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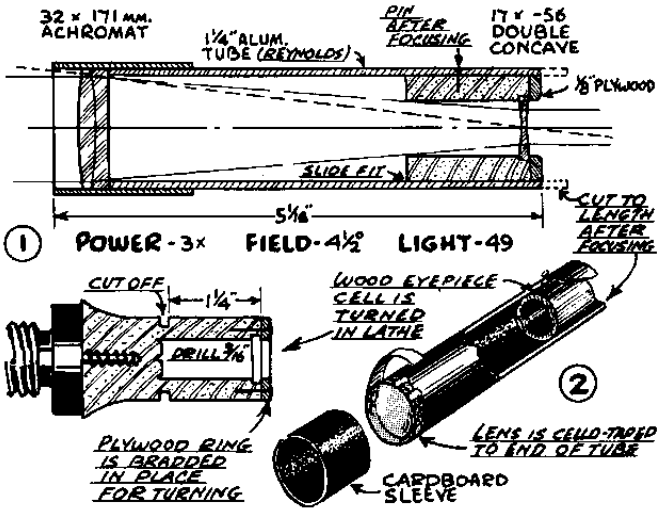
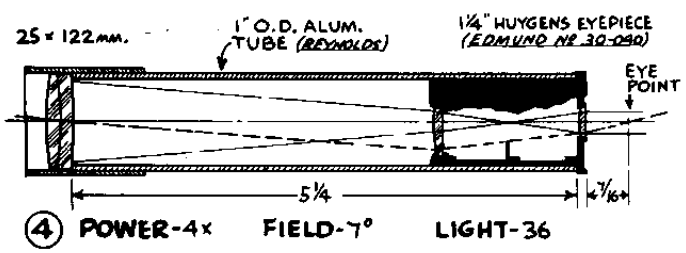
TELESCOPE FINDERS

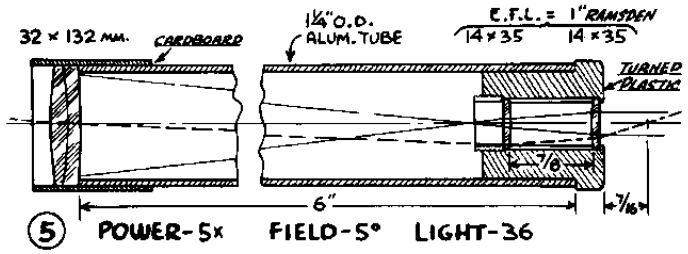
A FINDER for an astronomical telescope is usually a small telescope, which can be either astro or Galilean type. Reflex and collimator sights can also be used as well as all types of open metal sights. The whole idea is simply some means of sighting the telescope, which of itself is difficult to get "on target" when used at powers over 40X with consequent small fields -of-view of less than 1 degree. High power is not required in a finder telescope-the normal range is from 2X to 8X. If an illuminated or otherwise visible crosshair is used, the field of view should be as wide as possible; if no crosshair is used the field should be large enough to make easy finding possible and yet small enough to center the target with fair accuracy. This indicates a field of not less than 3 degrees nor more than 8 degrees.

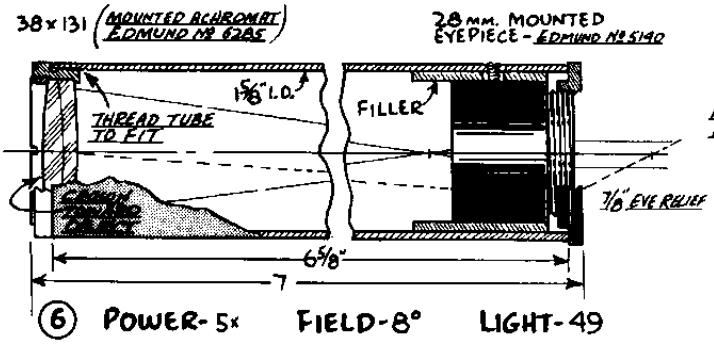
The Galilean Telescope. Although it is given scant attention by professionals, the Galilean telescope makes an excellent finder. It shows an erect image, which aids the beginner considerably in locating sky objects. The fact that the final view is inverted as seen at high magnification with the astronomical tel-

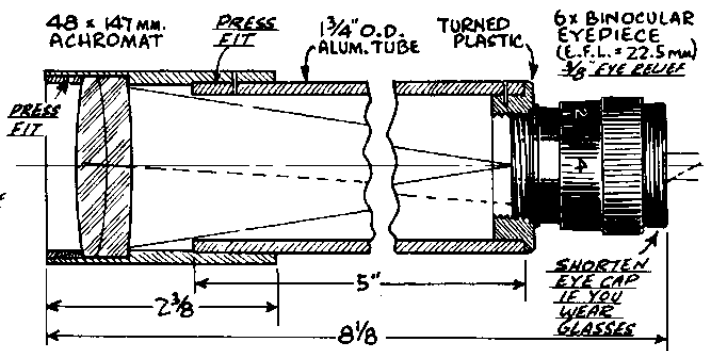


FINDERSCOPES- ERECT GALILEAN TYPE

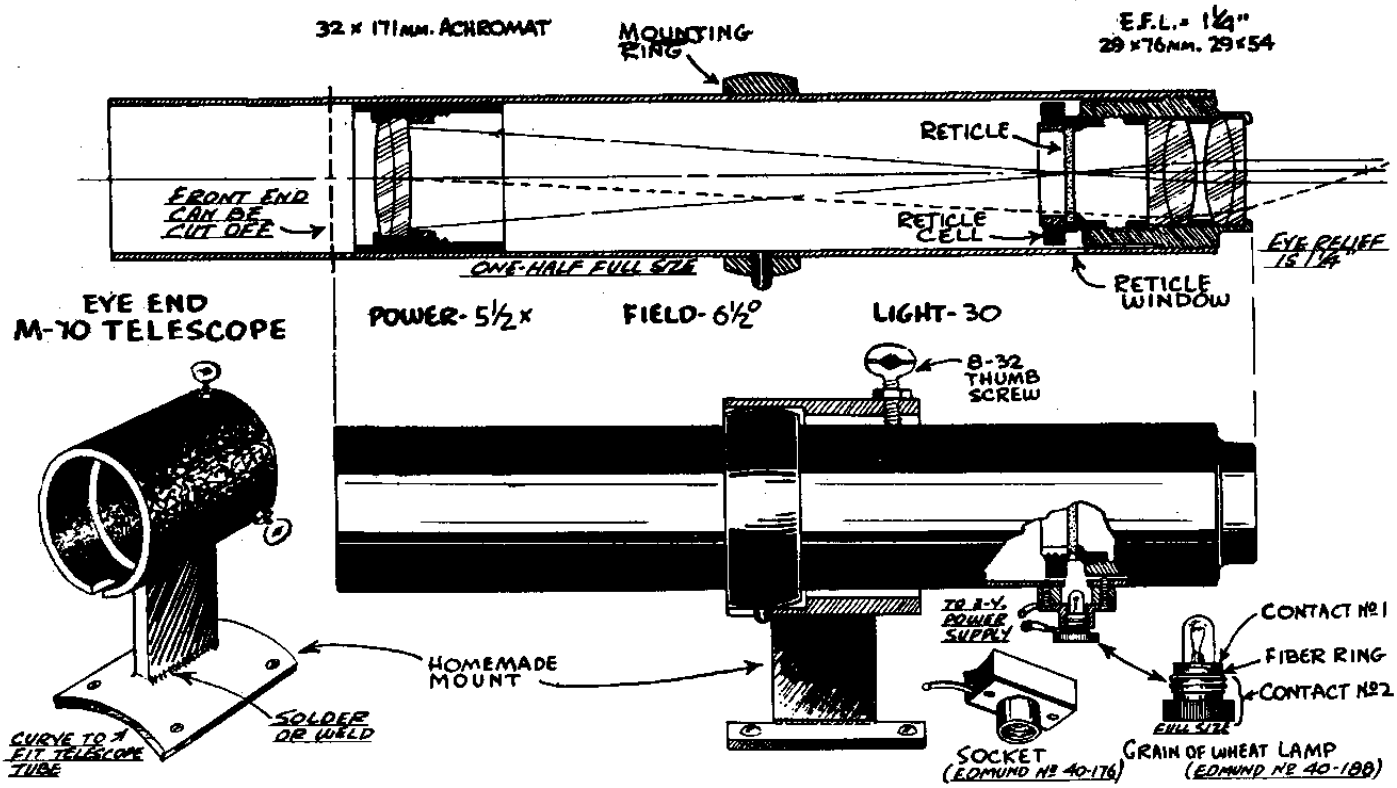








FINDERSCOPES- INVERTED ASTRONOMICAL TYPE



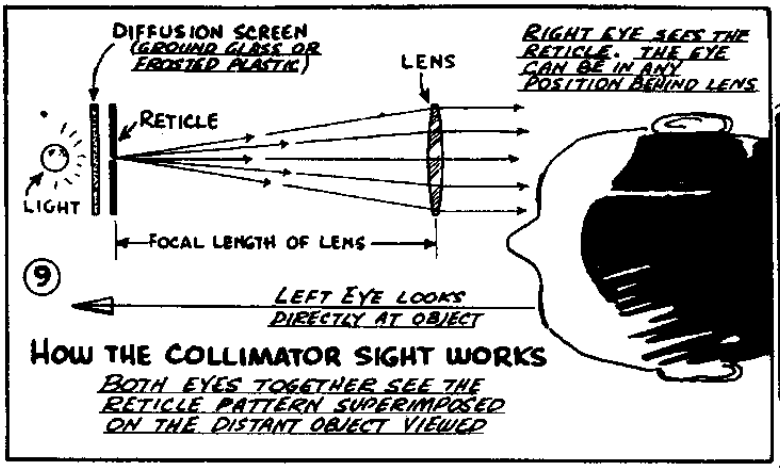
⑧ M-70 CONVERSION TO 5½x FINDERSCOPE WITH ILLUMINATED RETICLE

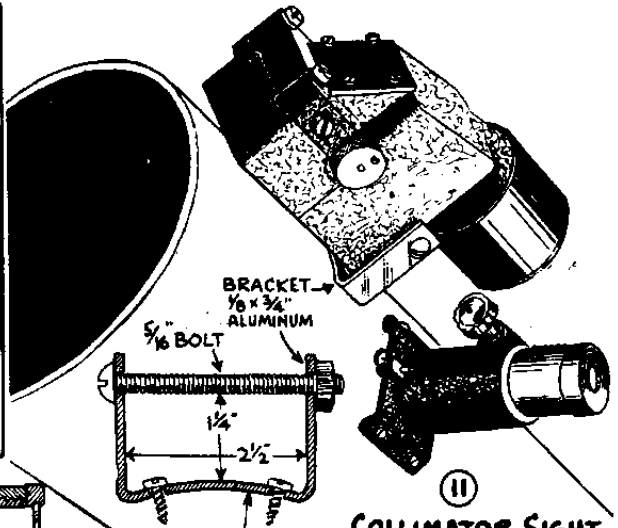
escope does not conflict in the least with finding the object with an erect view of the target area. Two typical Galilean telescopes suitable for finders are shown in Figures 1 and 3; you can easily make up other designs from available inexpensive surplus lenses. The Galilean telescope has no exit pupil, which means that the eye itself receives all the light it is capable of receiving. Hence, the Galilean gets a 100% rating as a night glass, equal to a telescope with 7mm exit pupil. The light rating used for the various designs is the square of the exit pupil in millimeters, that is, a rating of 49 indicates an exit pupil of 7mm, which in turn represents the maximum diameter of the eye pupil in darkness. The power of 3X common to both of the designs shown is adequate for all finding purposes, while the field of 8 degrees obtained with Figure 3 design is wide for a Galilean and the maximum that can be used with any type of finder telescope not fitted with a crosshair. One lone fault of the Galilean telescope is that a crosshair cannot be used because there is no real image plane in this system. However, simple centering of the target object in the center of the field is sufficiently accurate for most purposes.

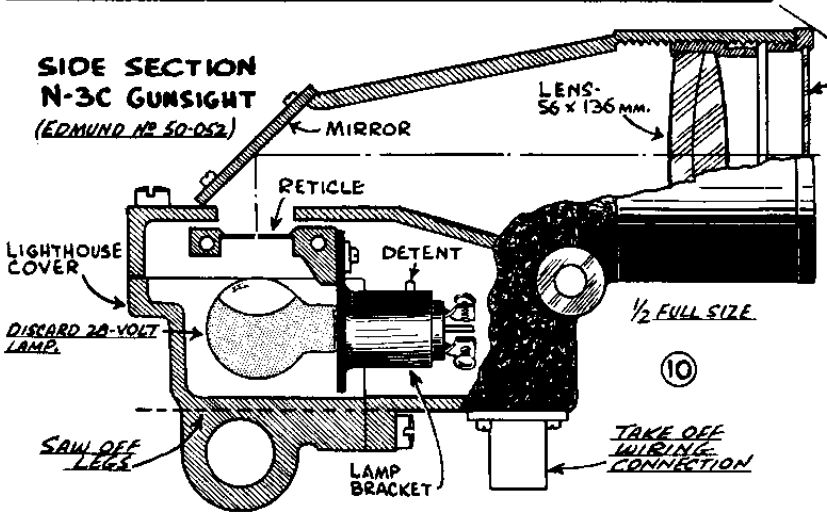
Astro Telescopes. The low-power astronomical telescope is the instrument most often used as a finder. Using surplus lenses, you can make up hundreds of excellent designs, of which the four in Figures 4 to 7 are typical. Simple lenses may be used as objectives if desired and give excellent results at powers of 2X to 6X. Working at low power and at a constant focus, it is not necessary to use a focusing eyepiece although Figure 7 design has this feature. In all telescopes the crown element of the objective should face the object viewed; some war surplus lenses in metal mounts, such as the objective in Figure 6 design, may require reversal in the mount to satisfy this requirement.

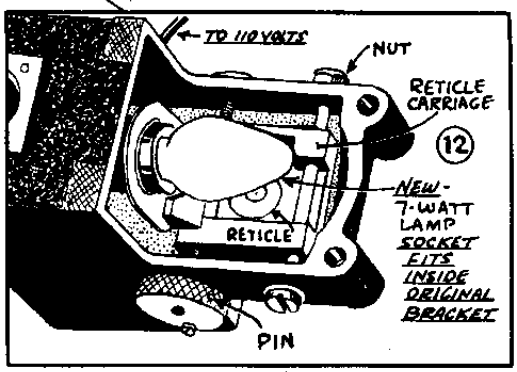
The M-70 Telescope. The rear half of the military M-70 telescope makes an excellent finder, as shown in Figure 8. A neat homemade mount is shown in the drawing. The M-70 has a glass reticle and reticle window already in place. You can illuminate the reticle by merely arranging a flashlight to shine on the reticle window. A neater method is to use a grain of wheat lamp mounted in a small socket, Edmund No. 40,176, as shown in Figure 8 detail. One wire is already fitted to the socket; the second wire is wrapped around the threaded portion of the lamp. The power supply consists of two 1-1/2-volt flashlight cells in a suitable metal case with switch. An ordinary two-cell flashlight can be adapted for this purpose.

Mounting the Finder Telescope. The finder telescope should be mounted near the telescope eyepiece in order to permit easy eye shifting from one to the other. On a reflector the finder should be at least two inches above the surface of the reflector tube for a comfortable head position. The finder must be mounted in such a way as to permit alignment with the main telescope. The common mounting consists of two mounting rings, each fitted with three adjusting screws which can be used to move the finder tube as needed. A single mounting ring, as used in Figure 8 mounting, is also popular.





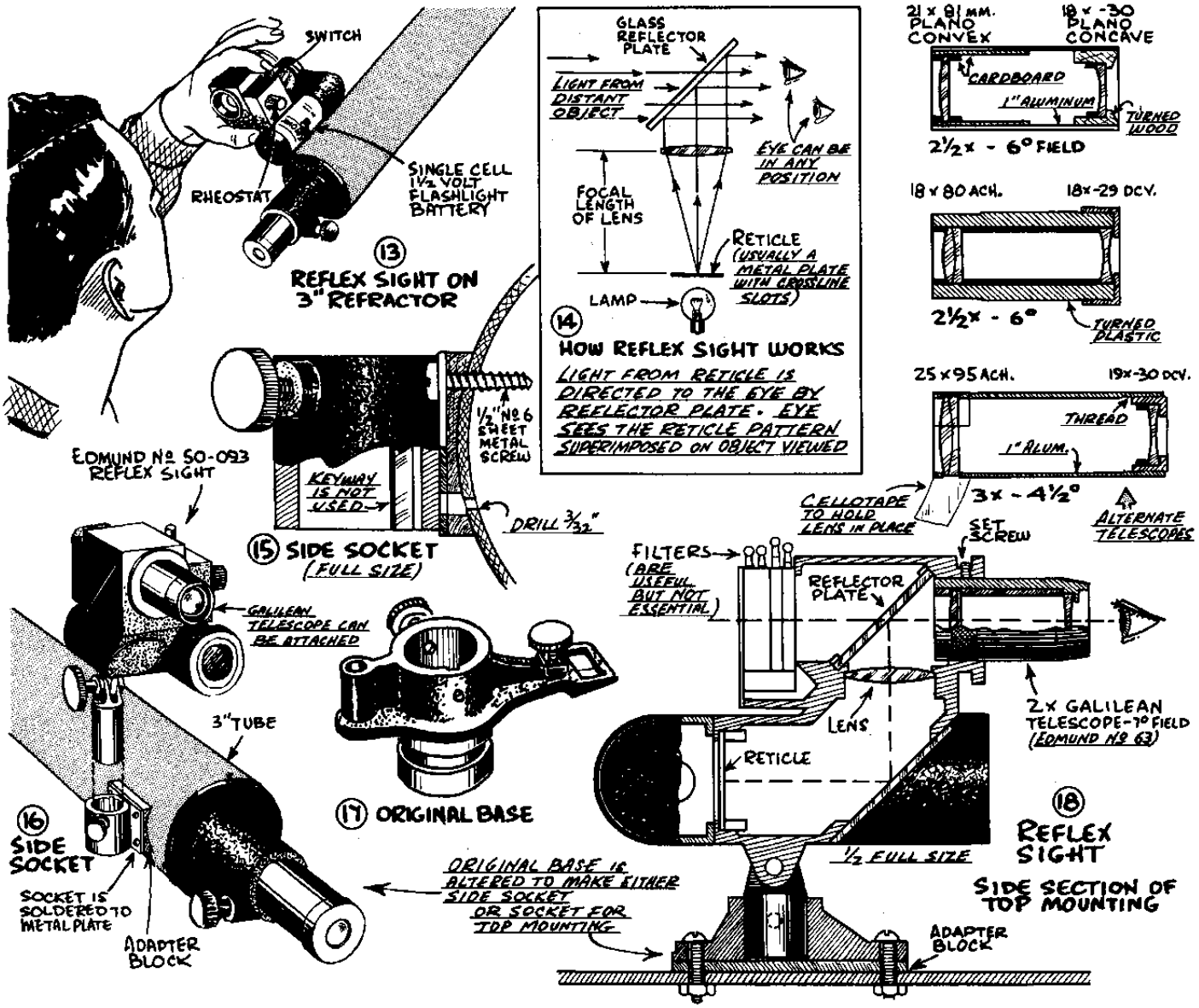




The actual alignment of the finder is best done in daylight by sighting the main telescope on an object at least 1/4 miles away. With the main telescope firmly clamped to prevent shifting, the finder telescope is then adjusted to center on the same target object. Bringing the target object to the center of the field by eye is usually accurate enough. Sometimes a finder is fitted with a fine crosshair and this can be useful for sighting-in although of doubtful value for actual night use when the fine wire is practically invisible. Fine wire crosshairs are sometimes improved with a coating of luminous paint. Luminous lines can be painted on a glass reticle or threads or thin strips of luminous plastic may be cemented in place. If the luminous crosshair is "charged" by shining a flashlight on it for a few seconds, it will remain bright for three or four hours. Another way of illuminating a wire reticle is simply to shine a small light through the objective. The light should be located off to one side as much as possible to minimize glare. A small pencil flashlight is good for this purpose.

The Collimator Sight. Collimator sights are used extensively on military weapons. The general nature of the system is shown in Figure 9 drawing. Both eyes must be used with this sight; the reticle must be illuminated. The collimator sight is used at unit magnification, that is, it has no power and is identical to the eye used alone. The big advantage of the sight is that the eye which views the reticle--the right eye usually--can be at any reasonable distance behind the lens and in any lateral position over an area of about 2 inches covered by the lens.

In military surplus, the collimator sight most available is the N3 Gunsight, which is shown in side section in Figure 10. The optical system is given a right-angle bend by means of a mirror, but is otherwise identical with the basic system shown in Figure 9. The N3C Gunsight is not a good finder for small telescopes because it is a bit bulky. However, with the legs cut off, it fits nicely on a 6-inch reflector, as shown in Figure 11. Mounting is made by means of a simple homemade U-shaped bracket, and the tilt adjustment obtained with this bracket plus the lateral movement of the reticle which is built-in as part of the original system provides all the movement needed to align the finder. The original light system calls for a 28-volt power supply. If this is not available you must convert to either 3 volts (flashlight) or regular 110-volt house current. Figure 12 shows a 7-watt, 110-volt lamp in use. You can obtain the lamp and socket from certain Christmas tree lights, or, you can buy lamp, socket and switch complete in the form of a night light. To remove the 28-volt socket, press down on the detent, Figure 10, and pull the socket out of the bracket. To do this it is



necessary to remove the entire reticle carriage. The only difficult part of doing this is the removal of the pin, Figure 12, from the lateral control wheel. The pin is 1/16 inch diameter and can be knocked out with a punch; alternately, drilling in the drill press with a light tapping motion will usually press the pin out. With the control wheel removed, the threaded control rod can be unscrewed. The rod on which the carriage slides can be removed after unscrewing the nut, Figure 12. In order to conserve space, the original wiring connection is removed; the new wiring is brought out through a 1/4 inch hole drilled in the side of the case. If you decide to use batteries, you can obtain any of several small flashlights which may be fitted entirely within the lighthouse space.

Reflex Sight. The reflex sight works something like a collimator sight except you can see the target and reticle with one eye, Figure 14. Of various reflex sights available as military surplus, the Mark 2-C Drift Sight makes the most compact and practical telescope finder. This unit has build-in battery illumination with off-on switch and variable rheostat. The original base, Figure 17, is readily altered to make either a side socket, Figure 15, or a socket for mounting on top of the telescope tube, Figure 18. A reflex sight is commonly used at unit magnification and is quite practical as such, Figure 13. However, it is possible to add a 2X or 3X telescope if desired, as can be seen in Figures 16 and 18. A telescope, if used, can be press-fitted (by hand--not hammering) inside the eye hole after pulling out the eye ring. It should be secured by at least one set screw, Figure 18. Collimation of the finder is accomplished by the rotating movement in the mounting socket plus the hinge action of the original fitting.