HIGH ALTITUDE ANTENNA

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Fig. 2.

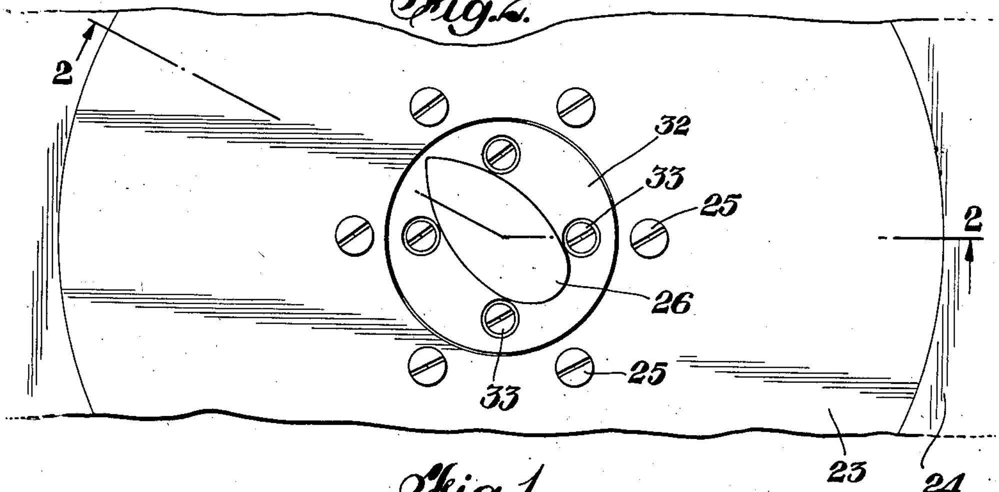
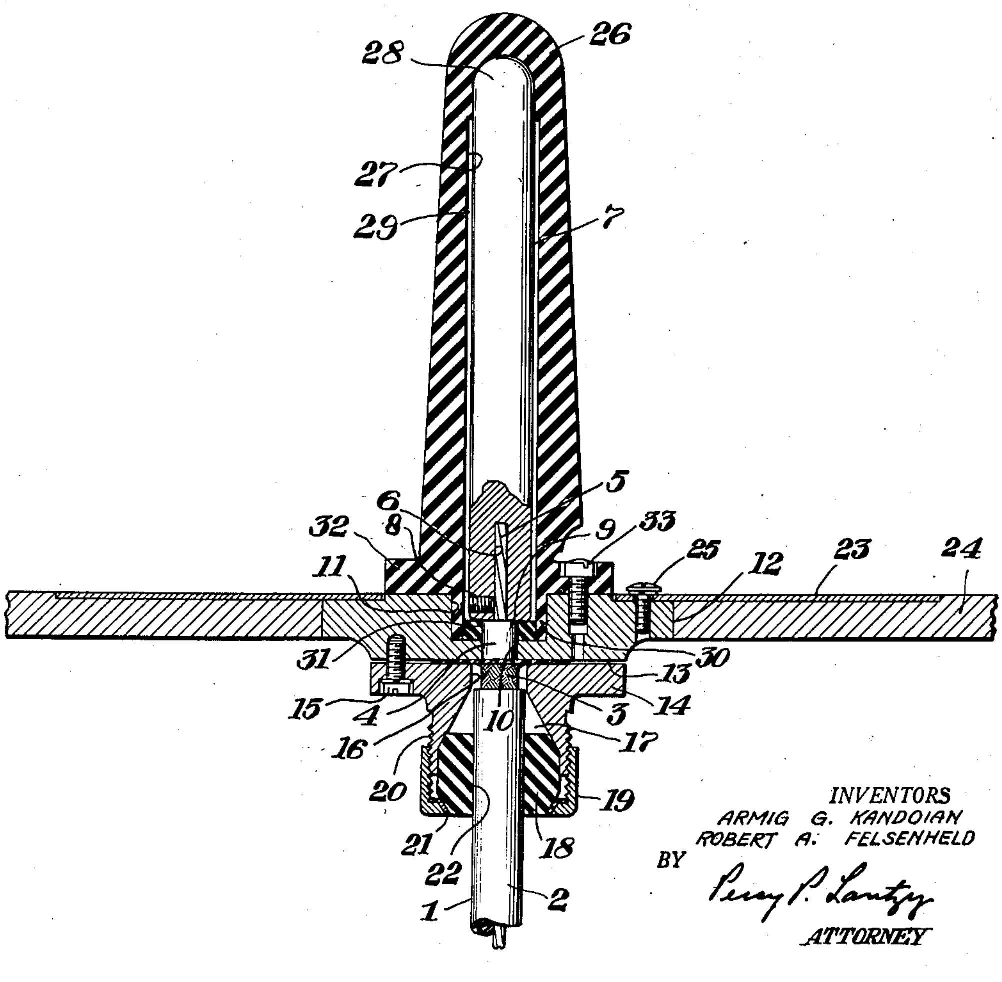


Fig. 1.



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HIGH ALTITUDE ANTENNA

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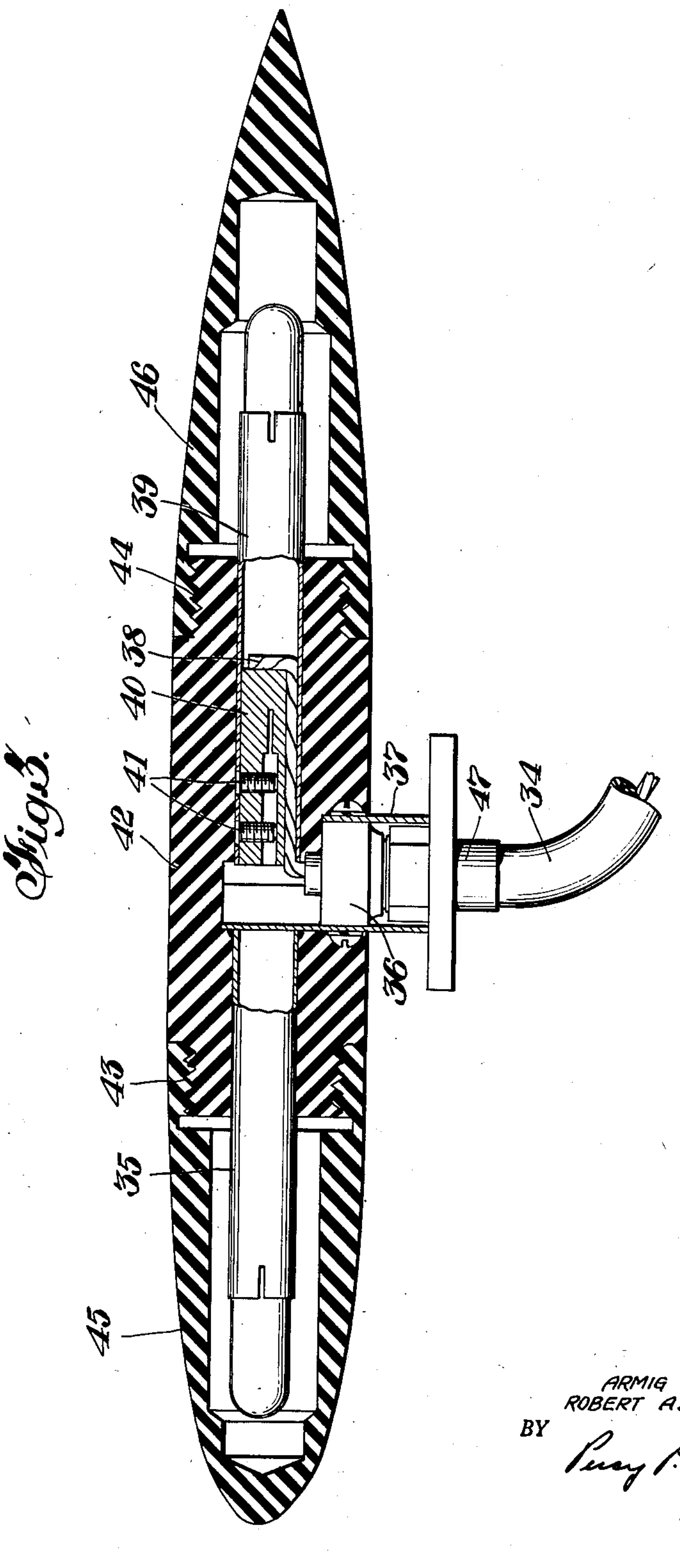

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HIGH ALTITUDE ANTENNA

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This invention relates to antennas and more particularly to antennas for aircraft transmitting radio signals at high altitudes.

In certain radio communication applications especially those involving pulse type signals, high peak voltages of the order of 5 to 10 kilovolts are placed on the transmitter antenna in the form of standing waves. When such transmitters are used on planes at high altitudes, say 40 to 50 thousand feet, with a corresponding decrease in ambient atmospheric pressure, the phenomenon known as corona discharge occurs, that is, the air near the high voltage point of the antenna or radiator becomes ionized. In consequence of this ionization, a loss in power and in the efficiency of transmission takes place.

To overcome this difficulty, numerous attempts have been made, particularly of molding low-loss dielectric materials over and on to antennas. The results, however, always proved unsatisfactory because of retained air bubbles or cracks in the insulation occurring near the radiator due to temperature effects, causing a corona loss or actual voltage breakdown.

A solution arrived at by us, according to our invention included the provision of a dielectric type cover for the radiator forming a sealed air chamber between the radiator and the cover.

It is accordingly an object of our invention to provide electro-magnetic energy radiator means for effective use at high altitudes.

It is also an object to provide a radiator with a structure for use at high altitudes, such that the radiator is housed in a medium whose conditions simulate atmospheric conditions at sea level.

It is a further object to provide a radiator and its immediate surrounding elements such that, at high altitudes and at high voltages, the transmission efficiency and losses will be commensurate with those at sea level.

It is a further object to provide a radiator or antenna in a gaseous medium such as air which is maintained substantially at atmospheric pressure at all altitudes.

It is a still further object to provide a radiator structure which will accomplish the objects set forth above.

In accordance with the invention, we provide an ultra-high frequency antenna with a dielectric housing which forms a pressurized hermetically sealed air chamber about the radiator which permits high altitude operation without dielectric breakdown. The antenna is preferably fed from a conventional coaxial cable provided with a

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pressurized connector for junction to the output coupling of a suitable oscillator unit.

These and other features and objects of the invention may be better understood from the following particular description of an embodiment thereof made with reference to the accompanying drawings in which:

Fig. 1 is a view in vertical section of a vertical dipole type antenna in accordance with the invention;

Fig. 2 is a partial plan view of the antenna of Fig. 1; and

Fig. 3 is a view in vertical section of a horizontal dipole antenna incorporating our invention.

In the view of Fig. 1 there is shown a portion of a solid dielectric type coaxial cable 1 having an outer insulating jacket 2, an outer tubular conductor in the form of a metallic braid 3, a solid dielectric 4, and an inner concentrically arranged conductor 5. A bared end of the conductor 5 is secured within an aperture 6 of a solid, conducting rod 7 which may be of aluminum and which serves as a radiator or antenna in this instance. A set screw 8 has been provided in the antenna 7 to secure the conductor 5 within the antenna. It will be noted that the lower end 9 of the radiator rod 7 is resting on the squared end face of the solid dielectric 4 which extends through a passage 10 and a recess 11 of an electro-conductive base or supporting member 12. The conductive braid 3, which is shown freed of insulation over a certain portion thereof, has been flared outwardly and is held clamped adjacent another face 13 of the base member 12 by means of a flange member 14 which is held secured to said base member by means of screws of which only one is shown at 15. The member 14 is provided with an axial passage 16 to permit the cable to pass therethrough, the passage being widened into a recess 17 to retain therein a rubber bushing 18 which may be compressed upwardly toward the narrow portion of the recess by means of a nut 19 which is movable on the member 14 on the threads 20 and which is effective in pressing upwardly the bushing 18 by means of action on a retaining ring 21. The bushing member is also provided with an axial aperture 22 to allow the passage of the cable 1. This rubber bushing serves as an additional pressure seal for the antenna structure at this point. The member 14 is electro-conductive so that a grounding circuit is thus established from the braided conductor 3, thru the member 12 to a discoid member 23 which serves as the antenna counterpoise. The member 23 may be secured to a main structure or fuselage of the plane 24. The member 23 is held secured to the base member 12 by means of screws of which one is shown at 25. Finally, there is provided over the radiator rod 7 a low loss dielectric housing 26 which may for instance be formed of polyethylene. The housing 26 is formed with a chamber 27 which at the closed end of the housing is shaped to conform closely to a rounded end 28 of the radiator 7. The major portion of the chamber 27, however, has a diameter somewhat larger than that of the rod 7 so that an annular chamber is formed between the rod and the housing along most of their length. The housing adjacent its open end is formed with an annular projection 30, which extends with a close fit into the recess 11 of the member 12, wherein the housing may be held secured by means of a suitable cement as shown at 31. The housing is also provided with a flanged portion 32 near its open end, the face of which is made to adjoin the top of the member 12, and whereto it may be held secured by means of screws around its periphery such as the one shown at 33. As may be seen in Fig. 2, the housing may take a streamlined configuration if the antenna is used in a location where such form is of advantage as on the outside of the airplane.

In Fig. 3 an embodiment of the invention is shown applied to the two portions of a half wave horizontal dipole. A coaxial cable 34, which is similarly constituted as the cable 1 in Fig. 1, is shown having its conductive braid connected to a tubular radiating member 35 by means of a clamping member 36 which is disposed within a radiator supporting member 37. The radiating member 35 is disposed at right angles to its support 37. A central conductor 38 of the cable 34 is shown freed of its insulation to a considerable extent and held in conductive contact within a second radiating tubular member 39 by means of a cable clamp 40 which is disposed within the radiator 39 and held therein by means of set screws 41. The entire central portion of the above described structure is enclosed in polyethylene forming a contiguous housing 42 for the central portion and leaving the ends of the radiators 35 and 39 to extend therebeyond. The housing 42 may if convenient be molded or potted over the said central portion of the radiating structure. The housing is provided at both ends with threads 43 and 44 which serve to receive thereon the chambered housing members of polyethylene 45 and 46. A flanged member 47 may be mounted on the cable 34 immediately adjacent and underneath the radiator support 37 for the support of the radiating structure.

The form of antenna shown in Fig. 1 is of the type known as a broad band quarter wave antenna for an ultra-high frequency band. It is assembled as a hermetically sealed unit and provided with an air cavity between the radiator and the housing within which air has been trapped at sea level pressure. The housing is sealed to the base member forming a pressurized chamber about the radiator so that voltage breakdown at high altitude is eliminated since the antenna is always surrounded by normal atmospheric pressure. Due to the cavity a wide range of temperatures may also be endured by the structure without cracking or other deleterious effects which may be due to different temperature coefficients.

The transmission line or cable may connect through a so-called pressurized connector to an oscillator to minimize possible leakage along the conductors which is held to a minimum by provision of the cement 31 in the recess 11 and a rubber bushing 18 at the radiator base. This arrangement has been tested and found to have eliminated the possibility of arcing or voltage breakdown up to altitudes of say, 40 to 50 thousand feet. The effectiveness of the radiator and its directive pattern is in nowise affected by the housing.

In both cases illustrated the transmission of pulses will result in high voltage points along the antennas, sometimes as high as 5 to 10 kilovolts. Due to the dielectric constants of the air-cavity and of the polyethylene housing, the voltage radiant on the outside of the housing is below the critical value for causing corona, regardless of the atmospheric pressure effective outside, or altitude. The pressure within the cavity with a proper seal may be kept substantially at the value prevailing at sea level for all practicable altitudes over an adequate period.

It will be seen therefore that with an antenna structure as described above, the transmission of high voltage signals may be effected at high altitudes without loss of efficiency due to voltage breakdown or leakage.

While we have shown two specific types of antennas and housings for providing an efficient high voltage radiating means at all altitudes, any other type of antenna or antenna system suitable for the respective circumstances may be substituted instead. Similarly many other variations in the housings in accordance with our invention will occur to those skilled in the art. The specific description of the particular embodiments is given above merely by way of illustration and is not to be considered as a limitation of our invention as indicated in the objects thereof and defined in the appended claims.

We claim:

1. An electro-magnetic energy radiator structure for aircraft comprising a radiator member, a rigid housing forming a chamber about said radiator member inclosing a gaseous medium, and means for sealing said chamber to maintain substantially constant sea level pressure in said chamber regardless of changes in pressure outside said chamber.

2. An electro-magnetic energy radiator structure for aircraft comprising a coaxial cable having an inner and an outer conductor, a radiator forming an extension of said inner conductor, an electro-conductive base member having a passage for said cable to extend therethrough, a counterpoise conductively secured to said base member, said outer conductor being in conductive contact with said base and thereby with said counterpoise, a rigid dielectric housing forming a chamber about said radiator supported on said base, and means for hermetically sealing substantially at sea level air pressure said chamber and said radiator therein including said base and a portion of said cable.

3. A radiator structure according to claim 2, further including means for forming a pressure seal about said cable secured to said base member.

4. An electro-magnetic radiator structure for aircraft comprising a coaxial cable having an outer and an inner conductor; a pair of radiators disposed at right angles to the axis of said cable, one of said radiators being in electro-conductive connection with said inner, and said other radiator being in connection with said outer conductor; means for supporting said pair

of radiators out of electric contact with one another, and rigid housing means forming a sealed pressure chamber approximately at sea level pressure about each of said radiators.

5. An electro-magnetic radiator structure for aircraft comprising a pair of radiators disposed along one axis, means for supplying energy to said pair of radiators, and rigid dielectric housing means forming a sealed pressure chamber substantially at sea level pressure about said radiators.

6. An electro-magnetic energy radiator for aircraft comprising a radiator member, a rigid housing forming a chamber about said radiator member enclosing a gaseous medium at approximately sea level pressure, a solid dielectric cable connected to said radiator, and means sealing said chamber about said radiator member and a portion of said cable connected thereto for maintaining the pressure about said radiator member constant, said sealing means including a pressurized connection about said cable.

7. A radiator according to claim 6 in which said pressurized connection includes a seal be-

tween said housing and the solid dielectric of said cable and a rubber bushing arranged between said outer conductor and said housing.

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