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SYSTEM AND METHOD OF RADIO TRANSMISSION AND RECEPTION

Filed March 2, 1929

Fig. 1

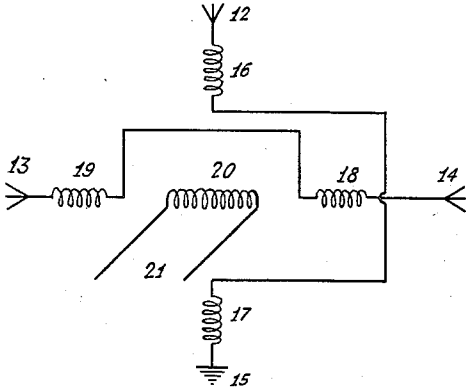


Fig. 2

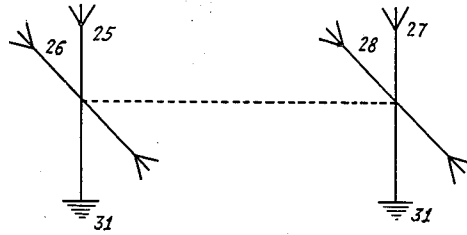


Fig. 3

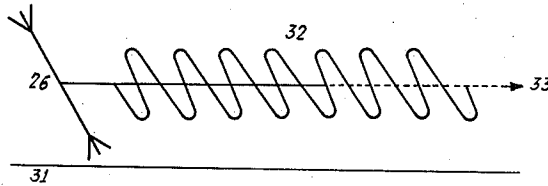


Fig. 4

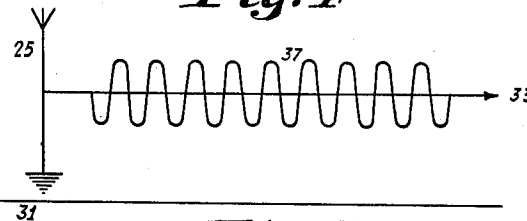


Fig. 5

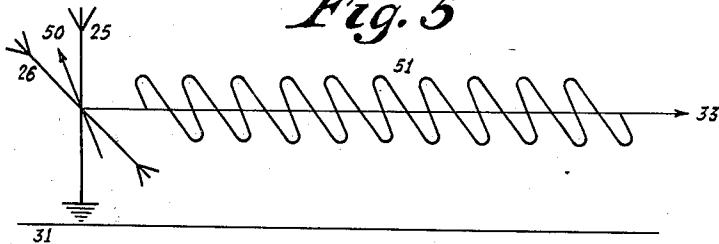


Fig. 6

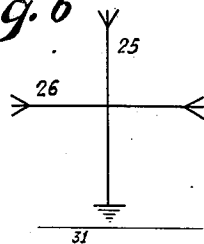
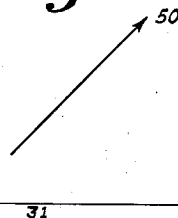


Fig. 7



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SYSTEM AND METHOD OF RADIO TRANSMISSION AND RECEPTION

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The radiation of electro-magnetic waves from various antennæ will have a polarized effect in accordance with the direction of the length of the antenna. Thus, a vertical antenna will transmit vertically polarized waves, whereas, a horizontal antenna will transmit horizontally polarized waves, or in other words, waves which may be best adapted to be received by a similar antenna depending upon distance and character of intervening territory. The effect of polarization of the ether waves is quite pronounced and transmission from a vertically polarized antenna, for instance, can not be received efficiently by horizontal antennæ and vice versa. But it has been observed that a wave polarized in a given direction may be best received on an antenna having a certain direction which need not necessarily, however, be the same as that of the transmitter and conversely that a given receiving antenna will receive waves which have been polarized in a certain direction better than other waves which have not been polarized, although as previously stated, the direction of the polarization of the transmitter need not be the same as the direction of the extent of the receiving antenna.

It is an object of the present invention to utilize the polarization characteristics of various antennæ and thus provide an improved method of transmission and reception of radiant energy.

It is a further object of this invention to provide a system of transmission and reception of radiant energy which shall assist in the elimination of static. It is another object of this invention to provide an improved system of transmission and reception which shall be more free from the effects of interference. It is an additional object of this invention to eliminate fading. These and other objects will become clear upon reading the following description of the invention in connection with the appended drawing.

The apparatus involved in this invention comprises, at each of the transmitting or receiving stations using this system, a vertical and a horizontal antenna and means for exciting either or both of these antennæ in the

case of a transmitter or in deriving space energy from either or both of said antennæ and supplying it to a receiver in the case of receiving equipment. The amount of energy received from or transmitted on the two antennæ being dependent upon the amount of coupling of a rotatable coil to the two antennæ coils in each case.

Having now briefly described my invention attention is invited to the accompanying drawing wherein,

Fig. 1 represents the horizontal and vertical antennæ with their respective pick-up coils and the adjustable pick-up coil for transferring power to or from the receiving or transmitting equipment respectively;

Fig. 2 represents schematically the horizontal and vertical antennæ at the transmitting and receiving stations respectively;

Fig. 3 represents the emission of a horizontally polarized wave;

Fig. 4 represents the emission of a vertically polarized wave;

Fig. 5 represents the emission of a wave which is neither vertically or horizontally polarized;

Fig. 6 is a schematic end view showing the exact relationship of the vertical and horizontal antennæ; and

Fig. 7 shows the direction of polarization of a wave being transmitted from the antenna represented in Fig. 6 when both antennæ are excited.

Having thus briefly described the figures accompanying this specification, attention is more particularly invited to Fig. 1 which shows the vertical antenna 12 the circuit of which is grounded at 15 and contains the secondary or antenna coils 16 and 17. 13 and 14 represent the diametrical portions of the horizontal antenna, the circuit of which is included in the antenna coils or secondaries 18 and 19. The rotatable coil 20 is connected to the output of a radio transmitter or to the input of a radio receiver by means of the connections or leads 21 and is adapted to be rotated so as to be inductively related to the coils in either or both of the two antennæ. In the position shown the coil 20 is inductively related to the coils 18 and 19 and the

entire transmission in the case of a transmitter or the entire reception in the case of the receiver is through the horizontal antenna.

This is shown more clearly in Fig. 3 which represents a projection showing the ground 31 with the horizontal antenna 26 and the horizontally polarized wave represented at 32 being radiated in the direction 33.

If the coil 20 of Fig. 1 is rotated to the vertical position the entire energy transfer will be between it and the coils 16 and 17, and the radiation in the case of a transmitter will be as represented in Fig. 4 wherein the vertical antenna is shown as 25 and the radiation represented at 37, in the direction 33 and is polarized in the vertical direction.

With the coil 20 at any intermediate position the entire energy transfer between this coil and the two antennae will be proportioned in accordance with the angles between the axis of the pick-up coils of the two antennae and the coil 20. This is shown more clearly in Fig. 5 assuming the angle of the coil 20 to be 45° with respect to both the vertical and horizontal antennae or in the direction shown by the arrow 50 or intermediate of the direction of the vertical antenna 25 and the horizontal antenna 26. The radiation, in this instance, as diagrammatically represented at 51 in the direction 33, will be polarized as indicated. In this latter instance, the direction of polarization is shown more clearly by the arrow 50 of Fig. 7 as being at 45° with respect to the ground 31.

The Fig. 6 is merely a view of the two antennae 25 and 26 with respect to the ground showing their actual angularity with respect to each other.

Fig. 2 shows the transmitting antennae 25 and 26 as they might be arranged relative to the receiving antennae 27 and 28. That is, the horizontal antenna would be parallel.

I will now describe the operation of my invention.

The operator will transmit in the position in which his coil 20 may be and upon establishing communication with the receiver will, if requested by the latter, rotate his coil until the best reception is experienced at the receiver. Similarly, the operator at the receiving station will rotate his coil 20 until the best reception is obtained. Theoretically, the axis of the two coils 20 in the transmitter and receiver should then be parallel and the angle of the coil 20, with respect to the horizon, would be determined by the character of the intervening earth, etc.

Now, if after communication has been established, interference is experienced at the receiver, the operator at the receiving station may direct the transmitter to shift the angle of his coil 20 until the least interference is experienced, at the same time rotating his own coil 20 to continue the maximum possible reception. Or, the receiver may rotate

his coil 20 to a position in which the interfering signal comes with least intensity and then request the transmitting station to shift the angle of transmission until the desired signal comes in the strongest.

If the above methods do not entirely eliminate the interference, the angle of transmission and/or reception may be varied until when the desired signal and interfering signals are both being received, there is a minimum amount of energy in the receiver circuit. In other words, the desired and undesired signals exactly neutralize each other with respect to the receiving antenna. The signal is then the complement of the interference and may be easily read by an experienced operator.

In a similar manner the effects of static may be more or less eliminated, that is, the direction from which the static proceeds due to the intervening terrain will result in causing the static impulses to be more or less polarized and by rotating the receiving pick-up coil 20 the effect of the static may be thus reduced. In this latter instance, of course, the transmitter operator is requested to tune his coil 20 to produce the best effect in the receiver.

In a similar manner the effects of fading may be greatly reduced if not entirely eliminated. Fading being caused by the effect of the Heaviside layer upon the reflected and directly transmitted ether waves, the change in polarization of the transmitted wave will cause it to meet the Heaviside layer at a different point as the polarization is changed and thus bring the receiving station into an area where there is no interference between the directly transmitted and the reflected ether waves. In this latter case the operator of the transmitter is therefore requested to shift his transmitting coil 20 until the least fading is experienced and the receiving operator rotates his coil 20 to receive the transmitted signal the best.

Having thus described my invention it is to be understood that a great many modifications and various embodiments may be devised from time to time and that, therefore, I am not to be limited by the specific construction shown and described for the purpose of illustration only, but by the scope of my invention as set forth in the appended claims.

I claim:

1. A method of radio transmission and reception which comprises transmitting the same signal with horizontally and vertically polarized ether waves, receiving said polarized ether waves and varying the effective composite angle of polarization of reception thereof so as to produce substantially the best transmission results.

2. A method of radio transmission and reception which comprises transmitting the

same signal with horizontally and vertically polarized ether waves, separately receiving said differently polarized ether waves and adjusting the respective angles for intelligible reception.

3. The method of elimination of fading which comprises altering the direction of polarization in radio transmission by transmitting the desired signal energy waves horizontally and vertically polarized, the amount of transmission from each thereof being proportioned so as to prevent interference between waves directly received and those indirectly received at the area occupied by the receiving station, and shifting the angle of reception by receiving different amounts of each of the polarized waves, the proportion of receipt thereof being determined by the reception characteristics desired.

4. A method of receiving signals despite excessive interfering energy which comprises, shifting the angle of transmission with respect to the angle of reception so as to obtain a minimum amount of energy at the reception end whereby the signal is made the complement of the interfering energy, noting the complement of the interfering energy and obtaining the signal therefrom.

5. The method of receiving signals despite excessive interfering energy which comprises shifting the angle of reception with respect to the angle of transmission so as to obtain a minimum amount of energy at the reception end whereby the signal is made the complement of the interfering energy, noting the reception of the interfering energy and translating the complement thereof to obtain the signal.

6. The steps in a method of radio transmission and reception which comprise transmitting waves representative of the same signals vertically and horizontally polarized in various proportions dependent upon the reception results at a receiver, and intercepting both of the polarized waves and varying the amount of each thereof utilized for, in effect, varying the angle of polarized reception in accordance with desired reception characteristics.

7. The method of receiving signals despite excessive interference which comprises changing the angle of polarized reception at a radio receiving station until the desired and undesired signals substantially neutralize each other at the receiver and noting the

signal from the complement of the interference.

8. A method of radio transmission and reception which comprises transmitting two sets of differently polarized ether waves, receiving said polarized ether waves, and shifting the polarization angle of transmission and the polarization angle of reception of both sets of waves in accordance with reception results at the receiver for obtaining good transmission results.

9. A signalling system adapted for use in localities subject to excessive interfering energy which comprises a vertical antenna system and a horizontal antenna system both thereof feeding into an amplifier, means for shifting the angle of reception of signal energy with respect to the polarization angle of transmission thereof so as to obtain a minimum amount of energy at the receiver, comprising variable means for coupling said two antennae systems to said amplifier, said means being adapted to vary the proportion of energy fed from each of said two antennae to the amplifier, whereby the signal is made the complement of the interfering energy and means for translating the received energy for obtaining the signal therefrom.

10. A signalling system adapted for use in localities subject to excessive interfering energy which comprises at the transmitter, a vertical antenna system and a horizontal antenna system, a source of signal energy, means for coupling said source to both said antennae systems comprising a variable coupling device adapted to transfer the signalling energy to said antennae systems in varying amounts depending upon adjustment thereof, means for receiving the transmitted energy from both systems comprising a vertical antenna and a horizontal antenna feeding into an amplifier system, means for shifting the angle of reception of signal energy with respect to the polarization angle of transmission thereof so as to obtain a desired amount of energy at the receiver, comprising variable means for coupling said antennae to said amplifier for varying the proportion of energy from each of said antennae to the amplifier whereby the signal is made the complement of the interfering energy and means for translating the received energy for obtaining the signal therefrom.

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