June 23, 1942. H. O. PETERSON 2,287,533

ULTRA HIGH FREQUENCY ANTENNA FEEDBACK BALANCER

Filed March 10, 1939

Fig. 1

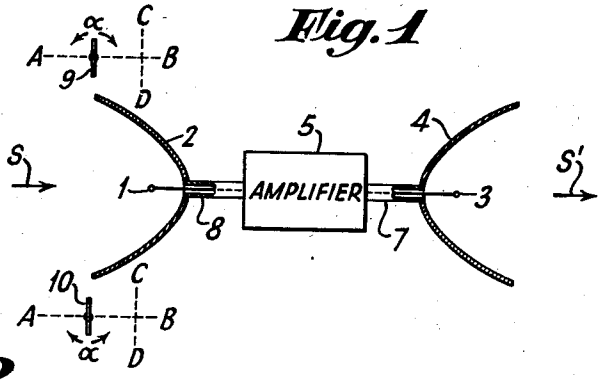


Fig. 2

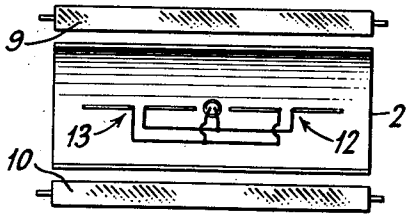


Fig. 3

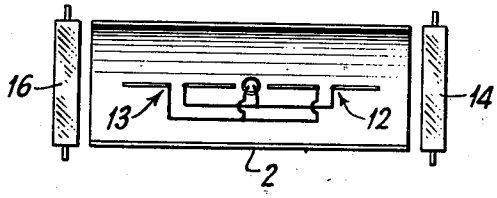


Fig. 4

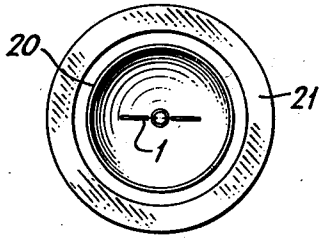


Fig. 5

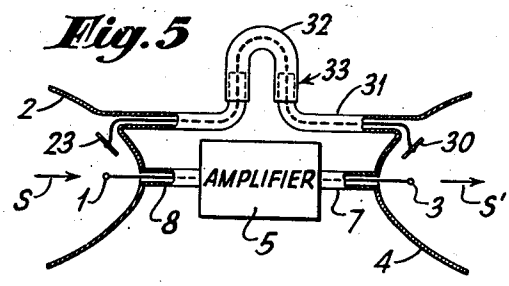


Fig. 6

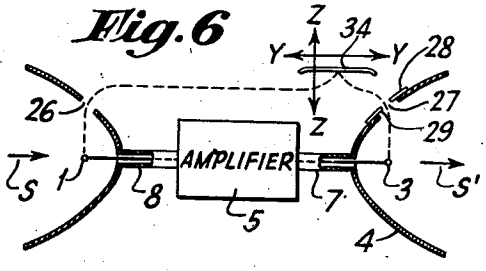
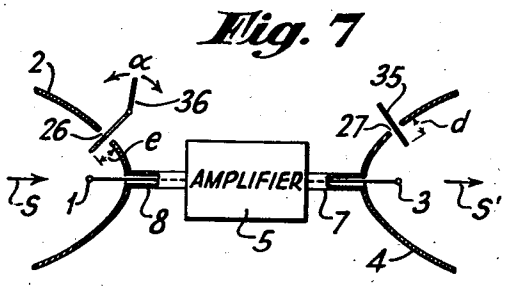


Fig. 7



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ULTRA HIGH FREQUENCY ANTENNA FEEDBACK BALANCER

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Application March 10, 1939, Serial No. 260,947

9 Claims. (Cl. 250—15)

This invention relates to high frequency relay systems and, more particularly, to a means for enabling the relaying of an ultra high frequency radio signal without signal conversion.

In radio relaying by ultra high frequencies, it is desirable to carry a radio signal along a chain of relay stations without resorting to frequency conversion. This may be done by receiving the incoming signal energy by a directional antenna on one supporting structure, amplifying and re-transmitting the signal from another direction antenna at some distance from the first at each relay station. Such an arrangement properly designed will have a feedback level low enough to preclude oscillations due to the re-radiated energy finding its way back into the receiving antenna. However, in practice, wherein relay stations are spaced 15 miles or more apart in order to obtain efficient transmission the antennas must be placed of the order of 100 feet, and in order to save expense a single tower is used for both transmitting and receiving antennas at each relay station. Due to diffraction around the edges of the concentrating reflectors and other effects, sufficient isolation of the output and input energies may generally not be obtained under these circumstances without additional provisions. For this reason, I propose to introduce means for neutralizing the feedback energy by introducing an additional feedback component of predetermined magnitude and phase so as to counteract the extraneous feedback otherwise encountered.

An object, therefore, of the present invention is to enable the reception, amplification and re-transmission of a radio signal without resorting to signal conversion.

A further object of the invention is to receive, amplify and re-transmit ultra high frequency radio signals without frequency conversion.

Still another object of the invention is to compensate for extraneous feedback between the transmitting and receiving antennas of an ultra high frequency relay station.

Still another object of the invention is to compensate for extraneous feedback between the transmitting and receiving antennas of an ultra high frequency relay station in which the signal frequency is not converted.

Still a further object of the present invention is to provide means for introducing and regulating the magnitude and phase of a component of feedback energy between the transmitting and receiving antennas of an ultra high frequency relay station whereby the otherwise unavoidable feedback is counteracted or neutralized.

Still a further object of the present invention is to introduce a component of feedback energy between the transmitting and receiving antennas of an ultra high frequency relay station of such magnitude and phase that the otherwise unavoidable feedback is counteracted or neutralized.

Referring, now, for a more complete understanding of the invention, to the following detailed description which is accompanied by a drawing in which Figure 1 illustrates a side view of an embodiment of the invention, Figures 2 and 3 show alternative end views of the embodiment of Figure 1; Figure 4 illustrates an end view of a modification of the embodiment of Figure 1 in which a circular reflector is used, and Figures 5, 6 and 7 illustrate partly in section other embodiments of my invention.

In Figure 1, the incoming signal is received by antenna 1 and concentrating reflector 2 indicated by arrow S. It is conveyed through a transmission line 8 to amplifier 5 and after being amplified by amplifier 5, indicated by a conventional box, is conveyed through transmission line 7 to antenna 3 which, in conjunction, as indicated by arrow S, with concentrating reflector 4, re-radiates the signal without change of frequency. Transmission lines 7 and 8, while shown as balanced shielded lines, may be of any other suitable form.

As heretofore indicated, due to diffraction around the edges of reflectors 2 and 4, reflection from extraneous objects, and other causes, some of the radiated energy finds its way back to the receiving antenna 1. My invention, therefore, is directed toward means for regulating the magnitude and phase of a component of energy which is fed back to the receiving antenna so as to counteract or neutralize the undesired feedback otherwise encountered. In Figure 1 this is accomplished by means of baffles 9 and 10 which may be situated in the field near the edges of one or both of the concentrating reflectors. In Figure 1 the baffles are represented by the vane like structures 9 and 10 shown at about the midpoints of dotted lines AB. These baffles may be adjustable to various positions along the line AB and the position of line AB may be moved closer to or further away from reflector 2 as indicated by dotted lines CD. Furthermore, the baffles may be rotated to assume various angles as indicated by α. In this way the phase and amplitude of the component of the field which leaks through between the baffles and the edge of the concen-

trating reflectors can be regulated to obtain a neutralizing balance against the summation of all other extraneous feedback components.

Figures 2, 3 and 4 show end-on views of these baffles used in various ways. In Figure 2 the antenna 1 is represented by a pair of dipoles 12 and 13 which may be connected to a transmission line 8 in a conventional manner. One possible manner of connection is illustrated. In order to make the connections clear the branched transmission line has been shown in a vertical plane beneath the dipoles 12 and 13. In actual practice it might be desirable to locate the branched position differently, possibly even on the outside of the reflector. The baffles appear at 9 and 10. In Figure 3 the baffles appear at 14 and 16. Another modification of the invention may employ both pairs of baffles 9, 10 and 14, 16, as shown in Figures 2 and 3 and entirely surrounding the reflector. In the case of a circular reflector, as shown in Figure 4, the baffle preferably takes the form of a ring, 21, and the adjustment may be made by altering the diameter of ring 21 and its position with respect to the circular reflector 20.

Another way to neutralize the extraneous feedback is shown in Figure 5. In this case the small pickup unit 30 feeds back through a transmission line 31 to a re-radiating unit 23. The amount of feedback may be controlled by adjustment of the position of units 23 and 30 and the phase may be adjusted by altering the length of the feedback transmission line as, for instance, by means of a sliding section 32 and 33. It is obvious that the transmission lines 7 and 8 may, in some instances, have considerable length. However, it is ordinarily desirable to keep the radio frequency circuit from the transmitting antenna 3 back through the balancing arrangement to the receiving antenna 1 relatively short because by so doing a lesser amount of total phase displacement is involved in the feedback circuit and consequently it may be expected to remain more stable in adjustment.

In Figure 6 another type of feedback arrangement is shown in which some moderate sized holes are cut in the concentrating reflectors, as indicated by reference numerals 26 and 27. The amplitude of the feedback component may be regulated by shutters whereby the effective size of the perforations can be regulated as, for instance, by the shutters at 28 and 29. The phase of the feedback component can be altered by either moving the effective position of the apertures as, for example, by sliding both components of the shutter at 28 and 29 or by adjustment of the position of a side reflecting element 34. This reflector may be moved in the directions indicated by arrows XX and YY. The effective angle between the reflector and the feedback energy ray may also be changed in order to alter the amount of energy fed back to the receiving antenna.

A further modification of Figure 6 is shown in Figure 7. In this modification the reflectors 2 and 3 have apertures 26 and 27 as in the case of Figure 6. In aperture 27 is inserted a short radiating member 35 and into aperture 26 a pickup and reradiating member 36 which is preferably L-shaped. As indicated by the dotted arc α the angular relationship of portion 36' of member 36 with respect to member 35 may be varied to vary the phase of the feedback energy. The amplitude may be varied by adjusting the penetration of the members into their respective reflectors as indicated by the letters d and c.

While I have particularly described and illustrated several embodiments of my invention, it is to be clearly understood that my invention is not limited thereto but modifications may be made within the scope of my invention.

I claim:

1. A high frequency relay station comprising a receiving antenna, a reflector for concentrating received signals on said antenna, an amplifier connected to said antenna and a transmitting antenna connected to an output of said amplifier, a baffle adjacent the edge of said reflector, said baffle being adjustable in its position with respect to said reflector and rotatable about an axis parallel to said edge whereby energy of a predetermined magnitude and phase may be fed back from said transmitting antenna to said receiving antenna.

2. A high frequency relay station comprising a receiving antenna, a reflector for concentrating received signals on said antenna, an amplifier connected to said antenna, a transmitting antenna connected to an output of said amplifier, a reflector for concentrating energy radiated from said transmitting antenna into a beam, said reflectors being directed in different directions, and a baffle plate adjacent the edge of one of said reflectors, said baffle being adjustable in its position with respect to said one reflector and rotatable about an axis lying in the plane of said baffle plate whereby energy of a predetermined magnitude and phase may be fed back from said transmitting antenna to said receiving antenna.

3. A high frequency relay station comprising a receiving antenna, a reflector for concentrating received signals on said antenna, an amplifier connected to said antenna, a transmitting antenna connected to an output of said amplifier, a reflector for concentrating energy radiated from said transmitting antenna into a beam, a plurality of baffles adjacent the edge of one of said reflectors, said baffles being adjustable in their positions with respect to said one reflector and rotatable about an axis parallel to said edge whereby energy of a predetermined magnitude and phase may be fed back from said transmitting antenna to said receiving antenna.

4. In combination with wave directive structure adapted to be associated with an antenna for increasing its directivity in a forward direction, said structure being incapable of entirely preventing radiation of energy in a rearward direction, means for introducing an additional component of radiation in a rearward direction for neutralizing said first-mentioned rearward radiation comprising baffle plate means along the edge of said structure.

5. A high frequency antenna system comprising a cylindrical parabolic reflector, a plurality of dipole antennas in the focus of said reflector, means for connecting said antennas to transducer means and a pair of adjustable baffle plates arranged along the sides of said reflector, the position of said baffle plates with respect to the sides of said reflector being adjustable and each of said baffle plates being rotatable about an axis parallel to said sides.

6. A high frequency antenna system comprising a cylindrical parabolic reflector, a plurality of dipole antennas in the focus of said reflector, means for connecting said antennas to transducer means and a pair of adjustable baffle plates

arranged along the ends of said reflector, the position of said baffle plates with respect to the ends of said reflector being adjustable and each of said baffle plates being rotatable about an axis parallel to said ends.

7. A high frequency relay system comprising a receiving antenna, a reflector for concentrating received signals on said antenna, an amplifier having its input connected to said antenna, a transmitting antenna connected to the output of said amplifier, a reflector for concentrating energy radiated from said transmitting antenna into a beam, an aperture in each of said reflectors and an adjustable reflector for directing energy passing from said transmitting antenna through the aperture in its reflector to the aperture in the reflector for said receiving antenna.

8. A high frequency relay system comprising a receiving antenna, a reflector for concentrating received signals on said antenna, an amplifier having its input connected to said antenna, a transmitting antenna connected to the output of said amplifier, a reflector for concentrating energy radiated from said transmitting antenna into a beam, an aperture in each of said reflectors and an adjustable reflector for directing energy passing from said transmitting antenna through the aperture in its reflector to the aperture in the reflector for said receiving antenna and shutter means for varying the effective size of at least one of said apertures.

9. A high frequency relay system comprising a receiving antenna, a reflector for concentrating received signals on said antenna, an amplifier having its input connected to said antenna, a transmitting antenna connected to the output of said amplifier, a reflector for concentrating energy radiated from said transmitting antenna into a beam, an aperture in each of said reflectors and an adjustable reflector for directing energy passing from said transmitting antenna through the aperture in its reflector to the aperture in the reflector for said receiving antenna and shutter means for varying the effective size and position of at least one of said apertures.

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