Newtonian Cassegrain

CN-212

Instruction Manual

TAKAHASHI

⚠ DANGER

NEVER TRY TO OBSERVE THE SUN THROUGH ANY TELESCOPE WITHOUT PROPER FILTEDR. IT WILL CAUSE PERMANENT BLINDNESS. KEEP CHILDREN AWAY FROM ANY TELESCOPE DURING DAYTIME. EVEN A SMALL FINDER SCOPE CAN DELIVER SUFFICIENT AMOUNT OF LIGHT TO MAKE EYE BLIND.

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Thank you very much for your purchase of TAKAHASHI Newtonian Cassegrain CN-212.

In order to make the best use of your instrument in your astronomical applications, please read the entire manual very carefully and familarize yourself with your instrument.

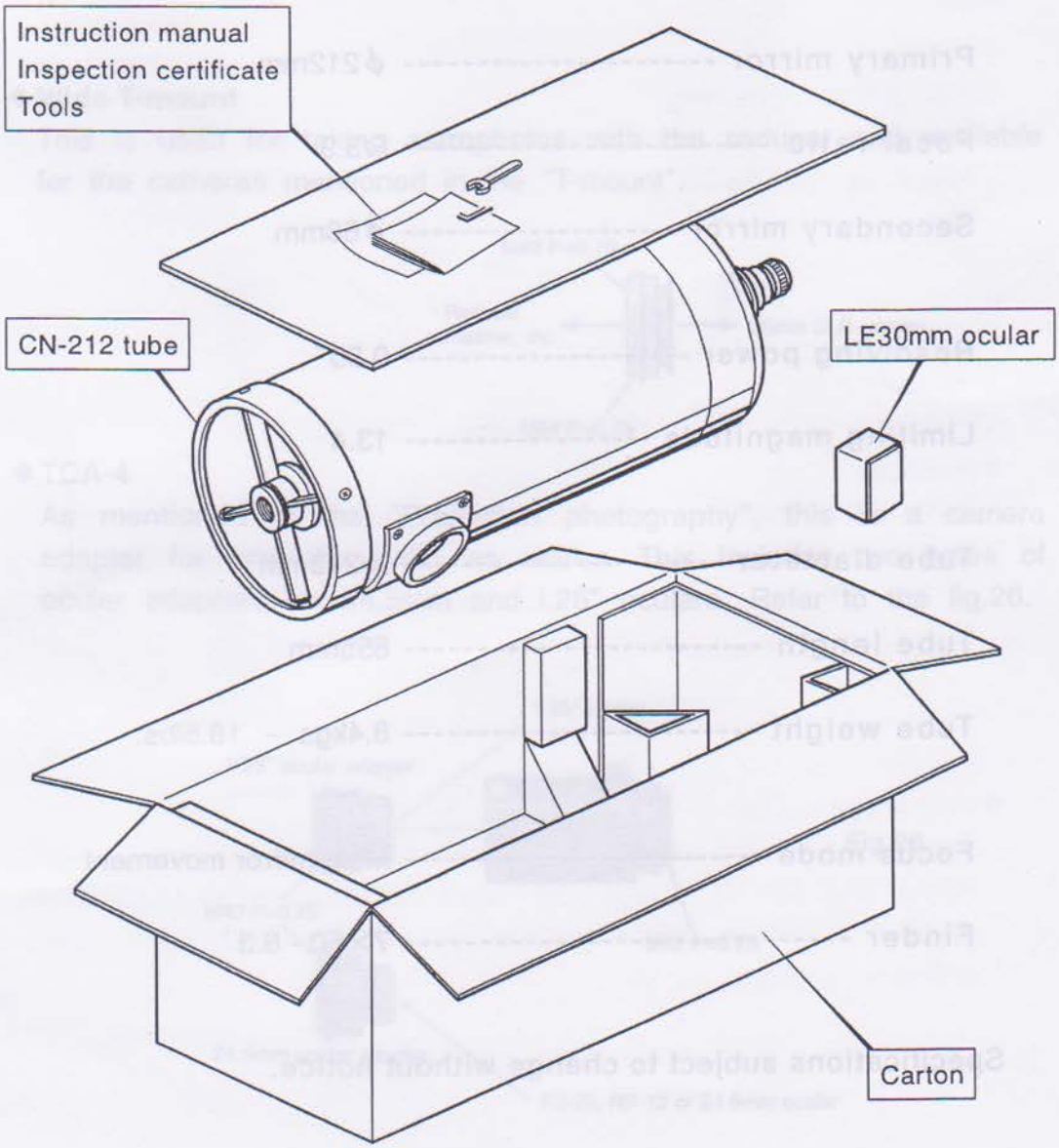
Outstanding Features of CN-212

1. By exchanging the secondary mirror of the classical Cassegrain with the diagonal mirror, your instrument turns instantly into an F/3.9 Newtonian telescope.
2. Ultra sharp images over the full field of view distinctive in the classical Cassegrain.
3. Ultra bright and faster optical system in the F/3.9 Newtonian telescope.
4. A wide variety of photo-visual accessories are available for your astronomical observation.

Unpacking instruction

When unpacking, make sure if all the contents are packed in order.

Note: An ocular LE30 is provided only with the complete set. When you buy the tube assembly only, it is not included.

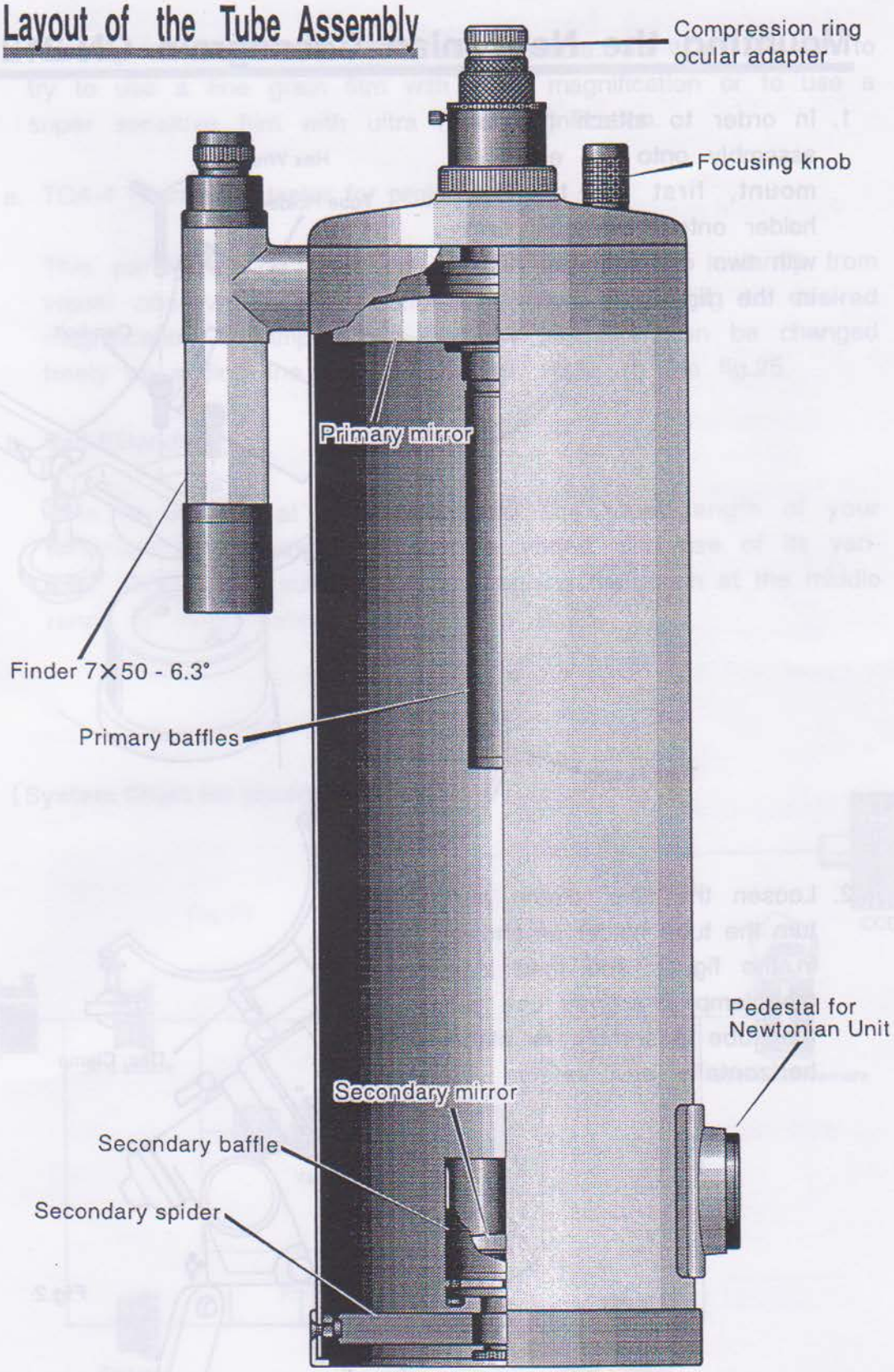


General Specifications

Effective aperture	ϕ212mm
Effective focal length	2160mm
Effective focal ratio	F/12
Primary mirror	ϕ212mm
Focal ratio	F/3.9
Secondary mirror	ϕ68mm
Resolving power	0.55″
Limiting magnitude	13.4
Tube diameter	ϕ243mm
Tube length	855mm
Tube weight	8.4kgs - 18.5lbs.
Focus mode	Main mirror movement
Finder	7×50 - 6.3°

Specifications subject to change without notice.

Layout of the Tube Assembly



Mounting the Newtonian Cassegrain CN-212

1. In order to attach the tube assembly onto the equatorial mount, first set the tube holder onto the mount firmly with two cap-bolts as shown in the fig.1.

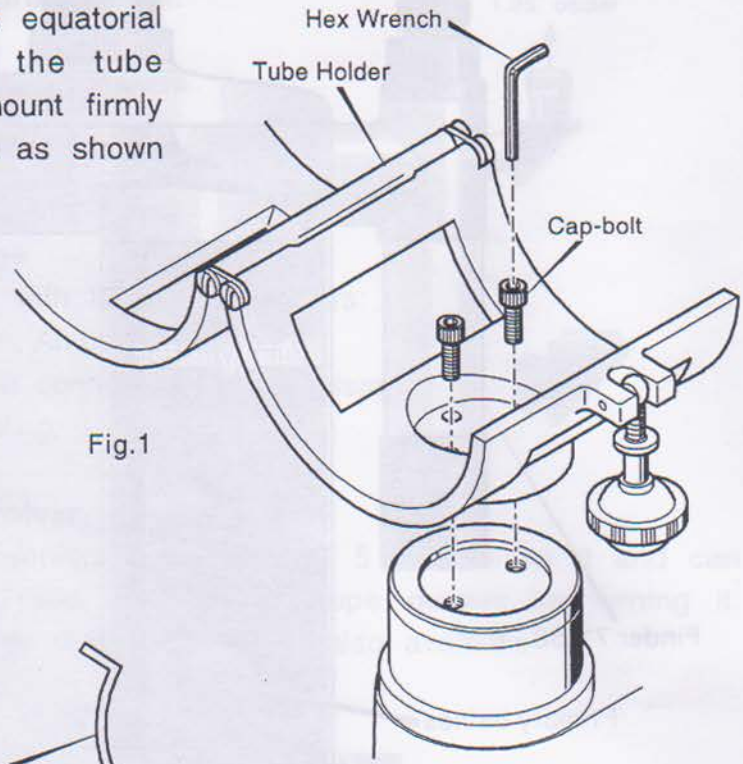
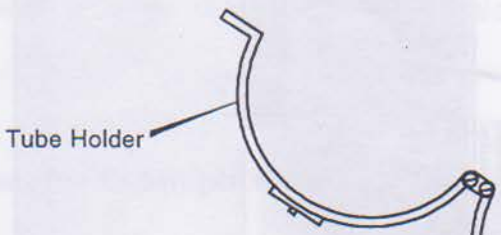


Fig.1



2. Loosen the Dec. clamp and turn the tube holder as shown in the fig 2. and then lock the clamp. Now you can set the tube assembly in place horizontally and safely.

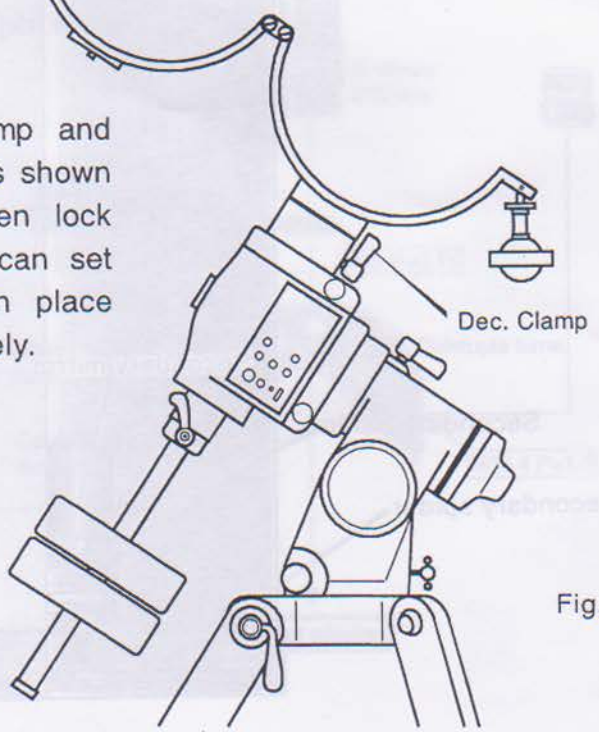
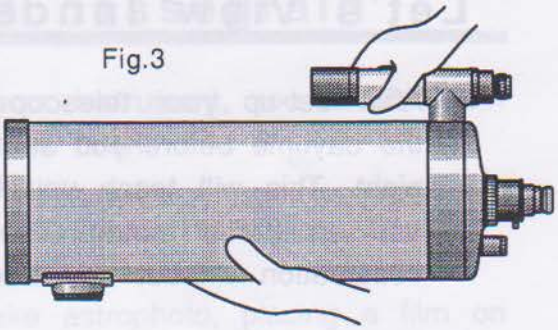


Fig.2

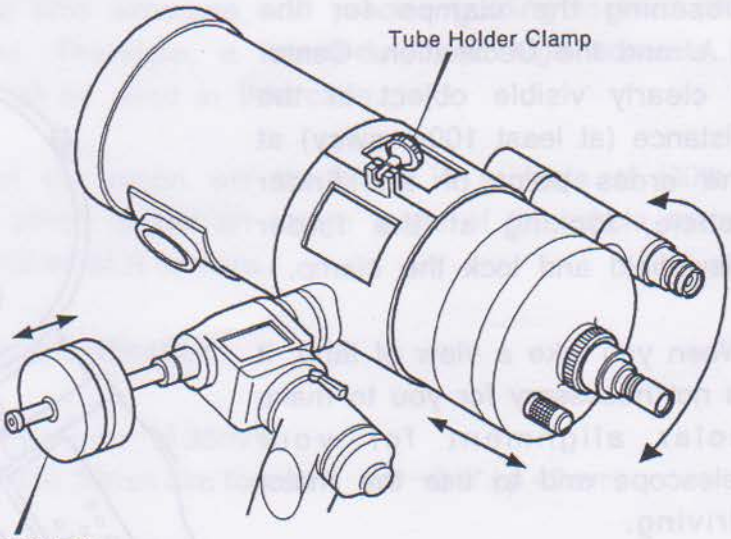
3. The tube assembly is so designed that it can be carried at ease, holding its finder scope. Hold the tube with one hand and grip the finder scope with the other hand as shown in the fig.3. Set the tube in place and lock it firmly with the locking handle.

Fig.3



4. Balancing of the tube assembly is very important. Check the balancing of the tube at its horizontal position, making the Declination clamp free and loosening the tube holder clamp, and then make the balancing of the tube, moving it forward and backward.

Fig.4



Let's view landscapes

After set-up your telescope, let's start to view landscapes in the daytime before you see some of astronomical objects in the night. This will teach you basically how to use your telescope and equatorial mount. Then, you will be able to enjoy your observation without any trouble in the night.

1. Take out the caps of the tube, of the finder scope, and of the visual back.
2. Make balancing both in the R.A. and Declination. For further details for balancing, refer to the explanation for the equatorial mount.
3. Set the tube to move freely, loosening the clamps for the R.A. and the Declination. Center a clearly visible object in the distance (at least 100m away) at the cross point of the finder reticle, looking at the finder view field and lock the clamp.

   When you take a view of land, it is not necessary for you to make polar alignment for your telescope and to use the motor driving.

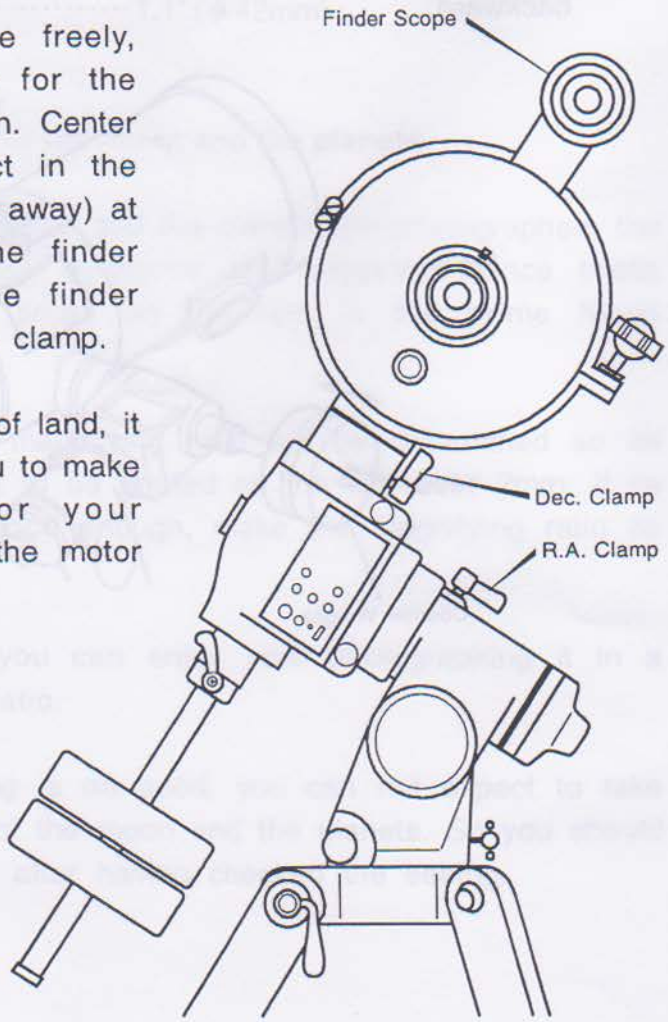


Fig.5

4. Try to view some objects with a low power ocular (an ocular with a long focal length), setting it into the ocular adapter. At first, images in the view field may be seen vague because they may be out of focus. Turn the focusing knob clockwise first. If the images will be sharply focused. Now, confirm if the object centered at the cross point of the finder reticle is the same one at the center of the view field of the main scope. If not, align the optical axis, referring to the "finder alignment".

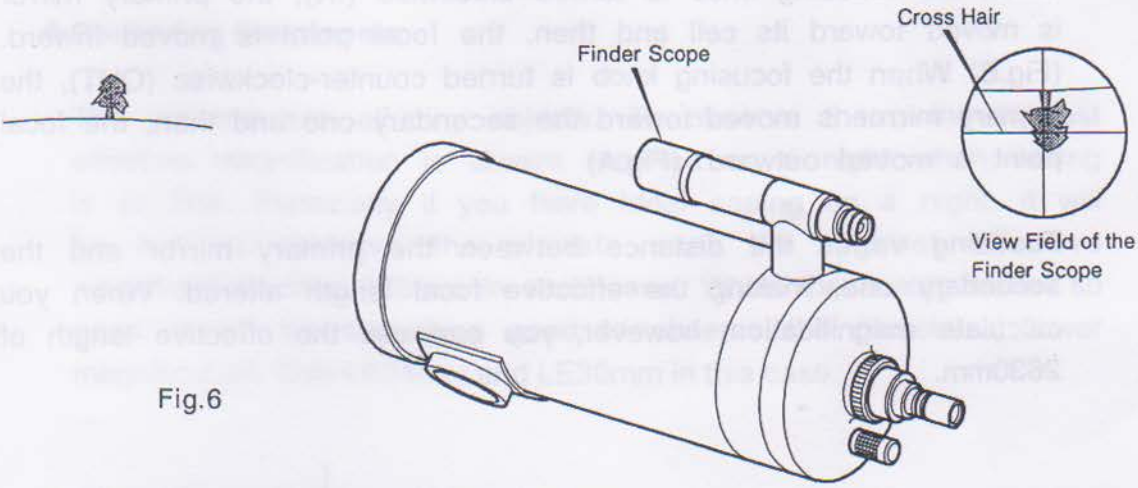
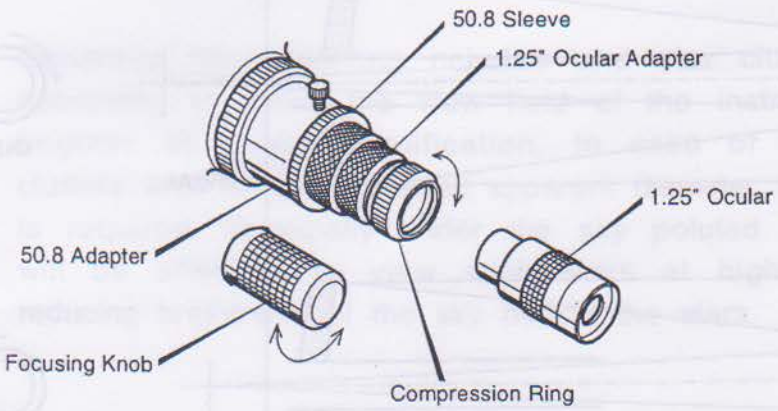


Fig.6



⚠ CAUTION

NEVER ATTEMPT TO LOOK AT THE SUN.
INTENSE LIGHT OF THE SUN WILL BURN YOUR EYE.

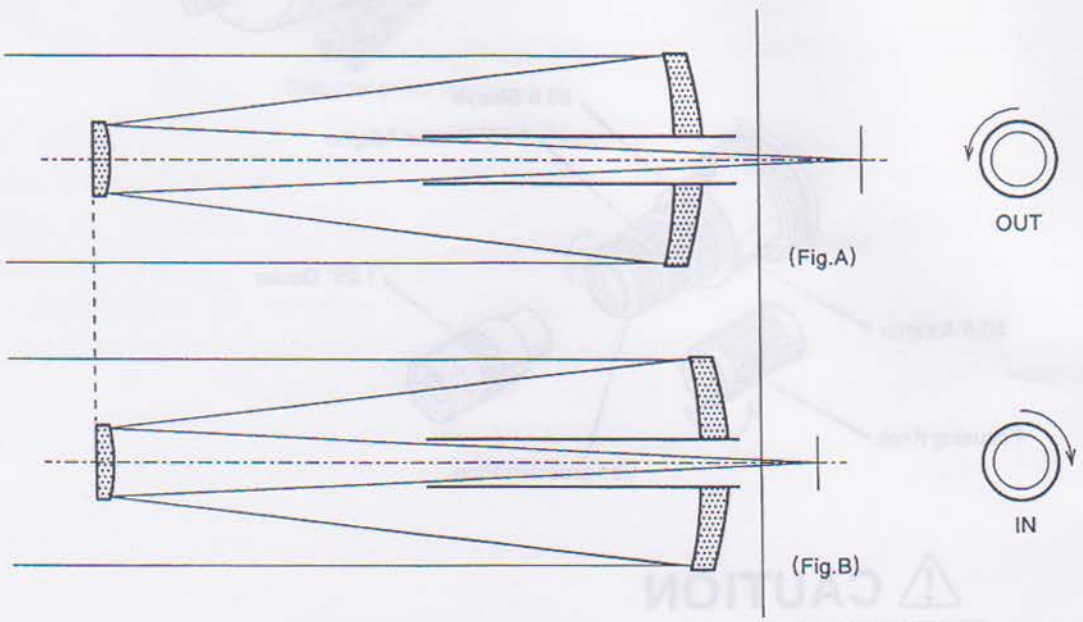
Visual Back

◆Focusing

Focusing of this optical system made by moving the primary mirror forward and backward with the focusing knob. The focal point has relation with the moving direction of the primary mirror as shown in the the diagram below.

When the focusing knob is turned clockwise (IN), the primary mirror is moved toward its cell and then, the focal point is moved inward. (Fig.B) When the focusing knob is turned counter-clockwise (OUT), the primary mirror is moved toward the secondary one and then, the focal point is moved outward. (Fig.A)

Focusing varies the distance between the primary mirror and the secondary one, making the effective focal length altered. When you calculate magnification, however, you can use the effective length of 2630mm.



◆How to use visual back (50.8 adapter)

The inside diameter of the 50.8 adapter is 50.8mm (2") so that a 2" ocular can be set. You can set a 2" ocular in and out quickly just by loosening the locking screws of the adapter. The system parts of the visual back are shown in the chart below.

At the inside edge of the 50.8 sleeve. 43mm thread is provided to connect a prime focus ring and other accessories. The 50.8 sleeve is available optionally. So if you would use the adapter with an accessory, you will be able to set the accessory to the visual back quickly whenever you like to use it. A lock ring is provided with the 50.8 adapter. You can turn the adapter, loosening the ring. It is convenient to set the camera angle in astrophotography and to change the viewing angle of a diagonal prism, etc. Be careful not to drop out the 50.8 sleeve with an accessory, loosening the locking screw too much.

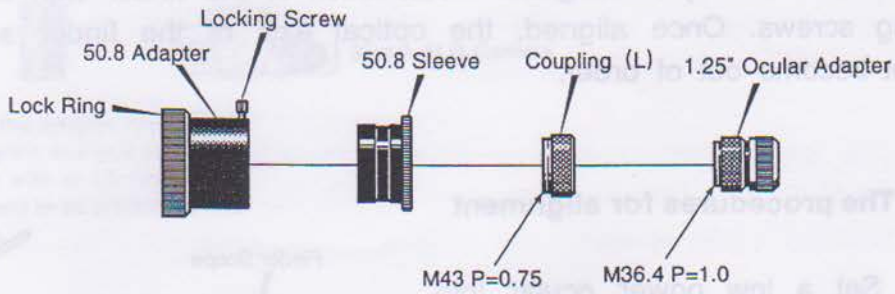


Fig.7

Aligning the finder scope

The view field of a telescope is so highly magnified and narrow that you can hardly catch, in the fiew field, the object you like to see. To help you to find the object at ease in the view field of your telescope, the finder scope with wide view field is provided with your telescope.

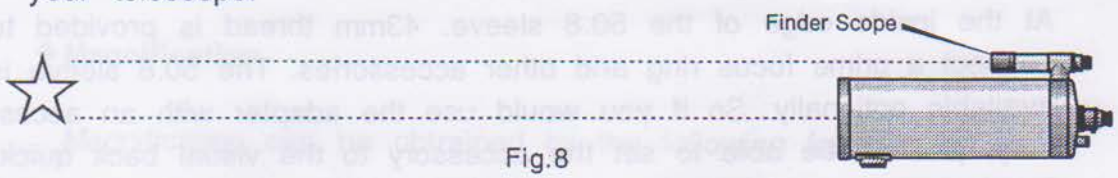


Fig.8

To see the same object in the view fields of the main scope and the finder scope, you must align the optical axes of the main scope and of the finder scope. They must be parallel each other as shown in the Fig.8. The finder of the Newtonian Cassegrain CN-212 is so made that it can be used for carrying handle permanently fixed on the main tube. Because of this structure, the optical alignment for the finder can be made by shifting the visual back of the finder with the adjusting screws. Once aligned, the optical axis of the finder scope will not become out of order.

◆The procedures for alignment

1. Set a low power ocular into the ocular adapter of your telescope and catch, in the center of the view field, the object in the distance of at least 100m away (otherwise not focused).

2. At first, loosen the lock ring and then loosen all three adjusting screws well enough so as to move the visual back freely.

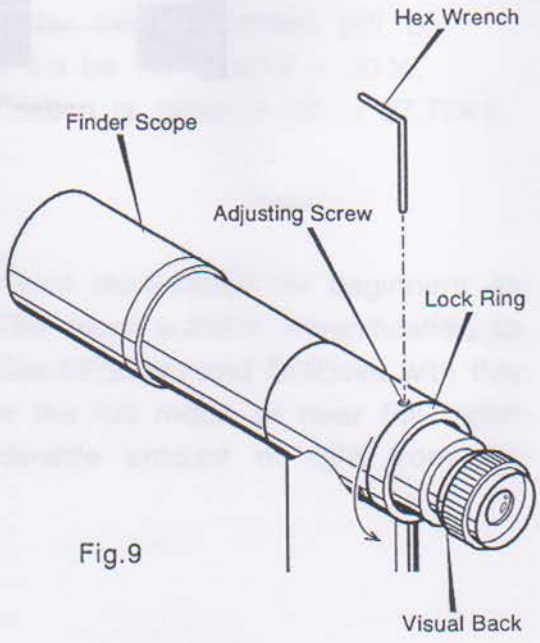
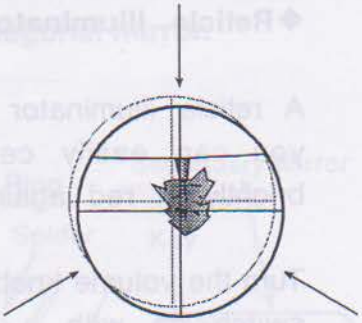


Fig.9

3. Hold the visual back with one hand and adjust the position of the visual back roughly so as to see the object, caught in the center of the view field of the main scope, at the cross point of the reticle. Then fasten the lock ring in half way with the other hand.



View Field of the Finder Scope

4. With a hex wrench provided, turn the three adjusting screws and place the object exactly at the cross point. Then, fasten the lock ring firmly to set the visual back in place.

You are now recommended to do these procedures in the daytime so that you can start your sky watching quickly in the night.

◆Reticle illuminator

A reticle illuminator is provided with the 7x50 finder scope so that you can easily center the object, seeing the reticle illuminated brightly in red against the dark sky.

Turn the volume knob clockwise and then switch on with a click. Turn further and the illumination become brighter. Turn the volume knob reversely counter-clockwise and the illumination is getting dimmer and switched off with a click. Refer to the Fig.10. Adjust the brightness of the illumination so as to see the star and reticle together at ease, looking into the finder scope.

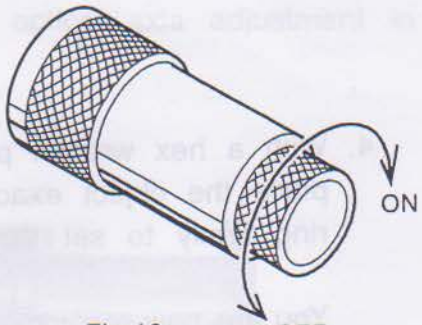


Fig.10

◆Replacing the battery in the illuminator

In case the battery must be replaced, take out the case, turning it counter-clockwise as shown in the Fig.11. Before replacing the batteries, clean the surface of them well and put them into the case, checking their polarity. Use two pieces of the mercury cell MR44 H-C (or equivalent). Refer to the Fig.11.

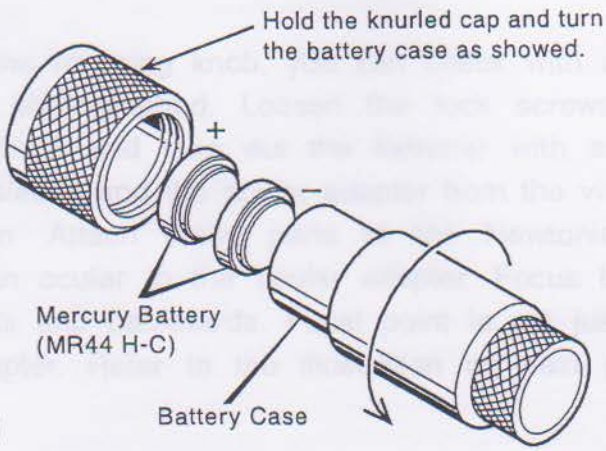


Fig.11

Air movement inside the tube

Your telescope can not be used instantly after setting because the air inside the tube is moving. Due to this, images focused in your telescope are not sharp and hard to be seen. So your telescope must be cooled down in the outside environmental temperature before you start for your observation. It will take about 40 minutes to one hour to make your telescope adapted to the temperature in the outside.

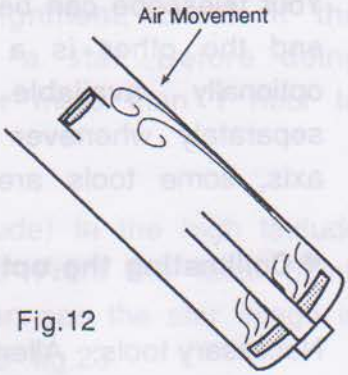


Fig.12

If such an airy pillar as shown in the fig.13 appears upward or downward when you see a star, the air movement in the tube has been not standstill yet. Once your telescope is cooled down, the air inside the tube becomes standstill and images focused are clearly seen. Start your observation after the such an airy pillar disappears.


Fig.13

Collimating the optical axis

Your telescope can be used in two ways: One is a classical Cassegrain and the other is a Newtonian telescope, using a Newtonian unit optionally available. So these optical systems must be collimated separately whenever used. To make the collimation for the optical axis, some tools are optionally available.

◆Collimating the optical axis of the Cassegrain

Necessary tools: Allen rench 1.5, 2.5; spanner 8mm (standard)
Collimating scope, Allen rench 3; spanner l4mm (optional tools)

Note: A center mark (a black dot at the center) is provided on the secondary mirror.

1. Preparation for the collimation

1) Locate a bright place like a white wall and point the tube to the bright place.

2) Take out the 3l.7mm ocular adapter from the visual back and attach the collimating scope. See the fig.14.

3) Point the diffusion plate (white plastic plate) of the collimating scope to the light source. Set the focusing tube of the scope at its original position.

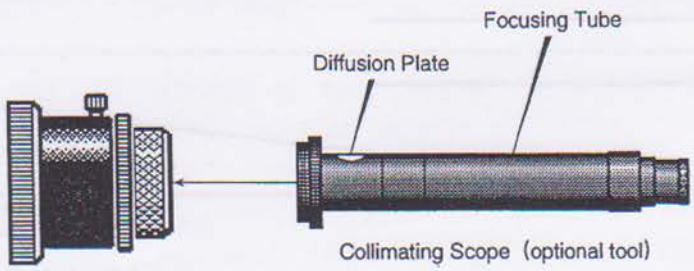


Fig.14

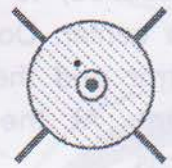
2. Collimating the optical axis of the secondary mirror

(place the center mark on the secondary mirror to the center of the collimating scope)

1) When you look through the eyepiece of the collimating scope, you can see the spider and the secondary mirror dimly in black at the center of the view field.

Fig.15

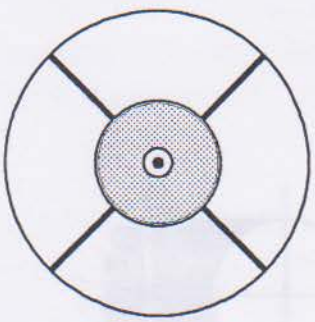
2) Set the focusing tube of the collimating scope at such position that you can see the spider clearly, sliding the focusing tube. Refer to the fig.15-a.



Check the black circle at the center of the collimating scope. If the optical axis is in order, the black circle is seen as shown in the fig.16. (The center mark is seen dimly overlapped on the center of the collimating scope.)

3) Slide the focusing tube of the collimating scope a little off from the position where the spider is clearly seen, and then the center mark of the secondary mirror will be focused as shown in the fig.15-b. If the center of the collimating scope, reflected on the secondary mirror, is just laid on the center mark, the optical axis is well collimated. If it is off, the optical axis of the secondary mirror must be collimated. Refer to the fig.15.

Fig.16



4) At first, loosen the lock nut of the adjusting screw. If the center mark of the secondary mirror is off from the center of the collimating scope as seen in the fig.15, Loosen the adjusting screws A and C, but pusing the screw B as shown in the fig.17. Then, the center mark of the secondary mirror comes close to the center of the collimating scope. Keep this procedure until the mark is just laid over the center of the collimating scope.

Note: The collimation for the secondary mirror is made with the three sets of the push screws. They are not only pushed but pulled (loosened) to make the collimation. Never touch the pull nut at the center. Doing so makes the distance between the secondary mirror and the primary one varied and it will change the focal point. At the result, some system parts will be unable to focus.

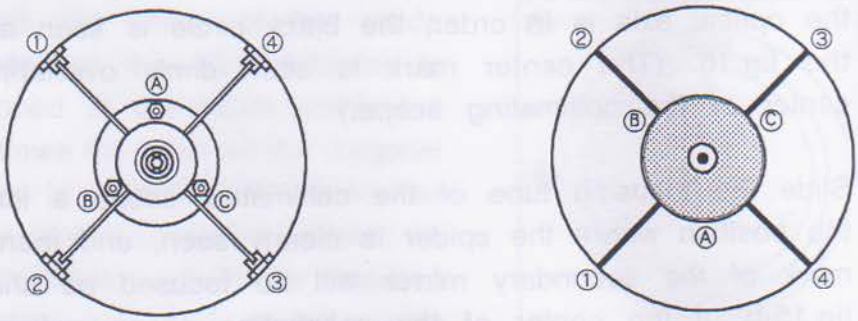


Fig.17

3. Adjusting the spider

1) Focus the spider with the collimating scope. Carefully look at the outer circle of the buffle of the secondary mirror and you see a circle in thin white a little bit inward as shown in the fig.16. This is the outer circle of the baffle of the primary mirror. If this is seen in a concentric circle with the baffle of the secondary mirror, the spider is in no need to be adjusted. If not, the spider must be adjusted.

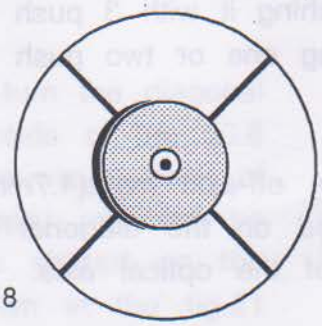


Fig.18

2) For example, take the case as shown in the fig.18 where the outer circle of the buffle of the secondary mirror is shifted to the left side. Loosen with an Allen rench the pull screws ① and ② in the fig.17 and tighten the screws ③ and ④.

3) When the outer circles of the buffles of the primary and the secondary mirror are seen largely in a concentric circle, check the collimation for the optical axis of the secondary mirror. Adjustment for the spider will make the optical axis of the secondary mirror out of order. So in turn adjust the secondary mirror again. Repeat this procedure until the optical system is seen as shown in the fig.16. Then, tighten the secondary miror lock nuts and the spider lock nuts, checking the optical axis is in order.

◆Optical axis alignment for the Newtonian system

This will be made with a collimating tube and a collimating eyepiece. These are optionally available. Besides these tools, Allen renches (l.5mm,2.5mm, and 3mm), spanners (8mm and l4mm) and screw driver are necessary to do this alignment.

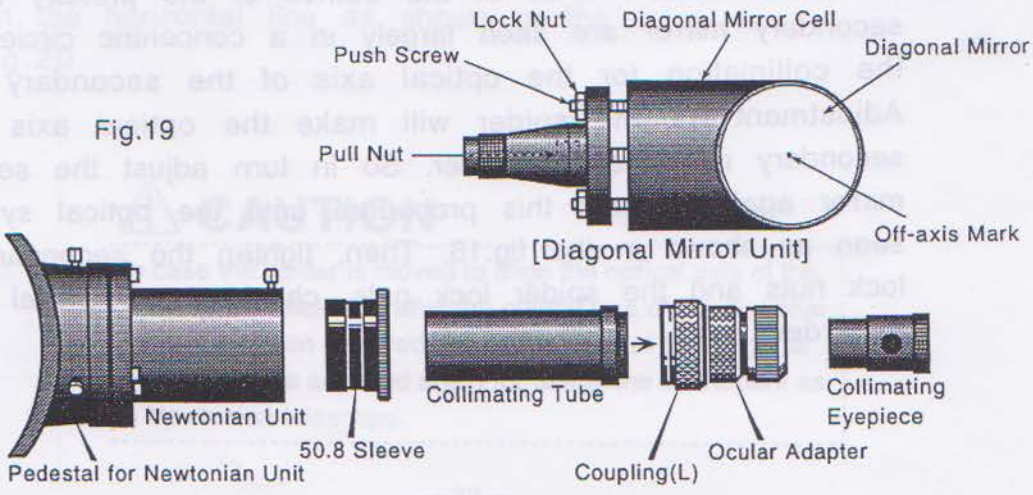
The optical axis adjustment for the diagonal mirror will be made at its position. The adjustment includes turning the mirror (by loosening the pull screw), shifting back and forth (by loosening the pull screw and by pushing it with 3 push screws or by reverse action), tilting (by loosening one or two push screws and by pushing other screw(s).

* As a reference, off-axis mark(4.7mm off from the center to the left) is provided on the diagonal mirror. This mark shows the actual center of the optical axis.

1. Preparation for the optical axis alignment

◇ Attach the Newtonian unit to the base of the visual back and connect the collimating tube to the coupling(L).
◇ Attach the collimating eyepiece to the ocular adapter.
◇ Take out the flattener and in exchange attach the 50.8 sleeve, the collimating tube with the coupling(L), and the ocular adapter.
◇ Take out the secondary mirror of the Cassegrain and in exchange attach the diagonal mirror in place. Refer to the fig.24.

Fig.19



1) Loosen the lock nuts on the visual back and turn the 50.8 sleeve so as to make the crossline of the collimating tube horizontal and perpendicular. Place the tube assembly on such position that both of the edge of the tube is faced to a plain and bright place like a white wall.

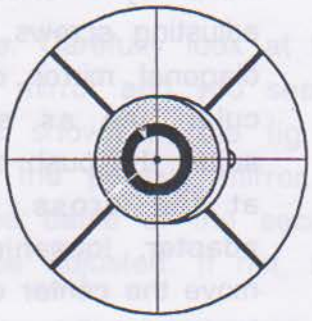
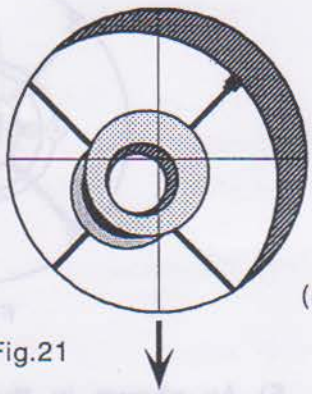


Fig.20

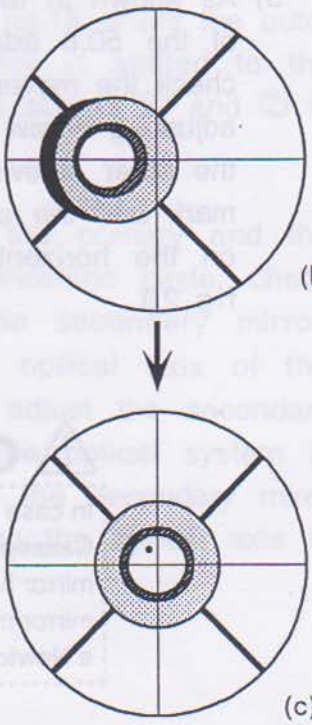
2) Loosen the pull nut to turn the diagonal mirror tube until the inside of the 50.8 adapter (attached to the visual back of the Cassegrain telescope) reflected on the diagonal mirror is shifted on the horizontal line as shown in the fig.21 (a) to (b).



(a)

Fig.21

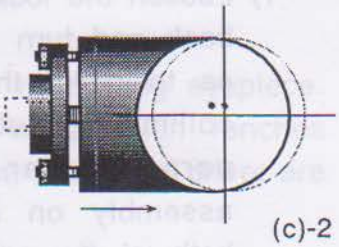
3) Bring the center of the 50.8 adapter at the cross, adjusting the push screws of the diagonal mirror. When the A screw shown in the fig.22 is screwed in, the 50.8 adapter will be moved to the cross as shown in the fig.(b) to (c). In the fig.(c)-1 the center of the 50.8 adapter is positioned at the cross, but the mark on the diagonal mirror will be at the upper left. Now the diagonal mirror must be moved toward the primary mirror and be faced downward.



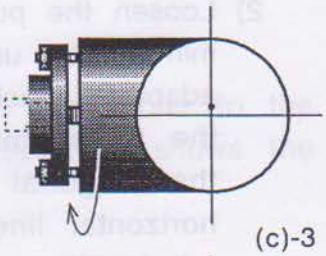
(b)

(c)-1

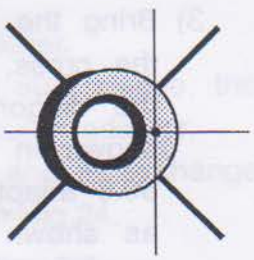
4) Loosen the pull nut of the diagonal mirror by a driver and screw in all the adjusting screws. When the mark on the diagonal mirror comes on the perpendicular line as shown in the fig.(c)-2, adjust the push screws to bring the mark at the cross. Then, turn the 50.8 adapter, loosening the pull screw and move the center of the 50.8 sleeve on the horizontal line as shown in the fig.(c)-3,fig.(d).



(c)-2



(c)-3



(d)

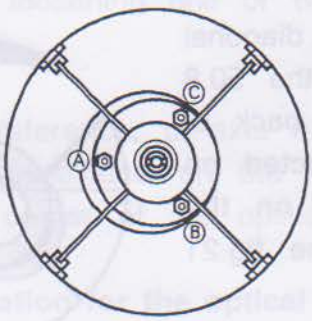


Fig.22

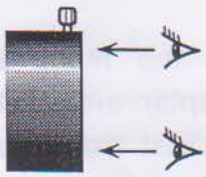
5) As shown in the fig.(d), when the center of the 50.8 adapter is seen at the left, check the movement of it by screwing the adjusting screw A and if necessary with the other screws. By doing so, place the mark and the center of the 50.8 adapter on the horizontal line as shown in the fig.20.

⚠ CAUTION

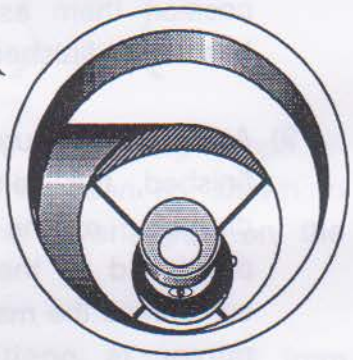
In case the spider is moved to align the optical axis of the Cassegrain telescope after the optical axis of the diagonal mirror has been adjusted, the optical axis of the diagonal mirror must be adjusted again for use of the instrument as a Newtonian telescope.

If you could not have the optical axis correctly aligned, try further according to the following procedures.

6) Take out the 50.8 sleeve from the visual back. Take a look at the side wall of the diagonal mirror holder through the 50.8

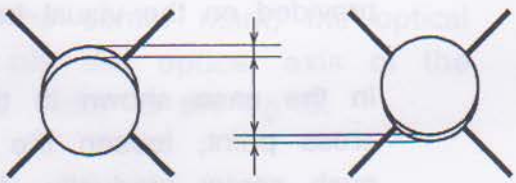


(e)

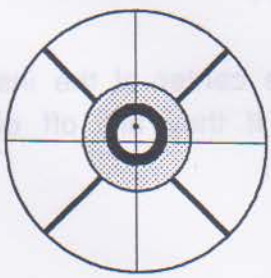


adapter and check the width of it viewed from the upper edge of the 50.8 adapter and from the lower edge as shown in the fig.(e). In the fig.(f), the holder is viewed better and positioned lower. If the width viewed in both case is equal, the alignment is finished.

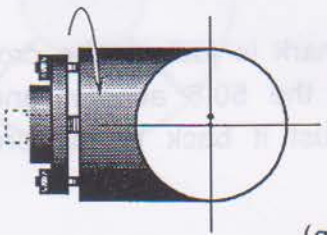
7) Loosen the screw C and push the screw B to adjust the position of the diagonal mirror holder so as to be seen its side in equal width from the both edge of the 50.8 adapter.



(f)



(g)-1



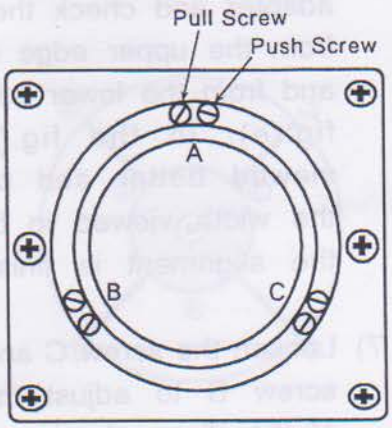
(g)-2

8) Next check again the position of the mark on the diagonal mirror and you can see the center of the inside diameter of the 50.8 adapter is positioned above the cross line. Refer to the fig.(g)-1.

Loosen the pull nut of the diagonal mirror and turn its holder. Then, the center of the inside diameter of the 50.8 adapter will come close to the cross line. When it comes to the cross point, tighten the pull nut.

Once more be certain that the cross point, the mark on the diagonal mirror, and the center of the 50.8 adapter are positioned on a concentric point. If they are not on it, adjust the screws to position them as seen in the fig.20. Then, the optical alignment has been finished.

9) As the procedure No.8 has been finished, the center of the inside diameter of the 50.8 adapter is positioned at the cross point, but sometimes the mark on the diagonal mirror is positioned above or below the concentric point. In these cases, adjust its position with the pull and push screws provided on the visual back.



(h)

In the case shown in the fig.(g)-2, if the mark is off from the cross point, loosen the pull screw in the fig.(h) and push the push screw gradually. At the same time, loosen the other pull screws a little and push the pull screws so that the visual back is a bit floated. As the A screw is pushed, the mark will come to the cross.

When the mark is just on the cross, check the center of the inside diameter of the 50.8 adapter and the cross. If they are off each other, readjust it back to the procedure No.2.

◆Checking the star image

After having finished the optical axis alignment, check if the optical axis is adjusted correctly, viewing a star. Before doing this, leave your instrument in the outside for more than 1 hour to make it adapted to the outside temperature.

Pick up the brighter star (2nd or 3rd magnitude) in the high latitude and bring it to the center of the view field. From the focal point, move the star image in and out. Then, you can see the star image in and out as the diffraction rings shown in the fig.23.

In case the optical axis is in order, the center, the inner ring, the middle ring, and the outer ring are all on the concentric circle both in the image in and out. If not in order, the centers of these rings are our of order. Then, the readjustment is required. When the focuser knob is turned counter-clockwise (OUT) from the focal point, the inner image can be seen and turn it clockwise, the outer image can be seen. The off-centering of these rings can be easily check just in and out of the focal point.

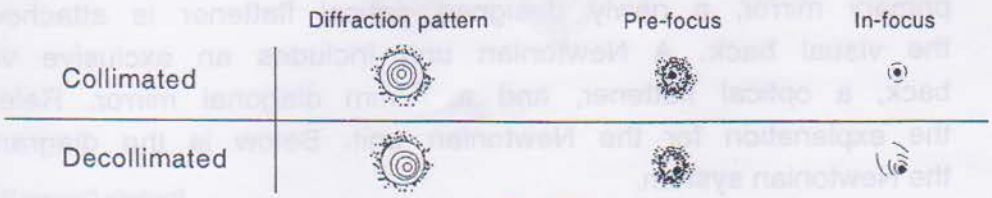


Fig.23

* The center of the diffraction ring can be seen not so easily due to the shadow of the secondary mirror.

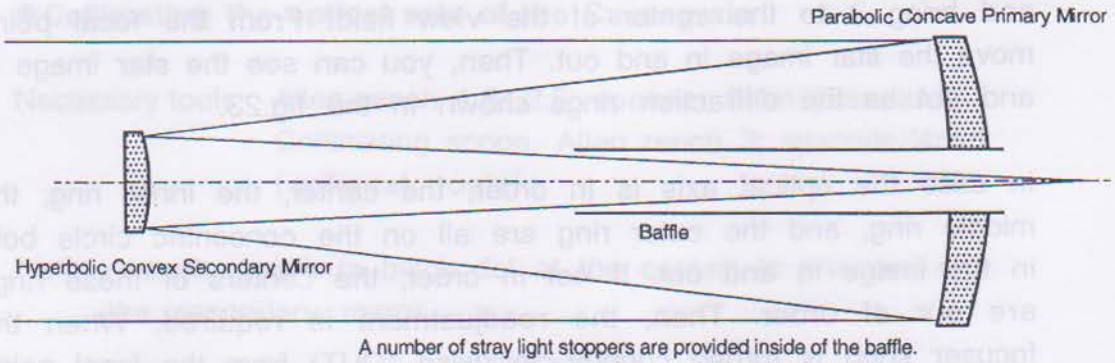
* While the air in the tube is moving, the diffraction rings can be seen as if the optical axis is out of order.

* The instrument can not perform as it should be, while the optical axis remains out of order. Start your observation after you have checked that the optical axis is in order, using a star image.

Cassegrain and Newtonian System

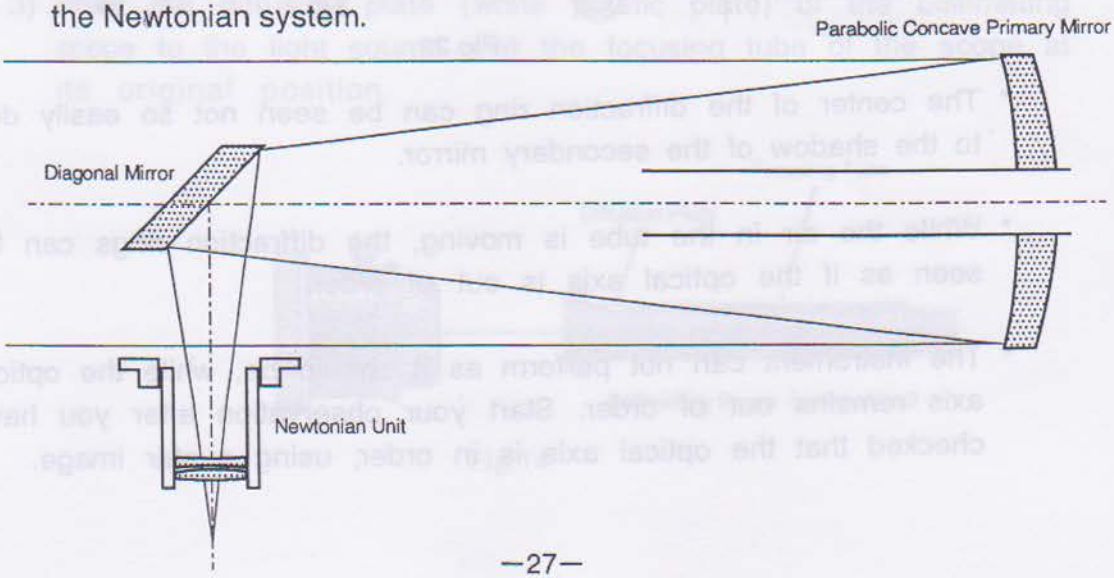
This instrument can be used in two ways by exchanging the secondary mirror and the diagonal mirror.

O In the Cassegrain, the original focal length by the parabolic F3.9 primary mirror is extended further by 3.2x by the hyperbolic secondary mirror to such a telescope with a long focal length of an effective focal ratio of F/12.4. Refer to the diagram.



A number of stray light stoppers are provided inside of the baffle.

O With use of a Newtonian unit optionally available, the instrument can be used as an F/3.9 Newtonian optical system. Take out the secondary mirror of the Cassegrain and set a 72mm diagonal mirror in place. To improve coma and curvature produced by the F/3.9 primary mirror, a newly designed optical flattener is attached to the visual back. A Newtonian unit includes an exclusive visual back, a optical flattener, and a 72mm diagonal mirror. Refer to the explanation for the Newtonian unit. Below is the diagram of the Newtonian system.



◆Exchange for the secondary mirror and the diagonal mirror.

When the instrument is used as a Newtonian system, the secondary mirror must be exchanged to the diagonal mirror. The optical axis adjuster screws are provided independently on these mirrors. So, once the optical axis of both mirrors has been adjusted in order, the optical axis will not be out of order whenever the mirrors are exchanged each other. See the fig.24.

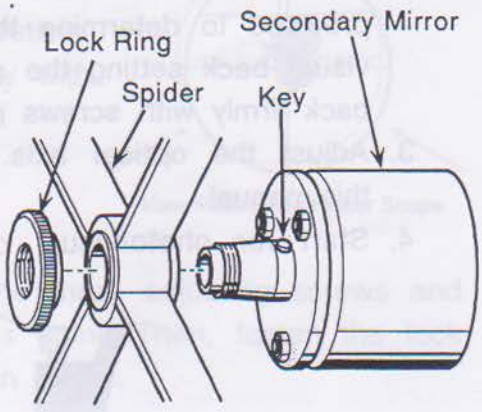
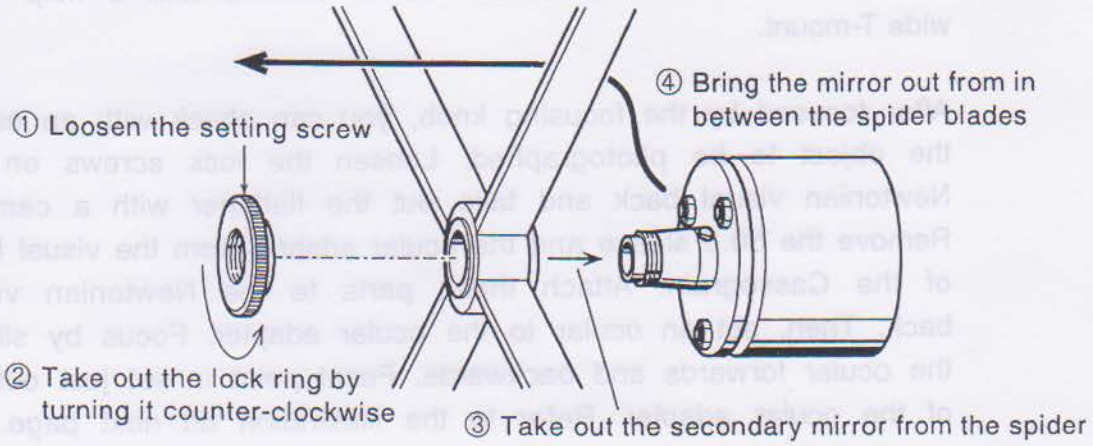


Fig.24

When you exchange the mirrors, set the tube horizontally. At first, take out the secondary mirror from the spider. Be careful not to drop and hit them, when exchanging.

Attach the diagonal mirror to the spider in the reverse procedure, fitting the key of the unit to the keyway of the spider. Tighten the lock ring firmly and lock it with a set screw. At the first setting, the optical axis must be adjusted in order. Refer to the explanation for the optical axis adjustment.

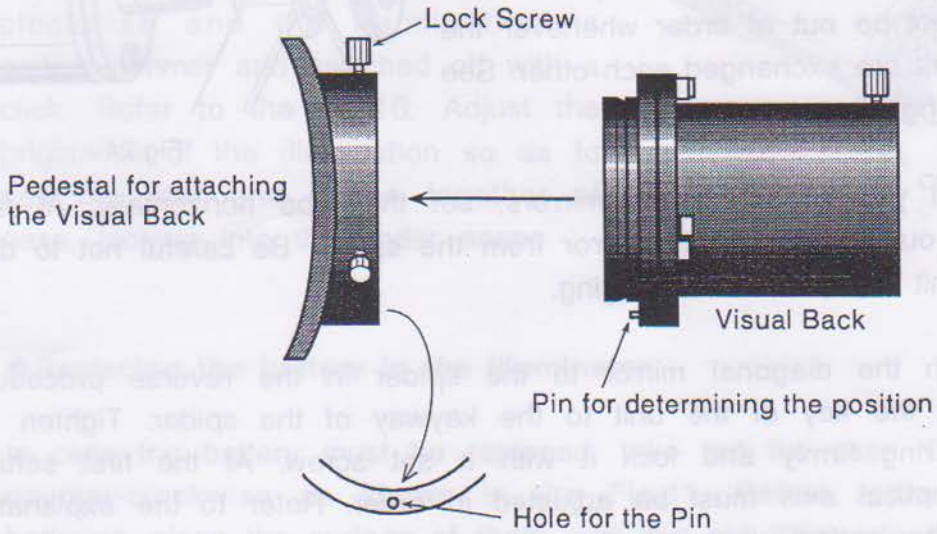
Below is an illustration how to exchange the mirrors.



* When exchanging the mirrors, be careful not to touch your fingers the aluminized mirror face.

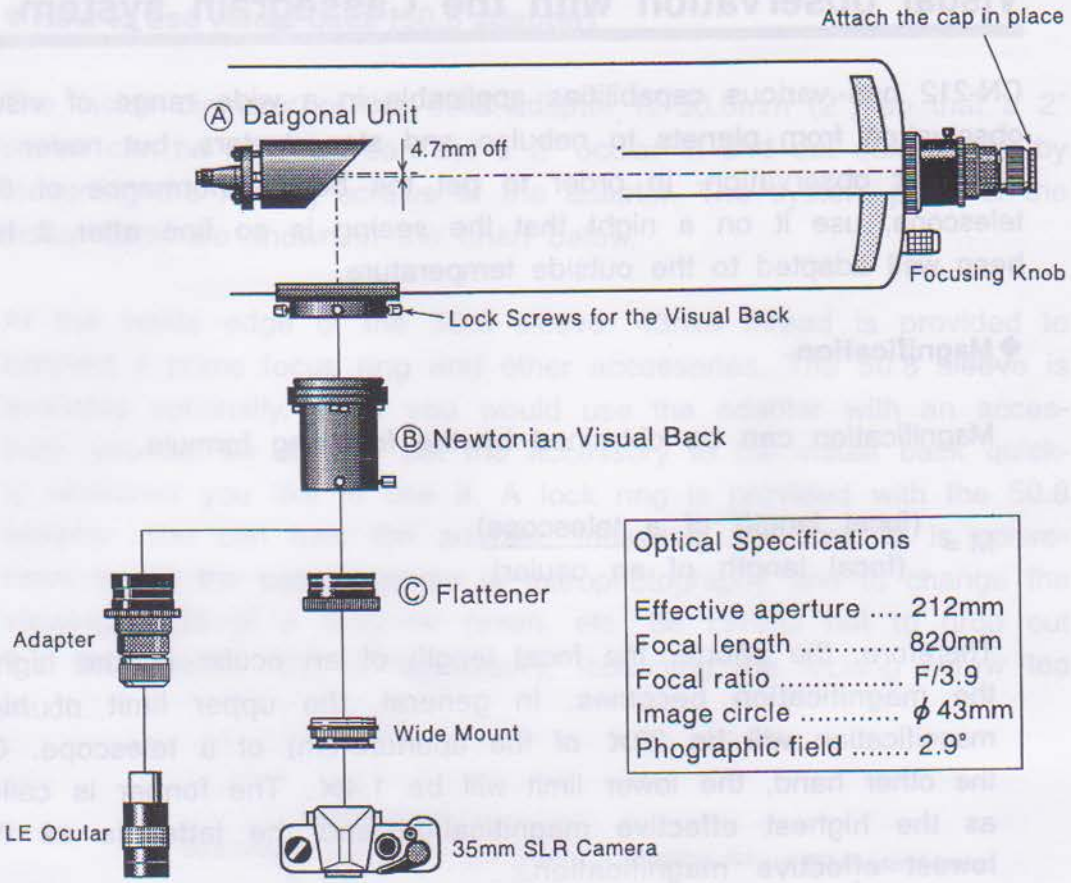
◆Attaching the Newtonian unit and photographing with it

1. Change the secondary mirror to the diagonal mirror.
2. On the base for attaching the visual back, a small hole is provided to determine the position of the visual back. Attach the visual back setting the pin into the hole and then lock the visual back firmly with screws provided on the base.
3. Adjust the optical axis. Refer to the optical axis adjustment in this manual.
4. Start for photo/visual observation.



Focusing for the Newtonian system can be adjusted with a focusing knob as same as in the Cassegrain. In photographing, attach the flattener to the visual back and set a camera with a help of a wide T-mount.

After focused by the focusing knob, you can check with an ocular the object to be photographed. Loosen the lock screws on the Newtonian visual back and take out the flattener with a camera. Remove the 50.8 sleeve and the ocular adapter from the visual back of the Cassegrain. Attach these parts to the Newtonian visual back. Then, set an ocular to the ocular adapter. Focus by sliding the ocular forwards and backwards. Focal point is set just outside of the ocular adapter. Refer to the illustration on next page.



Optical Specifications

Effective aperture	212mm
Focal length	820mm
Focal ratio	F/3.9
Image circle	ϕ 43mm
Phographic field	2.9°

* Attach the adapter for the Cassegrain and you can check visually with an LE ocular the object to be photographed.

Visual observation with the Cassegrain system

CN-212 has various capabilities applicable in a wide range of visual observation from planets to nebulae and star clusters, but never for the solar observation. In order to get the best performance of this telescope, use it on a night that the seeing is so fine after it has been well adapted to the outside temperature.

◆Magnification

Magnification can be obtrained by the following formula.

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

Therefore, the shorter the focal length of an ocular is, the higher the magnification becomes. In general, the upper limit of high magnification will be 20× of the aperture(cm) of a telescope. On the other hand, the lower limit will be 1.4×. The former is called as the highest effective magnification and the latter is as the lowest effective magnification.

The highest effective magnification by this instrument will be 20 × 21.1 = 424 × and the lowest will be 1.4 × 21.2 = 30×.
In case, LE30 is used, the magnification is 2630 ÷ 30 = 87.7(×).

◆Observing the moon

The moon is an ideal object for visual observation for beginners as well as for advanced observers. The most suitable magnification to see the whole moon will be 50×. Use LE50mm and Or40mm with this instrument. Do not continue to see the full moon or near full moon for a long time since the considerable amount of light from the moon may harm your eye.

There are a number of craters and valleys on the moon. Just to view these complicated land will give you a great pleasure. To observe it more in details, more or less 10× of the effective aperture (cm) of the instrument is most suitable. Use LE12.5 ocular in this case. When seeing is ideal, try to observe the moon at the highest effective magnification. You can observe craters and land more in details on the moon which you have not noticed yet. Use LE7.5mm in this case.

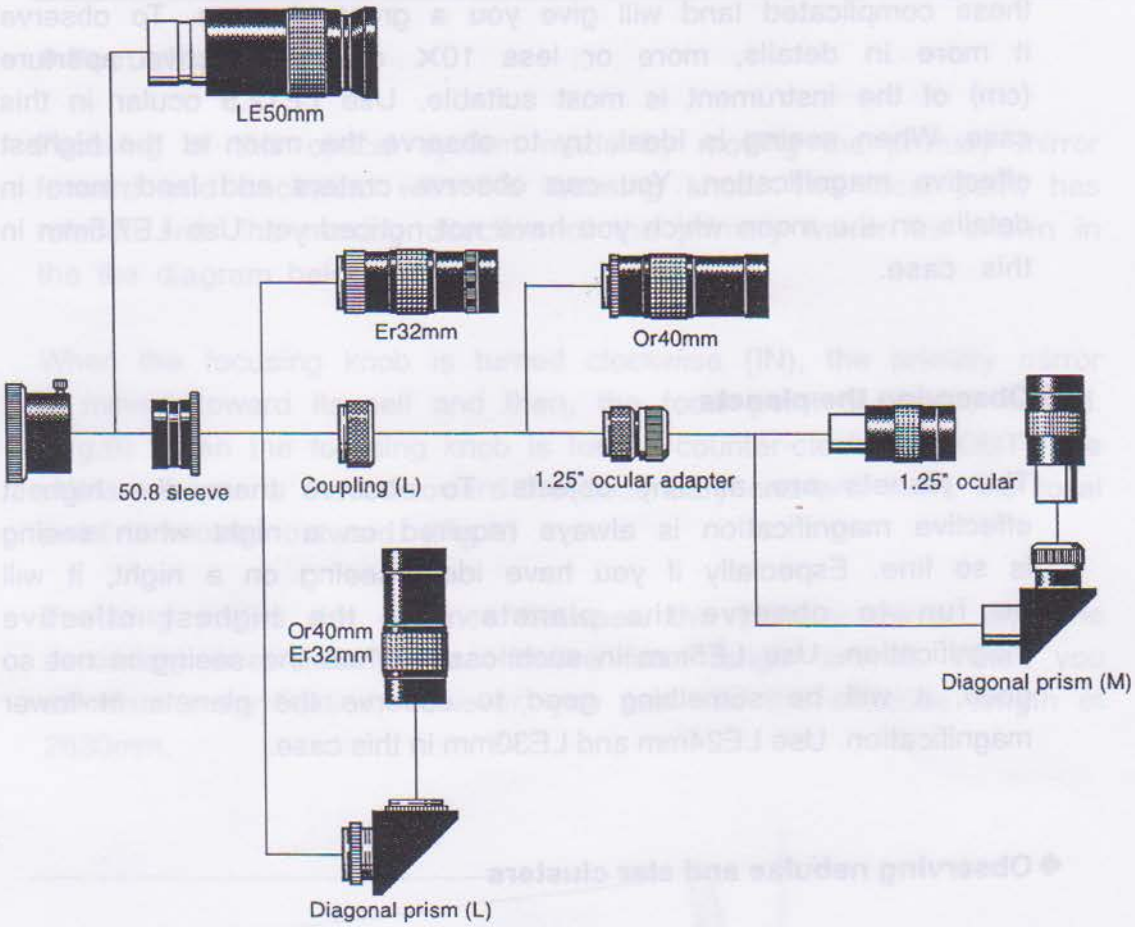
◆Observing the planets

The planets are all tiny objects. To observe them, the highest effective magnification is always required on a night when seeing is so fine. Especially if you have ideal seeing on a night, it will be fun to observe the planets over the highest effective magnification. Use LE5mm in such case. When the seeing is not so good, it will be something good to observe the planets at lower magnification. Use LE24mm and LE30mm in this case.

◆Observing nebulae and star clusters

Generally for observing nebulae and star clusters, it will be necessary to make the view field of the instrument wider and brighter at lower magnification. In case of viewing globular clusters and nebulae of small apparent diameter, high magnification is required. Especially under the sky poluted by city lights, it will be effective to view such stars at higher magnification, reducing brightness of the sky behind the stars.

◆System Chart for visual observation



Photographing with cassegrain

In order to make the best use of your instrument, you should learn well how to use the parts in the system chart.

◆Photographing with prime focus

This is one of the methods to take astrophoto, placing a film on the prime focal point. The instrument is used as a telephoto lens of focal length of 2630mm. As a classical Cassegrain, this instrument can produce very excellent photograpic images across its photo field.

This instrument is ideal for taking photos of small galaxies as the focal length is long: in other words, high magnification can be obtained. On the other hand, the focal ratio is so dark that it needs a long time exposure and precise guiding to take photos of small galaxies. Therefore, a heavy-duty and high accurate equatorial mount must be used in this case.

The image of the moon will be taken in a scale of l/l0th of the focal length, which is just an image scale of the whole moon to be taken with a 35mm SLR camera.

Photographic specification

Image circle ····· ϕ 36mm
Photo field on the 35mm film format ····· 0.9° (ϕ 42mm)

◆Photographing with the reducer

The exclusive reducer is optionally available. This will make the focal length shorter and the photo field less coma. So the star images to be produced will be batter than with the prime focus. Originally the focal ratio of this instrument is so large that it will not become lighter even with use of the reducer, but this way of photographing is ideal for taking small galaxies and planetary nebulae because the image circle is large.

Photographic specifications with the reducer

Effective focal length ·····2105mm
Effective focal ratio ·····F/9.9
Image circle ····· ϕ 29mm
Photo field ·····1.1° (ϕ 42mm)

◆Projection photography for the moon and the planets

When the details on the moon and the planets are photographed, the following parts (optionally available) are suggested since these objects are taken so small on the film in the prime focus photography.

In case of the planets, magnifying ratio will be determined so as to the image of a planet to be printed on the film over 2mm. If its light amount would be good enough, make the magnifying ratio as large as possible.

In case of the moon, you can enjoy your photographing it in a variety of magnifying ratio.

In the night when seeing is no good, you can not expect to take good photos regardless of the moon and the planets. So you should start your photographing after having checked the seeing.

Recently various kinds of films are available. So it will be fun to try to use a fine grain film with lower magnification or to use a super sensitive film with ultra high magnfication.

a. TCA-4 (Camera Adapter for projection)

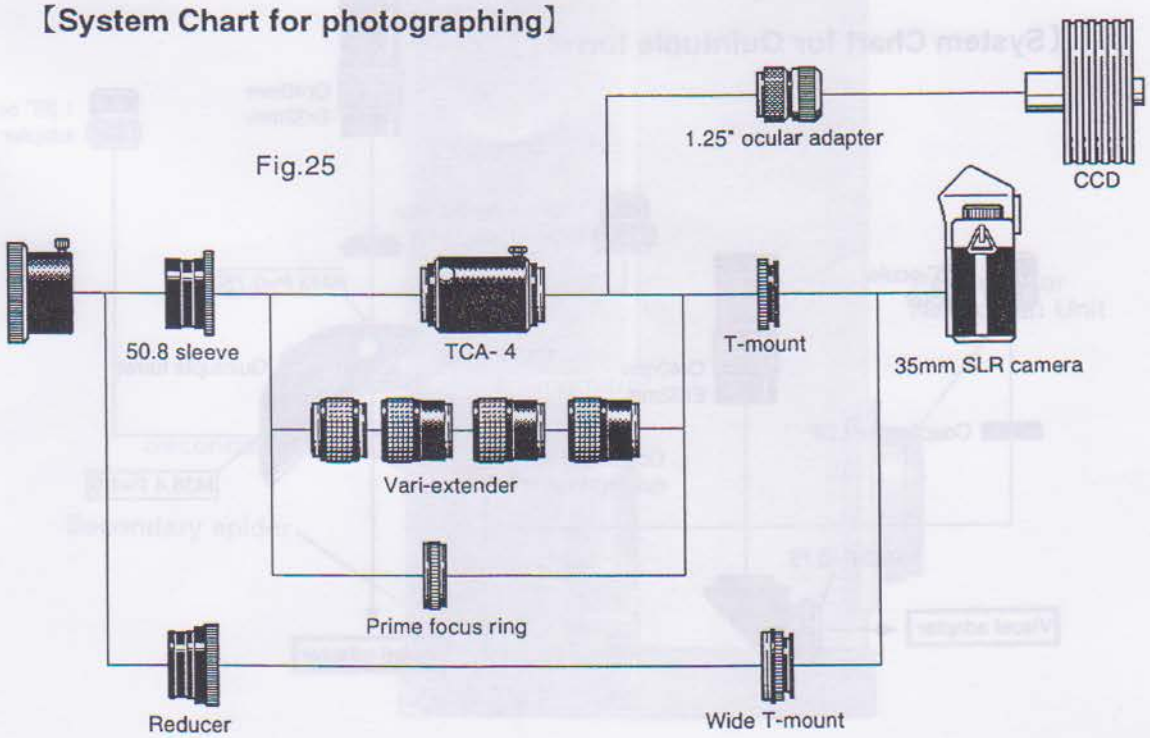
This parts can be attached on the visual back instantly from visual observation. To exchange oculars according to desired magnification is simple and easy. Magnification can be changed freely by sliding the magnifying tube. Refer to the fig.25.

b. Vari-Extender

This is an optical lens to extend the focal length of your telescope. Magnifying ratio can be varied with use of its vari-tube. This lens is suited for photographing the moon at the middle range of magnification. Refer to the fig.25.

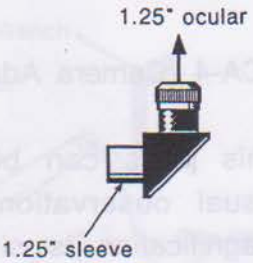
[System Chart for photographing]

Fig.25



Accessories for photo/visual observation

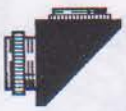
For a wide range of photo/visual applications, various accessories are availabl.



◆**Diagonal prism for 1.25" oculars**

◆**Diagonal prism, large**

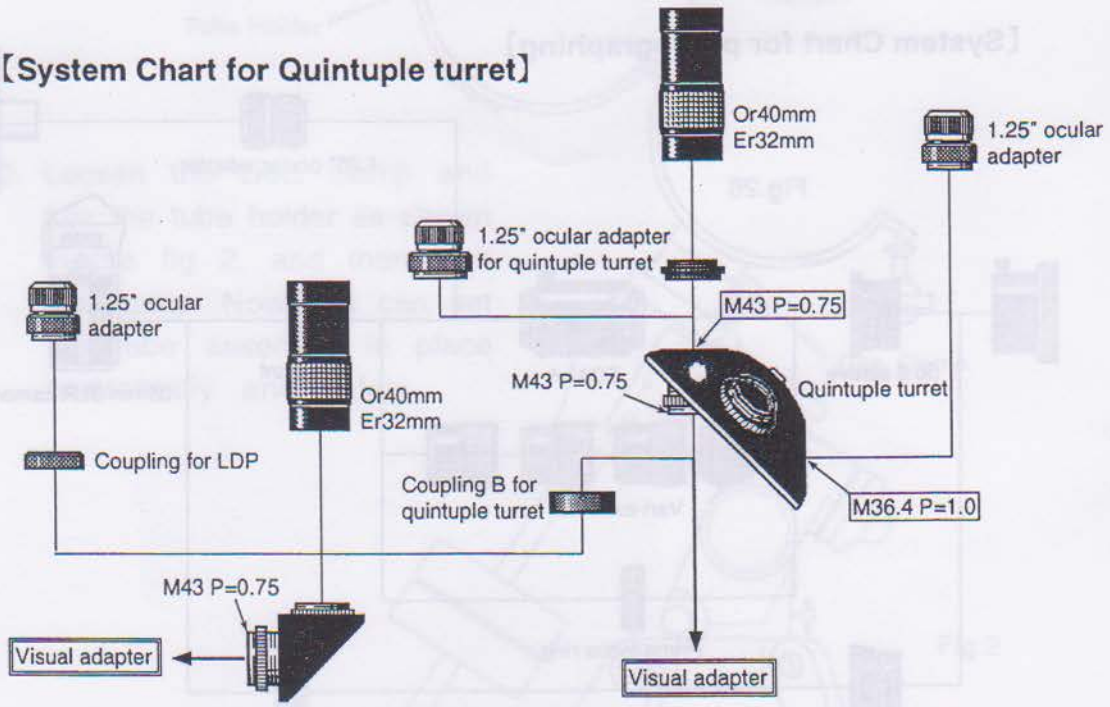
This prism is used with large size oculars: Er32mm and Or40mm. An ocular adapter for 1.25" oculars can be connected to this prism by means of a coupling.



◆**Quintuple turret revolver**

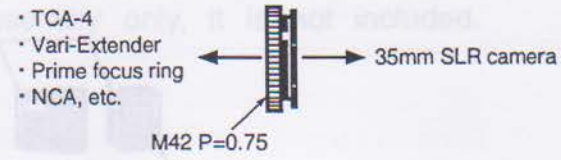
This is a very convenient device to set 5 oculars on it and can change magnifying ratio of your telescope quickly by turning it. The one with a large diagonal prism is also available.

[System Chart for Quintuple turret]



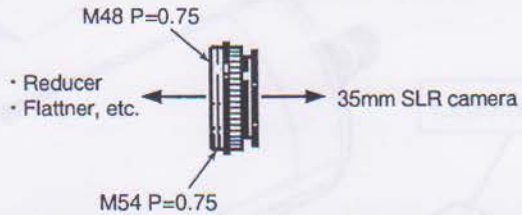
◆T-mount

This parts is used to attach an SLR camera to your telescope and available for Nikon, Canon, Canon EOS, Olympus OM, Minolta α, and Pentax K.



◆Wide T-mount

This is used for taking astrophotos with the reducer and available for the cameras mentioned in the "T-mount".



◆TCA-4

As mentioned in the "Projection photography", this is a camera adapter for projection with an ocular. This includes two types of ocular adapters for 24.5mm and l.25" oculars. Refer to the fig.26.

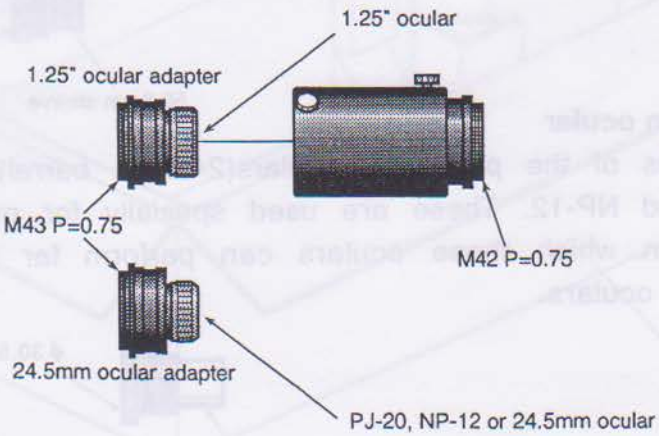
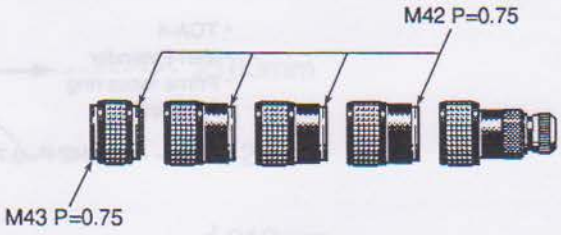


Fig.26

◆**Vari-Extender**

This is used to extend the focal length of your telescope and useful for photo/visual applications for a middle range of magnification. This includes an extender lens, 3 vari-tubes, and an ocular adapter.



◆**TSC prime focus ring**

This is used for taking astrophotos with the cassegrain system. Refer to the fig.27.

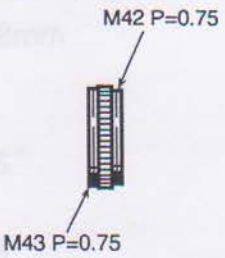
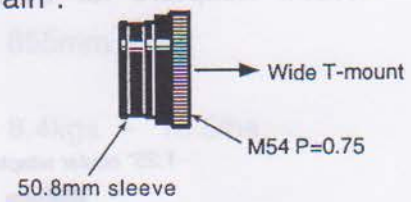


Fig.27

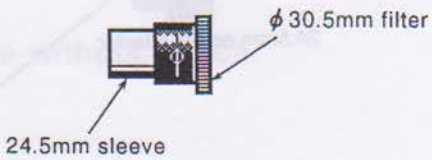
◆**Reducer**

This is an optical lens for astrophotography and reduces the focal length of the instrument and also reducing coma aberration. Refer to the "Photographing with the cassegrain".



◆**Projection ocular**

Two types of the projection oculars(24.5mm barrel) are available: PJ-20 and NP-12. These are used specially for projection photography, in which these oculars can perform far better than by ordinary oculars.

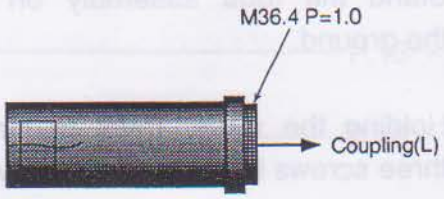


◆Collimating scope

This is used for adjusting optical axis of the Cassegrain. If you like to use this instrument for the other cassegrain than CN-212, provide the center mark on the secondary mirror. This can be also used for adjusting optical axis of a refractor with a focal length of more than 800mm.

◆Collimating tube

This is used for adjusting optical axis of a Newtonian system in combination use with the collimating scope. If you like to use this collimating scope for the other Newtonian telescope, the mark at the center of the diagonal mirror is required. Attach the cross hair on the tube opening.



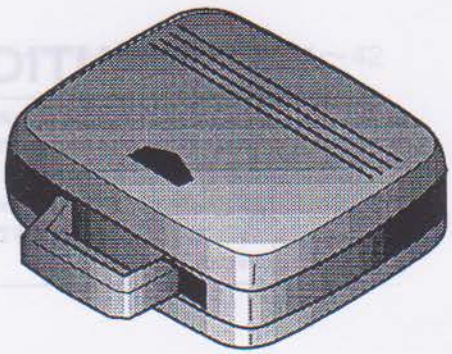
◆Collimating eyepiece

Two types of the collimating eyepieces are available: 24.5mm and 1.25" barrel. These are used for adjusting the optical asxis of a reflector. Its combination use with the collimating tube permits to do more precise adjusting the optical axis.

◆Plastic case

This can store the followings.

CN-212 reducer, Newtonian unit, collimating scope, collimating tube, and collimating eyepiece



Care and Maintenance for your telescope

The primary mirror of your CN-212 is exposed directly to the open air. If the surface of the mirror is left covered with dusts and dew, it will become dim and make the contrast of images worse. With the following procedures, clean up dusts from the surface of the mirror with a blower at the regular interval. When you set the mirror back onto the tube, set the cell precisely in place with the tube. Then, lock them with screws and the optical axis will hardly become out of order. Refer to the fig.28.

Caution: The space between the outer edge of the primary mirror and the inner wall of the tube is so narrow that great care must be taken not to hit each other when you take out the primary mirror.

1. Stand the tube assembly on a level place, facing its opening to the ground.

2. Holding the visual back to stand the tube safely and take out the three screws locking the primary mirror cell.

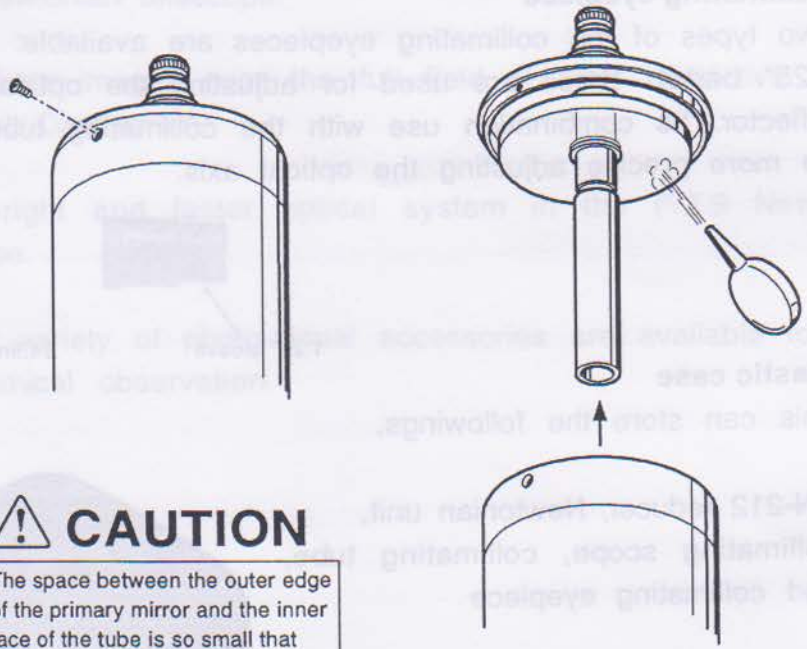


Fig.28

⚠ CAUTION

The space between the outer edge of the primary mirror and the inner face of the tube is so small that great care must be taken not to hit each other when you take out the primary mirror.

3. Pull up the primary mirror cell slowly with great care not to touch the mirror to the inside wall of the tube. Be certain that the end of the long baffle is completely out of the tube. If the primary mirror cell is set in the tube too tightly, pull it out very slowly until it comes totally out of the tube.

Note:

* After used, put the caps onto the opening of the tube and the ocular adapter to shut the dust out.
* When the tube well cooled in the outside is brought into the warm room, dew will sometimes form on the inside wall of the tube. Therefore, bring the tube into the room after it is closed up tightly with the caps.
* Dirt on the tube can be cleaned with car wax.
* When the mirrors become cloudy in white, they must be cleaned up or plated again. Is the dealers for repair.
* It is better for the secondary mirror to be cleaned by a blower in a regular interval.

Trouble Shooting

Symptoms	Check	Action
Nothing can be seen.	Is the cap taken out?	Take out the cap.
	Is the ocular set in?	Nothing can be seen without the ocular. Set the ocular in the ocular adapter.
	Is not dew formed cloudy on the surface of the mirror or the ocular lens?	Do not try your observation in such places as grassy area and liver side where there may exist high humidity. If could not, make anti-dewing inside of the tube.
	Is the finder aligned?	If the finder is not aligned with the main scope, the desired object will not be caught in the view field. Do alignment at first.
	Is the telescope focused?	Focus with the focusing knob.
Star images are seen fuzzy.	Is not dew formed on the surface of the mirror or the ocular?	Dry out the dew, sending the wind with a fun and the like. Do not use hot air.
	Do you use your telescope in good combination?	Check the system chart and use the parts correctly as shown.
Star images are seen deformed.	Have your telescope adapted well enough to the outside air?	Use your telescope after it has been adapted to the air for at least one hour.
	Is the optical axis well collimated?	Collimate the optical axis correctly.
	Is the atmosphere stable?	Do not try your observation in such a night when scintillation and seeing are no good.

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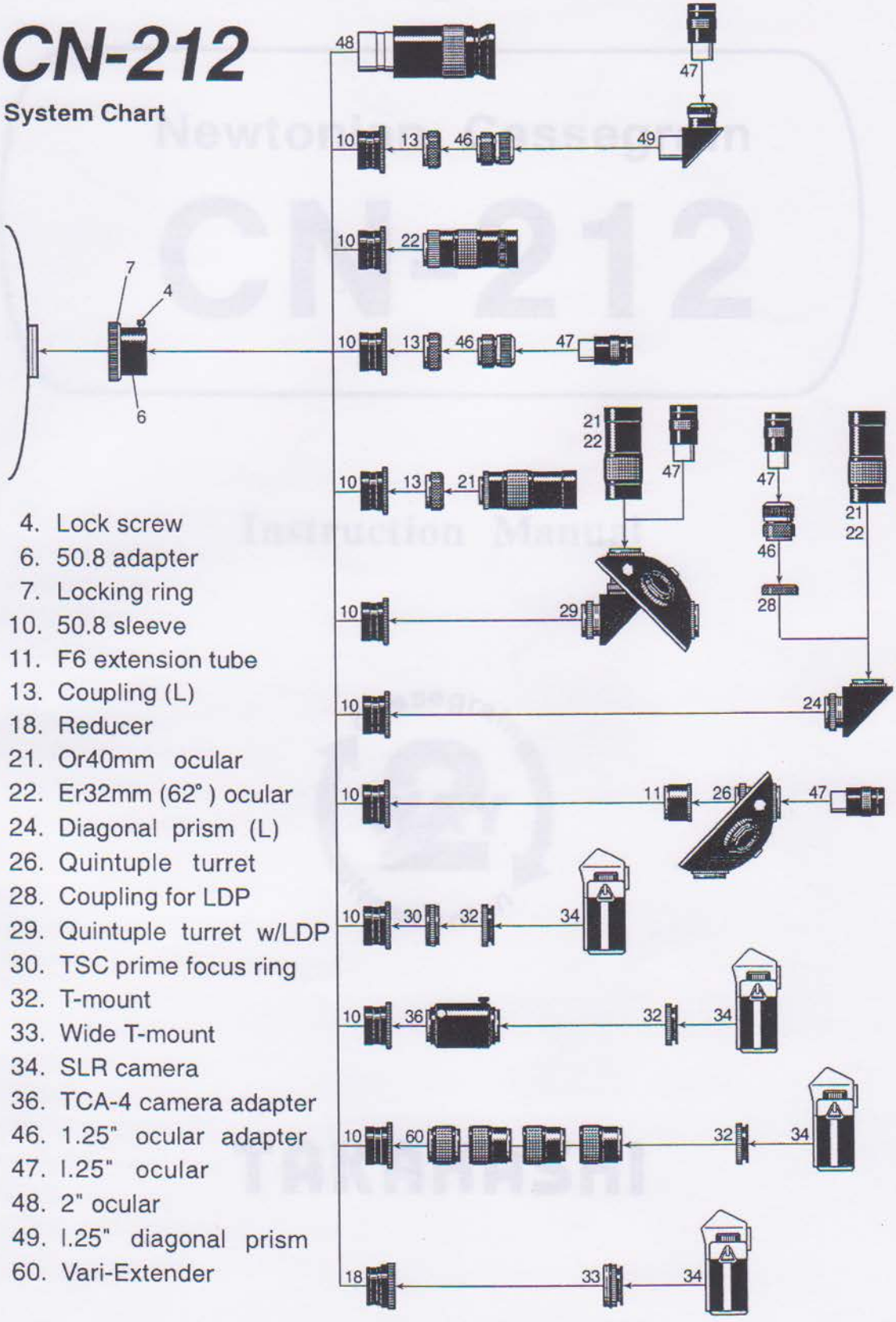
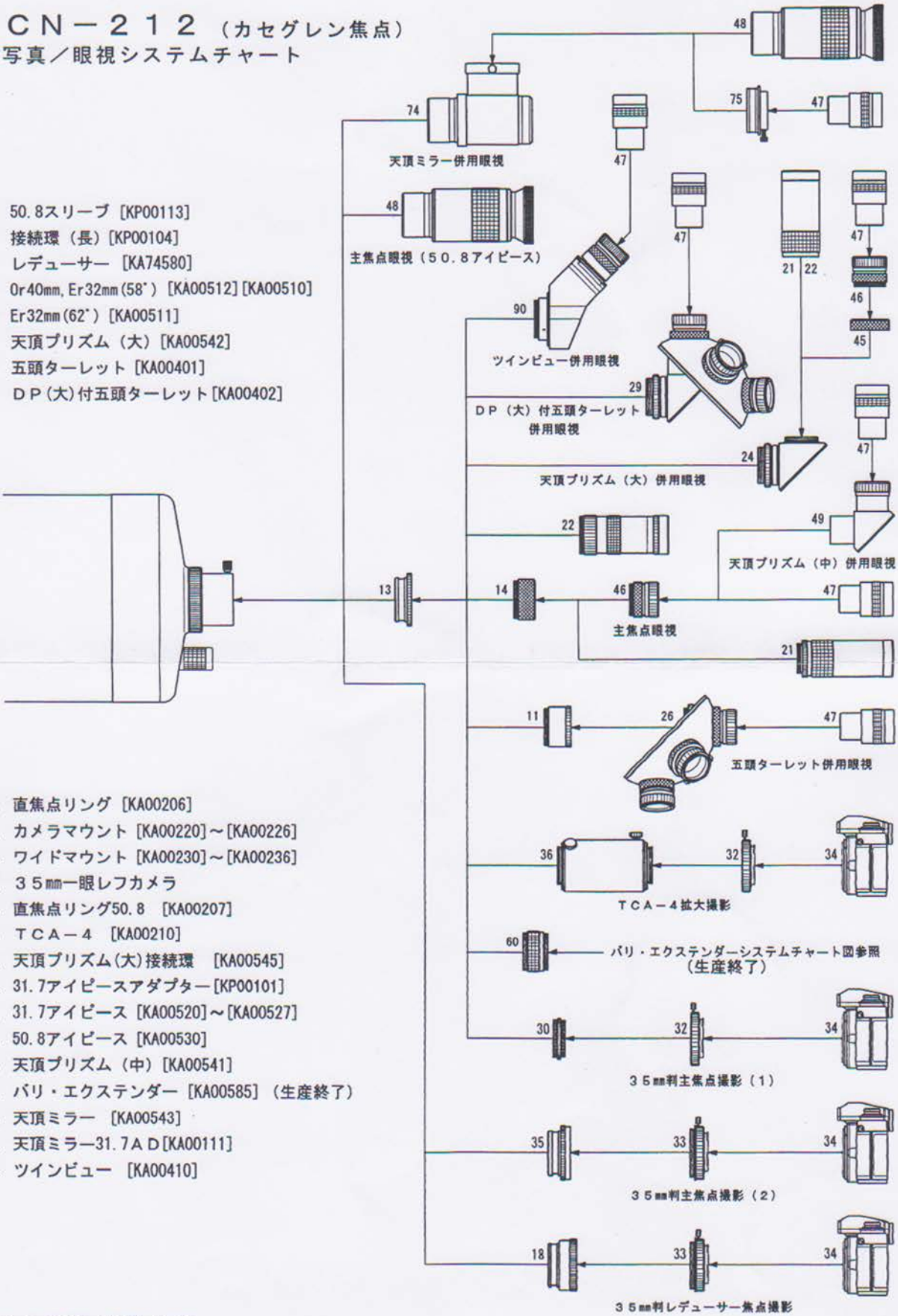
System Chart



4. Lock screw
6. 50.8 adapter
7. Locking ring
10. 50.8 sleeve
11. F6 extension tube
13. Coupling (L)
18. Reducer
21. Or40mm ocular
22. Er32mm (62°) ocular
24. Diagonal prism (L)
26. Quintuple turret
28. Coupling for LDP
29. Quintuple turret w/LDP
30. TSC prime focus ring
32. T-mount
33. Wide T-mount
34. SLR camera
36. TCA-4 camera adapter
46. 1.25" ocular adapter
47. I.25" ocular
48. 2" ocular
49. I.25" diagonal prism
60. Vari-Extender

ＣＮ－２１２（カセグレン焦点）
写真／眼視システムチャート

13. 50.8スリーブ [KP00113]
14. 接続環（長）[KP00104]
18. レデューサー [KA74580]
21. Or40mm, Er32mm(58°) [KA00512] [KA00510]
22. Er32mm(62°) [KA00511]
24. 天頂プリズム（大）[KA00542]
26. 五頭ターレット [KA00401]
29. ＤＰ(大)付五頭ターレット [KA00402]



30. 直焦点リング [KA00206]
32. カメラマウント [KA00220]～[KA00226]
33. ワイドマウント [KA00230]～[KA00236]
34. ３５㎜一眼レフカメラ
35. 直焦点リング50.8 [KA00207]
36. ＴＣＡ－４ [KA00210]
45. 天頂プリズム(大)接続環 [KA00545]
46. 31.7アイピースアダプター[KP00101]
47. 31.7アイピース [KA00520]～[KA00527]
48. 50.8アイピース [KA00530]
49. 天頂プリズム（中）[KA00541]
60. バリ・エクステンダー [KA00585]（生産終了）
74. 天頂ミラー [KA00543]
75. 天頂ミラー31.7ＡＤ[KA00111]
90. ツインビュー [KA00410]

＊ No.13,14,46は、標準付属品です。

＊ No.46を２４．５アイピースアダプターに交換すれば、スリーブ径２４．５㎜のアイピースが使用できます。

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