

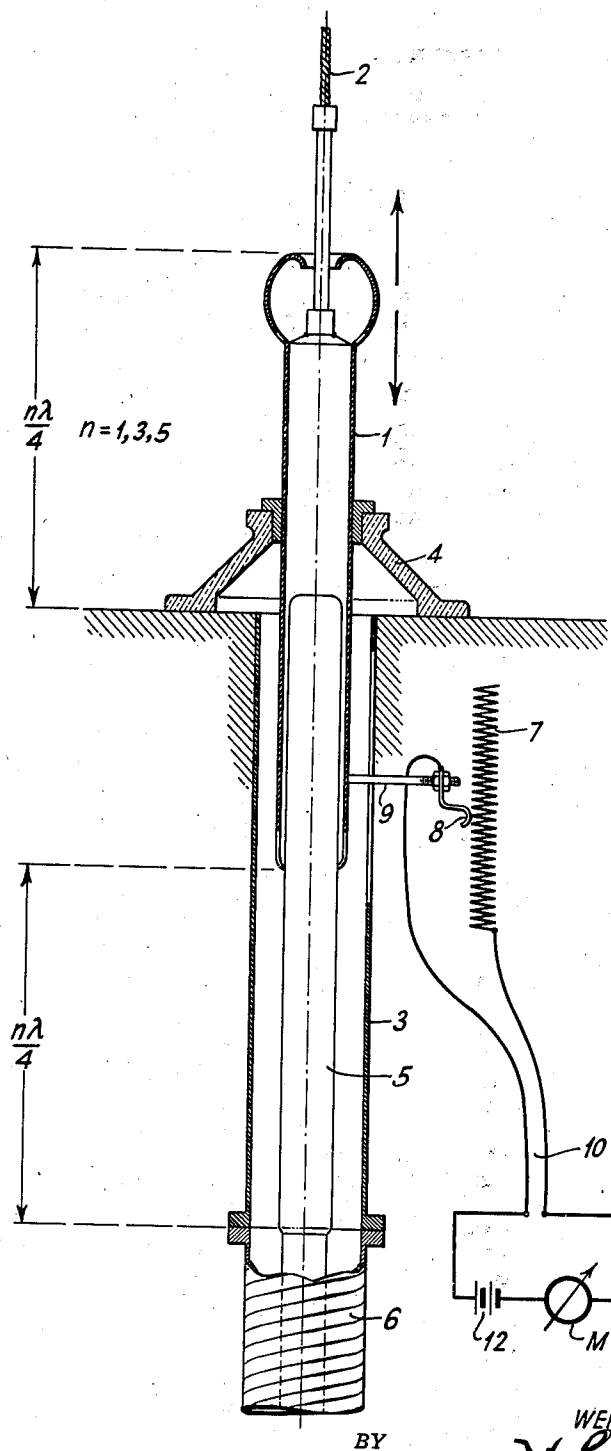
May 16, 1939.

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2,158,271

SHORT WAVE ANTENNA

Filed Oct. 9, 1937



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UNITED STATES PATENT OFFICE

2,158,271

SHORT WAVE ANTENNA

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Application October 9, 1937, Serial No. 168,120
In Germany October 13, 1936

4 Claims. (Cl. 250—33)

The invention relates to an arrangement for matching a short wave antenna, whose length can be adjusted, and is equal to $\lambda/4$, with an energy line.

In practice, it is often required to design an adjustable length short wave antenna for a wide wave range in such manner that matching with the feed line is assured for each antenna length. The best known example for such antenna arrangement is the radiator having a wavelength equal to $\lambda/4$ and connected to a concentric energy line whose wave resistance (surge impedance) is 36 ohms. Since the resistance at the bottom point of a $\lambda/4$ antenna is a purely ohmic one, and has for each wavelength the value of 36 ohms, the cable is always loaded with its wave resistance; that is, it is matched.

However, in practice a wave resistance (surge impedance) of the order of 60 ohms was found to be especially advantageous for concentric high-frequency cables, since at the ratio of the diameters of the inner and outer conductors of 1:2.7 which corresponds thereto, the cable is best exploited as regards voltage. Furthermore, the accessory parts, such as for instance phase transformers, detour lines, coupling arrangements at the transmitter etc., were recently standardized for 60 ohms wave resistance, so that a simple antenna arrangement is in demand which can be connected to a cable without obtaining reflections and without special coupling means. It is also desirable that it be possible to adjust the length of the antenna subsequently and still maintain the impedance match for each wave length.

In accordance with the invention, there is placed between the energy line and the antenna having the length $\lambda/4$, and whose length can be adjusted (λ =operating wavelength, $n=1, 3, 5, 7 \dots$), a line section whose length varies with the change in the length of the antenna, and which is always $n \cdot \lambda/4$, while its wave resistance (surge impedance) is equal to the geometrical mean value of the wave resistance of the energy line and the resistance at the bottom point of the antenna.

In a practical example, the antenna whose bottom point resistance is 36 ohms is connected reflection free to a cable having 60 ohms wave resistance. In order to accomplish this, use is made of the known property of a $\lambda/4$ line having the wave resistance W to transform an output resistance in accordance with the equation $R_1 \cdot R_2 = W^2$, wherein R_1 and R_2 represent the input resistance and output resistance of the $\lambda/4$ line.

One embodiment of the invention will now be described with particular reference to the accompanying single figure of the drawing.

The actual radiator 1 consists of a tube having a minimum length equal to

$$\frac{\lambda_{\max}}{4}$$

The antenna can be pulled out or moved into a tube 3 sunk into the ground by means of an insulated pulley and a rope 2, in order to vary the effective length of the antenna for a desired frequency of operation. The ratio of the diameters of the antenna 1 and of the tube 3 is such that the wave resistance (surge impedance) of the line formed by the immersing part of the antenna (i. e., that part located within tube 3) and the tube 3 is equal to the bottom point resistance (hence 36 ohms) of the antenna. Reference numeral 4 represents a supporting arrangement in which the outer conductor is slidably arranged and insulated therefrom. The antenna conductor is disposed to slide over a somewhat smaller metal tube 5 extended inside the outer conductor 3, and whose diameter is such that it has, together with the outer conductor 3, a wave resistance that is equal to the geometrical mean value between the bottom point resistance of the antenna and the wave resistance of the energy line. At its lower end this inner conductor 5 passes to the inner conductor 6 of the actual energy line, whose wave resistance is 60 ohms as above indicated. Now, if the length of the line piece between the end of the conductor 6 and the beginning of the antenna conductor 1 in the interior of the outer conductor 3 is equal to $\lambda/4$ or $n \cdot \lambda/4$ wherein n is an odd whole number, the cable resistance of 60 ohms is transformed upon the bottom point resistance of the antenna by means of this line piece or transformer section. The resistance of the transformer section is equal to 46.5 ohms in the example above chosen wherein the antenna impedance is 36 ohms and the transformer line impedance is 60 ohms. If this transformation piece is designed to have a length equal to the freely protruding part of the antenna conductor 1, the extent to which the antenna conductor 1 is pulled out of or immersed into tube 3 does not matter since the transforming portion of line 5 is always as long as the antenna, hence equal to $\lambda/4$, thus insuring correct impedance matching of the cable with the antenna. Exactly the same property as in a $\lambda/4$ antenna also exists for a line whose length is three $\lambda/4$, five $\lambda/4$, etc., so that antennas can

also be utilized which are excited in a corresponding harmonic relationship. In each case, the electrical contact between the outer conductor 1 and the conductor 5 must take place at the lower
 5 end of the antenna conductor, since the relations between the lengths do not otherwise properly conform with each other.

Since it is not possible to accurately determine the length of the antenna conductor 1 which is in
 10 use by means of the rope 2 serving to adjust the protruding length, a more convenient provision for determining the adjustment also forms a part of my invention. A resistance 7 is provided which is contacted by conductor 8 supported
 15 from the moving aerial conductor 1 by means of rod 9. At the remote location where it is desired to determine the length of the conductor protruding an indicating instrument M and a source of potential 12 is provided. The instru-
 20 ment and the source of potential are connected in series with the resistor 7 by means of conductors 10.

What is claimed is:

1. A short wave antenna system comprising a
 25 variable length aerial conductor adjustable to have an effective free length equal to an odd multiple including unity of one-quarter of the length of the operating wave, a feeder, and a line having a length equal to the effective free length
 30 of said aerial conductor connecting said feeder to said aerial conductor, said conductor being slidable over said line, whereby change of length of said aerial conductor simultaneously changes the length of said line an equal amount, the surge
 35 impedance of said line being intermediate the value of the surge impedance of said feeder and the surge impedance of said aerial conductor.

2. A short wave antenna system comprising a
 40 variable length vertical aerial conducting tube adjustable to have an effective free length equal to an odd multiple including unity of one-quarter of the length of the operating wave, a vertical concentric line section having an outer conductor
 45 and an inner conductor, said aerial tube being arranged to slide over and contact the inner conductor of said line, an energy feeder also in the form of a concentric line coupled to the bottom of said vertical concentric line section, the length of said inner conductor of said section, as
 50 measured from said feeder to the nearest point

of contact with said aerial tube, being substantially equal to the effective free length of said aerial tube, the surge impedance of said inner conductor of said line section being equal to the geometrical means value of the surge impedance
 5 of said feeder and the impedance of said aerial at the point of contact with said inner conductor.

3. A short wave antenna system comprising a variable length aerial conductor adjustable to have an effective free length equal to an odd
 10 multiple including unity of one quarter of the length of the operating wave, a feeder, and a line having a length equal to the effective free length of said aerial conductor connecting said feeder to said aerial conductor, said conductor being
 15 slidable over said line whereby change of length of said aerial conductor simultaneously changes the length of said line an equal amount, the surge impedance of said line being intermediate the value of the surge impedance of said feeder and the surge impedance of said aerial, a variable re-
 20 sistance coupled to said aerial conductor, a source of potential and an indicating instrument connected in series and located at a remote point, and connections from said resistance and said in-
 25 strument, a source of potential whereby an indication of the adjustment of said antenna system may be obtained.

4. A short wave antenna system comprising a central conductor and a surrounding shell, a
 30 tubular antenna conductor arranged to slide over and contact said central conductor and adjustable to have a free length outside of said shell equal to an odd multiple including unity of a quarter of the length of the operating wave, the
 35 ratio of the diameter of said shell and said tubular conductor being such that the effective impedance thereof is equal to the impedance of said antenna, an energy feeder in the form of a concentric cable and having an impedance differing from that of
 40 said antenna coupled to said shell and said central conductor, the length of said central conductor between the end of said antenna conductor and said energy feeder being equal to the free length of said antenna conductor and the ratio
 45 of the diameters of said central conductor and said shell being such that the impedance is the geometric mean between the impedance of said energy feeder and said antenna.

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