

AN ARRANGEMENT OF THE ROTATING SECTOR DISK.

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In using a spectrophotometer for comparing the intensities of two beams of light, wave length by wave length, the intensity of the comparison beam is frequently varied by means of a rotating sector disk. There are two types of these disks.

In one type two disks with sectors cut from them to form windows, with two sides parallel to the radii of the disk, are mounted on a common axis so that one may be rotated with respect to the other. The open sections of one can thus be made to partially overlap those of the other, in order to vary the effective size of the windows. The beam of light passing through these sectors while the disks are in rotation, is thus rendered intermittent and appears to flicker. But owing to the persistence of vision, the flicker will disappear when the speed of rotation exceeds a certain limiting value. Above this limiting speed of rotation the intensity of the beam will seem to be continuous but will vary as the sectors are changed in size.

According to Talbot's law the apparent intensity of the intermittent light bears to the actual intensity of the incident light the same ratio as does the time of exposure to the period of rotation.

In the Napoli-Abney and Keuffel & Esser disks this variation of sector size may be produced while the disks are in rotation.

In the other type a single disk has windows cut in it each varying in width with its radial distance from the axis of rotation. In the Hyde sector disk these sectors are formed of three arcs, one concentric with, and near the axle of the disk, the other two meeting near the circumference and forming with the first a triangle. There are six of these windows, their total width at the outer edge being zero, and at the inner edge 85% of 360 degrees.

This type of disk is usually mounted close to the slit of the collimator with its axis parallel to that of the collimator. To vary the intensity of the beam while the disk is in rotation it is shifted parallel to its own plane by means of a micrometer screw so that a different width of sector comes in front of the slit of the spectrophotometer. The incident beam can thus be varied continuously from 85% of its full intensity to zero. A calibration

curve gives the intensity of the transmitted beam for each reading of the micrometer screw scale.

The disk is usually enclosed in a housing and sometimes a comparison prism is mounted in front of the collimator slit, so that the disk can not be brought very close to the slit. As a result, when rays of light are focussed on the slit, they form a thin wedge with its base at the disk. The effective radial range along which the intensity of the beam can be varied is thus decreased by an amount equal to the width of the beam at the disk.

Besides, the disk and the motor for rotating it are usually mounted on a heavy metal base to avoid vibrations, and in shifting this considerable wear and strain in the fine threads of the micrometer screw may result.

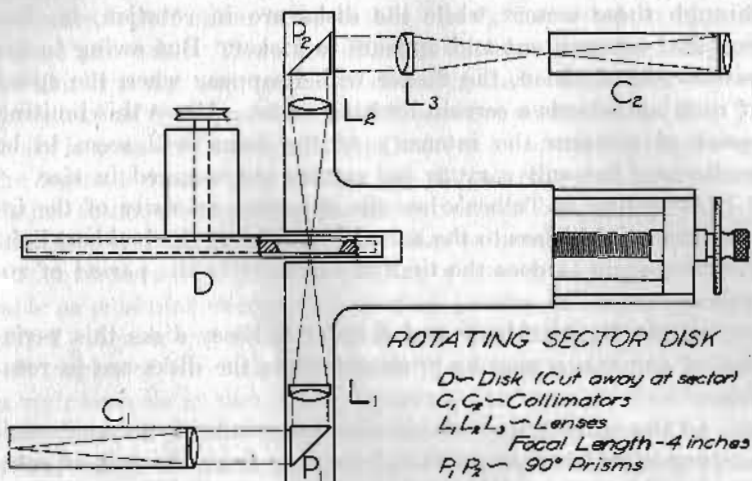


FIG. 1.

To avoid these difficulties the following optical system has been devised: Fig. 1.—The disk is mounted with its plane parallel to the axis of the collimator and remains at rest. The light to be varied in intensity is rendered plane parallel by a separate collimator, C_1 having its axis parallel to that of the spectrophotometer, C_2 . It is then totally reflected by a right angled prism P_1 and brought to a focus at the bevelled edge of the rotating sector disk D by means of a short focus achromatic lens L_1 . A second lens L_2 renders the beam once more plane parallel, and after reflection by a second prism P_2 in order that the beam may travel along the axis of the photometer collimator, it is brought to

a focus on the slit of this collimator C_2 by means of a third lens, L_3 .

The two prisms and two lenses between them are mounted on a light aluminum carriage, which straddles the disk and travels on tracks in a direction parallel to the disk. It is shifted by means of a fine micrometer screw, and the radial position of the beam in the open sector of the disk can be read off on the scales of the screw.

Because of the short focal length of the lens L_1 , the image of the first slit which is formed at the disk has a very small radial thickness, hence the full range of the radial sector length can be used. Also the movable parts are quite light and cause no strain or wear on the micrometer screw.

The two prisms move along beams of plane parallel light and with proper adjustment the slit image remains in position on the collimator slit as the carriage is shifted. The prisms must be "squared on" with the aid of a telescope having a Gauss ocular by observing the images of its cross hairs reflected from the four perpendicular faces of the prisms and adjusting until these images are superposed.

As constructed this optical system gave very satisfactory results. The lenses had a focal length of 4 inches and a diameter of 1.25 inch. The short sides of the prisms were also 1.25 inch in width. The radial range of the sectors was 2 inches and a micrometer screw of half a millimeter pitch was used.

The disk was calibrated by comparison with a Keuffel & Esser sector disk. Readings could be repeated within 1.5% usually.

Since the absorption of glass varies for different wave lengths, a correction curve was plotted to allow for this difference. The following table of values taken from this curve gives in A, the intensity of the beam direct; in B, the intensity after passing through the optical system described above.

Wave length	6563	5893	5270	4862
A	99.6	87.0	77.1	82.6
B	67.4	51.7	46.0	44.0
Difference	32.2	35.3	31.1	38.6
%Difference	32.3	40.6	40.3	46.7

It will be seen that the absorption varied from 32.3 to 46.7 percent for different wave lengths. (expressed in Angstrom units).

The system could therefore not be used to advantage with beams of low intensity.