

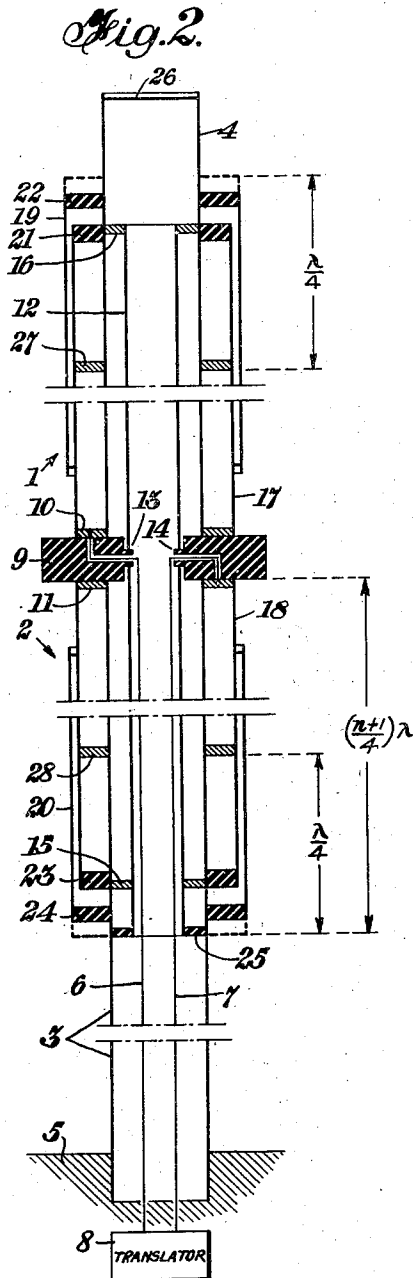
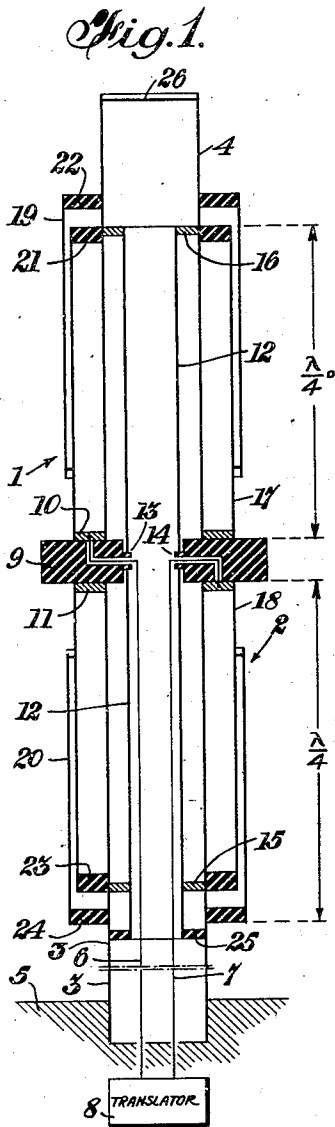
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CENTER FED ANTENNA

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CENTER FED ANTENNA

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This invention relates to antennas and more particularly to vertical antenna arrangements.

Heretofore center fed vertical dipole antennas were designed with radiator lengths which were based on the one-half wavelength as a standard unit. In certain cases like the present instance, structural limitations made it inopportune to employ antennas of such length and the height of the vertical antenna and of the radiators had to be limited so that it became necessary to explore the possibility of employing an antenna based on the quarter wavelength. It became immediately apparent that quarter wavelength vertical center fed antennas, especially ones which were to be used over a wide frequency band, presented a number of difficulties and particularly if a balanced double conductor transmission line were utilized. In feeding a vertical dipole antenna through its center an unbalance ordinarily would be created in the transmission line. In order to avoid this unbalance it is necessary to introduce a shield for the transmission line which may also be utilized as a supporting pipe structure for the radiators. In order, however, to prevent a coupling of the radiator current with the supporting pipe at the end away from the midpoint of the antenna, which if left open would present a direct short-circuit to such currents, a direct conductive contact must be established between the shield and the radiator adjacent the feed, or center, portion of the antenna. Thus, a large impedance is established at the other end between the radiators and the shield. Ordinarily, in the case of a single frequency and unless a very precise balance of the radiators is required, only an outer shield will be required in the upper antenna portion. Since, however, in such a case one of the two lines is connected to the shield, an unbalance would be created which would prevent the occurrence of current in the lower radiator due to the unbalance of the relative impedance values between the line conductors and the shield. It is therefore necessary to isolate the line from its shield by introducing an additional shield which has a length of a quarter wave at the midpoint frequency in a wide band antenna. A large effective impedance is thereby established between the line and the new shield and a zero impedance at a point which is a quarter wavelength from the point of maximum impedance when looking from the direction of the antenna midpoint or feed point. To establish a balance in the radiator structure, particularly when handling a wide band of frequencies, an image of

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the shield structure may be provided in the upper portion of the antenna structure. The length of the actual radiators for proper response over a desired range of frequencies may be made adjustable.

It is accordingly an object of the present invention to provide a vertical center fed dipole antenna which is operable over a wide band of frequencies and presents a symmetrical radiation characteristic, the length of the dipole being based on a quarter wave standard length and which is fed from a balanced dual transmission line.

In accordance with the present invention, I provide two vertically arranged tubular radiators which are fed by a balanced dual transmission line passing through the lower of the two radiators and which is arranged to feed the radiators at their mid or junction point. Disposed within the two radiators are two concentric shields the outer of which acts as a supporting structure for the antenna. The outer shield is conductively connected to the respective upper and lower radiators adjacent the mid or junction points thereof while the internal or second shield is itself conductively connected to the outer or first shield at a point which is a quarter or if desired an odd multiple of a quarter wavelength at midfrequency away from the nearest conductive contact between the outer shield and the radiators. This distance is a quarter wavelength from the midpoint for a quarter wave antenna and for an antenna longer than a quarter wavelength for each of its two radiators, it is an odd multiple of a quarter wavelength from the open end between the outer and inner shields.

These and other features and objects of my invention will become more apparent upon consideration of the following detailed description to be read in connection with the accompanying drawings in which:

Fig. 1 represents in diagrammatic form of an embodiment of the invention for an antenna having individual radiators substantially one quarter wavelength long at the midpoint frequency; and

Fig. 2 is a diagrammatic representation of an embodiment of an antenna in accordance with my invention the individual radiators of which may be longer than a quarter wavelength.

Referring to Fig. 1 the antenna structure is composed of radiators 1 and 2 which are structurally supported by tubular shields 3 and 4 the former member 3 being shown supported on a

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base 5. The radiators 1 and 2 and the supporting shields 3 and 4 are supplied with radiating energy over a balanced transmission line comprising conductors 6 and 7 which are supplied from an energy translator device 8. In the figure the conductor 6 is seen to be connected to the upper radiator 1 and the corresponding shield 4, the conductor 7 being arranged to supply the lower radiator 2 and the corresponding shield or supporting member 3. The two radiators and shield portions are disposed along the same axis and held out of conductive contact at their adjacent ends by means of an insulating member 9, disposed at the midpoint thereof. The two conductors of the transmission line may be made to pass through the said insulator 9 to make contact with conductive portions 10 and 11 which provide a connection between the respective radiators and their corresponding shields and which may be in the form of conductive and supporting discs, adjacent the two sides of the insulator 9. The transmission line conductors are further supplied with an additional or internal tubular shield 12 which is disposed within the outer shield 3—4 and preferably extending in one piece from the lower portion of the outer shield 3 to the upper portion of the shield 4. Openings may be provided in the inner shield 12 at 13 and 14 to permit the conductors 6 and 7 to pass therethrough toward the junction points at 10 and 11. The inner shield 12 is also provided with a short-circuiting member 15 therefrom to the outer shield 3 and a similar member 16 for the upper shield 4 each at a point which is located

$$\frac{\lambda_0}{4}$$

that is, a quarter wavelength at midfrequency from the respective open end between the outer and inner shields adjacent the insulator 9. The radiators 1 and 2 are each comprised of inner or fixed radiating members 17 and 18 respectively and outer or slidable tubular members 19 and 20 in contact with the inner radiators whereby the overall lengths of the individual radiators may be adjusted to a total length of a quarter wavelength of the maximum wavelength encountered in the frequency band to be covered. In order to provide structural strength, both the inner and outer radiator portions have been furnished with insulating members disposed between the respective radiator portions and the outer shields or supporting tubular members 3 and 4, as at 21, 22 for the upper radiator and at 23 and 24 for the lower radiator. Similarly, members may be provided as a support of the inner shield at 25. However, the member 25 may be omitted if desired and the inner shield terminated at the conductive member 15. The upper shield or support 4 has been provided with a closure or cap member 26.

The antenna structure of Fig. 2 is similar in all respects to that shown in Fig. 1 except that the length of the upper and lower radiating portions is a multiple of a quarter wavelength where limitation in physical length is not critical. The overall length of each radiator may be expressed by the general term:

$$\frac{(N+1)\lambda}{4}$$

where N may be any suitable integer from zero up. The essential difference over the antenna of Fig. 1 lies in the provision of a short-circuit respectively between radiators 1 and 2 and the correspond-

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ing outer shield or supporting tube portions 3 and 4 by means of short-circuiting portions 27 and 28 at a point which is a quarter or an odd multiple of a quarter wavelength away from the open outer end of the radiators and by locating the short-circuits 15—16 between the inner shield 12 and the outer shield 3—4 at points which are

$$\frac{\lambda}{4}$$

10. or if desired

$$\left(\frac{N+1}{4}\right)\lambda$$

15 away from the inner and open end of the inner shield 12.

It thus becomes apparent that in operation the antenna as described hereinabove provides an outer quarter wave trap and an inner quarter wave trap which are effective in preventing the appearance of radio frequency currents on the supporting tube and on the inner shield. The effect is such that the radiators are tuned to approximately a quarter wavelength with respect to the outer shield whereby a high impedance is seen at a point looking in at the open end of the radiators and similarly, a conductive contact between the inner shield and the outer shield is provided at a point substantially a quarter wavelength from the open end of the two shields which is at the antenna midpoint. A high impedance is thus seen between said inner and outer shield when looking in at the open end or feed point. Over a given range of frequencies the impedance between inner and outer shields varies from inductive to capacitive. However, both input lines have this impedance in shunt with the antenna to ground and therefore remain balanced. By giving the coaxial section a high surge impedance by means of high ratios of diameters the antenna may be made to cover a broad band. While the quarter wavelength radiators are the preferred form, it will be seen from the above that the principle outlined hereinabove has application in connection with radiators having a length which is a multiple of quarter wavelength.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of my invention as defined in the objects and the accompanying claims.

I claim:

1. A vertical dipole antenna comprising a pair of tubular radiators having outer ends and inner substantially adjacent ends; a balanced double transmission line comprising two conductors extending in part thru one of said radiators, said conductors being in conductive contact one with each of said radiators at said inner ends; an outer shield disposed coaxially within said radiators having a conductive connection therewith adjacent said inner ends, and an inner shield coaxially disposed within said outer shield having a conductive connection therewith a given distance from said inner ends.

2. An antenna according to claim 1, wherein said connection comprises a structural portion for each radiator and said outer shield constitutes a supporting structure for said portions and said radiators.

3. An antenna according to claim 1, further including insulating means disposed intermediate said inner ends.

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4. An antenna according to claim 1, wherein said pair of radiators comprises a pair of tubular members having each an axial length substantially equal to one quarter wavelength at a representative midfrequency.

5. An antenna according to claim 1, wherein said pair of radiators comprises a pair of tubular members having an axial length substantially equal to one quarter wavelength at the highest frequency in a given operation band further including a tubular sleeve slidably secured in coaxial relation to each of said radiators, whereby the effective length thereof may be adjusted in accordance with the operative wavelength.

6. A vertical dipole antenna comprising a pair of tubular radiators having outer ends and inner substantially adjacent ends, a balanced double transmission line comprising two conductors extending in part thru one of said radiators, said conductors being connected one to each of said radiators at said inner ends; outer shield means disposed coaxially within said radiators, inner shield means coaxially disposed within said outer shield, first means forming a trap for a wave of a given length between said radiators and said outer shield, and second means forming a trap for a wave of a given length between said outer shield and said inner shield.

7. An antenna according to claim 6, wherein said first and second trap forming means form traps which are effective for a one quarter wavelength at a representative midfrequency.

8. An antenna according to claim 6, wherein said first and second trap forming means form traps which are effective, for odd multiples of quarter wavelengths at a representative midfrequency.

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9. An antenna according to claim 6, wherein said first and second means forming traps comprise conductive connections between said radiators and said outer shield and between said outer and said inner shield, and high effective impedances therebetween at the ends thereof which are not connected.

10. A vertical dipole antenna comprising a pair of tubular radiators having outer ends and inner substantially adjacent ends; a balanced double transmission line comprising two conductors extending in part thru one of said radiators, said conductors being connected one to each of said radiators at said inner ends; outer shield means disposed coaxially within said radiators conductively connected thereto respectively adjacent said inner ends, and inner shield means coaxially disposed within said outer shield means conductively connected thereto a distance from said inner ends which is equal to an odd multiple of a quarter wavelength at a representative midfrequency.

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