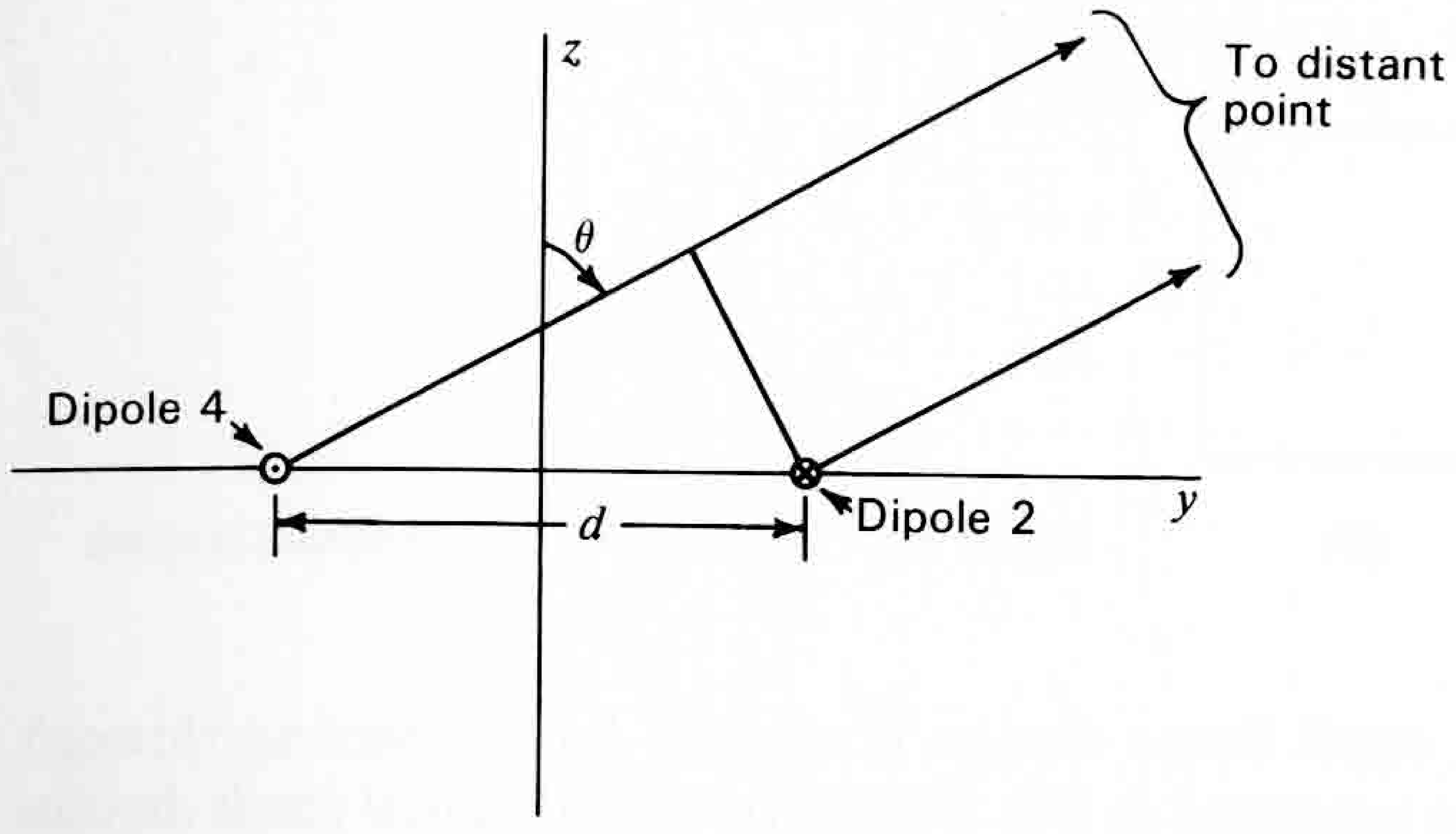


**Figure 6-3** Construction for finding far field of dipoles 2 and 4 of square loop.

The far field of the individual dipole was developed in Chap. 5, being given in Table 5-1. In developing the dipole formula, the dipole was in the $z$ direction, whereas in the present case it is in the $x$ direction (see Figs. 6-2 and 6-3). The angle $\theta$ in the dipole formula is measured from the dipole axis and is 90° in the present case. The angle $\theta$ in (5) is a different angle with respect to the dipole, being as shown in Figs. 6-2 and 6-3. Thus, we have for the far field $E_{\phi 0}$ of the individual dipole

$$E_{\phi 0} = \frac{j60\pi[I]L}{r\lambda} \tag{6}$$

where $[I]$ is the retarded current on the dipole and $r$ is the distance from the dipole. Substituting (6) in (5) then gives

$$E_{\phi} = \frac{60\pi[I]Ld_r \sin\theta}{r\lambda} \tag{7}$$

However, the length $L$ of the short dipole is the same as $d$, that is, $L = d$. Noting also that $d_r = 2\pi d/\lambda$ and that the area $A$ of the loop is $d^2$, (7) becomes

$$E_{\phi} = \frac{120\pi^2[I]\sin\theta}{r}\frac{A}{\lambda^2} \tag{8}$$

This is the instantaneous value of the $E_{\phi}$ component of the far field of a small loop of area $A$. The peak value of the field is obtained by replacing $[I]$ by $I_0$, where $I_0$ is the peak current in time on the loop. The other component of the far field of the loop is $H_{\theta}$, which is obtained from (8) by dividing by the intrinsic impedance of the medium, in this case, free space. Thus,

$$H_{\theta} = \frac{E_{\phi}}{120\pi} = \frac{\pi[I]\sin\theta}{r}\frac{A}{\lambda^2} \tag{9}$$