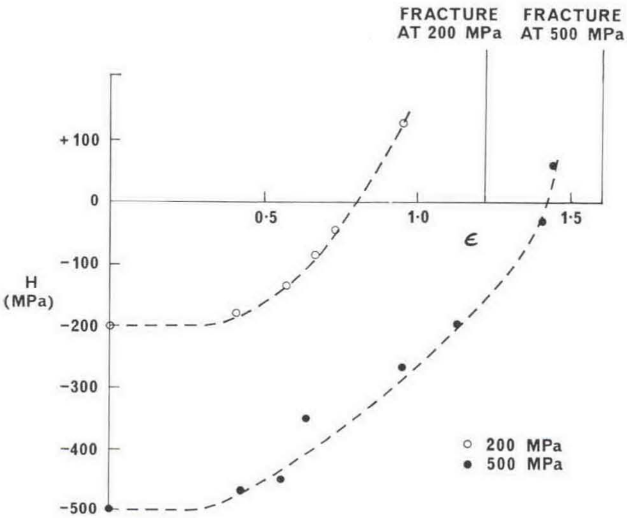

FIG. 4. The variation of resultant triaxial stress component at the centre of the neck (H) with natural strain (ε) for specimens strained at 200 and 500 MPa.

DISCUSSION

The plot of natural strain to fracture against hydrostatic pressure (Fig. 1) is in general agreement with the results of Beresnev *et al.*[6] who used a 60/40 brass, thus confirming that for this material the steeply rising relationship between pressure and fracture strain holds only up to pressures of about 300 MPa. This increase in fracture strain with hydrostatic pressure is strongly dependent on the formation and growth of voids in the neck, which is controlled by the value of the resultant triaxial stress component. The presence of voids weakens the material in the necked region and reduces ductility. As the hydrostatic pressure is increased, the formation of voids is suppressed to later stages of deformation until the resultant triaxial stress in the neck region reaches the necessary tensile value for void formation. Thus for pressures up to 300 MPa the fracture strain increases rapidly with increasing external hydrostatic pressure because of the increasing suppression of voids.

Above 300 MPa pressure the pressure sensitivity of the fracture strain is much reduced. This behaviour appears to be connected with the localisation of voids to a region very close to the fracture surface. The experimental results suggest the following explanation to account for this low sensitivity to pressure. At these pressures the resultant triaxial stress component (H) does not become tensile until very late in the deformation, when a highly developed neck exists in the specimen. Voids can therefore only develop in the narrow region near the centre of the neck. Under these circumstances very little further deformation can occur after macroscopic voids exist. This is confirmed by Fig. 4 which shows that the strain interval between the triaxial stress component becoming tensile and fracture at 500 MPa pressure is 0.18 whilst that at 200 MPa pressure is 0.41. Thus the decreased pressure sensitivity of the fracture strain–pressure relationship at pressures above 300 MPa occurs because little further deformation occurs after large scale void formation at higher pressures.

CONCLUSIONS

(i) The natural strain to fracture of leaded 60/40 brass increases rapidly with hydrostatic pressures up to 300 MPa but increases much less rapidly at higher pressures.

(ii) The numbers of voids present, and the distance from the fracture surface to which void formation extends, decreases markedly with increasing pressures in the range 0.1 to 300 MPa. At higher pressures however, the few voids present are restricted to a zone close to the fracture path.

(iii) The resultant triaxial stress component at the centre of the neck of specimens tested at pressures of both 200 and 500 MPa are tensile immediately prior to fracture. The strain interval between this stress becoming tensile and fracture however, decreases markedly with increasing pressure.

(iv) The reason for the decreased slope of the fracture strain–pressure relationship at pressures above 300 MPa is that voids develop only in a narrow region very late in the deformation at these pressures and are thus less effective in influencing ductility.

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