specimens of tungsten alloys and from thin strips (0·125 in. × 0·02 in. × 0·010 in.) of the copper spark-cut to give a transverse section of the helium-rich layer.

§ 4. Results and Discussion

4.1. *Tungsten and Tungsten Alloys*

The structure of doped PM tungsten recrystallized at 2200°c for 30 min is illustrated in fig. 1 (*a*). This particular annealing temperature was selected because it results in a sub-structure which contains a low density of dislocations with a void–matrix interface almost free from dislocations. The rows of circular areas, which lie along the axis of the wire, have been identified by diffraction contrast analysis as internal voids (Das and Radcliffe 1968 a). The size of the voids ranges between 100 Å and 1000 Å. The sub-structure of the tungsten–thoria alloy recrystallized at 2200°c for 30 min (fig. 1 *b*) exhibits isolated rounded particles of thoria ranging in size from 0·1 to approximately 1 micron and free from dislocations. However, sub-boundaries consisting of hexagonal networks of dislocations are observed in the tungsten matrix. In the case of the tungsten–HfC alloy, the hafnium carbide particles were also free from dislocations. The shapes of the hafnium carbide particles are more angular (fig. 1 *c*) and their size range smaller than for the ThO_2 particles.

The sub-structures of the matrix adjacent to the elastic discontinuities in the as-recrystallized condition and after pressurization were carefully compared under various diffraction conditions. Up to pressures as high as 25 kilobars, no evidence of dislocations or other defects due to pressurization was found in the vicinity of voids or particles of thoria or hafnium carbide. These observations are in keeping with the calculations made in § 2 in that at 25 kilobars (see table 2), the maximum values of shear stress developed for the cases of void, thoria and hafnium carbide particles are $G/80$, $G/360$, $G/520$, respectively, which are substantially lower than the stress for nucleating dislocations. However, on pressurizing the thoria and hafnium carbide alloys at 40 kilobars, new dislocations were developed, as illustrated in fig. 2. Around the larger thoria particles (fig. 2 *a*), complex dislocation arrays appear which are analogous to those observed (Radcliffe and Warlimont 1964) at iron carbide particles in an alpha-iron matrix on pressurization above some 5 kilobars. The areas adjacent to the smaller particles appeared unaffected by the pressure treatment. No well-developed prismatic dislocation loops were found. In contrast, in the case of HfC particles (fig. 2 *b*), well-developed rows of dislocation loops characteristic of prismatic punching were observed. The fact that these differences in the type of dislocation array persist for thoria and hafnium carbide particles of similar sizes indicates that the different compressibilities of the two compounds (both of cubic structure) play a significant role in determining the nature of the array formed.