

Jan. 27, 1942.

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2,270,965

ULTRA HIGH FREQUENCY RELAY SYSTEM

Filed June 30, 1939

Fig. 1

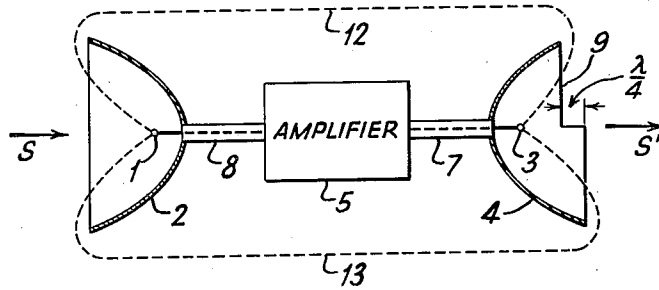


Fig. 2

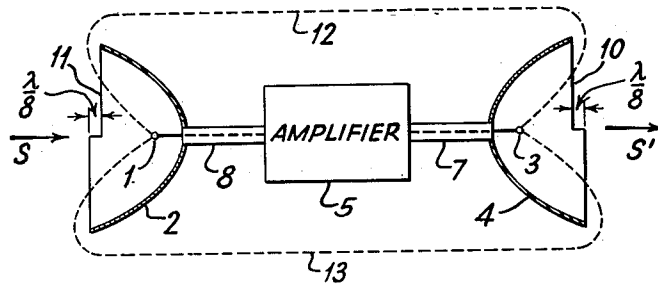


Fig. 3

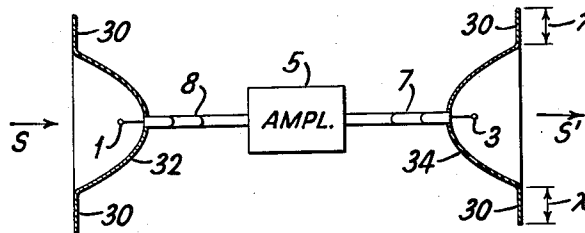
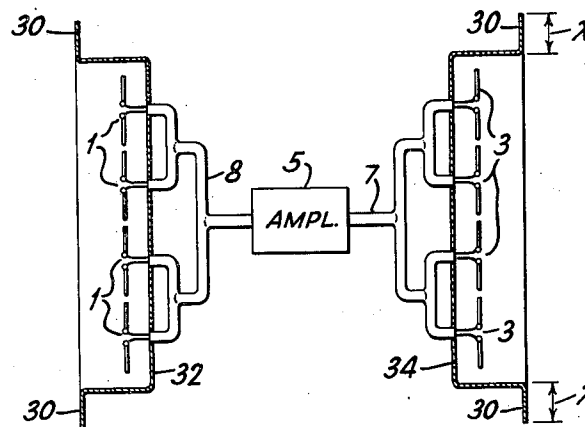


Fig. 4



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2,270,965

ULTRA HIGH FREQUENCY RELAY SYSTEM

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Application June 30, 1939, Serial No. 282,120

12 Claims. (Cl. 250—15)

This invention relates to ultra high frequency relay systems and, more particularly, to radio relay systems which do not utilize signal conversion at intermediate relay points.

In ultra high frequency radio relay service it is desirable to carry a radio signal along a chain of radio 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 retransmitting the signal from another directional antenna at some distance from the first at each relay station. Such an arrangement will have a feedback level low enough to include oscillations due to radiated energy from the second antenna 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 at a considerable height above ground, ordinarily in the order of 100 feet, or more, and in order to save expense a single tower is used at each relay station for both the transmitting and receiving antennas. 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. Ordinarily, there will be a certain small amount of energy fed back from the transmitting reflector to the receiving reflector over one or more paths. In order to prevent oscillations in the amplifier I propose to introduce means for causing the feedback over one of the paths between the receiving and transmitting antennas to neutralize the feedback energy over another similar path by causing the path lengths to differ by an odd multiple, including unity, of half the length of the communication wave.

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

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

Still another object of the invention is to cause the feedback existing between the transmitting and receiving antennas of an ultra high frequency relay station over a plurality of paths to be mutually self-neutralizing.

Reference will now be had, for a more complete understanding of the invention, to the following

detailed description, which is accompanied by the drawing, in which Figure 1 illustrates a view of an embodiment of the invention; Figure 2 illustrates a modification of the form of the invention shown in Figure 1, and Figures 3 and 4 illustrate, partly in section, elevation and plan views of a modification of my invention.

Referring, now, to Figure 1, the incoming signal S is received by receiving antenna 1 within the concentrating reflector 2. The signal is conveyed through transmission line 6 to an amplifier 5 and after being amplified therein is conveyed through a transmission line 7 to antenna 3 which, in conjunction with concentrating reflector 4, re-radiates the signal as indicated by the arrow S'. It will be noted that at no point within the relay station is the signal frequency changed. Transmission lines 7 and 8, while shown as balanced shielded lines, may be of any other suitable form such as concentric cables or balanced two-wire lines, and so forth. As heretofore mentioned, there will be a small amount of energy fed back from transmitting antenna 3 to receiving antenna 1. This energy, if of sufficient amplitude and of proper phase relationship, will tend to cause oscillation in the amplifier 5 and prevent its proper functioning. While the feedback paths 12 and 13 have been indicated as bending around the edges of the reflectors 2 and 4, it is to be understood that this is only for the purposes of illustration and the energy may, in fact, be actually picked up by the edges of the reflectors and re-radiated. In any event, the final resultant effect is as though the feedback energy actually followed paths 12 and 13.

In order to cause the feedback energy over the several paths to be mutually self-neutralizing one half of reflector 4 is cut back by a distance of approximately a quarter of the length of the operating wave as indicated by the stepped portion 9, as shown in Figure 1, so that the energy fed back over path 12 will be approximately 180 degrees out of phase with respect to the energy feeding back over path 13. Due to this 180 degree phase relationship the feedback energy in one path will tend to neutralize that in the other path as long as they are substantially of equal amplitude.

The modification shown in Figure 2 is similar to that heretofore described with reference to Figure 1, except that instead of cutting back one reflector a distance equal to a quarter of the length of the operating wave, both reflectors are cut back, as indicated at 10 and 11, a distance equal to one-eighth of the length of the

operating wave. As in the case of Figure 1, the resultant difference in path length is 180 degrees and cancellation will take place. The essential point is that the difference in path length should equal an odd multiple, including unity, of a half the length of the operating wave. Ordinarily, a single half wave difference is employed since this introduces less dissymetry in the reflector, and has a tendency to balance better over a wide band of frequencies.

In Figures 3 and 4 I have shown a modification of the invention in which the feedback is prevented by the addition of fender or baffle plates 30 around the aperture of the parabolic reflectors. In Figure 3 the reflectors are shown as sections taken in a plane perpendicular to the axis of the antenna. In Figure 4, which is a sectional view taken at right angles to that shown in Figure 3, the section is considered to be taken in a plane passing through the axis of the antenna. If the dimensions of the fender plates 30 were made infinitely large, substantially complete shielding would, of course, be effected between the antenna elements 1 and 3. However, in practice, by choosing a dimension of the order of one wavelength of the operating frequency, a substantially complete shielding is obtained.

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 that modifications may be made within the scope of the invention.

I claim:

1. A high frequency relay station comprising a receiving antenna including wave energy directive structure, an amplifier having an input connected to said receiving antenna, a transmitting antenna connected to an output of said amplifier, said transmitting antenna including wave energy directive structure, said relay station being characterized by a small amount of undesirable feedback of energy from said transmitting antenna to said receiving antenna over a plurality of paths around the edges of said directive structures, said structures having their edges so constructed that the energy fed back over some of said paths neutralizes the energy fed back over the others of said paths.

2. A high frequency relay station comprising a receiving antenna including wave energy directive structure, an amplifier having an input connected to said receiving antenna, a transmitting antenna connected to an output of said amplifier, said transmitting antenna including wave energy directive structure, said relay station being characterized by a small amount of undesirable feedback of energy from said transmitting antenna to said receiving antenna over a plurality of paths around the edges of said directive structures, the edges of at least one of said directive structures including means for causing said paths to differ by an odd multiple, including unity, of a half the length of the operating wave whereby said feedback energy is neutralized.

3. A high frequency relay station comprising a receiving antenna, an amplifier connected to said antenna and a transmitting antenna connected to an output of said amplifier, a reflector in operative relation with at least one of said antennas, the edge of said reflector being cut back for a portion of its perimeter a distance equal to a quarter of the length of the operating wave whereby feedback from said transmitting

antenna to said receiving antenna is neutralized.

4. A high frequency relay station comprising a receiving antenna, an amplifier connected to said antenna and a transmitting antenna connected to an output of said amplifier, a reflector in operative relation with at least one of said antennas, the edge of said reflector being cut back a distance equal to a quarter of the length of the operating wave for a portion of its perimeter whereby feedback from said transmitting antenna to said receiving antenna is neutralized.

5. A high frequency relay station comprising a receiving antenna, a reflector for concentrating arriving signals on said antenna, an amplifier connected to said antenna and a transmitting antenna connected to an output of said amplifier, a reflector for concentrating energy radiated from said transmitting antenna into a beam, an edge of each of said reflectors being cut back a distance equal to one-eighth of the length of the operating wave for half of its perimeter, whereby feedback from said transmitting antenna to said receiving antenna is neutralized.

6. A high frequency relay station comprising a receiving antenna, a reflector for concentrating arriving signals on said antenna, an amplifier connected to said antenna and a transmitting antenna connected to an output of said amplifier, a reflector for concentrating energy radiated from said transmitting antenna into a beam, an edge of each of said reflectors being cut back a distance equal to one-eighth of the length of the operating wave for a portion of its perimeter, said cutback portions being adjacent, whereby feedback from said transmitting antenna to said receiving antenna is neutralized.

7. A high frequency relay station comprising a receiving antenna, an amplifier connected to said antenna and a transmitting antenna connected to the output of said amplifier, and a reflector in operative relation with at least one of said antennas, the edge of said reflector being cut back a distance such that a feedback path from the transmitting antenna to the receiving antenna around one portion of said reflector differs in length from that around the remaining portion of said reflector by an odd multiple, including unity, of a half of the wave length whereby feedback from said transmitting antenna to said receiving antenna is neutralized.

8. A high frequency relay station comprising a receiving antenna, an amplifier connected to said antenna and a transmitting antenna connected to an output of said amplifier, reflectors in operative relation with each of said antennas, the edge of at least one of said reflectors being cut back for a portion of its perimeter a distance such that the feedback path from the transmitting antenna to the receiving antenna around one portion of said reflectors is out of phase with that around the remaining portion of said reflectors.

9. As an article of manufacture, a reflector adapted to be associated in operative relation with an antenna for increasing its directivity, the edge of said reflector being cut back a distance equal to a quarter of the length of the operating wave of said antenna for a portion of its perimeter.

10. As an article of manufacture, a reflector having an axis of symmetry extending therethrough and adapted to be associated in operative relation with an antenna in front of said reflector and on said axis for increasing its directivity, the edge of said reflector being cut back a distance such that the path from the location

of said antenna to a point on said axis, near the rear of said reflector, around one portion of the edge differs in length from that around the remaining portion of the edge of said reflector by an odd multiple, including unity, of a half of the operating wave length of said antenna.

11. As an article of manufacture, wave directive structure having an axis of symmetry extending therethrough and adapted to be associated in operative relation with an antenna in front of said structure and on said axis for increasing its directivity, said structure having its edges so constructed that the distance from the location of said antenna to a point on said axis, near the rear of said structure, around one portion of the edge of said structure differs from that around another portion of the edge of said structure by an odd multiple, including unity, of

a half of the operating wavelength of said antenna.

12. As an article of manufacture, wave directive structure having an axis of symmetry extending therethrough and adapted to be associated in operative relation with an antenna in front of said structure and on said axis for increasing its directivity, said structure having a portion of its edge cut back a distance such that the path from the location of said antenna to a point on said axis, near the rear of said structure, around said portion of the edge of said structure differs from that around the remainder of the edge of said structure by an odd multiple, including unity, of a half of the operating wavelength of said antenna.

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