United States Patent [19]

Collins

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[54] AERIAL FIELD MONITORING

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[52] **U.S. Cl.**.....**343/703,** 343/767

[51] **Int. Cl.**.....**G01r 1/24**

[58] **Field of Search**.....343/703, 767

[56] **References Cited**

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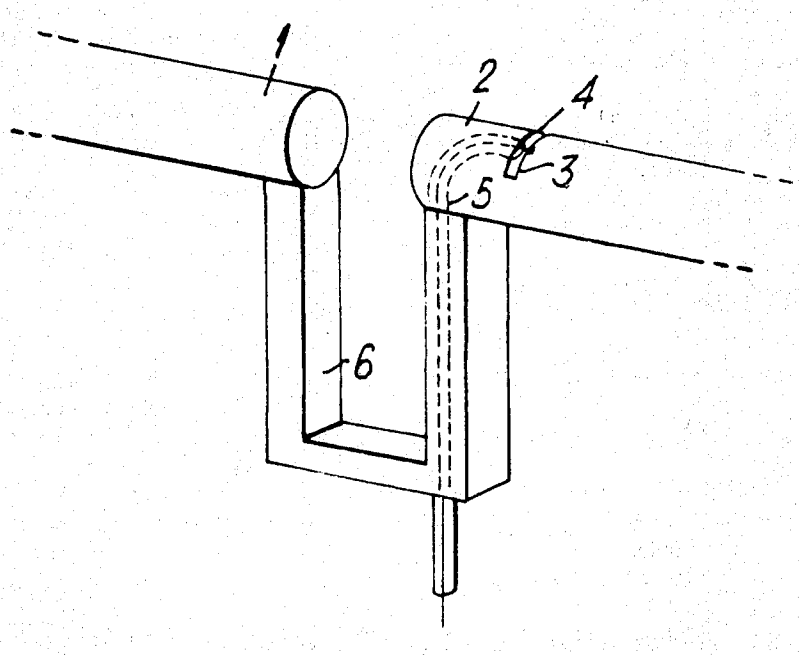
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[57] **ABSTRACT**

The radiated field of a dipole at any point is directly related in amplitude and phase to the current in the dipole arms. This can be sampled by a slot cut in the dipole arm. The voltage across this slot is fed to a transmission line which may be matched to subsequent processing units by a suitable positioning of a resistor. This enables both the R.F. current from the power fed to the dipole, and the current produced by interaction with other radiating elements to be measured.

3 Claims, 5 Drawing Figures



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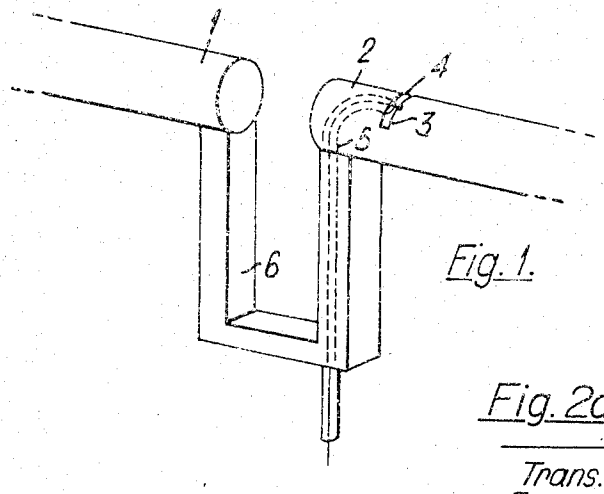


Fig. 1.

Fig. 2a

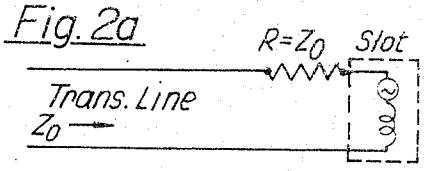
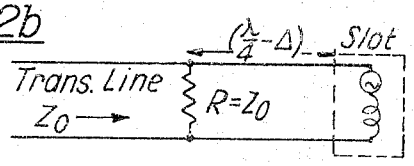


Fig. 2b



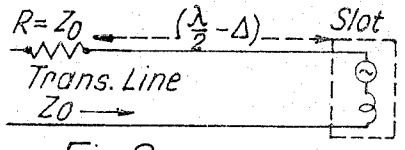


Fig. 2c

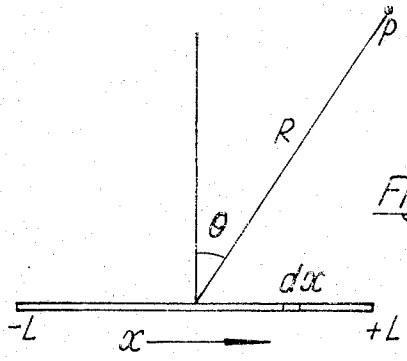


Fig. 3.

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AERIAL FIELD MONITORING

BACKGROUND OF THE INVENTION

This invention relates to radiating dipoles and to methods for monitoring the radiated field of a dipole by sampling the current in the dipole arms.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method for monitoring the radiated field of a dipole at any point in the field.

According to the invention, there is provided a method for monitoring the radiated field of a dipole at any point in the field comprising, cutting a slot in the dipole arm, coupling a transmission line to said slot, matching said line to a receiving unit, and measuring the R.F. current in both amplitude and phase.

The invention will now be described with reference to the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a dipole modified by means of slot to provide a monitoring output;

FIG. 2*a* shows a first technique matching a transmission line coupled to the slot wherein a resistor is placed directly in series with the slot;

FIG. 2*b* shows a second technique of matching a transmission line coupled to the slot wherein a resistor is placed in parallel to the slot;

FIG. 2*c* shows a third technique of matching a transmission line coupled to the slot; and

FIG. 3 is a representation of field conditions in the vicinity of a dipole.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows the adjacent ends 1 and 2 of the two arms of a dipole, with a narrow slot 3 cut in the surface of one arm, 2. Coupled into the slot 3 is the exposed core 4 of a coaxial transmission line 5, of which the outer sheath is connected to the edge of the slot.

A narrow slot cut in the dipole arm interrupts a small portion of the r.f. current flowing and has a voltage across its center proportional to the current. With convenient sizes of slot the power output to a transmission line fed across the slot is 30–50dB down on that fed to the dipole. Maximum coupling occurs when the slot is normal to the current flow as illustrated in FIG. 1. These orders of coupling have negligible effect on the current distribution in the dipole.

The slot represents a low impedance generator which is slightly inductive. It can be matched to a transmission line of characteristic impedance Zo by means of a resistor of resistance $R = Zo$ (See FIG. 2).

In method (a) of FIG. 2, the resistor is placed directly in series with the slot. This method has the maximum bandwidth but does not allow any compensation for the inductance of the slot, so that the matching is not exact.

In method (b) the resistor is placed in parallel to the slot a distance $(\lambda/4 - \Delta)$ from the slot. The length Δ can be made to compensate for the inductance of the slot.

In method (c) the resistor is placed in series a distance $(\lambda/2 - \Delta)$ from the slot. Again Δ can be made to compensate for the slot inductance.

Since the slot is a low impedance source, the coupling between it and the dipole is relatively insensitive to exterior conditions such as water in the vicinity of the slot.

Referring now to FIG. 3, this shows a polar representation of the field at the point P in the vicinity of such a dipole, P being at an angle θ and a radial distance R from the center point O of the dipole of length $2l$. Points along the dipole are measured in terms of linear distance x from point O, and dx represents a small element of the dipole.

Consider the dipole of length $2l$ fed with a current $I(x)$ of wavelength λ.

The r.f. voltage at the point P distant R ($\gg \lambda$) from the center point O of the dipole is given by:

$$V = \frac{60\pi \operatorname{Cos}\theta}{\lambda R}\int_{-l}^{l} I(x)\, e^{2\pi i \times \operatorname{Sin}\theta/\lambda} dx \qquad (1)$$

Now $I(x)$ can be written as $I_s \cdot f(x)$, where I_s is the current at the location of the slot.

Equation (1) can thus be rewritten:

$$V = \frac{60\pi \operatorname{Cos}\theta}{\lambda R}\int_{-l}^{l} I_s \cdot f(x)\, e^{2\pi i \times \operatorname{Sin}\theta/\lambda} dx \qquad (2)$$

$$= F(\theta, R).\ I_s \qquad (3)$$

Equation (3) shows that the slot output, which is proportional to I_s, reproduces the changes in V, both in amplitude and phase, due to changes in the current in the dipole. It reproduces both the effect of power directly fed and that due to interaction from other radiating elements.

It is to be understood that the foregoing description of specific examples of this invention is made by way of example only and is not to be considered as a limitation on its scope.

I claim:

1. A method for monitoring the radiated field of a dipole at any point in the field comprising:
   - cutting a slot in the dipole arm;
   - coupling a transmission line to said slot;
   - inserting an ohmic resistor equal to the characteristic impedance of said transmission line at a predetermined distance from said slot for matching said line to a receiving unit; and
   - measuring the amplitude and phase of the r.f. current.

2. A method according to claim 1 wherein said predetermined distance equals one-half of a wave length at the operating frequency in the case of a series connection.

3. A method according to claim 1 wherein said distance in one quarter of a wavelength in the case of a shunt connection.

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