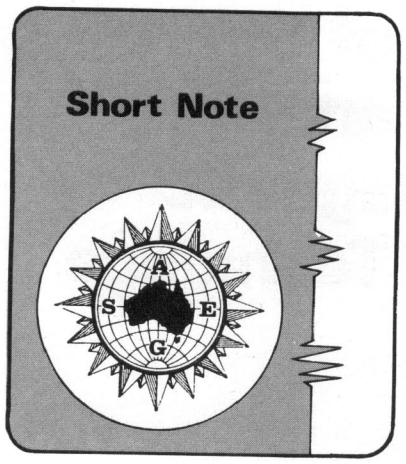

The Rotating Current Dipole Method of Prospecting*

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When the outputs of a 3 phase AC generator are connected sequentially to the three dipole electrode pairs in the arrangement of figure 1, the outputs will combine in the ground to produce a rotating dipole source. For the electric and magnetic field quantities Er, Eϕ, Ez, Hr, Hϕ, Hz for a horizontal electric dipole embedded in a conductive medium (Banos, 1966), the combination of angular quantities in phase and electrode geometry for the three dipoles involves the relations

$$\cos\Theta\sin\omega t + \cos\left(\frac{2\pi}{3}+\Theta\right)\sin\left(\omega t-\frac{2\pi}{3}\right) + \cos\left(\frac{2\pi}{3}-\Theta\right)\sin\left(\omega t-\frac{4\pi}{3}\right), \quad (1)$$

$$\sin\Theta\cos\omega t + \sin\left(\frac{2\pi}{3}+\Theta\right)\cos\left(\omega t-\frac{2\pi}{3}\right) + \sin\left(\frac{2\pi}{3}-\Theta\right)\cos\left(\omega t-\frac{4\pi}{3}\right), \quad (2)$$

where Θ is the azimuth and ω the transmitter angular frequency. Both (1) and (2) reduce to the result

$$\frac{2}{3}\sin(\omega t+\Theta)$$

Thus for measurements involving one of the above field quantities, for example H_z, the signal at a given radial distance in a homogeneous medium for all azimuths retains a constant amplitude and its phase varies only with Θ. With a receiver dipole the system is an omni-directional dipole – dipole E.M. method with galvanic source energisation.

Since at any point in the ground, the horizontal component of the current vector assumes all orientations, optimum conditions arise for induction in any dipping conductor and this together with the ability to survey in both azimuth and radial profiles about the source transmitter offers a distinct advantage over other galvanically energised ground based A.M. systems.

A field system consisting of a 3.5kw, 400H_z, six phase current balanced transmitter has been developed together with a phase and ratio null meter capable of detecting phase differences of 0.01°. Field studies have been concerned principally with establishing the transmitter radiation pattern under homogeneous conditions. A site at Bribie Island in a sand medium has been found to meet this requirement; a transmitter electrode circle of 50 ft radius and a transmitter current of 1.5A provided adequate s signal strength for observations to a radius of 450 ft. As an example of the field results a polar plot of phase difference $\Delta\phi$ on an azimuthal profile is given in figure 2 where the radius scale is 0.7 cm = 10° and the circles were surveyed at 50 ft intervals from the transmitter electrodes.

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Reference

BANOS, A. (1966) Dipole Radiation in the Presence of a Conducting Half Space. Pergamon Press, Oxford, UK.

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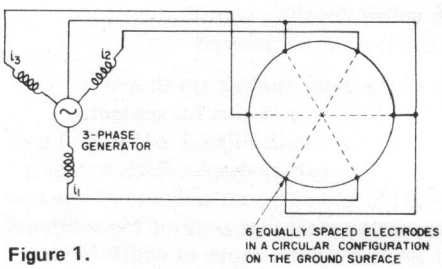

Figure 1.

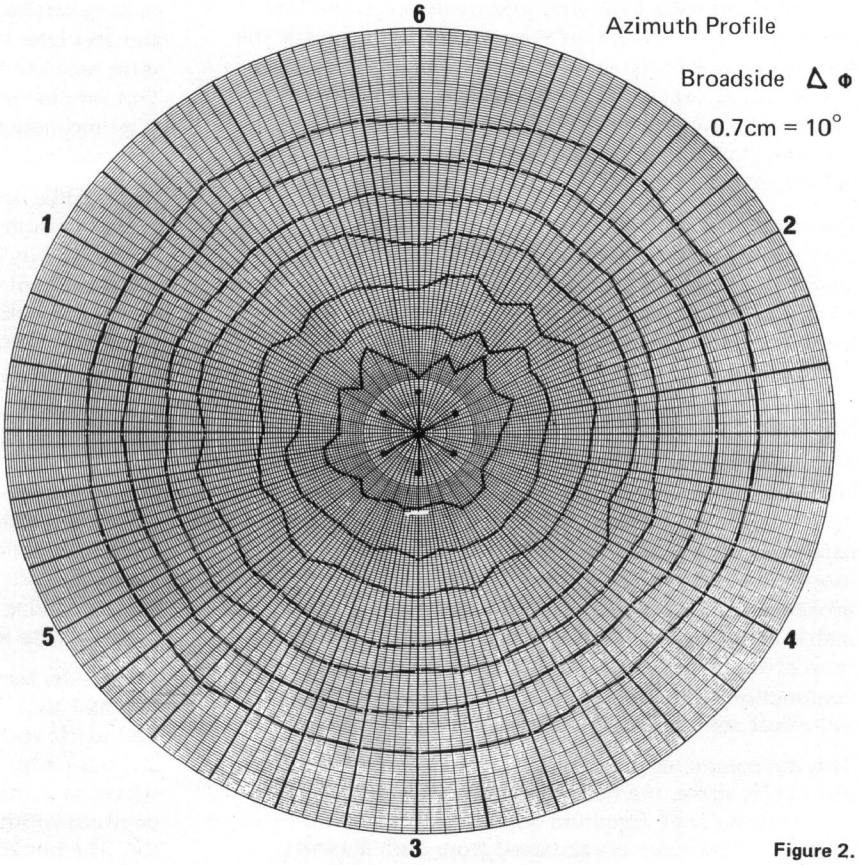

Figure 2.