The pinhole Lens attachment

Number One problem with model photography is the depth of field which is emphasized by the very conditions under which these subjects are shot. As we saw earlier, depth of field increases when aperture is reduced (f-stop is increased). For a given lens, the minimum aperture is limited by mechanical and optical constraints and hardly goes beyond f:22, in most cases.

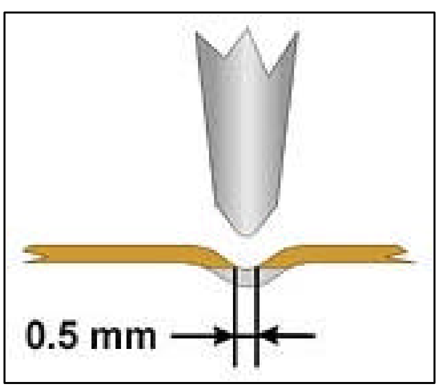
The answer to this problem is to tinker a little, in order to gain smaller apertures (which, by the way, will lead to even greater exposure times), as this kind of equipment is not commercially available.

In practice, it is considered that an f:100 aperture yields a quasi infinite depth of field (from a couple of inches to infinity). This aperture corresponds to a 0.5 mm diameter diaphragm "hole", for a 50mm focal length lens, which is practically the smallest hole that can be done without too much difficulty (since, as explained below, the making of this hole is not so simple). This amounts to build the camera of our grand-parents, the pinhole camera, which was based on the same principle but didn't include any lens.

With smaller diaphragms, appears the phenomenon of light diffraction due to the hole "edge effect". The thicker the hole edge, the more important the phenomenon. Also, the smaller the hole, the greater the effect. The effect of this phenomenon is to make the whole photo fuzzy, which is not much help as it is exactly the opposite of what we are looking for. So, what's it all about ?

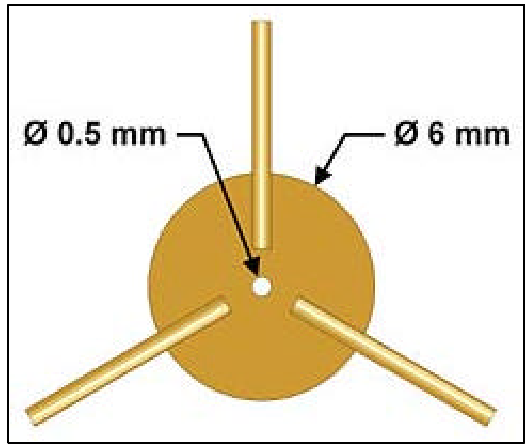
The first step is to get a lens that mounts on the camera that one owns, preferably an used and inexpensive lens, as we are going to ill-treat it. Prefer a fixed focal length lens (with a 50mm focal length - it's best) as they are much easier to disassemble than a zoom. Make sure that the rear lens group (the group of lenses at the rear, between the diaphragm and the mounting ring) is easily removable as a whole and does not require to remove the lenses one by one.

Now, we've got to make the "hole" which is no more, no less than a drilled disk that will be installed immediately behind the diaphragm, but which requires some care to make it.



Use brass sheet, as thin as possible (0.010 inch or less). Draw the hole position and disk outline on the brass sheet (the finished disk should be about 6mm in diameter). The hole cannot be made using usual techniques (a drill), as it would yield a "thick edge" hole, so we have to proceed differently.
Using a center punch, make a dimple at the hole location, as shown in the drawing at left. Then, file the resulting hump, using the finest possible file, until you file through the brass sheet.
Continue sanding down the brass sheet, using very fine abrasive paper (600 grit, at least), until you get a 0.5 mm diameter hole (check the diameter of the hole at regular intervals with drill bits of appropriate diameters). That way, you'll get a hole with a very thin edge and minimize the "edge effect".
If some burrs remains, after you finished sanding the brass sheet (check with a magnifier), you may remove them by gently twisting a 0.5mm drill bit in the hole.

Then, cut out the disc and solder 3 or 4 "legs" made of brass wire (see figure at right) which will be used to attach the disc to the lens.
It's now necessary to blacken the resulting assembly in order to avoid parasitic light reflections inside the lens that could have ill effects on pictures. To do that, you may use a thin coat of flat black paint (don't overdo it !) or, better, a chemical blackener which won't add thickness to the brass sheet, especially around the opening.



Mounting the "spider" on the lens is done by gluing the "legs" on the rear lens block, using epoxy adhesive. It is mandatory that the "hole" be perfectly centered and that the disc, once mounted, be immediately behind the diaphragm, without touching it. This may require several trials that will be done while the adhesive sets (use slow setting epoxy so that you have time to adjust everything) and will require to assemble and disassemble the rear lens block several times until you get the perfect alignment. Centering the "hole" can be done easily by manually closing the lens diaphragm (f:22) and making sure that the "hole" is well centered. The centering offset should be less than the hole diameter (0.5 mm)

Somewhat complicated, but very efficient !

The photo at left shows how, in my case, I installed the pinhole disc on the rear group of lens. The photo below shows the assembled rear group of lens (with the pinhole attachment), along with the rest of the lens, just before final assembly.

As you may have noted, the pinhole disc does not completely cover the lens diaphragm, when it is fully opened (sight position), which allows you to easily frame the scenes with an (almost) maximum aperture. Of course, for shooting, your aperture should be set at the minimum (f:22) so that there is an overlap between the diaphragm and the pinhole disc.

Because of the presence of the pinhole disc in the lens, your camera will not be able to determine any more the right exposure time for a photo. It' up to you to determine it experimentally by making some tests at various shutter speeds. However, it's good to know that the exposure time at f:100 will be roughly 20 times what your camera will indicate at f:22 (as there is a 20:1 ratio for the intensity of light between f:22 and f:100). But this is a very rough estimate since the presence of the pinhole disc will cause wrong light readings. Besides, the "reciprocity" law may apply due to the long exposure times. But it's a good starting point for your tests.

At last, it's good to know that if you "miss" the hole and that its diameter is 0.6 mm, instead of 0,5 mm, as planned, the aperture will be f:90 and things will be slightly different...

Good experiments with pinhole photography!