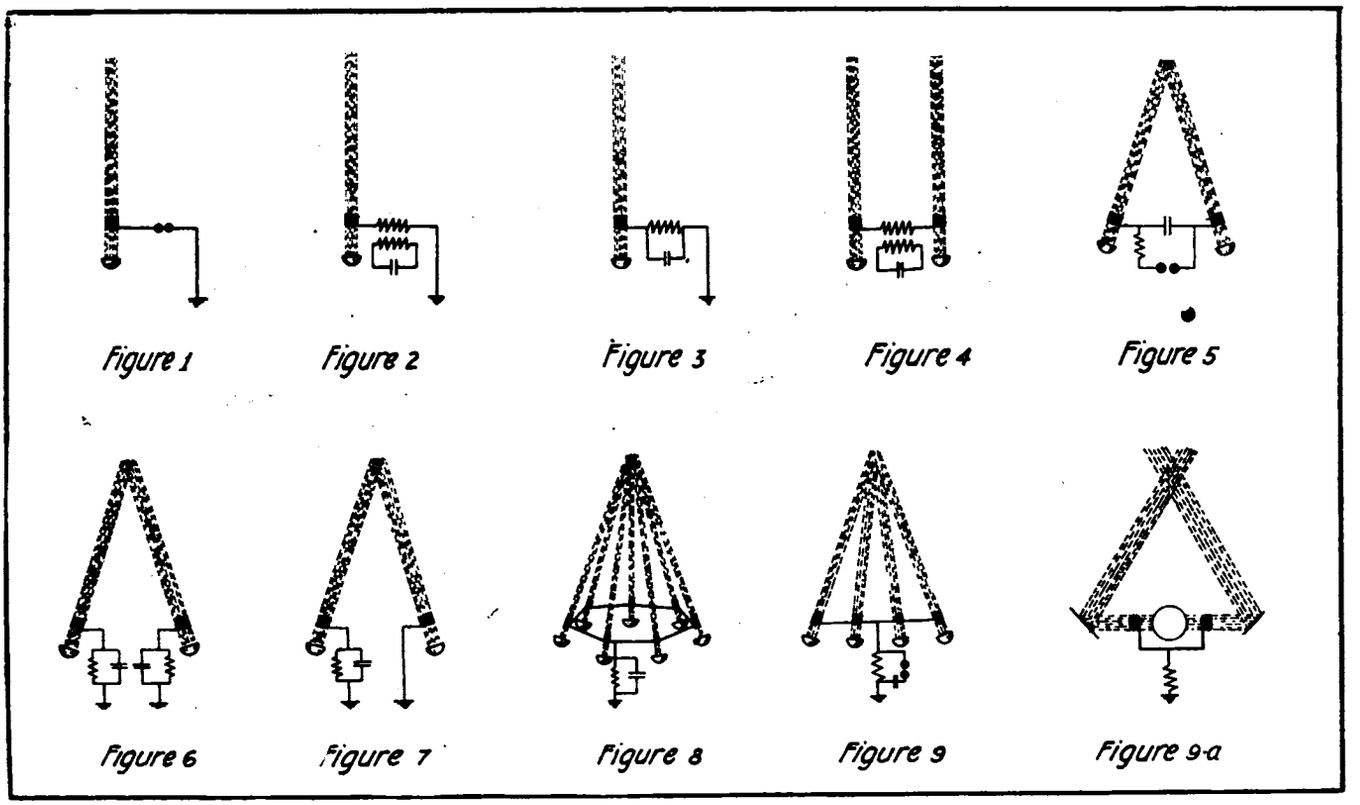
A High Antenna Without High Masts

RADIO men are more or less familiar with the effects which strong ionization in the upper atmosphere levels has upon the electrical waves used in wireless telegraphy. In studying the spectrum, we find that there is a decided absence of the shorter wavelengths. It has been shown by at least two scientists that the light which reaches the surface of the earth from the sun contains no wavelength shorter than about 2950 Angstrom units. It would be unreasonable to assume, in view of what we know, that no shorter wavelengths leave the sun and stars, and since it has been proven that an upper ionized layer of atmosphere exists, we have come to the belief that the light of the shorter wavelengths is absorbed prior to the time that it reaches the earth. The atmosphere immediately surrounding the earth then is not ionized, or, only very slightly so due perhaps to the radio-active matter in the sea or earth or to photo-electric action on dust particles.

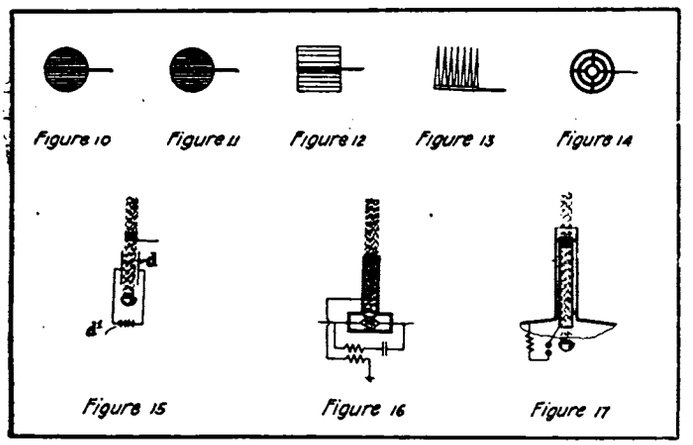
Ionization of gases is proven by the acquisition of electric conductivity on the part of the gas. An un-ionized gas is a perfect non-conductor. Advantage has been taken of this characteristic by John Hettinger of London, who has taken out a patent wherein he proposes to substitute conducting ionized beams, such as a search-light beam of ultra-violet rays produced by means of a suitable electric arc or mercury vapor lamp, for the wires of an antenna for transmission or reception of radio telegraphic and radio telephonic signals. According to the invention, a portion of the atmosphere is continuously ionized along a beam so as to render it more conductive than the remaining portion and a good electrical connection is established between the beam and the metallic portion of the electric circuit in which the beam is substituted for the long conductor. In view of the fact that the air along the beam is not enclosed but is in actual contact with the remaining part of the atmosphere there is a certain amount of diffusion, with the result that the surrounding atmosphere in the immediate neighborhood of the beam is also rendered conductive to a less extent.

The conductivity decreasing continuously and quickly along circles concentric with the beam and also gradually decreasing from its electrical connection in the direction of the beam facing away from its source. Further, owing to the fact that the air is free to move about, ionized particles of air will be shifted from the position they occupy in the track of the beam so that the actual form of the conductive zone will be altered to a certain extent at various points. The effect of these various conditions is that although ionization is actually maintained along the beam, the beam conductor is not supposed to have the actual form of the beam but a form depending upon circumstances above referred to, the line of comparatively strongest conductivity being in the center of the beam with small deviations therefrom, as in the case of movements of air. When used for signaling purposes this beam conductor may be compared to an elevated conductor of large surface in electrical connection with a metallic circuit, the other end of which is connected to earth. The potential imparted to the metallic portion of the circuit tries to equalize itself along the beam conductor and the entire system thus absorbs large amounts of energy as compared with the energy that could be imparted to the system without the ionized beam. In the latter case, all the lines of electrical force would be bent toward the earth immediately after leaving the other end of the metallic circuit. Where the beam is used, however, a current will flow along the lines of least resistance, viz: Upward within the beam and immediately around it and more particularly along its center and there will be lines of force which will start bending downward toward the earth at a much higher point than would be the case were the beam not used. While the amount of current actually flowing through the beam may be small and decreasing continuously toward the upper end of the



Various arrangements of aerials

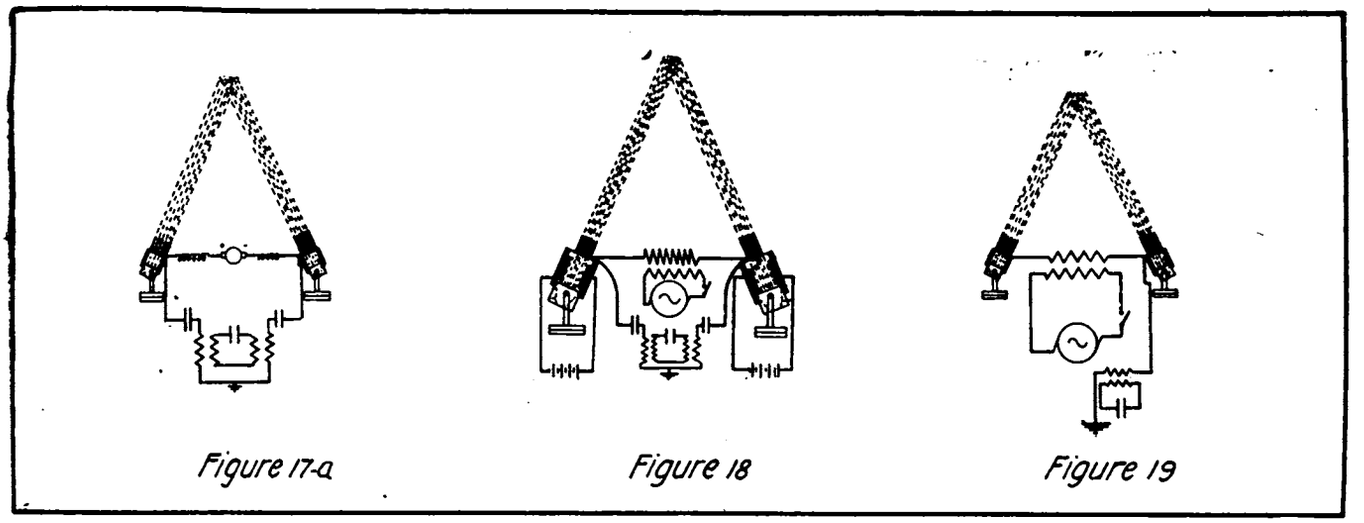
beam it is to be remembered that this is not material in the case of an aerial, it being known that the current flowing through the aerial and more particularly through the upper part thereof may be small as long as the potential is high in the upper part and the current large at the point where it is connected to the earth. The electrical connection of the ionized beam with a point of high potential and the absorption of great energy by such a beam insures the fulfillment of these conditions. The accompanying drawings illustrate diagrammatically various arrangements and details for carrying the invention into effect. Figures 1, 2, 3, 4, 5, 6, 7, 8, 9 and 9A illustrate various arrangements of aerials. Connections to the beam are made with devices as shown diagrammatically in figures 10, 11, 12, 13 and 14.



Various methods of producing beams and the types of connections

It is known that when certain metals are charged, more particularly with negative electricity, they have the property of becoming discharged under the action of light and it has been determined that this discharge is due to ultra-violet and other rays and would be dependent upon the state of the surface of the metal. This property of certain metals is usually referred to as photo-electric effect. Since a small length of the beam lies between the electrical connection and the source of the beam use may be made of the photo-electric property—possessed by certain metals and not by other metals—to prevent a discharge of electricity from the electrical connection toward the source of the beam, or to reduce it as much as possible and at the same time assist the discharge from the electrical connection in a direction away from the source of the beam. With this object in view the photo-electric effect, above referred to, has to be assisted in every respect on the surface of the connection facing away from the source of the beam, while the effect has to be prevented from taking place—or reduced as much as possible—on the surface facing the source of the beam. For instance, the surface of the gauzes or perforated plates facing away from the source may be highly polished while the opposite surface may be covered with a material which is not transparent with respect to ultra-violet rays. The same object may be obtained by using for this connector metal which is not very sensitive with regard to the photo-electric phenomenon, such as copper. This copper is provided, on the surface facing away from the source, with a covering of metal which is very sensitive with respect to the photo-electric phenomenon, such as rubidium or an alloy of potasium or sodium. The discharge of electricity from the metallic connection toward the source of the beam may also be prevented or greatly diminished by removing or greatly reducing the conductivity of the beam between its source and the metallic connection, causing a direct or alternating current to flow across the beam in that part lying between the source and the metallic connection. This flow of current may be produced by means of an electric field as shown in figure 15 and in figure 25. The two plates d of a condenser being connected to the two poles or source of d of constant potential may be replaced by an alternating current supply of low or high frequency which may belong to the transmitting system.

For the production of the beam use may be made of an ordinary searchlight in which an arc lamp or mercury vapor lamp is employed, care being taken to prevent the absorption of the ultra-violet rays by substituting quartz for all transparent parts usually employed in searchlights.



Method of superposing high-frequency currents upon a low alternating electric field or upon a continuous electric field of high potential

The spark or arc producing the oscillations may also be employed for producing the beam. In figure 16, illustrating such an arrangement, a spark gap is enclosed in a cylinder of insulating material having an extension which is open at its outer end to allow the passage of the beam to the exterior of the electrical connection which is effected by a series of pointed metal pieces carried on a support electrically connected with the secondary of an oscillatory transformer which is earthed. Quartz may also be arranged in the back of the beam.

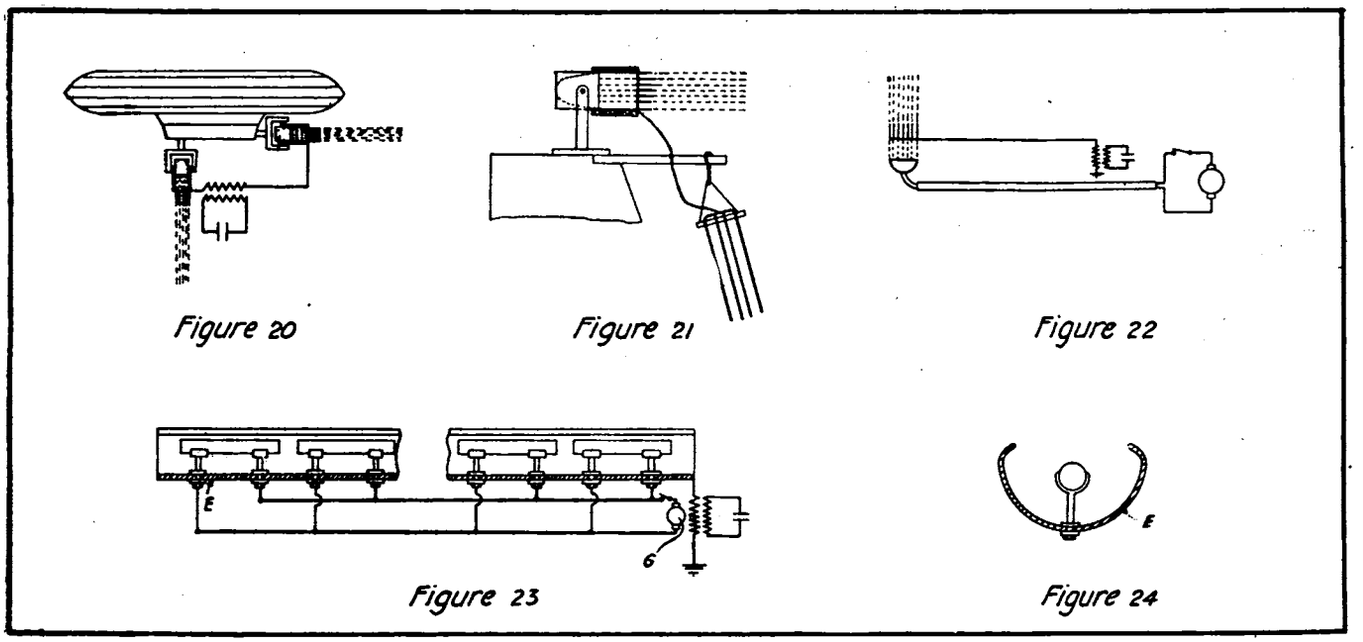
The high frequency currents or impulses supplied to the transmitting beam aerial or collected by the receiving beam aerial may be super-posed upon an alternating electric field of low frequency or upon a continuous electric field of high potential. This is illustrated in figure 17

in connection with a continuous electric field, and in figure 18 and figure 19 in connection with an alternating electric field. Referring to figures 17 and 18, the continuous or alternating field of low frequency is set up by connecting the two poles of a high voltage continuous current machine through inductive resistances, or the two terminals of the secondary of an ordinary transformer (not a high frequency oscillation transformer) to two electrical beam connections, one of which is directly connected to the oscillatory system while the other connection is not directly connected to the oscillatory system, and is placed in an ionized beam arranged to intersect the beam in which the beam connection, first referred to, is placed.

In the application of the invention to wireless signaling to and from aircraft use is preferably made on the aircraft of one ionized beam aerial directed downward so that it may strike the earth, a telegraph wire, a railroad track, or other conductors and of another ionized beam aerial which is substantially parallel to the earth, thereby forming a directive aerial. See figure 20.

The aerial may be used in connection with any wireless aerial of known construction, for example, it may be movably connected with the top end of the usual elevated aerial thereby forming a directive aerial of the horizontal type. Figure 21 illustrates such an arrangement in which the source of the beam together with the electrical beam connection, is mounted on and insulated from the casing of the arc and is electrically connected with the top of the aerial. It is mounted on a high support in the usual manner so that it may be turned in a horizontal plane as well as in a vertical plane.

Attempts have been made heretofore to transmit wireless signals over long distance by means of low horizontal aerials, but such attempts have not led to any practical results. Transmission over long distances may now be accomplished by combining low horizontal aerials with the ionized beam aerial, and leading the free end of the horizontal metallic aerial into the ionized beam by means of a beam connection, the source of the beam receiving its energy from a source of current G or by arranging the metallic aerial in a plane of ultra-violet rays directed upward. See figure 22. The latter arrangement is preferably carried out as shown in figures 23 and 24, by using as the metallic horizontal aerial, a long strip E of zinc or other metal which is sensitive with regard to the photo-electric phenomenon and is bent to form a trough, the ionized aerial being produced by several mercury vapor lamps of tubular shape supported in the concave part of the metallic trough and being directed upward in a plane containing the metallic aerial, the mercury vapor lamps receiving the current from the source of energy G.



Arrangements to realize the advantages secured through the use of beam aerials

This invention is also well adapted for use on submarines and figure 25 illustrates a transmitting arrangement used in connection therewith. The electrical connection is attached to the upper part of a metal tube which is arranged within a periscope and forms with the latter a condenser included in an oscillatory circuit. The system is earthed through the body of the submarine. The periscope mirror (not shown), which may be used to reflect the beam in any desired direction, must be made of metal or the glass used in ordinary mirrors must be replaced by quartz. The receiving apparatus may be connected up to the beam aerial in a similar manner.

The Effect of Direct Connection of Plate Circuit With the Antenna

THE novel feature of the wireless signaling system devised by W. C. White lies in the means which he takes in getting around certain difficulties encountered in the usual arrangements, by including the plate circuit inductance directly in the antenna circuit and thus impress the alternate component of the plate current upon the antenna, thereby avoiding the necessity of an inductive coupling between the plate circuit and antenna and the use of a separate coil. In his practical application however, it is found that the source of potential used for heating the filament together with the auxiliary apparatus used to control the heating current, instead of being at a fixed low potential with respect to the earth as in the ordinary arrangement, is at a potential which alternately varies at the frequency generated between positive and negative values with respect to the earth and that this potential may rise to such a high value that it becomes inconvenient