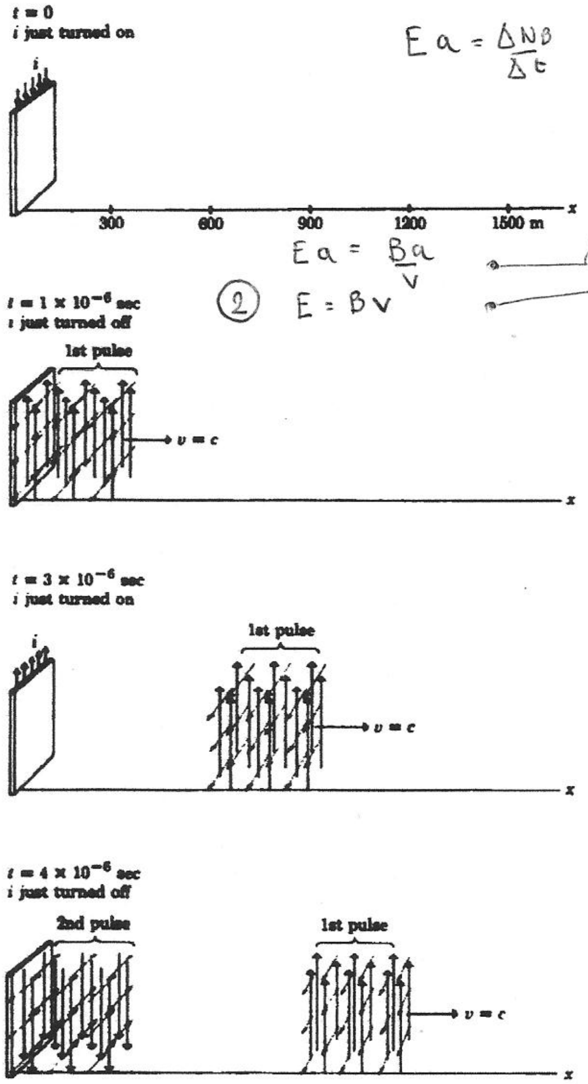
Fig. 8-24. Electromagnetic pulses of 1×10^{-6} sec duration being radiated by turning on and off an infinite plane of current. A square section of the infinite plane and electromagnetic wave is shown. Lines of B are in red and lines of E in black.

$Ea = \frac{\Delta N_B}{\Delta t}$



$Ea = \frac{Ba}{V}$

2 $E = BV$

electric field contributes to $(\overline{E}_L \cdot L)_{\text{closed path}}$ only along the left-hand side of the rectangle.

Thus $\quad (\overline{E}_L \cdot L)_{\text{closed path}} = E \cdot a$

Equation 8-26 is then

$$Ea = \frac{1}{c}\frac{\Delta N_B}{\Delta t}$$

Since $\quad N_B = Bax, \dfrac{\Delta N_B}{\Delta t} = Ba\dfrac{\Delta x}{\Delta t} = Bav$

Then the above equation becomes

$$Ea = \frac{Bav}{c}$$

or $\quad E = B\dfrac{v}{c}$

The result $v = c$ is obtained by dividing this equation by Eq. 8-28. *

Exactly the same derivation may be used to prove that if the current is suddenly turned on and then suddenly turned off, an electromagnetic square wave or pulse will be radiated. The radiation of such pulses is illustrated in Fig. 8-24. In fact, since E is proportional to i, it follows that if i is varied sinusoidally, then a sine wave will be radiated. Maxwell proposed that visible light consists of electromagnetic waves of the appropriate wavelength. Until this time (1864) perhaps the greatest unsolved question in physics was just what do light waves consist of? With the help of Maxwell, we now know that the light waves consist of oscillating electric and magnetic fields. This discussion is continued in Chapter 10.

* 1 $E = \dfrac{1}{\varepsilon_0\mu_0}\dfrac{B}{V}$

2 $E = BV$

$\dfrac{1}{\varepsilon_0\mu_0}\dfrac{1}{V} = V$

$V^2 = \dfrac{1}{\varepsilon_0\mu_0}$

$V = \dfrac{1}{\sqrt{\varepsilon_0\mu_0}} = c$