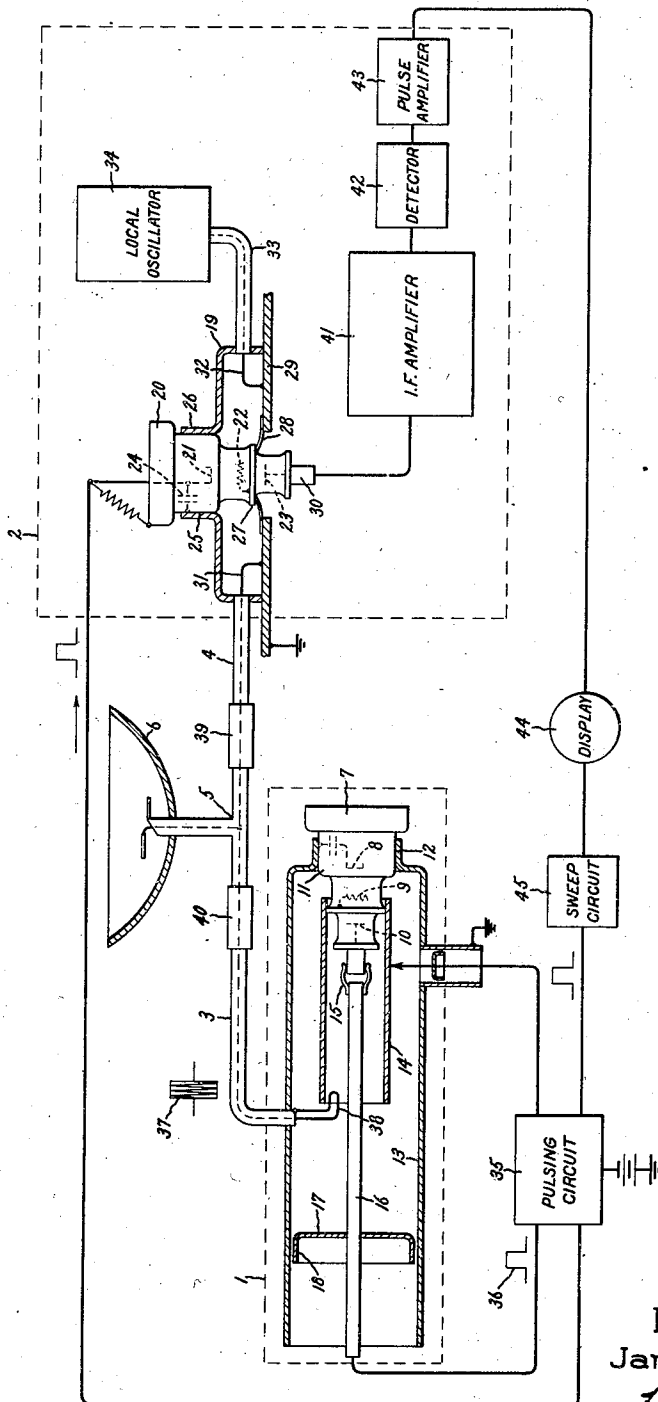
April 29, 1947.

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2,419,564

RADIO TRANSMITTER-RECEIVER SWITCHING SYSTEM

Filed June 10, 1943



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UNITED STATES PATENT OFFICE

2,419,564

RADIO TRANSMITTER-RECEIVER
SWITCHING SYSTEM

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Application June 10, 1943, Serial No. 490,249

6 Claims. (Cl. 250-13)

1

The present invention relates to radio equipment having a transmitting and a receiving circuit connected to a common antenna.

An object of my invention is to provide an improved arrangement for confining the transmitted and received signals to the respective circuits. The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization 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 in which the single figure is a diagram of radio equipment embodying my invention.

Referring to the drawing there is shown radio locating equipment having a 3000 megacycle transmitter 1 and a receiver 2 respectively connected by concentric transmission lines 3 and 4 through a junction 5 to a paraboloid antenna 6. The transmitter comprises a reentrant cavity oscillator having an ultra high frequency triode 7 which is shown in elevation with the cathode 8, grid 9, and anode 10 diagrammatically indicated in dotted lines. The cathode 8 is capacity coupled to a metal shell 11 connected at 12 to an outer metal cylinder 13; the grid 9 is connected to a concentric inner metal cylinder 14; and the anode 10 is connected by sliding contact 15 to axially movable metal rod 16 carrying a tuning disk 17 having a flange 18 capacity-coupled to the outer cylinder 13. The tuning of the oscillator is varied by moving the rod 16 in and out.

The receiver has an annular cavity 19 and an associated ultra high frequency triode 20 shown in elevation with the cathode 21, grid 22, and anode 23 diagrammatically indicated in dotted lines. The cathode 21 is capacity coupled, as indicated at 24, to a metal shell 25 telescoped within an upstanding sleeve 26 at the center of the cavity 19; the grid 22 is connected to a terminal flange 27 engaging contact fingers 28 on a grounded plate 29 which serves as the bottom wall of the cavity; and the anode 23 is connected to a terminal 30. The transmission line 4 is coupled to the cavity 19 through a loop 31 connected between the grounded plate 29 and the center conductor of the transmission line. A similar coupling loop 32 is connected through transmission line 33 to a local oscillator 34.

The transmitter oscillator is driven by a pulsing circuit 35 connected between the rod 16 and the cylinder 14 and reacting with the device 7 so as to

2

supply pulse voltages 36 at the desired repetition rate, causing corresponding pulses of radio frequency oscillations 37. The transmitter oscillations are picked up by a loop 38 in the anode grid cavity and conducted to the antenna along the transmission line 3. The transmitted pulse, upon reaching the junction of the transmission lines 3 and 4, divides, part flowing to the antenna 6 and the remainder flowing along the transmission line 4. The part of the transmitted pulse flowing along the transmission line 4 is wasted and may damage the receiver. This part is kept to a minimum by connecting the cathode 21 to the pulsing circuit 35 so as to apply a positive pulse coincident with the transmitted pulse sufficient to bias the triode 20 off during transmission. When the triode is non-conducting, the flow of energy through the triode to the receiver is prevented and the transmission line is terminated at the receiver end by the coupling loop 31. By means of a line stretcher 39, by which the length of the line may be adjusted to desired lengths, the transmission line 4 is tuned to an odd multiple of quarter wavelengths so that the short circuit of the coupling loop 31 causes a high impedance to appear at the junction 5 due to the impedance inversion characteristics of quarter wavelength transmission lines.

During the intervals between the transmitted pulses, reflections from the object to be located are picked up by the antenna 6 and conducted through the transmission line 4 to the receiver. Since the receiver triode 20 is conducting, the termination of the transmission line 4 now consists of the impedance of the loop 31 and the impedance coupled to the loop through the triode 20. This changes the tuning of the transmission line 4 so that it no longer presents a high impedance to the flow of energy from the junction 5. During receiving the transmitter triode 7 is biased off, preventing the flow of energy from the coupling loop 38 through the triode. By means of a line stretcher 40 the transmission line 3 is tuned to an odd multiple of quarter wavelengths so that the short circuit offered by the coupling loop 38 causes a high impedance to appear at the junction 5.

In the present equipment, the transmitter and receiver are at all times connected to the antenna through transmission lines and yet, without the use of any auxiliary devices, the transmitted and received signals are confined to the respective circuits.

The received signal is mixed in the cavity 19 with radio frequency waves from the local oscil-

lator 34 to produce a beat frequency which is fed through an IF amplifier 41, a detector 42, and a pulse amplifier 43 to a cathode ray tube 44. The received pulses are coordinated with the transmitted pulses by means of a sweep circuit 45 keyed by the pulsing circuit 35 so as to display the desired information.

While I have shown particular embodiments of my invention, it will be understood that many modifications may be made without departing from the spirit thereof, and I contemplate by the appended claims 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 receiver having an input circuit with an electron discharge device having a control grid, the effective grid bias of said device being adjustable between values permitting and preventing the flow of signals through the receiver, a transmission line having one end coupled to the receiver input circuit and the other end connected to a transmitter and to an antenna, said transmission line having a length such that when said grid bias is adjusted respectively to permit and to prevent the flow of signals through the receiver a low and a high impedance respectively appears at said other end of the transmission line, and keying means for causing the transmission of signals and the adjustment of said grid bias to a value preventing the flow of signals through the receiver whereby a high impedance is offered to the flow of the transmitted signals to the receiver.

2. In combination, a cavity resonator including a grid controlled electron discharge device, the grid bias of said device being adjustable to values permitting and preventing the transfer of energy between parts of said cavity resonator through said device, and a transmission line having at one end a coupling loop within said cavity resonator, said transmission line being of such length that under conditions in which the grid bias prevents the transfer of energy in the cavity resonator, a high impedance appears at the other end of the transmission line to the flow of energy toward said cavity resonator.

3. In combination, an antenna, an electron discharge device having a control electrode, an anode and a cathode, and circuit means to produce oscillations by action of said device, a second electron discharge device, transmission lines extending from each of said devices to said antenna, whereby oscillations generated by action of said first device are supplied to said antenna and oscillations received on said antenna are supplied to said second electron discharge device, means including said second device to translate said received oscillations, means to control said devices to produce low impedance alternately across the adjacent ends of the respective transmission line associated with said devices, said lines having such length that said lines alternately present high impedance to oscillations supplied to the opposite ends thereof.

4. In combination, a transmitter including a cavity resonator and circuit elements coupled

therewith through a bias controlled discharge device, a receiver including a cavity resonator and circuit elements coupled therewith through another bias controlled discharge device, transmission lines leading respectively to the transmitter and to the receiver resonators from a junction for connection with a channel for transmission and reception, and bias control means for said devices for alternately turning the transmitter and receiver on and off, said transmission lines being of such length that when the bias on one of said devices is adjusted to interrupt the current flow therein a high impedance appears at the junction to the flow of energy toward the resonator coupled to said device.

5. In combination, equipment for transmitting pulses of wave energy and equipment for receiving echoes of the transmitted pulses, each of said equipments including a cavity resonator and circuit elements coupled through an associated discharge device controlling the flow of energy through the respective equipment, transmission lines leading respectively from the resonators of said transmitting and receiving equipment to a junction through which the transmitted and received energy flows, control means for said devices alternately interrupting current flow in the devices at the desired repetition rate, said transmission lines being of such length that when a respective device is non-conducting a high impedance appears at said junction to the flow of energy toward the cavity resonator of said respective device.

6. In combination, a receiver having an input circuit with an electron discharge device having a control grid, the effective grid bias of said device being adjustable between values permitting and preventing the flow of signals through the receiver, a transmission line having one end coupled to the receiver input circuit and the other end connected to a transmitter and to an antenna, said transmission line having a length such that when said grid bias is adjusted respectively to permit and to prevent the flow of signals through the receiver a low and a high impedance respectively appears at said other end of the transmission line, and means for pulsing the transmitter and simultaneously adjusting said grid bias for the duration of the pulses to a value preventing the flow of signals through the receiver whereby a high impedance is offered to the flow of the transmitted signals to the receiver.

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