of O-rings on the piston depends on the maximum pressure. Each O-ring supports about 2700 atm. At this critical pressure the liquid suddenly leaks through the first ring and fills the volume separating it from the next one. As the pressure is further increased a second leakage occurs at about 5400 atm filling the volume between the first and second O-rings to this pressure and the volume between the second and the third to about 2700 atm. With four O-rings pressures up to 11 000 atm could be securely maintained.

THE PRESSURE-LOCKING SYSTEM is of the same type as described earlier.[1] After mounting the stationary bottom piston, the window pistons, and the sample cell, the vessel is placed in a vertical position and filled with the proper amount of glycerol. The top piston is inserted and its supporting screw, which has a *central bore*, screwed against it. The whole assembly is placed in a hydraulic press, and a steel rod is inserted into the screw bore. When pressure is applied to the protruding rod the top piston is driven down as the pressure increases leaving a space between itself and its supporting screw. After attaining the desired pressure the top screw is screwed tight against the plug. The force on the rod is then relieved and the rod in the screw bore removed. However, the pressure in the vessel is retained by the screws. In fact, it only drops by a few percent due to the yield in the screw.

The cell is now ready to be placed in the optical instrument and the required measurements may be performed. After their completion, the pressure may be increased by repeating the previously described operation, or the vessel may be disassembled by applying again the external force, releasing the screw supporting the piston, which then becomes loose; thereafter carrying out the decompression by a slow release of the external force.

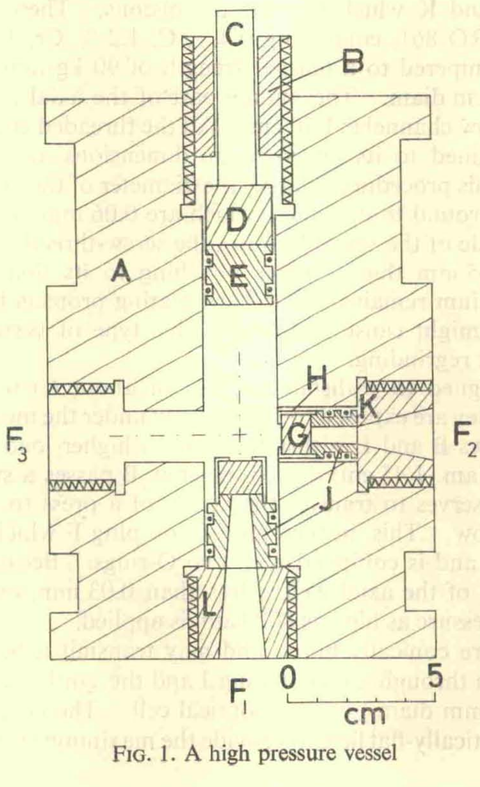

FIG. 1. A high pressure vessel

THE WINDOW SUPPORT is of the conventional unsupported area type.[3] The window pistons are of steel with holes for the light beam and normally provided with only two O-rings. They are supported by screws with tapered holes for the light beam. Previously [1] the windows were either kept in place with water-glass cement, or Poulters method [4] was used to obtain a close fit at low pressures—once the pressure gets high, the windows are leak-proof. In our present design each window G is enclosed in a threaded steel cap H, and is pressed by a plastic gasket against the inner side of the window. In this way the outer side of the window G is pressed against the optically flat surface of the steel piston J even before the high pressure is applied (see fig. 1). This arrangement is extremely convenient.

THE OPTICAL CELL contains the solution to be investigated. Since the cell is immersed in glycerol it must be leak-proof but flexible to allow the compression of the solution as the pressure of the outside liquid rises. Different designs have been tested. The best are: Teflon bellows or cells sealed by pistons with O-rings. The latter are preferred, especially for the light scattering work, because the solution may be maintained dust-free.

TECHNICAL DETAILS

In the studies reported in parts 2 and 3, the high pressure vessel shown in fig. 1 was used. It is provided with three windows, two for a straight-through beam, and the third, conveniently placed in the bottom piston, permitting observation at 90° to the other beam. This design is preferable, as it is more convenient to place a window in the bottom piston than in the wall of the vessel. A thick, cylindrical block A, with an axial hole and a smaller channel perpendicular to it for the light-beam, forms the main body. Both channels have wider ends, which are threaded to take screws B, L and K which support the pistons. These parts are machined out of Bofors steel CRO 861, containing 0.4 % C, 1.2 % Cr, 1.4 % Ni, 1.0 % Mn and 0.2 % Mo and tempered to a tensile strength of 90 kg/mm^2. The main block is 19 cm long and 13 cm diam. The middle part of the axial hole is 2.46 cm diam. while that of the window channel is 1.70 cm. All the threaded ends are 3.60 cm diam.

The body is machined to its approximate dimensions and then prestressed at about 10 000 atm. This procedure enlarges the diameter of the hole by about 0.5 mm. The holes are then reground to diameters which are 0.06 mm larger than the desired dimensions. The inside of the vessel (but not the screw-threads) is then given a hard chromium plating 0.05 mm thick. After polishing to its final dimensions, about 0.03 mm of the chromium remains. The hard plating protects the inner parts from scratches which later might cause jamming. This type of vessel can with care be used for years without regrinding.

Screws K are designed to withstand a load of about 60 tons each when fully screwed in, although they are exposed to 30 tons only under the most severe operational conditions, while screws B and L withstand an even higher load.

Through a hole (diam. 1.45 cm) drilled in screw B passes a steel piston C (diam. 1.40 cm). The latter serves to transfer the action of a press to a tightly fitted steel plunger D located below. This, in turn, presses on plug E which is machined either from steel or Nylon [2] and is equipped with two O-rings. Because the gap between piston D and the wall of the axial well is less than 0.03 mm, even Nylon does not creep into it when a pressure as high as 8000 atm is applied.

Screws K and L are conically bored and may transmit a beam of light 6.5 mm wide which passes then through a hole in plug J and the synthetic sapphire window G (12 mm thick and 15 mm diam.) into the optical cell. The *c*-axis of the sapphire is perpendicular to the optically-flat face to provide the maximum strength to the window,