Improved tandem Fabry-Perot interferometer

A very rigid and accurate tandem Fabry-Perot interferometer of rather simple construction has been made at the Nat.Lab. The mirrors are used in a horizontal position to minimize mechanical stresses and hence deterioration of surface flatness. The system is used as a tunable optical filter in which the scanning is done piezo-electrically. Relatively fast scanning in combination with electronic control of parallelism and spacing of the mirrors ensures optimum measuring conditions without the need for rigorous temperature stabilization. The tandem interferometer is used in studying relatively broad spectra in which a high wavelength resolution is needed. In particular the application is in Brillouin scattering, scattering from surface interactions, etc.

The Fabry-Perot interferometer, in which interference is observed between light reflected at two high-reflection, low-absorption mirrors, serves as a narrow-band optical filter that can be tuned by varying the mirror spacing. Exact parallelism of the mirrors is needed for minimum bandwidth and maximum transmission. With a good resolving power the free spectral range is, in general, limited and spectra of different orders will overlap. The tandem system offers a solution to this problem as it allows the free spectral range to be expanded without decreasing the resolving power. This, of course brings with it the need to keep both interferometers tuned at exactly the same frequency. Ways of achieving this are known from literature but none of these solutions, however, is completely satisfactory.

J.G.Dil, *N.C.J.A.van Hijningen*, *F.C.van Dorst* and *R.M.Aarts* constructed a tandem interferometer in which adjustment and tuning of each mirror pair is obtained with three electronically controlled piezostacks.

Each mirror pair is mounted in a cylindrical housing as shown in fig.1. The mirrors are used in the same horizontal position in which they have been tested for flatness during production. In this way influence of gravity and clamping forces is minimized. The reflective coating has also been chosen so that the surface flatness remains unaffected.

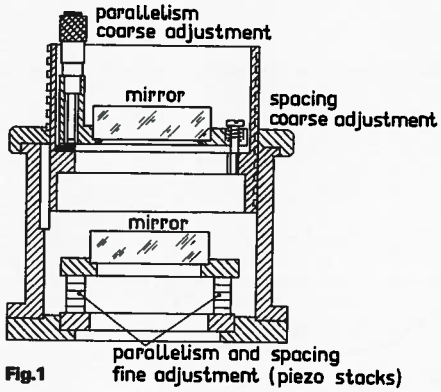

Fig.1

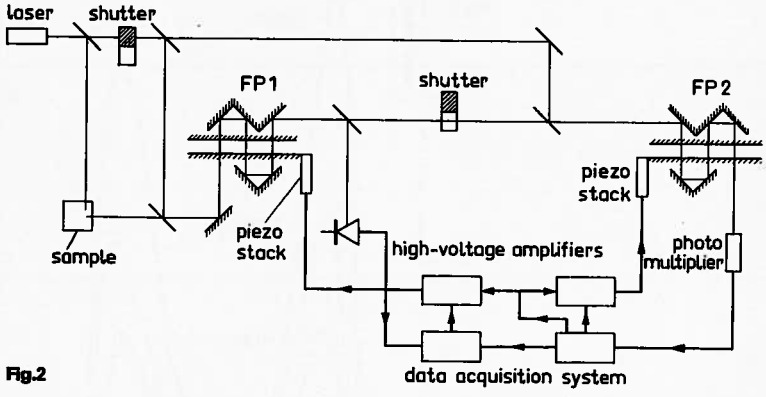

Fig.2

Two Fabry-Perot interferometers are arranged in tandem as shown in fig.2. With two sets of corner-cube prisms a triple pass of each of the interferometers is obtained. The optical output is observed with a photomultiplier and processed in data acquisition electronics. The spectrum is scanned by varying the mirror spacing in a sawtooth fashion. The moment when the interferometers are tuned to the laser emission wavelength the two shutters are activated, the interferometers are thus isolated and the servo electronics within the data acquisition system corrects for possible deviations in mirror parallelism and mirror spacing. Using a strong line in the spectrum measured, the speed of the scanning movement is adjusted so that optimum transmission is always obtained.