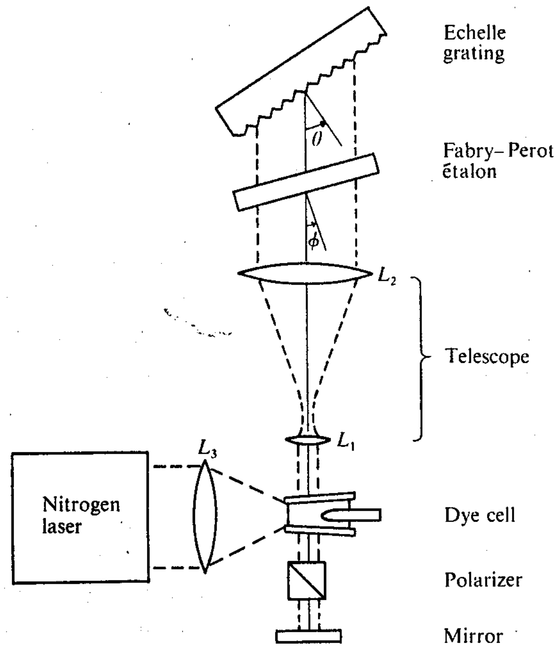

Fig.14.5. Dye laser with narrow bandwidth output pumped by pulsed nitrogen laser. (After Hänsch (1973).)

at 337·1 nm lasting 7-10 ns and having a peak power of ≈ 300 kW.

The radiation from the nitrogen laser emerges in the form of a beam of rectangular cross-section, approximately 5 mm × 40 mm, which is focussed by a spherical quartz lens into a line near the inner wall of the dye cell. The active volume of the dye forms a cylindrical filament about 0·2 mm diameter and 10 mm long having a single pass gain which approaches 10^3 mm^{-1} under these conditions. The optical cavity of the dye laser is about 40 cm long and consists of a plane dielectrically-coated mirror at one end and a Littrow-mounted diffraction grating at the other. Owing to diffraction, the rather small active cross-section in the dye results in a substantial angular spread of the emerging radiation and this

would normally limit the bandwidth obtainable with angle-dependent wavelength selectors such as gratings and étalons. However, this problem may be overcome by using a telescope as a beam expander within the cavity so illuminating the whole aperture of the grating. In this system a bandwidth of 0·03-0·05 Å can be obtained using the grating and telescope alone and the output bandwidth can be reduced by a further factor of ten by inserting a tilted Fabry-Perot étalon into the cavity. As explained in section 13.7.4 this acts simply as a narrow bandpass filter with the transmission maxima determined by the condition

$$2 \mu t \cos\phi = n\lambda \qquad (14.2)$$

where ϕ is the tilt angle, and μ and t are the refractive index and thickness of the étalon respectively. The laser wavelength can be tuned continuously over a range of several Ångstroms by altering the tilt angles of the étalon and grating simultaneously. The wavelength stability is limited by temperature changes in the étalon, but can be as good as 0·01 Å over several hours.

In dye lasers of this type the efficiency can be as high as 20 per cent. At low repetition rates thermal schlieren effects are absent because the pulse length is so short, 5-10 ns, and the output beam is nearly diffraction limited. However, for repetition rates above 10 Hz it is necessary to circulate the dye transversely through the cell. Peak optical output powers of several kW can then be generated at repetition rates approaching 100 Hz.

14.2.4. Argon laser-pumped dye lasers - C.W. systems. The very high intensity required to pump dye lasers on a C.W. basis can so far be obtained only by using the tightly focussed beam of an argon or krypton ion laser, as shown in Fig.14.6. In this particular design, developed by Kogelnik *et al.* (1972), the argon laser beam enters the dye laser cavity through a Brewster angle prism and is focussed to a spot of approximately 10 μm diameter in the tilted dye cell