Triplet Ortho Apochromat

TOA -130N

INSTRUCTION MANUAL

TAKAHASHI

Thank you for purchasing the TAKAHASHI TOA-130N Triplet Ortho Apochromat refractor. This newly designed objective produce an extremely high order of color correction, very small stars, superb contrast and greatly reduced field curvature. The optionally available flatteners, reducer makes the TOA-130N into the perfect flat field CCD or astro camera. The Extender ED 1.5X is the perfect accessory for high magnification lunar and planetary observation.

In order to use the TOA-130N to the limit of its capabilities, please read this owner's manual and familiarize yourself with the function of the system parts and accessories before using this instrument.

⚠ WARNING

NEVER ATTEMPT TO OBSERVE THE SUN THROUGH THIS TELESCOPE WITHOUT A FULL APERTURE SOLAR FILTER DESIGNED FOR THIS PURPOSE. FAILURE TO DO SO COULD CAUSE INSTANT BLINDNESS. COVER THE FINDER WITH AN OPAQUE COVER TO PREVENT ANY LIGHT FROM COMING THROUGH. AN UNCOVERED FINDER CAN ALSO CAUSE SERIOUS DAMAGE TO THE EYE. KEEP CHILDREN AWAY FROM THE TELESCOPE DURING DAYTIME.



⚠ CAUTION

- When placing the TOA-130N in the saddle, be carefull to balance the tube in the saddle. This will prevent injury to fingers and will prevent it from falling to the ground. When placing the telescope in the saddle, always hold the tube with one hand to keep it from falling off the saddle on to the ground.
- Always lay the tube assembly on a completely flat surface that totally supports it to protect it from damage.
- Keep the tube assembly out of the Sun. Otherwise, the tube assembly could heat up, causing lens damage.
- Great care should be taken during focusing.

CONTENTS

Warning & Caution 2
Specifications 3
Tube Assembly Layout 4
Photo/Visual Accessories Specifications 5
Attaching Finder & Tube Assembly 6
Focusing 9
Finder Alignment 10
Observation 12-13
Photo/Visual Accessories 14-20
Care & Maintenance 21
Additional Precaution 21
System Chart 22-23

SPECIFICATIONS

Optical System	Air Spaced Triplet
Effective Aperture	130mm
Focal Length	1000mm
Focal Ratio	1: 7.7
Resoving Power	0.89″
Limiting Magnitude	12.3
Light Gathering Power	345X
Diameter of Main Tube	156mm
Total Length of Main Tube [W/end cover]	Type S:1145mm(1015mm with shade retracted) Type F:1145mm(1015mm with shade retracted)
Weight of Main Tube Assembly	Type S abt. 10.5kg Type F abt. 11.4kg
Finder Scope	7x50 6.3°

Tube Assembly Layout

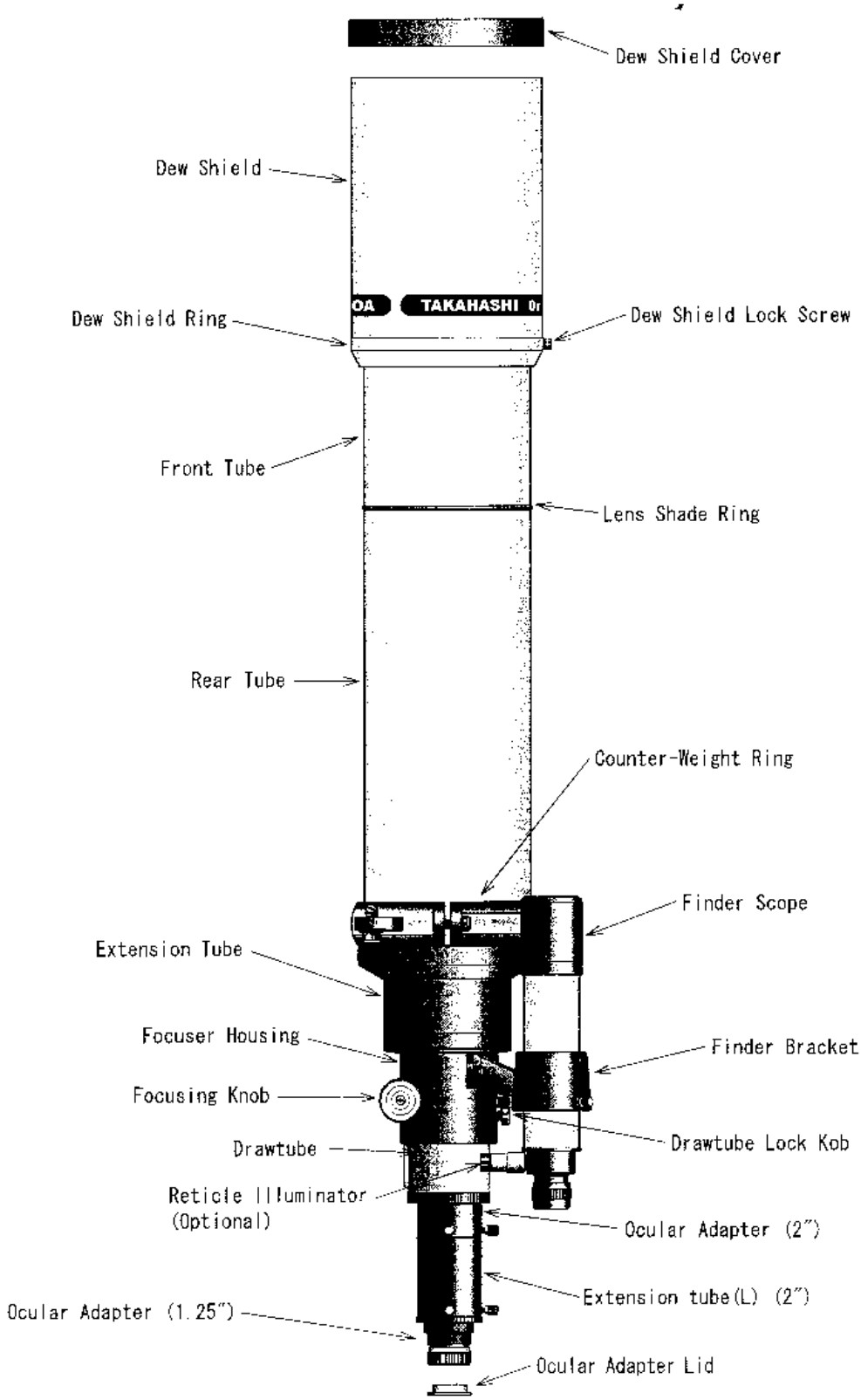


Fig. 1

Photo/Visual Accessories Specifications

Takahashi has manufactured flatteners, a reducer and a 1.5x corrector/extender for a large number of CCD, photographic and visual applications for the TOA-130N.

The TOA-35 & TOA-67 will produce flat field for 35mm, 6X7 or CCD photography. The Reducer changes the focal ratio to f/5.67 and flattens the field for CCD. The Extender ED extends the focal 1.5X to 1600mm for lunar, planetary and double star observations.

The flatteners and reducer corrects the field and produce stars that are 2.9 microns at the center and less than 8 microns at 40mm ϕ and less than 20 mircons at 80mm ϕ .

TOA-35 Flattener	Focal Length ..... 980mm Focal Ratio ..... F: 7.5 Image Circle ..... ϕ 40mm [60% illuminated] ϕ 25mm [100% illuminated]
TOA-67 Flattener	Focal Length ..... 1000mm Focal Ratio ..... F 7.7 Image Circle ..... ϕ 92mm [60% illuminated] ϕ 70mm [100% illuminated]
Reducer	Focal Length ..... 780mm Focal Ratio ..... F 6.0 Image Circle ..... ϕ 52mm [60% illuminated] ϕ 25mm [100% illuminated]
Extender ED-1.5X	Focal Length ..... 1500mm Focal Ratio ..... F11.5 Image Circle ..... ϕ 44mm [60% illuminated]

Attache the finder bracket to the tapped holes located on the left side of the focuser

Attaching The Finder And Tube Assembly

The TOA-130N is shipped with the finder detached to prevent damage. Use the following instructions to assemble and align the finder.

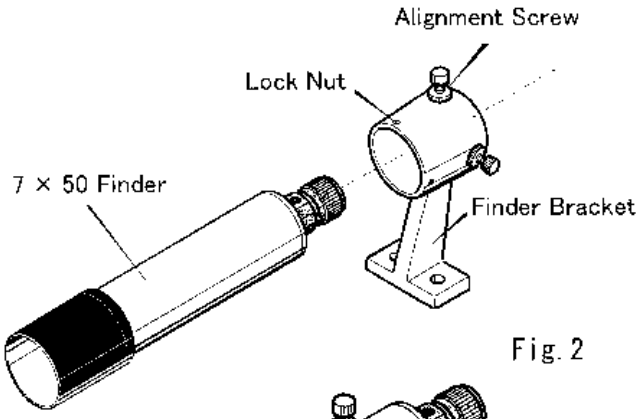


Fig. 2

■ Attaching The Finder Scope

Place the finder bracket over the holes in the focuser assembly and attach it with the two cap bolts provided. Make certain that the sides of the bracket are parallel to the sides of the tube assembly. Failure to do so will make finder alignment more difficult. A cap screw covers the illuminator hole. Refer to Fig.2,3.

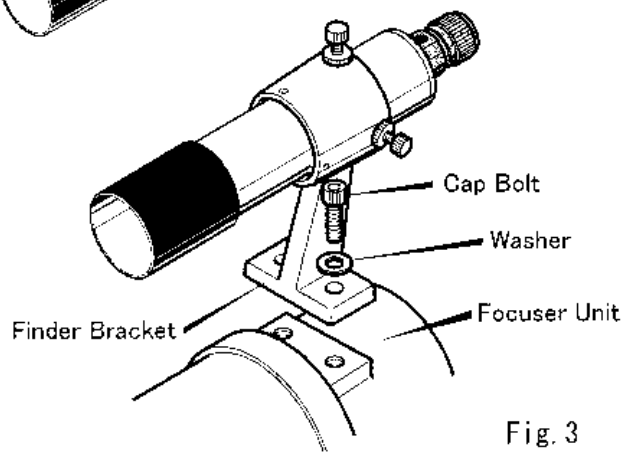


Fig. 3

■ Attaching Tube Assembly To The Equatorial Mount

Place the tube holder onto the top of the Dec. assembly and align the holes in the tube holder with the holes in the Dec. assembly. Attach it with two cap bolts provided for this purpose. This tube holder can be used with all Takahashi mounts. Refer to Fig.4.

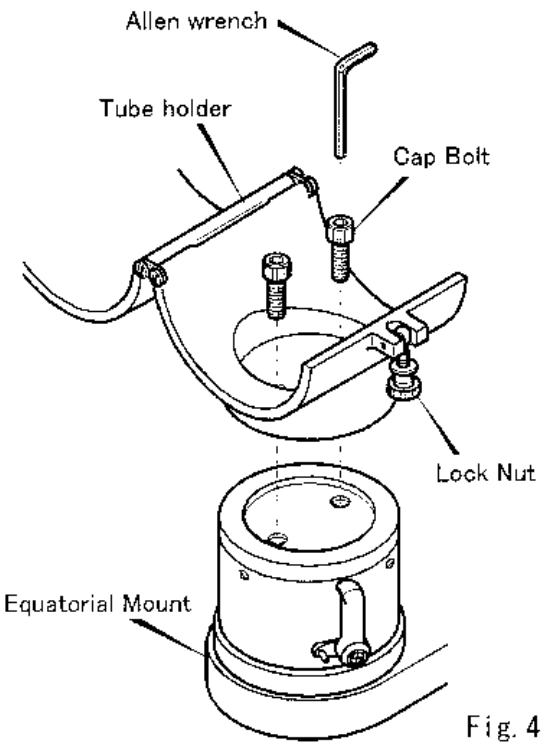


Fig. 4

The correct way to attach the tube holder to the mount is to use the two cap bolts provided. After an optical tube has been set into the tube holder, The next step is balancing. Refer to Fig.5.

Now that the instrument has been attached to the mount, it will be necessary to balance the load in the R.A. and the Dec.

The first step is to clamp the R.A. and unclamp the Dec. Hold the tube of the telescope in the event it is out of balance. Then, loosen the tube clamp slightly so that the tube can be moved in either direction. Move the tube in either direction until it balances. When the tube is balanced, tighten the clamp.

Next, loosen the R.A. clamp, and tighten the Dec. clamp. Unclamp the counter-weight(s) and slide them in either direction until the package is balanced.

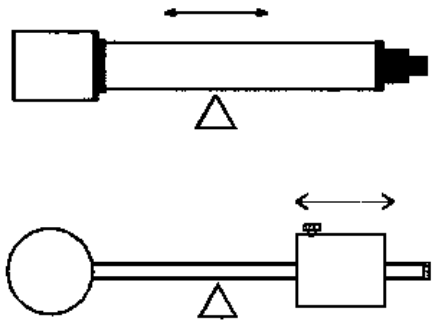


Fig. 5

●How To Use The Ring Counter-Weigh

The TOA-130N has been designed to be used with a wide variety photo, CCD and visual accessories; therefore, a tube counter-weight has been provided to achieve balance for better tracking and ease of operation.

This ring weight is felt lined, so it can easily be moved in either direction or removed when not needed. Use a 6mm Allen wrench to tighten, loosen or remove the ring weight. Refer to Fig.6.

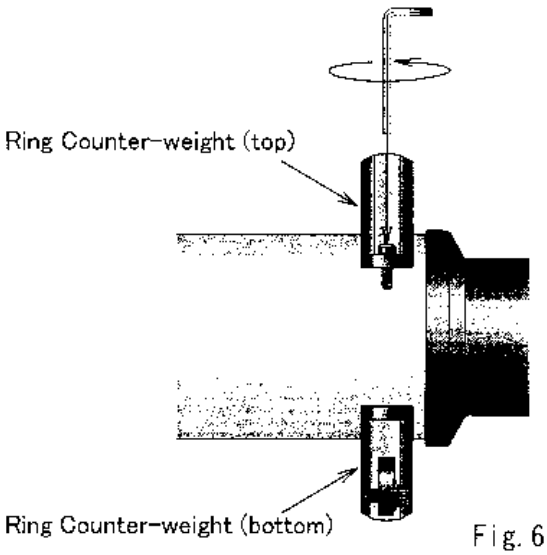


Fig. 6

● How To Retract The Lens Shade

The Lens Shade of the TOA-130N is retractable. When the TOA is to be transported, retract the lens shade until it rests on the satin chrome ring installed in the tube assembly for that purpose. The shade can be extended when the TOA is used.

1. Remove the cap of the dew shield.
2. Loosen the two lock screws.
3. Extend the dew shield.
4. Turn the locking screws until they make contact.

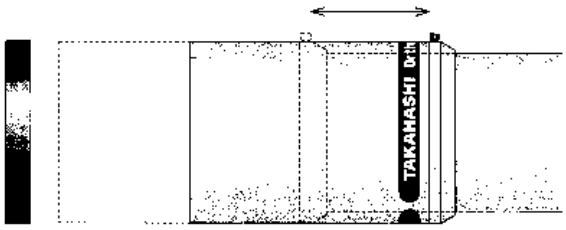


Fig. 7

[Caution]

Remove the lens shade cap before moving the Lens shade. The fit is tight enough to blow the lens shade cap off of the Lens shade and it allows the Lens shade to move easier.

■ Compression Ring

Remove the ocular adapter cover after the locking ring has been loosened by turning it counter clockwise. Then, insert the desired ocular or 31.7 diagonal into the adapter and tighten the ocular ring by turning it clockwise.

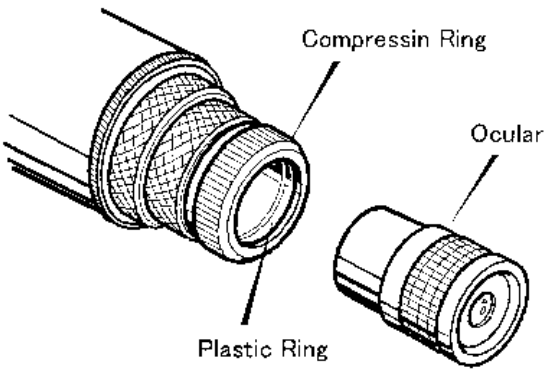


Fig. 8

■ Connection the System Parts

Carefully study the system chart in this manual before connecting the system parts. Connecting the parts incorrectly may prevent the TOA from coming to sharp focus or any focus at all!

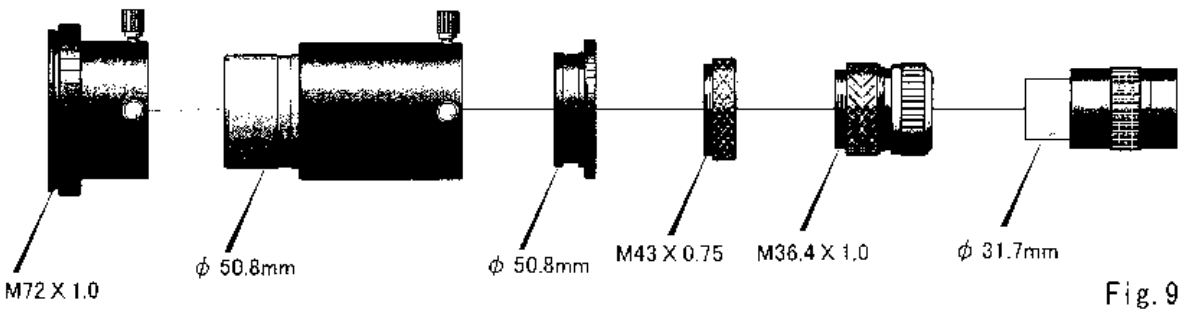


Fig. 9

■ Focusing

After inserting the ocular into the telecope, it is necessary to achieve the best possible focus. Remember the atomsphere will limit the highest magnification that can be used on any given night. Using the lowest power ocular; focus the image and then increase the magnification by using shorter and shorter focal length oculars until the desired magnification is reached. This procedure allows the centering of an object at high magnification. Please familiarize yourself with the following.

● Focusing System

The TOA-130N uses a rack-and-pinion focusing system. This system permits rapid focusing. By turning the focusing knob clockwise, the focuser will move out and by turning the knob counter-clockwise, the focuser will move in. Refer to Fig.10.

Remove the lens shade cover and the aluminum plug from the 31.7mm compression ring adapter. Insert the diagonal into the compression ring adapter. Carefully tighten the compression ring until it begins to make contact with the barrel of diagonal. It is not necessary to overtighten the ring to hold the diagonal.

Then insert the ocular into the compression ring of the diagonal, repeating previous process. Be careful not to overtighten the compression ring.

Begin the focusing process by choosing a bright star in a covenient position. When you think that you have achieved the best focus, move the focuser inside and outside of what you think is the best focus. This will confirm the critical procedure.

Begin with a low power ocular and then proceed higher and higher until the desired magnification has been achieved.

When the best focus at high magnification has been achieved, you may notice a bright and dim ring around the star. This is not a defect but rather a diffraction pattern which is an indication of diffraction limited optics.

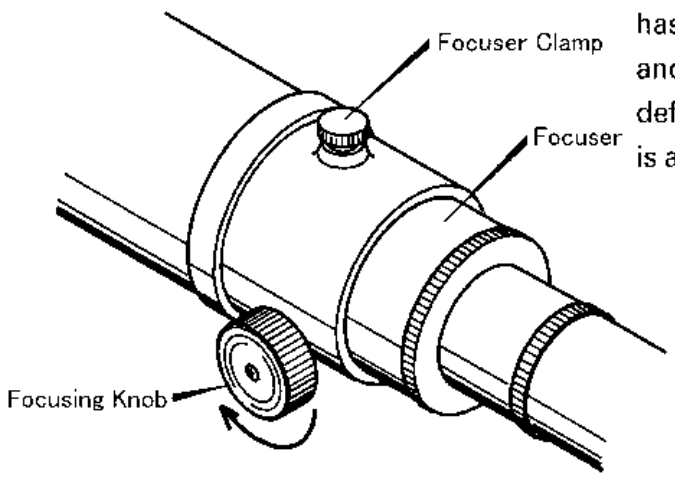
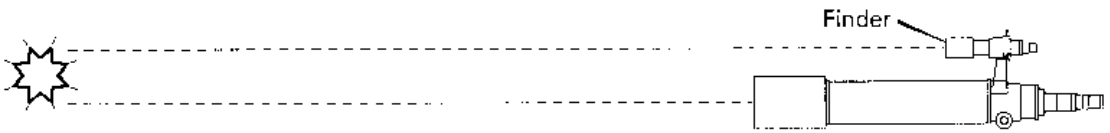


Fig. 10

Finder Alignment



Before the finder is placed in the finder holder, use plastic clear tape and tape the finder with two layers to prevent the tube from being scratched by the front finder set screws.

A finder is a useful tool. It permits the precise centering of an object in the field of view. The 6.3° field of view allows the easy centering of an object to be viewed or photographed.

The Takahashi finder uses an interrupted crosshair which is designed to allow the easy centering of an object to be photographed or observed. The wide field of the finder makes the finding of an object easier, therefore, it is important that the finder and the telescoep be in alignment. The following procedure can be used to align the finder.

◆ Alignment Procedure

1. Place a low power eyepiece in the telescope and center a bright star in a convenient part of the sky. Do not forget to engage the motor drive to keep the star centered. If this procedure is done in daylight, use an object that is at least one mile away. Loosen the lock nuts on the finder bracket and slightly move the star to the center of the field using the adjusting alignment screws.
2. Then use a higher magnification eyepiece and repeat the procedure by centering the object in the field of view of the telescope and then the finder. Continue this process until the highest possible magnification has been used.

◆ Adjusting Screw Procedure

1. Turn all the lock nuts until they reach the head of the alignment screws.

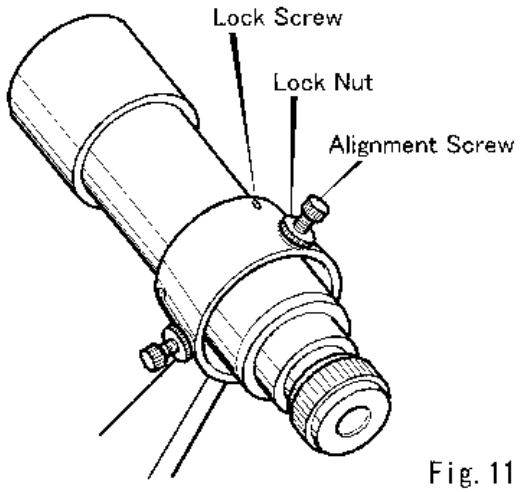


Fig. 11

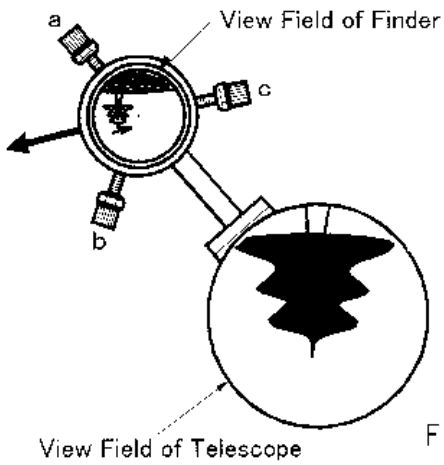


Fig. 12

2. In order to move the crosshair in the direction of the arrow, first loosen screw (a) and tighten (push) the finder with screw (c). This procedure will move the crosshair in the desire direction. The top of the finder will move in the opposite direction and the object will move in the direction of the smaller arrow. Refer to Fig.12.

3. In a similar fashion the direction of the movement of the finder is made by adjusting the three screws.

Learn the relationship between the movement of the three adjusting screws. If the finder cannot be moved in the desired direction, loosen the locking nuts.

◆ Reticle Illuminator [Optional]

The 7x50 finder has provision for an optional reticle illuminator.

If an illuminator will be installed, remove the cap screw at the end of the finder and install the reticle illuminator. The illuminator makes the centering of dim objects easier.

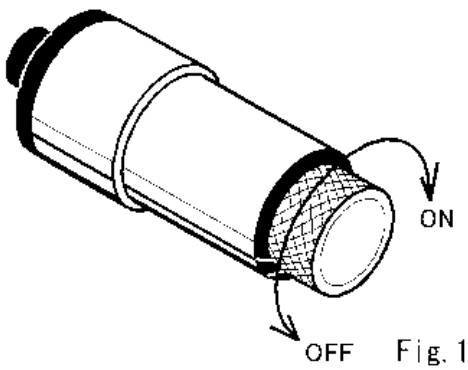


Fig. 13

In order to turn the illuminator on, turn the knob clockwise. The knob will click when the illuminator turns on. As the knob is turned, the reticle will brighten. Adjust the knob to the desired brightness. Turn the knob counter-clockwise past the click to turn the illuminator off. Refer to Fig.13.

◆ Replacing The Battery

Before changing the batteries in the illuminator, please be certain to turn it off. Unscrew the battery holder as shown in Fig.14. Remove the old batteries and insert new one after they have been wiped with a clean dry cloth. Check the polarity of the batteries before inserting them into the holder. Use two silver [V76-PK] or equivalent batteries.

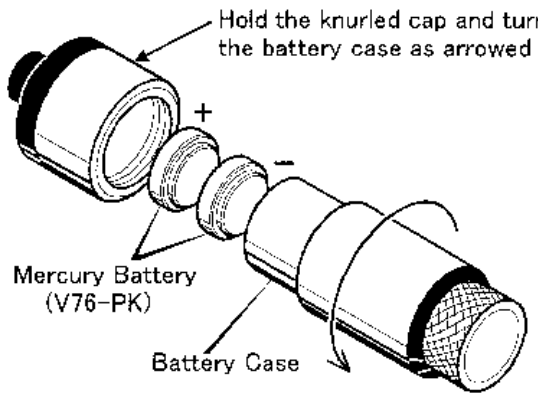


Fig. 14

Observation

■ Visual Observation

◆ Determining Magnification

The magnification of any ocular used with the TOA can be calculated by using the following formula.

$$\frac{\text{(focal length of a telescope)}}{\text{(focal length of an ocular)}}$$

Therefore, the shorter the focal length of the oculars used, the higher the magnification produced.

During the night of exceptional seeing, the TOA-130N can be used at a magnification of 130X per inch and on nights of exceptional seeing 160x or more can be used. These rare nights of exceptional seeing will reveal fine planetary filaments and small craterlets on the Moon. At the lower end, using a mignification of 10X per inch will produce breathtaking, ultra high contrast views of galaxies, nebulae and comets.

◆ Compression Ring Star Diagonals

Takahashi supplies each TOA-130N set [telescope w/mount] with a 90° compression ring 31.7 diagonal. The compression ring centers the ocular and makes the optical axes of the ocular and the telescope coincidental.

Set the ocular into the compression ring and carefully tighten the ring. Do not overtigten the compression ring.

■ Astrophotography

Focus is the most critical part of a fine astrophoto. Once critical focus is achieved, photos can be made. If possible, recheck focus to make certain that nothing has changed.

◆ Prime Focus Photography

This is the method to take photo by placing film at the focal point of the telescope. This means the telescope is used as a telephoto lens. The focal length of a telescope is far longer than that of a camera lens. Even a slight mistake to guide the telescope will make star images deformed. It is advisable to use a heavy duty equatorial mount for astrophotography.

◆ Eyepiece Projection Photography

When you want to take photos of the planets or the Moon, the TCA-4 is designed to make this easier.

When the image of the planet is properly illuminated, then increase the magnification to the limit of the seeing.

◆ Seeing

It is important that high magnification images of the Moon and planets require good seeing. The method for determining the quality of seeing on a scale of 1 to 10, with 10 being perfectly steady seeing is to look to the zenith at a bright star. If it is twinkling rapidly, the seeing is between 1 to 4. If the twinkling is moderate this is 5-6. If the star twinkles slowly to no twinkling, we have the 7 to 10 night. The less twinkle the better.

Focusing with the FM-60 focusing microscope and ground glass is shown in Fig.15. Set the ground glass in place with the mat side facing the objective of the TOA. Then focus and check for pinpoint focus over the field of view.

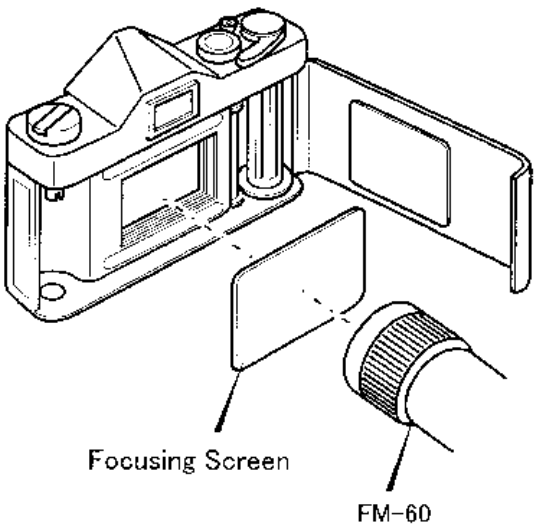


Fig. 15

⚠ Cautions

When taking high magnification photographs of the Moon and planets, pay careful attention to balance. Rebalance the telescope when the object is placed in the center of the camera.

If the telescope is moved to another object, then rebalance it in the position in which the photos will be taken. Do not use the camera shutter; use the "hat trick" a black card place over the lens shade before the shutter is set on bulb. After the vibration has stopped, remove the black card for the duration of the photo, which will normally be in seconds.

Accessories for Photo/Visual Application

A wide selection of photo/visual accessories are available. Here are the major items and their system charts.

■ TOA-35 Flattener

This flattener is specially designed to produce a flat field for use with a 35mm camera, CCD camera and visual use. It is necessary due to the generous back focus to use the a 50.8 extension tube.

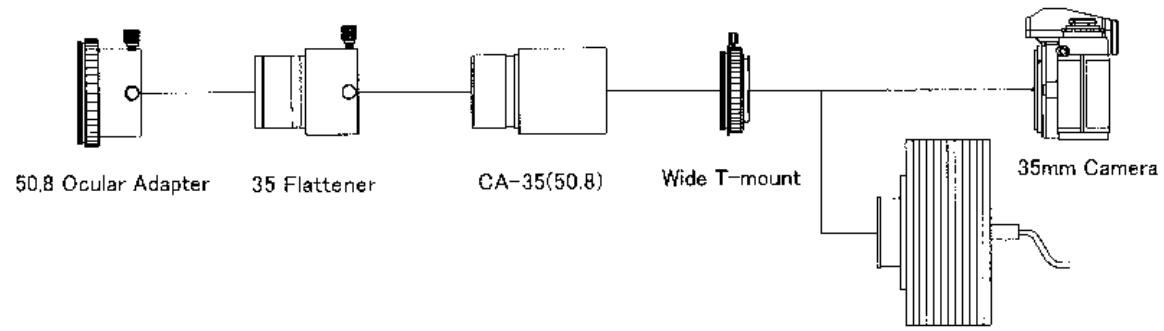


Fig. 16

■ TOA-67 Flattener

This is specially designed for the 130NF to produce a flat field ϕ92mm across with 3-micron stars at the center and 20 microns at the edge of 6X7 film. It also can be used visually with a 50.8 Mirror diagonal and Extender ED 1.5X which extends the focal length to 1500mm and is flat to the edge.

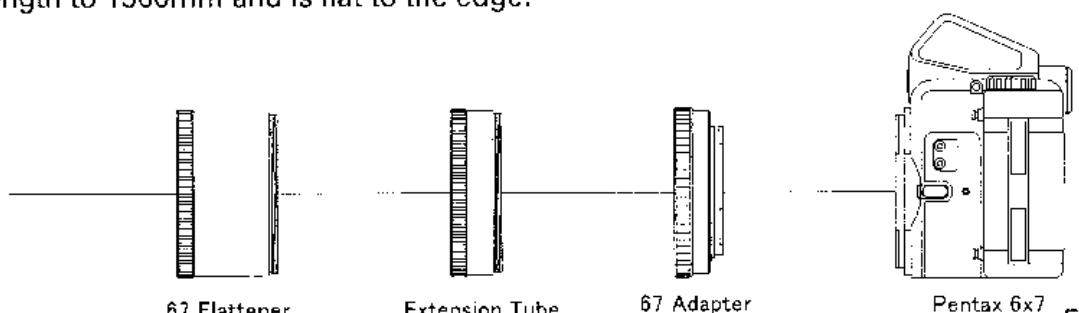


Fig. 17

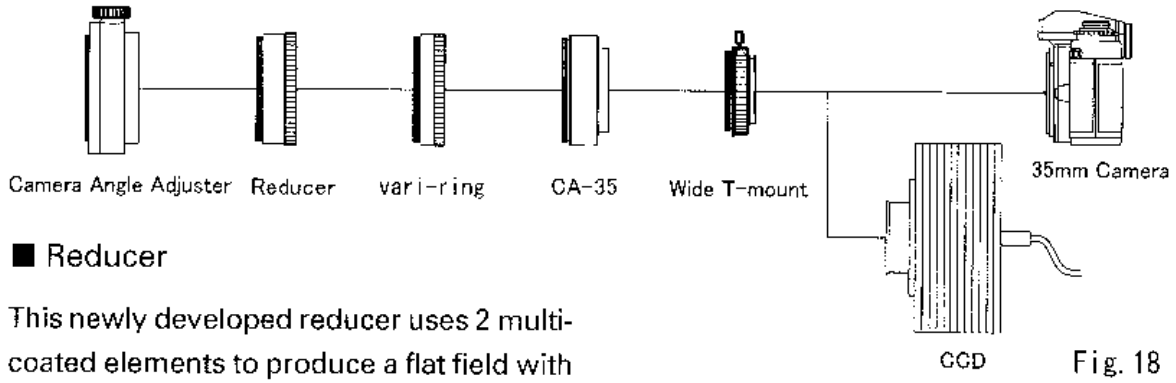


Fig. 18

■ Reducer

This newly developed reducer uses 2 multi-coated elements to produce a flat field with a faster focal ratio than the f/7.7 to f/5.6. The focal ratio can be further reduced to f/5.3 with the use of extension tubes; the stars still remain under 20 microns, which make it useful for CCD cameras with smaller chips.

■ CA-35

The CA-35 has been designed to be used with the TOA flatteners 35 and 67, the Reducer TOA and the Extender ED 1.5X. One version can be used with the TOA-35 flattener and Extender ED and the second for the TOA-67 flattener.

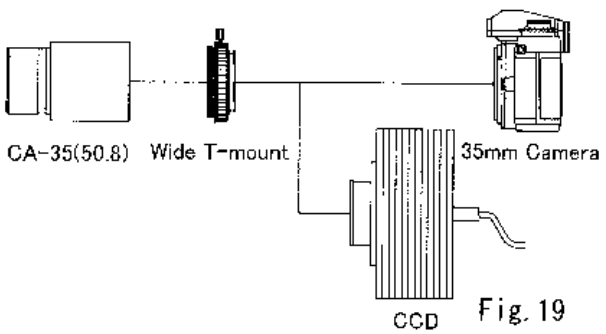


Fig. 19

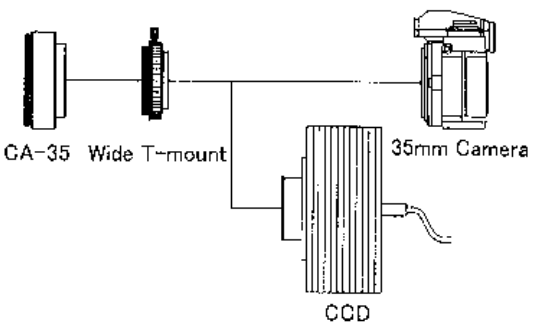


Fig. 20

■ Digital Camera Adapters

The Digital Camera Adapters are designed to allow the eyepiece projection [31.7 or 24.5 ocular] photos of the Moon and planets with your digital camera.

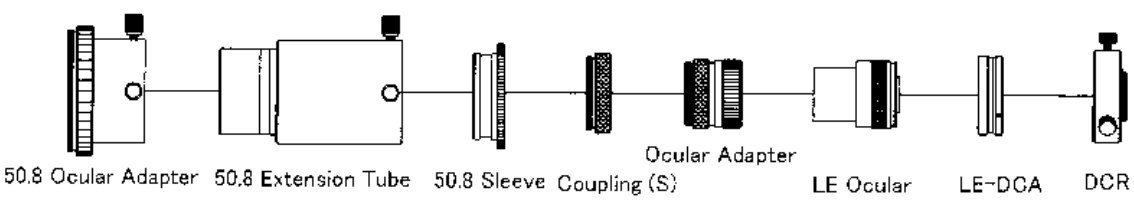


Fig. 21

■ TCA-4

This variable eyepiece device attaches easily to the TOA for high quality high magnification photos of the surface of the Moon and planets. It can be used with a film or CCD camera.

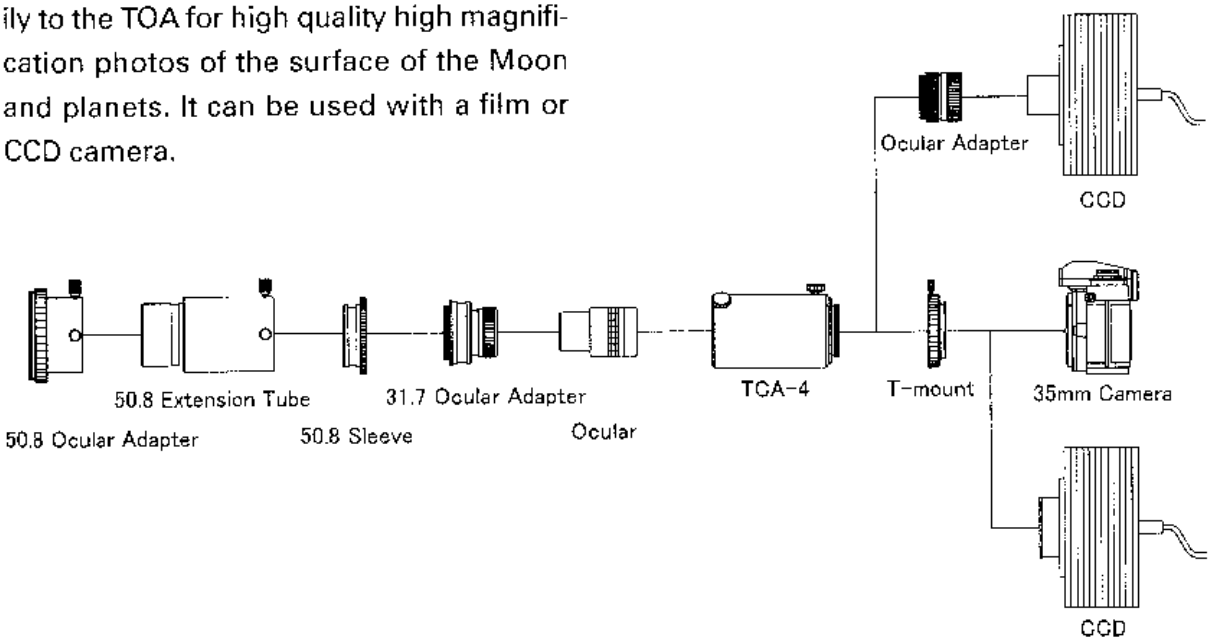


Fig. 22

■ T-Mount & Wide Mount T-Adapters

These adapters, one for the standard T-mount and the second for the Wide Mount T-Adapter.

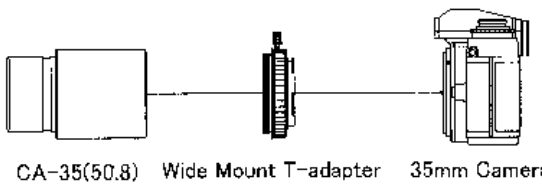


Fig. 22

The T-Mount is used to connect to the TCA-4 eyepiece projection adapter for high magnification photos and CCD images of the Moon and planets.

The Wide Mont T-Adapter can be used for prime focus, reducer, flattener or Extender TOA photography.

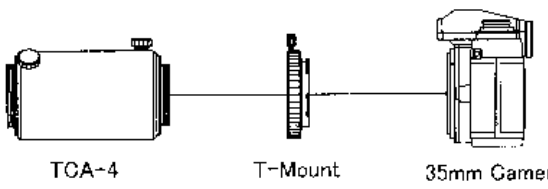


Fig. 23

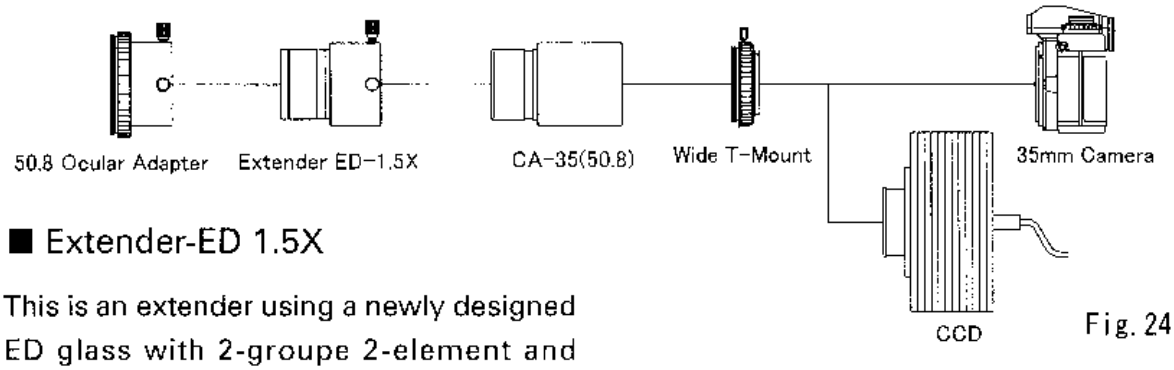


Fig. 24

■ Extender-ED 1.5X

This is an extender using a newly designed ED glass with 2-groupe 2-element and 50.8mm sleeve, which is convenient for attaching and detaching. This can extend the focal length by 1.5X perfectly keeping the original aberration-free optical performance of TOA series.

In general, visual observation by an eyepiece with short focal length will mark observer tired in a long time session due to short eye-relief. As the Extender-ED 1.5X can extend the focal length of TOA-130N to 1500mm, the visual performance will become better than that by the prime focus so that the Extender-ED 1.5X will be the best lens for highly magnified luna and planetar observation. When this is connected with 35-Flattener, this can produce perfect flatness across the field. In case this extender is used with the 35-Flattener, its light pass distance will become the same with that of 50.8mm mirror diagonal, the drawtube will be almost no need to be adjusted when straight viewing and diagonal mirror viewing are alternatively done or making photographic set-up.

The 35-Flattener wil make the image circle of TOA-130N to . ϕ 44mm, and the focal ratio to F:11.5, usable with a DSLR/SLR or CCD camera.

■ 2X Barlow Lens

This Barlow lens was originally designed for the FS Series and it can be used for the TOA for visual use. This short Barlow can be used with the 31.7 diagonal or mirror diagonal.

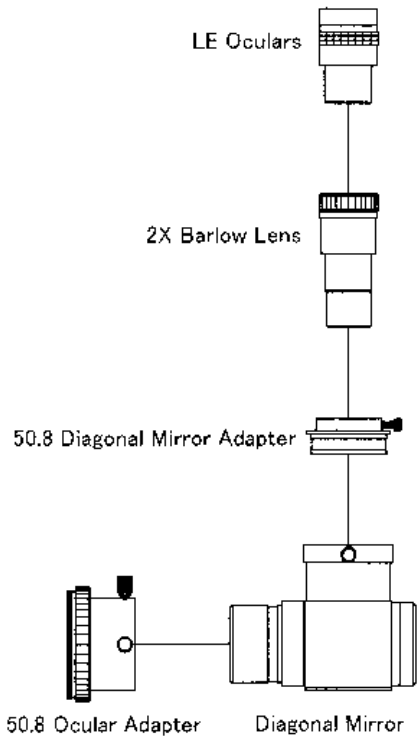


Fig. 25

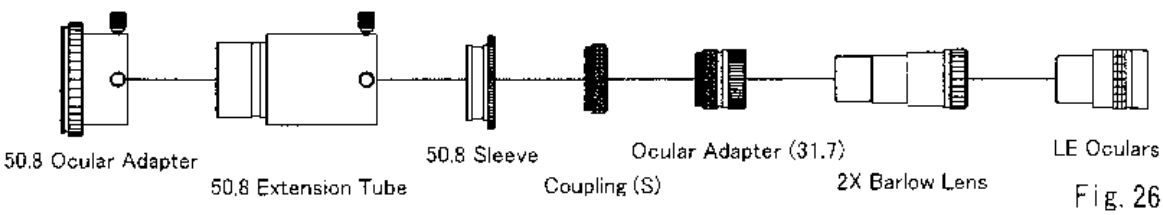


Fig. 26

■ 5-Turret Ocular Holder W/Large Prism Diagonal

The 5-ocular turret ocular holder with LPD give the visual observer great flexibility in choosing 5 different magnifications for their advanced visual studies.

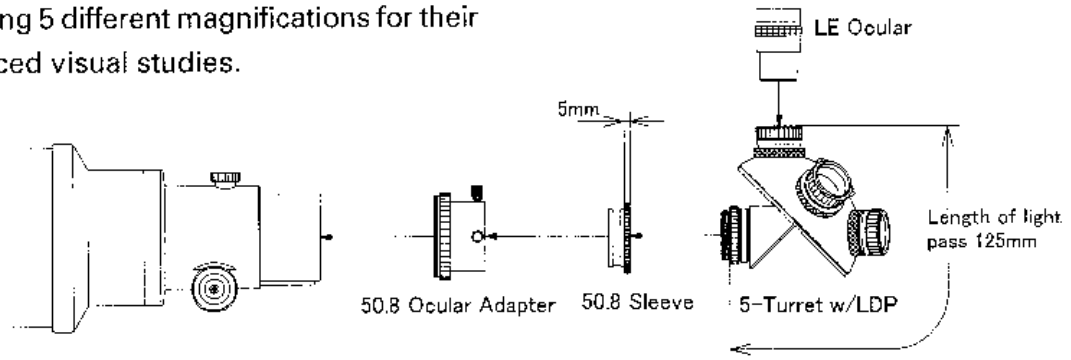


Fig. 27

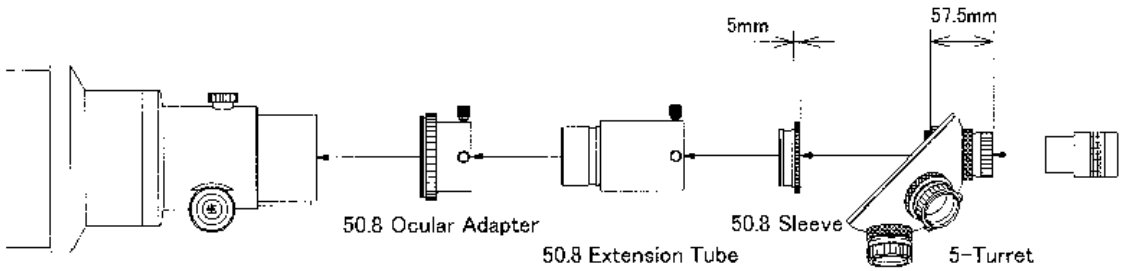


Fig. 28

■ Twin Vue Binocular Viewer

The Twin Vue binocular viewer is a 45°. The two compression ring ocular adapters insure that the optical axes are all coincidental for the best possible. The built in 2X barlow lens and LE oculars will provide excellent views of the Moon and planets and when the barlow is removed, wide field views of deep space objects.

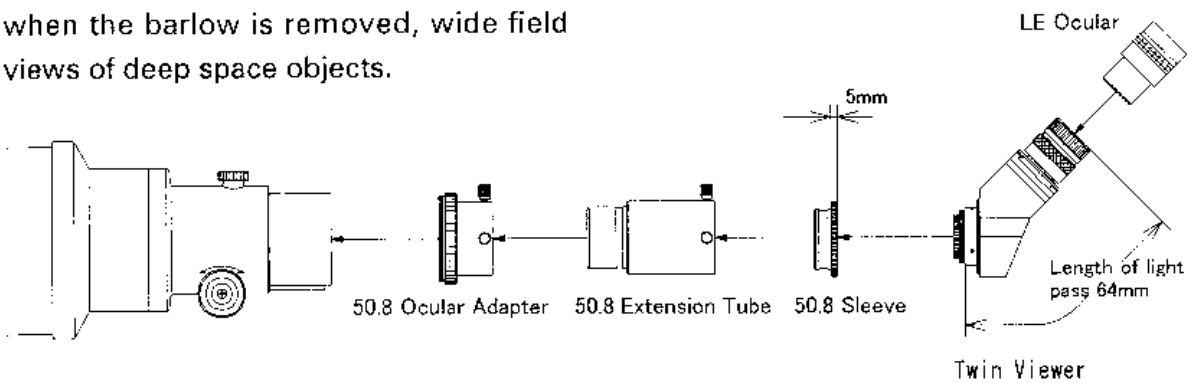
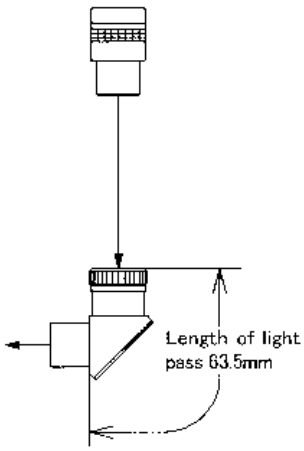


Fig. 29

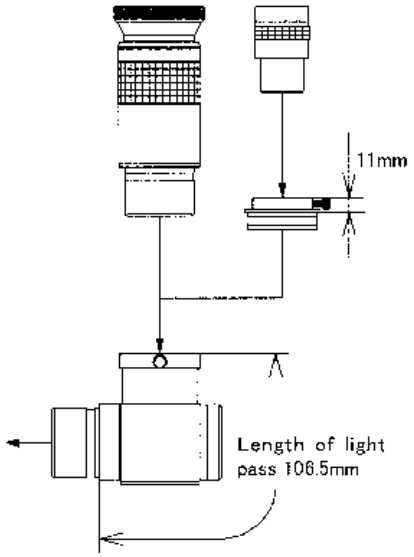
■ 31.7 Compression Ring Diagonal and Mirror Diagonal

Both of these diagonals take up different back focus. This is noted on the diagram. With the 200mm back focus this is not a problem. The 31.7 prism diagonal will require the focuser to be racked out further.



31.7 Prism Diagonal

Fig. 30



Mirror Diagonal

Fig. 31

■ Finder Scope

The 7x50 finder can be attached to the predrilled holes on the left side of the focuser.

If an 11X70 finder is used it can be attached directly to the counter weight ring using the single arm holder. The ears are threaded to accept the 11X70 finder bracket.

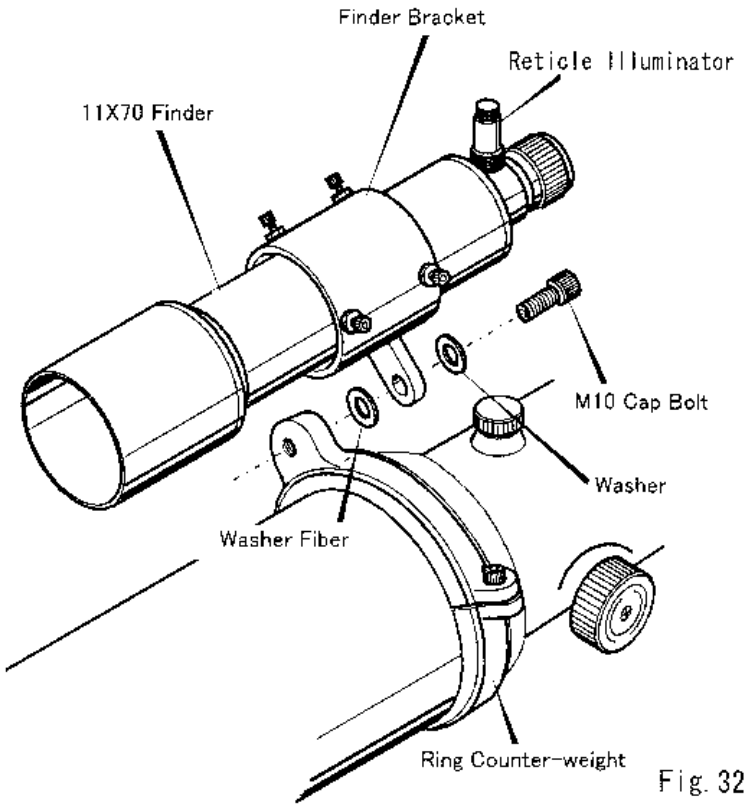


Fig. 32

■ Tube Holder

Two types of the tube holders are available. The one is a single type and the other is a double type. When a guiding scope is attached onto the main tube, the double type is useful. To set the double type tube holder onto the equatorial mount, accessory plates are available.

◆ Solar Observation

The high quality optics of the TOA-130 will provide outstanding images of the Sun. It is best to use high quality glass filters or H-alpha filter.

Never observe the sun directly. This will cause instant blindness. Cover your finder with two layers of aluminized Mylar, or an opaque cover finder to allow the observer to center the sun.



Sun Projection Observation System

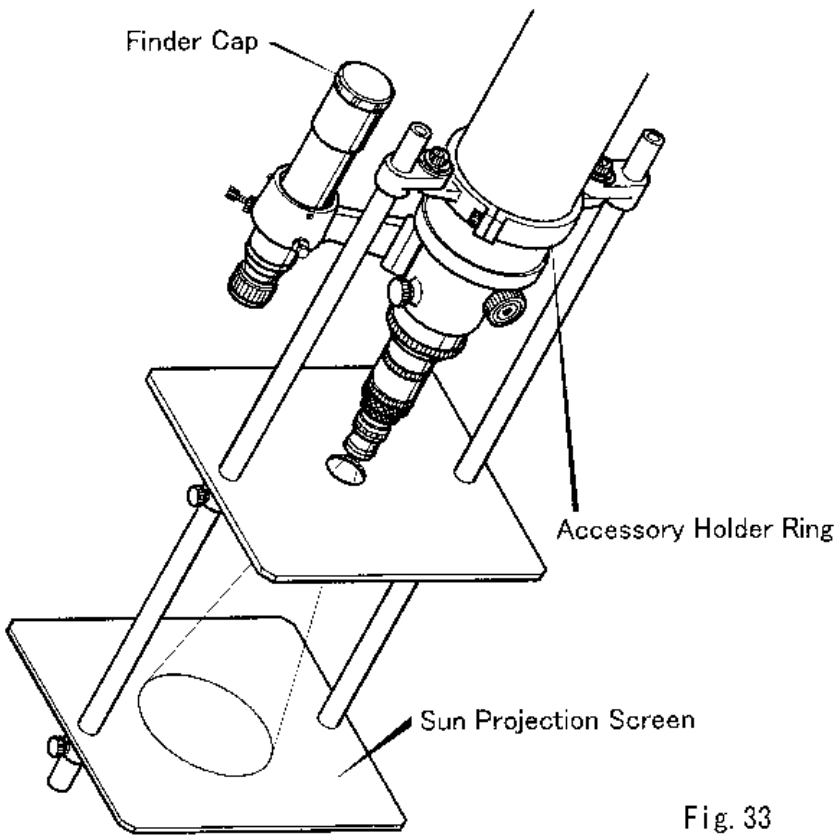


Fig. 33

Care & Maintenance

- Your TOA-130N apochromatic refractor has been precisely collimated at the factory by skilled optical technicians. In the even, as a result of a heavy blow, collimation is lost, please contact your local distributor. They will collimate the instrument and return it to you.

- If dust particles collect on the front element, retract the dew shield and remove the particles by using large handpower blower. Under no circumstances should canned air be used to remove these particles. Canned air contains a refrigerant that is very cold and could cause damage to the front element.

- Under no circumstances should the surface of the front lens be rubbed, as this could cause scratches in the coating.

- Use pure cotton swabs alightly moistened with lens cleaner and gently remove any dirt.

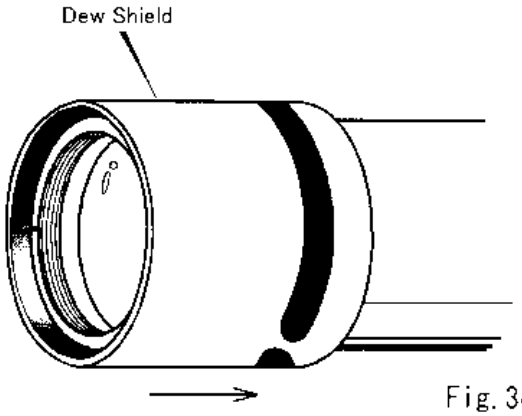


Fig. 34

Additional Precautions

- Keep the telescope away from large fluctuations in temperature. When the instrument is brought our from a warm room to colder air, dew may form.

- Store the telescope in a cool dry environment. Any dew should be removed by blowing it with a hair dryer with the heating element turned off, which means the air will be at room temperature. This flow of cool, room temperature air, will dry the dew and not leave a residue. Additionally, it is a good idea to store the telescope with a desicant [drying agent] near the objective to keep any moisture away from the objective.

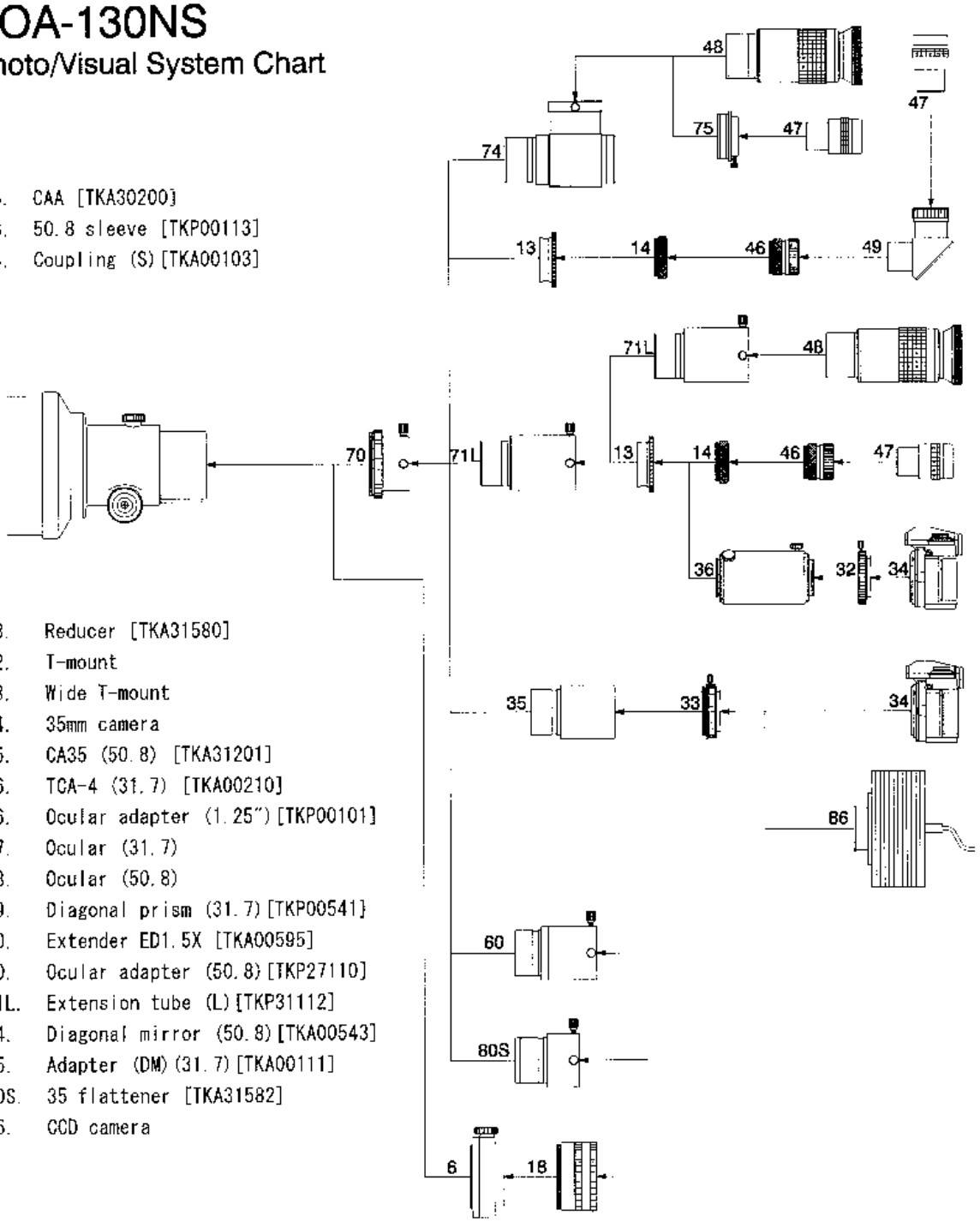
- As mentioned previousely, never use canned air due to the fact that the propellant is a refrigerant which could cause damage to the front element. If the element must be cleaned, make certain it is done in a cool room.

- Under no circumstances should the lenses be disassembled. The lenses have been properly aligned and set in place by skilled optical technician with special tools. Doing so will void any warranty on the tube assembly.

System Chart

TOA-130NS

Photo/Visual System Chart

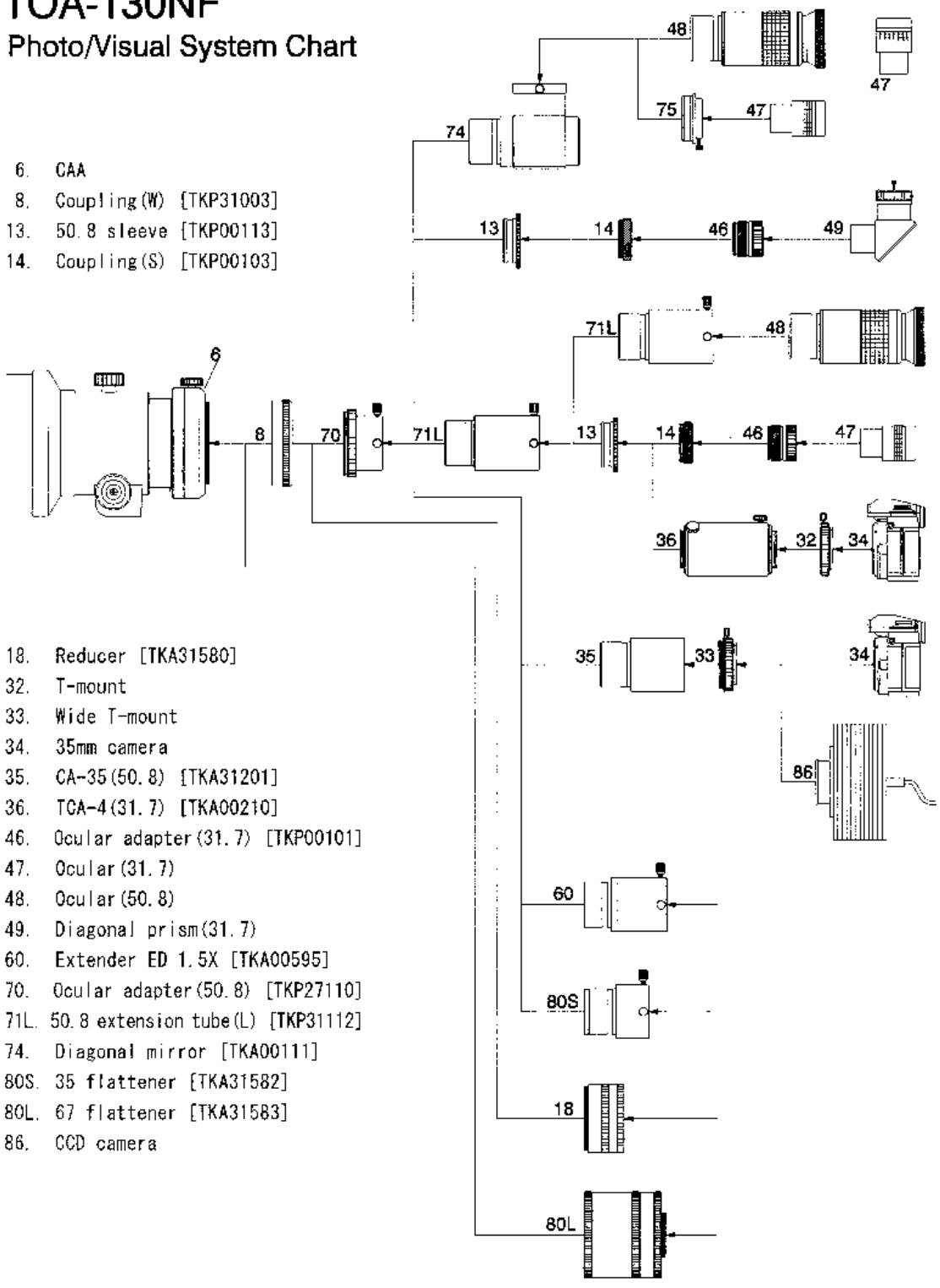


6. CAA [TKA30200]
13. 50.8 sleeve [TKP00113]
14. Coupling (S) [TKA00103]

18. Reducer [TKA31580]
32. T-mount
33. Wide T-mount
34. 35mm camera
35. CA35 (50.8) [TKA31201]
36. TCA-4 (31.7) [TKA00210]
46. Ocular adapter (1.25") [TKP00101]
47. Ocular (31.7)
48. Ocular (50.8)
49. Diagonal prism (31.7) [TKP00541]
60. Extender ED1.5X [TKA00595]
70. Ocular adapter (50.8) [TKP27110]
71L. Extension tube (L) [TKP31112]
74. Diagonal mirror (50.8) [TKA00543]
75. Adapter (DM) (31.7) [TKA00111]
80S. 35 flattener [TKA31582]
86. CCD camera

TOA-130NF

Photo/Visual System Chart



6. CAA
8. Coupling(W) [TKP31003]
13. 50.8 sleeve [TKP00113]
14. Coupling(S) [TKP00103]

18. Reducer [TKA31580]
32. T-mount
33. Wide T-mount
34. 35mm camera
35. CA-35(50.8) [TKA31201]
36. TCA-4(31.7) [TKA00210]
46. Ocular adapter(31.7) [TKP00101]
47. Ocular(31.7)
48. Ocular(50.8)
49. Diagonal prism(31.7)
60. Extender ED 1.5X [TKA00595]
70. Ocular adapter(50.8) [TKP27110]
71L. 50.8 extension tube(L) [TKP31112]
74. Diagonal mirror [TKA00111]
80S. 35 flattener [TKA31582]
80L. 67 flattener [TKA31583]
86. CCD camera

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