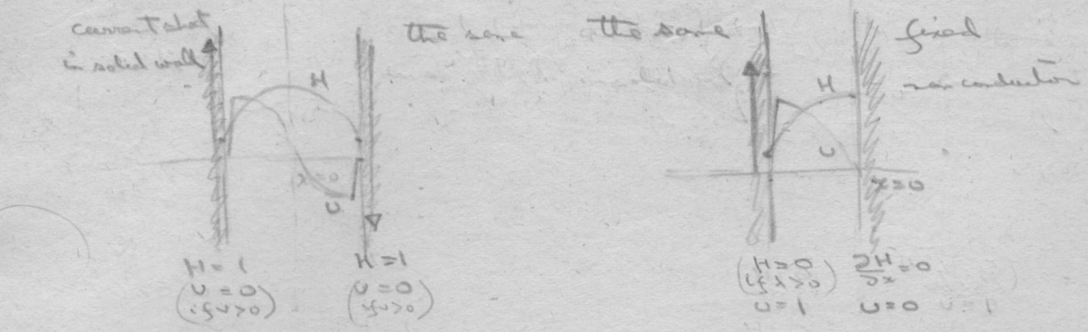
Wave patterns at resonance for possible methods of excitation



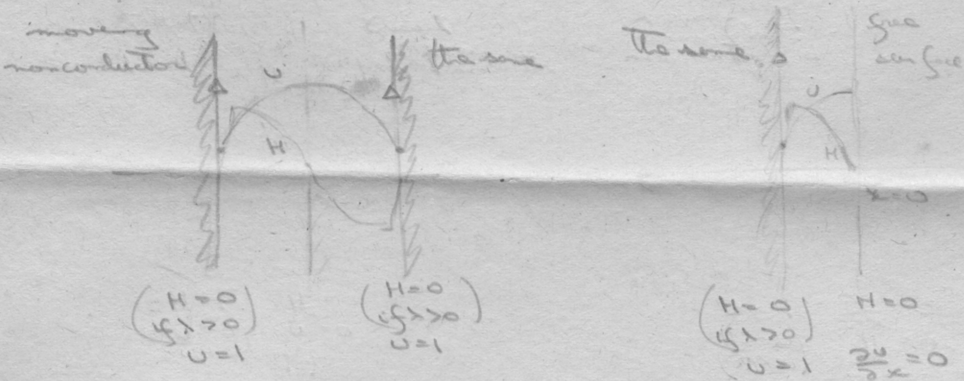
$\frac{1}{2}$ wavelength

$H = r\cosh x$

$U = \sinh x$

$\frac{1}{4}$ wavelength

(1a)



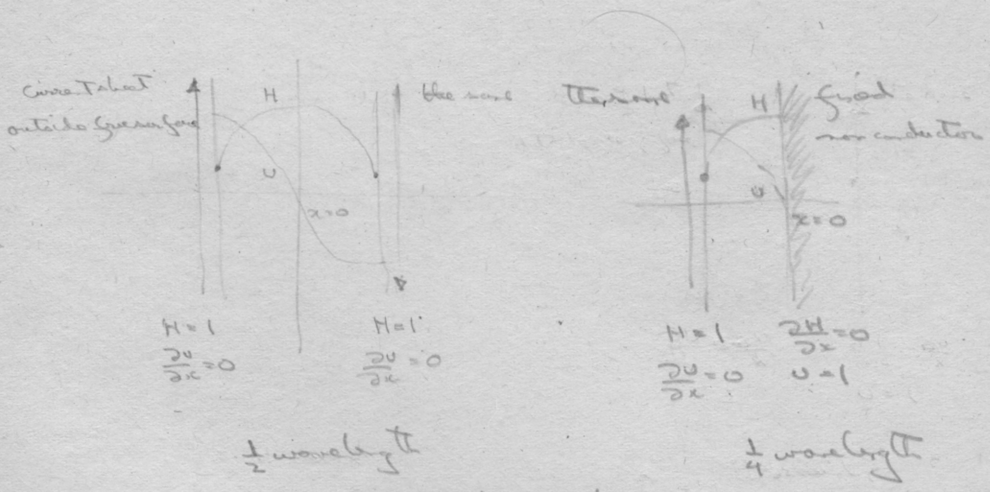
$\frac{1}{2}$ wavelength

$\frac{1}{4}$ wavelength

$H = r\sinh x$

$U = \cosh x$

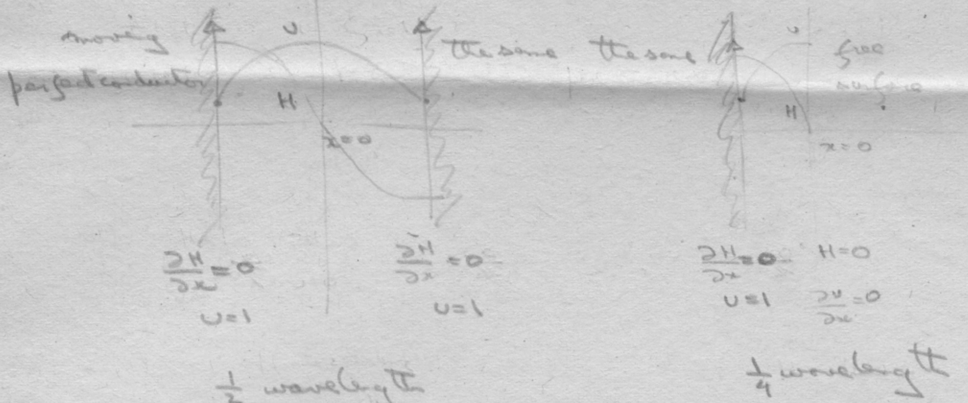
(1b)



$H = r \cos hx$

$U = \sin hx$

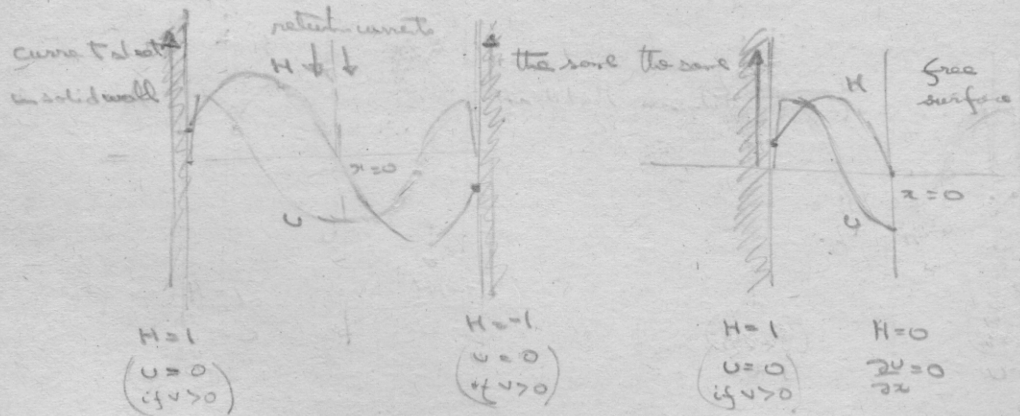
(2a)



$H = r \sin hx$

$U = \cos hx$

(2b)



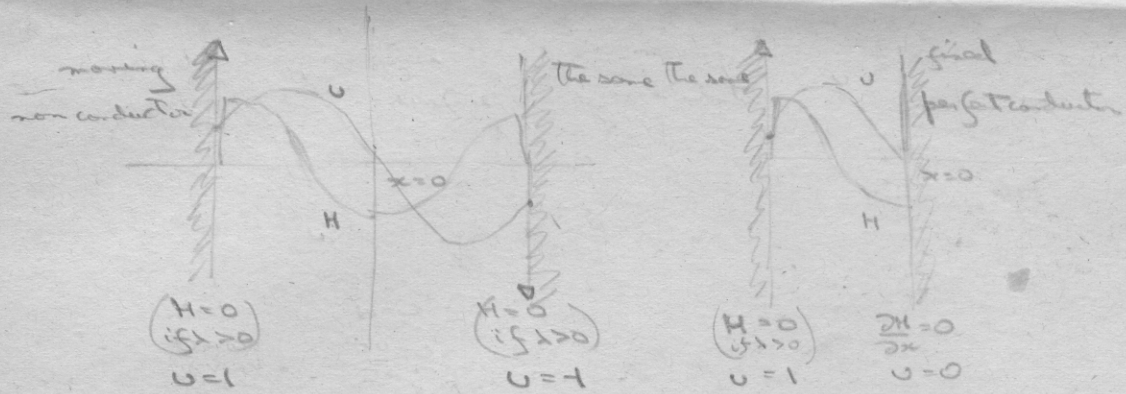
1 wavelength

1/2 wavelength

$H = r\cosh x$

$U = \sinh x$

(3a)



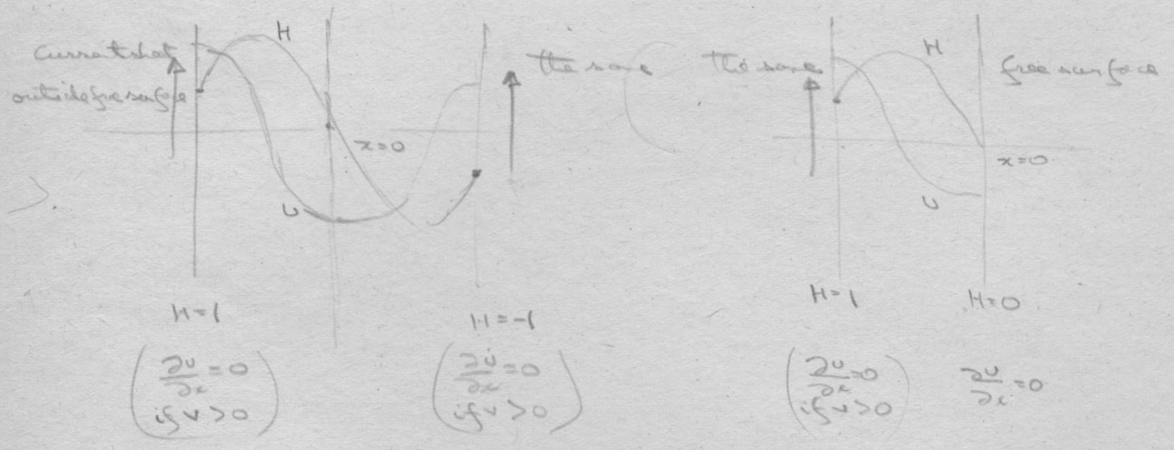
1 wavelength.

1/2 wavelength

$H = r\sinh x$

$U = \cosh x$

(3b)



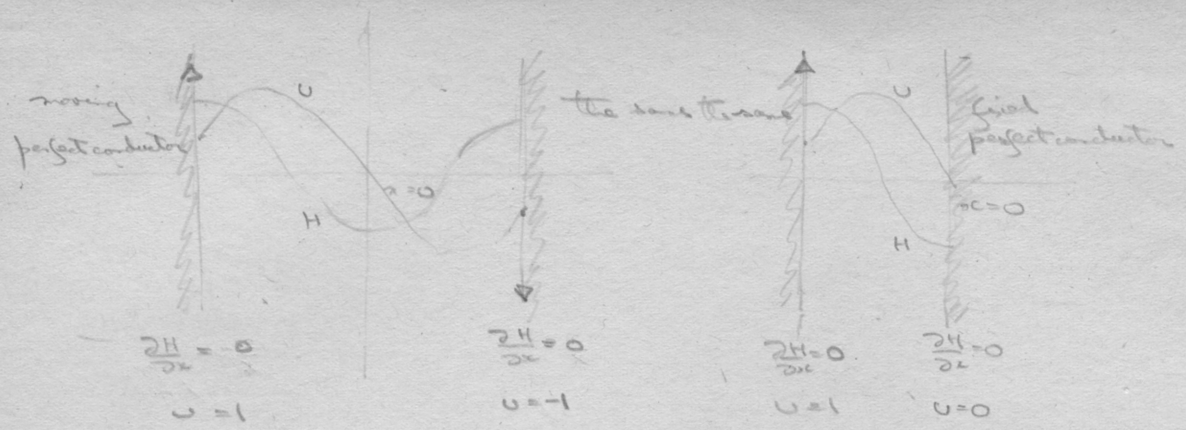
1 wavelength

$H = r \sin kx$

$U = \cos kx$

$\frac{1}{2}$ wavelength

(4a)



1 wavelength

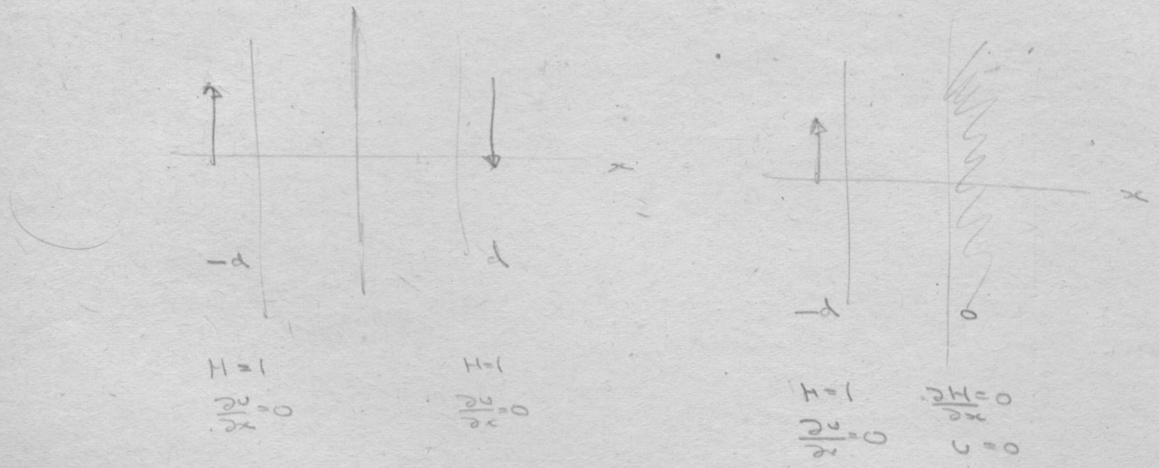
$H = r \cos kx$

$U = \sin kx$

$\frac{1}{2}$ wavelength

(4b)

Current sheet + free surface at the boundary



$$H = \frac{1}{r_1k_2 - r_2k_1}\left(\frac{r_1k_2\cosh k_1x}{\cosh k_1d} - \frac{r_2k_1\cosh k_2x}{\cosh k_2d}\right)$$

$$U = \frac{1}{r_1k_2 + r_2k_1}\left(\frac{k_2\sinh k_1x}{\cosh k_1x} - \frac{k_1\sinh k_2x}{\sinh k_2x}\right)$$

At $x=0$

$$H \doteq \frac{iQ}{iQ - \eta P}\,\frac{1}{\cos P(1-i\theta)} = \frac{1}{(1+iNP)\cos P(1-i\theta)},$$

$$U = 0$$

When $\cos P = 0$

$$H = \frac{i}{(1+i\Lambda P)\,\theta P}$$

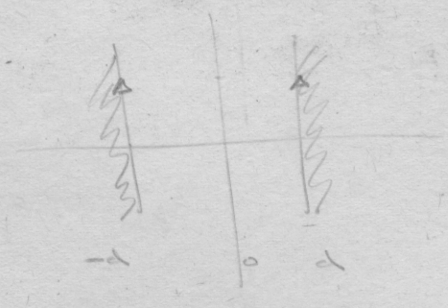
$$U = 0$$

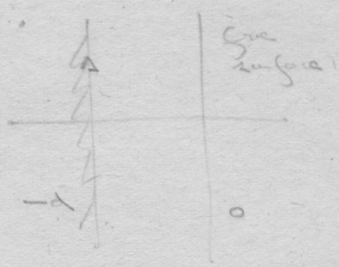
If $\Lambda = N$

$$H \doteq -\frac{i}{\Lambda P^2}$$

$$U = 0$$

Moving perfect conductor at the boundary





$\frac{\partial H}{\partial x} = 0$ $\qquad$ $\frac{\partial H}{\partial x} = 0$ $\qquad$ $\frac{\partial H}{\partial x} = 0$ $\quad H = 0$

$U = 1$ $\qquad$ $U = 1$ $\qquad$ $U = 1$ $\quad \frac{\partial U}{\partial x} = 0$

$$H = \frac{r_1 r_2}{r_2 k_2 - r_1 k_1}\left(\frac{k_2 \sinh k_1 x}{\cosh k_1 d} - \frac{k_1 \sinh k_2 x}{\cosh k_2 d}\right)$$

$$U = \frac{1}{r_2 k_2 - r_1 k_1}\left(\frac{r_2 k_2 \cosh k_1 x}{\cosh k_1 d} - \frac{r_1 k_1 \cosh k_2 x}{\cosh k_2 d}\right)$$

$\lambda = \nu$

Where

$$\left(ip - \lambda\frac{\partial^2}{\partial x^2}\right)H = c\frac{\partial U}{\partial x}$$

$$\left(ip - \lambda\frac{\partial^2}{\partial x^2}\right)U = c\frac{\partial H}{\partial x}.$$

if the boundary conditions for H and U are similar one can put
put $V = H+U$, $W = H-U$, giving

$$\left(ip - c\frac{\partial}{\partial x} - \lambda\frac{\partial^2}{\partial x^2}\right)V = 0$$

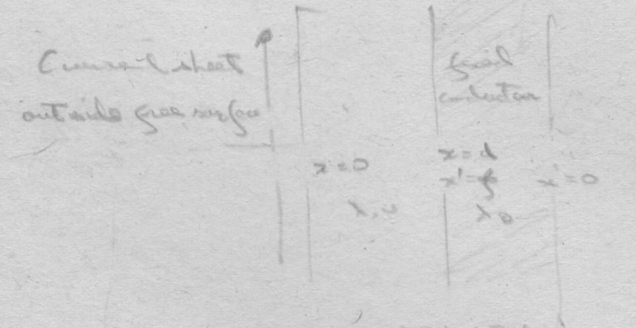
$$\left(ip + c\frac{\partial}{\partial x} - \lambda\frac{\partial^2}{\partial x^2}\right)W = 0$$

But if one boundary condition determines $\frac{\partial H}{\partial x}$, the other U,

or ——— $\frac{\partial U}{\partial x}$ ——— H

this procedure fails

Current sheet outside a free surface + conductor at the other end



$U = \cosh_1$

$\frac{\partial U}{\partial x} = \sinh_1 x$ + sin

$H=1$ $\lambda \frac{\partial H}{\partial x} = \lambda_0 \frac{\partial H_0}{\partial x}$ $H=0$

$\frac{\partial U}{\partial x} = 0$ $H' = H_0$

$U = 0$

$$\left(i\omega - \lambda \frac{\partial^2}{\partial x^2}\right) H = c \frac{\partial U}{\partial x}$$

$$\left(i\omega - \nu \frac{\partial^2}{\partial x^2}\right) U = c \frac{\partial H}{\partial x}$$

$$\left(i\omega - \lambda \frac{\partial^2}{\partial x^2}\right) H_0 = 0$$

$H = A_1 r_1 \sinh_1 x + B_1 r_1 \cosh_1 x + A_2 r_2 \sinh_2 x + B\, r_2$ ——

$U = A_1 \cos$ $+ B_1 \sin$ $+ A_2 \cos$ $+ B_2' \sin$

$H_0 = C \sin$

$B_1 r_1 + B_2 r_2 k = 1$

$B_1 k_1 + B_2 h_2 = 0$

$B_1 = \frac{k_2}{r_1 h_2 - r_2 h_1}$ $B_2 = \frac{-h_1}{r_1 h_2 - r_2 h_1}$

$A_1 r_1 \sinh_1 d$

$\lambda\left(A_1 r_1 h_1 \cosh h_1 d - B_1 r_1 h_1 \sinh_1 d + A_2 r_2 h_2 \right.$ ——— $\left.\right) = C \sinh_0 f$

$= \lambda_0 C\, k_0 \cosh k_0 f$

$A_1 \sinh_1 d + B_1 \sinh_1 d + A_2 \cosh_2 d + B_2 \sinh_2 d = 0$

Moving conductor at boundary

$H=0$ $\qquad \lambda_0 \frac{\partial H_0}{\partial x} = \lambda \frac{\partial H}{\partial x}$

$H_0 = H$

$v = 1$

$$\left(i\omega - \lambda \frac{\partial^2}{\partial x^2}\right) H = c \frac{\partial v}{\partial x} \qquad H = A_1 r_1 \sinh k_1 x + A_2 r_2 \sinh k_2 x$$

$$\left(i\omega - \nu \frac{\partial^2}{\partial x^2}\right) v = c \frac{\partial H}{\partial x} \qquad v = A_1 \cosh k_1 x + A_2 \cosh k_2 x$$

$$\left(i\omega - \lambda_0 \frac{\partial^2}{\partial x^2}\right) H_0 = 0 \qquad H_0 = B \sinh k_0 x'$$

$$A_1 \cosh k_1 d + A_2 \cosh k_2 d = 1$$

$$A_1 r_1 \sinh k_1 d + A_2 r_2 \sinh k_2 d = B \sinh k_0 \xi$$

$$\lambda\left(A_1 r_1 k_1 \cosh k_1 d + A_2 r_2 k_2 \cosh k_2 d\right) = \lambda_0 B k_0 \cosh k_0 \xi$$