$$\chi_V = \frac{\Delta\rho_D}{\rho_o}\ \frac{\rho_o}{\rho_V} \approx\ 1.2 \times 10^{-2}\ \frac{\Delta\rho_D}{\rho_o}\ . \qquad (10)$$

At 100 kbar for MRC silver, computed vacancy concentration is about 10^{-3} vacancies/atomic site. (In computation we have assumed that at these high concentrations the resistivity of N defects is still N times the resistivity of a single defect (Martin and Paetsch, 1973).) Defect concentrations generated by severe torsion deformation or radiation damage below 20°K are also of this magnitude (Thom, 1972; Wagner, Dworshak, and Wombacher, 1971). Estimates of equilibrium vacancy concentration at the melting points of metals range as high as 10^{-2} (Kraftmakher and Strelkov, 1970). For the temperatures and pressures in shocked states of the present work, concentrations like 10^{-3} correspond to strongly nonequilibrium defect concentrations. It should be kept in mind that the shock temperature rise is roughly proportional to pressure so that defects generated by two different shock strengths reside in different thermal as well as pressure environments.

These shock experiments correspond to deformation experiments at cryogenic temperatures in that defects generated in both cases are not allowed to migrate to the surface. In the cryogenic case the constraint is low thermal energy of the solid; in the shock case it is short time scale of the experiments.

E. Dislocation Models

We are concerned with defect production at high strain rates where the strain is due to plastic deformation associated with uniaxial shock compression. In seeking explanations of defect production in terms of dislocation models, vacancy type defects as opposed to interstitials will be considered to be the dominant defect. As previously mentioned, experimental evidence in face-centered cubic metals indicates vacancies are produced in preference to interstitials.

The concept of vacancies being produced by moving dislocations was first proposed by Seitz (1952). Mechanisms for this production include intense local heating due to dislocation motion; approach of edge dislocation segments of opposite sign on adjacent glide planes; and nonconservative motion (motion out of the surface defined by a dislocation's line and Burgers vector) of jogs on dislocations (Nabarro, 1967). It is generally accepted that the most important process for this discussion is the last one.

Short jogs are formed by intersection of a dislocation by a second dislocation having a small Burgers vector (Hull, 1965). A dislocation on one glide plane becomes jogged in passing through the network or forest of dislocations on another glide plane. Jogs, having edge character, can move conservatively only in the direction of the Burgers vector. For screw dislocations, motion is not confined to that direction, so nonconservative motion of jogs on screws will occur. The nonconservative motion of these jogs being dragged along by a moving dislocation generates vacancies or interstitials depending on the sign of the jog (Fig. 12).