

Modifications to the Sevenoaks Spectroheliograph

H. R. Hatfield

This paper describes how the Sevenoaks Spectroheliograph¹ has been improved by the introduction of a new vibrating slit mechanism to replace the original Sellers vibrating slits.

Introduction

The Sellers vibrating slit mechanism has served well over the past fifteen years or so, and has enabled me to observe and photograph many 'Hydrogen Alpha' events on the Sun. About five years ago one of its fourteen springs broke. Since then it has been difficult to adjust the system so as to get the highest performance, since the replacement spring did not exactly match its predecessor, and I could find no way of making a compensating adjustment. In practice the hydrogen alpha window could not be made more than about 5mm (0.2 ins.) wide without introducing an apparent, and spurious, doppler shift. The two slits were not remaining exactly parallel with each other as they vibrated, and nothing that I could do would make them behave properly.

For some time I had wanted to be able to mount the two slits on a rigid bar, so that they must remain parallel once they had been set up properly. The snag was that this configuration would not work, since the system requires the slits to move in opposition to one another. The breakthrough came when I re-read a booklet published by Mr F. N. Veio,² of California, which described general principles governing the construction of spectroheliographs. He described briefly a system which had been suggested by Mr Maurice Gavin. The idea was that the slits should move together, and that the apparent motion of one of them should be reversed optically by placing a large right angled prism in the light path between it and the collimation lens and grating. The system described below applies these new ideas.

Mechanism

Figure 1 shows the new mechanism. The two slits, A and B, are mounted rigidly on the brass rod C; they can be adjusted so that they are parallel. The rod C slides in the teflon bearings D and E, and is driven backwards and forwards by the connecting rod F. The bell crank G, which must be very rigid, pivots about the bearing H. It drives F and C, and is itself driven from the brass flywheel N through the connecting rod J. A small mains driven shaded pole motor K pivots about the bearing L, and can be raised or lowered by the phosphor bronze spring rod O working in the ratchet P, so that its rubber-tyred driving wheel M rests lightly on N, and drives it by friction. The wheel M can be lifted clear of N when the machine is not working, so that the rubber tyre, which is a small 'O' ring, is not damaged.

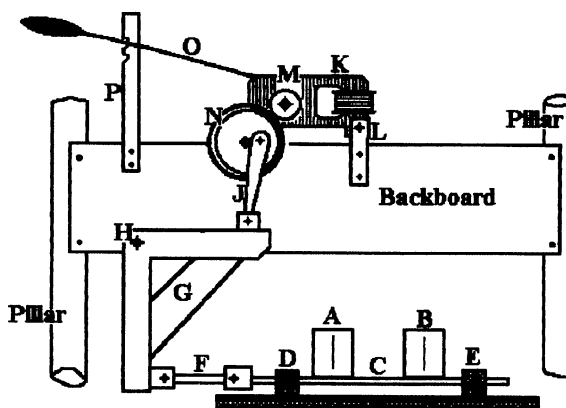


Figure 1. The vibrating slit mechanism.

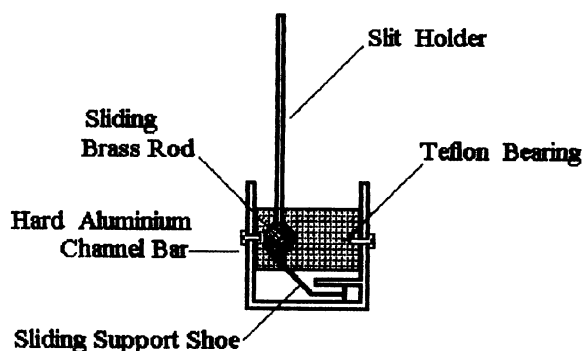


Figure 2. Cross-section through the channel bar.

The ratio of the diameters of N and M is 3.27:1. Since the shaded pole motor K is mains driven, and has virtually no load, it rotates about 48.9 times each second; N rotates 15 times per second, and the slits scan the window 30 times per second. This arrangement gives a good flicker-free picture. It is not difficult to make all the parts required for this mechanism. However all the bearings must fit closely, and the various moving parts must be carefully aligned in one plane, if vibration is not to be a problem. I was surprised to find how much noise was created by a bearing which had only very slight play.

Figure 2 shows a cross section through the channel bar which supports the teflon bearings and the vibrating slits. This bar started life as the support for a venetian blind. It is made of hard anodised aluminium, and has a very conve-

The Sevenoaks Spectroheliograph

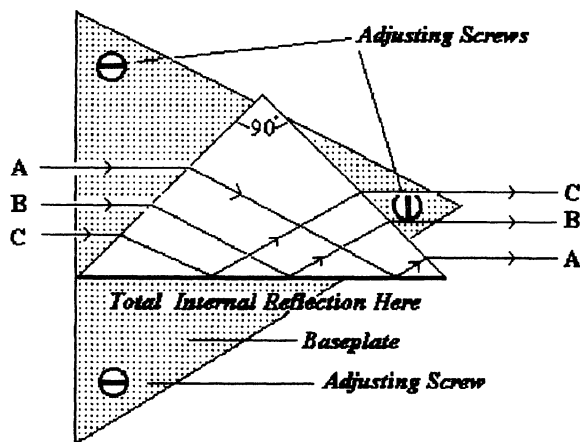


Figure 3. The reversing prism (diagrammatic only).

nient channel in which the sliding support shoe attached to the brass rod C fits. This support shoe makes quite certain that the slits will remain vertical as they move backwards and forwards.

Operation

The operation of the reversing prism is illustrated in Figure 3. The two smaller faces of this prism are 50mm (2.0 ins.) square; it works well when the slits are vibrating with an amplitude of up to 15mm (0.6 ins.). It is placed close to the slit B, on which the white light image of the Sun is focused, and between this slit and the collimating lens and grating (see Figure 4). It is mounted on a three point mount, with adjustable legs made from 2BA brass screws. Two of these

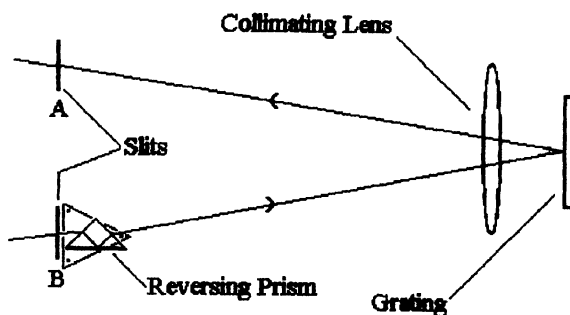


Figure 4. General layout (not to scale).

lie parallel to the slits and the bar C, so that as they are adjusted the prism moves slightly in a plane at right angles to the optical path. As it does this it rotates the image about the optical path in a fashion that can be very delicately controlled whilst the slits are vibrating. Any small mechanical misalignment in the parallelism between the slits can thus be removed optically. The results are superb.

The modified system has been operating for 6 months. It has worked very well indeed. The slits were made truly parallel optically by adjusting the screws on the prism mounting five months ago. No adjustment has been necessary since then. The picture is better than it has ever been.

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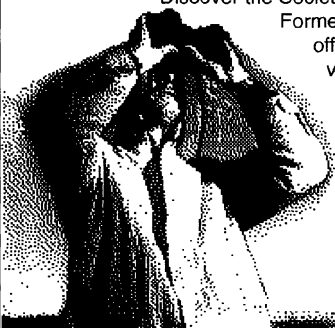
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- 1 Hatfield, H. R., *J. Brit. Astron. Assoc.*, **98**(7), 342 (1988)
- 2 Veio, F. N., *The Spectroheliograph*, private publication, 1991. From PO Box 467, Clearlake Park, CA 95424, USA

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