London Eqns. (i) $\frac{d\vec{J}}{dt} = + \frac{n_s e^2}{m} \vec{E}$

if $\vec{E} = 0$, $\frac{d\vec{J}}{dt} = 0 \Rightarrow \vec{J} = \text{constant}$

i.e. for steady current to flow, no ext. field is reqd. but to change $\vec{J}$, $\vec{E}$ is reqd.

$\vec{J} \rightarrow$ current density vector

$n_s \rightarrow$ no. of super conducting e's per unit volume

ii) $\vec{\nabla} \times \vec{J} = -\frac{n_s e^2}{m} \vec{B}$ as $\vec{B} = \vec{\nabla} \times \vec{A}$

$\vec{A} \rightarrow$ mag. vector pot.

$\Rightarrow \vec{\nabla} \times \vec{J} = -\frac{n_s e^2}{m} \vec{\nabla} \times \vec{A}$

$\Rightarrow \vec{J} = -\frac{n_s e^2}{m} \vec{A}$ which is the substitute of ohm's law for superconductors.

for Conductors $\vec{J} = \sigma \vec{E}$

& for super Cond. $\frac{d\vec{J}}{dt} = \frac{n_s e^2}{m} \vec{E}$

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As $\vec{B}$ is solenoidal

i.e. $\vec{\nabla} \cdot \vec{B} = 0$

Also div. (curl) = 0

$\therefore$ $\vec{B}$ can be written as curl of some vector.

$\therefore$ $\vec{B} = \vec{\nabla} \times \vec{A}$

$\vec{A}$ is the magnetic counterpart of electric pot. V which is scalar.