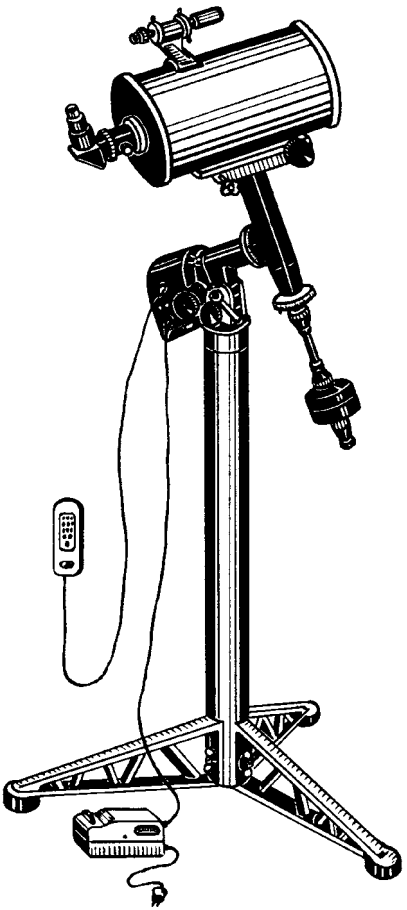
TELESCOPE TAΛ-200K



Service manual

NPZ ®

CONTENTS

The telescope is subject to continuous development and improvement, consequently it may incorporate minor changes in detail from the information contained herein.

1. GENERAL DIRECTIONS

ATTENTION!

Telescope TAJI-200K (hereinafter in the text referred to as «telescope») is not intended for direct visual observation of Sun at full operating aperture. Because of high light intensity an image of Sun in focus of primary mirror has a high temperature. To avoid on overheating of corrector it is recommended to avoid any direct observation of Sun disk.

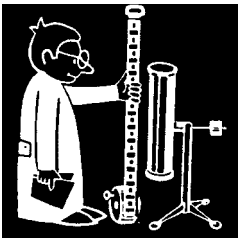
One should remember that overheated corrector being in field of direct sunlight can be out of order or make a turbulent air torrents in telescope tube that to reduce considerably a quality of image.

Also if it is necessary to leave a telescope out of door (for example, to dry it) one should orient it so that the direct sunlight do not get into the optical system.

The telescope can operate normally at the ambient temperature from 30°C to minus 30°C.

It is a precise powerful amateur astronomer telescope. It demands a careful handling and certain knowledge in the field of astronomy. Only in this case user will be fully satisfied.

When buying the telescope one should pay attention to the package safety ensured by the seal of the manufacturing plant. After unsealing the case one should check compliance of the complete set denoted in the list of enclosure. Prior to using the telescope one gets acquainted with its handling and order of operation.



2. SPECIFICATIONS

Diameter of objective lens (operating aperture), mm	200
Focal length, mm	2000
Relative aperture	1:10
Magnification and angle field of view (changeable):	
- with the eyepiece f'=25 mm	80^{x} 31.3′
- with the eyepiece f'=10 mm	200^{x} 12.5′
- with the eyepiece f'=25 mm and Barlow lens	160^{x} 15.4′
- with the eyepiece f'=10 mm and Barlow lens	400^{x} 6.3′
Photographic angle field of view	40′ (23.3mm)
Screening of pupil in center	12%
Resolution limit	0.6″
Pellucid capacity	13.4^{m}
Rotation of the telescope:	
in right ascension (hour-long angle)	360° (24h)
in declination	360°
Operation limit by latitude	0°-70°
Angular field of view of the finderscope	7°
Magnification of the finderscope	8^{x}
Voltage of the supplying mains, V	220(110V)±10%
Current frequency	50Hz (60Hz)
Output voltage of the supply unit, V	12
Size of the telescope, mm:	
length tube	550
height	1320
Weight of the telescope, Kg	30

3. STANDARD EQUIPMENT

Name	Qty
Telescope	1
Supply unit	1
Eyepiece of f'=25mm	1
Finderscope	1
Equatorial mounting	1
Supports	3*
Tripod	1*
Pier	1*
Bundled conductors	1
Higned clips	2
Control panel	1**
Cable for car mains	1**

Accessories and Parts

Eyepiece of f'=10 mm	1
Barlow lens	1
Reticle	1
Black light filter (solar)	1
Neutral light filter (gray, lunar)	1
Blind	1
Bushing	1
Adapter	1
Stopper	1
Fuse link ВПТ19-0.16А (220V)	1
Fuse link ВПТ19-0.32А (110V)	1
Housing	1
Service manual	1

*** Telescope can be completed witha metal pier or tripod**
**** Optional accessories**

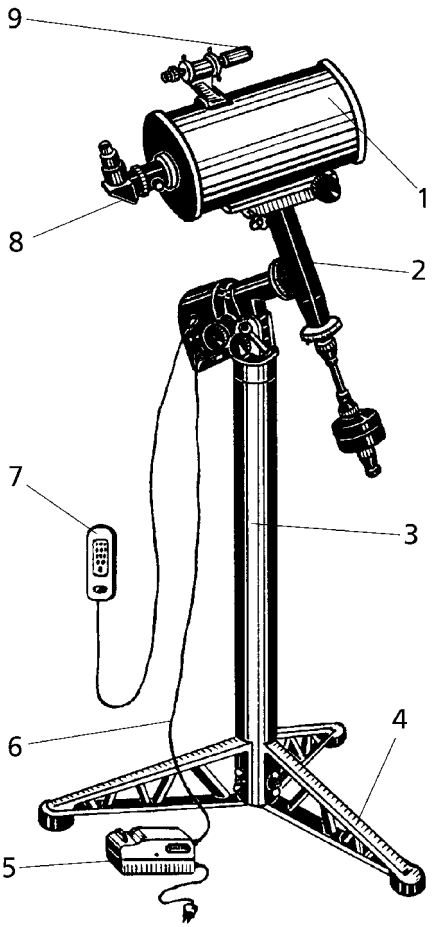


Fig.1. **General view:**

1 - telescope tube; 2 - equatorial mounting; 3 - pier; 4 - supports;
5 - supply unit; 6 - bundled conductor; 7 - control panel;
8 - eyepiece set; 9 - finderscope

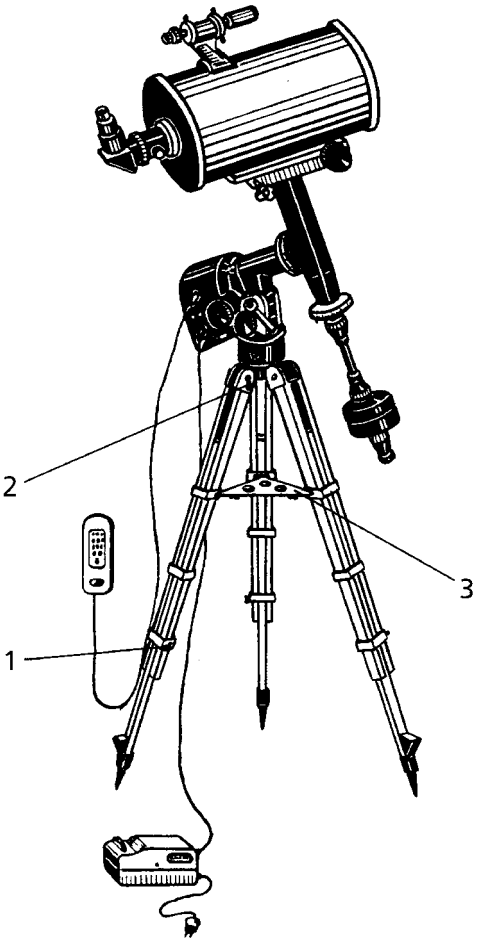


Fig. 2. **General view of telescope mounted on tripod:**

1,2 - stoppers; 3 - table

4. DESIGN AND PRINCIPLE

The telescope (fig.1, 2) consists of three basic units such as the telescope tube, equatorial mounting, pier with supports or tripod and supply unit.

The tube 1 (fig.1) is the basic part of the telescope, which embodies the optical units such as a primary mirror, corrector, eyepiece set and finderscope.

The primary mirror 1 (fig. 3) is fastened with the bushing 2 in the center hole. The blending tube 3 on the collet bushing prevents stray light. The mirror is adjustable on ball hinge by means of the six screws 4.

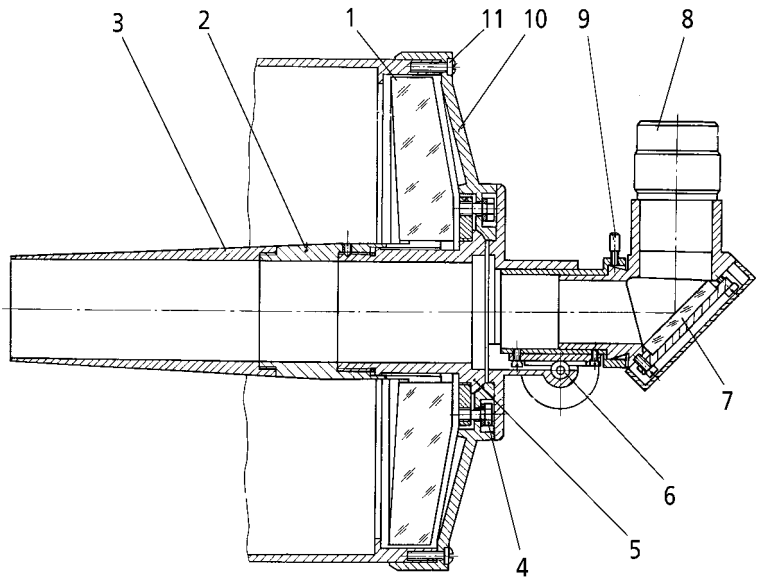


Fig.3. **Assemble of primary mirror together with eyepiece set:**

1 - mirror; 2 - bushing; 3 - blending tube; 4 - screws;
5 - bushing; 6 - focusing mechanism; 7 - diagonal mirror;
8 - eyepiece; 9 - screw; 10 - back flange; 11 - screw

The corrector (fig.4) consists of secondary mirror 2 and meniscus lens 3 spaced by means of padding rings 4 in the mounting 1. The corrector is adjustable on the ball hinge 5,6 by means of adjusting screws 7. The

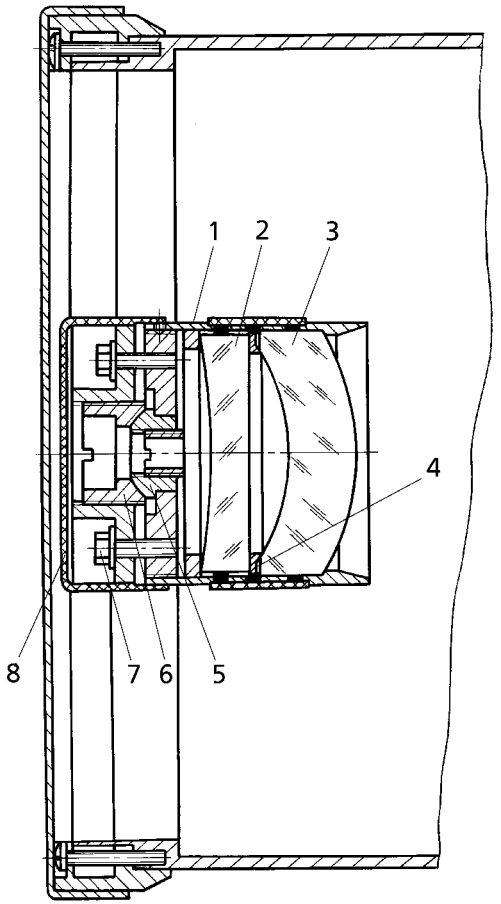


Fig. 4. **Corrector:**

1 - mounting; 2 - reflecting lens; 3 - meniscus; 4 - padding ring;
5 - hinge bushing; 6 - hinge ped; 7 - screw; 8 - cap

corrector assembly is mounted in the telescope tube.

Eyepiece set (fig.3) consists of focussing mechanism, diagonal mirror, set of symmetrical eyepieces f'=25mm and f'=10mm fixed in the mounting of 31.8mm (1.25″), Barlow lens mounted in the same one.

Finderscope 9 (fig.1) is a telescope with 8^{x} magnification and view field 7°.

The equatorial mounting (fig.5) consists of polar axes 1 and declination axis 8 perpendicular to the polar axis.

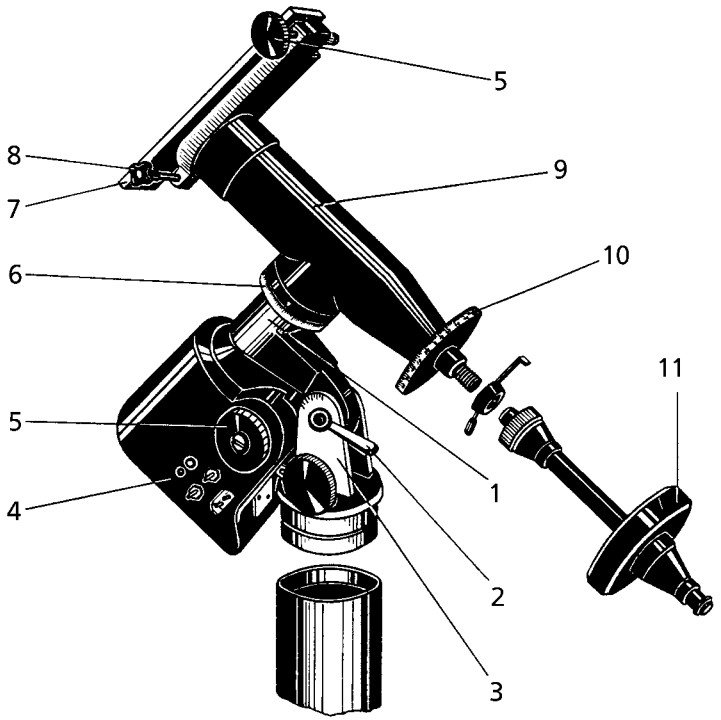


Fig. 5. **Equatorial mounting:**

1 - polar axis; 2 - handle; 3 - bracket with scale of lalitudes;
4 - watch drive; 5 - handwheel of slow-mothion mechanism;
6 - circle of hour angles; 7 - bracket; 8 - screw of axis brake;
9 - declination axis; 10 - circle of declinations;
11 - counterweights

Fastened on one end of the declination axis is the saddle with hinged clips in which the telescope tube is mounted; fastened on the other end of the axis is the counterweights 11 which can move along the axis for balancing the telescope tube.

The casing of the polar axis is fastened on the bracket 3 provided with a scale of latitudes with the help of handle 2.

The southern (lower) end of the polar axis embodies electric watch drive 4; the northern (upper) end embodies the casing of declination axis 9.

Both axis's are provided which a setting circles which shows an hour angle or declination of the object visible in the telescope field of view. Setting circle 10 on the declination axis, which shows the object declination, is figured from 0 to 90° with a division value of 2°. Circle 1 positioned on the polar axis (the circle of hour angles) is figured from 0 to 24 hours with a division value of 10 minutes.

The declination axis has braking screw and mechanism of slow motion, which moves the tube in the range of ±4°. By using this mechanism it is possible to correct the position of the object in the field of view.

Pier 3 (fig. 1) consists of a pipe with three supports 4.

The tripod (fig. 2) allows to adjust a height of telescope and to fix each leg of tripod with the help of stops 1 and 2. It is completed with table 3.

The supply unit 5 (fig. 1) powers the watch drive tracking the celestial objects. It is designed for 220 V/ 50 Hz (110V/60Hz) mains and activated with the key. If the control panel is provided the car's mains or storage battery 12 V can be used through the car's cable.

The control panel (fig.6) is designed to select modes of watch drive by means of buttons 2. The watch drive provides the sun, celestial and moon speed modes. The control panel is equipped with the local lighting which can be switched on by button 4.

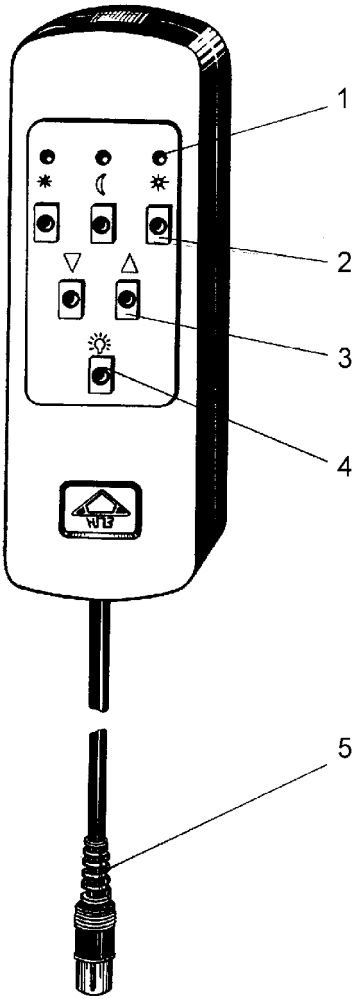


Fig. 6. **Control Panel:**

1 - indicator; 2 - speed selection buttons; 3 - correction buttons;
4 - lighting button; 5 - plug

5. OPTICAL TRAIN

Telescope ТАЛ-200К is developed on the basis of Klevzov's original optical train, which does not use any aspherical surfaces. Klevzov's optical train (fig. 7) consists of primary concave mirror 1 and correcting unit consisting of two single lenses 4,5. The lens 4 is made in form of negative meniscus directed by concave side to the observed object. The lens 5 is negative one having a reflecting surface.

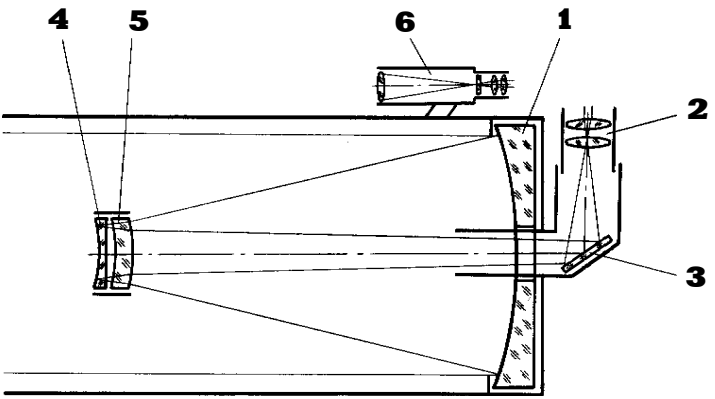


Fig. 7. **Optical train of telescope:**

1 - primary mirror; 2 - eyepiece; 3 - diagonal mirror- lens;
4 - secondary mirror; 5 -meniscus; 6 - viewfinder

Reflecting from the primary mirror 1 a beam passes through correcting lenses 4,5, reflects from the reflecting surface of lens 5, passes through correcting lens forming an image of observed object in the focal plane which is located behind a primary mirror 1.

In the main the Klevzov's optical train is an improved Kassegran optical train, which has a spherical primary mirror and double lens corrector having a reflecting surface that to allow reducing an aberration. A meniscus 5 corrects a spherical aberration and coma and fully compensates a little longitudional chromatic aberration with the help of negative lens 4. Because two lenses of corrector are made of the same mark of glass a secondary color of system is extremely little one, and correction of the residual aberration is perfect that to allow obtaining an image of observed object which can be compared with the image of object obtained with the help of mirror telescope. Besides, Klevzov's optical train is not subject to unadjastment.

The lacks of aspherical surfaces, high quality of correction of the residual aberration in the wide range of spectrum and small length are indisputable advantages of Klevzov's optical system. The telescope has a possibility to achieve that to allow satisfying all requirements of amateur astronomer.

Telescope is completed with two symmetrical eyepieces f'=25mm and f' = 10 mm and 2^x Barlow lens. For easy observation of celestial objects near by zenith an eyepiece set of telescope is turned to optical axis of tube by 90° with the help of diagonal mirror 3. To locate an object in the center of view field the telescope is completed with finderscope, which consists of objective lens, reticle with the cross and eyepiece.

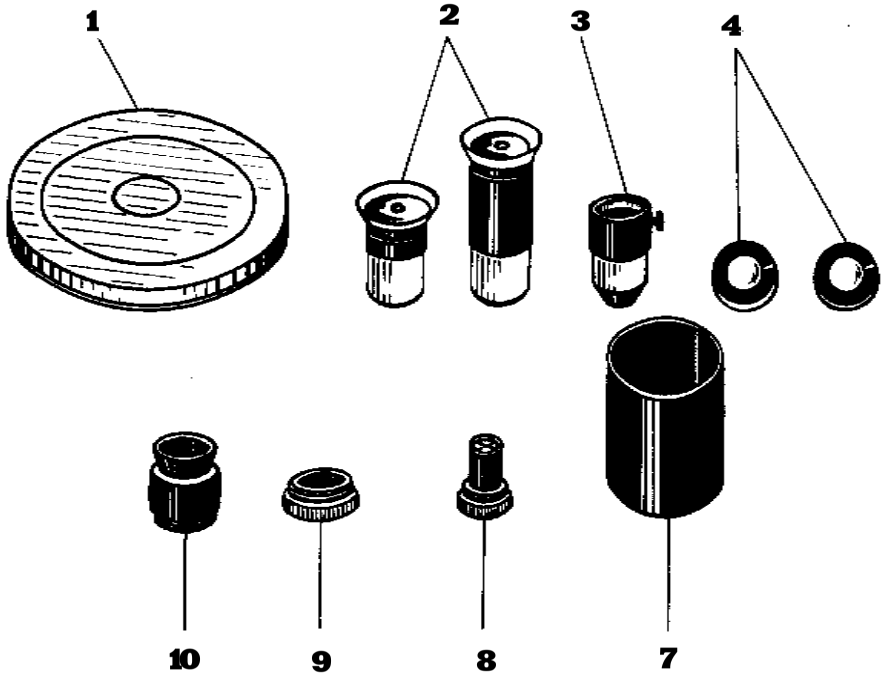
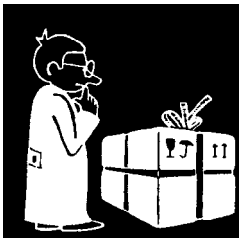


Fig. 8. **Tools and accessories:**

1 – cap; 2 – eyepieces; 3 – Barlow lens; 4 – light filters; 7 – blind;
8 – reticule; 9 – adapter; 10 – bushing



6. PREPARATION FOR OPERATION

6.1. Telescope assembling

Prior to assembling the units and parts should be cleaned from the sluicing compound of the plant.

The telescope is assembled in the following way.

Three supports provided with captive screws are fixed to the lower end of the pier through holes. The equatorial mounting is set on the upper end of the pier. At the same way it is fixed on the tripod.

In order to aim the polar axis turn the equatorial mounting by the value of the observation site latitude by means of elevation gear and latitude scale. Lock the direction adjusted with the lock handle.

Mount the axle with the counterweight 11 (fig. 5) on the declination axis unit and fasten it with the nut. Mount the clips 1 on the bracket and then the telescope 1 in them (fig. 1). The telescope tube is mounted on the supports of the saddle and fixed by means of two clips with the help of hinged screws.

The finderscope is mounted on the tube in two rings and fixed with six set screws available on the rings.

In transportation and storage a hole in the eyepiece tube is plugged with a stopper which should be removed and put in the case in preparation for operation.

For obtaining the required magnification of the telescope the respective eyepiece or the eyepiece with Barlow lens is inserted in the eyepiece tube.

A toggle switch of the supply unit is to be set in position "0". Connect bundled conductors 6 (fig. 1) to the clock drive and to the supply unit through a socket designated, connect a plug of cord of the supply unit to the mains of 220V/ 50Hz (110V/ 60Hz). Set the toggle switch of the supply unit in position "I", set the toggle switch of the drive in position "I". The control panel if provided is connected to the mounting by means of the plug 5 (fig. 6). Set the switch of control panel operation on the mounting into "I" position. The watch drive is activated by one of the buttons 3. When it operates the indicator lights. The switch of autonomous operation on the mounting and the key of supply unit must be set into "I" position previously.

6.2. Telescope balancing

For smooth motion of the telescope and reliable operation of the slow motion knob it is important to balance its movable parts on the axes of the equatorial mounting.

For this purpose one should set the telescope tube in the horizontal position of the declination axis. Then it is necessary to remove a cover 11 of clock drive (fig. 9) and screw up each of three screws 12. Holding slightly the declination axis by handle see to it whether it remains in the indifferent equilibrium. If the tube is not in balance, move a counterweight 11 (fig. 5) along the declination axis until it will be in balance. After that one screws in the screws 12 of polar axis that telescope tube moves by slightly pressinghand. When mounting the various devices on the telescope, for example,acamera, it is required to balance the telescope additionally.

6.3. Precautionary measures

The rate of the fuse link mounted in the supply unit must be in compliance with the rate denoted under the fuse link holder.

Mount the fuse link only after complete disconnection of the supply unit from the mains.

Connect the bundled conductors to the watch drive and supply unit when supply unit is disconnected from the mains.

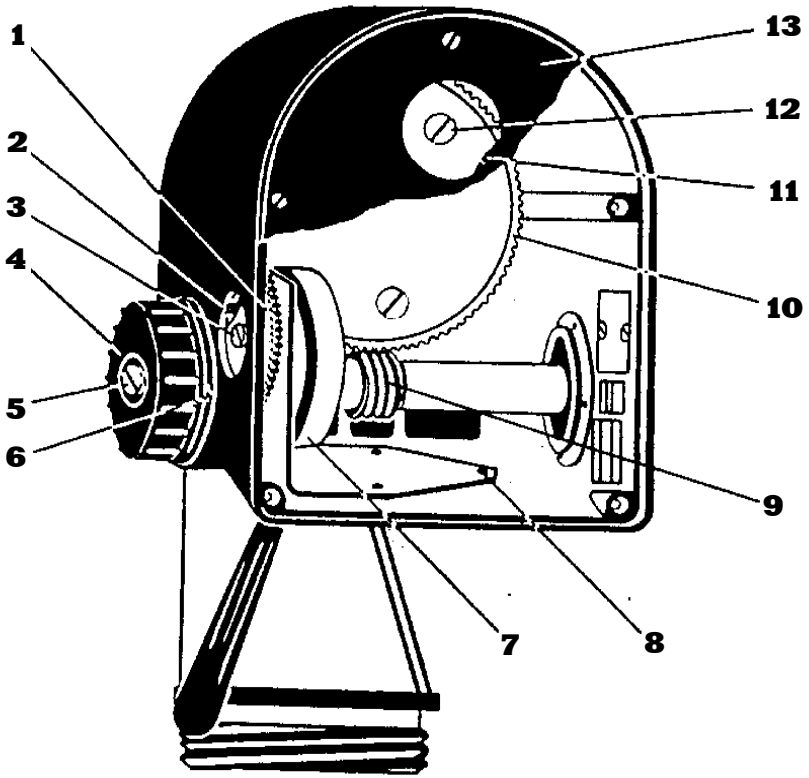


Fig. 9. **Watch drive:**

1 - worm gear wheel; 2 - cap; 3 - screw; 4 - handwheel; 5 -screw;
6 - screw; 7 - drive; 8 - screw; 9 - worm with gear wheel; 10 - worm wheel;
11 - cover; 12 - screw; 13 - cover

7. ORDER OF OPERATION

7.1. Operation withtelescope

Before mounting the telescope it is required to choose a place and prepare a site. It must be even and solid. Mount the telescope on the site and check it for reliable stability.

For pointing to an object the telescope should be rotated about two axes. For rotation of the declination axis it is necessary to undo braking screw 8 (fig. 5), rotate the telescope and screw in the braking screw.

If backlash is arisen in the worm gear it is necessary to disengage drive 7 (fig. 9). For this purpose it is required to take off cover 13, slacken three screws 8, displace drive 7 upwards and fix it with screws 8. Remove handwheels 4 after unscrewing screws 5. After that slacken screws 6 which fasten worm 9 in the bearings. After pressing the worm to worm wheel 10 fix it with screws 6. Mount handwheels 4 and secure them with screws 5. Then slacken screws 8, displace the motor downwards until engagement with the toothed wheel of the worm takes place and secure them with screws 8. Mount cover 13 on the casing.

The smoothness of rotation of toothed wheel 1 together with the toothed wheel of worm 9 is checked by rotation of the handwheels, in doing so probable sliding or jamming of the friction clutch may take place.

For its adjustment it is required to displace cap 2 and tighten or slacken three screws 3. The friction clutch adjustment is considered to be finished if handwheels 4 rotate smoothly.

The telescope rotates about the polar axis owing to minor effort and is not fixed. The axis is connected to the watch drive with the help of a friction mechanism.

The celestial sphere and all astronomical objects perform a complete rotation for twenty-four hours. As a result the object in the telescope field of view displaces constantly. The speed of its displacement increases with the increase of the telescope magnification. Therefore, the telescope is provided with electric clock drive 8 (fig. 5) which rotates uniformly the telescope, which follows the object. As a result, in the process of observation the object remains constantly at the center of the field of view.

In the process of observation it is often required to perform minor corrections in the diurnal run of the telescope. For this purpose one makes use of handwheels 4 (fig. 9) of the polar axis or the buttons 3 (fig. 6) of the control panel. The buttons 3 speed up or slow down the tracking speed of the watch drive relative to the nominal providing the correction of right ascension angle. The correction modes are activated when one of the buttons 3 is pressed continuously and the

indicator 1 blinks. If the button 3 is released the tracking speed returns to the nominal.

The telescope has high magnifications and, hence, small fields of view, therefore it is provided with a finderscope.

After mounting the telescope it is necessary to set parallel of the optical axes of the telescope tube and finderscope. For this purpose one should mount a reticle with cross into the eyepiece f'=25 mm. One should make an adjustment by remoted object.

By operating with the set screws of rings of the finderscope one brings the chosen remote object to the center of the finderscope field of view. This operation is performed once. In the future before observation only a check-up of parallelism of the telescope and finderscope optical axes is needed.

In order to avoid corrections of the declination axis during operation of the watch mechanism it is required to set the telescope polar axis in parallel to the celestial axis. In this case the northern (upper) end of the polar axis faces the celestial pole positioned near Polaris (α Ursae Minoris). For visual observations it is enough to incline the polar axis at an angle equal to the latitude of the observing site and direct it approximately along the line the South - the North. With such coarse setting of the telescope the object will "deviate" step by step in declination (it is lifted or lowered in the field of view). This error is corrected at times by means of the micrometer screw of the declination axis.

For photographic operations and in the case when the telescope can be set stationary, the polar axis of the telescope should be set precisely. For this purpose one observes any bright star in the East, then in the South and makes notice of the direction of the star displacement.

If in observation of the star in the East it is displaced in the telescope field of view so that in its tracking the upper end of the telescope tubes sinks slowly, the north end of the polar axis should be somewhat lifted.

If the upper end of the tube is lifted step by step, the north (upper) end of the polar axis should be lowered.

For precise setting of the axes by azimuth one observes the star near the meridian circle (above the south point) in the same way. If in the star tracking one has to lower slowly the upper end of the telescope tube, the north end of the polar axis should be displaced to the West. If in the process of the star tracking the upper end of the telescope tube is lifted, the north end of the polar axis should be displaced to the East.

In 20-30 minutes of such observations one can set the polar axis so that the star will remain on the cross hairs for 10-15 minutes without correction in declination.

After precise setting of the polar axis one can set the declination and hour circles which must help to search the objects invisible with a naked eye or even through the finderscope.

First of all one should set the hour circle which is fixed on the polar axis. After a fine setting of the polar axis set the declination axis horizontally. The horizontal setting should be checked with the aid of a level. After setting of the axis one sets the hour circle so that "0" is found against the index. Fix tile circle by means of screws.

For setting the declination circle fixed on the declination axis one should find the declination of two-three bright stairs in the star catalogue or make use of the declinations of the planets. With the help of the finderscope one brings the star or the planet to the center of the field of view of the telescope at maximum magnification. After that one sets the declination of the required star against the index. The circle is to be fastened with a screw. Then one makes attempt to find the second star by its declination. For this purpose one slackens the screws of the axis brake and adjusts the telescope so that the declination of the star to be sought is set on he declination circle. Fix the declination axis and, by rotating the telescope tube slowly clockwise and counter-clockwise around the polar axis, one brings the star to the center of the telescope field of view. After checking of the circle setting one tightens it with a nut.

In order to avoid resetting of the polar axis and circles one should choose a solid horizontal site. Best of all it is made of some concrete of 1.5x1.5 m size. The position of three supports of the telescope pier should be marked on this site. The telescope is mounted according to the marks on the concrete site.

7.2. Photographic observations

Photographing star fields is carried out with the use of the telescope in the main focus. To make it one should use a small size 35-mm camera or other devices having fitting thread of 42x1.0mm or 42x0.75mm. To mount a camera it is necessary to remove eyepiece from tube and to mount a bushing with the thread of 42x1.0mm. If it is necessary one should mount an adapter on the bushing when using the telescope with camera provided with the thread 42x0.75.

Mounted a camera one should make a focus it and to balance the telescope.

The exposures, which are required for photographing the star fields, are tenths of minutes without hindrance of the street lighting. Therefore, for this period of time one should see to it that the camera follows the sky precisely in its diurnal rotation. Near the center of the field of view of the camera one chooses the bright star to which the telescope is pointed. To keep the star on the reticle cross hairs of the finderscope is the problem for an observer for the whole period of exposure. As the cross-hairs of the finderscope is not illuminated, the image of the guide stair should be slightly defocused in order to cross a light circle of the unsharp image of the star by the cross-hairs and to keep the star in this position for the period of exposure.

One applies minor corrections for a clockwork drive with the help of handwheel 4 (fig. 9) keeping the star on the cross hairs for the whole period of exposure. One corrects the position of the guide star with the micrometer screw of the declination axis if necessary. To obtain the minimum corrections in declination the polar axis should be set as precisely as possible to the celestial pole. One should remember that if the polar axis is set incorrectly, even in the case when the star image is kept on the cross-hairs, the images of the stars at the edges of the field of view appear as dashes.

7.3. Telescope and atmospheric conditions

Telescope has a high magnification. In this case one should remember the following feature. When increasing a magnification of telescope a distortion of image to be made by aerial heterogeneity becomes more visible. It is a scintillation and distortion of image of remoted objects, scintillation and distortion of image of stars, reduction of sharpness of small parts of Moon and stars. So, one should make a testing of telescope resolution by double pares of equal brightness and permeability by photometric standards, observation of little contrast parts of planets in good atmospherical conditions such as calm, high transparence of atmosphere and low turbulent air torrents.

Because a resolution of telescope ТАЛ-200К is sufficiently high the testing should be made in atmospherical conditions which are valued by Pikering's scale. It is 6 scopes that to allow obtaining the satisfactory and good images when diffractional disk of star is visible constantly.

There are some meteorological factors, which can reduce a quality of image such as mist, dust and so on. These factors reduce a transparence of atmosphere that to reduce a permeability of telescope considerably. This factor is especially noticeable in observation of remoted objects, but sharpness of image is not changed.

It is not necessary to remind that observation through the window is possible if the ambient temperature in the room and temperature out of door are not different. Otherwise the warm air coming out of the window deteriorates the images so that observations are impossible whatsoever. Besides, inequality of surfaces of window can distort an image.

If it is necessary to make an observation out of door, one should stay the telescope in the street within 30 minutes so that all parts of telescope have the same temperature.

In observation at cold damp nights a moisture can penetrate into the telescope tube. If the telescope is covered, optical surfaces can get misted under direct sunlight. So, one should protect the telescope from the direct sunlight. It is recommended to stay it in dark cold room for some time. But if the mirror got misted it is not necessary to wipe it. One should open the telescope and stay it within 30 minutes in daylight. The moisture is evaporated in full.

After operation one should pack the telescope and store it according to the rules of storage.

8. MAINTENANCE

For faultless operation the telescope should be kept in cleanness and protected against mechanical damage. The metal surfaces are periodically cleaned by using clean soft napkins, then wiped with a napkin impregnated with acidless vaseline, after that with a dry napkin.

The aluminized mirrors require particular care. The accumulated dust is removed only with the use of a soft brush or cotton wool tampon. If a visual inspection reveals the need to clean the main mirror prepare it as follows: remove the eyepiece assembly with gearing, remove the screws 11, mark the position of thread holes in mirror assembly for following reassembly, extract the mirror assembly and place it with mirror surface upward. Clean the surface with soft brush and then with cotton wool swab wetted with ether or alcohol. Residual cotton fibers can be removed by air blasting.

The reassembly is done in reverse order. To avoid a readjustment of main mirror the position of mirror assembly must correspond to the mark made previously.

The corrector should not be removed from the tube for cleaning. In the case of need the meniscus surface is cleaned with removed main mirror assembly.

A cleaning of optical parts and adjusting of telescope is prohibited before warranty expiration. It requires care and thoroughness and should be fulfilled in the case of absolute necessity only.

9. RULES OF STORAGE

It is recommended practice to store the telescope in the heated room with the relative humidity of maximum 80% at the temperature from 5 to 40° C.

It is recommended to avoid any strokes and shakes.

It is forbidden to store any acid, alkali and materials educing moisture or chemical active gas and streams.

10. ACCEPTANCE CERTIFICATE

Telescope ТАЛ-200К , serial . . . . . is found fit for service.

Date ofmanufacture andslushing_____

Signatures _____

Table of close stellar pairs for testing image quality of the telescope

Name of star	Coordinates		Magnitude, m	Visible distance, ang. s.	Constellations
	h, m	ang. degrees, ang. min.			
αPsc	$1^h59.4^m$	+02°31′	4.3-5.3	1.9′′	Pisces
γCet	$2^h40.7^m$	+03°02′	3.4-4.4	2.8′′	Cetus
ξOri	$5^h38.2^m$	-01°58′	2.0-4.2	2.5′′	Orion
αGem	$7^h31.4^m$	+32°00′	2.0-2.8	1.8′′	Gemini
εHyd	$8^h44.1^m$	-06°36′	3.5-6.9	2.9′′	Hydra
σ^2Uma	$9^h06.0^m$	+67°20′	4.9-8.2	2.7′′	Ursa Major
38Lyn	$9^h15.8^m$	+37°07′	4.9-6.0	2.8′′	Lynx
ξUma	$11^h15.6^m$	+31°49′	4.4-4.8	2.9′′	Ursa Major
ξBoo	$14^h38.8^m$	+13°56′	4.6-4.6	1.2′′	Bootes
εBoo	$14^h42.8^m$	+27°17′	2.7-5.1	3.0′′	Bootes
μDra	$17^h04.3^m$	+54°32′	5.8-5.8	2.2′′	Draco
τOph	$18^h00.4^m$	-08°11′	5.4-6.0	2.0′′	Ophiucus
70 Oph	$18^h02.9^m$	+02°31′	4.0-6.0	2.4′′	Ophiucus
ε^1Lyr	$18^h42.7^m$	+39°37′	5.1-6.2	2.7′′	Lyra
ε^2Lyr	$18^h42.7^m$	+39°37′	5.1-5.4	2.2′′	Lyra
δCyg	$19^h43.4^m$	+45°00′	3.0-6.5	2.2′′	Cygnus
μCyg	$21^h41.9^m$	+28°30′	4.7-6.1	1.8′′	Cygnus
ξAqr	$22^h26.3^m$	-00°17′	4.4-4.6	1.8′′	Aquarius