MODEL ENGINEER

Many amateur astronomers and some model engineers will be familiar with the friction-drive Crayford focuser used on may telescopes, which is typically far superior to rack and pinion arrangements. They may not be aware that its inventor, John Wall, named it after the Crayford House Astronomical Society, of which he was a member.

They may be surprised to learn that subsequent to publishing a description in the British Astronomical Society's journal, he wrote a constructional article , with plans, for Model Engineer, having decided not to patent it.

The basic designed has since been refined but what is fundamentally John Wall's design is now found on telescopes made by many different manufacturers.

John Wall's original article from Model Engineer No. 3441, Volume 138, 19-31 May 1972 is reproduced here

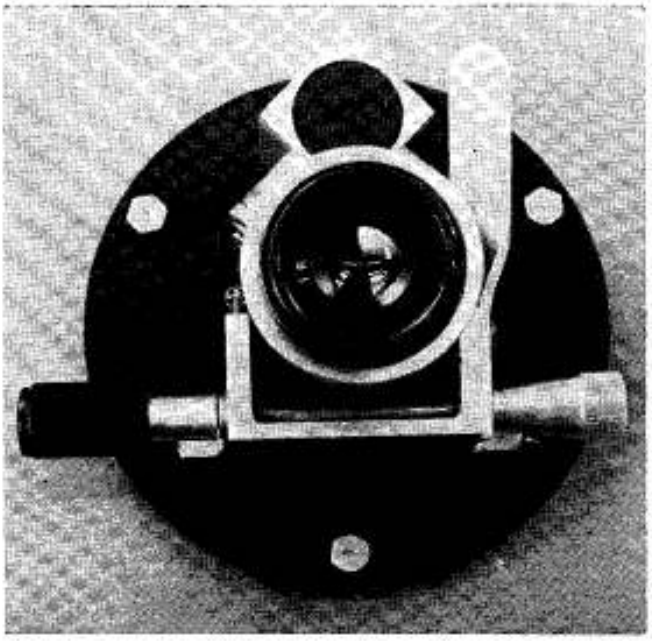
An Ingenious Telescope Eyepiece Mounting

designed by J. Wall

MANY TELESCOPE EYEPIECES suffer from unwanted deficiencies which hamper the serious observer. Often as not the pleasure is taken out of observing whilst one is struggling with a sticky and recalcitrant eyepiece tube. The problem of loose fitting tubes and screw focusing mounts is equally irksome. These ills are far too often found in inferior professional mounts, let alone the amateurish efforts of the novice constructor, and how many worthy observers are treated to the delights of trying to get better focus out of a mount that needs Herculean strength to operate it, or to see the evanescent surface of Mars hopping all around the sky every time he even touches the focusing screw. This may seem a colourful picture for those who own one of the many very excellent mountings now on the market, but it is a fact that there are so many bad ones fitted to too many good telescopes that do not deserve them.

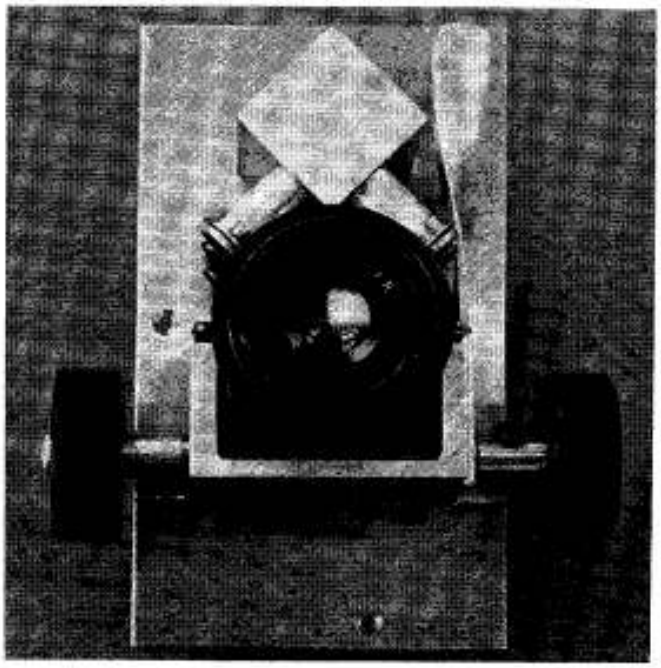
The problem of designing a good positive action eyepiece mount cropped up during construction of a 34 cm comet seeker; as the mirror is f/4, the focusing is critical for this type of instrument. However, the problem was solved very elegantly, resulting in the creation of an eyepiece mount of surprising smoothness of action, positive eyepiece tube location, and the novel feature of having a quick tube release for rapid eyepiece changing.

The whole idea of the mounting is based on the simple mechanical concept, that if a tube is supported near each end by two Vee notches, it will be restrained to movement back and forth parallel with its axis only. The tube will also be free to rotate, but we are not interested in the rotational motion, only in the four-point stability of the Vee notches. The system is roughly analogous to the stability afforded by a three-point support or tripod. If four wheels are substituted for the fixed Vee notches while retaining the points of contact on the tube, and if these wheels are so orientated that they rotate in the direction of movement of the tube, then the tube will move freely in an axial direction without any side play.



In the mountings that have been built, the tube which holds the eyepiece is a separate detachable unit, which rolls on four small ball races set in two Vee configurations. These races are attached to a support pillar, which stands out from a facia plate fixed to the telescope. The tube is moved back and forth on its ball race supports by a simple cross shaft fitted with focusing wheels, which bears down under spring pressure on the side of the eyepiece tube, opposite the supports. In this way, the tube is retained in the mounting. The rotation of the focusing shaft is necessarily smooth due to the absence of a rack and pinion, and the movement of the tube is quite frictionless. The action is sensitive, light and delicate, with a complete absence of jamming, stickiness and side wobble.

Due to the fact that the eyepiece tube is not built integrally into the mounting as in conventional designs, but is merely gripped between five points of contact, the tube may very easily be removed. This is done by mounting the shaft-bearing bracket on a hinge attached to the facia plate, so that the whole assembly can be pushed up and away from the eyepiece tube, thus detaching the fifth point of support—the focusing shaft—and subsequently releasing the tube for removal; it is then but a few seconds work to change tubes. It is possible to have several tubes per mount, each holding an eyepiece of a different power. One of the tubes may even hold a Barlow Lens as is actually the case in one of the mountings that have been constructed. As can be seen, the design has a quick release and change feature which is very convenient, when effortless eyepiece changing is a big consideration in observing. Finally, the mounting is simple in concept, and easily constructed.

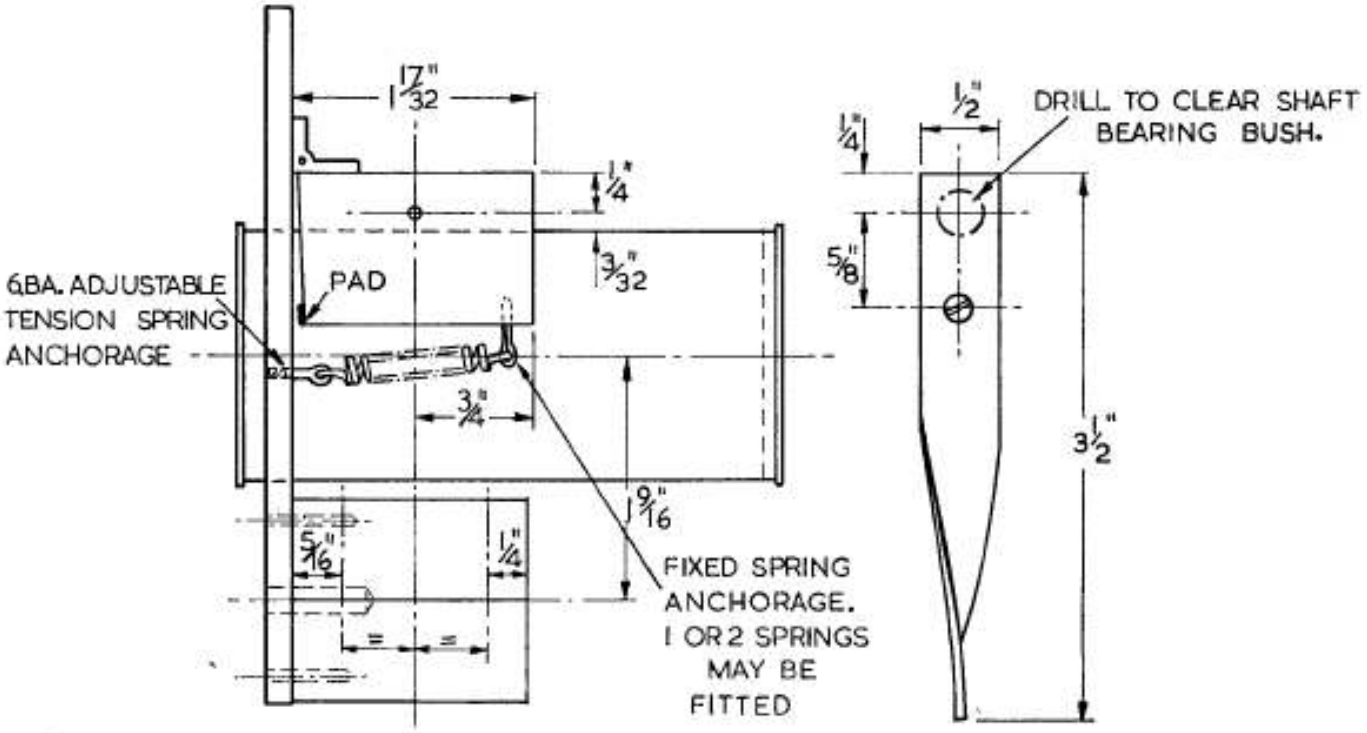


The frictionless movement means that there is no need for a rack and pinion, the simple bearing of the smooth focusing shaft on the tube is quite sufficient to move it. In fact, the whole system is so frictionless that a felt pad must be fitted against the focusing shaft, in order that the tube will not wind itself out under the weight of the eyepiece when the telescope is so orientated that the mounting is pointed toward the ground.

The mounting is made generally from aluminium alloy, the facia plate is a thick piece of resin bonded paper or fabric insulation panel measuring about 150 mm. × 127 mm. The whole mounting protrudes from the facia plate by not more than 100 mm. so that the assembly is quite compact; this can be made more so by cutting down the size of the facia plate which is of liberal dimensions anyway. The focusing shaft and eyepiece tube are made from stainless steel, or they may be made from hard brass, especially if chromium plated; ordinary steel tubing will give trouble through rusting which will impair the smoothness of the motion. The stainless steel tube and shaft were purchased quite cheaply in a ground and polished state ready for cutting to length. Ordinary small ball races are used for the tube supports, but these were shielded by metal covers to protect the races from night dew and observer's breath, dust, etc., and to retain grease.

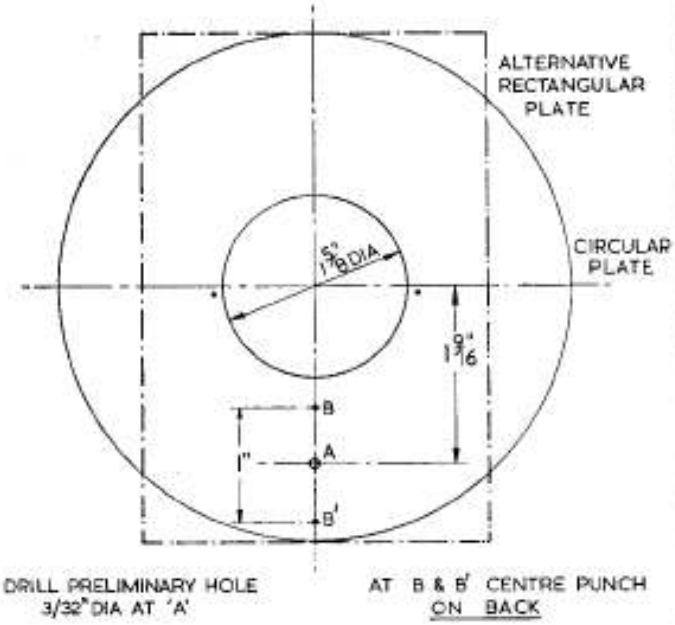
The mounting has a pleasing appearance if made carefully, and has the complicated look of expensive equipment. It is, however, neither expensive nor complicated, but just a useful ancillary that will not degrade a good telescope, or exasperate its user.

The general arrangement drawing gives a complete overall picture of the mounting and the disposition of the various parts, although a lot may be left to the ingenuity of the constructor who makes his own version. The facia plate may be made from metal, plastic, insulation material or wood; it is a base plate for construction, and the means whereby it may be fixed to the telescope. The eyepiece tubes may be made from brass, hard plastic, or preferably stainless steel. This may be obtained from a mail order firm, already ground



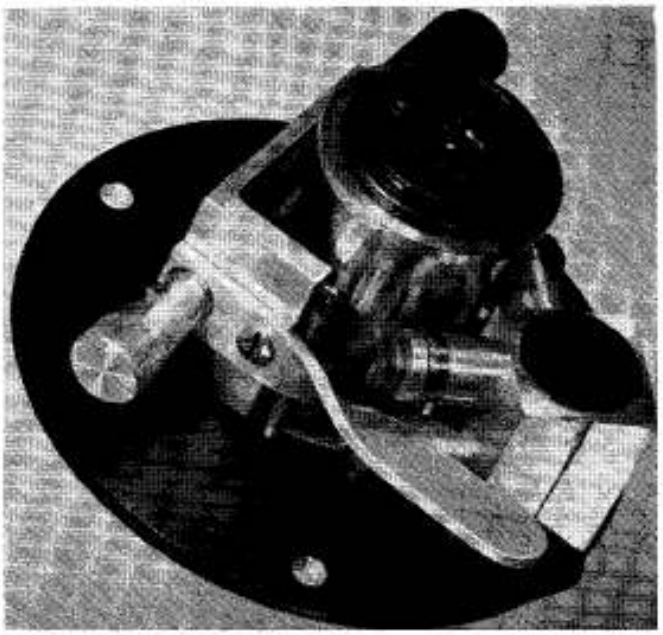
cylindrical and true on the outside diameter (330 mm. long—38 mm. outside diameter), and is enough to make four eyepiece tubes. The aluminium alloy bar stock and angle, plus the piece of stainless steel rod for the focusing shaft, may be obtained from the same firm, as also may the four ball races and various screws, knobs, etc.

A word about the four ball race tube supports, these may be any reasonable size as long as they are all of the same outside diameter; a recommended size is 13 mm. outside diameter × 6 mm. bore × 4 mm. thick. The mounting of the ball race supports is quite a simple matter, four short pillars are required, all of exactly the same length, each having a central hole drilled to accept a No. OBA screw; the screws will pass nicely through the 6 mm. bore of the races too, and so the four pillar and ball race assemblies may then be screwed directly on to the central support. The central support may be made from aluminium alloy angle, and screwed on to the facia plate. The dew covers are optional, but these are preferred to protect the ball races from night dew and breath condensation, and to keep out the dust.

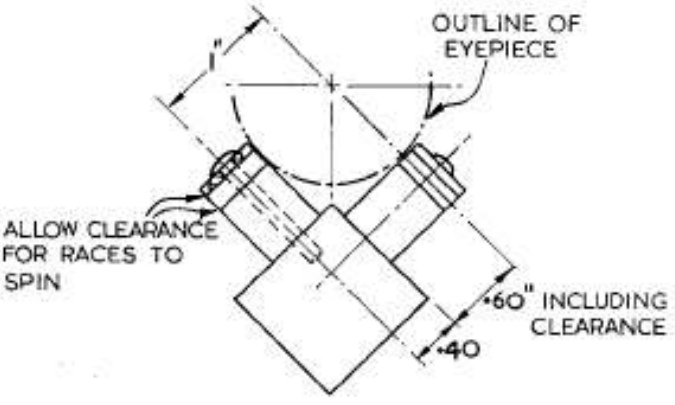


They may be made from tinplate, and bent up into box forms to cover the races, leaving clearance for the eyepiece tube; furthermore, holes must be drilled in the covers for the assembly screws, and it is a good idea to put a small washer inside the covers next to the bearing, and of a diameter slightly smaller than the outer race so that the outer races do not rub on the covers. Finally, the races should be packed with grease before assembly.

The four eyepiece tubes must be turned or filed square on the ends, and the aluminium alloy eyepiece adaptors turned to fit very tightly inside the tubes. A flat will have to be filed on the spigot part of the adaptor to create a clearance for the welding seam that runs along inside the tubing. The usual astronomical thread may be cut in the adaptors to take the standard eyepieces. The other ends of the tubes should have a light flange ring fitted, with the flange diameter 1 mm. greater than the outside diameter; this is to prevent the tube from being wound right out, the flange interfering with the back ball races. Conversely, the eyepiece adaptors should also stand proud in order that the tube is not wound into the inside of the telescope, where it may plummet unrestrainedly down upon the mirror. The interference device should only be sufficient to prevent complete wind out, and should not interfere with the free removal of the eyepiece tube when changing powers.

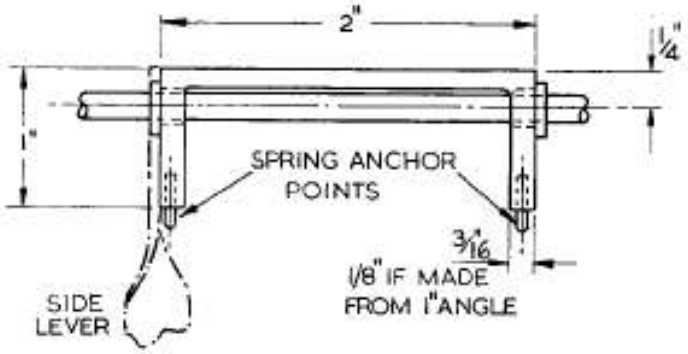


The focusing shaft is mounted on a hinged bracket which is made from pieces of aluminium alloy angle, and the bearings may be ball races, but if the mount is in brass, reamed holes to accept the diameter of the shaft with no slack will be sufficient. The shaft should not be greater than 6 mm. diameter as larger diameters will mean a loss of fine focusing action. Plastic knobs on each end of the protruding shaft ends will retain the shaft in



situ. It may be necessary to fit a felt wedge against the shaft to brake its action, in order that heavy eyepieces do not move the tube when the mounting is not horizontal.

The hinged bracket carrying the focusing shaft may be fixed to the facia plate with a good quality steel butt hinge, this should have very little play or looseness, and conversely must not be too stiff. The thumb lever for tilting up the hinge bracket also doubles as the spring retainer. A suitable disc, slightly smaller than the internal diameter of the spring is fixed to the back of the thumb lever, also a similar disc should be mounted directly opposite on the facia plate, and should be so arranged that the spring is straight when it is assembled and under compression with a tube in place. The hinge bracket should have a stop to prevent it from over-riding when a tube is taken out and the bracket is released, about 6 mm. of extra motion is all that is required. Spring pressure is a matter of taste and of individual feel in focusing action, but should be strong enough to retain the tube firmly. A recommended rating is about 0.5 kilogram per centimetre. The focusing shaft should be placed approximately half way between the front and rear support races, in order that equal pressure bears on all four supports for stability.



The eyepiece mounting was invented by the author who is a member of the Crayford Manor House Astronomical Society, and was on show at the 1968 and 1969 B.A.A. Exhibition Meetings; it is now known as the Crayford Eyepiece Mounting.

We are indebted to Mr. F. R. Hole for the accompanying drawings and photographs, and to the British Astronomical Association for permission to publish this article.—Ed.