314(6): Development of the First Evans Identity

The first Evans identity is:

$$\underline{E}^b \cdot \underline{B}^a + \underline{B}^b \cdot \underline{E}^a = 0 \quad -(1)$$

In the presence of field matter interaction:

$$\underline{D}^a = \epsilon_0 \underline{E}^a + \underline{P}^a \quad -(2)$$

and

$$\underline{B}^a = \mu_0 \left(\underline{H}^a + \underline{M}^a \right) \quad -(3)$$

where for each state of polarization a, $\underline{D}$ is the displacement, $\underline{P}$ is the polarization, $\underline{H}$ is the magnetic field strength and $\underline{M}$ the magnetization. Here ϵ_0 and μ_0 are the vacuum electric permittivity and magnetic permeability.

From eqs (1) to (3):

$$\left(\underline{D}^b - \underline{P}^b \right) \cdot \left(\underline{H}^a + \underline{M}^a \right) + \left(\underline{H}^b + \underline{M}^b \right) \cdot \left(\underline{D}^a - \underline{P}^a \right) = 0 \quad -(4)$$

Eq. (4) is true generally in the presence of field matter interaction.

Following the engineering model in UFT 303 the electric field strength $\underline{E}^a$ and the magnetic flux density $\underline{B}^a$ can be expressed as:

2)

$$\underline{E}^a = -\underline{\nabla}\phi^a - \frac{\partial \underline{A}^a}{\partial t} - \omega^a{}_b \underline{A}^b + \phi^b \underline{\omega}^a{}_b \quad - (5)$$

and
$$\underline{B}^a = \underline{\nabla} \times \underline{A}^a - \underline{\omega}^a{}_b \times \underline{A}^b \quad - (6)$$

By antisymmetry:

$$\underline{E}^a = -2\left(\underline{\nabla}\phi^a + \omega^a{}_b \underline{A}^b\right) \quad - (7)$$

$$= -2\left(\frac{\partial \underline{A}^a}{\partial t} + \phi^b \underline{\omega}^a{}_b\right) \quad - (7a)$$

So:

$$\left(\underline{\nabla} \times \underline{A}^a - \underline{\omega}^a{}_b \times \underline{A}^b\right) \cdot \left(\underline{\nabla}\phi^b + \omega^b{}_c \underline{A}^c\right)$$
$$+ \left(\underline{\nabla} \times \underline{A}^b - \underline{\omega}^b{}_c \times \underline{A}^c\right) \cdot \left(\underline{\nabla}\phi^a + \omega^a{}_b \underline{A}^b\right) = 0 \quad - (8)$$

and:

$$\left(\underline{\nabla} \times \underline{A}^a - \underline{\omega}^a{}_b \times \underline{A}^b\right) \cdot \left(\frac{\partial \underline{A}^b}{\partial t} + \phi^c \underline{\omega}^b{}_c\right)$$
$$+ \left(\underline{\nabla} \times \underline{A}^b - \underline{\omega}^b{}_c \times \underline{A}^c\right) \cdot \left(\frac{\partial \underline{A}^a}{\partial t} + \phi^b \underline{\omega}^a{}_b\right) = 0 \quad - (9)$$

If there is no scalar potential present:

$$\phi^a = \phi^b = 0 \quad - (10)$$

Itter from eqs. (7) and (7a):

$$\frac{\partial \underline{A}^a}{\partial t} = \omega^a{}_{0b} \underline{A}^b \quad -(11)$$

In this case both eqs. (8) and (9) simplify to:

$$\omega^b{}_{0c} \underline{A}^c \cdot \left(\underline{\nabla} \times \underline{A}^a - \underline{\omega}^a{}_b \times \underline{A}^b \right) + \omega^a{}_{0b} \underline{A}^b \cdot \left(\underline{\nabla} \times \underline{A}^b - \underline{\omega}^b{}_c \times \underline{A}^c \right) = 0 \quad -(12)$$

ECE Vacuum

In this case:

$$\underline{E}^b = \underline{0}, \; \underline{B}^a = \underline{0} \quad -(13)$$

so eq. (1) is satisfied trivially. The ECE vacuum is defined from eqs. (7) and (7a) by:

$$\frac{\partial \underline{A}^a}{\partial t} = -\phi^b \underline{\omega}^a{}_b \quad -(14)$$

and

$$\underline{\nabla} \phi^a = -\omega^a{}_{0b} \underline{A}^b \quad -(15)$$

Similarly the ECE vacuum is defined from (6) by:

$$\underline{\nabla} \times \underline{A}^a = \underline{\omega}^a{}_b \times \underline{A}^b \quad -(16)$$

Eqs. (14) to (16) obey eq. (1) automatically.

4) Eq. (12) can be written as:

$$\omega^b{}_{0c}\,\underline{A}^c \cdot \underline{B}^a + \omega^a{}_{0b}\,\underline{A}^b \cdot \underline{B}^b = 0 \quad -(17)$$

or as:

$$\frac{\partial \underline{A}^a}{\partial t} \cdot \underline{B}^b + \frac{\partial \underline{A}^b}{\partial t} \cdot \underline{B}^a = 0 \quad -(18)$$

So these are sets of new equations that can be entered into the standard model.
