A MINIATURIZED SPECTROHELIOSCOPE

FREDRICK N. VEIO

In 1964 the writer[1,2,3] constructed an efficient and compact spectrohelioscope to observe eruptions, filaments, plages and prominences on the solar disk in Hα light. The instrument is discussed in the literature by Hale[4], Ingalls[5] and Sidgwick[6].

The design consists of three 1-metre high wood piers with a concrete base, each weighing 30 kilograms. Two piers support a 2-metre long wood spectroscope box. The 100 mm heliostat mirror and telescope lens are placed on the third pier. The various parts are portable and can be stored in the home, thereby eliminating an expensive permanent observatory. Total costs were about $265. Only 5 metres in a straight line are required.

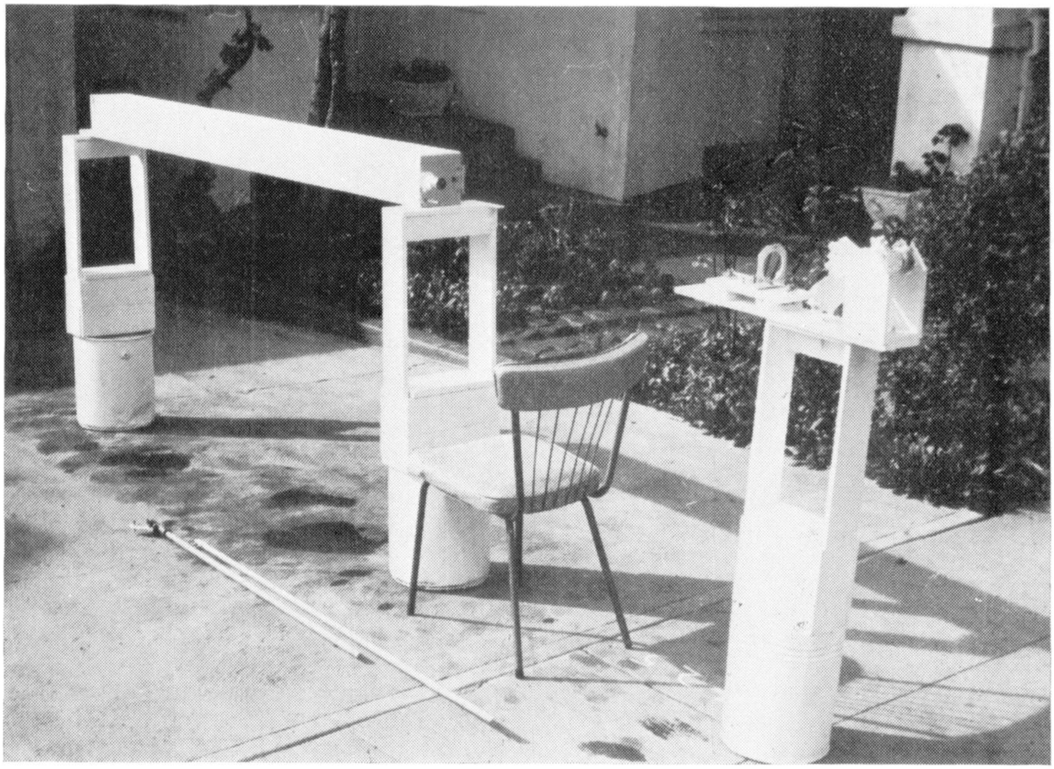
The telescope has a 64 mm clear aperture and a 2·7-metre focal length. The spectroscope has a 50 mm clear aperture and a 1·9-metre focal length with a positive meniscus shape to easily eliminate internal lens reflections. Mitchell[7] recommends the rotating glass disk as the solar image synthesizer. A 108 mm diameter painted glass disk has 24 slits of 0·15 mm width, giving 0·6 Å passband for excellent contrast of the solar disk in Hα light. The 108 mm disk rotates on the output axle of a one revolution per second synchronous motor, giving 24 solar images per second into the eye for a continuous image. There is no vibration problem.

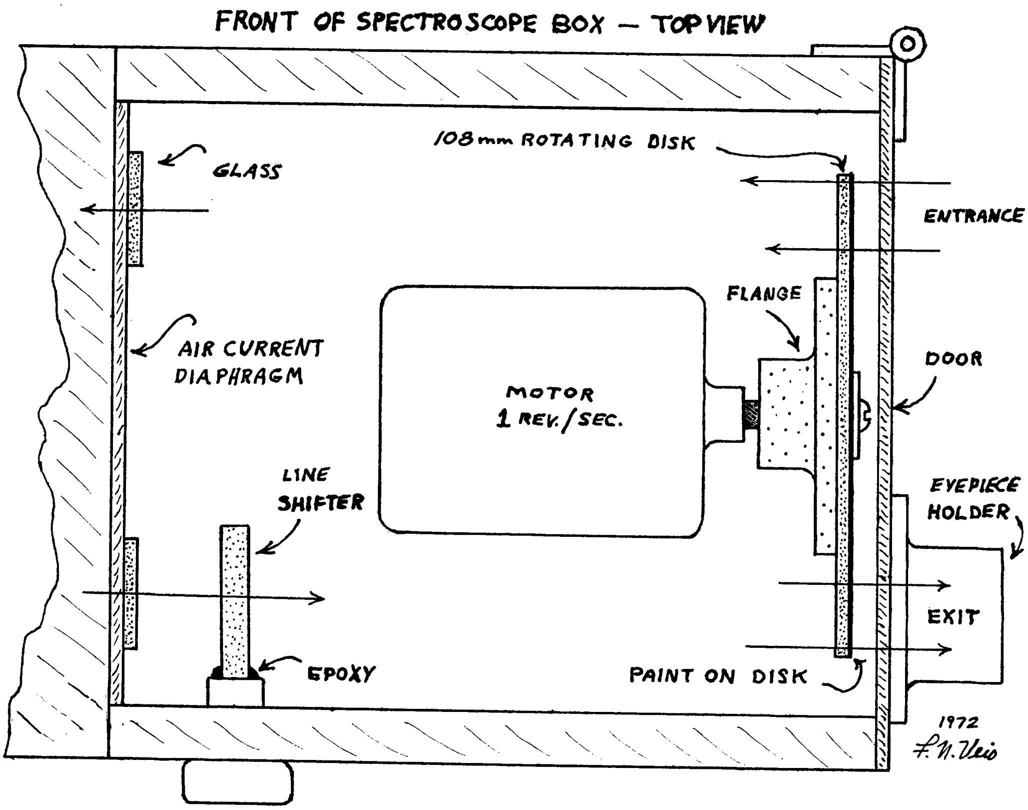
A Bausch and Lomb reflectance grating is employed. It has a ruled area of 32 mm × 30 mm, 1 200 lines/mm, and 5 000 Å blazed wavelength. The linear dispersion is 4·0 Å/mm in the first order. The grating resolution is calculated by dividing the total number of lines of the grating into the interested wavelength. Thus, 32 mm × 1 200 lines/mm equals 38 400 total lines. With the Hα line, then 6 563 Å wavelength divided by 38 400 lines equals 0·17 Å grating resolution in the first order. A grating should have a resolution about one-third the passband that will give good solar contrast. Hence, one-third of 0·6 Å passband is 0·2 Å desired grating resolution. This is why a small top-quality grating will give excellent performance.

The resolution of the telescope lens for a spectrohelioscope depends upon the diameter of the solar image on the entrance slit and the width of the slit. A 2·7-metre focal length telescope will produce a 25 mm diameter solar image at the prime focus. With slit width of 0·15 mm, then:

$$\text{telescope resolution} = 32' \,(=\text{diam. Sun in the sky}) \times \frac{0{\cdot}15\ \text{mm slit}}{25\ \text{mm solar image}} = 12''$$

The 12″ estimate above is average resolution. The shape and brightness (plage and eruptions) or darkness (filament) of the solar feature determines the truer resolution. Therefore, about 6″ is a better value. All the main solar




FRONT OF SPECTROSCOPE BOX — TOP VIEW
108mm ROTATING DISK
GLASS
ENTRANCE
FLANGE
AIR CURRENT
DIAPHRAGM
DOOR
MOTOR
1 REV./SEC.
LINE
SHIFTER
EYEPIECE
HOLDER
EXIT
EPOXY
PAINT ON DISK
1972
F. N. Veio

details are about 5″ or larger. That is why a 2·7-metre focal length telescope will yield fine views of the solar disk in Hα light.

Small air currents exist inside the spectroscope box. They cause slight movements of the solar spectrum at the exit slit. The 0·15 mm wide Hα line does not remain in a constant position on and through the exit slit. The slight shifting of about 0·10 mm of the Hα line creates a dark and light patchy appearance of the solar disk in Hα light. The effects of the slight air currents in the box can be considerably minimized by placing a diaphragm about 200 mm from the exit slit. The exact distance is not critical. The diaphragm has two holes for the solar light to pass to and from the grating. The holes are covered with good quality reticle glass. Now the details on the solar disk will be seen in better contrast. The air currents in the box are the same nuisance as detected in the testing of a long focal length mirror at the centre of curvature with the Foucault test.

A most compact spectrohelioscope design can be achieved by using two optical flats to fold up the long focal length optics in a U-shape. Have a 1·9-metre focal length telescope with a 1·5× adjusted Barlow lens to give a 2·7-metre equivalent focal length in order to retain the desired 25 mm diameter solar image on the entrance slit. With the optics and other components in a 2-metre long box and the latter mounted on a *rigid* fork mounting, hardly any space is necessary. Even an altazimuth mounting is workable.

References

1 Veio, F. N., *Sky and Telesc.*, January, 1969.
2 Veio, F. N., *The Heavens**, August, 1970.
3 Veio, F. N., *Orion*, February, 1971.
4 Hale, G. E., *Astrophys. J.*, **70**, 285 (1929).
5 Ingalls, A. G., *Amateur Telescope Making*, **1**, 192, New York, 1957.
6 Sidgwick, J. B., *Amateur Astronomer's Handbook*, 248, London, 1957.
7 Mitchell, G., *Astrophys. J.*, **88**, 542, 1938.

NOTE: Mr Veio's paper gives only a brief outline of his simplified design of spectrohelioscope which, while not capable of such high performance as the much larger and more expensive Hale and similar designs, will encourage many more amateurs to build than would attempt the larger instruments. A 56-page booklet giving all constructional details is published by Mr Veio at his address—PO Box 338, Clearlake Park, California 95424, USA. One copy has been presented to the Association's Library by Mr Veio.

**The Heavens*, reference 2, is a monthly publication of the Oriental Astronomical Association of Japan.