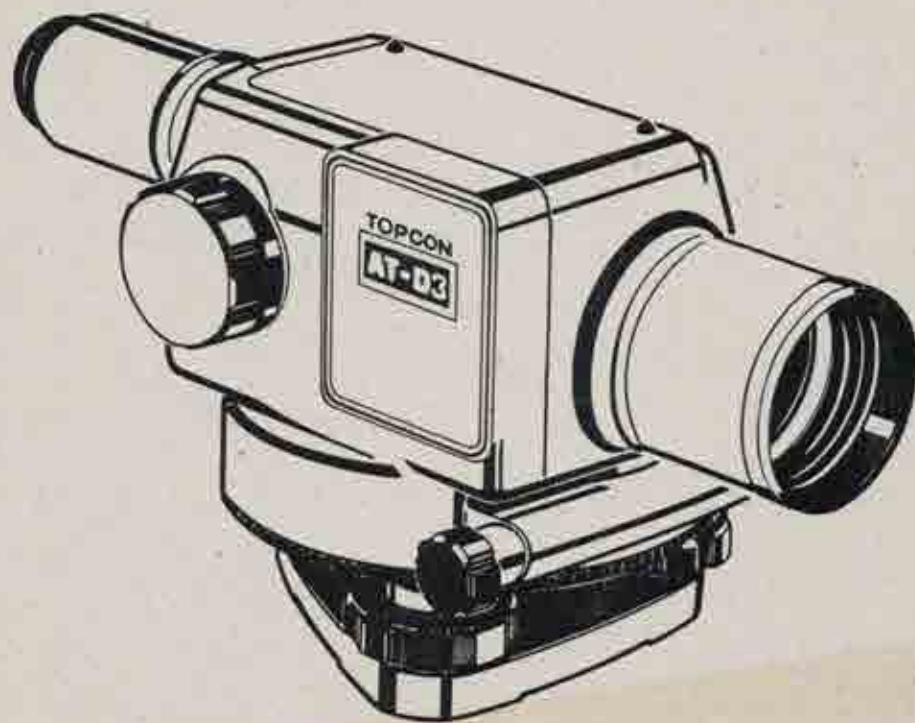


TOPCON

**AUTO LEVEL
AT-D3**



**TOKYO KOGAKU KIKAI K.K.
(TOKYO OPTICAL CO., LTD.)**

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INTRODUCTION

Congratulations on your choice of the TOPCON/Auto-Level, Model AT-D3, which is one of the models in the new series of Auto-Levels developed by TOPCON, based on its more than ten years of experience in designing and manufacturing top-quality Auto-Levels for the world market.

The automatic leveling mechanism, of great accuracy and super shock-resistance properties (patent pending), automatically and accurately levels the line of sight even when there is slight tilting of the instrument and/or when the bubble of the circular level is not accurately centered. Very fast, accurate leveling is possible because the automatic leveling range is a maximum 15 minutes of the arc, which permits automatically leveling of the line of sight with a far shorter set-up time. The mechanism also has a very fast return speed, which shortens leveling-time and doubles working efficiency. In addition, four jewels and special material, plus careful designing and workmanship combine to maintain stable compensation and high precision, even with temperature changes and/or vibrations and shocks.

The optical system and interior mechanisms are effectively sealed against water and moisture which means that these instruments can be used for wet-surveying operations in the rain or in tunnels, without worrying about damage to the instrument and without clouding of the lens. Only test-approved waterproofed telescopes are used and, furthermore, dry nitrogen gas is sealed in the telescope tube for effective prevention of lens clouding or moisture condensation, due to temperature differences.

This manual will acquaint you with some of the finer points of the Model AT-D3, its operation and construction, as well as adjustments, so that you may be able to use the instrument with maximum efficiency in the field, at all times. Carefully read through the manual once before touching the instrument, as you will be able to use the instrument more efficiently when you fully know it.

MAIN FEATURES OF THE AT-D3

- (1) **Completely Waterproofed Telescope**
"All Weather" use is possible because of the completely waterproofed construction.
- (2) **Highly Reliable Automatic Leveling Mechanism**
Very simple patented construction is practical yet very accurate, with very stable compensations and high precision plus improved resistance to vibrations.
- (3) **Double Scale Horizontal Circle**
A horizontal circle is incorporated with two types of scales, for convenience of users. One scale is graduated straight through from 0 to 359° while the other is a compass-type scale, with graduations in quadrants (0 to 90° to 0 to 90°, etc.).
In the case of centesimal system, has only one scale which is graduated straight through from 0 to 399.
- (4) **Large Focusing Knob with Infinity Direction**
The large focusing knob is easy to manipulate and shows the direction of infinity, thus making possible fast initial manipulations.
- (5) **Stadia Lines Permit Simple Stadia Calculations**
As the stadia ratio is 100 and stadia constant 0, it is only necessary to multiply the rod reading between the stadia lines by 100 to find the distance to the target from the instrument.
- (6) **Twin Fine Horizontal Knobs**
Fine horizontal knobs are available on both sides, which means that either hand can be used for manipulating the fine horizontal knob. Furthermore, adjustments are clampless which means greatly speeded-up operations.

NOMENCLATURE

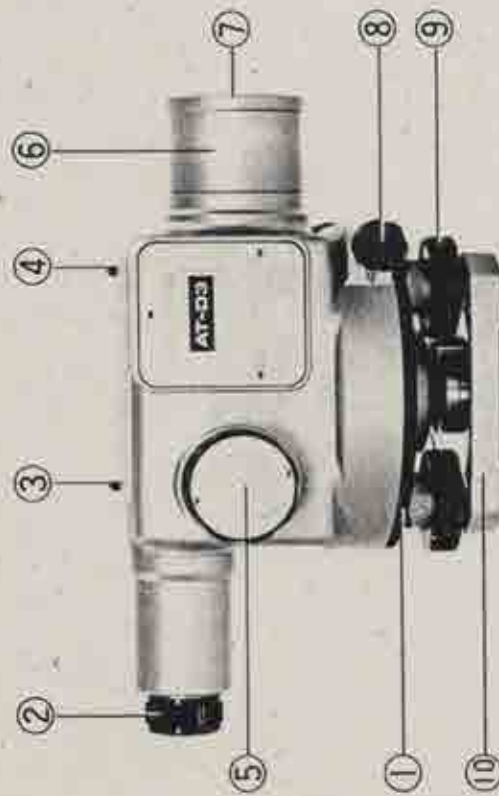


Fig. 1

- ① Milled horizontal circle plate
- ② Eyepiece adjustment ring
- ③ Rear aiming sight
- ④ Front aiming sight
- ⑤ Focusing knob
- ⑥ Sun shade
- ⑦ Objective lens
- ⑧ Fine horizontal knob
- ⑨ Leveling screws
- ⑩ Base plate

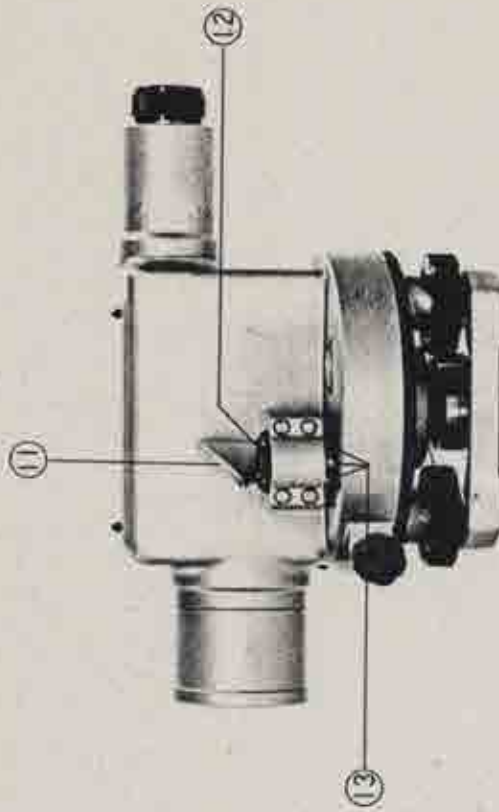


Fig. 2

- ⑪ Circular level view mirror
- ⑫ Circular level
- ⑬ Circular level adjustment screws

SPECIFICATIONS

Telescope	
Image	Erect
Magnification	26X
Effective diameter of objective lens	30mm (1-3/16in.)
Field of view	1° 20' (2.3m circle at 100m)
Minimum focus	1.8m (70-7/8in.)
Resolving power	3.5"
Stadia ratio	100
Stadia constant	0
Horizontal Circle	
Diameter	88mm (3-15/32in.)
Scale division	1°
Circular Level	
Sensitivity	10' / 2mm
Automatic Leveling Mechanism	
Automatic leveling range	±15'
Special Accessories (Supplied Against Specific Orders Only)	
Tripod (Metal extension-leg type)	0.98m - 1.65m
Length of metal tripod	

EQUIPMENT

Standard Equipment

Instrument only (with lens cap)
 Size 245.3mm long x 123mm wide x 138mm high (9-21/32 x 4-27/32 x 5-7/16in.)
 Weight 2.2 kgs. (4.8 lbs.)

Plastic Carrying Case (with contents)
 Size 350mm long x 208.5mm wide x 184mm high (13-25/32 x 8-3/16 x 7-1/4in.)
 Weight 1.2 kgs. (2.6 lbs.)

Special Accessories (Supplied against Orders)
 Tripod
 Diagonal eyepiece

Centering platform

Contents of Plastic Carrying Case

Instrument	1 each	Tool Box	1 each
Lens cap	1 each	Adjustment pin	1 each
Plumbing bob	1 set	Cleaning brush	1 each
		Screwdriver	1 each

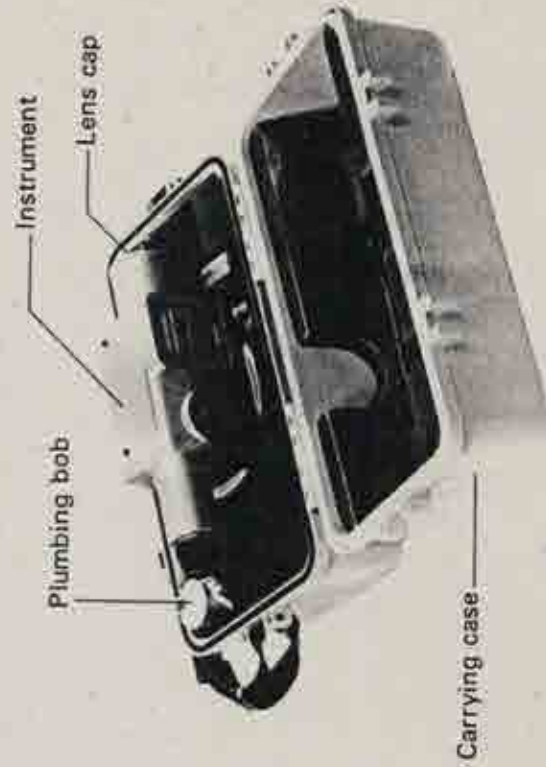


Fig. 3

CONSTRUCTION AND FUNCTIONS

The Model AT-D3 Auto-Level is an automatic level, with a patented waterproofed construction, in which an automatic leveling mechanism has been incorporated in the telescope optical system, for the purpose of automatically re-adjusting the optical axis, to compensate for slight tilting of the telescope, and thus maintaining the line of sight in the horizontal plane at all times.

1. Telescope

The telescope permits speedy sighting of the target, in spite of its high magnification power, because of the wide field of view, while surveying in the early morning hours or in the evening gloom is also quite easy because the large 30 mm effective diameter objective lens shows a bright and distinct target under all conditions.

The optical system of the telescope, as illustrated in Fig. 4, consists of a two element objective lens, erecting prism "a" (compensator prism), erecting prism "b", a two element focusing lens, reticule glass of two elements and, finally, a three element eyepiece lens.

The light passing through the objective lens is initially reversed laterally by erecting prism "a" and then reversed vertically by erecting prism "b".

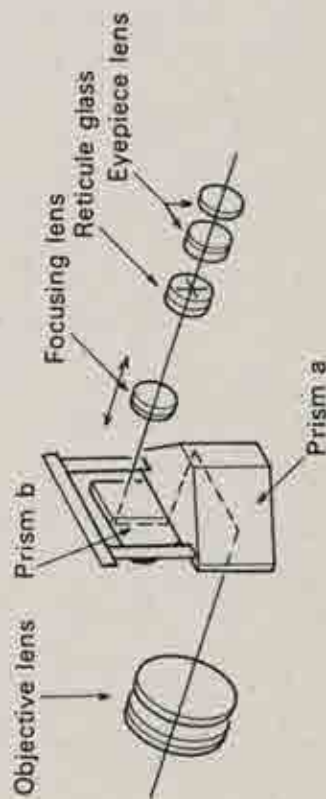


Fig. 4

thus producing an erect image which is then focused on the reticule glass, for observation through the eyepiece lens.

Rotating the focusing knob moves the focusing lens forward or backward for internally focusing the telescope from infinity to 1.8 meter (71 in.) from the objective lens.

The eyepiece lens may also be adjusted in or out, by simply revolving the eyepiece adjustment ring, for adjusting the dioptric power of the eyepiece to the user's eyesight.

All light transmitting glass surfaces of the optical system, excluding the reticule glass, are coated for prevention of reflection, with the result that loss of light due to reflection on the lens surface, as well as stray light which could effect the brilliance of the image, are effectively eliminated and a clear, distinct and brilliant image of great contrast is observed at all times.

The sun shade is built-in on the outside of the telescope tube, on the objective lens side, and is simply pulled out for use and pushed back in for storage. Thus it is both simple to use and in no danger of getting lost.

2. Automatic Leveling Mechanism

A newly-developed automatic leveling mechanism (patent pending) has been incorporated in the instrument which automatically compensates for tilting of the optical axis, up to $\pm 15'$, even when the instrument is only roughly centered with the circular level or when one of the tripod legs sinks in the soft ground after leveling, thus maintaining an absolutely horizontal line of sight at all times.

Erecting prism "a" is suspended by special ribbon-like material and, like a compound pendulum, has greatly improved motion characteristics, with very fast return speed for speedy stabilization of the pendulum swing.

At the same time, four jewels are used in the automatic leveling mechanism to improve resistance to vibrations and shocks, with the result that the mechanism has highly accurate compensations and great durability.

3. Focusing Knob

The large focusing knob is easy to manipulate and shows the direction of infinity, thus making possible fast initial manipulations.

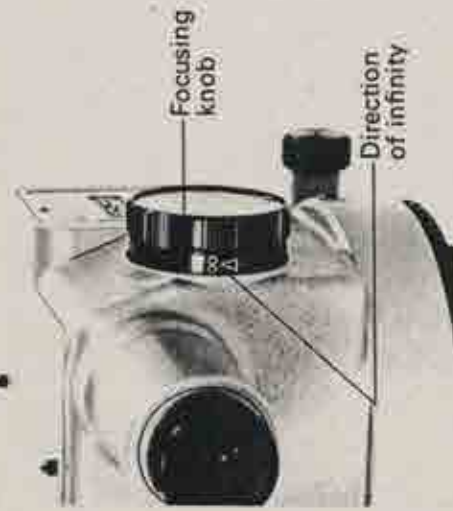


Fig. 5

4. Reticule Glass

The reticule glass is a finely polished optically flat glass of high quality on which extremely fine and durable cross-hairs are deposited by a special chemical process, thus eliminating misalignments and/or breakages of the lines during the service-life of the instrument.

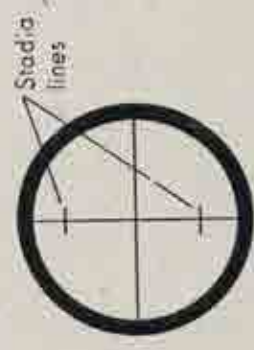


Fig. 6

Stadia lines are also incorporated in the cross-hair pattern, thus making it extremely convenient for simple, quick measurements of distances, as well as for the purpose of obtaining equal sight distances in the backsight and foresight, during leveling operations.

5. Horizontal Circle

The horizontal circle has two type of scales, for convenience of the user, with one graduated straight through from 0 to 359° and the other a compass-type scale with graduations in quadrants (0° to 90° to 0° and so forth).

In the case of centimal system has only one scale which is graduated straight through from 0 to 399.

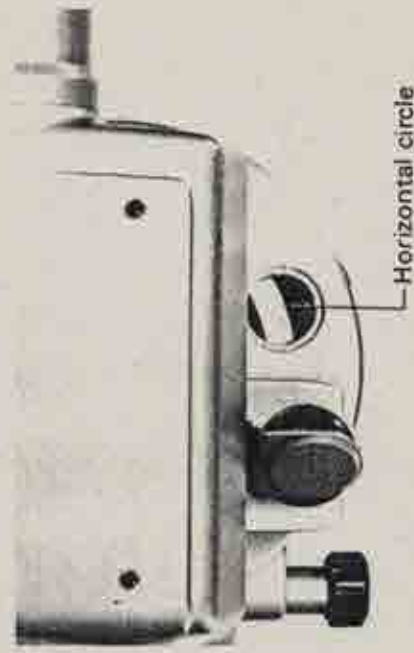


Fig. 7

6. Circular Level

The circular level of the instrument has a sensitivity of 10"/2-mm, which means that each 2 mm movement of the bubble indicates a 10 minute tilt of the level.

Three circular level adjustment screws are found below the circular level for the purpose of making

adjustments in the level accuracy.

The circular level view mirror, above the circular level, permits direct viewing of the level without any change in posture from telescope viewing.

Two circular lines are drawn on the glass surface of the circular level. When the bubble of the level is within the inner circle, the vertical axis is roughly perpendicular to the horizontal plane. The outer red circle, on the other hand, shows the limits of the automatic leveling range, which is 50 percent larger than previous automatic leveling ranges. When the bubble is in contact with the outer circle, the vertical axis is tilted 15 minutes and the instrument is at its limit for automatic leveling action.

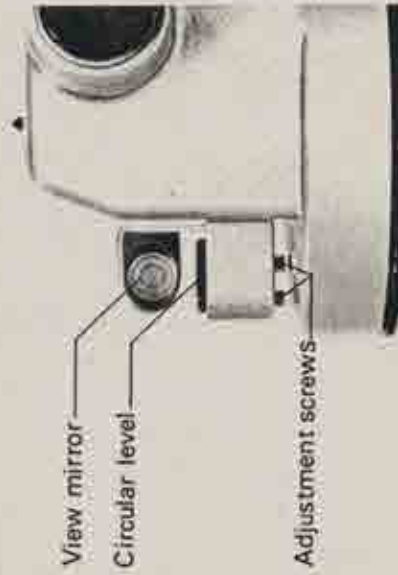


Fig. 8

7. Fine Horizontal Adjustments

The fine horizontal knob can be manipulated with either hand, since it is available on both sides. Furthermore, adjustments are clampless which means greatly speeded-up operations.

8. Waterproofed Construction

The instrument has a completely waterproofed construction and, therefore, may be used in the rain or in tunnels where water is constantly dripping.

Dry gas (nitrogen) is sealed inside the telescope tube and effectively prevents condensation on the lens surface inside the telescope tube, when there are sudden changes in the surrounding temperature, which could prevent observation of the target.

9. Stadia Constant

As stadia ratio is 100 and stadia constant 0, it is only necessary to multiply the rod reading, between the stadia lines, by 100 to find the distance to the target from the instrument.

However, since the stadia lines are mainly used for the purpose of obtaining equal sight distances in the backsight and foresight, in the case of the level, there is no need for stadia calculations and, consequently, the stadia constant is not required as with the transit.

OPERATION

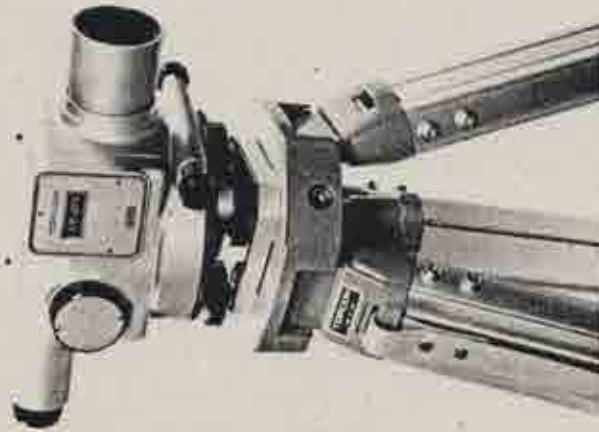


Fig. 9

- (1) Spread the legs and press in firmly so that the tripod head is roughly level and at a suitable height for attachment of the instrument.
Use tripods with a tripod screw of 5/8 in. diameter and 11 threads per one inch, as per J.I. S. B standards.

- (2) Take the instrument carefully out of the plastic carrying case and place it on the tripod head; screw the tripod screw into the instrument's tripod socket and tightly fix the instrument to the tripod.
- (3) When the instrument is to be used for measuring angles or establishing a line, the instrument must be set up exactly over the point.
Therefore, set up the tripod so that the center of the instrument is approximately over the point, hang the plumb bob on the hook of the tripod screw and shift the instrument (and tripod) around until the plumb bob is about one centimeter directly above the point.
Next, loosen the tripod screw slightly and shift the instrument around on the tripod head until it is exactly over the point, at which point tighten the tripod screw.
- (4) Leveling the instrument.
Adjust the three leveling screws, while looking at the circular level bubble, and center it correctly, as illustrated in Fig. 10.
Do not touch the telescope during this operation.

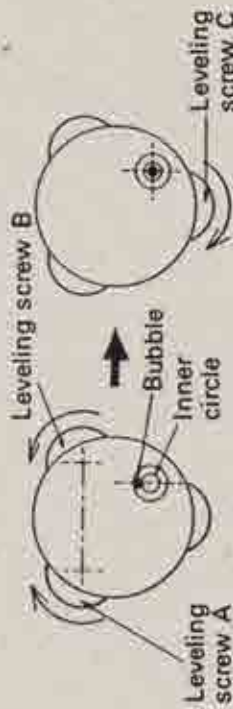


Fig. 10

- (a) First, use two of the leveling screws and move the bubble so that it is centered on a line perpendicular to a line running through the centers of the two leveling screws being used for the initial adjustment.
- (b) Next, use the remaining leveling screw and shift the bubble towards the center of the

circular level.

If it is not possible to center the level bubble, then repeat once more from the beginning.

- (5) Take a firm hold on the lens cap attached over the objective lens and pull strongly, which will extend the sun shade. (See Fig. 11) Another strong pull will detach the lens cap itself.



Fig. 11

- (6) Point the telescope towards the light and rack the eyepiece out fully, by revolving the eyepiece adjustment ring counter-clockwise.



Fig. 12

Then, revolve the ring gradually in the clockwise direction, while looking through the eyepiece, until the cross-hairs of the reticule glass are seen sharply and distinctly, at which point the eyepiece will be adjusted to the user's eyesight.

- (7) Align the telescope with the target, using the rough aiming sights on top of the telescope. The large focusing knob is easy to manipulate and shows the direction of infinity, thus making possible fast initial manipulation.



Fig. 13

- (8) Next, revolve the focusing knob slowly, in either direction, until the target is seen distinctly through the telescope. At the same time, revolve the fine horizontal knob until the vertical line of the reticule cross-hairs is coincided with the leveling rod or target.

Check focus once more.

Rotating the focusing knob in the counter-clockwise direction, as far as it will go, will let you focus down to 1.8 meter (70-7/8 in.).

- (9) Shift the eye to the left and right and check whether there are any deviations between the cross-

hairs and the leveling rod image at this time, which will mean that parallax exists. When there is parallax, either focusing is incomplete and/or dioptic adjustment of the eyepiece with the eyepiece adjustment ring is improper and, therefore, there will be errors in the reading of the leveling rod. Parallax must be eliminated by re-focusing or re-adjusting the eyepiece to the user's eyesight, or both.

Readings are taken in the above manner. Readings at the foresight and backsight are taken by simply repeating the operations noted in (7), (8) and (9).

ADJUSTMENT

The Auto-Level, Model AT-D3, is an exceptionally sturdy and ruggedly constructed instrument which will seldom require adjustments, in spite of incorporating an automatic leveling mechanism.

All instruments delivered undergo strict and rigid inspections, from the time the raw material is delivered to the factory until the final equipment is thoroughly inspected and precisely adjusted, by experienced technicians, and then carefully packed for shipment to you.

Unless the instrument is subject to excessive rough handling during transportation, it should arrive properly adjusted and ready for operation.

Even if it is suspected that the instrument has been subjected to excessive rough treatment by the carrier, be absolutely certain that adjustment is required before making the adjustment. Check the instrument until it is absolutely certain beyond doubt that adjustment is required and then proceed as explained following.

After adjustments, check the instrument once more to see whether adjustments have been properly made.

The adjustments noted following are also important for the purpose of obtaining the greatest accuracy and service from the instrument.

Adjustment of the Circular Level

- (1) Set the instrument up on the tripod and carefully center the bubble of the circular level with the three leveling screws.
- (2) Revolve the telescope 180° around its vertical axis. If the bubble remains centered, adjustment is not required but, if the level bubble moves from the center, then the following adjustment is required.
- (3) Tighten the adjustment screw on the side that the bubble has moved to, with the adjusting pin, which will return the bubble towards the center. However, return the bubble by only one-half the amount of

error by this method.

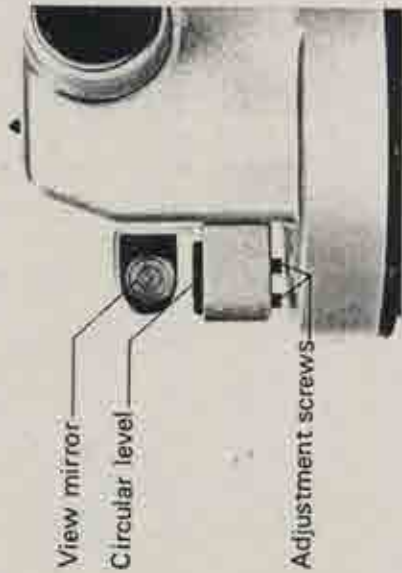


Fig. 14

- (4) Re-center the level bubble with the three leveling screws.
- (5) The level bubble should now remain centered as the telescope is revolved around its vertical axis. If not, repeat the adjustments noted above until the level bubble remains centered when the instrument is revolved on its axis.

Collimation of the Instrument

- (1) Set the instrument up on a tripod at a point midway between two walls which are approximately 50 meters distance apart.
- (2) Level the instrument properly by centering the circular level bubble with the three leveling screws.
- (3) Place the test scales against both walls and alternately collimate both scales on a horizontal line of sight, using 100 on the test scales for collimation, and adjusting the test scales up or down as required.
- (4) Move the instrument to a position 2 to 3 meters from one of the test scales and center the level bubble once more, with the three leveling screws.

- (5) Collimate both test scales on a horizontal line of sight again and read the scales. If the readings on both test scales are identical adjustment is not required but, if the readings are different, the following adjustment is required.

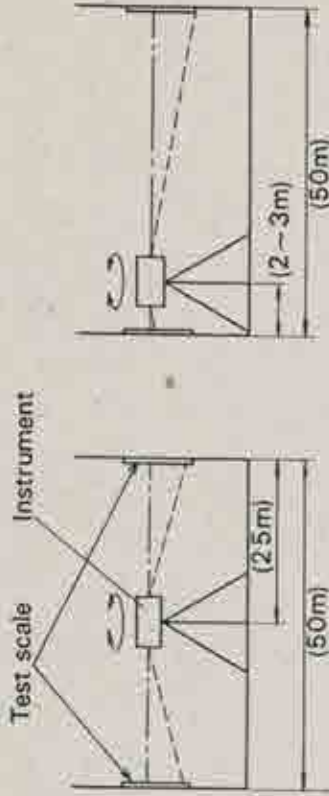


Fig. 15

- (6) Sight the farther test scale and shift the horizontal cross-hair line either up or down, as required, by revolving the cross-hair adjustment screws with the adjusting pin until the reading obtained is identical to that of the nearer test scale.
The four adjustment screws are to be found under the cross-hair adjustment device cover, when it is unscrewed. (See Fig. 17) When shifting the cross-hair reticule glass, first loosen the adjustment screw in the direction in which the horizontal cross-hair line must be shifted and then tighten the adjustment screw, on the opposite side, by an equal amount. Thus, if the bottom adjustment screw is revolved a half turn in the counter-clockwise direction to loosen, then revolve the top adjustment screw by the same half turn in the clockwise direction to tighten, which will leave the tensions of the adjustment screws unchanged.
- (7) Check once more whether the test scales give identical readings with the instrument set in the above manner and, if not, repeat the adjustment once more.

Adjustment of the Cross-Hair Reticule Glass

- (1) Set the instrument up on the tripod and carefully center the bubble of the circular level with the three levelling screws.
- (2) Sight on a suitable target about 40 meters from the instrument or place a suitable mark on the levelling rod, if the former is unavailable.
- (3) Coincide the horizontal cross-hair line with the mark so that the mark is aligned flush with the line.
- (4) Next, revolve the fine horizontal knob so that the horizontal cross-hair line traces the mark.

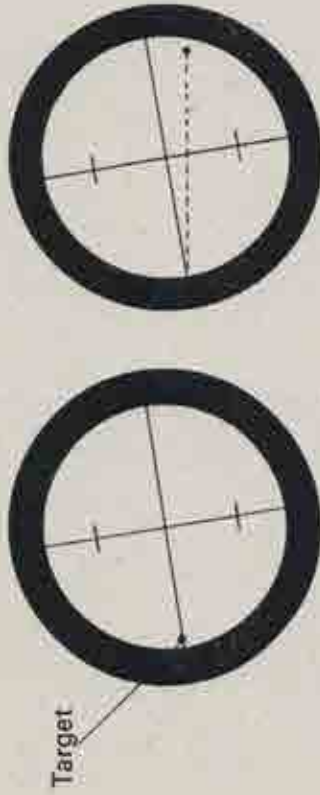


Fig. 16

- (5) If the target mark is displaced from the horizontal cross-hair line as it is moved across the field of view, then adjustment is required in the cross-hair reticule glass.
- (6) Revolve the cross-hair adjustment device cover in the counter-clockwise direction and take it off, which will expose four fixing screws, in addition to four capstan adjustment screws. (See Fig. 17)
- (7) Slightly loosen all four fixing screws, with a screwdriver, and revolve the reticule glass so that the horizontal cross-hair line is correctly located. Re-tighten the fixing screws by the amount that they were loosened.

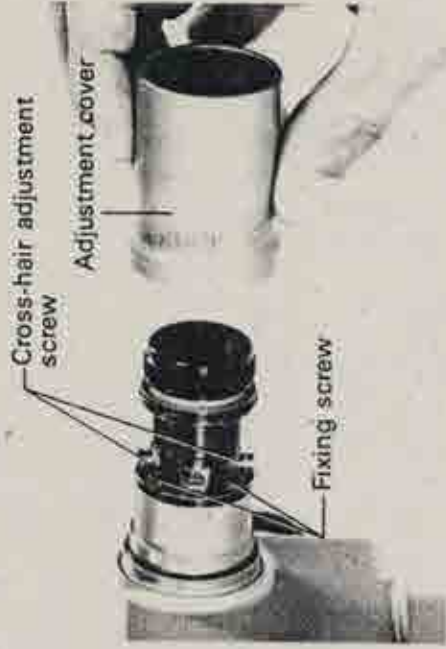


Fig. 17

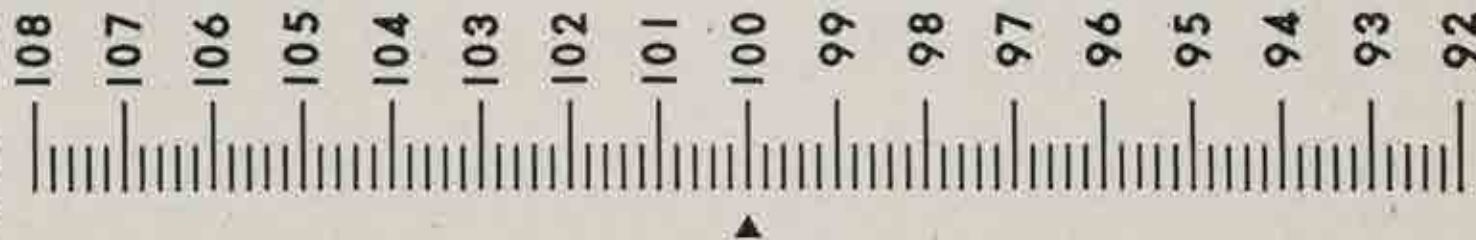
- (8) Repeat the checking operation once more and if the target mark is still displaced from the horizontal cross-hair line when the telescope is revolved with the fine horizontal knob, repeat adjustments once more. The accessory test scale may be used as the target for this purpose.

IMPORTANT

- (1) To increase precision in surveying operations, always eliminate parallax by making proper dioptic adjustments of the eyepiece and by focusing carefully.
- (2) For precision operations, place the circular level bubble inside the blue circle, otherwise, it can be used within the red-colored circle for most surveying operations.
- (3) For high precision surveying, cover the instrument and the tripod with some kind of awning or umbrella to shield them from the strong direct sunlight.
- (4) Use care when carrying or transporting the instrument so that it is not subjected to shock or vibrations, and, if possible, cushion it with suitable material.
- (5) Carefully wipe away dust and moisture from the instrument after use and then store it in a dry and well-ventilated location, which is, at the same time, not dusty.
- (6) Do not try to dismantle the instrument, especially the screws and revolving parts, but contact the nearest experienced and well-equipped factory for this purpose.

CARE AND MAINTENANCE

- (1) Clean the lens surface by brushing away the dust with the cleaning brush first, or blowing it away with an air blower.
- (2) When absolutely necessary to wipe dirt or fingerprints from the lens surface, use a well-washed soft cotton cloth, dipped in alcohol or a mixture of alcohol and ether, and lightly wipe the lens surface several times. On no condition should the surface be rubbed hard but repeat the light wiping action, if necessary.
- (3) To ascertain whether the automatic leveling mechanism is in action, revolve the nearest leveling screw slightly, to the left or right, while looking into the telescope through the eyepiece. If the line of sight is momentarily shifted but instantly returned to its horizontal plane, the mechanism can be considered as being in proper working order.



TOPCON

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