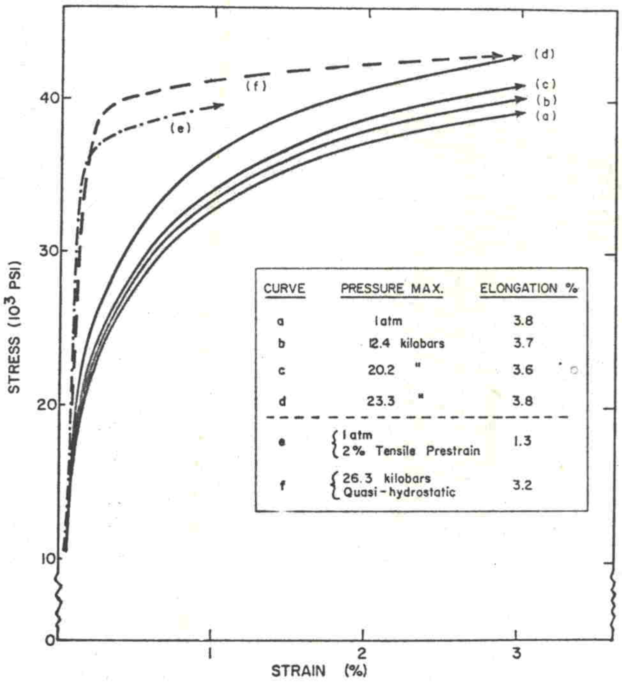

FIG. 12. Effect on tensile stress–strain behavior of cycling to indicated pressures. Annealed powder metallurgy beryllium.

of 23 kb is more than twice that for 20 kb. These effects are illustrated in Fig. 12.

An additional feature of the modification of stress–strain behavior by high pressure cycling was observed for specimens which were accidently subjected to quasi hydrostatic conditions arising from high viscosity or actual solidification of a particular batch of the pressure-transmitting fluid (isopentane)—attributable to chemical deterioration of the fluid in storage. Specimens subjected to pressure in this batch of fluid, although showing no external evidence of deformation—i.e. no dimensional change— exhibited a radical change in stress–strain characteristics, as is also shown in Fig. 12. Although it is impossible to equate plastic strain induced by the quasi-hydrostatic pressure with that by tensile pre-strain at atmospheric pressure, it is important to note (Fig. 12) that the form of the resulting stress–strain curve is similar, although the pressurised material exhibits a higher flow stress than that resulting from a 2% prestrain. The higher ductility of this pressurised material is in keeping with other observations of the effects of deliberate prestrain at high pressure.[15]

3.2.3 *Planar defects*. The small parallel defects which were observed in thin foils of both powder-metallurgy and zone-refined beryllium after pressure cycling to 23 kb and higher (e.g. Fig. 7) are unlike any previously reported for beryllium with respect to their small size, dense and uniform distribution, and the facts that they are observed in very strong contrast only when the basal plane is parallel to the electron beam and are never observed when the basal plane is normal to the beam. The absence of non-matrix spots in diffraction patterns from the foils and the presence of the above contrast effects indicates that the defects cannot be precipitate particles since in that case at least some contrast should be apparent in the 'face-on' position. Instead, it is concluded that the defects correspond to dislocation loops 200–500 Å dia. and lying on basal planes. The application of the invisibility or minimum contrast criterion for dislocations ($\mathbf{g}\cdot\mathbf{b} = 0$, i.e. Burgers vector lying in the reflecting plane) indicates that the Burgers vectors of the loops must lie out of the basal plane. Such prismatic dislocation loops lying on basal planes in beryllium appear to be unique to the pressure-cycled specimens. Dislocation loops observed previously in beryllium, whether formed by quenching,[16] irradiation[17] or plastic deformation[16] have been found to be prismatic loops on non-basal planes and with Burgers vectors lying in the basal plane.

Exact determination of the displacement vector of the basal plane loops by use of the invisibility criterion, or by the change of apparent loop size with change of sign of the quantity $(\mathbf{g}\cdot\mathbf{b})$s proved impractical since both of these methods require extensive tilting through specific operative reflections.[18,19] This is made very difficult by (1) the limited tilt control imposed by the hexagonal symmetry of beryllium and the single tilt axis goniometer available, (2) the ambiguities in identifying desired diffraction patterns directly on the microscope screen, (3) the inability to observe the defects under prismatic operative reflections (i.e. from (XXXO) planes) and (4) gradual loss of contrast and resolution due to specimen contamination in the electron microscope. However the apparent absence of such loops in all grains observed under prismatic operative reflections, their appearance in intermediate contrast under $\{10\bar{1}1\}$ type pyramidal operative reflections, and their visibility in maximum contrast under an (0002) operative reflection indicate that their Burgers vector is close or parallel to [0001]. Further evidence to this effect is furnished by the uniformity of contrast of all loops in a given region under pyramidal operative reflections. Since an inclined Burgers vector for the loops, e.g. parallel to $\langle 20\bar{2}3\rangle$, would have six possible directions of this type in the hexagonal lattice, one would expect loops formed by point defect condensation to have Burgers vectors lying along any and all of these six directions. This should give rise to varying contrast among loops