



FIG. 4.5. Loci of a succession of fluid parcels (eight of them in this sketch) emitted at constant speed from a source fixed on the rotating sun.

$$U_{\phi} = -\omega r$$

Then the magnetic field stretched out along the path of plasma flowing from the fixed source in this coordinate system has components related by

$$\frac{B_{\phi}}{B_r} = \frac{U_{\phi}}{U_r} = \frac{-\omega r}{u(r)} \quad (4.14)$$

This gives a differential equation for the field lines near the solar equator (solar latitude = 0) as

$$\frac{r \, d\phi}{dr} = \frac{-\omega r}{u(r)}$$

If the radial-expansion speed is constant, as in the solar wind well out in interplanetary space, this equation becomes

$$\frac{dr}{d\phi} = -\frac{u}{\omega}$$

and has the obvious solution

$$r = -\frac{u}{\omega} \phi + K''$$

Specification of the location of the source of a field line at longitude ϕ_0 at $r = R$ then yields