The Hargreaves Strut

Give your telescope a new and improved level of stability without the expense of a new mount.

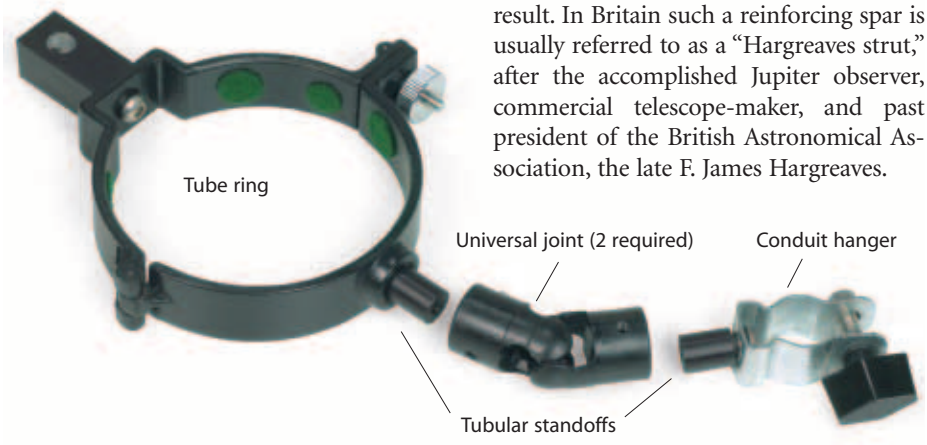
By Thomas A. Dobbins

Above: **The author's Celestron CP-102 refractor is attached to a CG-5 mount. The Hargreaves strut, which joins the objective end of the telescope with the mount's counterweight shaft, greatly improves the stability of the setup. The strut assembly is made from off-the-shelf components. All photos by the author unless otherwise specified.**

Right: **Since hinged tube mounting rings are sold by the pair, you may want to use the second ring (arrowed) to fabricate a sliding tube counterweight to counterbalance accessories like cameras and heavy eyepieces. The example shown here was made from ¾-inch aluminum square bar, a length of ⅜-inch-diameter stainless-steel rod, and a short length of 2-inch-diameter stainless-steel round bar.**

THE LIGHT- AND MEDIUM-DUTY German equatorial mountings manufactured in Japan by Vixen and their Chinese clones dominate today's marketplace. Sadly, they're often severely overtaxed by the instruments that many amateurs call upon them to carry. The long overhang of the tubes of many refractors and Newtonians makes such a combination very susceptible to flexure and vibration.

To cure the annoying shakes of an undersize German equatorial mounting (or to further improve the stability of a well-proportioned one), generations of amateurs have installed a brace between the upper end of the telescope tube and the declination axle or counterweight shaft of its mounting. The brace forms the hypotenuse of a triangle. Since a triangle is an inherently rigid structure, improved stiffness and vibration damping invariably result. In Britain such a reinforcing spar is usually referred to as a "Hargreaves strut," after the accomplished Jupiter observer, commercial telescope-maker, and past president of the British Astronomical Association, the late F. James Hargreaves.



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Rounding Up the Pieces

A Hargreaves strut suitable for most amateur telescopes can be assembled in less than an hour using inexpensive, off-the-shelf components available from several sources, including the McMaster-Carr Supply Company. You can peruse this firm's huge catalog online at www.mcmaster.com. It's a treasure-trove of hard-to-find parts, tools, machining stock, and fasteners for the amateur telescope maker.

The strut itself is nothing more than a length of ½-inch diameter aluminum tubing with a 1/16-inch wall thickness (McMaster-Carr catalog number 89965K54, $11.96 for a 6-foot length). Resist the temptation to use a solid rod here — it

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has less stiffness per unit weight than a hollow tube. The ends of the tube slide into a mating pair of injection-molded plastic universal joints (McMaster-Carr catalog number 60625K96, $12.05 each) and are held in place with setscrews.

One universal joint is attached to a stamped metal conduit hanger via a ⅝-inch-long, ½-inch-outside-diameter aluminum tubular standoff (McMaster-Carr catalog number 92510A343, $1.14 each, specify #10 screw size bore when ordering). Tap the standoff's bore with a ¼-20 tap and secure it to the conduit hanger with a ¼-20 machine screw. Clamp the conduit hanger firmly around the mounting's declination axle simply by tightening a bolt. With a portable instrument, you'll probably want to replace the conduit hanger's slotted-head bolt and mating hex nut with a thumbscrew and knurled knob for easier assembly and disassembly. A ½-inch conduit hanger (in galvanized steel, McMaster-Carr catalog number 3006T11, $2.92 for a package of 10; in stainless steel, catalog number 3006T41, $11.27 for a package of 10) will fit the counterweight shaft of Vixen's Great Polaris (GP) and Great Polaris Deluxe (GP-DX) mountings as well as their Chinese equivalents, Celestron's CG-4 and CG-5. To avoid marring the shaft's rather soft electroplated finish, it's advisable to line the interior of the conduit hanger with a thin layer of felt. Alternatively, you might consider modifying a standard shaft collar or even turning one from scratch on a lathe.

Now to connect the other end of the strut to the telescope. Naturally, most amateurs would balk at the prospect of drilling a hole in the tube of their telescope in order to attach the second universal joint. Fortunately, spare felt-lined clamping rings to fit the tubes of all the popular Japanese and Chinese telescopes are available from Hands On Optics (Damascus, Maryland) and Sky Instruments (Vancouver, British Columbia, Canada). These rings have a handy flat mounting boss complete with an integral ¼-20 threaded stud that was originally intended to attach 35-millimeter cameras for piggyback photography. This feature makes attaching a universal joint a breeze. Simply screw a second tapped standoff over the threaded stud, then slide the universal joint over the standoff.

Once you have oriented the second universal joint so that it pivots along the axis defined by the telescope's tube, secure it to the ring's mounting boss by tightening a setscrew bearing against the ½-inch bolt. Now the ring is aligned radially so that the universal joint is perpendicular to the bottom surface of the telescope's tube, then tightened behind the objective-lens cell. Finally, lightly tension the strut by sliding the conduit hanger or shaft collar toward the bottom of the counterweight shaft and clamping it in place. Alternatively, you can apply compression by sliding the conduit hanger toward the telescope tube.

Even instruments with relatively short tubes can benefit from having a Hargreaves strut. Here the author's well-equipped Celestron C14 Schmidt-Cassegrain rides with remarkable sturdiness atop his Losmandy G-11 mount.

Exceptions and Alternatives

If your mounting's counterweight shaft doesn't rotate when its declination axle is turned, adding a Hargreaves strut becomes a bit more complicated. Rather than simply clamping the bottom end of the strut to the counterweight shaft, you'll have to use a collar lined with a nylon or bronze sleeve bearing so that it can rotate freely as the telescope is moved in declination. This collar should be sandwiched between a pair of thrust washers and shaft collars that can be locked in position once the proper tension has been achieved.

Retrofitting a Hargreaves strut to a Newtonian reflector with a rotating tube presents a few complications. The ring that supports the universal joint will have to be loosened and retensioned (along with the usual pair of mounting rings) whenever you rotate the tube. Otherwise, the installation and operation of a Hargreaves strut will be no different than for a telescope with a nonrotating tube.

As a rule of thumb, the longer the tube of your telescope, the more pronounced the improvement a Hargreaves strut will provide. Nevertheless, the stability of the author's Losmandy G-11 mount, which carries the heavy payload of a 14-inch Schmidt-Cassegrain festooned with a video camera, sliding counterweight sets, an auxiliary 80-mm f/5 finder, and a 90-mm f/11 guidescope, improved dramatically after one of these simple widgets was retrofitted. In my case a $50 investment paid very rich dividends — it stopped me from spending a small fortune on a larger mounting!

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