Some Thoughts on the Correct # of Vanes for Spiders

by Doug Miller

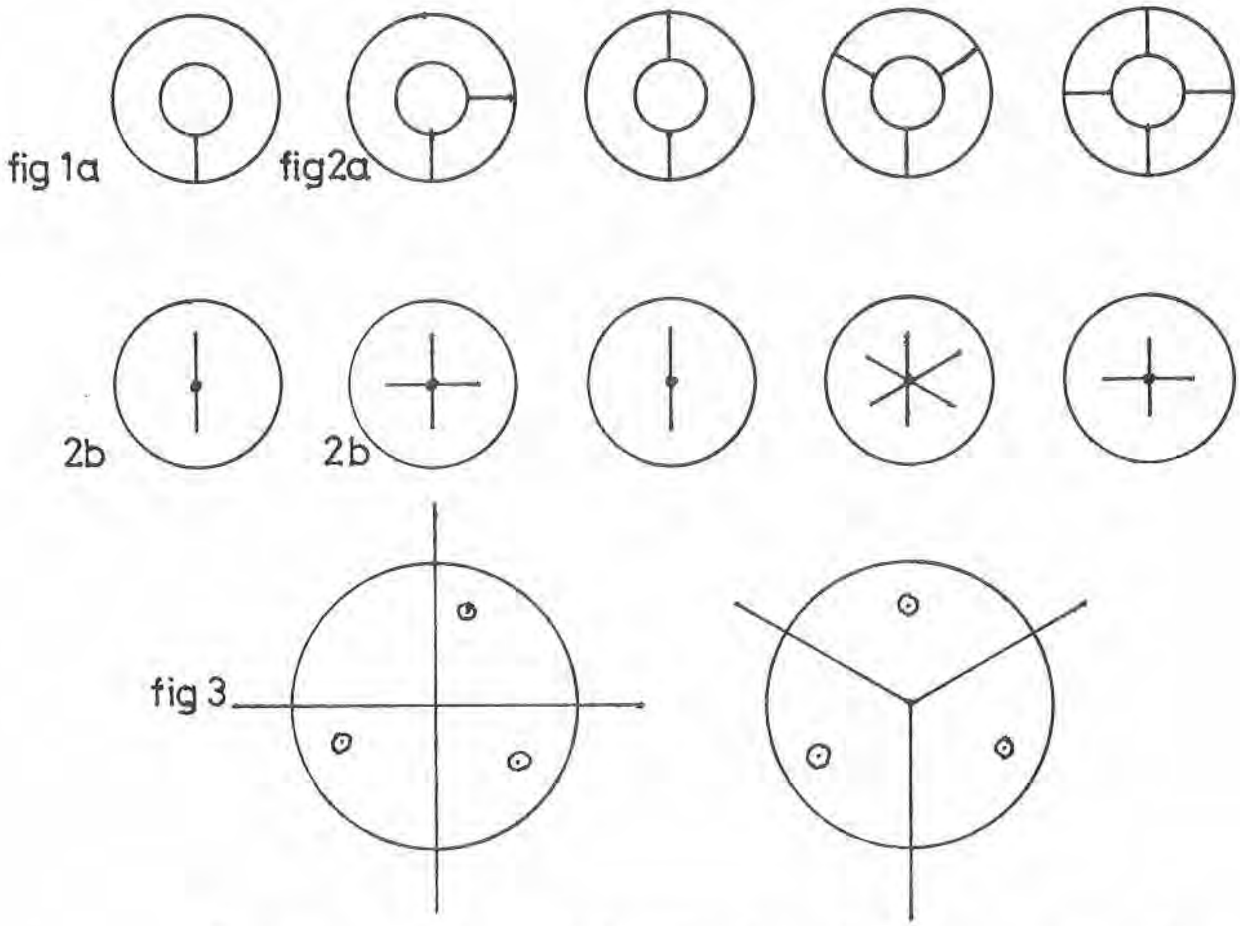
In many amateur telescopes, a spider is required to support a secondary mirror; a flat in a Newtonian or a convex mirror in a Cassegrain. Traditionally, the spider has been held in place by four vanes attached to the telescope tubing. In the following discussion I will give reasons why the appropriate number of vanes should be three.

Each vane introduced into the system causes two diffraction spikes to form which are seen on the image of bright stars. This effect is particularly noticeable during photography. One vane extending halfway across the aperture(figure 1a) will cause two diffraction spikes as shown in figure 1b which extend an equal distance on either side of the star image. Another vane extending halfway across the aperture perpendicular to the first vane will introduce another pair of diffraction spikes which are perpendicular to the other diffraction spikes(figure 2a and 2b). The traditional philosophy is to place four vanes at right angles to each other. This produces only four visible diffraction spikes. What is actually happening is that the diffraction spikes of opposing vanes are superimposed on each other.

With three vanes located at 120 degree intervals, six diffraction spikes result. At first glance this would appear to be worse than the case of four vanes. However, the amount of energy diffracted is proportional (assuming the same vane thickness) to the total vane length. Three vanes thus diffract only 3/4 as much energy as four vanes. As well, this energy is equally split into six spikes versus four spikes. The net result is that each diffraction spike from a three vane system has only half as much energy as the diffraction spikes in a four vane system. On photographs taken with a three vane system, stars should much less conspicuous spikes compared to a four vane system.

This reduction in the number of vanes can be carried only so far as it compromises the spider's rigidity if the number of vanes is reduced to less than three. Small telescopes (4¼" or less) are available which use a single thick vane (1|8" or more) to support the secondary but this is impractical for larger systems.

SPIDER SUPPORT SYSTEMS



There are two other side benefits from three vane systems. The reduction in the number of vanes gives a slight decrease in the primary mirror obscuration. As an example, a 10" Newtonian with a 2.6" diagonal and 1|16" thick vanes will have obscurations of 8.28% and 8.62% for three and four vane spiders respectively. This is not a large improvement but it is an improvement nevertheless.

The other advantage is a practical one. Three vane spiders should be easier to orient in the telescope as there is one less nut to loosen or tighten compared to a four vane spider. As well, adjustment screws for the secondary tilt can be arranged for easier access for three vane spiders. This is shown in figure 3. The four vane spider gets in the way of the three adjustment screws.

In conclusion, the advantage of four vane spiders in giving only four diffraction spikes versus six diffraction spikes for three vane spiders is no advantage at all. There is less total diffracted energy in the spikes of the three vane spider. The diffraction spikes of the three vane spider willbe only half as bright as the spikes in a four vane system. As well, a three vane spider is (mechanically) simpler to adjust.