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A new versatile He–Ne laser for optical adjustments

He–Ne lasers are commonly used in optical laboratories as artificial optical axes, for adjustments of different optical elements, and also in a variety of scientific investigations. The most frequently used laser has the discharge tube mounted horizontally in an appropriate laser head. Thus, the laser itself occupying about 50–100 cm of the optical bench length reduces considerably the space available for other optical elements. In this report we present some details on a new vertical He–Ne laser which has proved to be very suitable for adjustments of optical components, and which occupies but little space on the optical bench. The discharge tube in this device has been fixed vertically within a very stable optical resonator head. The laser beam is then directed via a prism in the horizontal direction. The laser mounted in the upper part of the device can be rotated thorugh an angle ranging from 0 to 360°. Due to special mechanical elements, mounted in the lower part, changes in the laser beam height (with respect to the optical bench), as well as precise horizontal and vertical rotations are possible. Hence any desired position of the beam can be easily obtained.

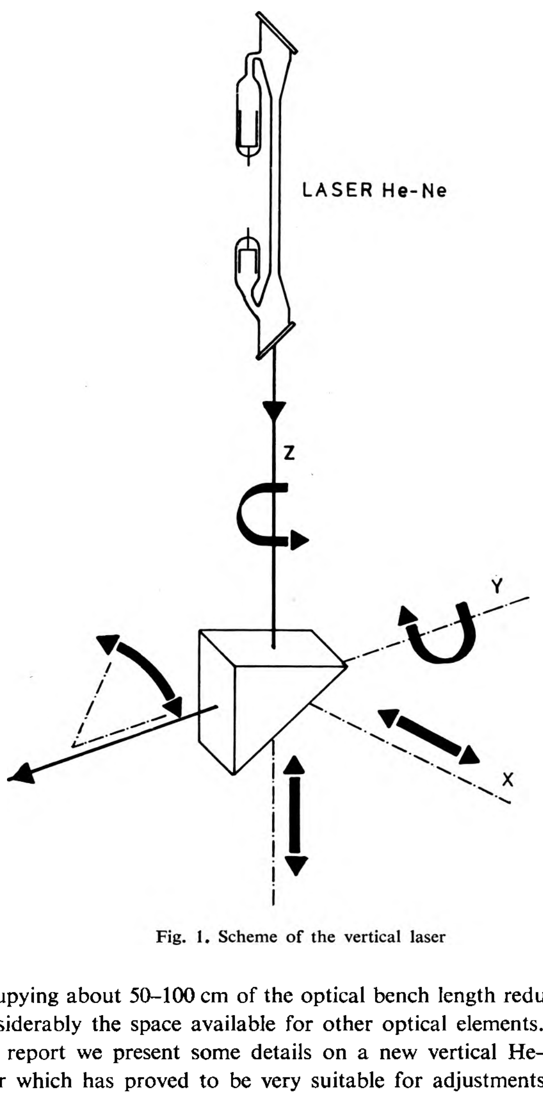

Fig. 1. Scheme of the vertical laser

A small long-life discharge tube (life-time exceeds 10 000 hours) has a total length of 34 cm. The effective (discharge) length amounts to 27 cm. The output power was about 1 mW, the cavity being composed of a pair of dielectric mirrors: the concave of "0" transmission and 110 cm curvature radius and the flat one of 1.5% transmission. This power level is enough to use the laser for many purposes in daylight. Divergence of the laser beam depends on the curvature of the mirrors. In our case, the divergence (estimated from the full diameter of the light spot, 7 m from the laser) was 2.15′. The laser operates in its fundamental TEM_{00q} mode. The number N of axial

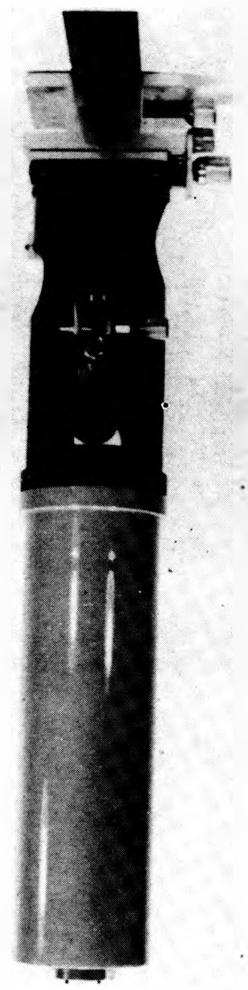

Fig. 2. Overall view of the vertical He-Ne laser

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modes depends on the length of the resonator:

$$N = \frac{c}{2L} \Delta\nu_g,$$

where $\Delta\nu_g$ is the line-width for the transition under investigation ($\Delta\nu_g = 1700$ MHz for $\lambda = 6328$ Å). Taking $L = 28$ cm we get: $N = 3$. The number of really oscillating axial modes can be easily measured by means of a scanning Fabry-Perot interferometer. It has been found that at a slightly lowered power level the laser oscillates in only one axial mode. Fig. 1 presents a scheme of the laser built, and fig. 2 — a photograph of the device. Details of upper and lower parts of the device are shown in figs. 3 and 4, respectively. Some technical data are summarized in Table.

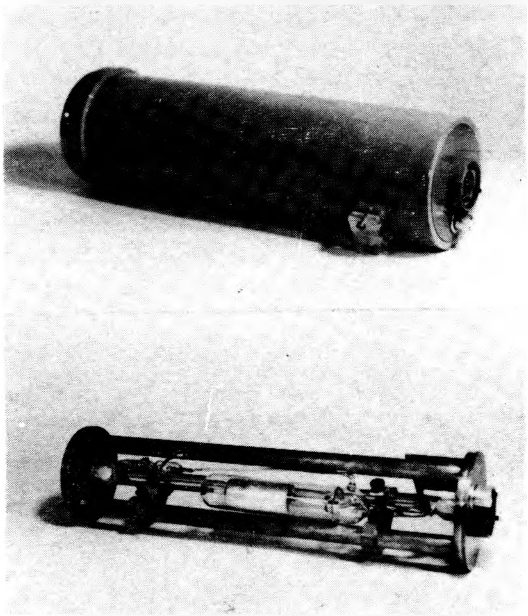

Fig. 3. Laser head

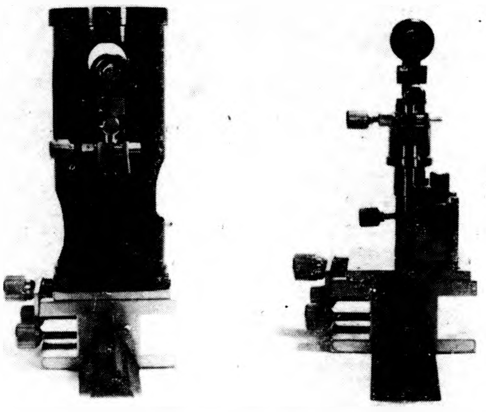

Fig. 4. Laser head mounting and adjustment mechanism

Technical data of the laser

1. Total height	73 cm
2. Diameter	11 cm
3. Length of the laser head (upper part)	39 cm
4. Length of the lower part	34 cm
5. Standard height of the laser beam (with respect to the optical bench)	25 cm
6. Rotation angle of the laser head	0-360°
7. Rotation angles of the laser beam at the position of the laser head:	
— fixed horizontally	22°
— fixed vertically	32°
8. Parallel displacement of the laser beam	
— vertical	0-20 mm
— horizontal	0-20 mm
9. Space occupied by the laser on the optical bench	11 × 13 cm