and, since this is true for the space contained within any closed surface, however large or small, it follows that everywhere the quantity in parentheses has zero divergence:

$$\nabla \cdot \left(\iota + \frac{d\mathbf{D}}{dt} \right) = 0 \qquad [175]$$

Two obvious substitutions in equation 175 then give

$$\nabla \cdot \left(\gamma \mathbf{E} + \epsilon \frac{d\mathbf{E}}{dt} \right) = 0 \qquad [176]$$

Comparison of equation 175 with 166 is very enlightening. Equation 166 tells us that current has no divergence in steady flow, that is, if the electric field strength is unchanging. If the electric field is changing, however, current does not flow without divergence. But, as we are informed by equation 175, if another term involving the rate of change of the electric field is added to current density at every point, the result is a quantity that has zero divergence under all circumstances.

We are tempted to look upon this additional quantity, this $d\mathbf{D}/dt$, as something similar to current—perhaps even as a kind of current itself. It is not a **conduction current,** which is the name given to γ **E**, so we will call it a **displacement current.** The total current, the sum of conduction current and displacement current, according to this terminology, is made up of two parts:

$$\iota_t = \iota_c + \iota_d = \gamma \mathbf{E} + \frac{d\mathbf{D}}{dt} \qquad [177]$$

The divergence of this *total* current density is always zero, and ι_t is therefore *solenoidal.*

Electromotive Force. The electric field **E**, as it has been considered so far in the discussion, results from the presence of free electric charge. The flux lines of the field begin and end on electric charge. But any source of electromotive force can also contribute to the electric field: a familiar and important example that will receive a good deal of attention in later chapters is the induced electric field that appears in the neighborhood of a changing magnetic field. If the component of electric field that is due to electric charge is called $\mathbf{E}_s$ and the component resulting from electromotive action is called $\mathbf{E}_m$, then we may continue to use **E** for the total electric field strength at any point, and

$$\mathbf{E} = \mathbf{E}_s + \mathbf{E}_m \qquad [178]$$