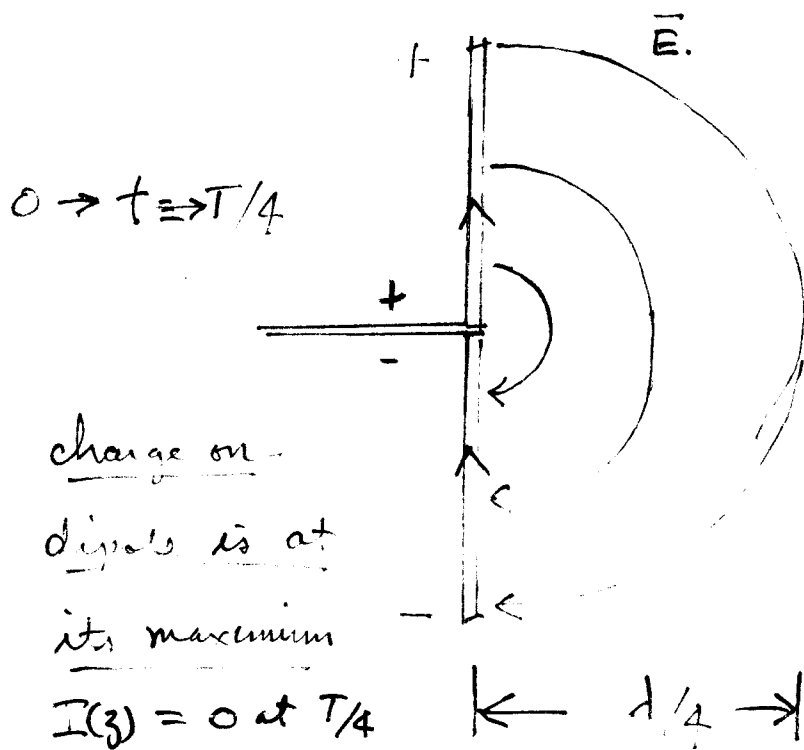


# A heuristic explanation of radiation

Consider a  $\lambda/2$  dipole - driven at the center

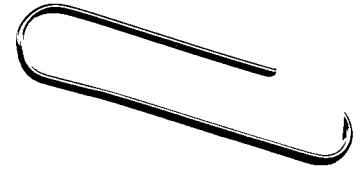
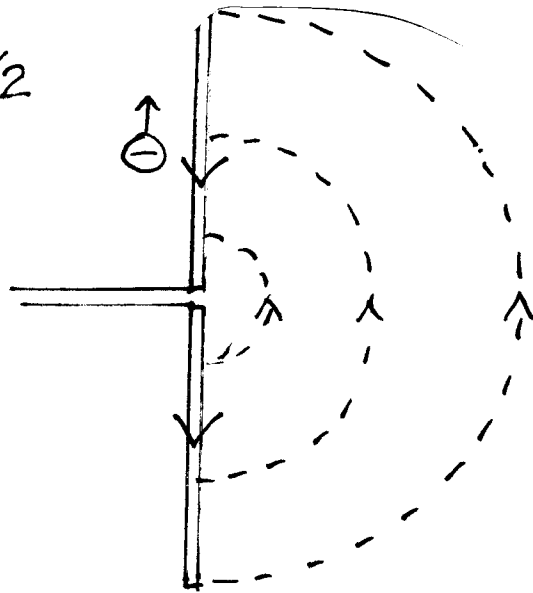


Three lines of  $\vec{E}$  originate and terminate on  $q$ .

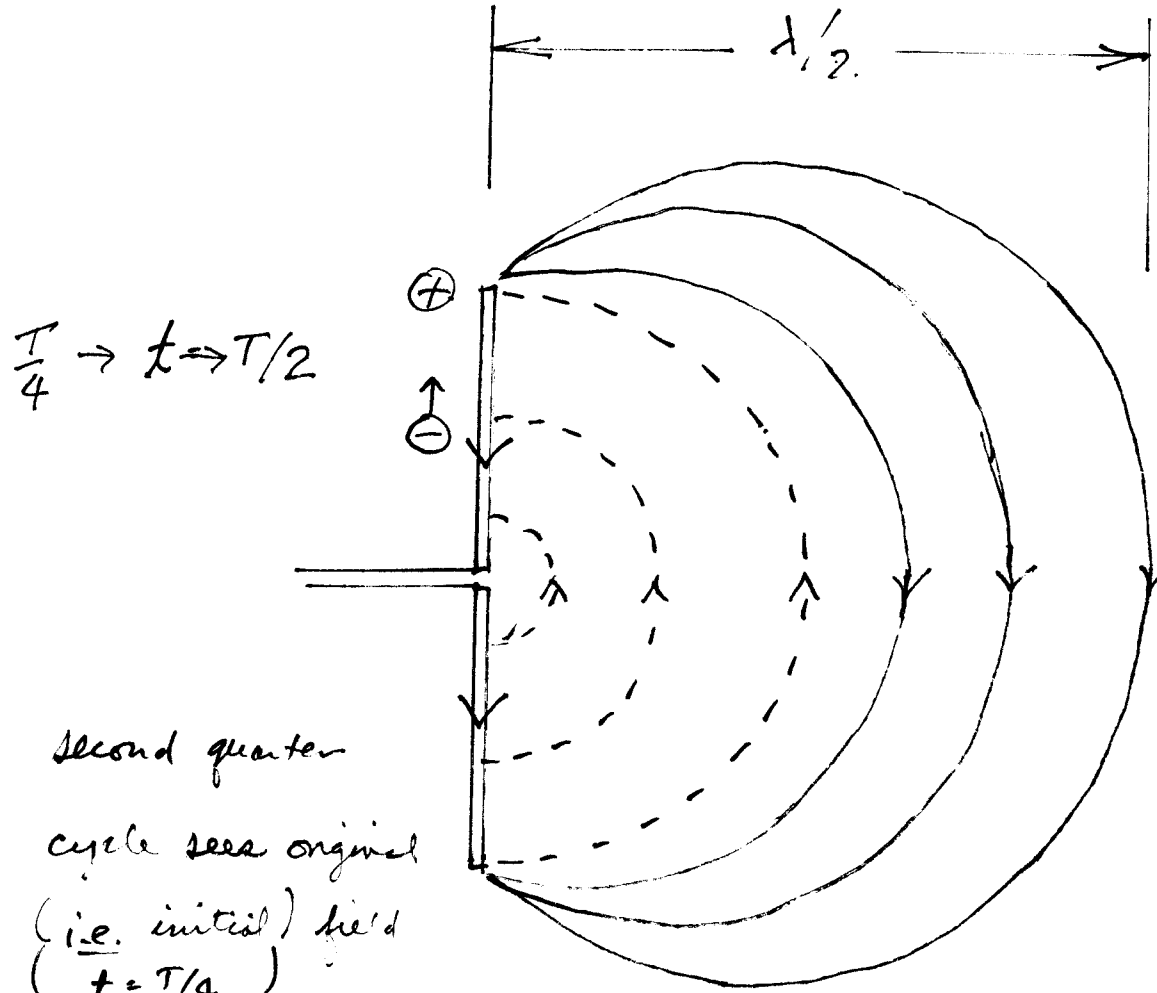
Fields build up to this point as antenna element is charged..

Effects of this quarter cycle propagate on  $\lambda/4$ .

$\frac{T}{4} \rightarrow t \rightarrow T/2$



/...



$\frac{T}{4} \rightarrow t \rightarrow T/2$

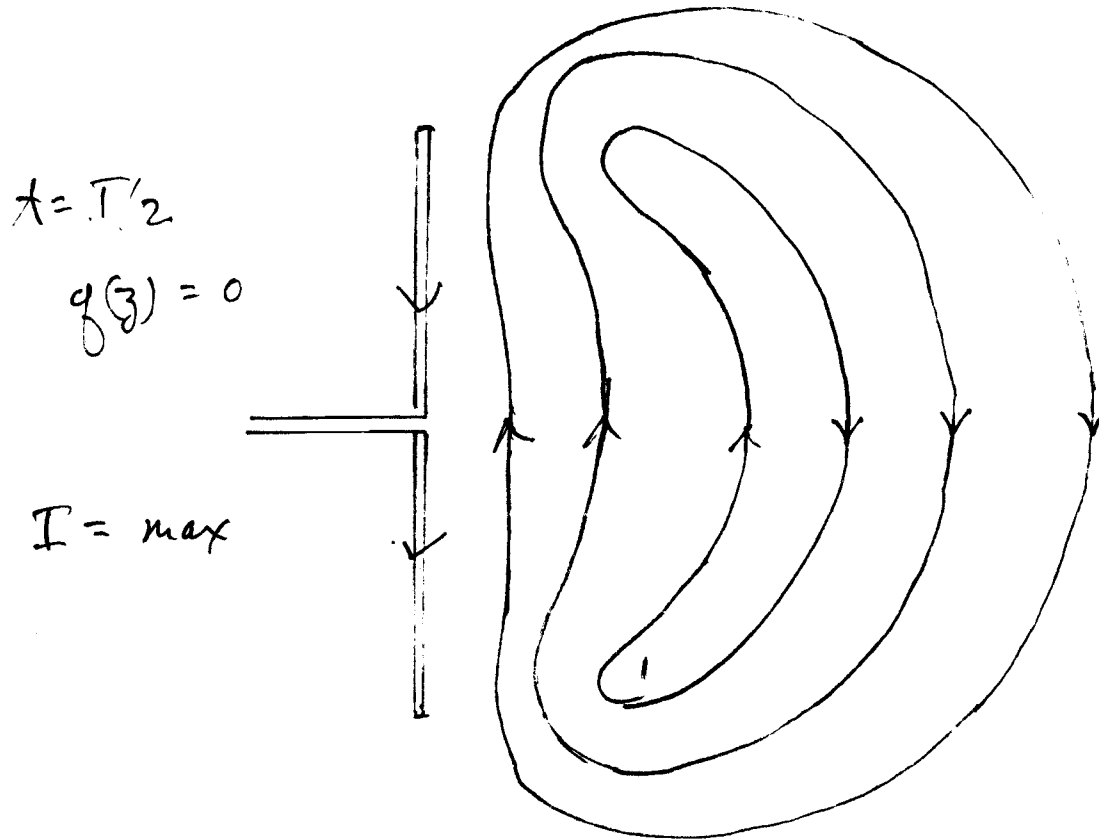
Second quarter  
cycle sees original  
(i.e. initial) field  
( $t = T/4$ )

lines move out and additional  $\lambda/4$ , charge on conductor  $\rightarrow 0$

/...

1...

With zero charge on the dipole, the field lines detach

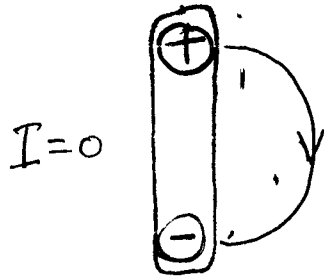


After Balanis, p 11.

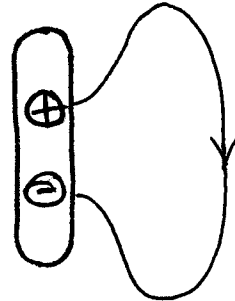
✓

Another view point  
(from Kraus)

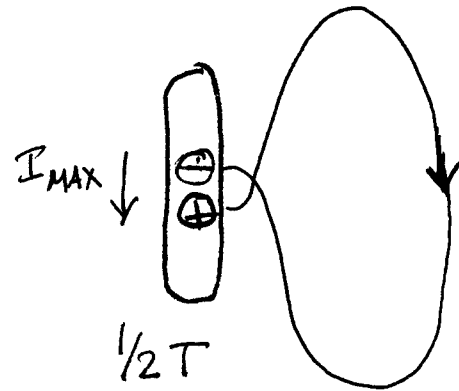
Simple Harmonic Motion



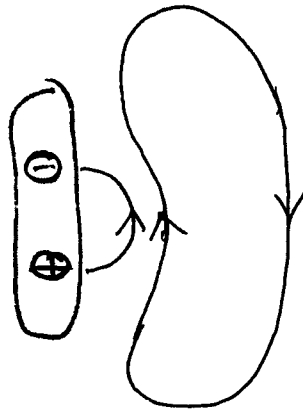
$t = \frac{T}{4}$



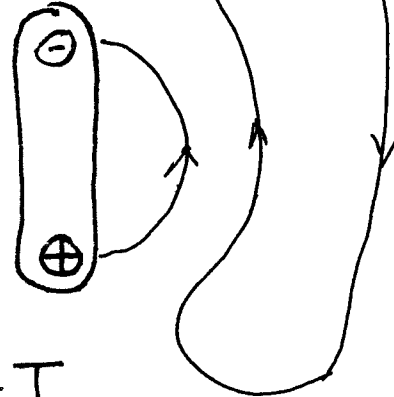
$\frac{3}{8} T$



$\frac{1}{2} T$



$\frac{5}{8} T$



$\frac{3}{4} T$

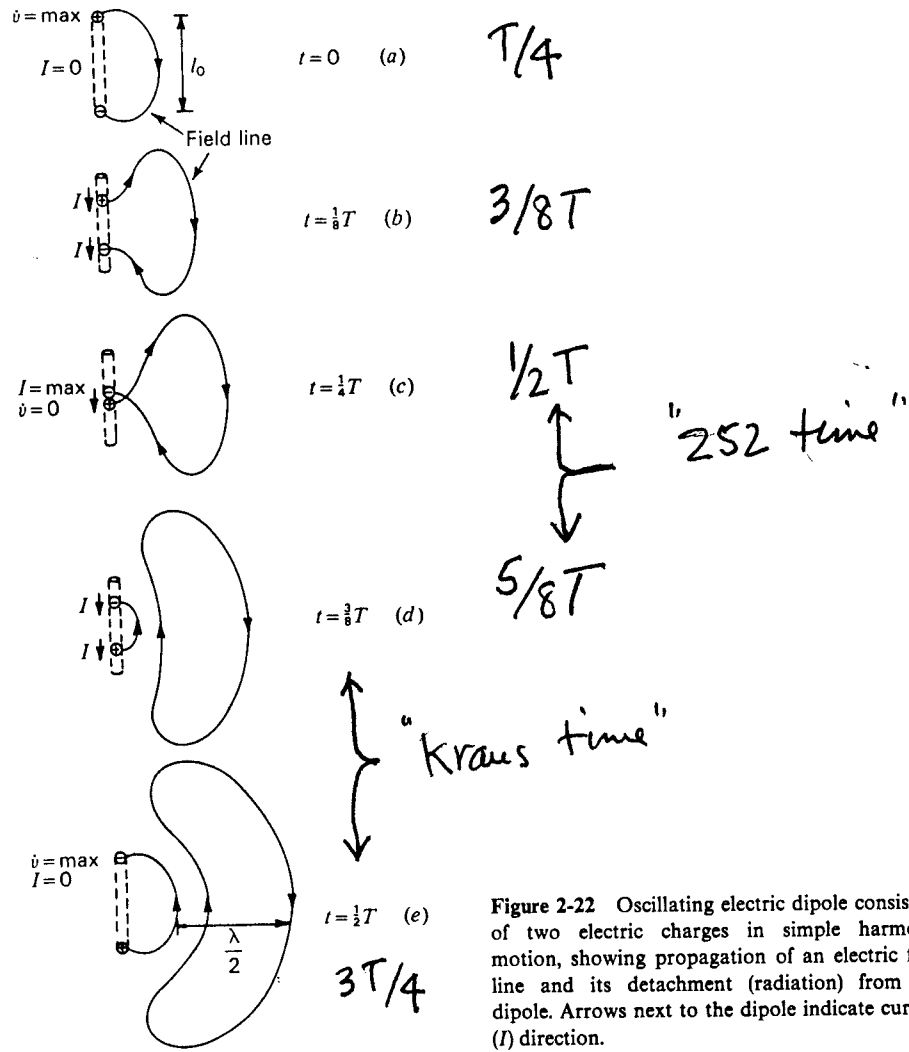
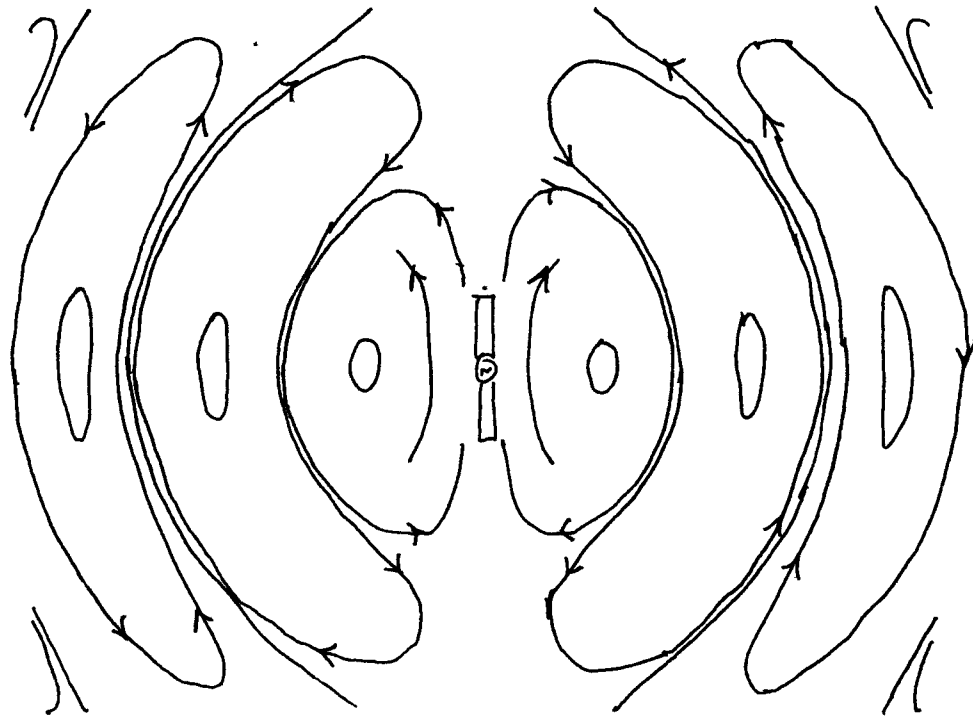
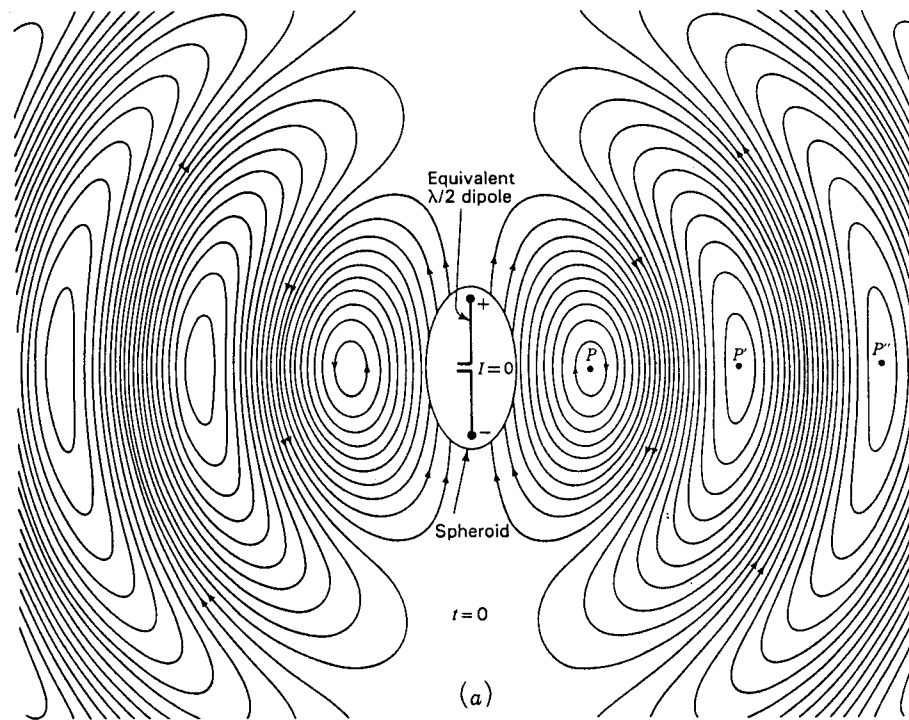


Figure 2-22 Oscillating electric dipole consisting of two electric charges in simple harmonic motion, showing propagation of an electric field line and its detachment (radiation) from the dipole. Arrows next to the dipole indicate current ( $I$ ) direction.

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**Figure 2-23** Electric field configuration for a  $\lambda/2$  antenna at four instants of time: (a)  $t = 0$ , (b)  $t = T/8$ , (c)  $t = T/4$  and (d)  $t = \frac{3}{8}T$ , where  $T = \text{period}$ . Note outward movement of the constant-phase points  $P$ ,  $P'$  and  $P''$  as time advances. These points move with a velocity  $v = c$  remote from the

Fig. 2-23(a)

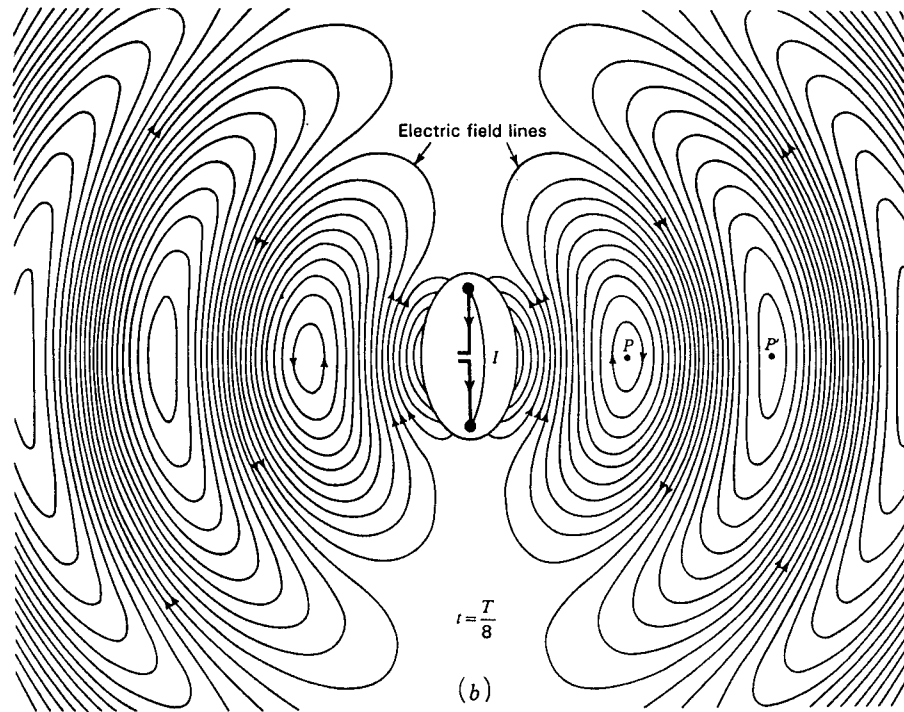


Fig. 2-23(b)

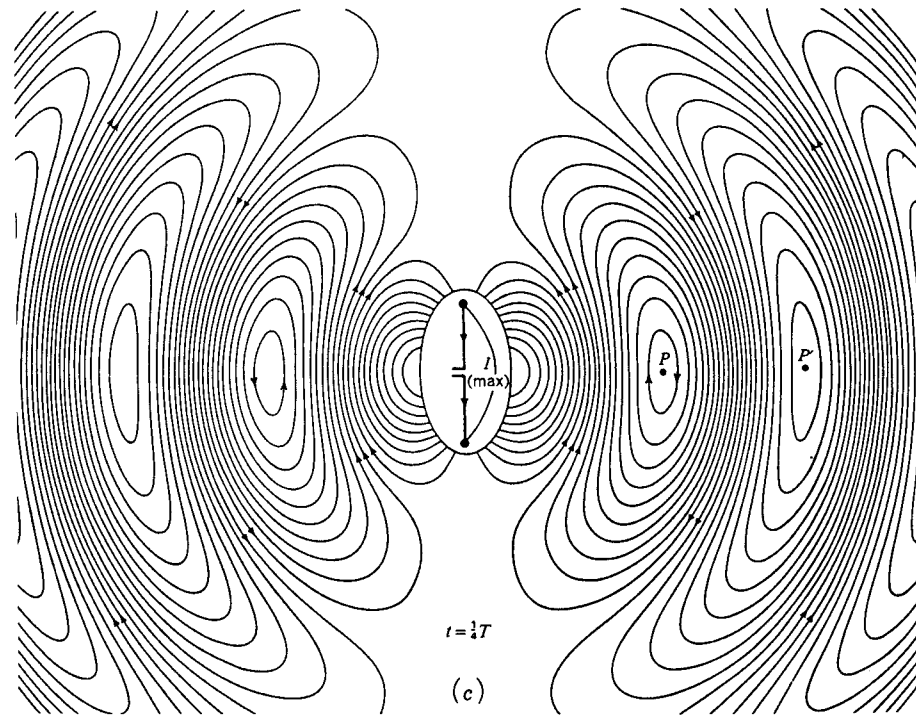


Fig. 2-23(c)

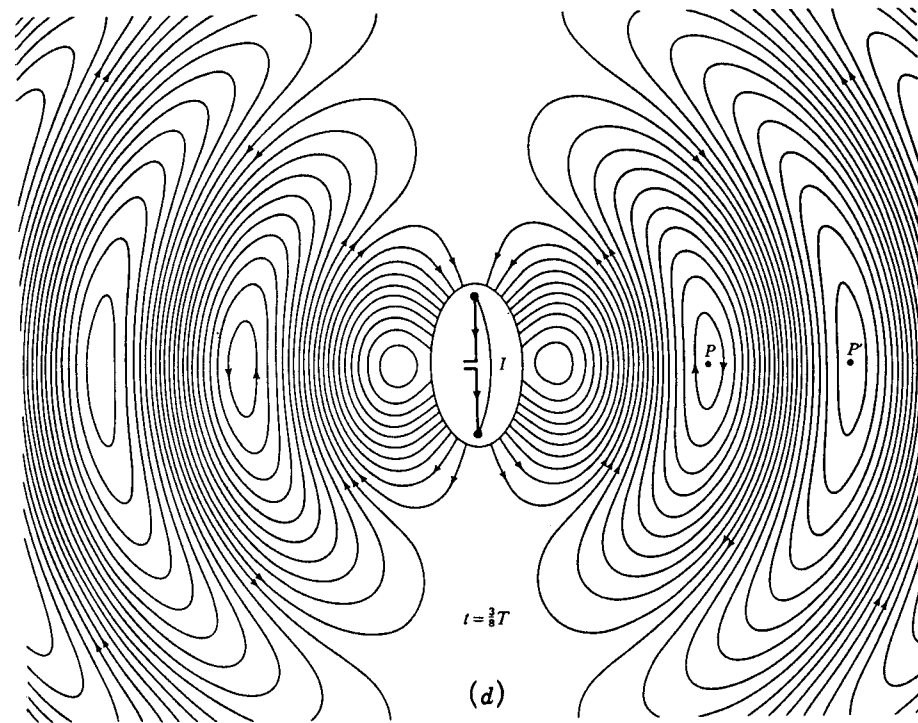
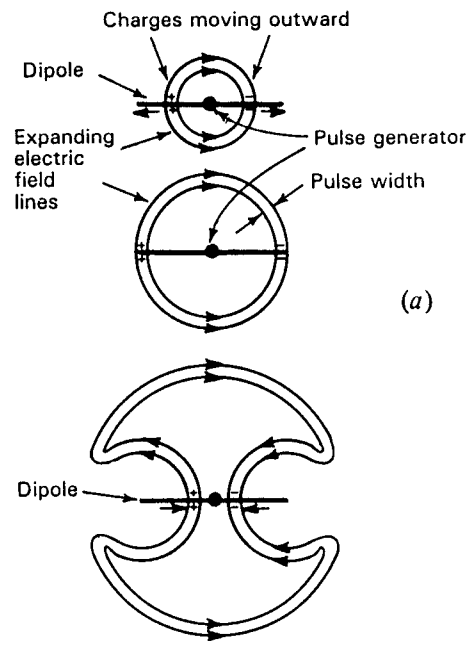


Fig. 2-23(d)



**Figure 2-24** (a) Three stages of radiation from a center-fed dipole antenna following the application of a single short voltage pulse at the terminals showing expanding electric field lines of the pulse. Two later stages at (b) and (c) show the pulse trains of electric field ( $E_\theta$ ) broadside and 30° from broadside to the dipole. The fields below the dipole [not shown in (b) and (c)] are mirror images of the fields above.

Fig. 2-24(a)

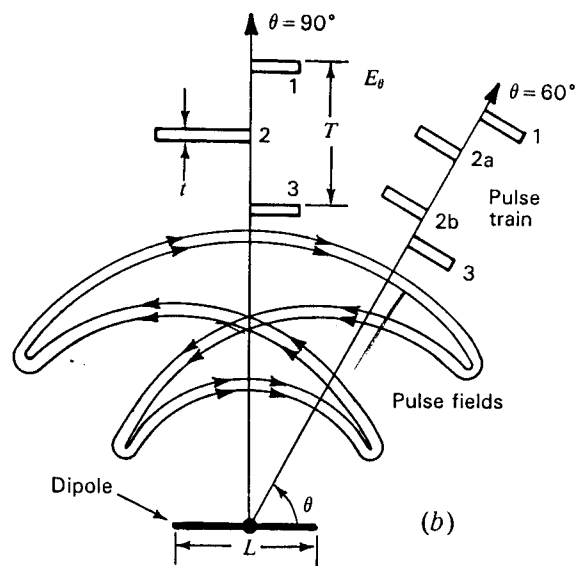


Fig. 2-24 (b)

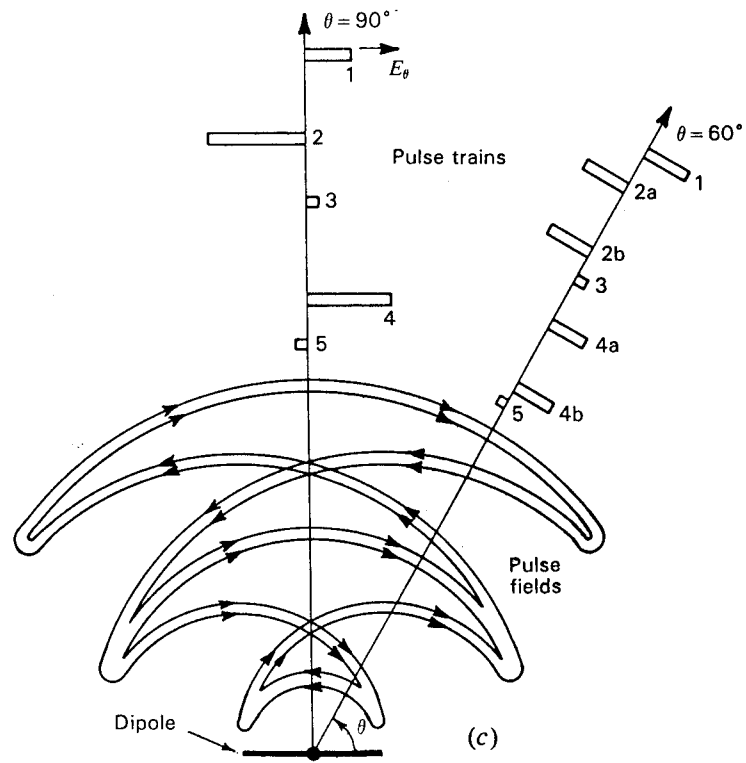


Fig. 2-24(c)