Appendix

The Law of Electrodynamics

Consider two electric charges of equal mass positioned at A and B in Fig. 14. Let the forces AF′, BF denote the electromagnetic field interaction exerted between the charges. The value of AF′ or BF, as an attractive force, is the product of the two charges in electromagnetic units multiplied by the scalar product of their velocities and divided by the square of AB. The velocities of the charges are represented by u, v in the directions AO and BO, respectively, as shown.

We now suppose that an external force acts on the system. The force will be effective through the centre of gravity of the two charges and will be equally apportioned in providing an action AX′ or BX at A and B. The total force on the charge at A is then AX′ + AF′ and this may be resolved into a component AP at right angles to AO and a component AU along OA. Similarly, the total force on the charge at B is BX + BF and this may be resolved into a component BQ at right angles to BO and a component BV along OB.

The nature of the force component BV is that needed to slow down the charge at B, since we assume its speed is changing due to the interaction effects. Then, for there to be no turning action on the system as a whole, this force component must have a counterpart at A. Hence, we equate UX′ and BV. Similarly, for speed changes at A there is the force component AU which is balanced by the force VX induced at B.

Given the positions of A and B, the interaction force BF, and the vector directions u and v, we can then derive the value of the force AX′ or BX from the geometry of Fig. 14. To find the force on B, draw FQ in the direction opposite to u, determining Q by the perpendicular to v from B. Then derive V by drawing FV (shown by the broken line) from F perpendicular to u, V being

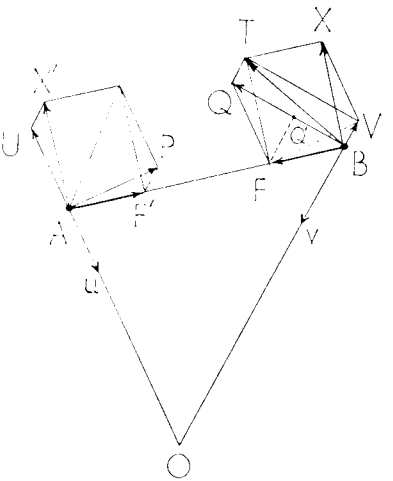

Fig. 14

at the interception with the velocity direction v through B. The electrodynamic force on the charge at B is then BF + BV + FQ, adding to BT.

Note that for action between discrete charges, if u and v are parallel then the force FQ′ applies at B but then BV will cancel FQ′ and so the electrodynamic force on B will act directly towards A.