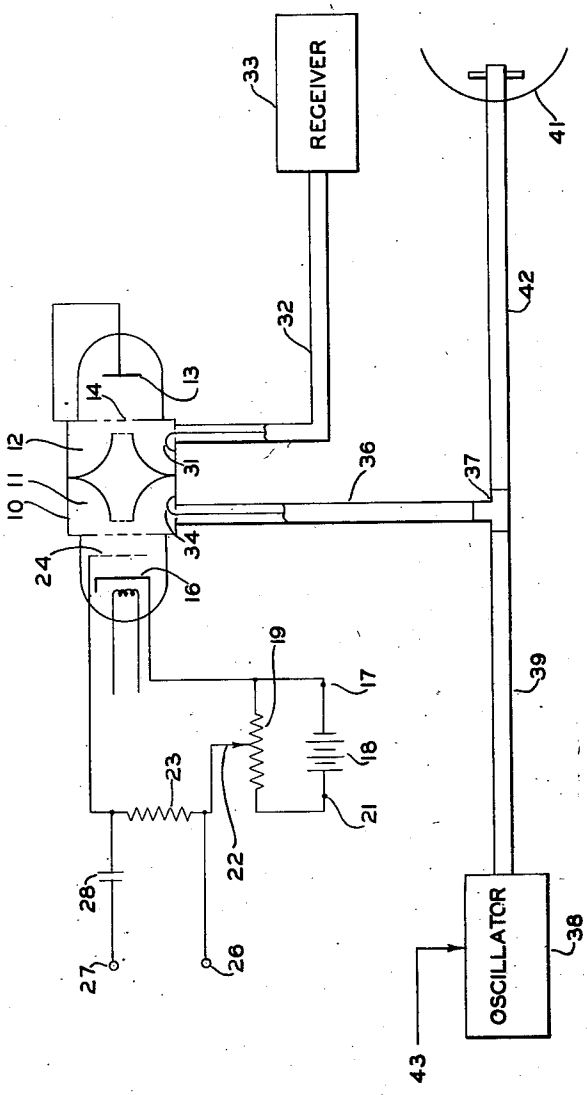
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ELECTRONIC DUPLEXING DEVICE

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ELECTRONIC DUPLEXING DEVICE

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This invention relates to radio systems and more particularly to transmit-receive devices for such systems.

In many radio circuits designed to transmit and receive pulses of radio-frequency energy the same radiating means is utilized to both transmit and receive signals. Where this is done, both the transmitter and the receiver of the radio set must be connected to the radiating means so that the receiver will be ready to receive signals very soon after the transmitter stops operating. It is necessary that means be provided to prevent the transmitted signal from reaching the input to the receiver, otherwise the high-level transmitted signal would damage the receiver circuits.

It is an object of the present invention, therefore, to provide simple and novel means for alternately connecting the receiver and transmitter of a radio set to a common radiating means.

It is a further object of this invention to provide means for amplifying the received signals before said signals are applied to the receiver.

In accordance with the present invention there are provided a receiving means, a transmitting means, a radiating means, and a velocity-modulated amplifier means or "klystron." Said transmitter means is directly connected to said radiating means by suitable radio-frequency transmission means, while said receiver means is connected to said radiating means through said velocity-modulated amplifier means.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing which presents a schematic diagram of the invention.

Referring to the drawing, a velocity modulated tube or "klystron" 10 has a first cavity 11 and a second cavity 12. An anode 13 is connected to a grid 14 of cavity 12. "Klystron" 10 has a cathode 16 connected to a negative terminal 17 of a direct-current potential source 18. A resistor 19 is connected from terminal 17 to a positive terminal 21 of source 18. A movable tap 22 on resistor 19 is connected through a resistor 23 to a control grid 24 of "klystron" 10. An input terminal 26 is connected directly to tap 22 while a second input terminal 27 is connected to control grid 24 through a capacitor 28.

A coupling loop 31 in cavity 12 is connected to a coaxial line 32 which is, in turn, connected to a receiver 33. A coupling loop 34 in cavity 11 is connected to a coaxial line 36. Coaxial line 36 is connected to one branch of a T-junction 37.

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A radio-frequency oscillator 38 is connected to T-junction 37 by a coaxial line 39, and an antenna array 41 is connected to T-junction 37 by a coaxial line 42. A suitable means (not shown) is provided for supplying a modulating signal to oscillator 38.

In the operation of this system the modulating signal is applied at point 43 causing oscillator 38 to produce a pulse of radio-frequency oscillations at relatively high amplitude. The radio-frequency energy generated in oscillator 38 travels through the transmission line 39 to T-junction 37. At this point the energy divides between transmission lines 36 and 42. The ratio of the division is not fixed but will depend on the impedances respectively presented by the transmission lines 36 and 42 at T-junction 37. It is desirable that most of the energy pass on through transmission line 42 to antenna 41 where it is radiated into space. The circuit impedances should be chosen with this point in mind. The signal passing through transmission line 36 is at a relatively high energy level. "Klystron" 10 has the characteristic found in many velocity-modulated tubes that the gain or amplification of the tube is greatest at one particular energy level but decreases greatly for signals above that level. In this instance the signal coupled into cavity 11 by coupling loop 34 is sufficiently high so that the actual signal derived out of cavity 12 by coupling loop 31 is not sufficiently high to damage any of the circuits in receiver 33. "Klystron" 10 will usually protect receiver 33 even though the electron flow in "klystron" 10 is not interrupted, but still further protection for receiver 33 may be obtained by interrupting the electron flow in "klystron" 10. This may be done by applying a negative voltage pulse between terminals 27 and 26. This negative pulse is coupled through capacitor 28 and resistor 23 in such a manner that grid 24 becomes more negative than cathode 16. Such blanking action during a signal from oscillator 38 does not affect the normal bias on grid 24 determined by potential source 18 and tap 22 on resistor 19.

When a signal of relatively low energy level is received by antenna 41, the signal travels down transmission line 42 to T-junction 37. The impedance of oscillator 38 in its non-oscillating condition may be such that none of the received energy enters transmission line 39, and all of it travels down transmission line 36 and is coupled into cavity 11. This signal is normally of such an energy level that it is amplified by "klystron" 10 and applied to receiver 33 at a higher energy level. It should be understood that such a signal,

even though amplified by "klystron" 10, is still not of sufficiently high energy level to damage receiver 33.

The advantages of this system are obvious from the foregoing disclosure. "Klystron" 10 prevents the signal generated by oscillator 38 from reaching receiver 33 at a sufficiently high energy level to damage any of the circuit elements, whereas signals received by antenna 41 are amplified by "klystron" 10 with the resulting increase in sensitivity and improvement of signal-to-noise ratio of the system.

While there has been described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention.

I claim:

1. Electronic apparatus comprising a high intensity signal source, radiating-receiving means connected to said signal source and receptive to weak outside received signals, receiver means, a velocity modulated amplifier tube having input and output terminals and possessing characteristics such that its maximum amplification occurs at a low input signal level and sharply decreases with signals above said level, means joining said receiver to said output terminal, and means joining said input terminal to both said signal source and said radiating receiving means, whereby said amplifier tube will serve to shield said receiver from said signal source.

2. Apparatus as set forth in claim 1, and also including pulsing means coupled to said velocity modulated amplifier tube, for entirely suppressing its operation when said signal source is in operation.

3. Electronic apparatus comprising a radar antenna, a high intensity pulsed oscillator, wave transmission means joining said oscillator to said radar antenna, a receiver, a velocity modulated amplifier tube whose characteristics are such that its amplification is greatest at a low input signal level and decreases sharply at higher levels, said tube having input and output terminals, wave transmission means connecting said tube output terminal to said receiver, and wave transmission means connecting said tube input terminal to said wave transmission means joining said antenna to said oscillator whereby the relatively weak target signals presented to said antenna and the powerful output of said oscillator are presented to the input of said velocity modulated amplifier tube, said amplifier serving to shield said receiver from said oscillator.

4. Apparatus in accordance with claim 3, and also including pulsing means coupled to said amplifier for entirely suppressing its operation when said oscillator is in operation.

5. Electronic apparatus comprising signal source means, radiating-receiving means, receiver means, and a velocity-modulated vacuum tube connecting said radiating-receiving means and said signal source means to said receiver means, said vacuum tube having characteristics such that its output is very small when a signal from said signal source means above a predetermined level is applied thereto in passing to said receiver means while a signal below said predetermined level from said radiating-receiving means causes a very large output to be produced by said tube means in passing to said receiver means.

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