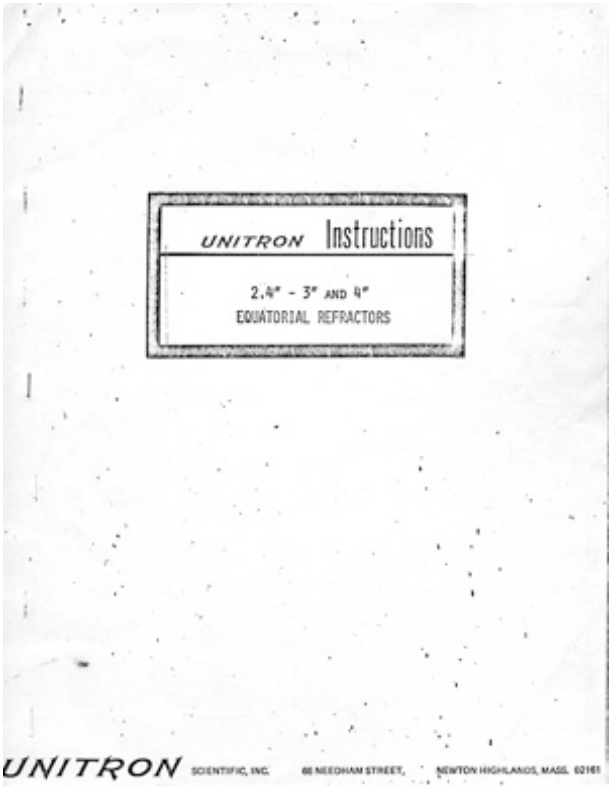
Company Seven

Astro-Optics Division



UNITRON Instructions 2.4″ - 3″ AND 4″ EQUATORIAL REFRACTORS

Extract, Pages 1 to 11. By Unitron 1965

Showroom: 14300 Cherry Lane Court
Laurel, MD 20707

Correspondence: Box 2587
Montpelier, Maryland 20709-2587

Telephone: 301-953-2000

E-Mail: info@company7.com
URL: http://www.company7.com

UNITRON Instructions

2.4" - 3" AND 4"
EQUATORIAL REFRACTORS

UNITRON SCIENTIFIC, INC. 66 NEEDHAM STREET, NEWTON HIGHLANDS, MASS. 02161

Instructions *for* UNITRON®

2.4", 3", and 4" Equatorial Refractors

TABLE OF CONTENTS

UNITRON INSTRUMENT CO. TELESCOPE SALES DIVISION 66 NEEDHAM STREET, NEWTON HIGHLANDS 61, MASS.

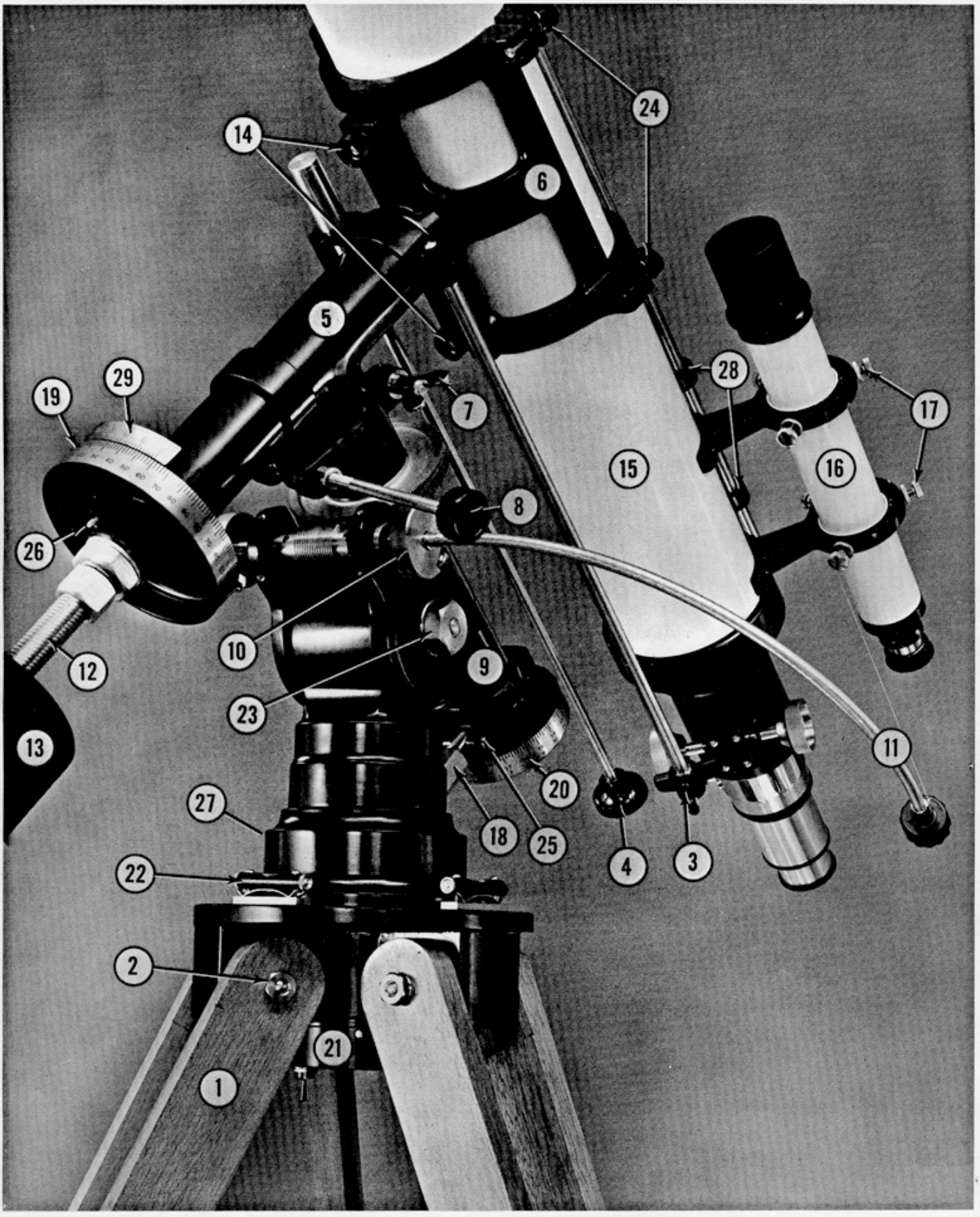

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29

Fig. 1: UNITRON Equatorial Refractor

1. Tripod legs
2. Tripod leg bolts
3. Declination fast motion clamp rod
4. Declination slow motion control rod
5. Declination axis
6. Cradle
7. Right ascension fast motion clamp
8. Auxiliary right ascension control rod
9. Polar axis
10. Right ascension control knob
11. Flexible cable
12. Counterweight rod
13. Counterweight
14. Cradle nuts
15. Refractor tube
16. Viewfinder
17. Viewfinder collimating screws
18. Latitude screw
19. Declination circle
20. Right ascension or hour circle
21. Shelf light (4" models only)
22. Tripod level vials (4" only)
23. Trunion nuts
24. Cradle clamp nuts
25. Latitude screw retaining bolt
26. Lock screw - declination circle
27. Azimuth locking screw (not visible in Fig. 1)
28. Sun screen brackets
29. Vernier for declination circle

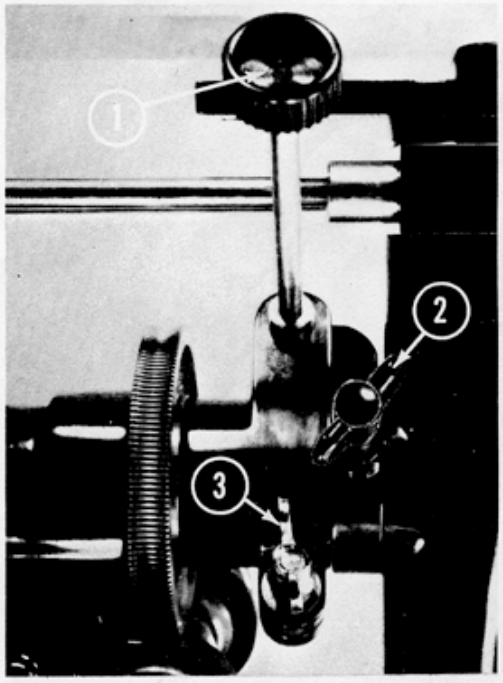
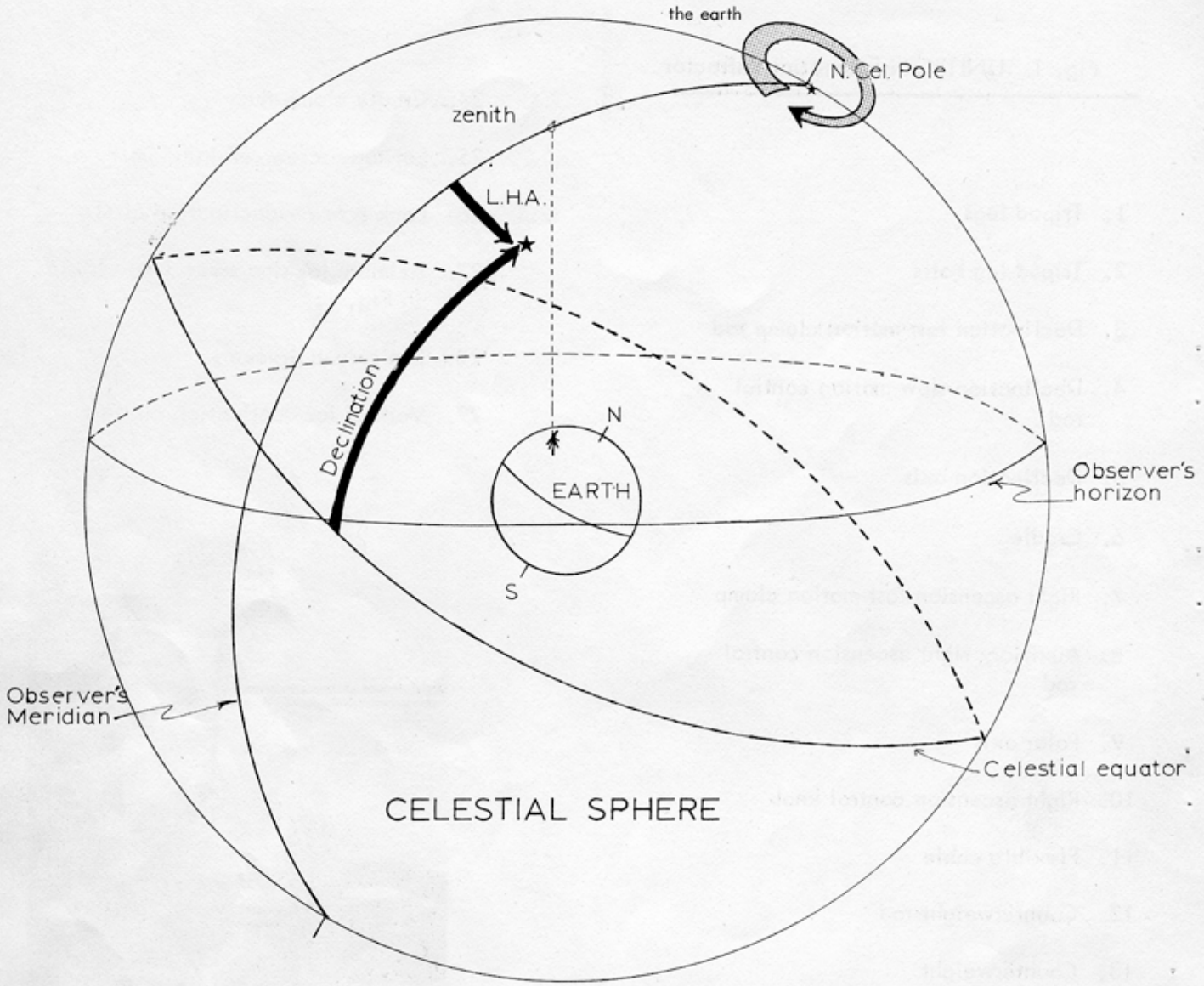
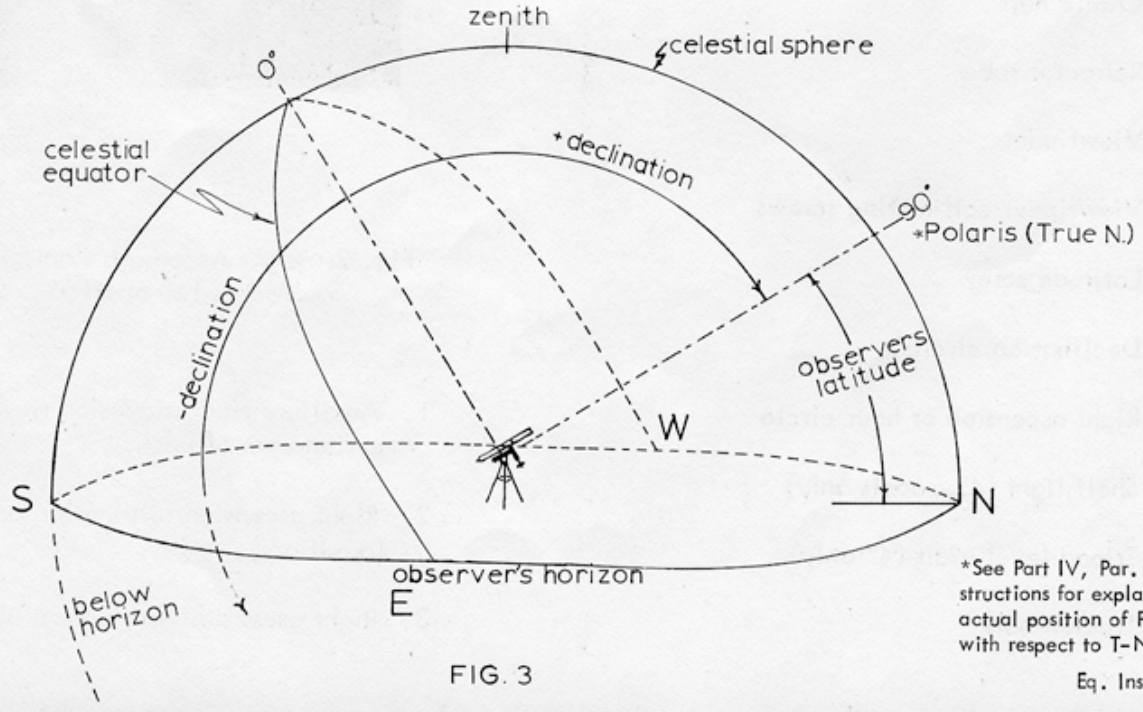


Fig. 2: Right Ascension Controls - Models 160 and 166

1. Auxiliary right ascension slow motion control knob.
2. Right ascension fast motion control (auxiliary)
3. Right ascension fast motion clamp





*See Part IV, Par. 7 of Instructions for explanation of actual position of Polaris with respect to T-North

FIG. 3

Eq. Inst.

Instructions

UNITRON Equatorial Refractors

PART I: INTRODUCTION

A telescope with an equatorial mounting offers the observer many features not available on the simpler altazimuth models. The advantages of the equatorial mounting result from its ability to be oriented parallel to the earth's axis of rotation. Once the mounting has been oriented, objects can be tracked with one motion only as they revolve about the polar axis; two motions are required for an altazimuth mounting. By using a single control knob only, the observer can follow the celestial object in a completely straightforward manner, without danger of "losing" it. Furthermore, since the objects move at a uniform rate, this one motion, the right ascension, can be operated by a clock drive, leaving the operator completely free to concentrate on his observations.

Movements of the mounting correspond to the grid lines normally employed on star charts. These grid lines divide the sky in declination and right ascension in the same manner that latitude and longitude is used on the surface of the earth. Setting circles on the equatorial mounting are provided for both declination and right ascension. Just as the position of a feature on the earth's surface can be specifically located, in terms of latitude and longitude, so can a celestial object be positioned in the sky, in terms of declination and right ascension. This means that objects not familiar to the observer can easily be located by consulting a star chart or ephemeris which will provide the declination and right ascension. This data can then be applied to the setting circles for the time of observation and the telescope pointed toward the object with a considerable degree of accuracy. The advantages of the equatorial mounting render it highly desirable for visual observation and a MUST for astro photography.

In the instructions which follow, detailed information is given on the use of the setting circles and on aligning the telescope with the high degree of precision needed to insure most accurate readings. However, if you are a beginner, do not be misled into thinking that you must understand all of these complexities before enjoying the use of your UNITRON Equatorial Refractor. By making a rough adjustment with respect to the North Star Polaris, you can enjoy the convenience of single-knob tracking: later, as your interest and skill develops, you can use the setting circles to locate celestial objects which are not readily apparent.

Although there are many variations of equatorial mountings available, they all consist of two axes, positioned at right angles to each other. UNITRON refractors are equipped with the German-style mounting which is the most common type and is noted for its adaptability to portable instruments and ease of operation.

Although the apparent movement of the stars, from east to west, results from the revolution of the earth, it is, perhaps, an easier concept for observers previously unfamiliar with the equatorial mounting to visualize the earth as being a fixed point, and the stars as objects fixed on a celestial sphere which revolves approximately once every 24 hours about the earth's axis. Fig. 3 illustrates this concept. A major portion of these instructions will be devoted to the proper orientation and use of the equatorial mounting. A glossary of terms applicable to the orientation and use of equatorial refractors is included at the end of these instructions.

> CAUTION: As in the case of any precision instrument, certain skills and equipment are employed in in the assembly of your refractor that are generally not available to the amateur observer. We advise the user against attempting any disassembly or adjustment of the objective, eyepieces, or mounting. If, at any time, your instrument requires servicing beyond the maintenance described in these instructions, please communicate with our Instrument Service Department at the address shown on the front of this instruction manual.

In general, these instructions apply to all UNITRON Equatorial Refractors. On the few occasions where there is a variation between equatorial models, the instructions will specify the model number or objective diameter of the instrument referred to.

SEPARATE INSTRUCTIONS: The following components have separate instructions packed with them. If any of the items are supplied as standard equipment with the telescope that you ordered, or were ordered as separate accessories, refer to the instructions which accompany the accessory.

a) Synchronous Motor Drive (2.4", 3" or 4" models)
b) Weight Driven Clock (Models 160 and 166 only)
c) 2.4" Photo-Guide Telescope
d) Astro-Camera, Model 220A
e) UNIHEX Eyepiece Holder
f) DUETRON Double Eyepiece Holder
g) 60mm Eyepiece

PACKING: The major components of all equatorial models are shipped in three separate containers as follows: Optics Cabinet - contains the refractor with eyepieces, sunglass, dewcap, dustcap, cradle, sun-screen apparatus, star diagonal and erecting prism system. (If the UNIHEX eyepiece holder was selected, then this will be in a separate small styrofoam box.) Mounting cabinet - contains the equatorial mounting with control rods, counterbalance rod, counterbalance weight, and the flexible cable. For the Model 128, a 3-piece flat bar assembly is included with the legs for holding the legs in position when the instrument is set up. For 3" and 4" models, a tripod shelf is provided in a separate carton. Tripod legs for 2.4" and 3" models are in a separate carton. For 4" models, they are in a wooden cabinet.

NOTE: All references to illustrations appear as hyphenated numbers in parentheses. The number of the figure is given first followed by the item number in the figure.

PART II: ASSEMBLY

1. ATTACHING THE TRIPOD LEGS: Attach the tripod legs (1-1) to the base of the mounting by using the tripod leg bolts (1-2) packed with the tripod legs. Attach the spreader bar (Model 128) or shelf (3" and 4" models) at the mid-point of the legs to hold the tripod legs in position.

2. INSTALLING THE CONTROL RODS:

A) Declination fast motion clamp (1-3): This rod is identified by the 3-pronged handle and coarse thread. Its purpose is to lock the telescope on the declination axis. When loosened, it permits major changes in the position of the telescope tube, in declination. In some models, a shipping bolt must be removed to permit insertion of this rod. Tighten this rod sufficiently to prevent movement but do not overtighten.

B) Declination slow motion control (1-4): this rod is identified by the round knob and fine thread. The rod should be screwed into a point where turning the rod causes a movement of the cradle around the declination axis. For this rod to act upon the cradle, the declination fast motion clamp must be tightened. This control permits the fine adjustments to be made in declination, while observing.

C) Right ascension fast motion clamp (1-7): This may be a wing screw, as illustrated, or a short rod with 3-pronged handle similar to the declination fast motion clamp. This clamp locks the telescope on the polar axis (1-9). It should be kept tightened except when making major changes in right ascension. Tighten sufficiently to prevent movement over-tightening may result in damage to clamp housing.

D) Auxiliary right ascension control rod (1-8): screw this rod in until it causes a movement of the mounting around the polar axis. The right ascension fast motion clamp must be tight in order for this control to operate properly. This control is used to make fine adjustments in right ascension when a synchronous motor drive is being used with the telescope. (Ordinarily, the right ascension control knob (1-10) would be used for this purpose, but the installation of a synchronous motor drive eliminates the right ascension control knob as a means of manual control. Fine manual adjustments, or corrections, can then be accomplished with the auxiliary right ascension control rod.)

E) Flexible cable (1-11): this is provided to extend the right ascention control to a comfortable position for manual tracking while viewing through the telescope. On all models except the 160 Series, it may be used on either side of the instrument by inserting it into the recessed center of the right ascension hand wheel and tightening the thumbscrew. On the 160 Series, it can be used on the left side only since a gear box replaces

the righthand knob. If a synchronous motor is installed on any of the equatorial mountings, then the flexible cable should be removed as it will create an uneven drag on the motor.

F) For 4" models only (refer to Fig. 2): An added feature on these models is the dual clamping system on the polar axis. In addition to the auxiliary right ascension control rod and the fast motion clamp (2-3), a short wing screw (2-2) is provided. The observer will find that the auxiliary control (2-1) is sometimes difficult to reach when the telescope is pointed in certain directions. By loosening both the clamp screws (2-2) and (2-3) simultaneously, the entire clamping collar may be repositioned about the polar axis. Loosening either clamp individually will permit fast motion about the polar axis.

3. COUNTERBALANCE:

A) Counterweight rod (1-12): screw the end of the rod containing the hexagonal stop nut into the recess at the end of the declination shaft until the stop nut seats against the face of the shaft.

B) Counterweight (1-13): for 2.4" and 3" models, the counterweight threads onto the counterweight rod. In 4" models, the counterweight slides onto the shaft and is held in place by two hexagonal nuts which are screwed down against opposite sides of the weight.

4. OPTICS:

A) Install the refractor tube (1-15) on the mounting by removing the cradle nuts (1-14) and inserting the bolts through the holes on the flat bar at the upper end of the declination axis. Replace and tighten these nuts. Hand tightness is sufficient as the use of pliers is unnecessary and may damage the nuts.

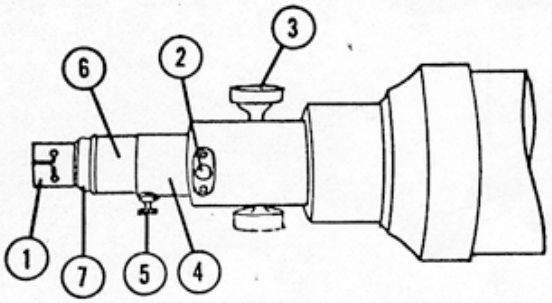
B) Viewfinder (1-16): on the 2.4" models, the viewfinder is shipped mounted in the collimating brackets on the main tube. On 3" and 4' models, the viewfinder is in a separate cardboard carton in the optics cabinet and must be slid into the brackets after backing out all six collimating screws (1-17) to obtain clearance. Instructions for aligning viewfinder are in Part III (3) of these instructions.

C) Dewcap and Dustcap: the dewcap and dustcap are packed separately in the optics cabinet. On the 2.4" model, the dewcap slides over the objective lens. The dustcap, in turn, fits over the end of the dewcap. On the 3" and 4" models, the dewcap screws onto the outer cell over the objective lens and the dustcap slides over the end of the dewcap.

This completes the assembly of the major components of the refractor.

PART III: OPERATION OF OPTICAL SYSTEM

1) FOCUSING: The 2.4" and 3" models are equipped with the Standard rack and pinion focusing mechanism, unless the Deluxe rack and pinion was specified in the order, at extra cost. The 4" models are equipped with the Super rack and pinion. Focusing procedures are the same regardless of the type of rack and pinion except for the use of locking screws on Deluxe and Super models, shown as items (4-2) and (4-5). These must be loosened during focusing and then may be tightened to prevent accidental movement of the mechanism. If the observer is unfamiliar with high powered telescopes, it is desirable to practice focusing the instrument during daylight on a distant object. Select a low power eyepiece and insert it directly in the end of the drawtube (4-1). The magnification, or power, will be determined by dividing the focal length of the eyepiece into the focal length of the objective. The focal length of the eyepiece, in millimeters, is shown on the top of each eyepiece. The focal lengths of objectives are as follows: 2.4" refractor - 900mm; 3" refractor - 1200mm; 4" refractor - 1500mm. To obtain an approximate focus, loosen the fine focus locking screw (4-2) and by turning the fine focus knobs (4-3) move the fine focusing sleeve (4-4) until it is approximately at the center of its total travel. Next, loosen the coarse focus locking screw (4-5) and while sighting through the eyepiece, slowly pull out the drawtube (4-6) until the distant object is as close as possible to being in focus. A sharp focus can then be obtained by adjusting the fine focus knobs (4-3) in the appropriate direction. As eyepieces are changed, a minor adjustment in fine focus will be necessary to achieve maximum resolution.



1. Eyepiece holder
2. Fine focus lock (not on standard R & P)
3. Fine focus knob
4. Fine focus sleeve
5. Coarse focus lock (not on standard R & P)
6. Drawtube (coase focus)
7. Eyepiece holder collar

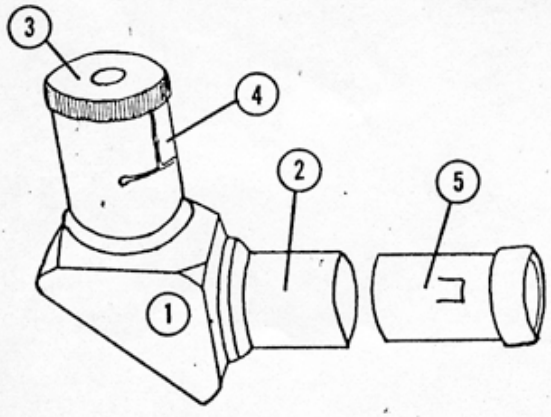
Fig. 4

The Deluxe and Super model rack and pinions have drawtubes with reversible eyepiece holders. The eyepiece holder collar (4-7) can be unscrewed and reversed 180° to provide a 1-1/4" eyepiece holder. The Super rack and pinion features a double drawtube. The inner drawtube is the same type used in the Deluxe rack and pinion while the outer drawtube, of approximately 58mm diameter, permits use of the Super rack and pinion and 60mm widefield eyepiece.

Your instrument has been supplied with either a UNIHEX eyepiece holder or a star diagonal and erecting prism system. If you chose the UNIHEX eyepiece selector, instructions for this accessory are packed in the box with the UNIHEX. If your instrument was equipped with a star diagonal and erecting prism, instructions for the use of the star diagonal are contained in paragraph (2) below.

Use of the erecting prism is discussed in Part VI of these instructions.

2) STAR DIAGONAL & ACHROMATIC AMPLIFIER: (Refer to Fig. 5) The star diagonal (5-1) is a special right angle eyepiece holder designed to permit comfortable viewing regardless of the position of the telescope tube. It is designed for astronomical observation only, as the image viewed when using a star diagonal will be upright, but reversed from right to left. To use the star diagonal, insert the drawtube end (chrome tube without slot) (5-2) into the eyepiece holder of the drawtube. An eyepiece (5-3) is inserted into the eyepiece holder (5-4) of the star diagonal. The telescope is then focused using the same procedure previously outlined. An Achromatic Amplifier (5-5) is supplied as standard equipment with the star diagonal. The Amplifier is a two-element Barlow-type negative amplifying lens. It is located in the drawtube end of the star diagonal and has an appearance similar to an eyepiece, but without marking. When inserted in the optical system it will double the magnification of any eyepiece with which it is used. Use of the Amplifier will provide the higher magnifications desired for lunar and planetary observations.



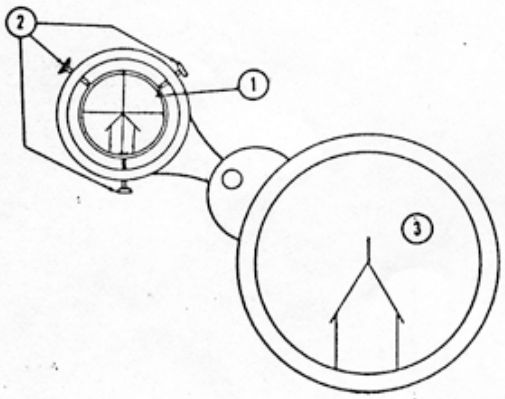
1. Star diagonal
2. Chrome tube
3. Eyepiece
4. Eyepiece holder
5. Achromatic Amplifier

Fig. 5

Use of the Amplifier will, of course, result in a narrowing of the field and a reduction of light passage through the instrument. Consequently, the Amplifier is most useful on bright objects under good "seeing" conditions. The

Amplifier has a friction fit in the star diagonal and can be removed or replaced, as desired by the observer.

3) VIEWFINDER: (Refer to Fig. 6) The viewfinder (6-1) is a low power, widefield telescope which aids in locating objects to be viewed with the main telescope. It is focused by simply moving the eyepiece in or out of the drawtube. The eyepiece has built-in crosshairs which permit an object to be centered in the field of view. Before the viewfinder can be used effectively, its optical axis must be carefully aligned with the optical axis of the main telescope. During daylight hours, select a well defined, distant object, such as a church steeple or flagpole. Using a low power eyepiece center the object in the field of the refractor, as shown in (6-3). By using the collimating screws (6-2) in the viewfinder mounting brackets, move the viewfinder within the brackets until the object is centered in the crosshairs. The optical axes are now close to being parallel. To improve this adjustment, select a well-defined celestial object, such as a prominent star, and repeat the procedure outlined for daylight alignment. Polaris is an excellent choice as its extremely slow apparent movement allows sufficient time for accurate alignment of the viewfinder after the star has been placed in the center of the main refractor field.



1. Viewfinder
2. Collimating screws
3. Refractor

Fig. 6

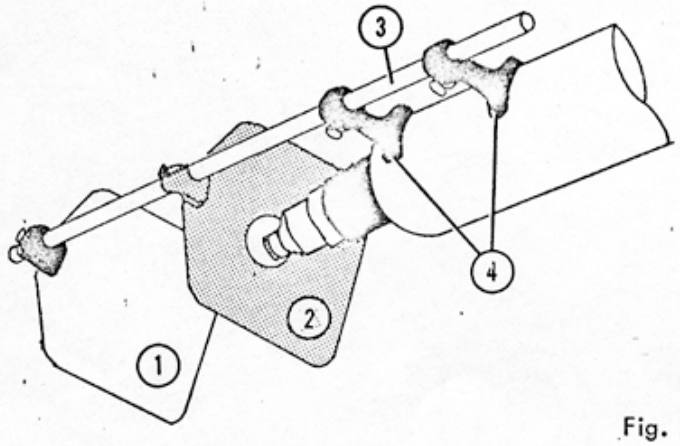
4) SUNGLASS: A sunglass is included with all UNITRON refractors. It will be found attached to the top of one of the eyepieces, generally the 12.5mm, but can be removed by simply loosening the thumbscrew and transferred to the eyepiece of your choice.

Caution

Extreme care must be exercised when using the sunglass. The high magnifications employed in astronomical telescopes produce a concentration of heat at the eyepiece sufficient to crack the sunglass if the telescope is pointed at the sun for longer than a brief period of time. SEVERE EYE DAMAGE CAN RESULT IF THIS OCCURS. When viewing, the instrument should be turned away from the sun at frequent intervals. The viewfinder should be covered to prevent accidental exposure of the naked eye to the sun's rays passing through the viewfinder.

When viewing the sun it is recommended that a solar aperture diaphragm be used in front of the objective. A solar aperture diaphragm is included as a standard component of all equatorial instruments. It is similar in appearance to the dustcap but has a small hole located in the center. Use of the aperture diaphragm reduces the area of objective lens surface that is directly exposed to the sun, and consequently limits the amount of light passing through the instrument. Even when using the solar aperture diaphragm, however, the instrument can be pointed directly toward the sun only for brief periods of time if damage to the sunglass is to be prevented. A safer method of direct viewing involves the use of a Herschel Solar Wedge, available as an extra accessory. The Solar Wedge is similar in appearance to a star diagonal but has a small hinged door which, when opened, permits dissipation of most of the sun's heat before it reaches the eyepiece. The Solar Wedge is used in combination with the sunglass.

5) SUNSCREEN: The safest method of viewing the sun requires the use of a sun projecting screen apparatus, which is included with all equatorial models. When sun projection screens are used, the sun's image is projected on a white metal screen, where it may be viewed safely with the naked eye. This method also has the advantage of permitting several persons to view the projected image simultaneously. Attach the brackets (7-4) to the tube, through the use of the thumbscrews provided in the tube. The rod is inserted through the brackets and the screens locked on the rod. The black screen with the hole in the center is used as a shade to prevent the direct rays of the sun from striking the white screen and "washing out" the image of the sun projected through the telescope. The size of the projected image can be regulated by moving the white screen along the rod. The sun's image can be sharply focused by use of the drawtube and rack and pinion mechanism.



1. Sunscreen
2. Shade
3. Sunscreen rod
4. Sunscreen brackets

Fig. 7

PART IV: ORIENTATION OF THE MOUNTING

The accuracy with which a good equatorial mounting performs is a reflection of the accuracy with which it was oriented and balanced. If the instrument remains set up in one location, then it will be necessary to orient one time only. If it is taken down between observing periods, then, with the exception of the latitude adjustment, the remaining orienting procedure will have to be repeated each time the instrument is set up. Although the procedure may appear to be involved the first time that it is performed, you will find that orientation requires only a short time once you become familiar with the operation of the mounting. A small inexpensive hand level should be acquired to facilitate leveling and orienting the mounting.

1) LEVELING: Level the mounting by reference to the level vials provided on the 4" models (1-22) or by using the hand level on smaller models, placing it on the flat surface of the tripod head. On soft ground, the tripod legs may be pressed into the ground to achieve a level position. On hard surfaces, shims of plywood, masonite, or cardboard can be used to raise the tripod in the appropriate direction to obtain a level position. Lifting and swinging one tripod leg right or left will also accomplish limited leveling of the head.

2) BALANCING:

a) Loosen the right ascension fast motion clamp (1-7) and place the declination axis in a horizontal position. Move the counterbalance weight (1-13) in and out along the counterweight rod (1-12) until the declination axis remains balanced in the horizontal position, unsupported.

b) With the declination axis balanced and locked in the horizontal position loosen the declination locking rod (1-3) and rotate the telescope tube (1-15) to a horizontal position. Loosen the cradle locking screw (1-24) and slide the tube, in the cradle, as necessary to permit balancing. The addition of certain accessories, such as the Astro-Camera, may necessitate the use of auxiliary equipment for balancing the tube. A counterbalance clamp is available for 2.4" and 3" models and a UNIBALANCE assembly is available for the 3" and 4" models. Refer to the list of accessories at the end of these instructions for further information.

Note: It will be found, while observing, that the telescope may seem to be out of balance in certain viewing positions. This results from a displacement of the center of gravity and minor adjustments of the counterweight