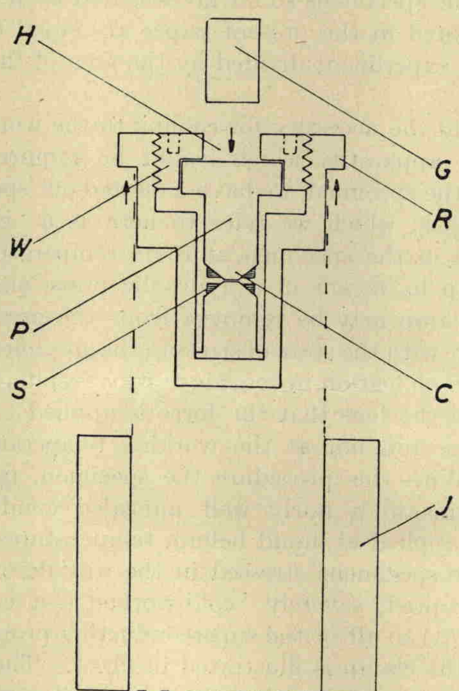
metals under very high pressures, Bridgman interposes a disc-shaped specimen between the plane faces of two truncated conical bosses, each machined on massive blocks of steel or Carboloy. As the blocks are forced together, very intense stresses are developed over the small area of contact, and the specimen and compressing surfaces deform in such a way that the pressure in the specimen approaches a hydrostatic distribution locally, with a value which decreases radially from the centre to the perimeter. The actual form of the variation is difficult to estimate, but it was believed by Bridgman that a large central part of such a specimen would be under fairly uniform pressure. This question is discussed elsewhere (Chester 1953), and we shall only mention here certain indications arising from the present results which suggest that this is true for the metallic specimens so far investigated by us. (The values of mean pressure quoted in the present paper are equal to the total force applied in a given experiment divided by the area of the specimen under stress.)

In order to avoid the necessity for cooling to the working temperature the rather bulky apparatus which would be required to transmit a sufficient force to the specimen, we have mounted our specimens in a small self-contained device, which we refer to here as a ' clamp '. Pressure may be generated in the spec'men at room temperature by applying a force to the clamp by means of a hydraulic press, and after a suitable adjustment the clamp may be removed from the press and transferred to a small cryostat, with the state of stress in the specimen still maintained. Apart from the simplification in technique wich results, there is an important advantage in the fact that the force is applied to the specimen at room temperature, and not at the working temperature in the liquid helium region. With this procedure the specimen, particularly if of a soft metal, remains in a fairly well annealed condition throughout. If the force were applied at liquid helium temperatures, annealing would not occur and the specimens stressed in the way described would be, if not actually disrupted, severely ' cold-worked '—a condition which is known (Hilsch 1951) to affect the superconducting properties profoundly.

The design of the clamp is illustrated in fig. 1. The specimen, in the form of a thin disc, is set between the truncated compressing cones C. For the application of pressure, the clamp is supported by its rim R in the cylindrical jig J, a plunger G is inserted in the axial hole H in the screw W, and the whole unit placed between the rams of the press. When force is applied between the plunger and the base of the jig, the pistons P of the clamp—and therefore the specimen—are put under compression, whilst the outer wall of the clamp is put into tension. The various members can now be ' locked ' in their state of stress by tightening the screw.

In practice it is not possible to preserve the full stress because of friction in the screw-thread, and the following procedure is adopted to ensure that the fraction preserved is as large as possible and is accurately known : When a suitable value of the force is reached, the screw is tightened progressively and the hydraulic press relaxed at such a rate as to keep constant the strain in the clamp—as indicated by a resistance strain-gauge cemented to its outer wall. As the press is relaxed further, the screw becomes more difficult to turn and after a certain stage no further tightening is attempted. At this point the press is relaxed completely and the fraction of the original strain which has been retained (in practice never less than 90%) is noted from the indication of the strain-gauge. The clamp is now transferred to the cryostat. No change in the pressure applied to the specimen is to be expected on subsequently cooling the clamp to the working temperature because its load-bearing members are made wholly of one material, and therefore contract equally.

Fig. 1



Schematic diagram of clamp (for explanation of symbols see text).

The superconducting transition of the compressed specimen is observed by a magnetic method. This is to be preferred to a method depending on the measurement of resistance, because it avoids the difficulties of electrical insulation at high pressure, and is less likely to lead to the spurious effects associated with the existence of filaments of abnormally high critical field—as reported by Lazarew and Galkin (1944) for inhomogeneously strained superconductors and by de Haas and Voogd (1930) for inhomogeneous superconducting alloys. The method best suited to the geometry of the clamp is to wind secondary coils S, in series, round each