TM 5-6675-270-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE MANUAL

THEODOLITE, DIRECTIONAL 0.2 MIL GRADUATION; 5.9 IN. LONG TELESCOPE, W/ACCESSORIES (WILD HEERBRUGG MODELS) (MODEL T16-MIL 66, TYPE II) FSN 6675-926-4505 (MODEL T16-MIL 68, TYPE II) FSN 6675-861-7939 THEODOLITE, DIRECTIONAL: 1 MIN GRADUATION; 5.9 IN. LONG TELESCOPE, W/ACCESSORIES (WILD HEERBRUGG MODEL T16-68 DEG, TYPE I) FSN 6675-770-4958

This copy is a reprint which includes current pages from Changes 1 through 5. (formerly bound)

HEADQUARTERS, DEPARTMENT OF THE ARMY

12 MARCH 1970

WARNING

TRAFFIC ACCIDENTS

Never set the theodolite up on a highway or road without first posting caution signs around curves, or at least 500 feet up and down the road to prevent accidents due to passing traffic.

WARNING

EYE INJURY

Severe eye injury can result from looking directly at the sun without the sunglasses.

Changes in force: Cl, C3, C5 and C6

TM 5-6675-270-15
C 6

CHANGE

No. 6

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 5 February 1990

Operator, Organizational, Direct and
General Support and Depot Maintenance Manual

THEODOLITE: DIRECTIONAL; 0.2 MIL GRADUATION,
5.9 IN. LONG TELESCOPE W/ACCESSORIES
(WILD HEERBRUGG MODELS)
(MODEL T16-MIL66, TYPE II) NSN 6675-00-926-4505
(MODEL T16-MIL68, TYPE II) NSN 6675-00-8(1-7939
THEODOLITE: DIRECTIONAL; 1 MIN GRADUATION;
5.9 IN. LONG TELESCOPE W/ACCESSORIES
(WILD HEERBRUGG MODEL T16-68 DEG, TYPE I)
NSN 6675-00-770-4958

Approved for public release; Distribution is unlimited.

TM 5-6675-270-15, 12 March 1970, is changed as follows.

Page 2-6. Figure 2-7 is changed as follows: Delete illustration of dummy batteries. Appendix B, Section II, Change 5. Delete all references to dummy batteries.

By Order of the Secretary of the Army:

CARL E.VUONO
General, United States Army
Chief of Staff

Official:

THOMAS F. SIKORA
Brigadier General, United States Army
The Adjutant Genera/

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A Operator, Unit, Direct Support and General Support Maintenance requirements for Theodolite, Directional, .2 mil Grad./l min Grad. 5.9 in." Telescope (T16-MIl-66, T160MIL68, T16-68DEG).

☆U.S. GOVERNMENT PRINTING OFFICE 1990 - 754-029/20018

TM 5-6675-270-15
C5

CHANGE
NO. 5

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D C, *27 December 1976*

Operator, Organizational, Direct and General Support and Depot Maintenance Manual

THEODOLITE: DIRECTIONAL; 0.2 MIL GRADUATION, 59 IN. LONG TELESCOPE W/ACCESSORIES (WILD HEERBRUGG MODELS) (MODEL T16-MIL66, TYPE II) NSN 6675-00-926-4505 (MODEL T16-MIL68, TYPE II) NSN 6675-00-861-7939 THEODOLITE: DIRECTIONAL; 1 MIN GRADUATION; 5.9 IN. LONG TELESCOPE W/ACCESSORIES (WILD HEERBRUGG MODEL T16-68 DEG, TYPE I) NSN 6675-00-770-4958

TM 5-6675-270-15, 12 March 1970, is changed as follows.

Title page and table of contents page are changed as shown above.

Page iii. The appendixes in the table of contents are superseded as follows:

APPENDIX	A.	References
	B.	Components of End Item List
	C.	Additional Authorization List
	D.	Maintenance Allocation Chart
	E.	Expendable Supplies And Materials List

Page 1-1. Paragraph 1-4 is superseded as follows:

1-4. REPORTING OF ERRORS

You can help to improve this manual by calling attention to errors and by recommending improvements. Your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), and/or DA Form 2028-2 (Recommended Changes to Equipment Technical Manuals), may be used. Copies of DA Form 2028-2 are attached in the back of the manual for your use. Please mail your recommended changes directly to the Commander, U. S. Army Troop Support Command, ATTN: DRSTS-MPP, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished directly to you.

Page 3-1. Paragraph 3-1, line 3, change "appendix C" to read "appendix B".

Paragraph 3-2, line 3, change "appendix C" to read "appendix B".

Page 4-1. Paragraph 4-6, line 3, change "appendix C" to read "appendix B".

Page 5-1. Paragraph 5-1, line 3, change "appendix C" to read "appendix B".

Page A-1. Paragraph A-1 is superseded as follows:

A-1. PAINTING

AR 740-1	Storage and Supply Activity Operation
AR 746-1	Color, Marking and Preparation of Equipment for Shipment

Paragraph A-3. Add the following:

TM 5-235	Special Surveys
TM 5-236	Surveying Tables and Graphs

Paragraph A-4. Line one (1) is changed to read:

TB 740-97-1	Preservation of USAMECOM Mechanical Equipment for Shipment and Storage

Page B-1. Appendix B is superseded as follows:

APPENDIX B
COMPONENTS OF END ITEMS LIST

Section I. INTRODUCTION

B-1. Scope

The Components of End Item List is divided into the following sections:

a. Section II. Integral Components of the End Item. These items, when assembled, comprise the theodolite and must accompany it whenever it is transferred to turned in. These illustrations will help you identify these items.

b. Section III. Basic Issue Items. These are minimum essential items required to place the theodolite in operation, to operate it, and to perform emergency repairs. Although shipped separately, they must accompany the theodolite during operation and whenever it is transferred between accountable officers. The illustrations will assist you with hard-to-identify items. This manual is your authority to requisition replacement BII, based on Table(s) of Organization and Equipment TOE/Modification Table of Organizational and Equipment (MTOE) authorization of the end item.

B-3. Explanation of Columns

a. Illustration. This column is divided as follows:

(1) Figure Number. Indicates the figure number of the illustration on which the item is shown (if applicable).

(2) Item Number. The number used to identify item called out in the illustration.

b. National Stock Number (NSN). Indicates the National Stock Number assigned to the item and which will be used for requisition.

c. Part Number (P/N). Indicates the primary number used by the manufacturer which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items.

d. Description. Indicates the Federal item name and, if required, a minimum description to identify the item.

e. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

f. Usable on Code. "USABLE ON" codes are included to help you identify which component items are used on the different models. Identification of the codes used in these lists are:

CODE	*USED ON*
CJY	T16-MIL66, Type II
CJZ	T16-MIL68, Type II
CKA	T16-68DEG, Type I

NOTE

When the column is blank the item required is applicable to all models.

g. Quantity Required (Qty Req'd). This column lists the quantity of each item required for a complete major item.

h. Quantity. This column is left blank for use during inventory. Under the Rcv'd column, list the quantity you actually receive on your major item. The Date columns are for use when you inventory the major item at a later date, such as for shipment to another site.

Section II. INTEGRAL COMPONENTS OF END ITEM

(1) ILLUSTRATION (a) FIGURE NO.	(1) ILLUSTRATION (b) ITEM NO.	(2) NATIONAL STOCK NO.	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUANTITY RCVD	DATE	DATE	DATE
1-5			T16-4200-66 (89905)	Tribrach		CJY	1				
1-6			GDF1-000000 (89905)	Tribrach		CKA CJZ	1 1				
5-21			GSB1 (89905)	Sunshade			1				
2-1			GVP3-00-000-66 (89905)	Case Assembly Carrying w/Base			1				
4-1			NT1-893-895 (89905)	Desiccant Container			1				
1-9	A		T16-771 (89905)	Case, Shipping			1				
2-6				Case Accessory, Containing the following:			1				
2-6			T16-761G (89905)	Case, Accessory			1				
2-6			NT2-549A (89905)	Cover, Theodolite			1				
2-6			GSU100000DEG (89905)	Compass Assy		CKA	1				
2-6			GBU100000MIL (89905)	Compass Assy		CJY CJZ	1				
2-6			OPF0100-66 (89905)	Eyepiece, Diagonal Telescope			1				
2-6			OPM01000 (89905)	Eyepiece, Diagonal Microscope			1				
2-6			GOF-00000 (89905)	Sunglass I			1				
2-6			GOF4-00001 (89905)	Sunglass II, Black			1				
2-7				Battery Box Assy Containing the following			1				
2-7			GEB8-000-000-66 (89905)	Box Assy, Battery			1				

Section II. INTEGRAL COMPONENTS OF END ITEM (Cont'd)

(1) ILLUSTRATION (a) FIGURE NO.	(1) ILLUSTRATION (b) ITEM NO.	(2) NATIONAL STOCK NO.	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUANTITY RCVD	DATE	DATE	DATE
2-7			GEB10-000000 (89905)	Battery, Dummy			2				
2-7			GEB1-00000-66 (89905)	Handlamp Assy w/Lamp			1				
2-7			G 11-000000-66 (89905)	Cable Assembly			1				
2-7			T16-11US (89905)	Illumination Assy w/Holder			1				
2-5			HDS1-2A (89905)	Haversack			1				
2-3		6675-00-614-3572	21B00000-66 (89905)	Tripod Assy, Extension leg consisting of			1				
2-11			21B (89905)	Tripod Assy			1				
4-7			3A63A (89905)	Cover, Head			1				
2-4			2A20A23A (89905)	Tripod Accessory Case			1				
2-4			3A29 (89905)	Wrench, Tripod			1				
2-4			2A001000 (89905)	Plumb Bob Assy w/Adjuster			1				
1-3 and 1-4			T16-47000	Mirror Assembly Circle Illumination			1				

Section III. BASIC ISSUE ITEMS

(1) ILLUSTRATION (a) FIGURE NO.	(1) ILLUSTRATION (b) ITEM NO.	(2) NATIONAL STOCK NO.	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUANTITY RCVD	DATE	DATE	DATE
				TM 5-6675-170-15 Operator, Organizational, Direct Support General Support and Depot Maintenance Manual			1				
2-6			3A55 (89905)	Pin, Adjusting			2				
2-6			HDW1-5 (89905)	Screwdriver, Jewelers			1				
2-6			HDW-1-10 (89905)	Screwdriver, Large			1				
2-6			KKC300 (89905)	Chamois			1				
2-6			3A59 (89905)	Brush, Dust			1				
2-7			HEG3-64 (89905)	Lamps			4				
2-6			HDP3-4 (89905)	Container, Lubricant			1				

Page A-1. Appendix C is added after Appendix B as follows:

APPENDIX C
ADDITIONAL AUTHORIZATION LIST

Section I. INTRODUCTION

C-1. Scope

This appendix lists additional items you are authorized for the support of the theodolite.

C-2. General

This list identifies items that do not have to accompany the theodolite and that do not have to be turned in with it. These items are authorized to you by CTA, MTOE, TDA or JTA.

C-3. Explantion of Listing

National Stock Number, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment. "USABLE ON" codes are not used because the item required is applicable to all models.

Section II. ADDITIONAL AUTHORIZATION LIST

(1) NATIONAL STOCK NUMBER	PART NUMBER & FSCM	(2) DESCRIPTION	USABLE ON CODE	(3) U/M	(4) QTY AUTH
	BA30 (81349)	Battery Dry, 1.5 Volts		EA	8

Page B-1. Change "Appendix B MAINTENANCE ALLOCATION CHART" to read "Appendix D MAINTENANCE ALLOCATION CHART".

Page C-1. Appendix C is superseded by Appendix E as follows:

APPENDIX E
EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E-1. Scope

This appendix lists expendable supplies and materials you will need to operate and maintain the theodolite. These items are authorized to you by CTA50-970, Expendable Items (except Medical, Class V, Repair Parts, and Heraldic Items).

E-2. Explanation of Columns

a. Column 1 - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, Item 5, App. D").

b. Column 2 - Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. Column 3 - National Stock Number. This is the National Stock Number assigned to the item; use it to request or requisition the item.

d. Column 4 - Description. Indicates the federal item name and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parenthesis, if applicable.

e. Column 5 - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	C,O	6850-00-680-2233	Desiccant Activated 1.5 lb	lb
2	C,O	7920-00-401-8034	Cloth, Lint-free, Non-abrasive, General Purpose Part No. 1001	bx
3	C,O	9150-00-985-7244	Grease, Instrument, and Aircraft (GIA) MIL-G-23827, 4 oz.	Tube
4	C,O	9150-00-252-6382	Oil, Clock and Watch (OCW) MIL-L3918 5cc	Btl
5	C,O	6810-00-223-2739	Acetone, Technical, 1 pt can; Fed Spec MMM-A-185	Pt
6	C,O	6850-00-664-5685	Cleaning Solvent Fed Spec PD-680	qt
7	C,O		Lens Tissue NNNP40TYPEICLASSI (81348)	Pkg
8	C,O		Orange Sticks 13218E3063 (97403)	Pkg

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

PAUL T. SMITH
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-32, Operator maintenance requirements for Surveying Equipment.

★U. S. GOVERNMENT PRINTING OFFICE: 1977--765029/47

TM 5-6675-270-15
C 3

CHANGE
NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *25 April 1974*

Operator, Organizational, Direct and General Support, and Depot Maintenance Manual THEODOLITE: DIRECTIONAL; 0.2 MIL GRADUATION, 5.9 IN. LONG TELESCOPE W/ACCESSORIES (WILD HEERBRUGG MODELS) (MODEL T16-MIL66, TYPE II) FSN 6675-926-4505 (MODEL T16-MIL68, TYPE II) FSN 6675-861-7939 THEODOLITE: DIRECTIONAL; 1 MIN GRADUATION; 5.9 IN. LONG TELESCOPE W/ACCESSORIES (WILD HEERBRUGG MODEL T16-68DEG, TYPE I) FSN 6675-770-4958

TM 5-6675-270-15, 13 March 1970 is changed as follows:

Page 1-1 paragraph 1-4 is superseded as follows:

1-4. Recommendation for Publications Improvements. You can help to improve this manual by calling attention to errors and by recommending improvements. Your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) should be mailed direct to: Commander, US Army Troop Support Commander attn: AMSTS-MPP, 4300 Goodfellow Blvd, St Louis, MO 63120. A reply will be furnished direct to you.

Page 1-1 paragraph 1-6 is superseded as follows:

1-6. Difference Between Models. This manual covers the Wild Heerbrugg Theodolite Models T16-MIL66, T16-MIL68 and T16-68DEG Type I. There are no known operating differences between models. However, differences do exist in the component assemblies. Refer to the applicable Repair Parts List for this information. Some differences between models are as follows:

a. The configuration of the clamping assembly on the tribrach differs. Model T16-MIL66 is locked by a clamp lever which slides into locking position; models T16-MIL68 and T16-68DEG are locked by a clamping knob which is rotated 180° and which is secured in position by a setscrew.

b. The horizontal and vertical circles on models T16-MIL66 and T16-MIL68 are graduated in mils where as those on the model T16-68-DED are graduated in degrees.

c. Models T16-MIL68 and T16-68DEG only have a telescope level assembly.

d. Model T16-MIL66 only has a telescope rear sight.

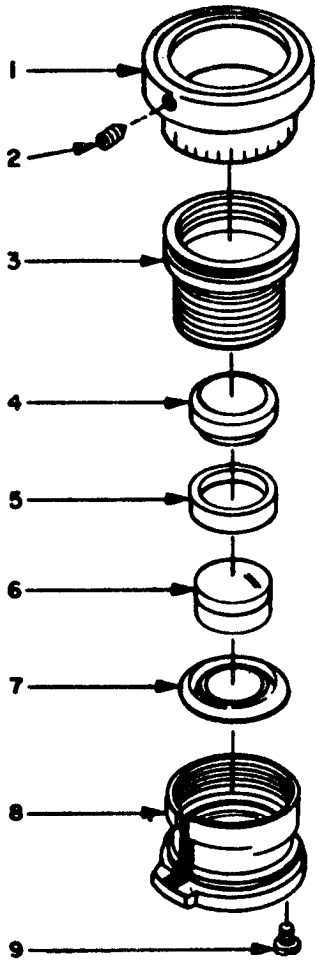
e. Differences do exist in the telescope and microscope assemblies.

f. Figures 1-9.1., 2-4.1, 4-7.1, 4-8.1, 6-2.1, 5-20.1 (Change 1) apply only to Theodolite Model T16-68MIL, FSN 6675-861-7939, serial numbers 136735 through 136754, 136885 through 136949 and 137035 through 137099.

g. Figures 1-9.1, 2-4.1, 4-7.1, 4-8.1, 6-2.1 (Change 1) and figure 5-20.2 apply only to Theodolite Model T16-68DEG, FSN 6675-770-4958, serial numbers 166681 through 166730, 167181 through 167205, 171981 through 172005, 17228 through 172581 through 172605 and 17831 through 172866.

h. Instructions contained in this manual are for all models except as otherwise specified.

Page 5-19 immediately after figure 5-20, figure 5-20.2 is added as follows:



1 Dial Scale
2 Setscreen
3 Threaded Sleeve
4 Lens
5 Spacer Sleeve
6 Lens
7 Lockring
8 Flange
9 Machine Screw

Figure 5-20-2. Telescope eyepiece assembly, model TD-16-68GED.

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Official:
VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-25A (qty rqr block No. 174) organization maintenance requirements for Surveying Equipment.

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C. *29 September 1971*

Operator, Organizational, Direct and General Support, and Depot Maintenance Manual

THEODOLITE: DIRECTIONAL; 0.2 MIL GRADUATION, 5.9 IN. LONG TELESCOPE W/ACCESSORIES (WILD HEERBRUGG MODELS) (MODEL T16-MIL66, TYPE II) FSN 6675-926-4505 (MODEL T16-MIL68, TYPE II) FSN 6675-861-7939 THEODOLITE, DIRECTIONAL: 1 MIN GRADUATION; 5.9 IN. LONG TELESCOPE, W/ACCESSORIES (WILD HEERBRUGG MODEL T16-68 DEG, TYPE 1) FSN 6675-770-4958

TM 5-6675-270-15, 12 March 1970 is changed as follows:

Page 1-1. Paragraph 1-6 is superseded as follows:

1-6. Difference Between Models

This manual covers the Wild Heerbrugg Theodolite Models T16-MIL66, T16-68MIL and T16-68 DEG Type I. There are no known operating differences between models. However, differences do exist in the components assemblies. Refer to the applicable Repair Parts Lists for this information. Some differences between models are as follows:

a. The configuration of the clamping assembly on the tribrach differs. Model T16-MIL66 is locked by a clamp lever which slides into locking position; models T16-MIL68 and T16-68DEG are locked by a clamping knob which is rotated 180° and which is secured in position by a setscrew.

b. The horizontal and vertical circles on models T16-MIL66 and T16-MIL68 are graduated in mils where as those on the model T16-68DEG are graduated in degrees.

c. Models T16-MIL68 and T16-68DEG only have a telescope level assembly.

d. Model T16-MIL66 only has a telescope rear sight.

e. Differences exist in the telescope and microscope assemblies.

f. Figures 1-9.1, 2-4.1, 4-8.1, 6-2.1, 5-2.1 apply only to Theodolite Model T16-68MIL, FSN 6675-861-7939, serial numbers 136735 through 136754, 136885 through 136949 and 137035 through 137099.

g. Instructions contained in this manual are for all models except as otherwise specified.

Page 1-10. Add figure 1-9.1.

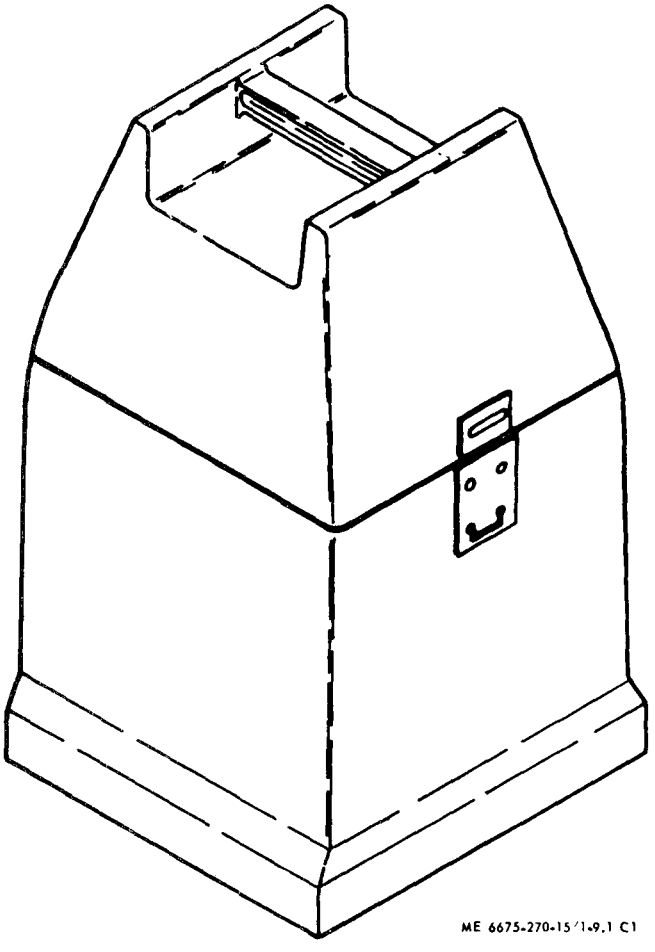


Figure 1-9.1. Shipping case (model T16-MIL68 type II)

Page 2-3. Add figure 2-4.1.

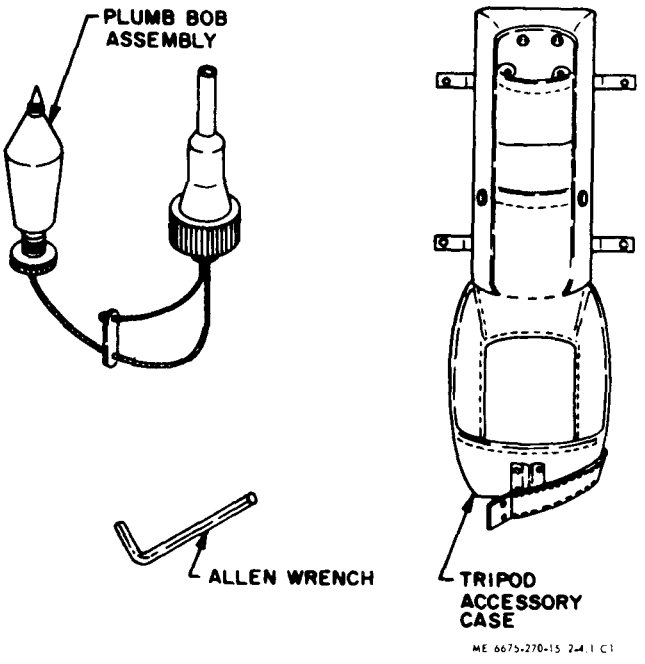


Figure 2-4.1. Tripod accessory case and accessories, unpacked view (model T16-68 type II)

→

1 Cover
2 Head
3 Washer
4 Fixing screw
5 Clamp jaw
6 Nut
7 Bearing
8 Leather strap
9 Washer
10 Wood screw
11 Clamp plate
12 Wing screw
13 Clamp
14 Stop plate
15 Machine screw
16 Tripod Shoe
17 Machine Screw
18 Lower Wood Leg
19 Carrying Strap
20 Leg Housing
21 Clamp Jaw
22 Machine Screw
23 Leg Housing
24 Wedge
25 Machine Screw
26 Wedge
27 Wood Leg
28 Wood Leg
29 Machine Screw
30 Machine Screw
31 Stop Plate
32 Clamp
33 Wood Screw
34 Bracket
35 Accessory Case
36 Rivet

Page 4-10. Add figure 4-7.1.

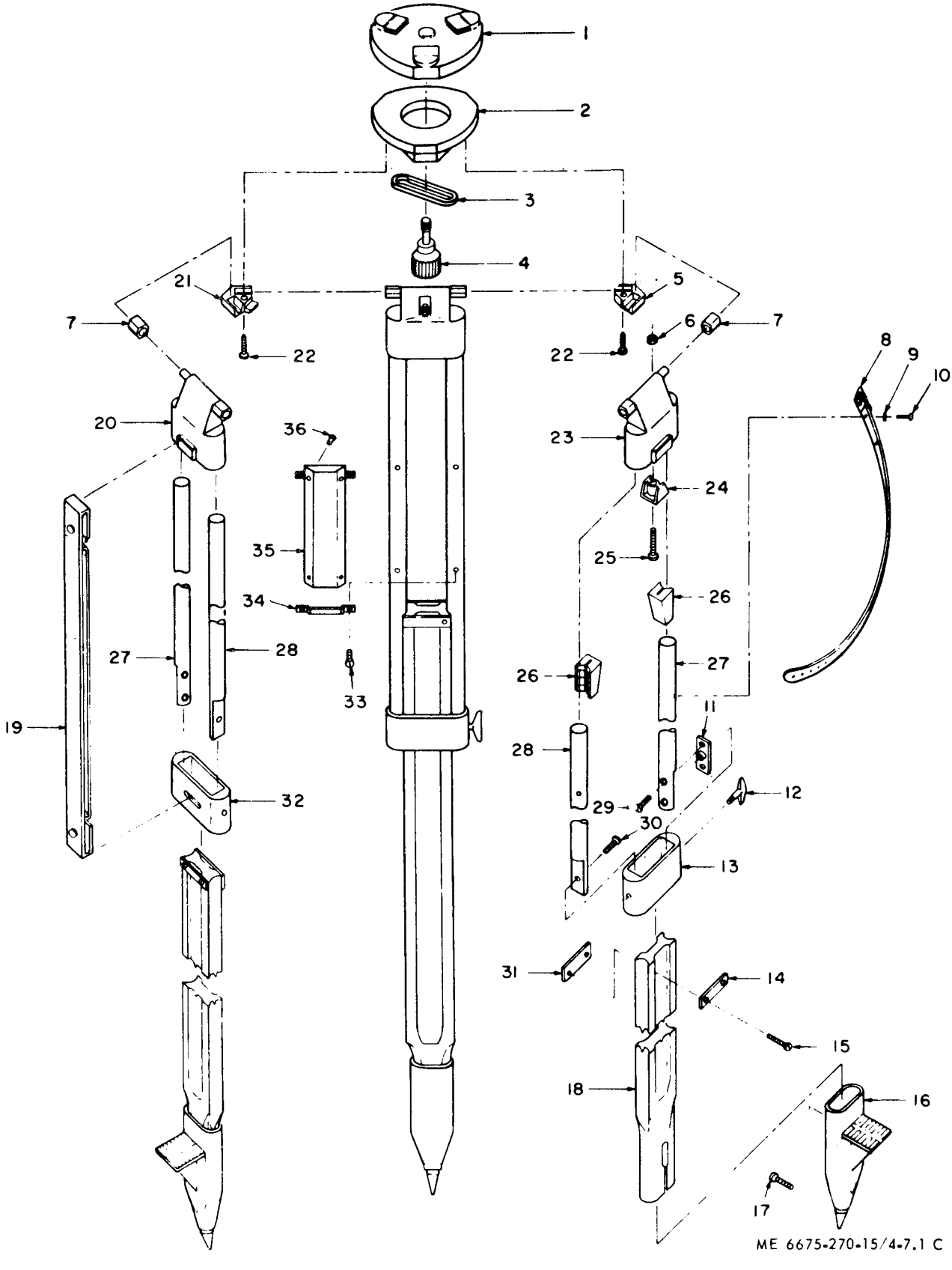


Figure 4-7.1. Tripod assembly (model T16-68 type II)

Page 4-11. Add figure 4-8.1.

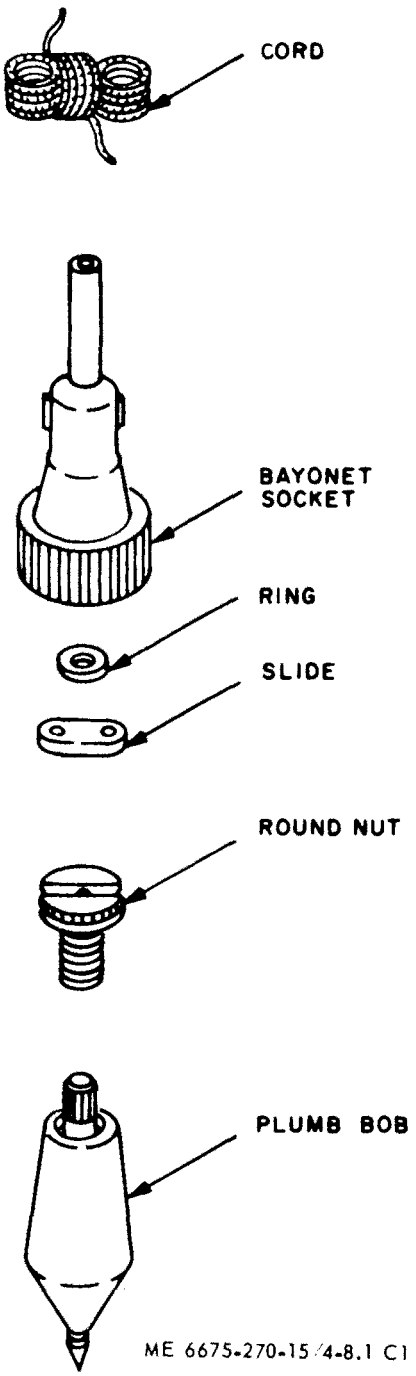
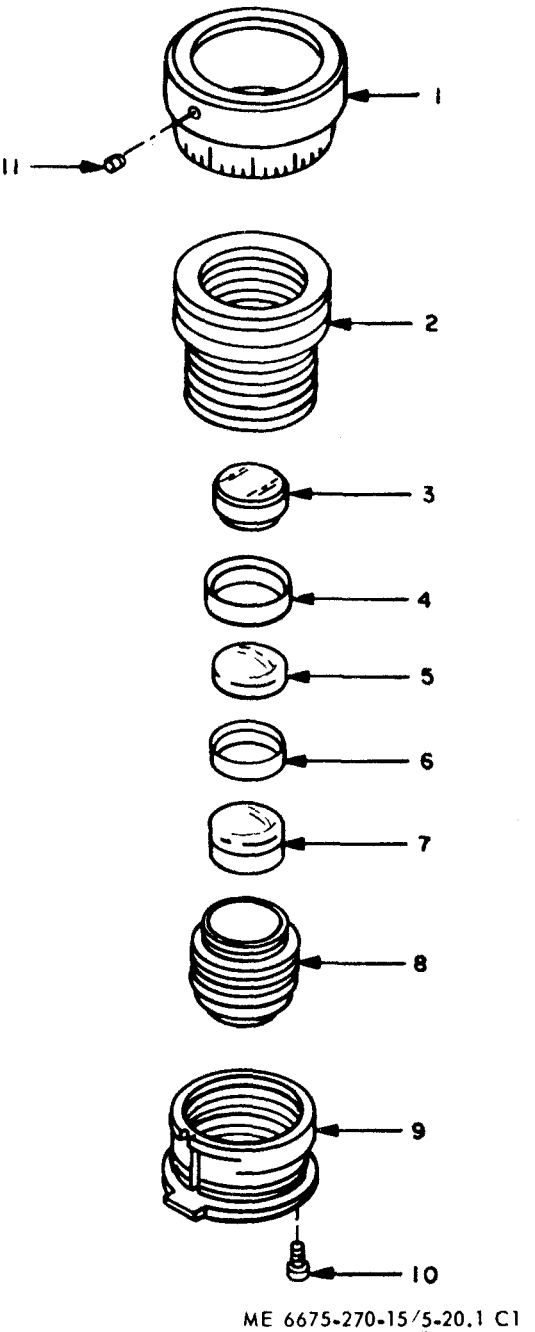


Figure 4-8.1. Plumb bob assembly (model T16-68 type II)

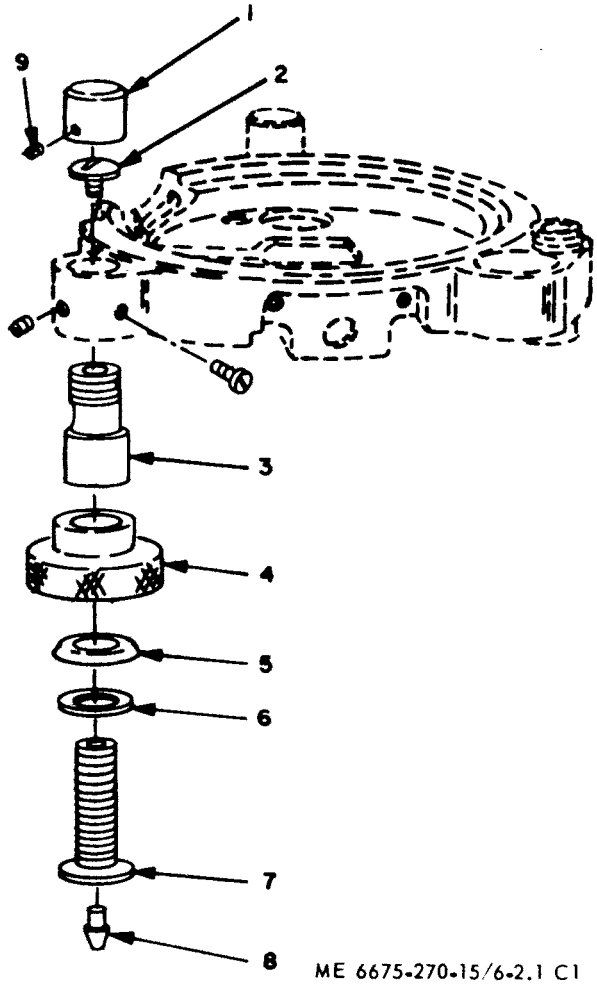
Page 5-19. Add figure 5-20.1.



1 Dial Scale
2 Threaded Sleeve
3 Lens
4 Spacer Sleeve
5 Lens
6 Spacer Sleeve
7 Lens
8 Lens Mount
9 Flange
10 Machine Screw
11 Setscrew

Figure 5-20.1. Telescope eyepiece assembly (model T16-68 type II).

Page 6-3. Add figure 6-2.1.



1 Cover
2 Machine Screw
3 Nut
4 Knob
5 Cap
6 Washer
7 Screw
8 Point
9 Setscrew

Figure 6-2.1. Tribach footscrew assembly (model T16-68 type II)

Page C-2. Section II Basic Issue Items, item 2, change column 2 to 6675-127-2859.

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

VERNE L. BOWERS,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12-25, Sec I (qty rqr Block No. 174), Organizational maintenance requirements for Equipment: Surveying.

TECHNICAL MANUAL
No. 5-6675-270-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *12 March 1970*

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE MANUAL

THEODOLITE, DIRECTIONAL: 0.2 MIL GRADUATION; 5.9 IN. LONG TELESCOPE, W/ACCESSORIES (WILD HEERBRUGG MODELS) (MODEL T16-MIL 66, TYPE II) FSN 6675-926-4505 (MODEL T16-MIL 68, TYPE II) FSN 6675-861-7939 THEODOLITE, DIRECTIONAL: 1 MIN GRADUATION; 5.9 IN. LONG TELESCOPE, W/ACCESSORIES (WILD HEERBRUGG MODEL T16-68 DEG, TYPE I) FSN 6675-770-4958

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual contains instructions for the use of operator, organizational, direct support, general support and depot maintenance personnel maintaining the Wild Heerbrugg Theodolites, Models T16-MIL 66, Type II; T16-MIL 68, Type II; and T16-68 DEG, Type I as allocated by the Maintenance Allocation Chart. It provides information on the operation, lubrication, preventive maintenance services, and maintenance of the equipment, its accessories and components.

1-2. Forms and Records

Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

1-3. Equipment Serviceability Criteria (ESC)

There are no ESC's applicable to the theodolite.

1-4. Reporting of Errors

Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged, Reports should be submitted on DA Form 2028, Recommended Changes to Publications, and forwarded direct to Commanding General, U.S. Army Mobility Equipment Command, ATTN: AMSME-MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

Section II. DESCRIPTION AND DATA

1-5. Description

The Wild Heerbrugg Model T16 series theodolites (fig. 1-1 through 1-8) are precision, directional-type surveying and tracking instruments. They have both vertical and horizontal circles calibrated in roils (type II) and degrees (type I) for reading angle values. These readings are made through the microscopic eyepiece (fig. 1-1 and 1-2), located at the right of the telescope eyepiece. The tribrach and base plate (fig. 1-5) support the main body of the instrument, which is readily detachable from the tribrach. The latter contains the leveling screws, circular level, tribrach clamp lever (fig. 1-7) and tribrach clamp knob (fig. 1-8).

1-6. Differences Between Models

Differences between models are as follows:

a. The configuration of the clamping assembly on the tribrach differs. Model T16-MIL 66 is locked by a clamp lever which slides into locking position; models T16-MIL 68 and T16-68DEG are locked by a clamping knob which is rotated 180° and which is secured in position by a set-screw.

b. The horizontal and vertical circles on models T16-MIL 66 and T16-MIL 68 are graduated in roils where as those on the model T16-68 DEG are graduated in degrees.

c. Models T16-MIL 68 and T16-68 DEG only have a telescope level assembly.

d. Model T16-MIL 66 only has a telescope rear sight.

e. Differences exist in the telescope and microscope assemblies.

f. Instructions contained in this manual are for all models except as otherwise specified.

1-7. Identification and Tabulated Data

a. *Identification*. The theodolites have two identification markings. One appears on the theodolite hood and one on the right side cover of the instrument. The data stenciled on the hood and engraved on the right side cover is listed in the tabulated data.

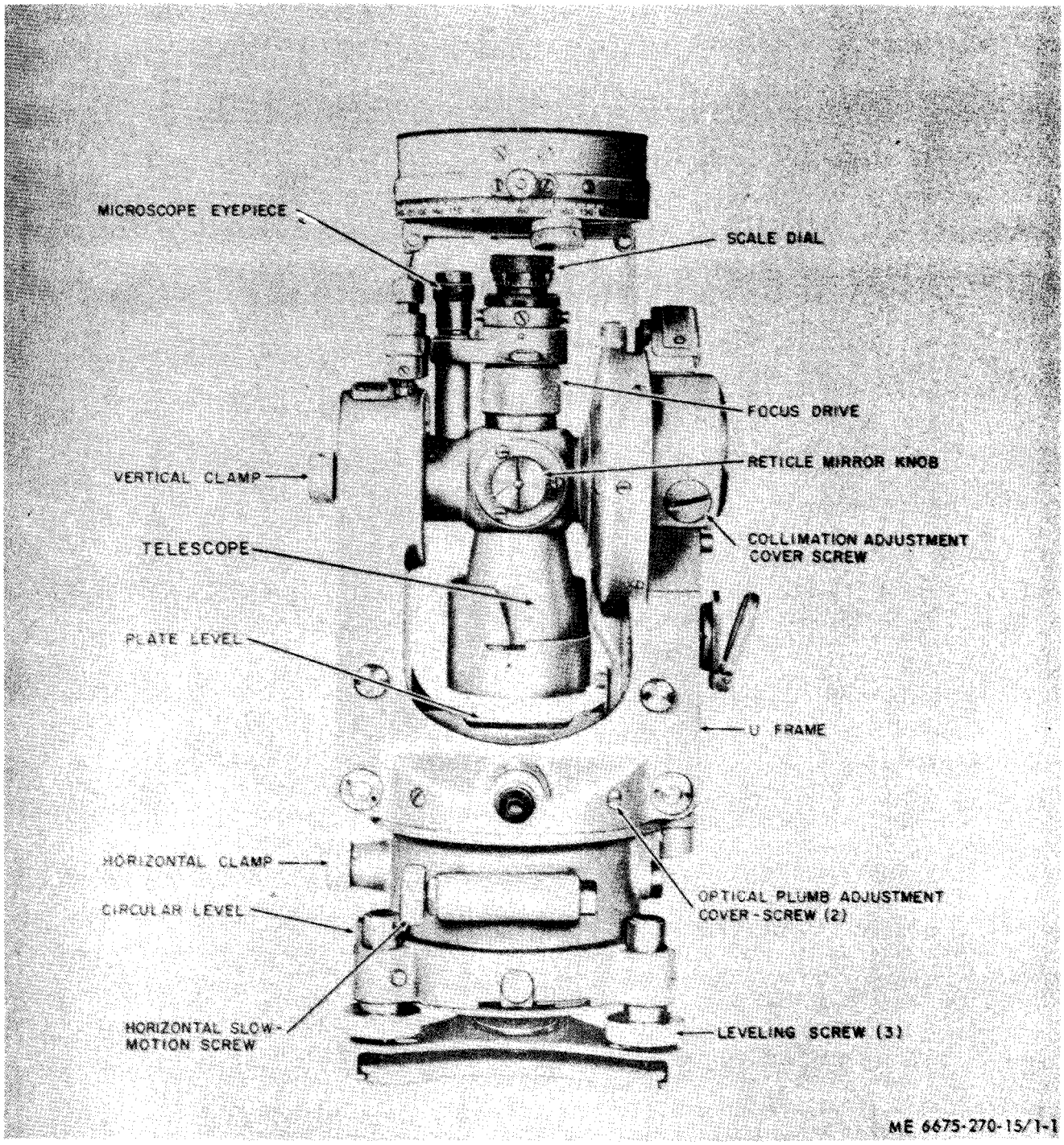

Figure 1-1. Model T16-MIL 66 theodolite, front view.

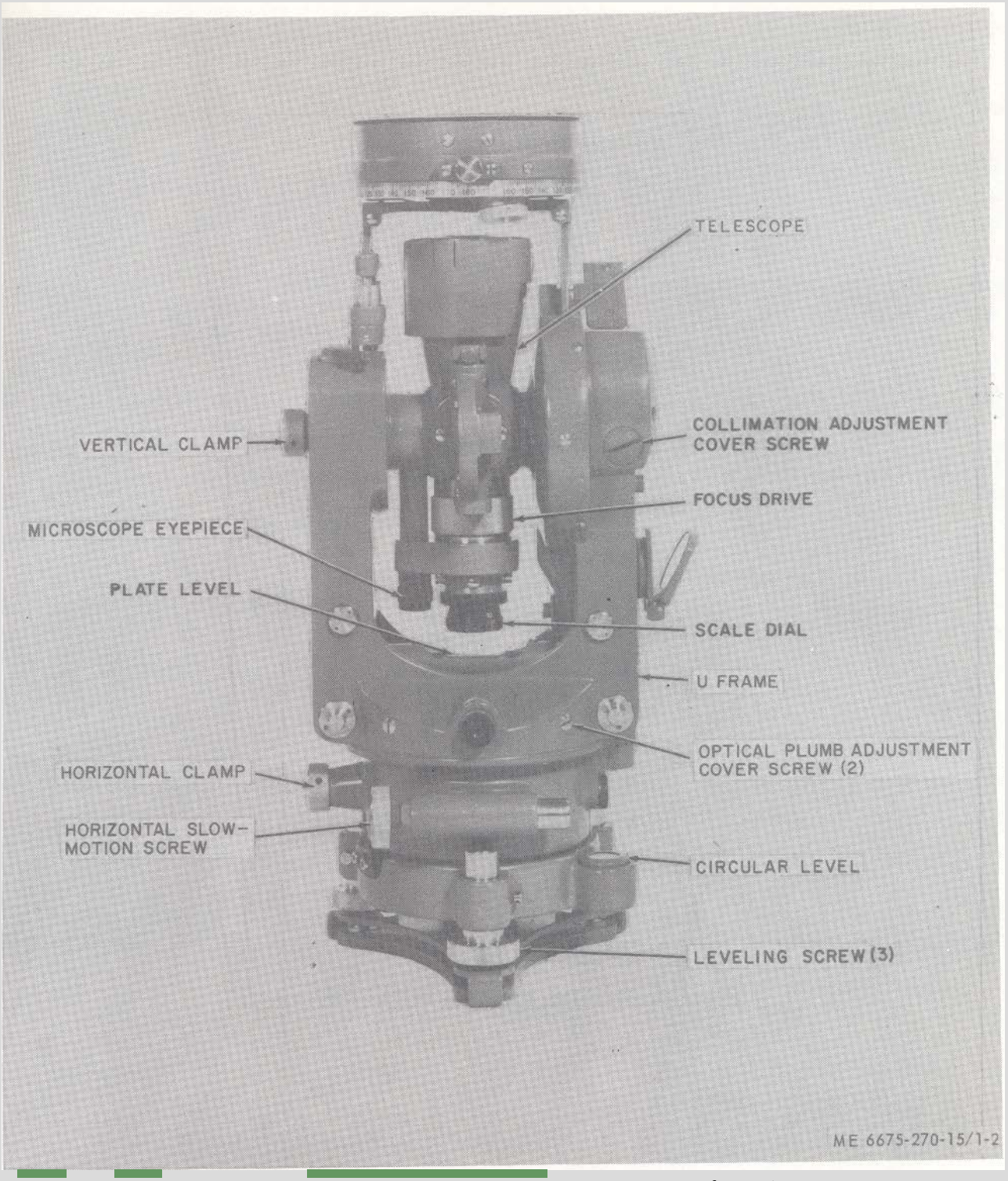

Figure 1-2. Model T16-MIL 68 and T16-68 DEG theodolite, front view.

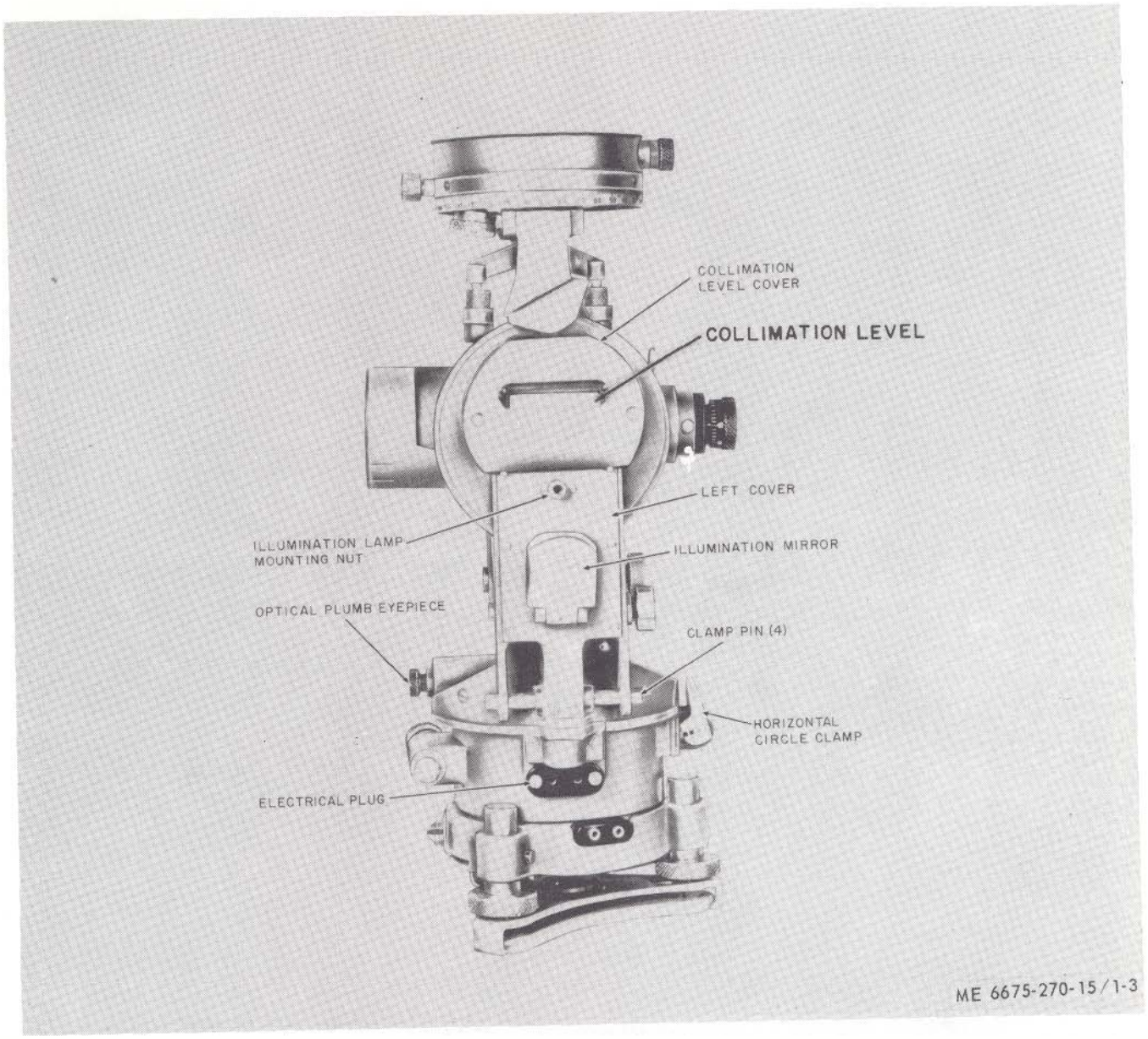

Figure 1-3. Model T16-MIL 66 theodolite, left-side view.

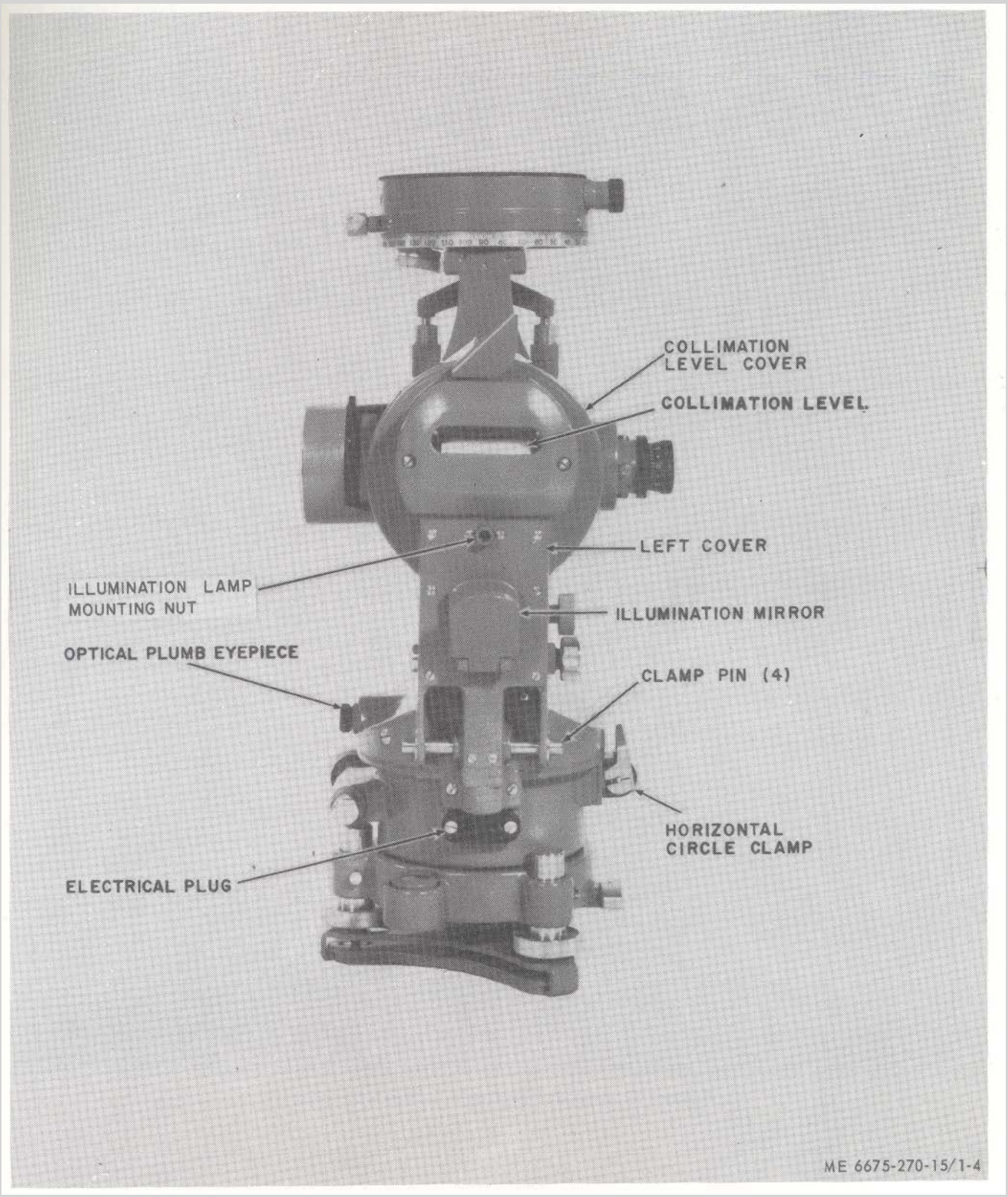

Figure 1-4. Model T16-MIL 68 and T16-68 DEG theodolite, left-side view.

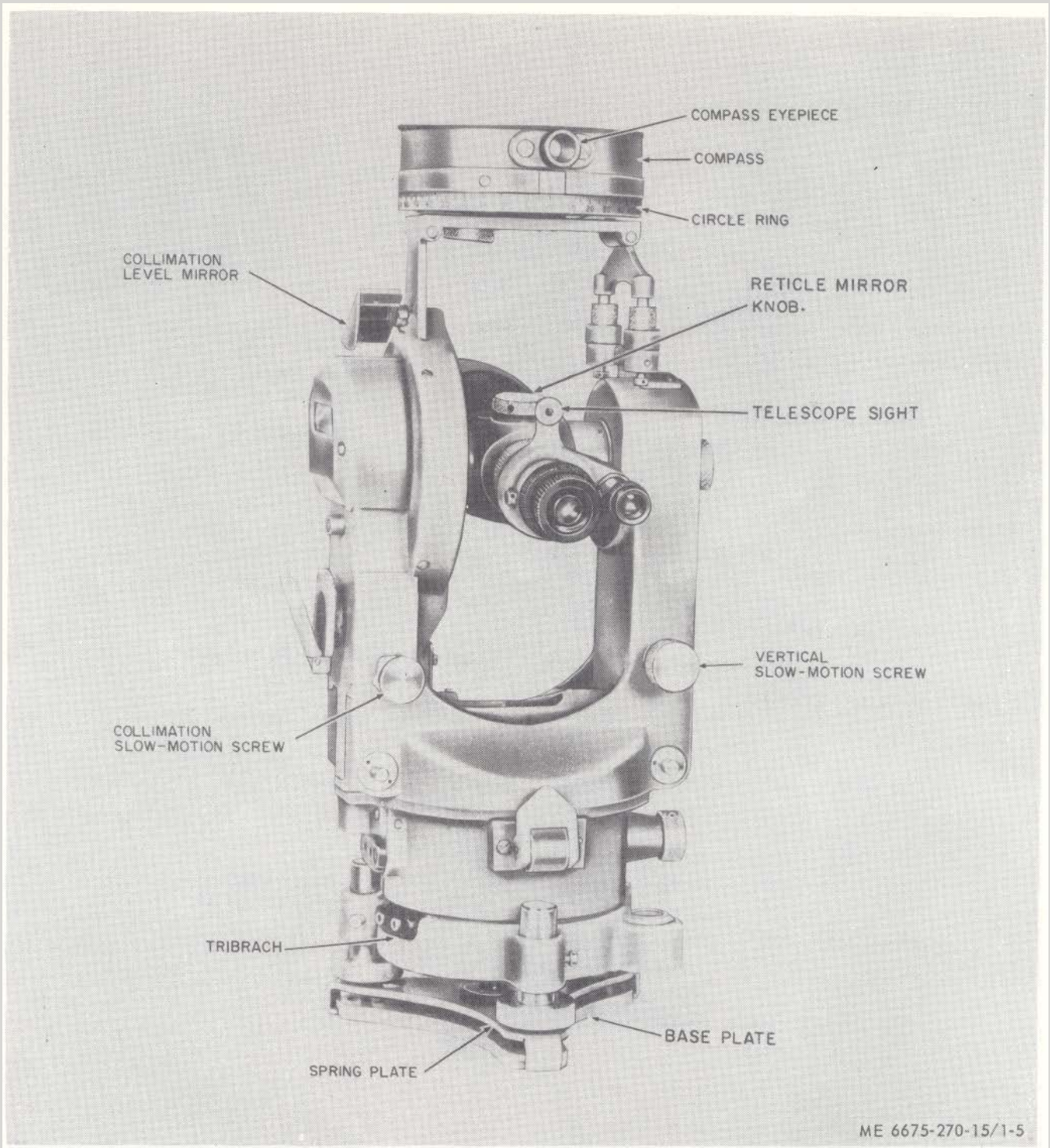

Figure 1-5. Model T16-MIL 66 theodolite, rear view.

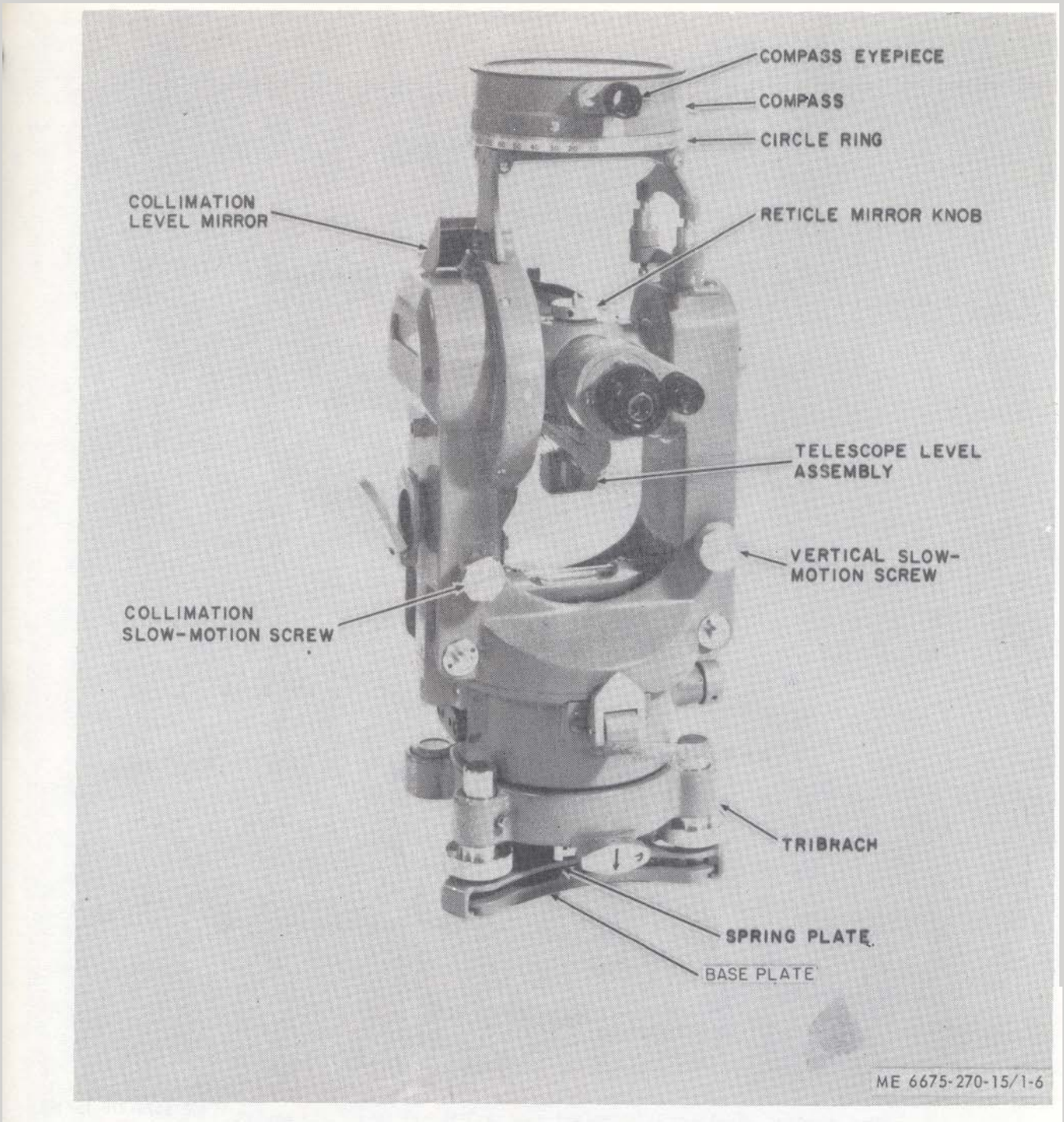

Figure 1-6. Model T16-MIL 68 and T16-68 DEG theodolite, rear view.

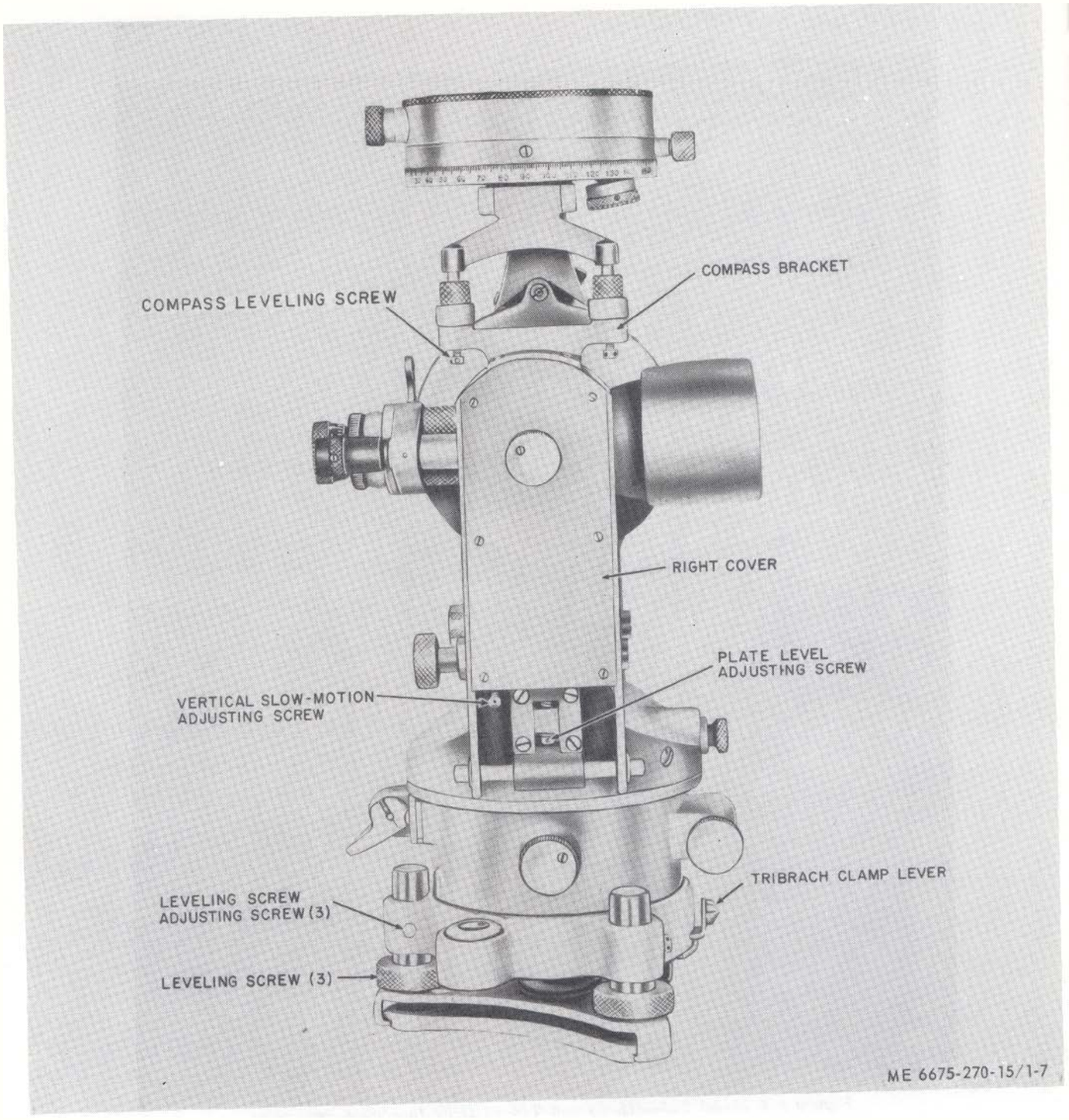

Figure 1-7. Model T16-MIL 66 theodolite, right-side view.

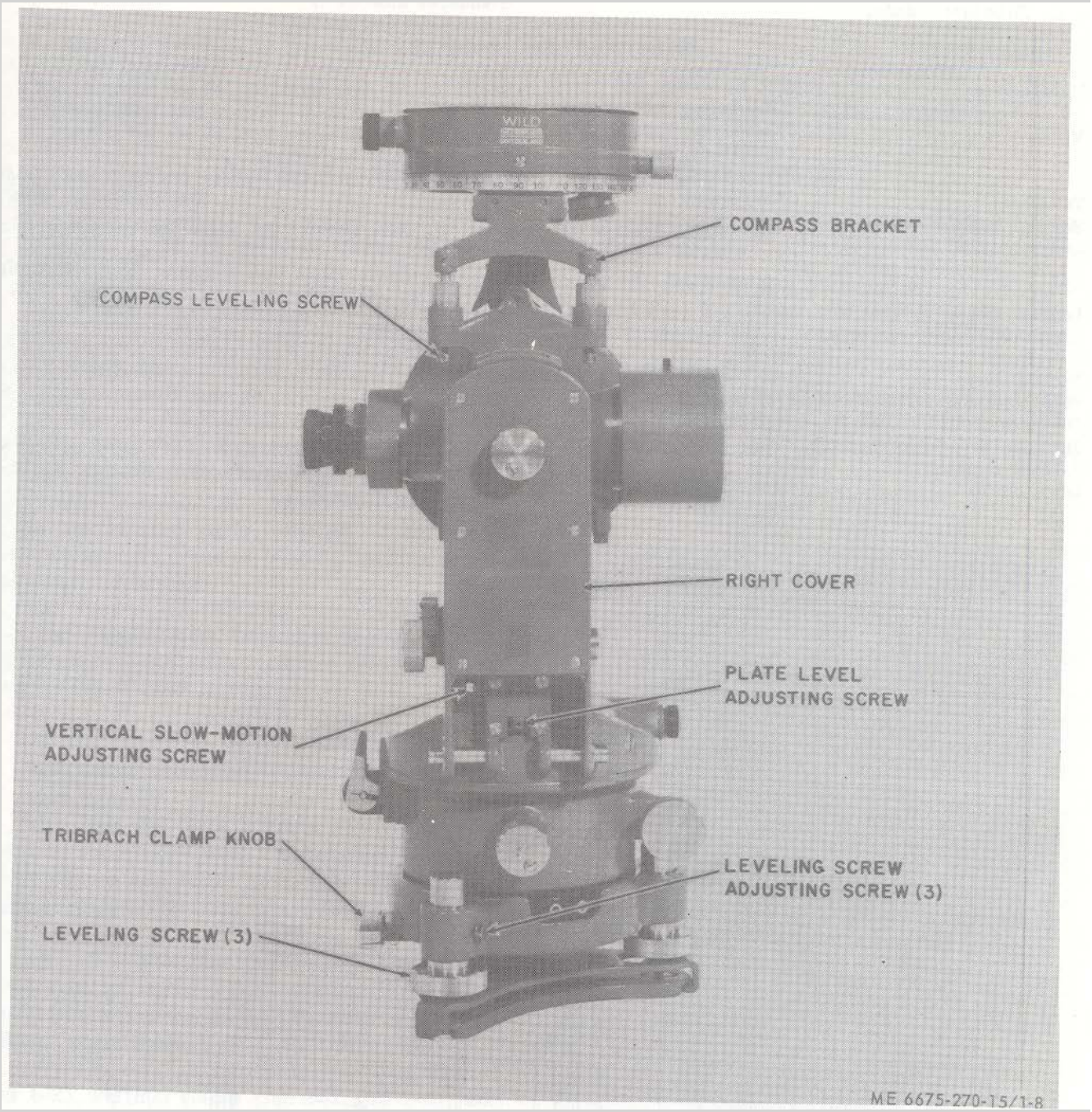

Figure 1-8. Model T16-MIL 68 and T16-68 DEG theodolite right-side view.

b. Tabulated data.

(1) General.

Manufacturer ---------- Wild Heerbrugg Ltd. Heerbrugg, Switzerland
Models ---------- T16-MIL 66, Type II
T16-MIL 68, Type II
T16-68 DEG, Type I
Telescope ---------- 28 x (power)
Shortest focusing distance ------- 4.5 ft.
Longest aiming distance at which centimeter can be read ---------- 1000 ft.
Longest aiming distance at which millimeter can be evaluated ---------- 450 ft.
Normal range ---------- 6 to 12 mi. (miles)
Clear objective aperture ------- 1-57 in.
Diameter of field at 1000 ft ----- 29 ft.
Multiplication constant ---------- 100
Addition constant ---------- 0
Glass circles ---------- 6400 mils (Type II)
360° (Type I)
Graduation interval of horizontal and vertical circles ---------- 0.2 mils (Type II)
1 minute (Type I)
Sensitivity of plate level ------ 30 sec (seconds) per 2 mm (millimeter)
Sensitivity of collimation level - 30 sec per 2 mm
Ragnification of microscope ----- 40x
Illumination system lamps ----- 4v (volts), 3 amps (amperes), miniature screw base
Illumination system batteries --- BA 30

(2) *Dimentions and weights.* Refer to figure 1-9 for illustrated shipping dimensions.

Tripod, extended ---------- 5 1/2 ft.
Tripod, folded ---------- 3 ft.
Instrument ---------- 10 lb. (pounds)
Carrying case ---------- 3 3/4 lb.
Tripod ---------- 12 1/2 lb.

(3) *Maintenance and operating supplies.* There are no maintenance or operating supplies for this equipment.

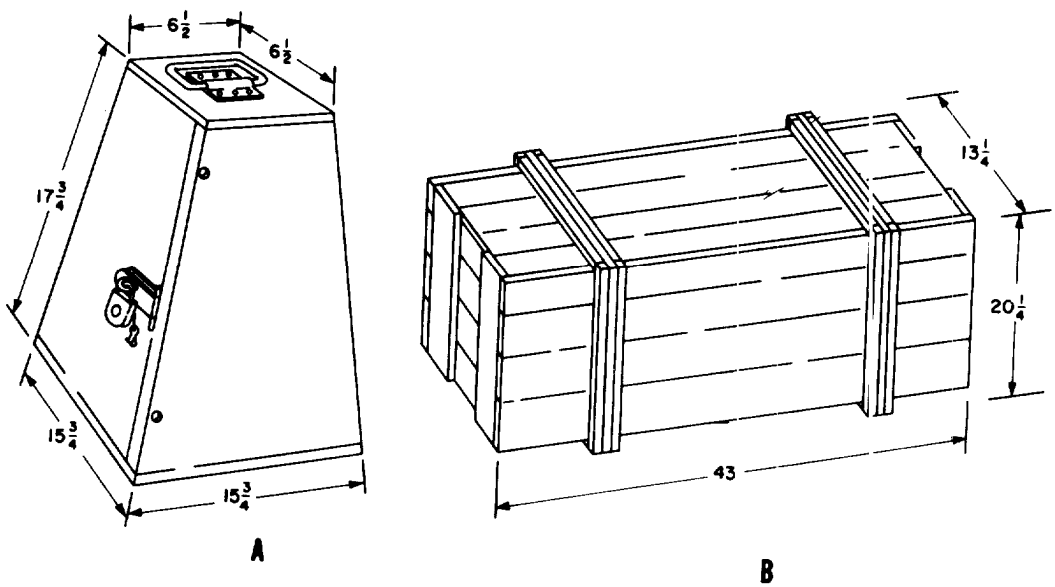

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Figure 1–9. Shipping cases, with dimensions.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIEL

2-1. Inspecting and Servicing the Equipment

a. Theodolite and Carrying Case.

(1) Remove the theodolite and carrying case from the shipping case (para 2-2) and inspect the carrying case (fig. 2-l) for dents, cracks, rust, and other signs of damage.

(2) Refer to paragraph 2-2 and remove the theodolite from the carrying case.

(3) Place the theodolite (fig. 2-2) on a firm, clean, level surface and inspect it visually for broken or missing parts, cracked or scratched lenses or mirrors, loose or missing hardware, and other signs of damage.

(4) Inspect the carrying case desiccant (fig. 2-2) for discoloration. Desiccant should be blue. Pink desiccant indicates moisture saturation and must be dehydrated or replaced.

CAUTION

At any indication of pink desiccant, the instrument should be inspected for moisture damage.

(5) Test the three leveling screws (fig. l-l and l-2) for rough travel. They should turn easily under thumb and finger pressure, but should be tight enough to hold the instrument in any position.

(6) See that the horizontal, slow-motion screw (fig. l-l and l-2) and vertical slow-motion screw (fig. 1-5 and l-6) turn smoothly and easily, without play, throughout their full travel.

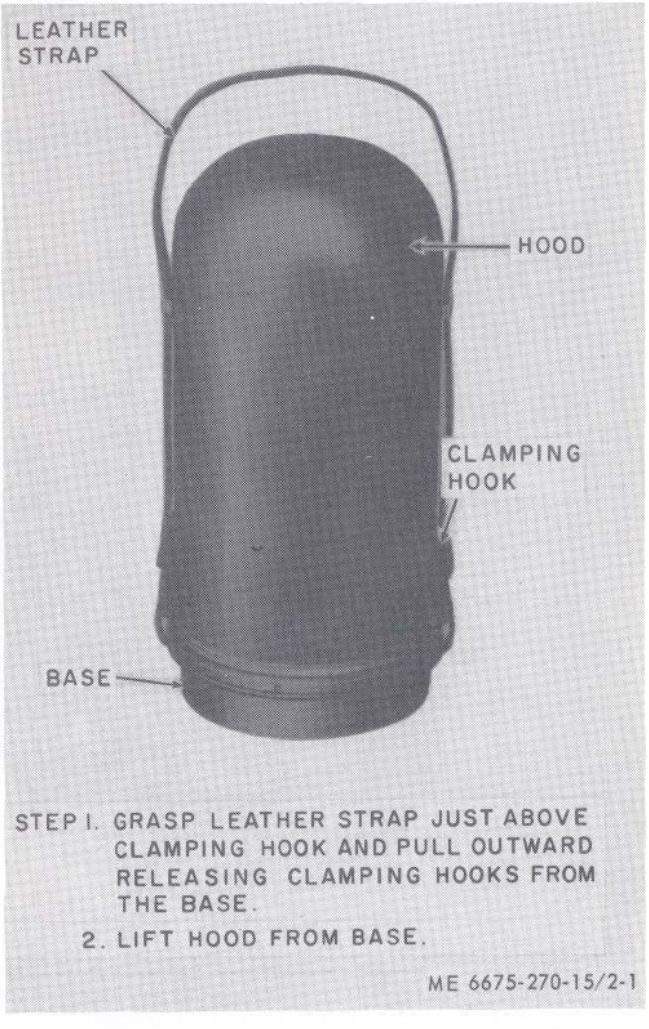
(7) Inspect the horizontal clamp (fig. l-l and 1–2), vertical clamp (fig. l-l and 1–2), and horizontal circle clamp (fig. l-3 and l-4) for proper operation.

(8) Inspect the optical lenses of the instrument for finger marks, dust, scratches, and etching. Remove any dust with a camel-hair brush. If breathing on the glass and wiping with a chamois skin does not adequately clean the lenses, clean with lens tissue and grain alcohol or acetone.

(9) Inspect the thribrach clamp lever, model T16-MIL 66, (fig. l-7) or clamp knob, models T16-MIL 68 and T16-68 DEG, (fig. l-8) as applicable, for proper functioning. There should be enough tension to lock the theodolite to the tribrach assembly.

(10) Inspect the illumination mirror (fig. l-3 and l-4) for proper positioning on the instrument. It should rotate easily but should be tight enough to stay in any desired position.

(11) Inspect the circular level (fig. l-l and l-3), plate level (fig. l-l) and collimation level mirror (fig. 1-5 and l-6) for cracks, breakage, and looseness.



2-1. Theodolite carrying case, removal and installation.

(12) Inspect the focus drive (fig. l-l and l-2) for proper functioning. There must be no end play or roughness of travel.

(13) Inspect the reticle mirror knob (fig. 1-5 and 1-6) for smooth turning throughout its travel. When the line on the top of the mirror knob is parallel to the telescope axis, the mirror does not obstruct daylight from the reticle. When using electrical illumination, turning the knob counterclockwise from the parallel position permits light to fall on the reticle.

b. Tripod Assembly.

(1) Refer to paragraph 2-2 and remove the tripod from its shipping crate.

(2) Inspect the tripod assembly (fig. 2-3) for damaged or missing tripod head cover, aged legs, and cut or broken leather strap or carrying strap.

(3) Inspect the cover bracket and battery box bracket for insecure mounting.

(4) Unbuckle the leather strap and open the tripod legs to permit access to the tripod accessory case. Inspect the case for insecure mounting to the tripod, torn seams, and loose or missing fastener. Make sure the case contains a tripod wrench and plumb bob assembly (fig. 2-4).

c. Canvas Field Pack.

(1) Refer to paragraph ***2-2a. (2)*** and remove the field pack from the tripod shipping crate.

(2) Inspect the field pack (fig. 2-5) for rips, tears, missing straps, and broken buckles.

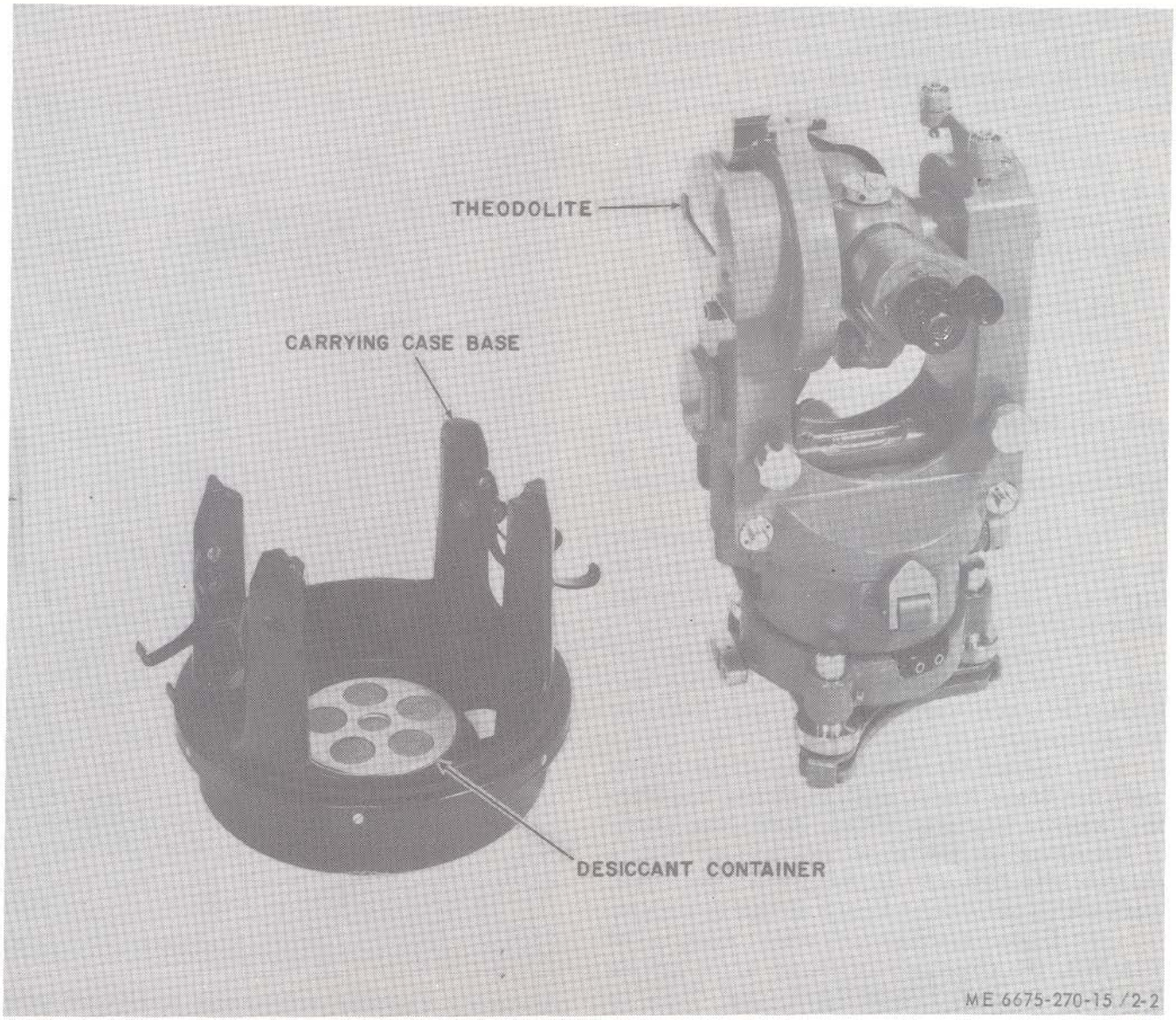


Figure 2-2. Theodolite and desiccant container with base removed.

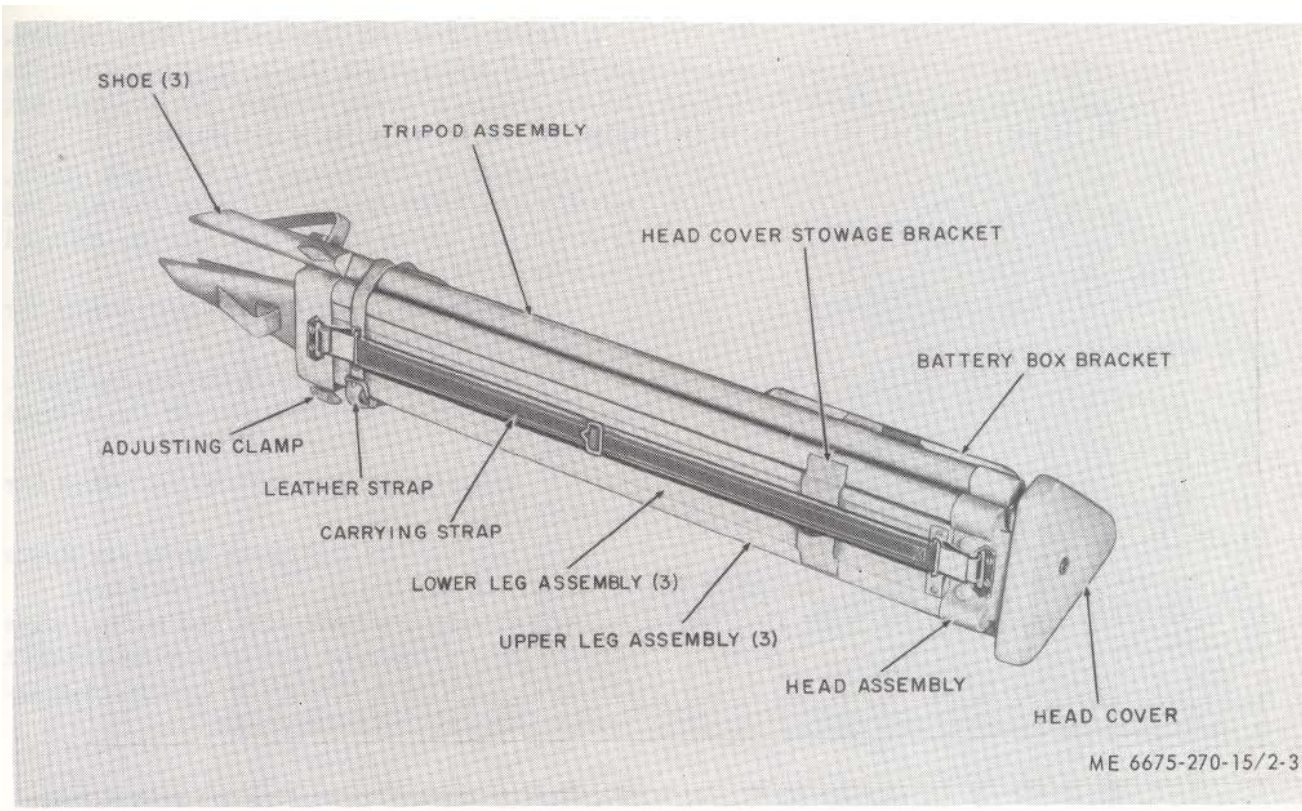


Figure 2-3. Tripod assembly.

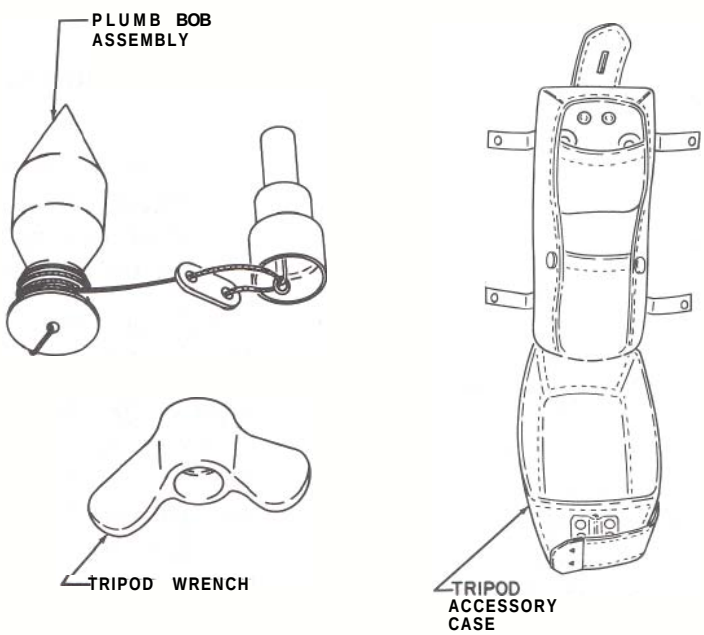


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Figure 2-4. Tripod accessory case and accessories, unpacked view.

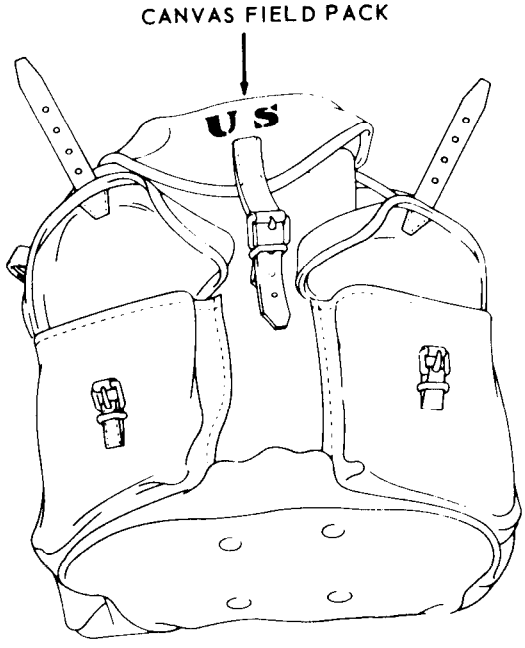


Figure 2-5. Canvas field pack.

d. Accessory Case and Accessories.

(1) Refer to paragraph 2-2 *a.* (2) and remove the accessory case and accessories from the tripod shipping crate.

(2) Inspect the accessory case (fig. 2-6) for rips, defective zipper and other damage, Make sure all inside pockets, flaps, and retaining loops are in good condition.

(3) Inspect the theodolite plastic cover and chamois for damage.

(4) Inspect the sunglass I, sunglass II, and telescope eyepiece assembly for dirty and defective glass. If the glasses are dirty, clean with camel-hair brush and chamois.

(5) Inspect the compass for broken cover glass, loose or missing hardware, broken or missing eyepiece, and other damage. See that the circle swings freely on the needle screw throughuot its travel. Inspect the circle caging knob for proper operation.

(6) Inspect the two screwdrivers, two adjusting pins, spare needle container, spare needle, and camel-hair brush for dirt and damage.

(7) Replace a defective accessory case and all defective accessories.

e. Battery Box and Components. Refer to para. graph 2-2 and remove the battery box from the tripod shipping crate. Inspect the battery box (fig. 2-7) and components as follows:

(1) Inspect the battery box for dents, cracks, missing or broken clamps, and other damage. See that the lid closes easily and can be clamped securely to the box.

(2) Inspect all electrical contact points for corrosion and defects.

(3) Run the rheostat knob through its travel, making sure the movement is smooth and without binding.

(4) Inspect the two dummy batteries for loose or dirty contacts.

(5) See that the four spare lamps are secure in the mounting holes and in good condition.

(6) Inspect the hand light and battery cable for defective wiring and connector plugs. Inspect the hand light for a cracked or broken case, defective lamp, or damaged switch.

NOTE

Batteries are not issued with the battery box.

(7) Inspect the electrical illumination assembly for defective wiring, lamp, or connector plug.

(8) Report all defects to organizational maintenance.

2-2. Installation

CAUTION

Avoid setting up the instrument near a battery or firing site, where possible vibrations may affect the accuracy of the instrument.

a. Unpacking Equipment. Select a location that is protected from the weather. Set the theodolite shipping case up off the ground on a box, table, or on the tripod shipping crate. After unpacking, do not discard the theodolite shipping case or the tripod and accessories shipping crate and packing materials.

(1) *Theodolite.*

(a) Unlock the padlock on the theodolite shipping case, remove it from the hasp, and open the hasp.

(b) Loosen the two captive screws (fig. 2-8) near the edge of the shipping case door, above and below the hasp, and open the door.

(c) Remove the theodolite (fig, 2-8), in its carrying case, from the shipping case.

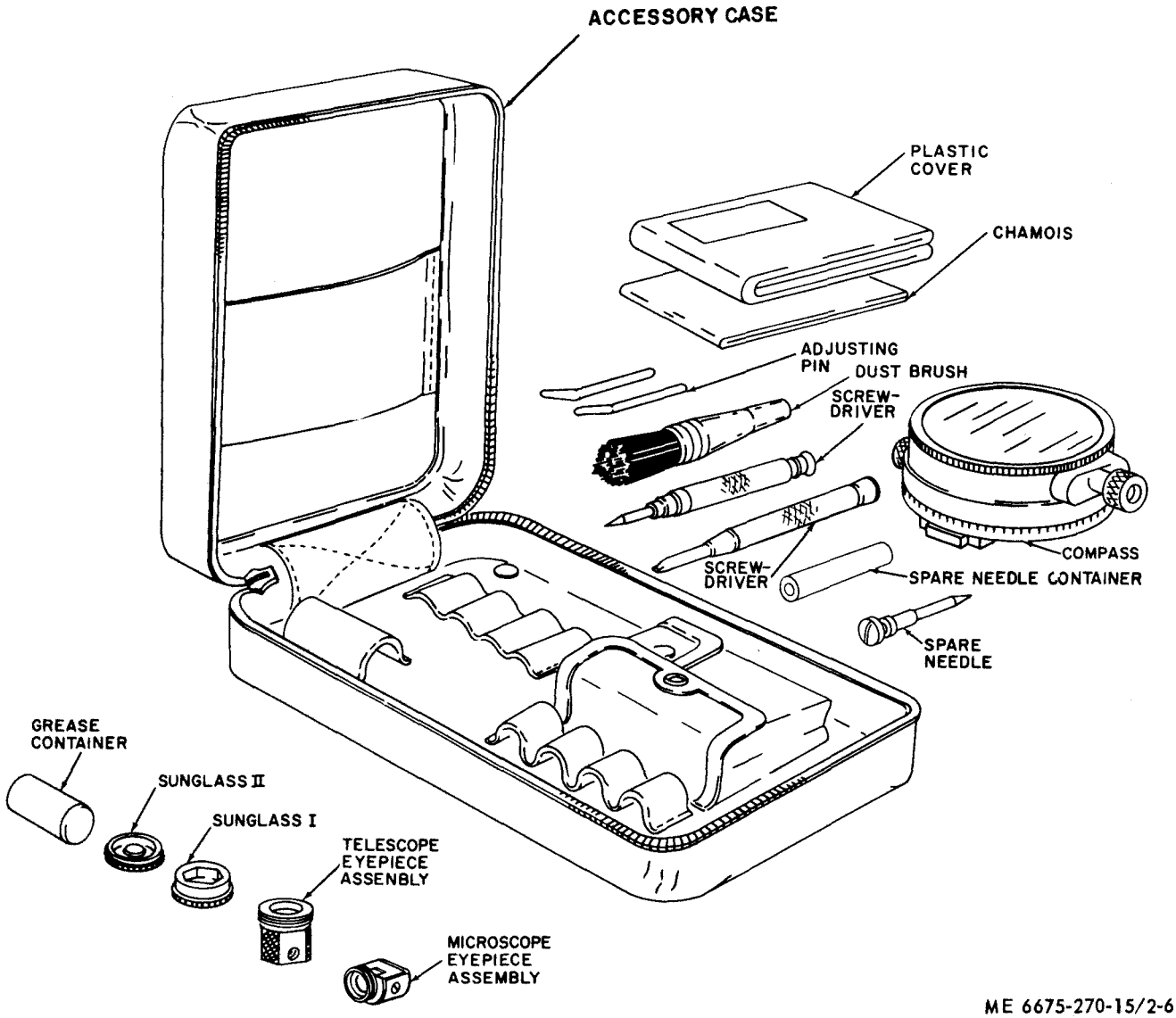


Figure 2-6. Accessory case and accessories, unpacked view.

(d) Remove the carrying case hood (fig. 2-1).

(e) Remove the theodolite (fig. 2-9) from the base.

(f) Close the door of the shipping case, tighten the two captive screws, close the hasp and attach the padlock to it.

(2) *Tripod and Accessories.*

(a) Remove the top of the tripod shipping crate.

(b) Remove the wrapped tripod, canvas field pack, accessory case, battery case, and packing material from the crate. Remove all wrapping material.

(c) Put wrapping and packing in the crate and replace the top. Store the crate in a safe place.

b. Installation of Components.

(1) *Compass.*

(a) Remove the compass (fig. 2-6) from the accessory case.

(b) Unfold the compass legs from the closed position.

(c) Refer to figure 2-10 and install the compass.

(2) *Tripod.* Refer to figure 2-11 and erect the tripod over the station point.

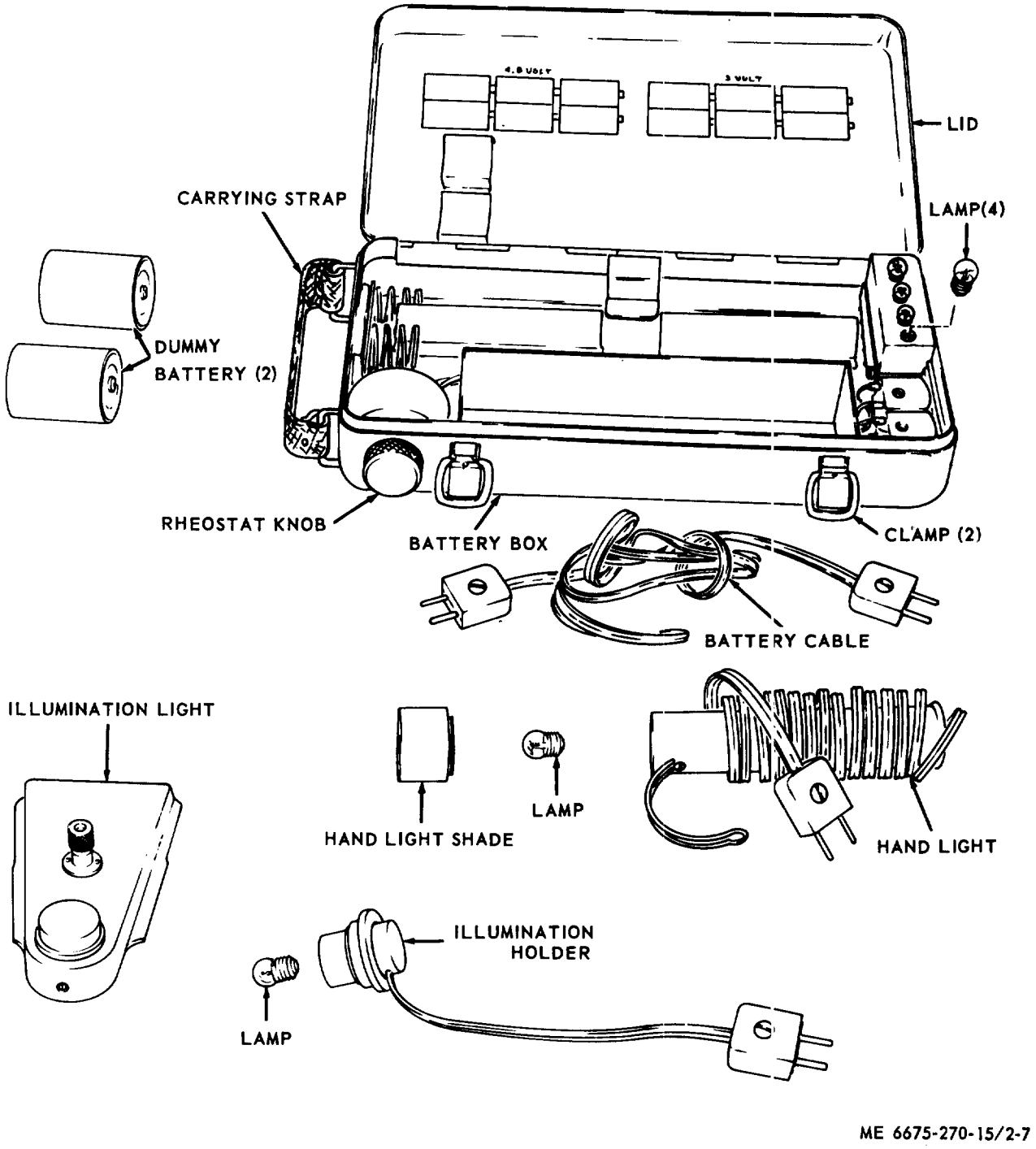


Figure 2-7. Battery box and components, unpacked view.

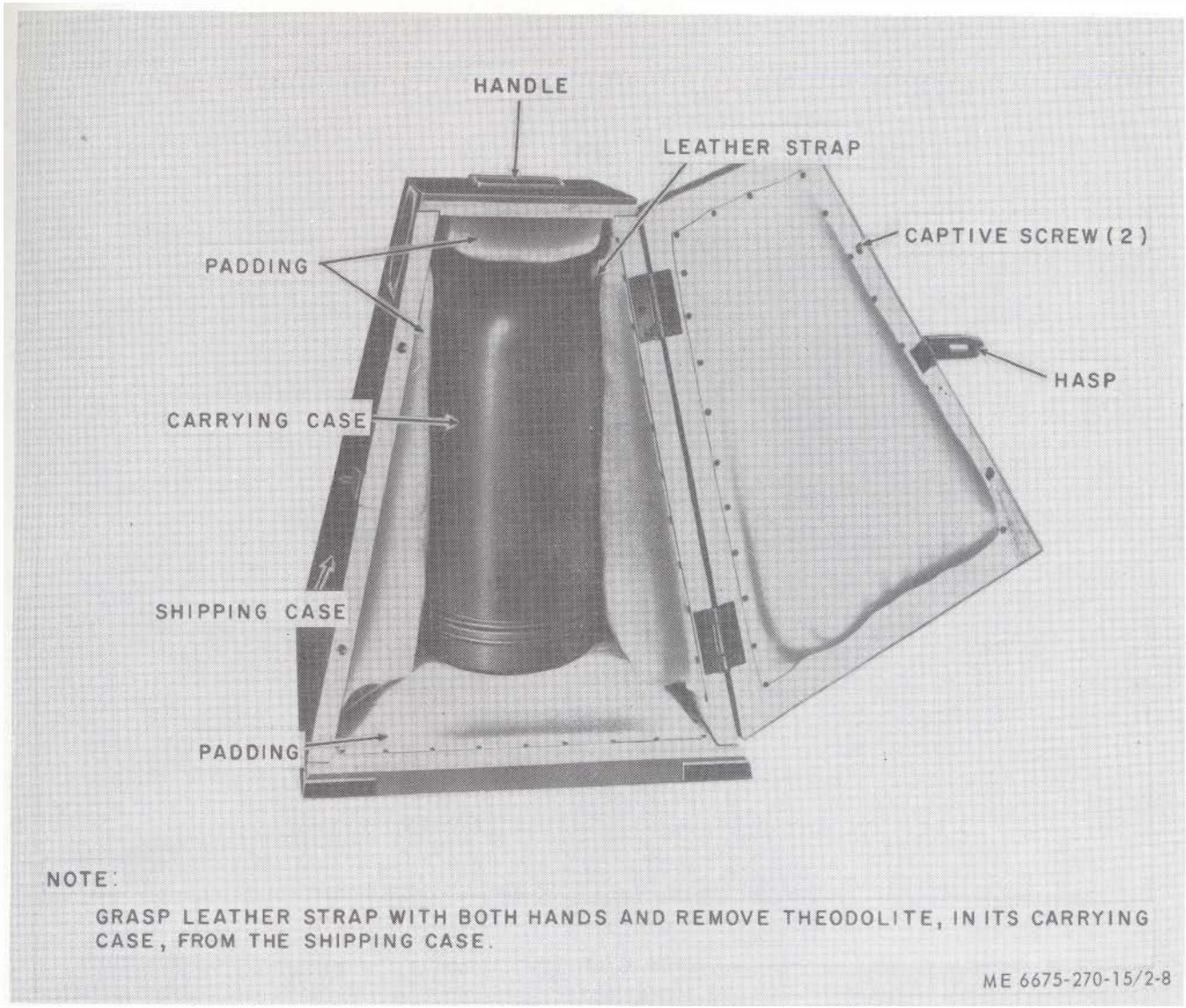


Figure 2-8. Theodolite in shipping case, removal and installation.

(3) Theodolite. Refer to figure 2-11 and install the theodolite on the tripod.

CAUTION

Always keep one hand on the instrument until after the bridge screw is secured to the instrument. This will prevent the instrument from falling off the tripod if it is accidentally bumped or moved.

2-3. Equipment Conversion

a. *General.* The theodolite is equipped for normal daytime operation as it comes from the carrying case. However, for dark-day or night operation it will be necessary to install the illumination system. For high vertical-angle observation, use the eyepiece prisms and sunglass.

b. Night or Dark-Day Operations. To adapt the theodolite for use on dark days or at night, remove the illumination mirror (fig. 1-3 and l-4) and refer to figure 2-12 and install the electrical illumination system.

c. High Vertical Angle Observations. To sight vertical angles up to 65" from horizontal, install the telescope and microscope eyepiece prisms and, if needed, the sunglass as shown in figure 2-13.

WARNING

Severe eye injury can result from looking directly at the sun without the sunglass.

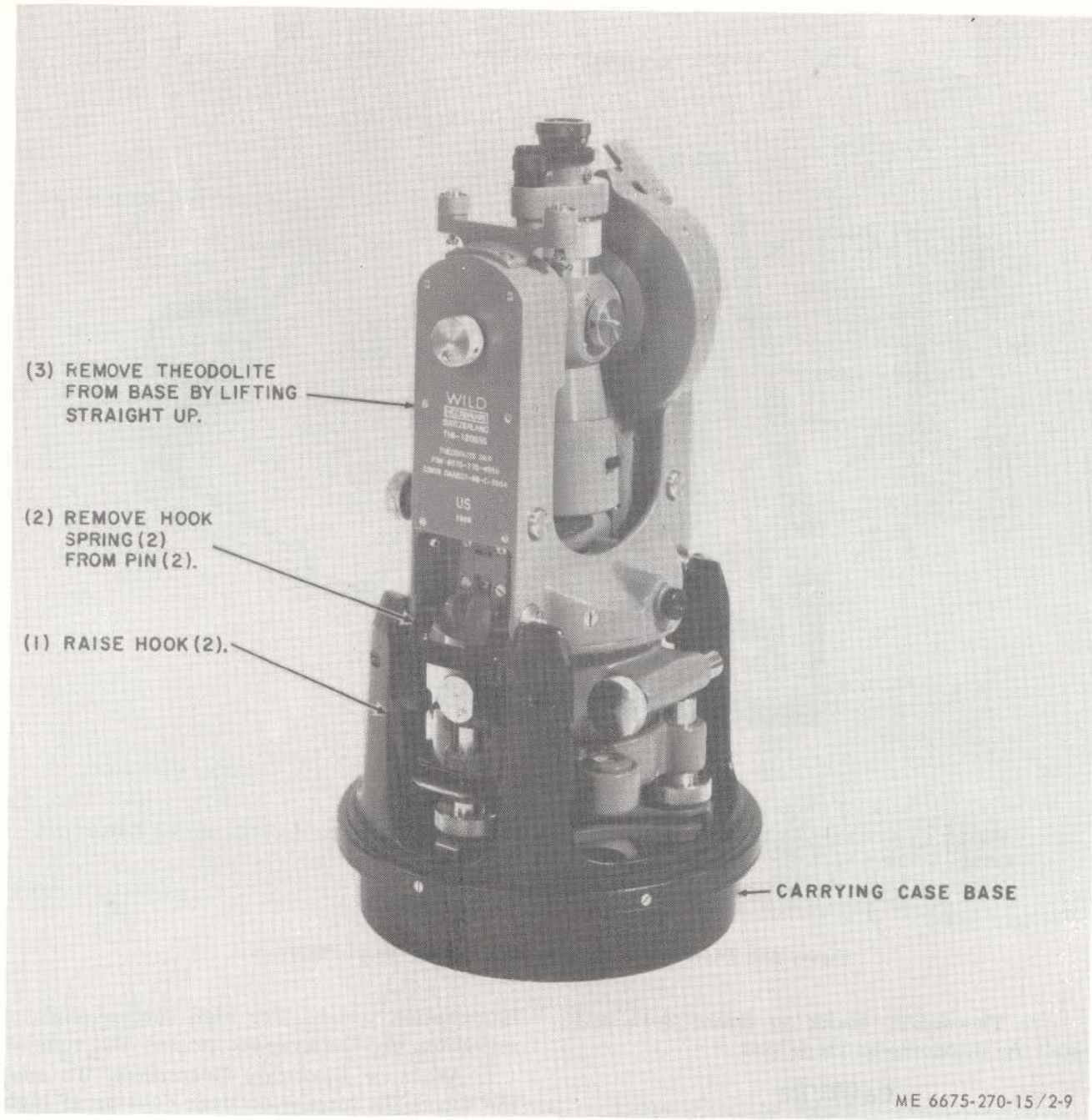


Figure 2-9. Theodolite base, removal and installation.

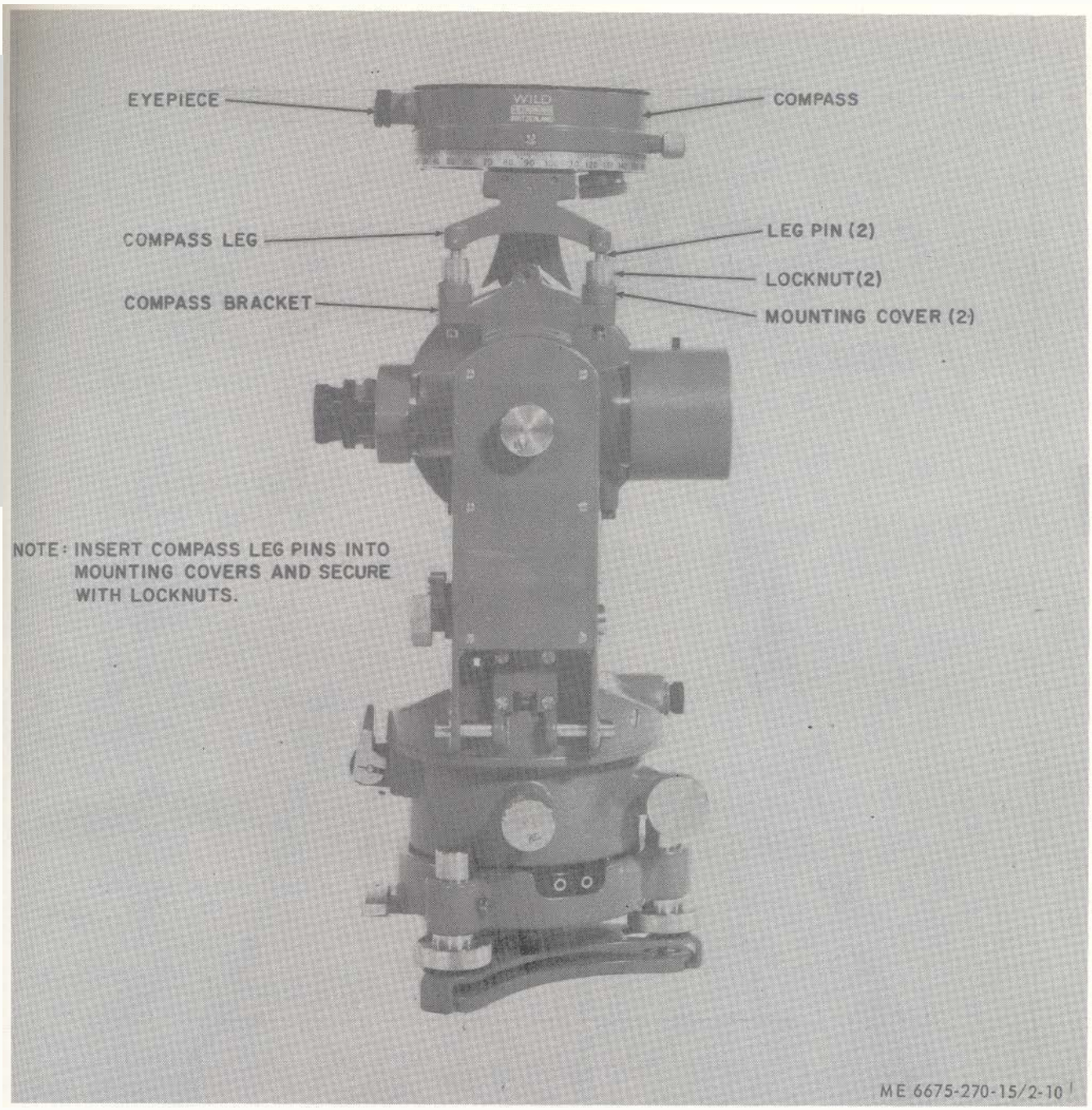


Figure 2-10. Compass, removal and installation.

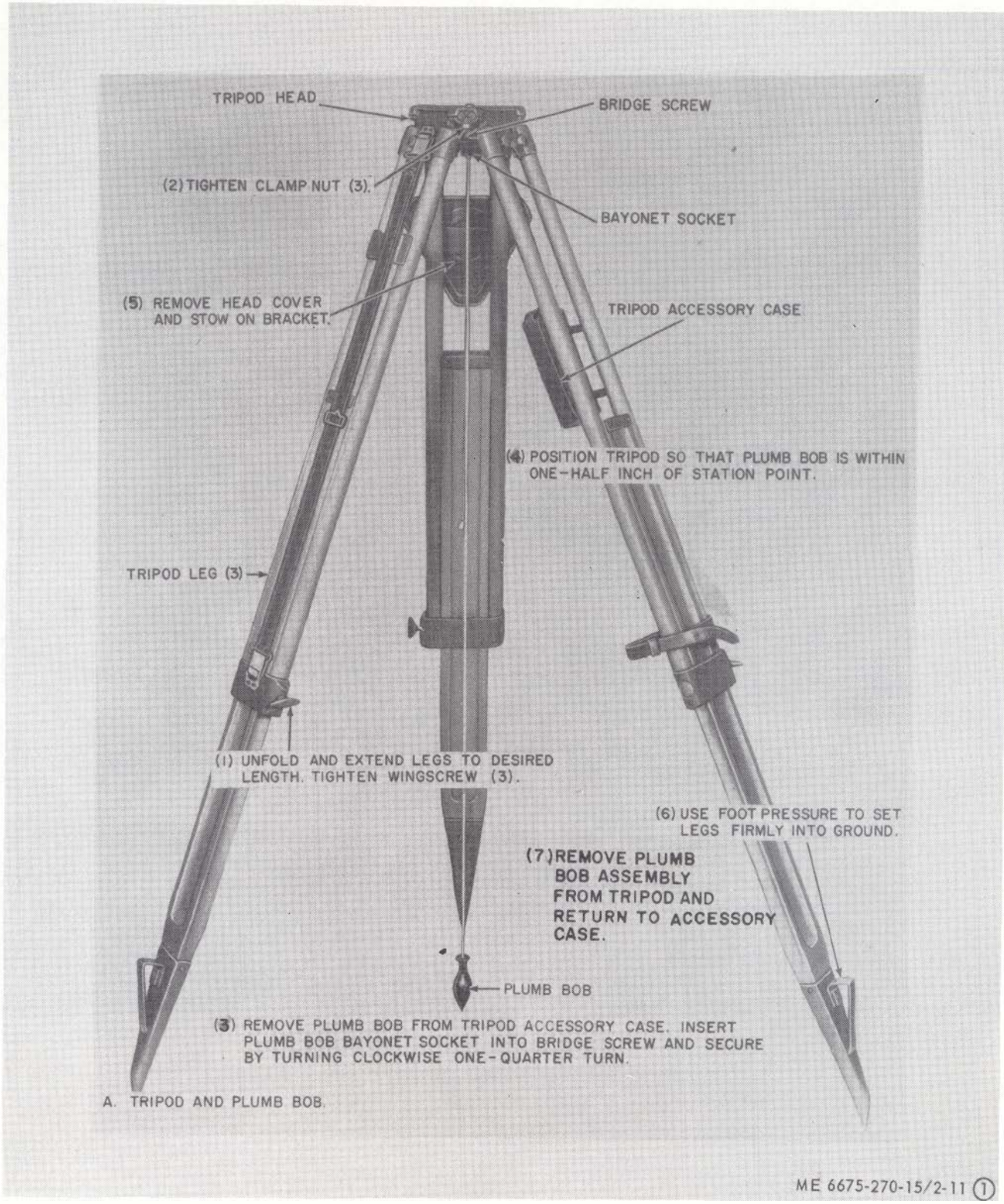
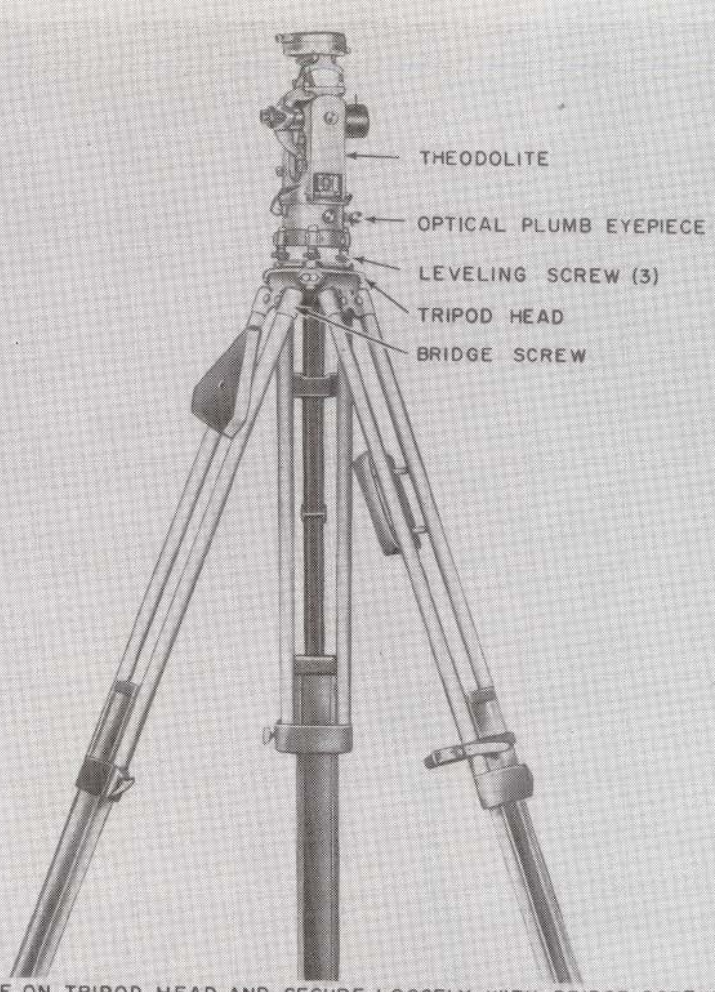


Figure 2-11. Tripod, plumb bob, and theodolite, removal and installation (sheet 1 of 2).



(1) POSITION THEODOLITE ON TRIPOD HEAD AND SECURE LOOSELY WITH BRIDGE SCREW.

(2) CENTER CIRCULAR LEVEL BUBBLE USING LEVELING SCREWS.

(3) SIGHT THROUGH OPTICAL PLUMB EYEPIECE AND ADJUST EYEPIECE UNTIL THE CIRCULAR MARKS ARE CLEARLY VISIBLE.

(4) CAREFULLY MOVE THEODOLITE ON TRIPOD HEAD UNTIL THE STATION POINT IS CENTERED IN THE EYEPIECE CIRCULAR MARKS.

(5) TIGHTEN BRIDGE SCREW.

NOTE: WHEN OPTICAL PLUMB EYEPIECE IS NOT IN USE, IT SHOULD BE PUSHED BACK INTO HOUSING.

B. THEODOLITE

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Figure 2-11. Tripod, plumb bob, and theodolite, removal and installation (sheet 2 of 2).

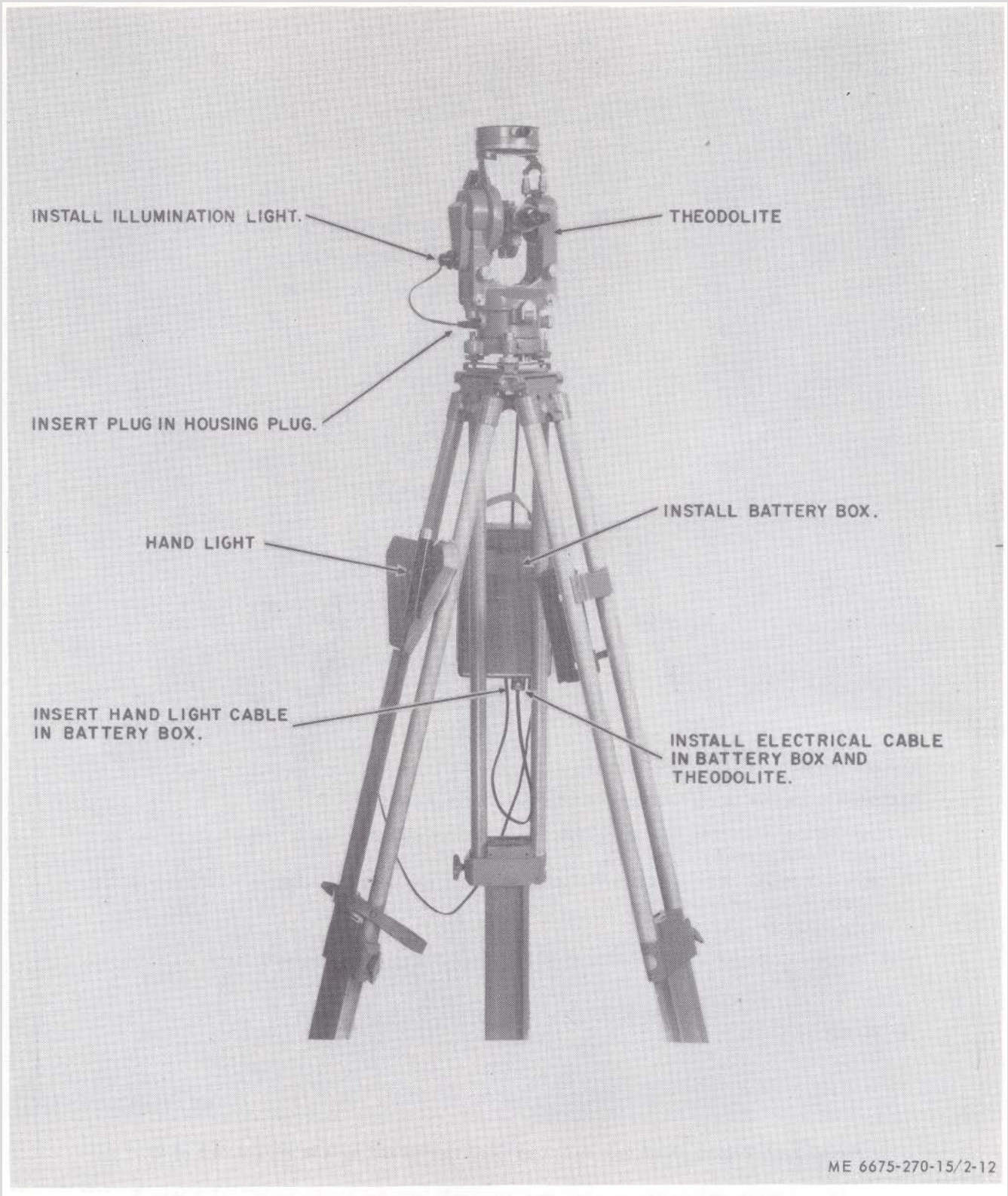

Figure 2-12. Illumination system, removal and installation.

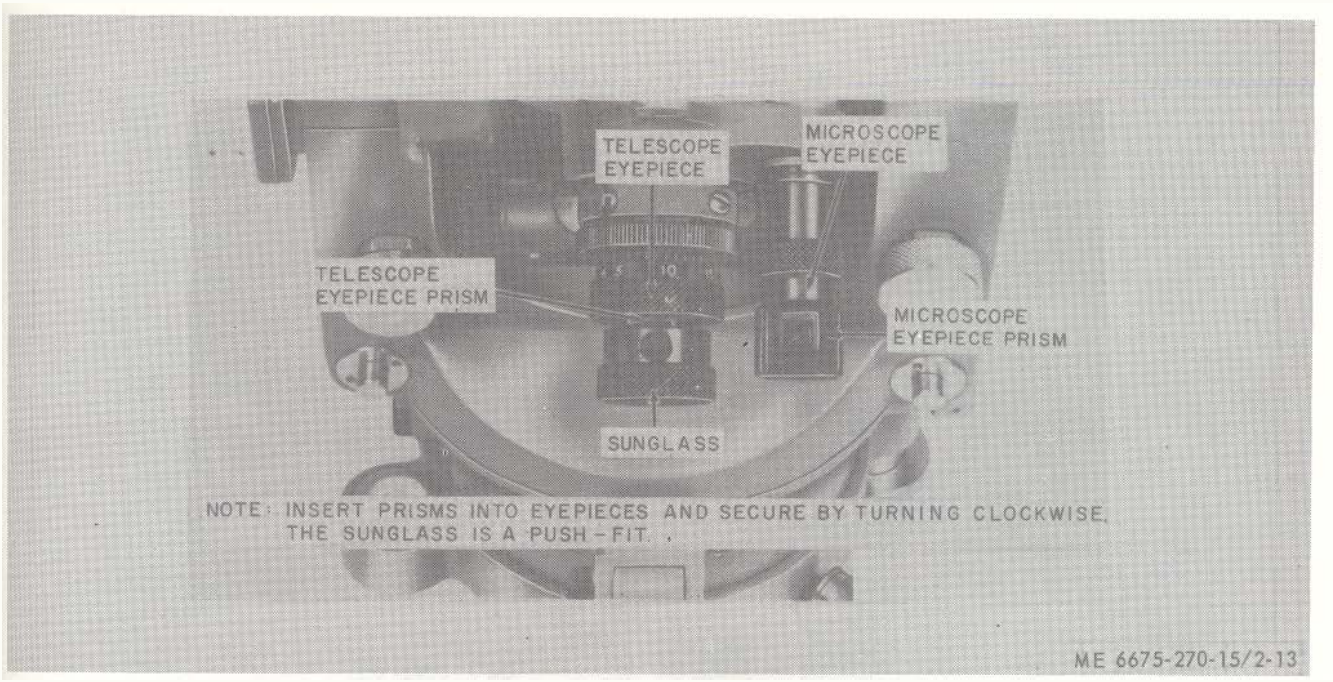

Figure 2-13. Eyepiece prisms and sunglass, removal and installation.

Section II. MOVEMENT TO A NEW WORKSITE

2-4. Dismantling for Movement

a. Short Distances. For short distances in cleared, level areas, the operator may carry the instrument while it is still mounted on the tripod. Correct carrying position is with the tripod head cradled against the shoulder with the instrument in a vertical position.

CAUTION

Always secure the horizontal, vertical, and compass circle clamps before moving the instrument. Never carry the instrument over the shoulder.

b. Confined *Areas.* When moving the tripod mounted instrument through doorways or other confined areas, the operator will hold it in a tilted position with the tripod shoes to the rear and the theodolite in front and well below eye level.

CAUTION

Never hold the theodolite so as to block view of the path ahead.

c. Long Distances. When moving the theodolite for long distances, over rough terrain, or at night, return it to the carrying case for maximum safety to the instrument.

CAUTION

Be very careful to avoid dropping the instrument. If the carrying case is dropped, inspect the instrument thoroughly for damage and readjust if necessary.

2-5. Reinstallation After Movement

After movement to a new worksite, install the theodolite as outlined in paragraph 2-2.

Section III. CONTROLS AND INSTRUMENTS

2-6. General

This section describes the various controls and instruments and provides the operator/crew sufficient information to insure proper operation of the theodolite.

2-7. Controls and Instruments

Refer to figure 2-14 (Model T16-MIL66) or figure 2-15 (Models T16-MIL68 and T16-68DEG), as applicable, for the location, description, and function of controls and instruments.

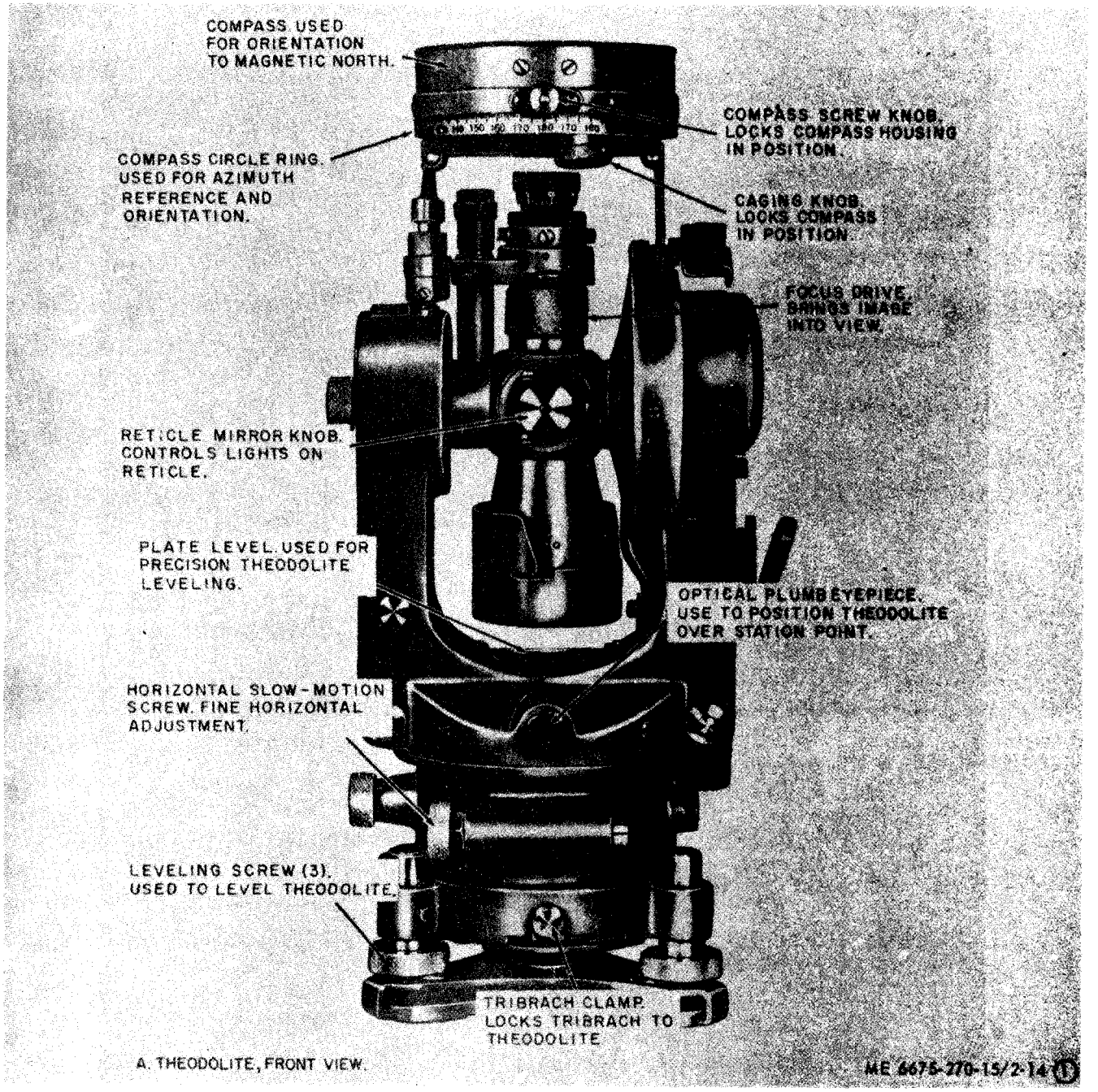

Figure 2-14. Controls and instruments, Model T16-MIL66 (sheet 1 of 3).

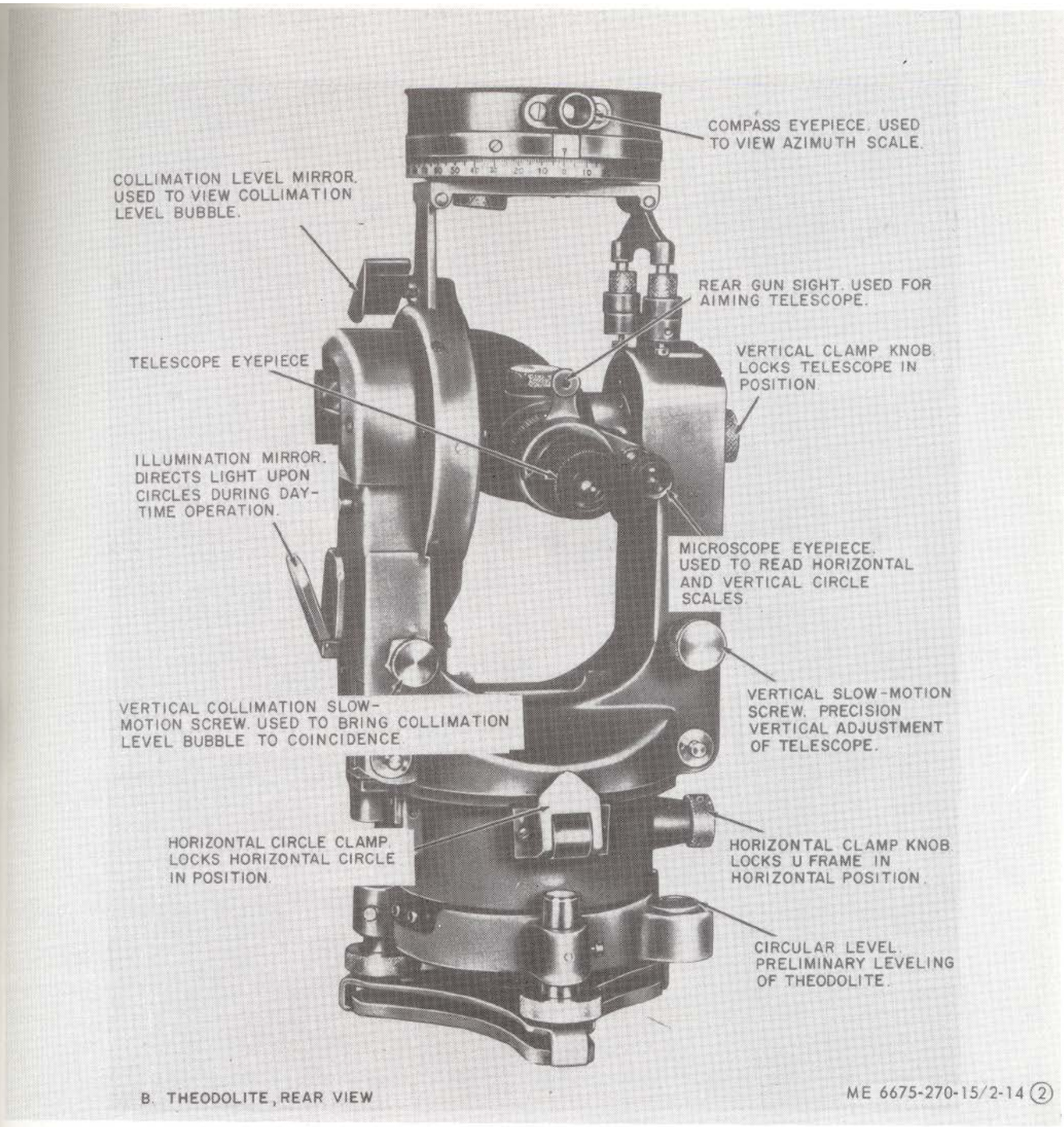

Figure 2-14. Controls and instruments, Model T16-MIL66 (sheet 2 of 3).

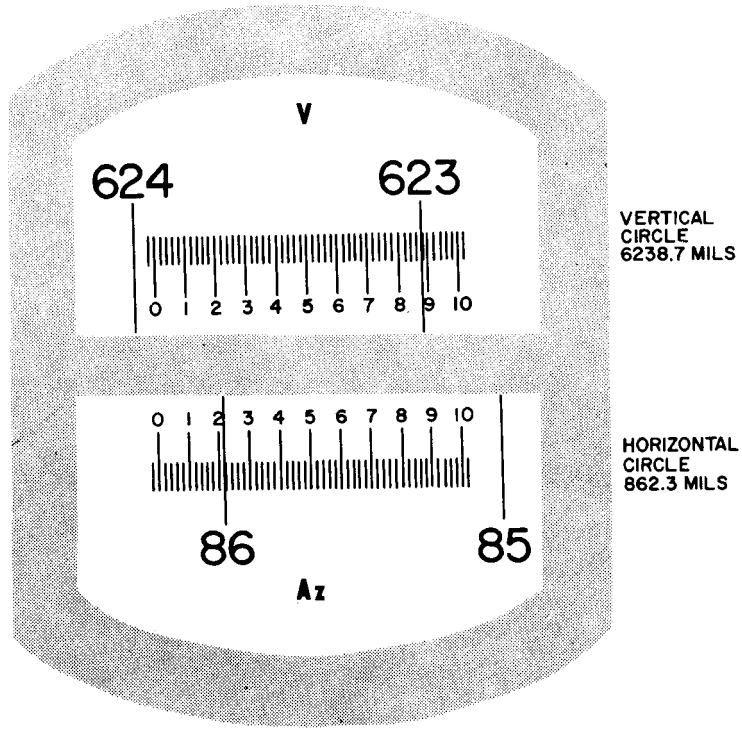

Figure 2-14. Controls and instruments, Models T16-MIL66 and T16-MIL68 (sheets 3 of 3).

Section IV. OPERATION UNDER USUAL CONDITIONS

2-8. General

CAUTION

Always notify the battery executive officer before starting operations so that adequate warning may be given surveyors prior to firing exercises. Always notify the chief of any construction project of the survey plans, so he can protect surveyors against injury from moving equipment or blasting.

a. The instructions in this section are published for the information and guidance of the personnel responsible for the operation of the theodolite.

b. The operator must know how to perform every operation of which the theodolite is capable. This section gives instructions on handling and setting up the theodolite, the basics motions and adjustments, and how to coordinate the basic motions and adjustments to perform the specific tasks for which the theodolite is designed. Since

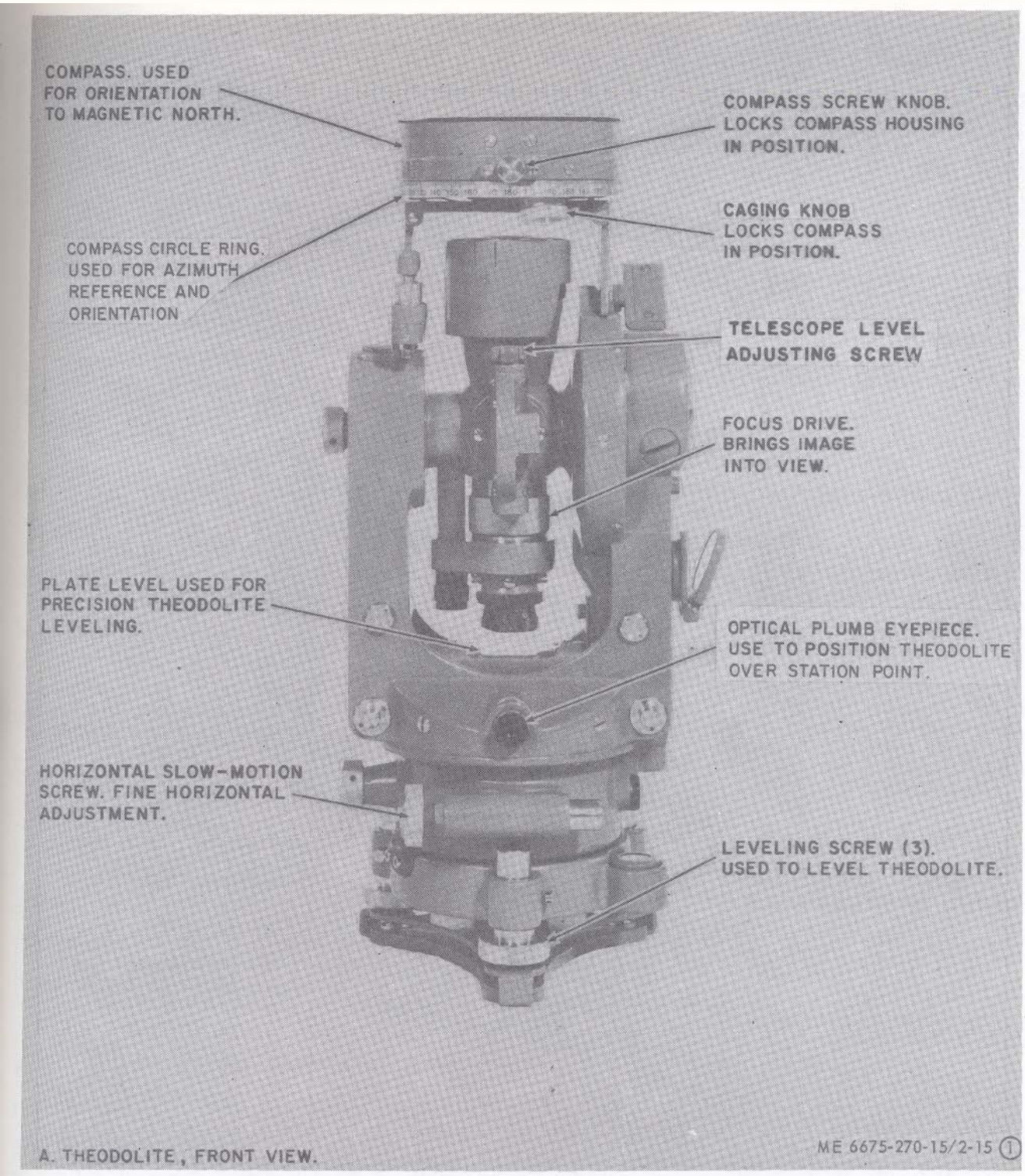

Figure 2-15. Controls and instruments, Models T16-MIL68 and T16-68DEG (sheet 1 of 3).

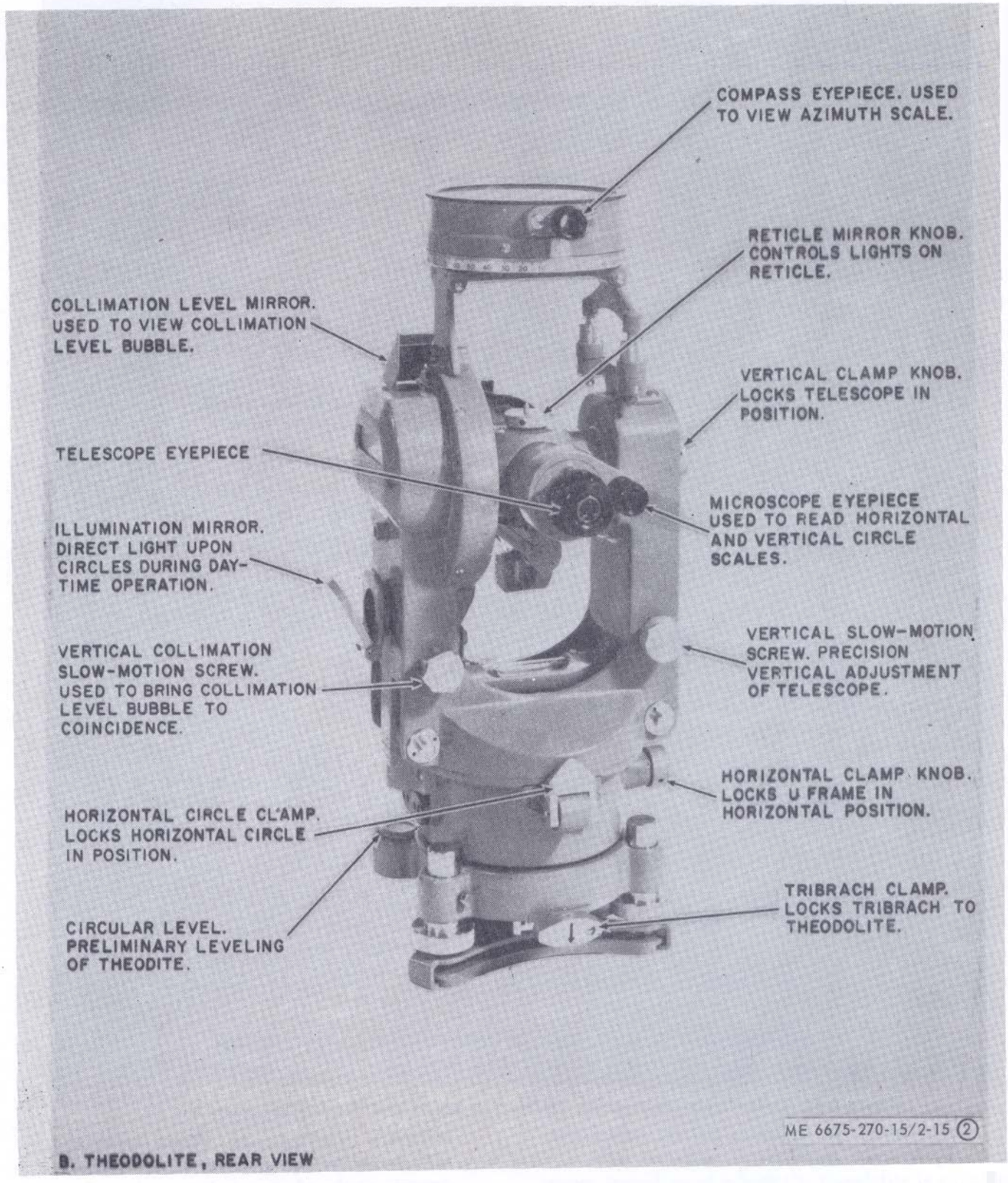

Figure 2-15. Controls and instruments, Models T16-MIL68 and (sheet 2 of 3).

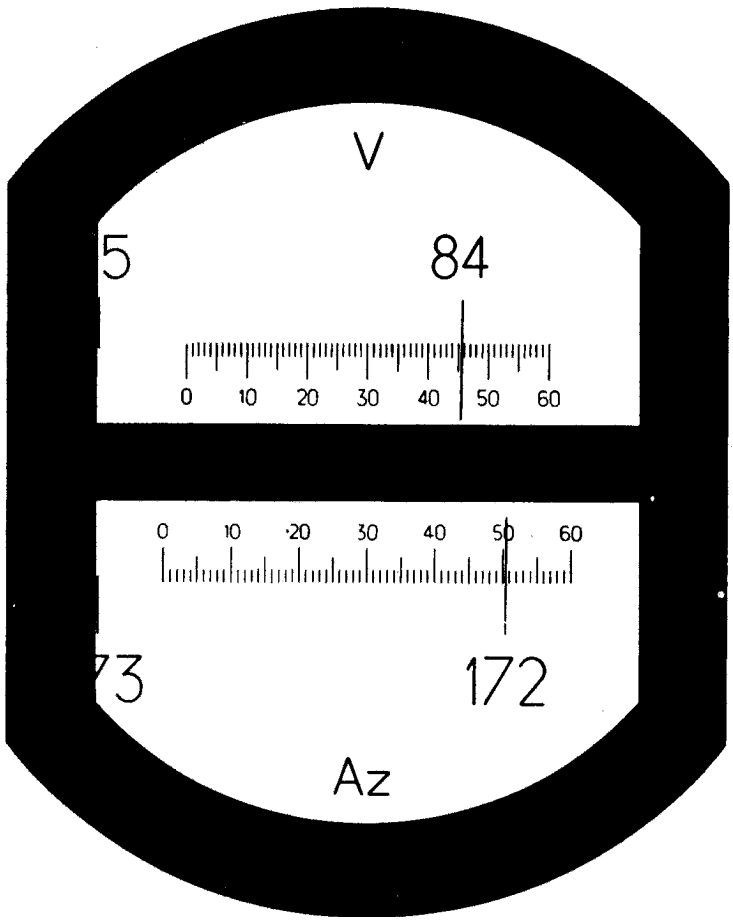

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Figure 2-15. Controls and instruments, Model T16-68DEG only (sheet 3 of 3).

nearly every job presents a different problem, the operator may have to vary the given procedure to fit the individual job.

2-9. Adjustments

a. *Circular Level.* Refer to figure 2-16 and adjust the circular level.

b. Plate Level.

(1) Level the theodolite (para 2-10).

(2) Refer to figure 2-17 and adjust the plate level.

c. Optical Plummet.

(1) Set up the tripod and theodolite (para 2-2 *b.)*

(2) Place a cross or other distinctive mark on the ground and center the instrument directly over it. Observe this mark through the optical plummet eyepiece and move the instrument until the ground mark is in the exact center of the microscope.

(3) Unlock the horizontal clamp and rotate the U-frame 180". Lock the clamp. If the microscope circle mark has moved, loosen the tripod head bridge screw (fig. 2-11) and move the theodolite toward the ground mark one-half the displacement.

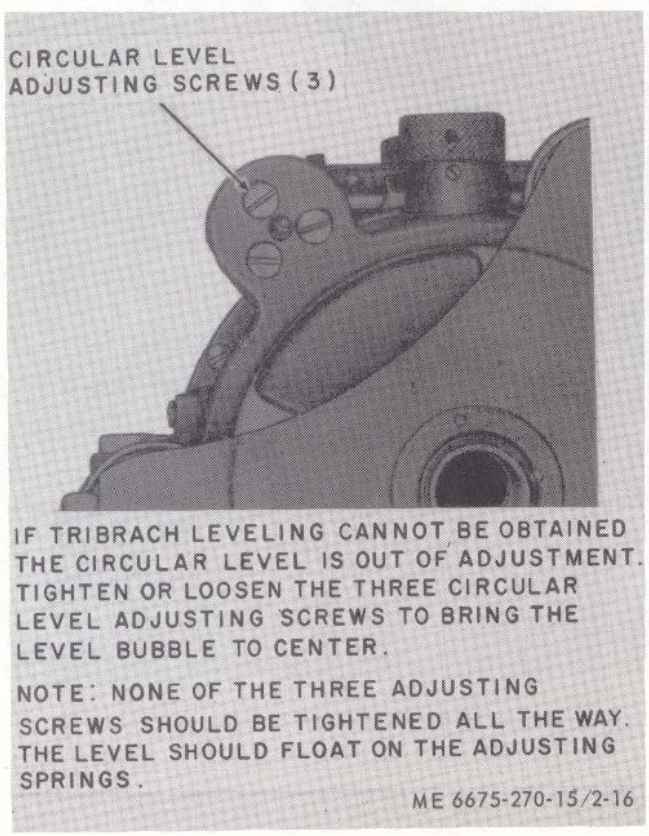


Figure 2-16. Circular level adjustments.

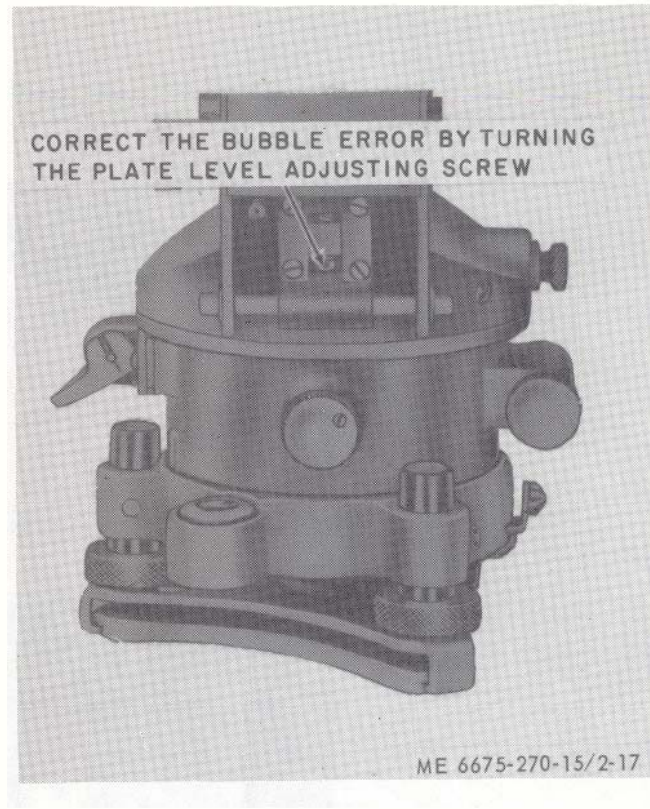


Figure 2-17. Plate level adjustment.

(4) Refer to figure 2-18 and adjust the optical plummet.

d. Collimation Slow-Motion Screw. Refer to figure 2-19 and adjust the collimation slow-motion screw.

e. Vertical Slow-Motion Screw. Refer to figure 2-20 and adjust the vertical slow-motion screw.

f. Horizontal Slow-Motion Screw. Refer to figure 2-21 and adjust the horizontal slow-motion screw.

g. Compass.

(1) Level the theodolite (para 2-10).

(2) Install the compass (para *2-2b.).*

(3) Refer to figure 2-22 and adjust the compass.

h. Horizontal Collimation.

(1) Set up the tripod and theodolite (para *2-2b.).*

(2) Sight on a well defined object at a distance of about 300 feet, with the telescope as nearly horizontal as possible.

(3) Observe and record the horizontal circle reading through the microscope.

(4) Reverse the telescope to the opposite horizontal position and rotate the U-frame to the reverse position. Resight on the same object and observe and record the reading.

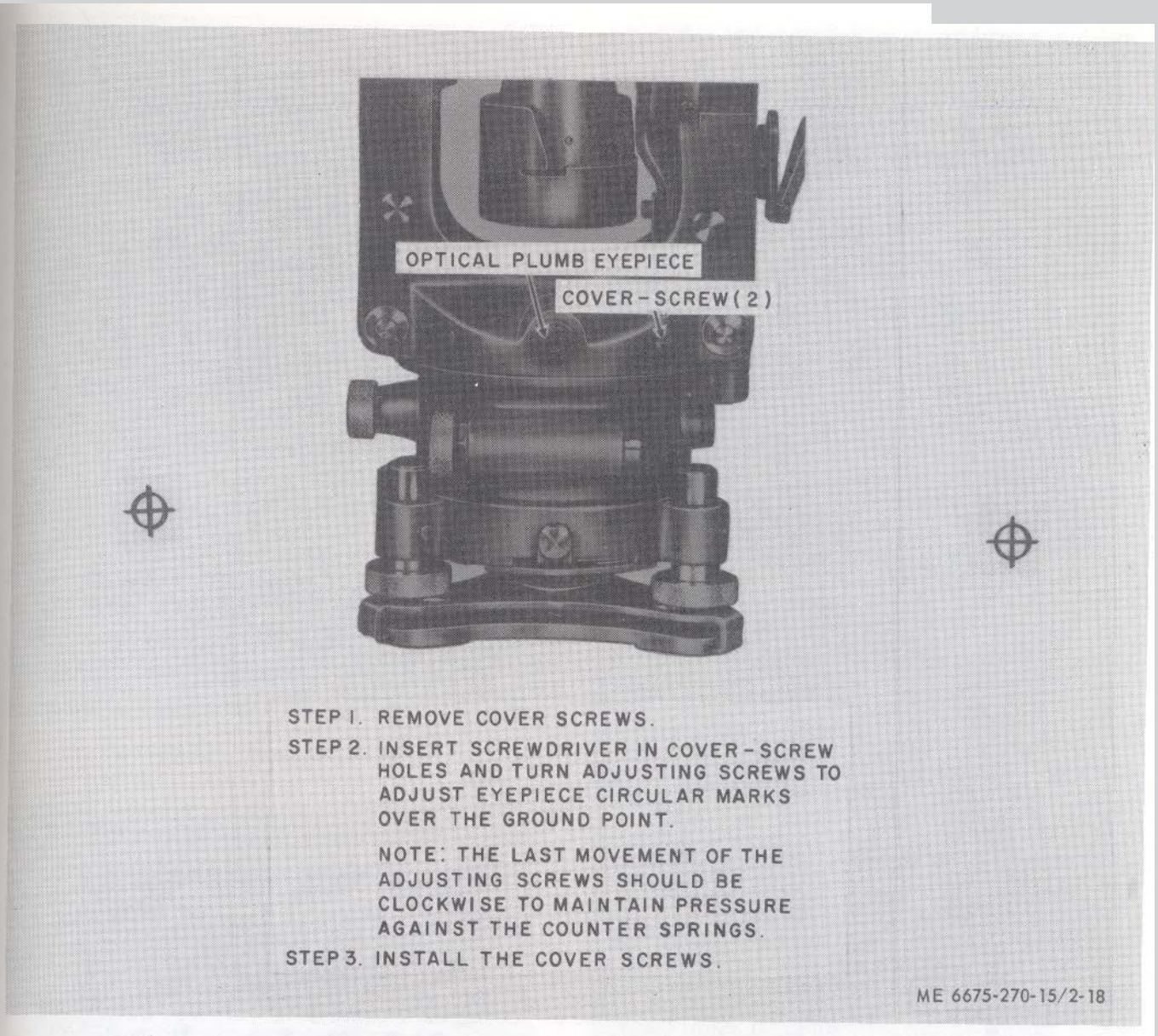


Figure 2-18. Optical plummet adjustment

(5) Add the two readings, substract 180 degrees or 3200 mils as applicable and divide by two. The difference between the quotient and the lesser of the two readings is the collimation error.

(6) Using the horizontal slow-motion screw, set the mean value of the collimation error on the horizontal circle scale.

(7) Refer to figure 2-23 and correct the horizontal collimation.

i. Collimation Level.

(1) Inspect and, if necessary, adjust the theodolite for proper horizontal collimation.

(2) With the telescope in horizontal position and the collimation level at coincidence, the reading of the vertical circle scale must be 1600 mils for the models T16-MIL66 and T16-MIL68 theodolites. The reading of the vertical circle scale must be 90 degrees on the model T16-68DEG theodolite. To check this, proceed as follows:

(a) Sight an object at a distance of at least 300 feet. View the vertical circle scale through the microscope eyepiece and record the reading.

(b) Reverse the telescope to the opposite horizontal position and rotate the U-frame until the sighting object is again in view. View the vertical circle scale through the microscopic eyepiece and record the reading.

(c) The sum of the readings in steps (a) and (b) must be 6400 miles for the models T16-MIL66 and T16-MIL68 theodolites, or 360 degrees for the model T16-68DEG theodolite. If the sum

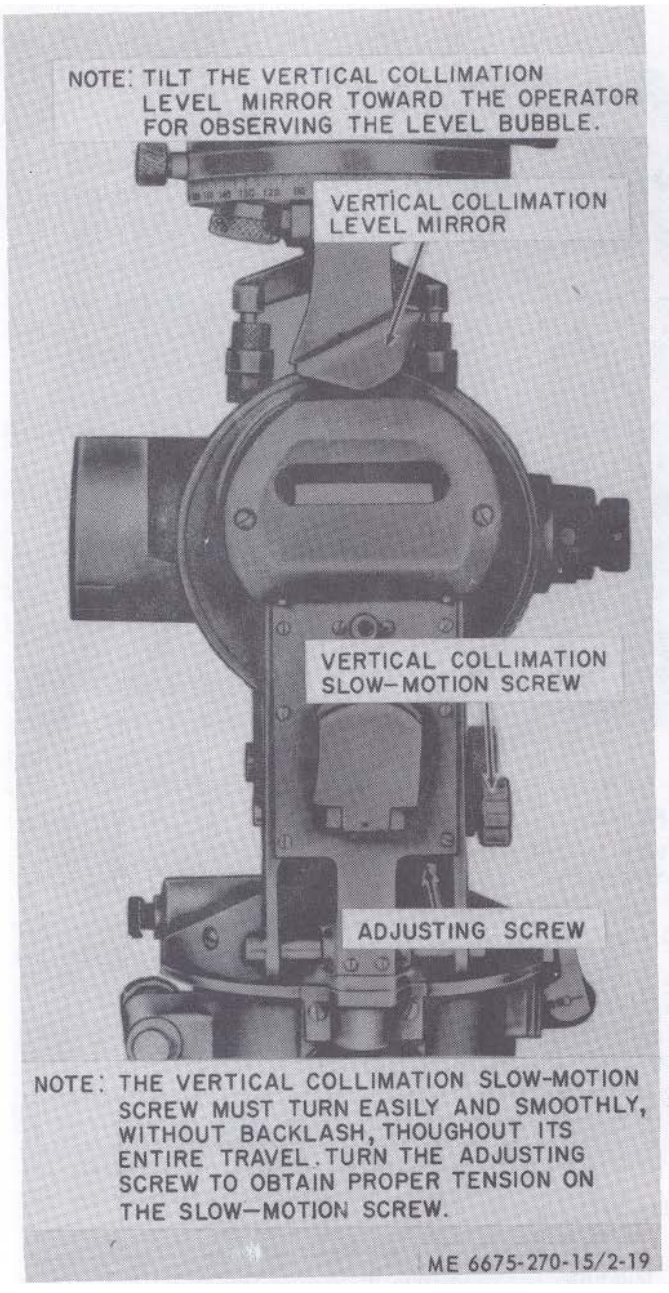


Figure 2-19. Collimation slow-motion screw adjustment.

exceeds the required value, one-half the difference is the collimation error.

(d) To correct this condition, resight the object and, using the collimation level knob, set the corrected value on the vertical circle scale.

(e) Remove the screw on the side of the collimation level cover (fig. l-l and l-2).

(f) Refer to figure 2-24 and adjust the collimation level.

j. *Telescope Level.* Bring telescope level into coincidence with telescope adjusting screw (fig. 2-15④).

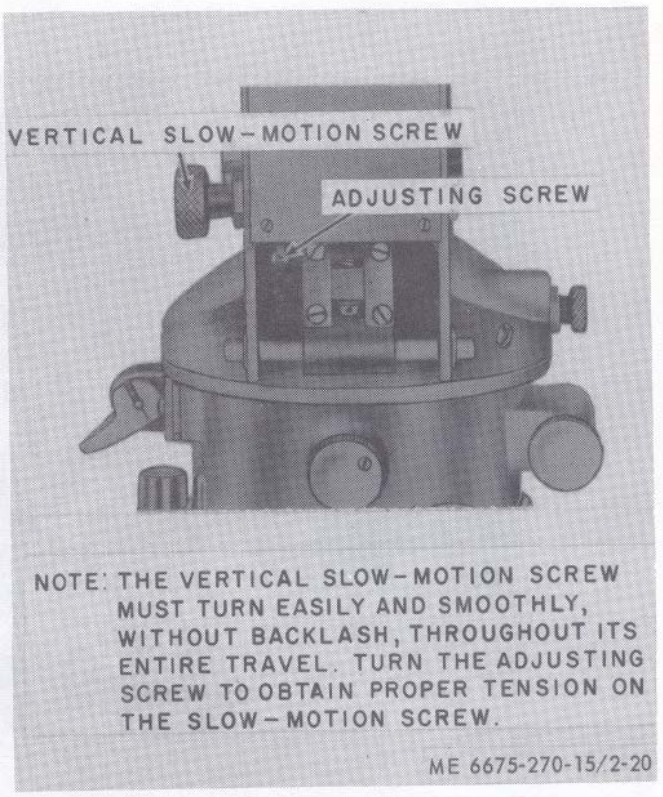


Figure 2-20. Vertical slow-motion screw adjustment.

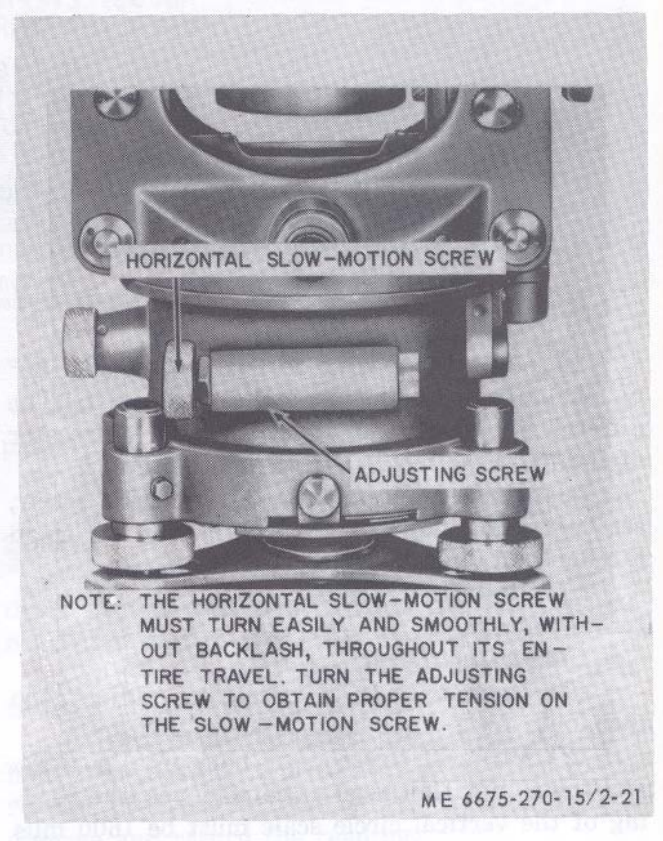


Figure 2-21. Horizontal slow-motion screw adjustment.

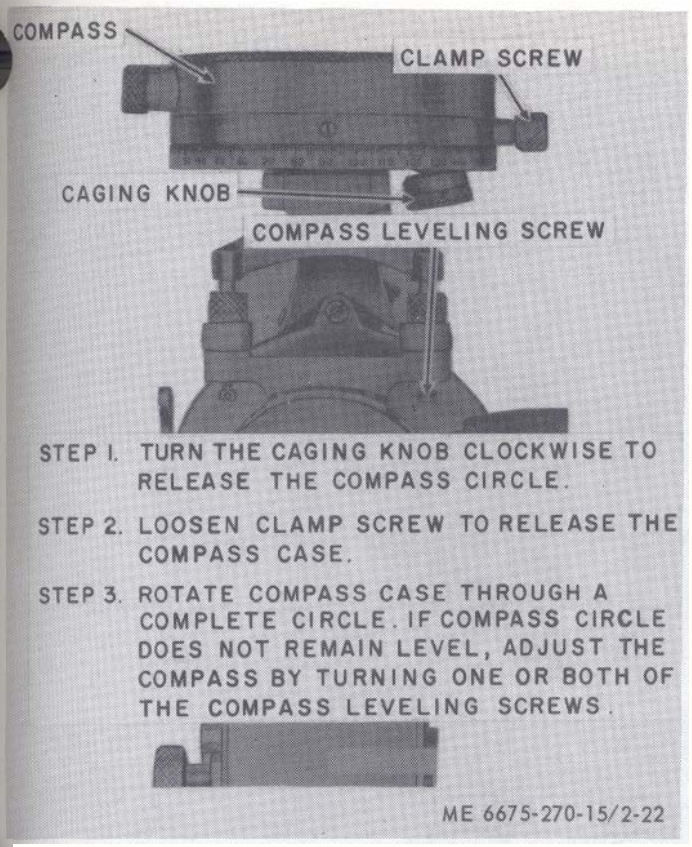


Figure 2-22. Compass adjustment.

2-10. Operation of Equipment

a. Set up the theodolite on the tripod (para *2-2b.).*

b. If necessary, install the electrica. illumination system (para 2-3).

NOTE

To operate the illumination system, position the rheostat knob for desired brilliance and place the hand light switch in the ON position.

c. Install the eyepiece prisms and sunglass, if required (para 2-3).

d. Perform the operator's daily services (para *3-5)*

e. Refer to figure 2-25 and level the theodolite.

f. Focus the telescope as follows:

(1) Direct the telescope towards a uniformly light background. Turn the scale dial (fig. l-l and l-2) on the telescope eyepiece until the cross-lines are sharp and black.

NOTE

Observe the settings on the scale dial. This setting will remain constant for the same observer but will vary for other observers.

(2) Turn the focus drive (fig. 1-1 and l-2) until there appears a clear image of the object sighted.

g. The horizontal and vertical circle reading scales are both observed through the microscope eyepiece (fig. 2-14 and 2-15). The horizontal circle scale image appears in the upper half of the window. The circles of the 0.2 MIL theodolite both horizontal and vertical are graduated in mils, and can be read directly to 0.2 mil (fig. 2–14③), and estimated to the nearest 0.1 mil. The main scales are marked and numbered every 10 mils, with the last zero dropped. The auxiliary scales are graduated from 0 to 10 mils in 0.2 mil increments. The circles are read by using the 10-mil graduation which passes through the auxiliary scale as the index line. The reading under this line is added to the 10-mil value for the total.. It is good practice to set the horizontal circle to 0.1 mil for initial reading. This eliminates working values less than zero when computing a mean of direct and reverse pointings. The circles of the l-MIN theodolite, both horizontal and vertical, are graduated in degrees (fig. 2–15③). They are graduated from 0 to 360 degree with a major or index graduation for each degree. This degree index mark appears superimposed over the auxiliary scale which is graduated in minutes to cover 60' or 1 degree. The position of the degree mark on the auxiliary scale is used as an index to get a direct reading in degrees and minutes. The scale can be estimated to the nearest 0.1' arc.

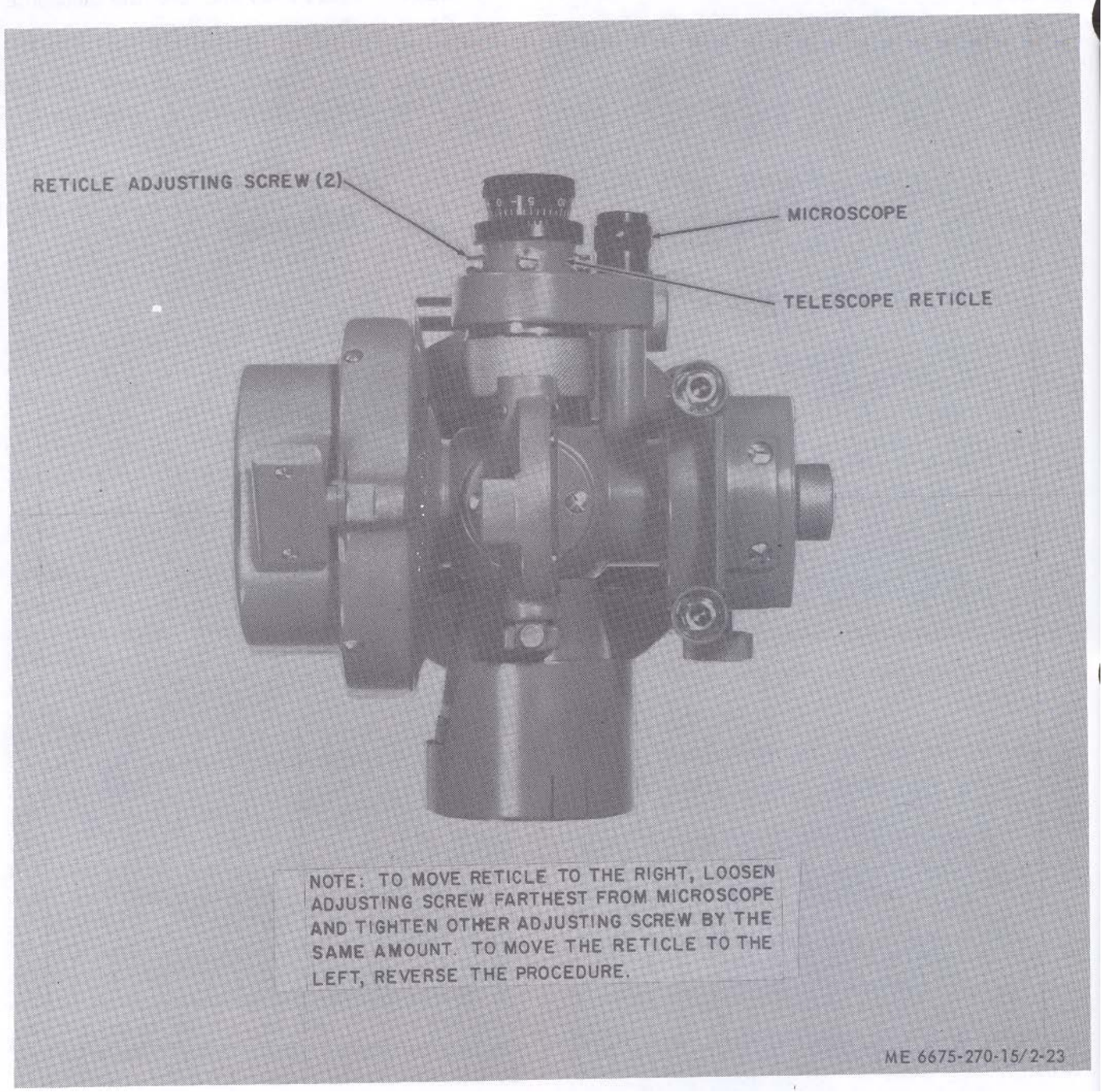


Figure 2-23. Horizontal collimation *error correction.*

Figure 2-24. Collimation level adjustment.

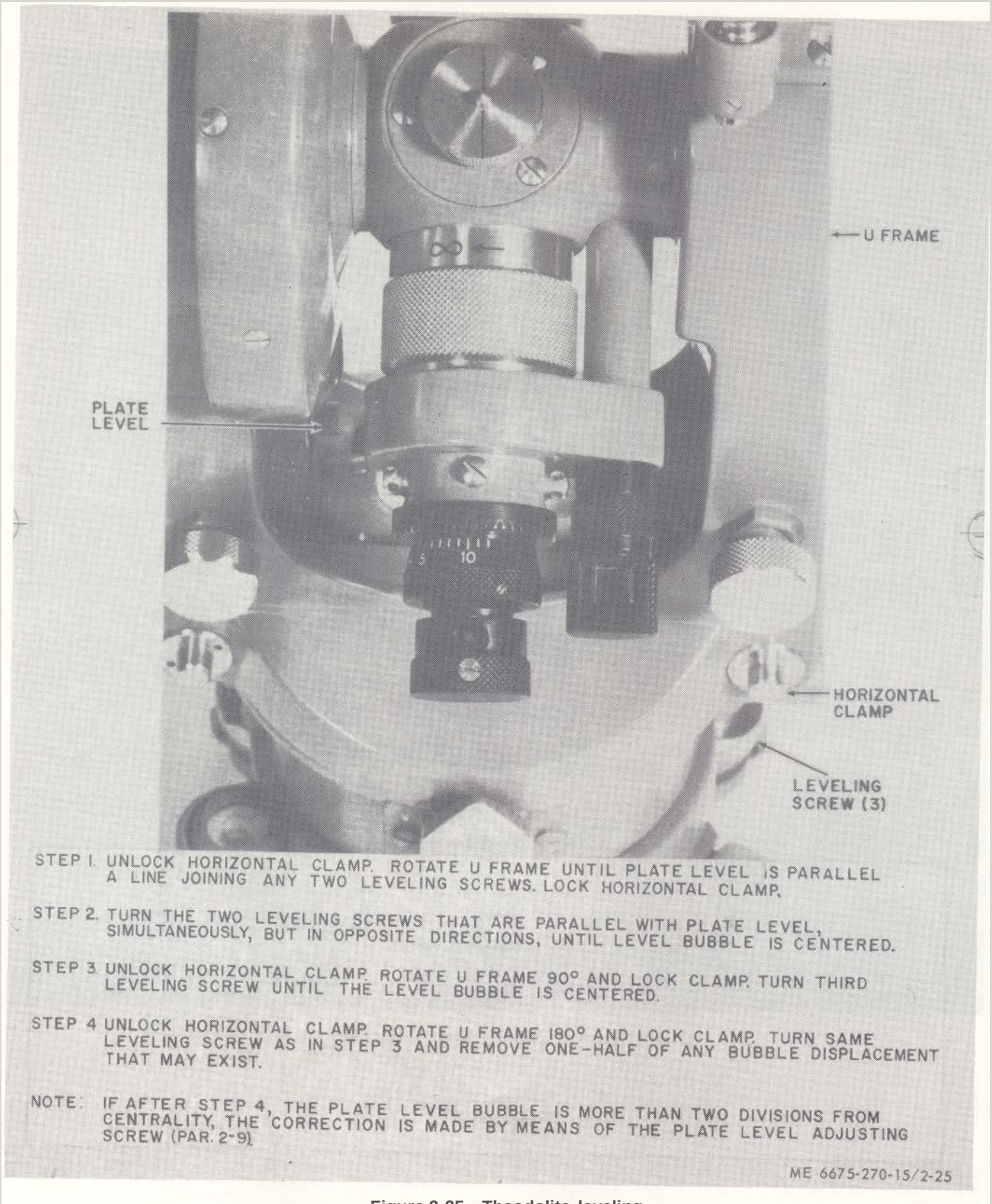


Figure 2-25. Theodolite leveling.

Section V. OPERATION UNDER UNUSUAL CONDITIONS

2-11. Operation in Extreme Cold (Below O°F)

With proper precautions and servicing, the theodolite can be used in extreme cold. Its use is limited only by the endurance of operating personnel and by conditions affecting visibility. The instrument should be kept out-of-doors or in unheated buildings for short periods of non-use. Extreme changes in temperature will cause internal stresses affecting accuracy, and lenses and prisms may become fogged. Theodolites should be cleaned and all lubricants removed before being put to use under extremely cold conditions. Snowfall, winds, and refraction of light are some of the adverse conditions encountered at low temperatures.

CAUTION

Avoid subjecting the theodolite to sudden changes in temperature.

2-12. Operation in Extreme Heat

Both theodolite and operator should be protected by a surveyor's umbrella when sightings must be taken in strong sunlight. Direct rays of the sun may cause internal stresses and distortion in the instrument. Heat ripples in the air near ground level create poor sightings condition. When such conditions prevail, taking shorter sightings will reduce sighting errors. Also, taking sightings in the early morning or late evening will reduce error magnitude. Operator error resulting from eyestrain and fatigue can be lowered if the operator wears suitable dark glasses. If the theodolite is stored in a cool place, it should be removed from storage long enought before use to allow the instrument temperature to approach that of the outside air.

2-13. Operation in Dusty or Sandy Areas

An instrument used in dusty or sandy areas requires special care because both dust and sand are highly abrasive. The theodolite's moving parts will soon bind if they remain on threaded or sliding surfaces, and the instrument will become inaccurate or inoperable. Brush the theodolite frequently, and carefully wipe it clean. Take care not to scratch lens and prism surfaces while cleaning. Protect the instrument from blowing dust and sand. Place a protective cover over the theodolite when it is not in use.

2-14. Operations Under Rainy or Humid Conditions

In humid areas, a slight lowering of the ambient temperature will cause condensation of moisture. The result will be fogging of lenses and prisms. To avoid this condition, keep the theodolite warmer than the surrounding air. Internal fogging can usually be removed by putting the theodolite in a warm dry place. Corrosion resulting from high humidity can be minimized by utilizing warm, dry storage areas and by using dessicants. After using the theodolite, dry the instrument thoroughly and wipe all metal parts with a soft cloth lightly impregnated with watch oil. Do not get any oil on the lens, prisms, or level vial surfaces.

2-15. Operation in Salt Water Areas

Salt air is highly corrosive to metals and especially to brass, from which many theodolites are made. Salt reacts with brass to produce a green deposit (verdigris), which must be guarded against and removed as soon as it is noticed. Wipe the instrument frequently with a soft cloth and dry thoroughly. Clean the instrument daily and apply a light film of watch oil to metal parts. If the theodolite is exposed to direct salt spray, it should be cleaned thoroughly and returned to an instrument shop for overhauling as soon as possible.

2-16. Operation at High Altitudes

No special operating procedures are required at high altitudes.

2-17. Operation Below Sea Level

No special operating procedures are required below sea level.

CHAPTER 3

OPERATOR'S MAINTENANCE INSTRUCTIONS

Section I. BASIC ISSUE ITEMS

3-1. Tools and Equipment

Tools, equipment, and repair parts issued with or authorized for the theodolite are listed in the basic issue items list, appendix C.

3-2. Special Tools and Equipment

The special tools required to perform operator's maintenance on the theodolites are listed in table 3-1 and appendix C. References and illustrations indicating the use of these tools are listed in the table. No special equipment is required by operator personnel for performing maintenance on the theodolites.

Table 3-1. Special Tools

Item	FSN or part number	Figure number	Use
Screwdriver, flat tip	5120-446-2860	2-6	Circular level adjustment
Pin, adjusting	6675-353-4103	2–6	Adjust theodolite adjusting screws.
Wrench, tripod	5120-378-9520	2–4	Tripod leg adjustment, and removal and installation.

Section II. LUBRICATION INSTRUCTIONS

3-3. General Lubrication Information

All moving parts of the theodolite, with both smooth and threaded surfaces, are fitted within extremely fine tolerances. For this reason most parts of the theodolite must be cleaned before being lubricated. Any attempt to lubricate the theodolite without first cleaning it may result in damage to the instrument, and may render it unfit for use. Unless specifically called for, no lubrication will be performed in the field.

CAUTION

Never perform any lubrication operation other than that specified or use lubricants other than those that are specifically approved for use on the instrument.

3-4. Detailed Lubrication Information

a. General. Keep all lubricants in closed containers and store in a clean, dry place away from external heat. Allow no dust, dirt, or other foreign material to mix with the lubricants. Keep all lubrication equipment clean and ready to use.

b. Cleaning. Keep all external parts not requiring lubrication clean of lubricants. Before lubricating the equipment, wipe all lubrication points free of dirt and grease. Clean all lubrication points after lubricating to prevent accumulation of foreign matter.

c. Approved Lubricants. No lubricants other than those approved for use on surveying instruments will be stocked. Approved lubricants are noncorrosive and highly refined, and must be free from all paint removing ingredients. Ordinary machine oil is not an approved lubricant. The following lubricants are approved for use on this theodolite:

(1) OCW: oil, clock and watch MIL-L-3918.

(2) GIA: grease, aircraft and instrument MIL-G-23827.

d. Component Requiring Lubrication.

(1) *Leveling screws.* Turn the leveling screws (fig. 1–1 and 1–2) outward to the extreme limit of their travel. Clean well with a lint-free cloth. Apply grease (GIA) sparingly and run the screws through their travel several times to distribute the grease evenly. Wipe off all excess grease.

(2) *Tribrach backing plate.* Unlock the tribrach clamp. Remove the tribrach and thoroughly clean all contact points on the tribrach, locking plate, and the lever (knob) and its guides. Using grease (GIA), lubricate all contact points sparingly. Position the tribrach on the instrument and secure it with the tribrach clamp.

(3) *Spring plate.* The sloped sides of the spring plate (fig. 1–5 and 1–6), which contact

the leveling screws to hold them snugly against the tripod base, should be lubricated sparingly as occasion may require, using grease (GIA).

e. Lubricating Procedure. Cleaning and lubrication services which require partial or complete disassembly of the instrument must be performed in the dust-free atmosphere of an instrument repair shop, and then only by qualified instrument repair personnel. Taking the instrument apart under any other condition, especially where dust may get into recesses, may result in damage to the instrument. Because the lubricants must be applied sparingly, never use a container with a spout, as an oil can, to squirt oil on parts or into assemblies.

CAUTION

Never attempt to take the theodolite apart in the field.

Section III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

3-5. General

To insure that the theodolite is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed are listed and described in paragraph 3-6. Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has eased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment if operation were continued. All deficiencies and shortcoming will be recorded together with the corrective action taken on DA Form 2404 (Equipment Inspection and Maintenance Worksheet) at the earliest possible opportunity.

3-6. Preventive Maintenance Checks and Services

Table 3–2 contains a tabulated listing of the operator's periodic (daily and weekly) preventive maintenance checks and services. The item numbers indicate the sequence of minimum inspection requirements.

Table 3-2. Preventive Maintenance Checks and Services

Item number	Interval: Operator: Daily: B	D	A	W	Org.: M	Q	B–Before operation D–During operation: Item to be inspected	A–After operation W–Weekly: Procedure	M-Monthly Q-Quarterly: Reference
1	X	X	X				Canvas Field Pack	Inspect pack for serviceable condition.	para 2–1c
2	X	X	X				Theodolite	Inspect eyepieces, adjusting and clamping knobs, and adjusting screws for proper operation. Inspect U-frame for paint chips and dirt. Clean frame with lint-free cloth, if necessary. Clean prisms with a lint-free cloth. Inspect lenses, level vials, and mirrors for dryness, cleanliness, and serviceable condition. Clean lenses, vials, and mirrors. Clean sunglasses with a lint-free cloth.	
3	X	X	X				Compass Assembly	Inspect compass for serviceable condition. Clean with a lint-free cloth.	Fig. 1-5 & 1–6
4	X	X	X				Accessory Case	Inspect case for serviceability and	para 2–1d para 2–1a

Table 3-2. Preventive Maintenance Checks and Services

Item number	Interval Operator Daily B	D	A	W	Org. M	Q	Item to be inspected	Procedure	Reference
	B–Before operation D–During operation		A–After operation W–Weekly		M-Monthly Q–Quarterly				
6	X	X	X				Tripod	Inspect tripod for serviceable condition. Inspect tripod accessory case for tears and other damage. Check tripod accessory case for presence of components.	para 2-1b
7	X	X	X				Battery Box	Inspect box for presence of components. Inspect batteries and wiring for serviceable condition. Check rheostat for tight and clean connections and for proper operation.	para 2-1e
8	X	X	X				Hand Light	Inspect light for serviceable condition and proper operation.	para 2-1e
9	X	X	X				Controls and Instruments	Inspect the controls and instruments for serviceable condition. Check for proper operation. *Note.* During operation observe for proper function, alinement, adjustment, and calibration.	para 2-7

Section IV. TROUBLESHOOTING

3-7. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the theodolite and its components.

3-8. Troubleshooting

Malfunction switch may occur are listed in table 3–3. Each malfunction stated is followed by a list of probable causes of the trouble. The corrective action recommended is described opposite the probable cause.

Table 3-9. Troubleshooting

Malfunction	Probable cause	Corrective action
1. Compass circle will not rotate freely.	*a.* Caging knob loose.	*c.* Tighten knob setscrew
	b. Compass not level.	*b.* Level compass (para 2-9g).
2. Compass housing will not rotate on compass base.	Clamp screw locked.	Release clamp screw (para. 2-9g).
3. Compass reference mark not clearly visible.	*a.* Compass eyepiece not properly focused.	*c.* Turn focusing knob until sharp image is obtained.
	b. Eyepiece lens dirty.	*b.* Clean external lens.
4. Compass assembly will not seat on theodolite mounting.	Leveling screws in compass mounting bridge out of adjustment.	Adjust screws (para 2-9g).
5. Tripod legs will not lock in position.	Leg clamp nuts and lockscrews too loose.	Tighten screws with tripod wrench (para 2-2b).
6. Tripod extension leg play excessive.	Wing screws too loose.	Tighten wing screws para 2–2b).
7. Theodolite will not seat properly on tripod head.	Bridge screw improperly started or defective.	Restart or replace bridge screw (para 2-2b).
8. Instrument will not stay in line.	*a.* Instrument out of level.	*a.* Level the instrument (para 2-10).
	b. Horizontal collimation out of adjustment.	*b.* Correct collimation (para 2-9).
	c. Collimation level out of adjustment.	*c.* Adjust collimation level (para 2-9).
9. Circular level bubble does not stay in center.	Circular level out of adjustment.	Adjust level (para 2–9).
10. Collimation level bubble does not stay in center.	Collimation slow motion screw loose.	Adjust screw (para 2-9i).

Table 3-3. Troubleshooting-Continued

Malfunction	Probable cause	Corrective action
11. Platelevel bubble does not stay in center.	Plate level out of adjustment.	Adjust plate level (para *2-9b).*
12. Light on vertical and horizontal circles unequal or absent.	a. Illumination mirror not properly adjusted.	a. Adjust mirror.
	b. Illumination lamp defective.	*b.* Replace lamp (para 3-9 and 3-10).
13. Illumination system faulty or fails to function.	a. Lamp burned out.	a. Replace lamp (para 3-9 and *3-10).*
	b. Batteries discharged.	*b.* Replace batteries (para 3-13).
14. Horizontal circle hard to move.	Horizontal circle clamp locked.	Release clamp.
15. Telescope turns too hard to too easily.	Vertical clamp screw improperly set.	Reset clamp screw.

Section V. MAINTENANCE OF LAMPS

3-9. Removal

a. Illumination Lamp. Refer to figure 3-1 and remove the illumination lamp.

b. Hand Light Lamp. Refer to figures 3-l and 2-7 and remove the hand light lamp.

3-10. Installation

a. *Illumination Lamp.* Refer to figure 3-l and install the illumination lamp.

b. Hand Light Lamp. Refer to figures 3-l and 2-7 and install the hand light lamp.

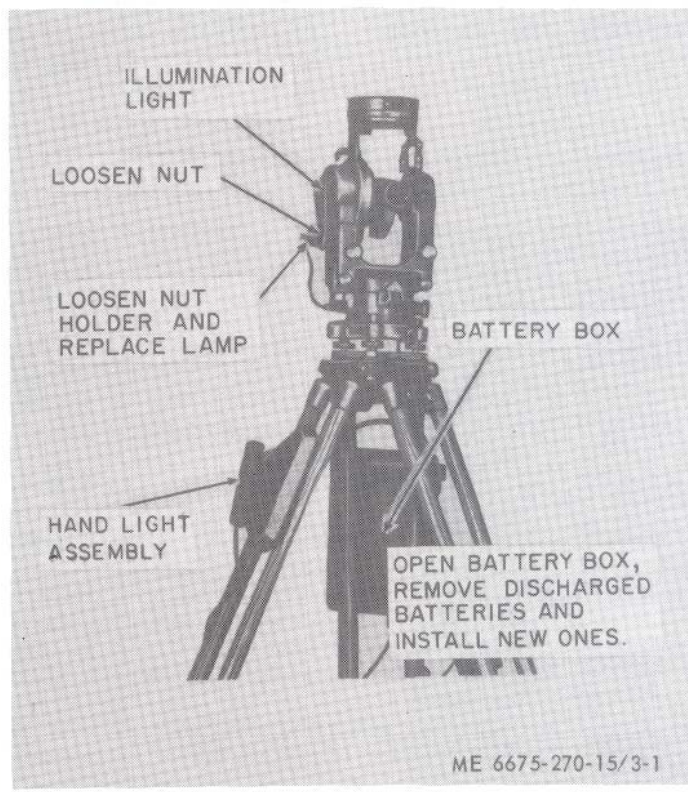


Figure 3-1. Lamp and battery, removal and installation.

Section VI. MAINTENANCE OF HAND LIGHT

3-11. Removal

Refer to figure 2-12 and remove the hand lamp from the tripod assembly.

3-12. Installation

Refer to figure 2-12 and install the hand light on the tripod assembly.

Section VII. MAINTENANCE OF BATTERY AND BATTERY CABLE

3-13. Battery Replacement

Refer to figure 3-1 and replace an unserviceable battery.

3-14. Battery Cable Replacement

Refer to figure 2-7 and replace an unserviceable cable.

Section VIII. MAINTENANCE OF SUNGLASSES

3-15. Removal

Refer to figure 2-13 and remove the sunglasses.

3-16. Cleaning

Refer to paragraph 2-1d. and clean the sunglasses.

3-17. Installation

Refer to figure 2-13 and install the sunglasses.

Section IX. MAINTENANCE OF LEVEL ASSEMBLIES

3-18. Cleaning

a. Circular Level. Clean the circular level (fig. 1-1 and 1-2) with a chamois cloth.

b. Collimation Level. Clean the collimation level (fig. 1-3 and 1-4) with a chamois cloth.

c. Plate Level. Clean the plate level (fig, 1-1 and 1-2) with a chamois cloth.

d. Telescope Level Assembly. Clean the telescope level assembly (fig. 1-6) with a chamois cloth.

3-19. Adjustment

a. Circular Level. Refer to paragraph 2-9a. and adjust the circular level.

b. Collimation Level. Refer to paragraph 2-9i. and adjust the collimation level.

c. Plate Level. Refer to paragraph 2-9b. and adjust the plate level.

d. Telescope Level Assembly. Refer to paragraph 2-9j. and adjust the telescope level assembly.

Section X. MAINTENANCE OF TRIPOD ACCESSORY CASE

3-20. Inspection

Refer to paragraph 2-1d. and inspect the accessory case.

3-21. Cleaning

Remove foreign material from the case with a stiff brush.

Section XI. MAINTENANCE OF TRIPOD ASSEMBLY

3-22. Inspection

Refer to paragraph 2-lb. and inspect the tripod assembly.

3-23. Cleaning

Remove foreign matter from the tripod assembly (fig. 2-3) with a stiff brush.

Section XII. MAINTENANCE OF CARRYING CASE

3-24. Inspection

Refer to paragraph 2-1a. and inspect the carrying case and desiccant.

3-25. Cleaning and Replacement

a. Remove foreign matter from the carrying case with a stiff brush.

b. If necessary, replace desiccant (para 2-1a).

Section XIII. MAINTENANCE OF CANVAS FIELD PACK

3-26. Inspection

Refer to paragraph 2-1c. and inspect the canvas field pack.

3-27. Cleaning

Remove foreign material from the canvas field pack with a stiff brush.

Section XIV. MAINTENANCE OF U-FRAME

3-28. Inspection

Inspect the U-frame (fig. 1-1 and 1-2) for dents, cracks, and burs.

3-29. Cleaning

Clean the U-frame with a cleaning solvent and dry thoroughly.

Section XV. MAINTENANCE OF TRIBRACH ASSEMBLY

3-30. Inspection

Inspect the tribrach assembly (fig. 1-5 and 1-6) for cracks and breaks.

3-31. Cleaning

Brush all dirt and foreign matter from the tribrach.

Section XVI. MAINTENANCE OF COMPASS ASSEMBLY

3-32. Removal

Refer to figure 2-10 and remove the compass.

3-33. Inspection and Cleaning

a. Inspect the compass (fig. 2-10) for dents and cracks.

b. Clean the compass with a cleaning solvent and dry thoroughly.

3-34. Installation

Refer to figure 2-10 and install the compass.

Section XVII. MAINTENANCE OF TELESCOPE

3-35. Cleaning

Clean the telescope (fig. 1-1 and 1-2) with a lint-free cloth.

3-36. Adjustment

Refer to figure 2-14 or 2-15, as applicable, and adjust the focus drive.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

4-1. Inspecting and Servicing the Equipment

To inspect and service the theodolite, follow the procedures outlined in paragraph 2-1.

4-2. Installation

For installation procedures, refer to paragraph 2-2.

4-3. Equipment Conversion

For equipment conversion, refer to paragraph 2-3.

Section II. MOVEMENT TO A NEW WORKSITE

4-4. Dismantling for Movement

For dismantling procedures, refer to paragraph 2-4.

4-5. Reinstallation after Movement

For reinstallation procedures, refer to paragraph 2-5.

Section III. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

4-6. Tool and Equipment

Tools, equipment, and repair parts issued with or authorized for the theodolite are listed in the basic issue items list, appendix C.

4-7. Special Tools and Equipment

For special tools, refer to paragraph 3-2. No special equipme It is required by organizational personnel for performing maintenance on the theodolite.

4-8. Maintenance Repair Parts

Repair parts and equipment are listed and illustrated in TM 5-6675-270-25P.

Section IV. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (MONTHLY AND QUARTERLY)

4--9. General

To insure that the theodolite is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed are listed and described in paragraph 4-10.

4-10. Preventive Maintenance Checks and Services

Table 4-1 contains a tabulated listing of preventive maintenance checks and services to be performed by orginizatioinal maintenance personnel at monthly and quarterly intervals. A quarterly interval is equal to three calendar months, or 250 hours of operation, whichever occurs first. The item numbers indicate the sequence of minimum inspection requirements.

Table 4-1. Preventive Maintemznce Checks and Services

Item number	Interval: Operator: Daily: B	Interval: Operator: Daily: D	Interval: Operator: Daily: A	Interval: Operator: Daily: W	Interval: Org.: M	Interval: Org.: Q	Item to be inspected	Procedure	Reference
	B–Before operation D–During operation		A–After operation W–Weekly		M–Monthly Q–Quarterly				
1					X	X	Canvas Field Pack	Inspect pack for serviceable condition.	para 2-1c
2					X	X	Theodolite	Inspect eyepieces, adjusting and clamping knobs, and adjusting screws for proper operation. Inspect U-frame for paint chips and dirt. Clean frame with lint-free cloth, if necessary. Clean prisms with a lint-free cloth. Inspect lenses, level vials, and mirrors for dryness, cleanliness, and serviceable condition. Clean lenses, vials, and mirrors. Clean sunglasses with a lint-free cloth.	
3					X	X	Compass Assembly	Inspect compass for serviceable condition. Clean with a lint-free cloth.	fig. 1-5 & 1-6.
4					X	X	Accessory Case	Inspect case for serviceability and presence of components.	para 2-1d
5					X	X	Carrying Case	Inspect case for serviceability. Check dessicant for proper color (blue). Dehydrate or replace dessicant of any other color.	para 2-1a
6					X	X	Tripod	Inspect tripod for serviceable condition. Inspect tripod accessory case for tears and other damage. Check tripod accessory case for presence of components.	para 2-1b
7					X	X	Battery Box	Inspect box for presence of components. Inspect batteries and wiring for serviceable condition. Check rheostat for tight and clean connections and for proper operation.	para 2-1e
8					X	X	Hand Light	Inspect light for serviceable condition and proper operation.	para 2-1e
9					X	X	Controls and Instruments	Inspect the controls and instruments for serviceable condition. Check for proper operation. *Note.* During operation observe for proper function, alinement, adjustment, and calibration.	para 2-7

Section V. TROUBLESHOOTING

4-11. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the theodolite and its components.

4-12. Troubleshooting

Malfunctions which may occur are listed in table 4–2. Each malfunction slated is followed by a list of probable causes of the trouble. The corrective action recommended is described opposite the probable cause.

Table 4-2. Troubleshooting

Malfunction	Probable cause	Corrective action
1. Tripod legs will not lock in position.	Tripod head worn or defective.	Replace tripod head (para 4-39).
2. Tripod extension leg play excessive.	Tripod leg clamp defective.	Replace clamp (para 4-39).
3. Theodolite will not seat properly on tripod head.	Base plate defective.	Replace tribrach assembly (para 4-28).
4. Instrument will not stay in line.	Leveling screws defective.	Replace tribrach assembly (para 4-28).
5. circular level bubble does not stay in center.	*a.* Circular level out of adjustment.	*c.* Replace tribrach assembly (para 4-28).
	b. Tripod clamp loose or defective.	*d.* Tighten or replace tripod leg clamp (para 4-39).
6. Light on vertical and horizontal circles unequal or absent.	Illumination socket defective.	Replace tribrach assembly (para 4-28).
7. Leveling screws hard to move or have excessive play.	Leveling screws defective.	Replace tribrach assembly (para 4-28).

Section VI. MAINTENANCE OF CARRYING CASE

4-13. General

The theodolite carrying case (fig. 2-1) consists of the hood and base assembly. It provides a safe and convenient means of carrying the theodolite in the field and serves as a dustproof and moisture-proof container for the instrument while in storage.

4-14. Removal

a. Hood. Remove the hood from the base (para 2-2).

b. Base. Remove the theodolite from the base (para 2-2).

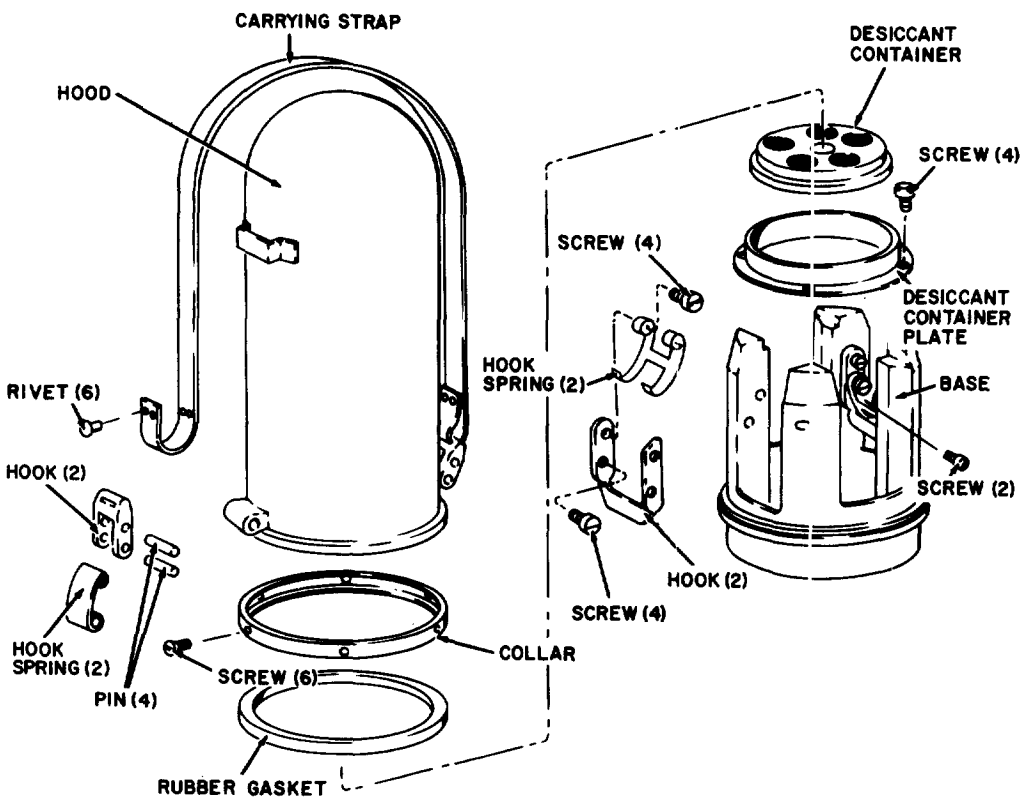


Figure 4-1. Carrying case assembly, disassembly and assembly.

4-15. Disassembly

a. Hood. Refer to figure 4-1 and disassemble the hood.

b. Base. Refer to figure 4-1 and disassemble the base.

c. Desiccant Container. Refer to figure 4-2 and disassemble the desiccant container.

4-16. Cleaning, Inspection, and Repair

a. Hood (fig. 4-1).

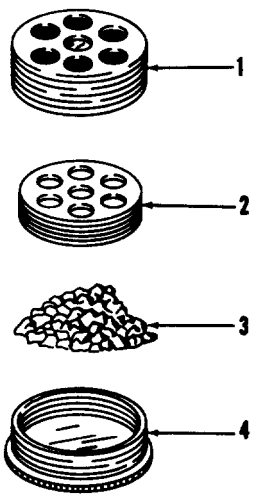
(1) Clean all metal parts with a cleaning solvent and dry thoroughly. Clean the carrying strap with saddle soap or other approved leather cleaner.

(2) Inspect the carrying strap for cuts, cracks, and breaks. Inspect for worn mounting holes and deterioration due to age and wear.

(3) Inspect the lever pins for burs and wear. Inspect the locking hooks and hook springs for burs, bends, and cracks.

(4) Inspect the hood for dents, cracks, and holes. Inspect the bottom rim for out-of-round.

(5) Remove all burs from hook pins, locking hooks, and hook springs. Straighten all minor bends. Remove any trace of rust; paint where necessary.



ME 6675-270- 15/4-2

1 Upper container
2 Inner container
3 Desiccant
4 Lower container

Figure 4-2. Desiccant container, disassembly and assembly.

(6) Straighten all minor dents or bends in the hood. Seal all cuts or holes in the hood by brazing. Smooth out the brazed area and repaint where necessary.

(7) Replace all unserviceable parts with serviceable parts.

b. Base (fig. 4-1).

(1) Clean all metal parts with a cleaning solvent and dry thoroughly. Be sure that all threaded surfaces are brushed free of any foreign matter. Wipe the rubber washer clean with a soft cloth.

(2) Inspect all threaded surfaces for worn or damaged threads. Inspect the hooks, hook springs, and washers for burs, bends, dents, and worn surfaces. Inspect the base for cracks and broken casting. Inspect the metal collar for bends, breaks, and out-of-round. Inspect the rubber washer to see whether it is damaged or hardened because of age or excessive heat.

(3) Remove all bus from the base, studs, hooks, hook springs, and metal collar. Straighten minor bends in the collar and washers. Replace all defective parts.

c. Desiccant Containor (fig. 4-2).

(1) Clean all metal parts with a cleaning solvent and dry thoroughly.

(2) Inspect the window and screen for cracks and breaks. Inspect the three sections of the container for bends, breaks, and damaged threads.

(3) Inspect the desiccant for residual capacity. Satisfactory desiccant is blue in color.

(4) Replace desiccant that is pink in color or dehydrate it.

(5) Replace all unserviceable parts of the container with servicesble parts.

4-17. Assembly

a. Hood. Refer to figure 4-1 and assemble the hood.

b. Desiccant Container. Refer to figure 4-2 and assembly the desiccant container.

c. Base. Refer to figure 4-1 and assemble the base.

4-18. Installation

a. Base. Install the theodolite on the base (fig. 2-9).

b. Hood. Install the hood on the base (fig. 2-1).

Section VII. MAINTENANCE OF CANVAS FIELD PACK

4-19. General

The field pack (fig. 2-5) is a canvass and leather back pack. It permits easy and safe conveyance of the theodolite and accessories over all types of terrain. The field pack must be properly maintained if it is to prevent loss of, or damage to, the surveying equipment in the field.

4-20. Cleaning, Inspection, Repair and Replacement

a. Brush all dirt from the outer side of the field pack with a stiff fiber brush. Invert the pack and clean out the inside with a soft cloth.

b. Wash the canvas parts of the pack with mild soap and water and dry thoroughly.

c. Wash the leather parts with saddle soap or other leather cleaner.

d. Inspect the pack for ripped seams, and for tears and cuts in the canvas and leather parts.

e. Inspect the straps for cuts and breaks and for damaged and missing buckles.

f. Inspect the thong drawstrings for weak spots and stiffness.

g. Inspect the shoulder strap for wear and signs of weakness.

h. Inspect the metal bow for breaks, bends, and loose rivets.

i. Restitch a ripped seam. Patch a small tear with canvas or similar material. Tighten a loose rivet. Replace a missing strap or buckle. See TM 10-269.

j. Replace an unrepairable field pack.

Section VIII. MAINTENANCE OF COMPASS ASSEMBLY

4-21. General

The compass enables the operator to orient the target with magnetic north.

4-22. Replacement

a. Refer to paragraph 3-32 and remove the compass from the theodolite.

b. Replace a defective compass with a serviceable one.

c. Refer to paragraph 3-34 and install the compass.

Section IX. MAINTENANCE OF TELESCOPE AND MICROSCOPE IEYEPIECES

4-23. General

The eyepieces used on the theodolite consist of the telescope and microscope eyepieces, the eyepiece prisms for both telescope and microscope, and the telescope sunglass. The eyepiece prisms screw directly into the telescope and microscope eyepieces, and the sunglass is a push-fit over the end of both the telescope eyepiece and the telescope eyepiece prism. The eyepiece prisms permit sighting up to 65° from the horizontal.

4-24. Removal

a. Telescope and Microscope Eyepieces. Refer to figure 4-3 and remove the telescope and miscoscope eyepieces.

b. Eyepiece Prisms and Sunglass. Refer to paragraph 2-3 and remove the eyepiece prisms and sunglass.

4-25. Cleaning, Inspection, and Replacement

a. Telescope and Microscope Eyepieces.

(1) Clean the eyepiece lenses with a lint-free cloth moistened with acetone or grain alcohol Dry and polish with lens tissue.

(2) Inspect the lenses for scratches, chips, cracks, and etching. Inspect all threaded surfaces for worn or damaged threads.

(3) Replace a defective telescope or microscope eyepiece.

b. Eyepiece Prisms and Sunglass.

(1) Clean the eyepiece prisms and sunglass with a lint-free cloth moistened with acetone or grain alcohol. Dry and polish with lens tissue.

(2) Inspect the eyepiece prisms and sunglass for chips, cracks, scratches, or etching. Inspect the threads on the prisms for excessive wear or damage.

(3) Replace a defective eyepiece prism and sunglass.

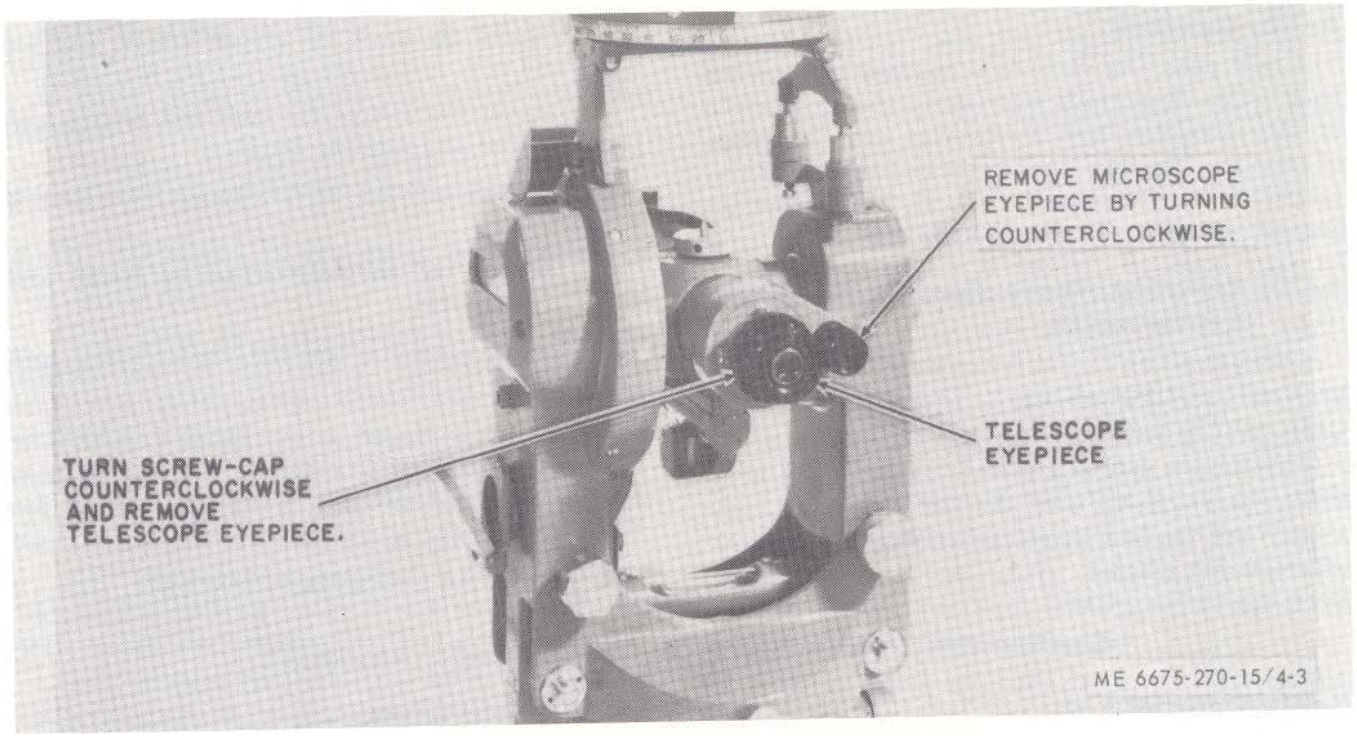


Figure 4-3. Telescope and microscope eyepieces, removal and installation.

4-26. Installation

a. Telescope and Microscope Eyepieces. Refer to figure 4-3 and install the telescope and microscope eyepieces.

b. Eyepiece Prisms and Sunglass. Refer to paragraph 2-3 and install the eyepiece prisms and sunglass.

Section X. MAINTENANCE OF TRIBRACH ASSEMBLY

4-27. General

The tribrach assembly consists of the tribrach, leveling screw, and base plate assemblies. Together they enable the operator quickly and accurately, to secure the theodolite to, and remove it from, the preleveled base which remains attached to the tripod head. By using the tribrach assembly, the operator can shift the instrument back and forth between established stations, as when closing a traverse, without having to level or realine the theodolite each time it is moved.

4-28. Removal

Refer to figure 4-4 and remove the tribrach assembly.

4-29. Cleaning, Inspection, and Replacement

a. Brush all dirt, dust, and foreign matter from the tribrach components. Wipe all surfaces clean with a soft, lint-free cloth moistened with a cleaning solvent. Clean all bearing surfaces on which the tapered locking wedges ride.

b. Inspect the tribrach, base plate, and spring plate for cracks and breaks. Inspect the leveling screws for proper operation. They should turn smoothly and evenly, and yet require a moderate amount of force exerted by thumb and forefinger to turn without backlash. Lubricate bearing surfaces sparingly before assembling the tribrach assembly.

c. Replace a defective tribrach assembly, and adjust the circular levels (para 2-9).

4-30. Installation

Refer to figure 44 and install the tribrach assembly.

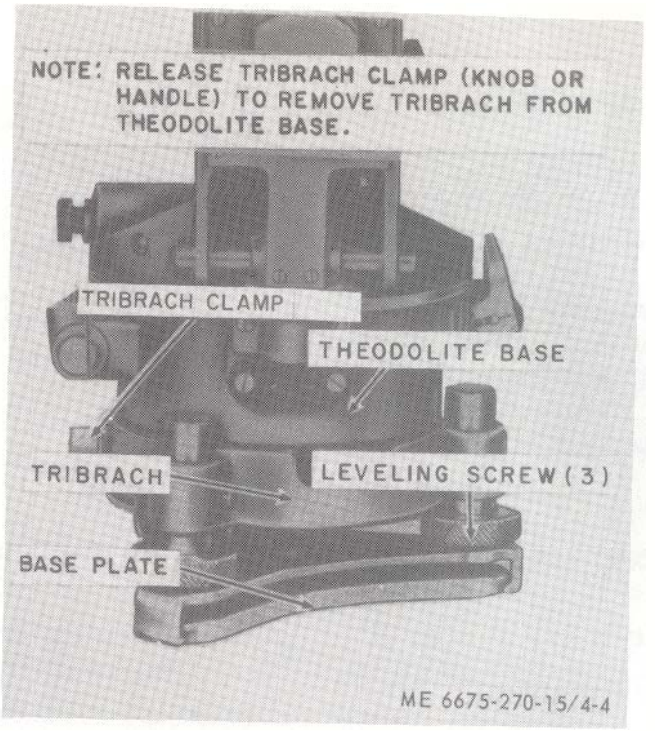


Figure 4-4. Tribrach assembly, removal and installation.

Section XI. MAINTENANCE OF ILLUMINATION MIRROR ASSEMBLY

4-3 1 ¢ General

The rotatable illumination mirror *assembly* is used to reflect available natural light through the illuminating prisms within the theodolite and onto the reading circles. At night and on dark days it is replaceable by the electrical illumination lamp.

4-32. Removal

Refer to figure 4-5 and remove the illumination mirror assembly.

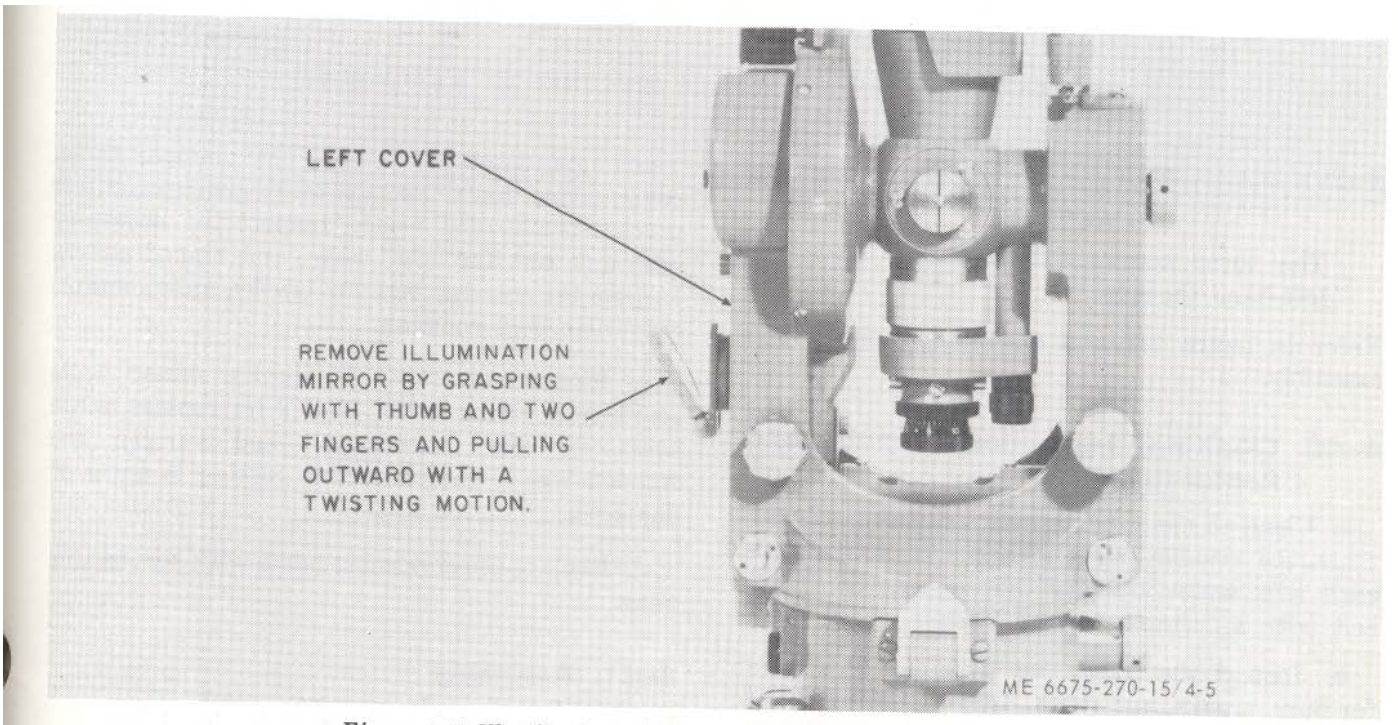


Figure 4–5. Illumination mirror assembly, removal and installation.

4-33. Cleaning, Inspection, and Replacement

a. Clean the metal parts with a soft cloth moistened with a cleaning solvent. If dusty, clean the mirror with a camel-hair brush or, if foggy, with a chamois cloth.

b. Inspect the hinge action for stiff or loose movement. It should remain in the position where placed. Inspect the push-fit mirror mounting for too tight or too loose fit, distortion, and other damage. Oil the hinge sparingly if needed, and wipe off all excess oil. Inspect for a cracked or broken mirror.

c. Replace a defective illumination mirror assembly.

4-34. Installation

Refer to figure 4-5 and install the illumination mirror assembly by grouping with thumb and two fingers and pushing inward with a twisting motion.

Section XII. MAINTENANCE OF TELESCOPE LEVEL ASSEMBLY

NOTE

The telescope level assembly is applicable to the models T16-MIL68 and T16-68DEG only.

4-35. General

The telescope level provides a means for positioning the telescope in a true horizontal position. The telescope level reading prism can be rotated so that the level bubble can be seen when the telescope is reversed 180°.

4-36. Removal

Refer to figure 4-6 and remove the telescope level assembly.

4-37. Cleaning, Inspection and Replacement

a. Clean the metal parts with a cloth moistened with a cleaning solvent. Clean the prism and vial window with a soft, clean cloth moistened with grain alcohol or acetone.

b. Inspect the vial and prism for cracks, chips, and etching.

c. Replace a defective telescope level assembly.

4-38. Installation

Refer to figure 4-6 and install the telescope level assembly.

Section XIII. MAINTENANCE OF TRIPOD ASSEMBLY

4-39. Disassembly

CAUTION

The three screws (11, fig. 4-7) have left-hand threads.

Refer to figure 4-7 and disassemble the tripod assembly.

440. Cleaning, Inspection, Repair, and Replacement

a. Clean all metal parts with a cleaning solvent. Clean the wooden parts with a soft cloth moistened with water and dry thoroughly. Clean the belt with a suitable leather cleaner.

b. Inspect the tripod leg housings and cover for burs, cracks, and wear. Inspect the head and bridge for bends, burs, cracks, breaks, scratches, wear, and damage. Inspect the clamps, shoes, cover fixing plate, and battery box bracket for cracks, bends, and wear. Inspect the accessory case and belt for cuts, wear, and ripped seams. Inspect the wooden legs for cracks, splits, splinters, wear, and warping.

c. Remove all burs. Straighten minor dents and bends. Refer to TM 10-269 for repairs to the accessory case. Sandpaper and varnish the wooden legs if the protective coating is worn or damaged.

d. Replace unserviceable parts with serviceable ones.

4-41. Assembly

Refer to figure 4-7 and assemble the tripod.

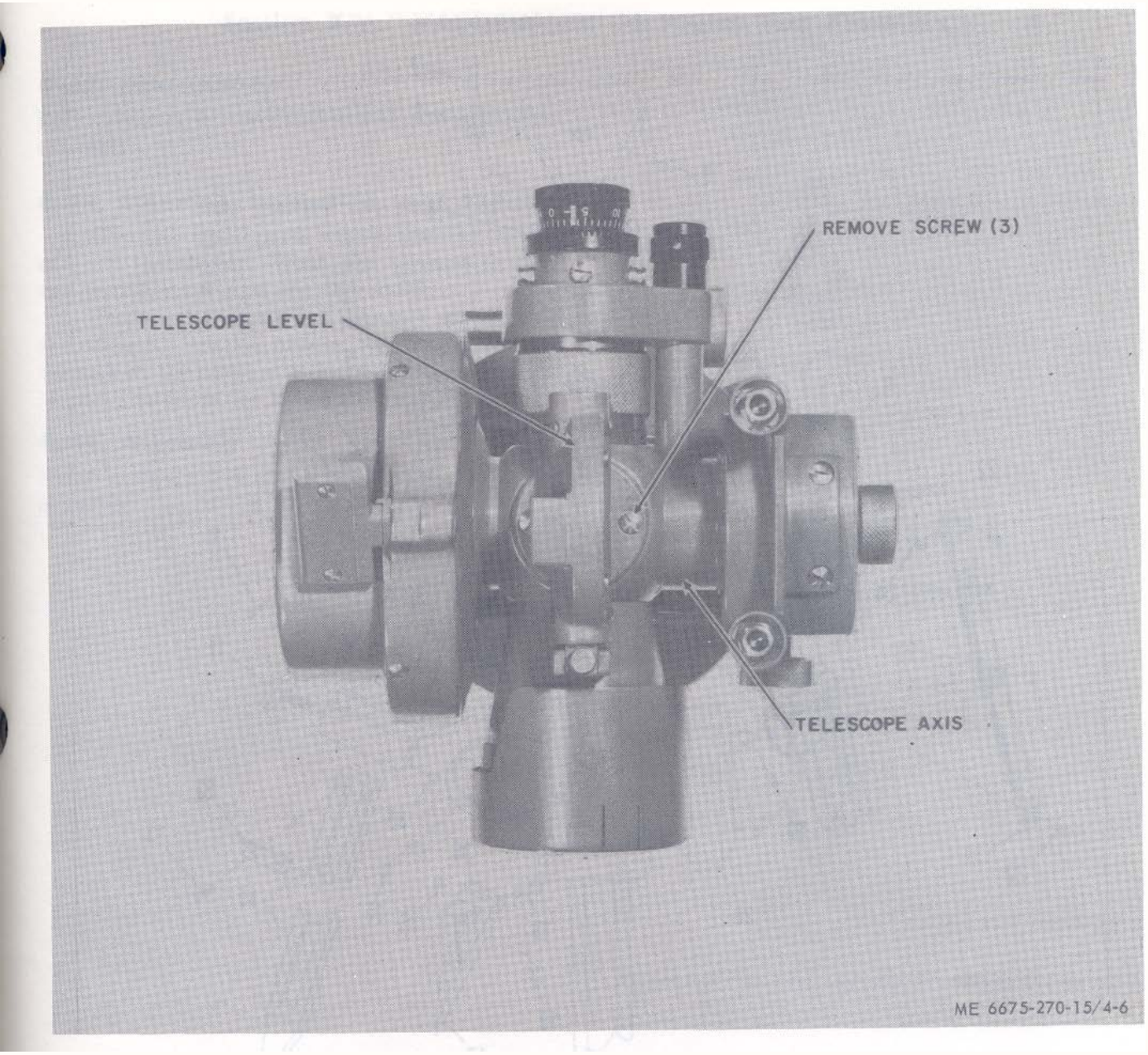
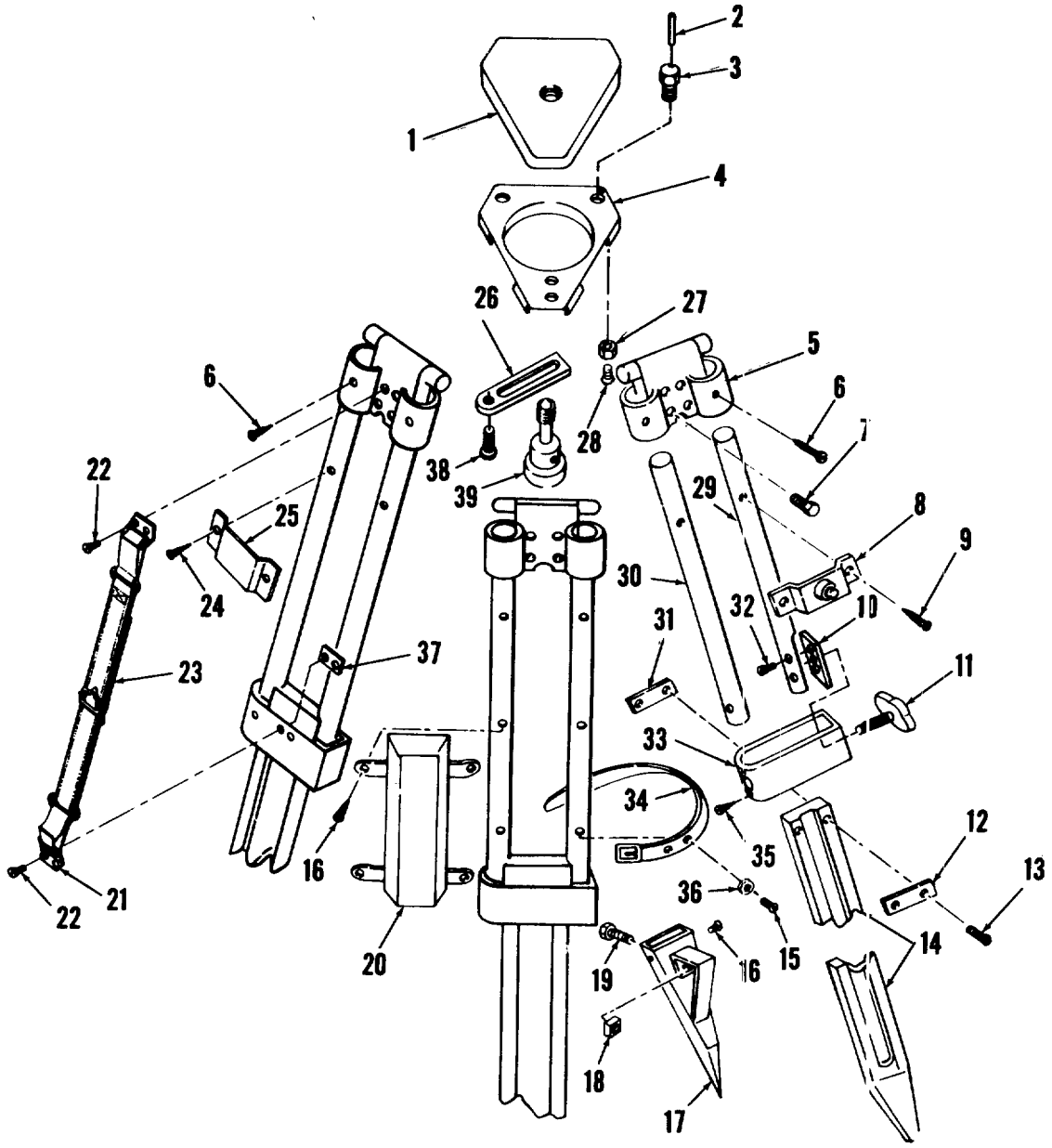


Figure 4-6. Telescope level assembly, removal and installation.



1	Cover	14	Leg (3)	27	Nut (3)
2	Pin (3)	15	Machine screw (2)	28	Machine screw (3)
3	Bolt (3)	16	Machine screw (10)	29	Wood leg (3)
4	Plate	17	Shoe (3)	30	Wood leg (3)
5	Leg housing (3)	18	Nut (3)	31	Stop plate (3)
6	Machine screw (6)	19	Bolt (3)	32	Machine screw (6)
7	Bolt (6)	20	Accessory case	33	Leg clamp (3)
8	Bracket cap	21	Bracket (2)	34	Leather strap
9	Machine screw (2)	22	Machine screw (4)	35	Machine screw (12)
10	Plate (3)	23	Carrying strap	36	Washer (2)
11	Wing screw (3)	24	Machine screw (2)	37	Plate (2)
12	Stop plate (3)	25	Battery plate	38	Machine screw
13	Machine screw (6)	26	Flat washer	39	Screw

Figure 4–7. Tripod assembly, disassembly and assembly.

Section XIV. MAINTENANCE OF PLUMB BOB ASSEMBLY

4-42. Disassembly

Refer to figure 4-8 and disassemble the plumb bob assembly.

4-43. Cleaning, Inspection, and Repair

a. Clean all metal parts with a cleaning solvent and dry thoroughly. Wash the cords with soap and water; rinse and dry thoroughly.

b. Inspect the plumb bob, bayonet socket, ring and slide for cracks, breaks, and wear. Inspect the lugs on the bayonet socket for burs and bends. Inspect the cords for knots and fraying.

4-44. Assembly

Refer to figure 4-8 and assemble the plumb bob assembly.

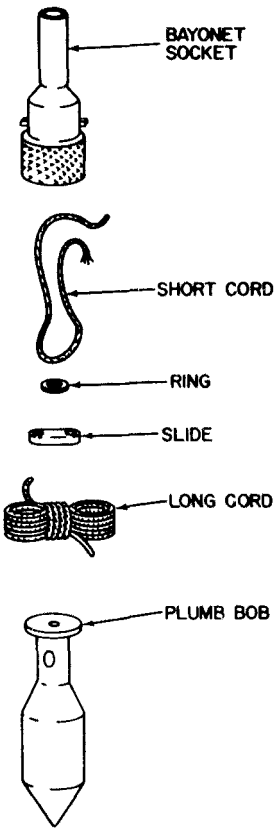


Figure 4-8. Plumb bob assembly, disassemble and assembly.

Section XV. MAINTENANCE OF TRIPOD WRENCH

4-45. General

The tripod wrench (fig. 2-4) is stored in a pocket of the tripod accessory case. It has wing lugs for turning with thumb and forefinger. The hexagonal socket fits the 12 mm metric nuts and screw heads used on the tripod. The wrench is used to tighten or loosen the nuts and capscrews that hold major components of the tripod together.

4-46. Cleaning, Inspection, Repair, and Replacement

a. Clean all dust, dirt, and foreign matter from the wrench with a cleaning solvent and dry thoroughly.

b. Inspect the wing lugs for burs, bends, breaks and other damage. Inspect the hex socket for burs and distortion. Inspect the protective coating for scratches, chipping, and wear.

c. Remove all burs. Straighten a slightly bent wing lug. Repaint the wrench as needed.

d. Replace an unserviceable wrench with a serviceable one.

Section XVI. MAINTENANCE OF BATTERY BOX

4-47. Inspection

Refer to paragraph 2-1e and inspect the battery box.

4-48. Replacement

Replace an unserviceable battery box with a serviceable one.

Section XVII. MAINTENANCE OF ACCESSORY CASE

4-49. Inspection

Refer to paragraph 2-1d and inspect the accessory case.

4-50. Repair and Replacement

a. Refer to TM 10-269 and repair the accessory case.

b. Replace an unserviceable accessory case with a serviceable one.

CHAPTER 5

DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

5-1. Tools and Equipment

Tools, equipment, and repair parts issued with or authorized for the theodolite are listed in the basic issue items list, appendix C.

5-2. Special Tools and Equipment

a. No commercially available special tools or equipment are required for direct support, general support, and depot maintenance of the theodolite.

b. The specially designed tools shown in figure 5-1 and listed in table 5-1 are for direct support, general support, and depot maintenance personnel performing major overhaul work on the theodolite. These specially designed tools are not available for issue but must be fabricated by qualified direct support, general support, and depot maintenance personnel.

Table 5-1. Specially Designed Tools

Item	Reference		Use
	Figure	Paragraph	
Adjustable spanner wrench.	5-1	5-12	Remove horizontal circle housing.
		5-14	Remove mirror axis nut.
		5-19	Remove clamp pins.
		5-34	Remove 90° prism sleeve and bracket.
Assembly tool.	6-1	6-2	Remove compass window lockring.

5-3. Maintenance Repair Parts

Repair parts and equipment are listed and illustrated in TM 5-6675-270-25P.

Section II. TROUBLESHOOTING

5-4. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the theodolite and its components.

5-5. Troubleshooting

Malfunctions which may occur are listed in table 5-2. Each malfunction stated is followed by a list of probable causes of the trouble. The corrective action recommended is described opposite the probable cause.

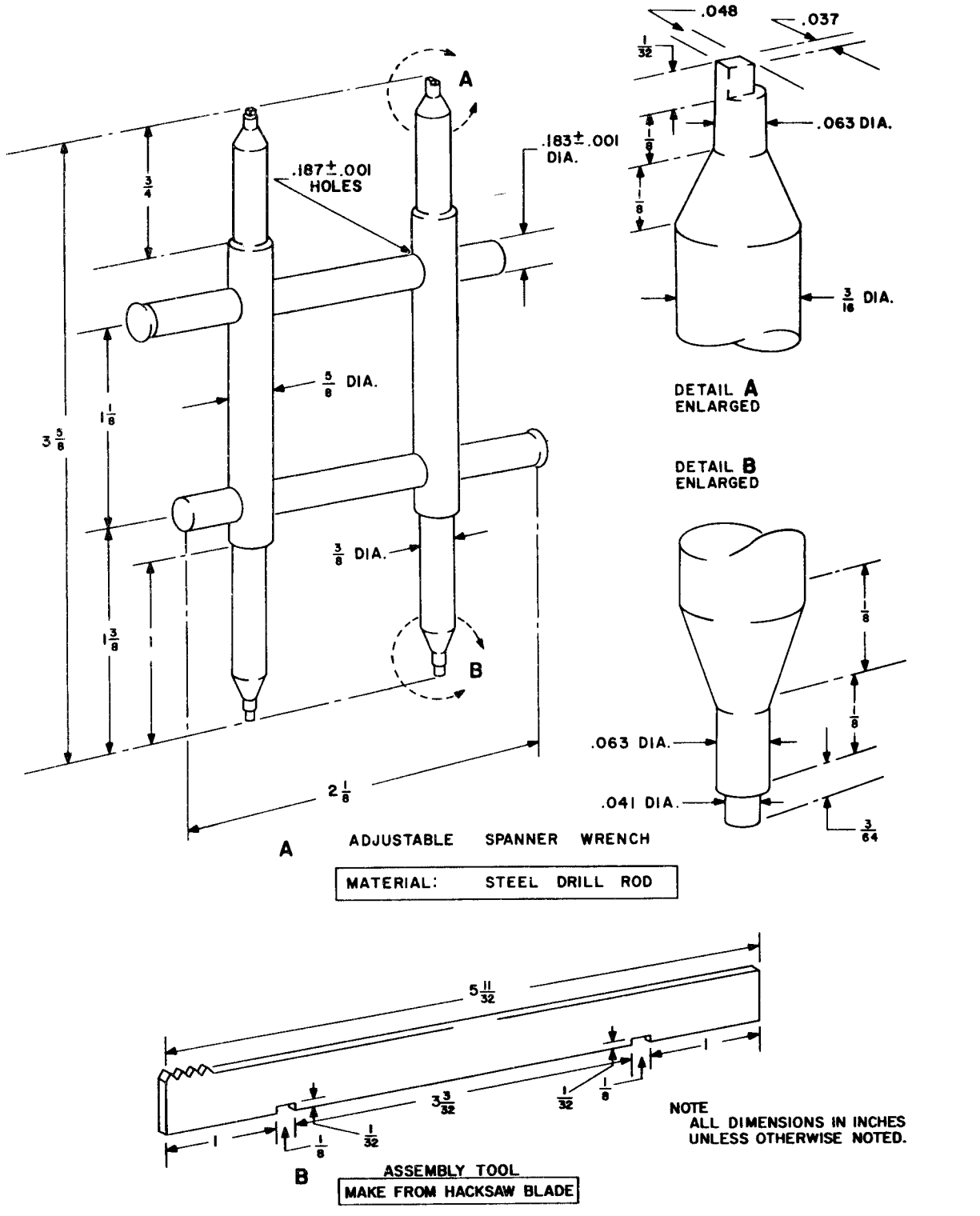


Figure 5-1. Specilly designed tools.

Table 5-2. *Troubleshooting*

Malfumtioo	Probable cause	Corrective action
L Compass circle will not balance or rotate freely.	a. Circle weights defective.	*a.* Replace weights (para 6-2).
	b. Worn or damaged needle bearing.	*b.* Replace needle bearing (para 6-2).
	c. Compass base defective.	*c.* Replace base (para 6-2).
	d. Circle lifter spring damaged.	*d.* Replace lifter spring (para 6-2).
2. Compass housing will not rotate on compass base.	*a.* Compass housing defective.	*a.* Replace housing (para 6-2).
	b. Compass base defective.	*b.* Replace base (para 6-2).
3. Compass reference mark not clearly visible or out of focus.	*a.* Reading prism dirty or defective.	*a.* Clean or replace reading prism (para 6-2).
	b. Eyepiece lens defective.	*b.* Replace eyepiece lens (para 6-2).
4. Compass will not seat properly on compass bridge.	*a.* Compass bridge bent.	*a.* Replace bridge (para 6-2).
	b. Compass leg pins or knob worn or damaged.	*b.* Replace leg pins or knob (para 6-2).
	c. Compass leg defective.	*c.* Replace leg (para 6-2).
5. Theodolite will not seat properly on tripod head.	*a.* Base plate defective.	*a.* Replace base plate (para 6-6).
	b. Base plate nut defective.	*b.* Replace nut (para 6-6).
6. Telescope will not stay on line.	*a.* Vertical travel off line.	*a.* Replace telescope axis bearing (para 6-122).
	b. Telescope axis defective.	*b.* Replace axis (para 6-122).
7. Circular level bubble does not stay in line.	*a.* Vial loose in mount.	*a.* Cement vial (para 6-6).
	b. Level vial defective.	*b.* Replace level vial (para 6-6).
8. Vertical collimation level bubble does not stay in center.	*a.* Vial holding screws loose.	*a.* Tighten screw(s) (para 6-74).
	b. Vertical collimation level loose.	*b.* Adjust and tighten screws (para 6-74, 2-9).
	c. Level vial defective.	*c.* Replace level vial (para 6-74).
	d. Spring sticking.	*d.* Clean spring (para 6-74, 6-75).
9. Plate level bubble does not stay in center.	*a.* Leveling screws loose or worn.	*a.* Tighten or replace leveling screws (para 6-54).
	b. Level vial defective.	*b.* Replace level vial (para 6-54).
10. Field of vision not clear.	*a.* Objective lens dirty or defective.	*a.* Disassemble and clean or replace lenses (para 6-118).
	b. Focus lens defective.	*b.* Replace focus lens (para 6-118).
	c. Reticle lens defective.	*c.* Replace reticle lens (para 6-118).
11. Light on vertical circle unequal or absent.	Combination prism and lens assembly dirty or defective.	Clean or replace combination prism and lens assembly (para 6-102, 6-103).
12. Light on horizontal circle unequal or absent.	Horizontal illumination prism dirty or defective.	Clean or replace prism (para 6-102, 6-103).
13. Horizontal circle graduations not at right angles to line dividing the two images.	Horizontal circle prism defective.	Replace prism (para 6-22).
14. Illumination system faulty.	*a.* Faulty contact between horizontal circle housing and inner base housing.	*a.* Clean spring contact and inspect housing plug (para 6-30, 6-31).
	b. Cable and connector contact pins faulty.	*b.* Repair or replace cable and pins (para 6-139).
	c. Battery box rheostat or contacts defective.	*c.* Repair or replace battery box (para 6-130).
15. Horizontal circle hard to move.	*a.* Outer vertical axis worn or damaged.	*a.* Replace axis (para 6-38).
	b. Ball bearing, dirty, dry, or defective.	*b.* Clean, lubricate or replace ball bearing (para 6-42, 6-43).
	c. Horizontal slow-motion screw defective.	*c.* Repair or replace slowmotion screw (para 6-26).

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIES

5-6. Compass and Compass Bracket Assembly

a. Removal. Refer to figure 5-2 and remove the compass and compass bracket assembly from the U-frame.

b. Installation. Refer to figure 5-2 and install the compass and compass bracket assembly.

c. Adjustment. Refer to paragraph 2-9 and adjust the compass.

5-7. Collimation Lever Cover and Collimation Level Mirror

a. Removal. Refer to figure 5-3 and remove the collimation level cover and collimation level mirror.

b. Installation. Refer to figure 5-3 and install the collimation level cover and collimation level mirror.

5-8. Illumination Mirror Assembly and Reticle Mirror Assembly

a. Removal. Refer to figure 5-3 and remove the illumination mirror and reticle mirror assemblies.

b. Installation. Refer to figure 5-3 and install the illumination and reticle mirror assemblies.

5-9. Horizontal Circle Clamp Assembly

a. Removal. Refer to figure 5-4 and remove the horizontal circle clamp assembly.

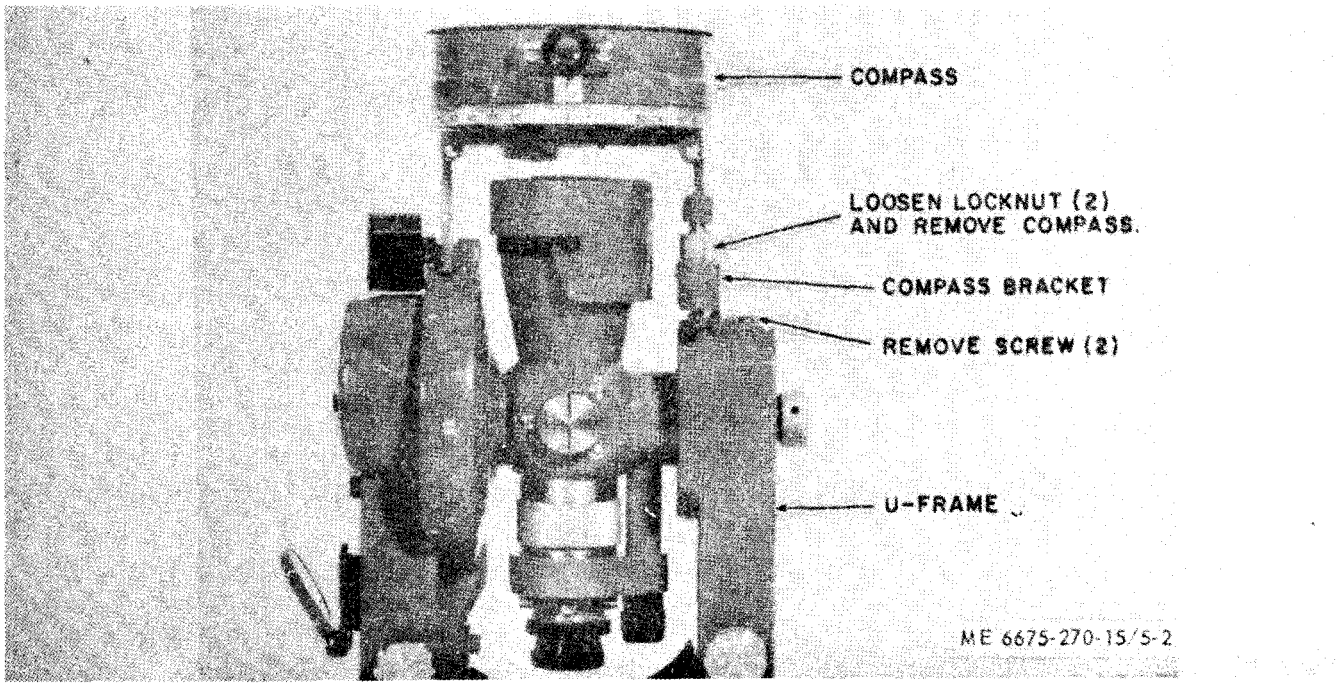
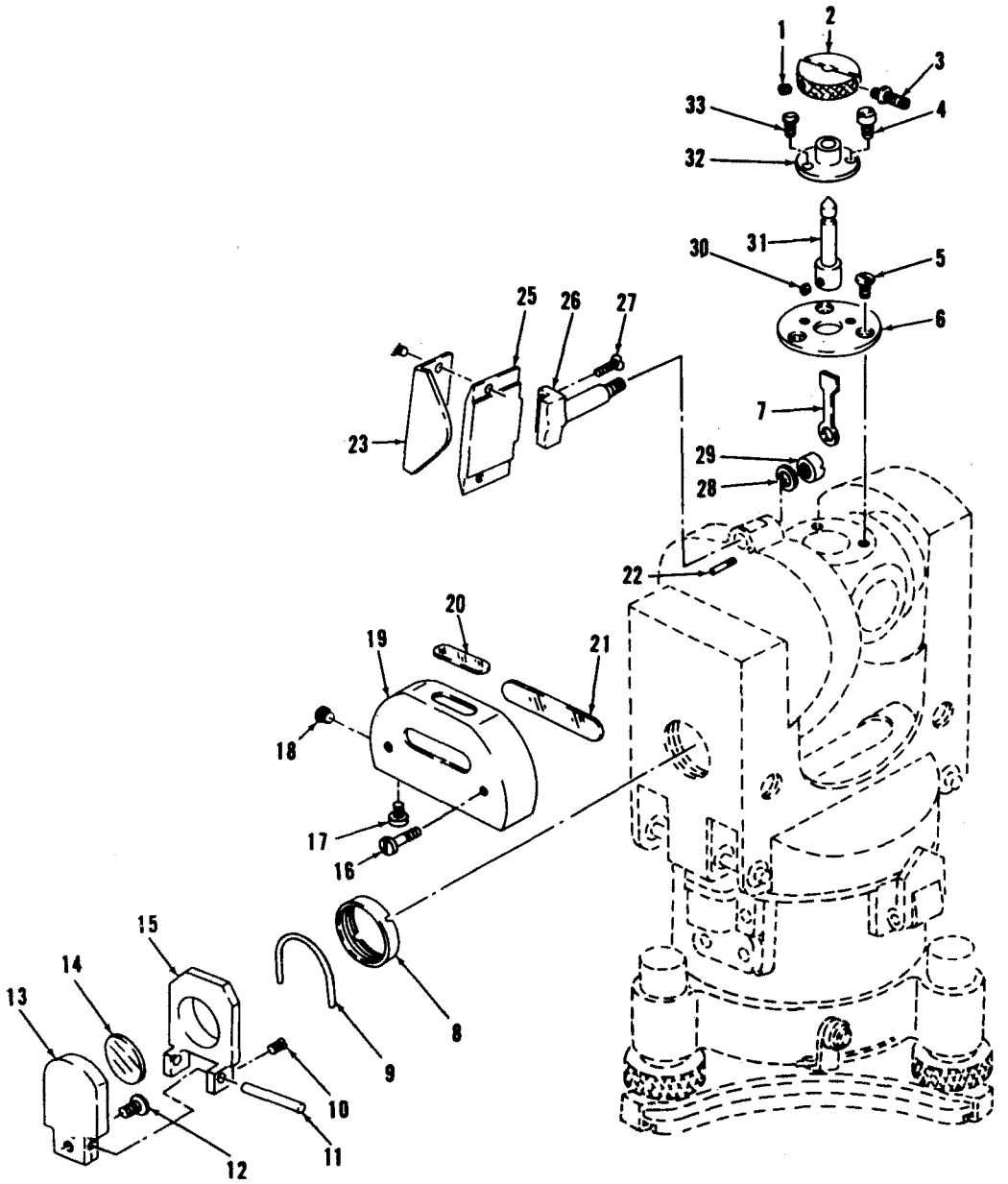


Figure 5-2. Compass and compass bracket assembly, removal and installation.



1 Setscrew (2)
2 Knob
3 Bolt
4 Machine screw
5 Machine screw (3)
6 Cover plate
7 Reticle mirror
8 Ring cover
9 Spring
10 Setscrew
11 Pin
12 Machine screw
13 Mirror housing
14 Illumination mirror
15 Bracket
16 Screw (2 rqr)
17 Setscrew (2 rqr)
18 Screw cover
19 Collimation level cover
20 Side window
21 Upper window
22 Machine screw
23 Angle bracket
24 Machine screw (2 rqr)
25 Collimation level mirror
26 Mirror axis
27 Machine screw (2 rqr)
28 Washer
29 Nut
30 Setscrew
31 Mirror axis
32 Bushing
33 Machine screw

Figure 5-3. Collimation level cover, collimation level mirror, and illumination mirror and reticle mirror assemblies; removal, disassembly, assembly, and installation.

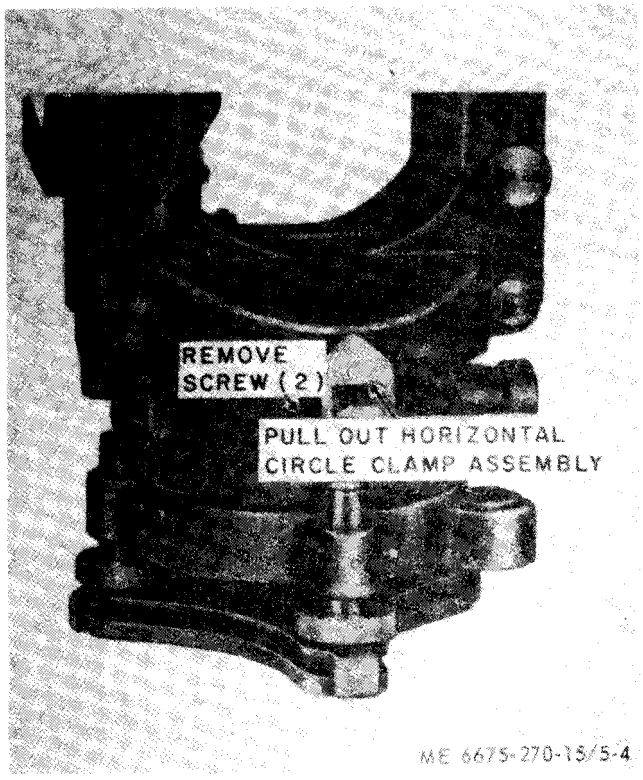


Figure 5-4. Horizontal circle clamp assembly, remeval and installation.

b. Installation. Refer to figure 5-4 and install the horizontal circle clamp assembly.

5-10. Horizontal Circle Prism Assembly

a. Removal. Refer to figure 5-5 and remove the horizontal circle prism assembly.

b. Installation. Refer to figure 5-5 and install the horizontal circle prism assembly.

5-11. Horizontal Slowmotion Screw Assembly

a. Removal. Refer to figure 5-6 and remove the horizontal slowmotion screw assembly.

b.Installation. Refer to figure 5-6 and install the horizontal slowmotion screw assembly.

c. Adjustment. Adjust the horizontal slowmotion screw (para 2-9).

5-12. Horizontal Circle Housing and Inner Base

a. Removal.

(1) Remove the tribrach assembly (para 4-28).

(2) Remove the horizontal circle clamp assembly (para 5-9).

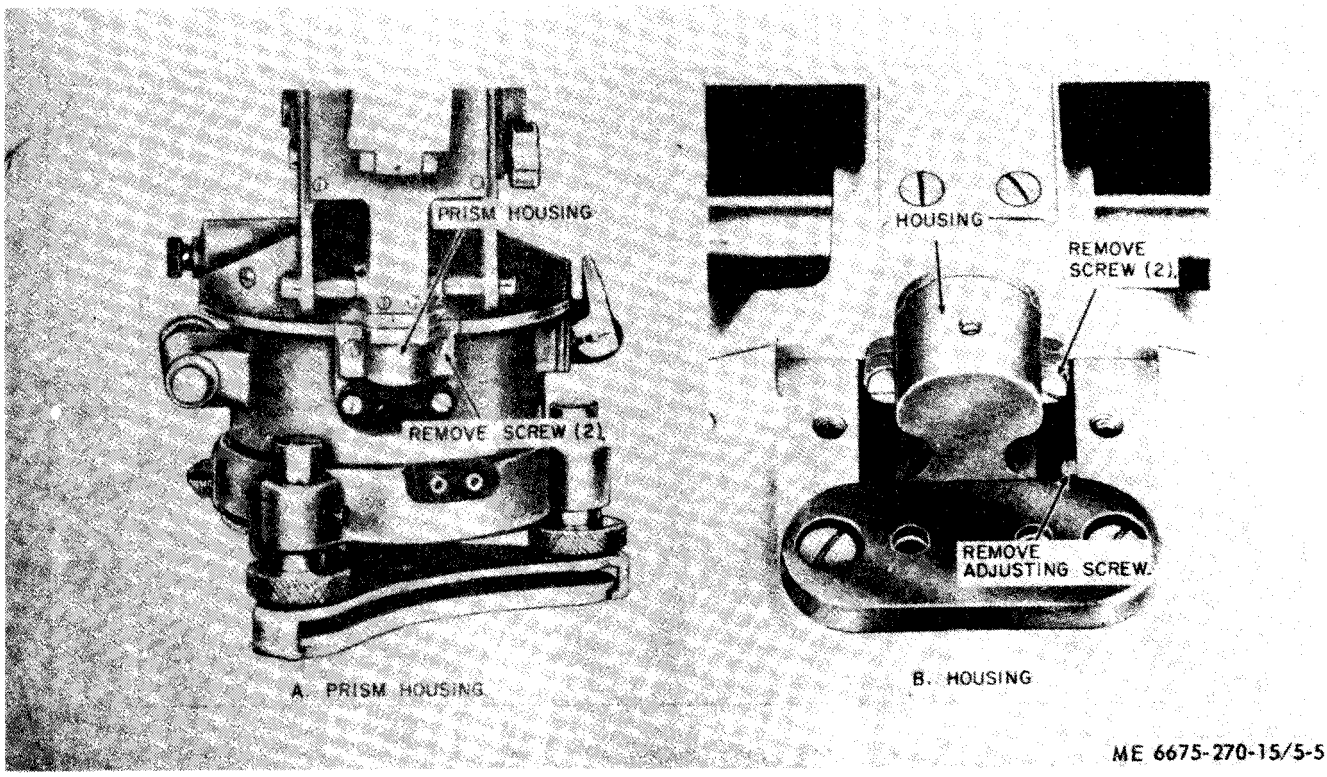
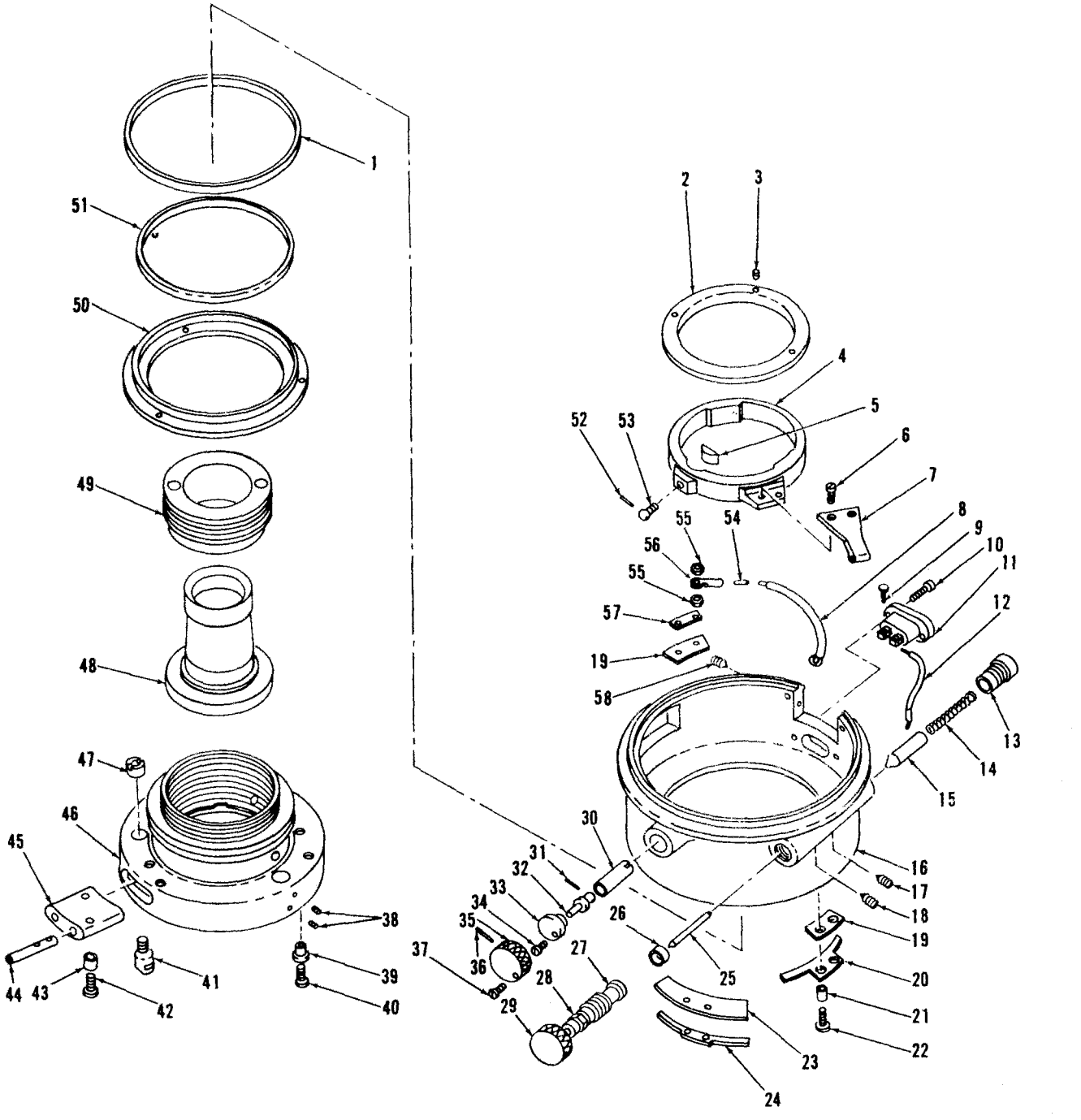


Figure 5-5. Horizontal circle prism assembly, removal and installation.



1	Contact ring	13	Housing	25	Pin	37	Machine screw	48	Sleeve bushing
2	Ring clamp	14	Spring	26	Round nut	38	Setscrew (6)	49	Lockring
3	Setscrew	15	Detent plunger	27	Screw subassembly	39	Insulator bushing	50	Insulator ring
4	Horizontal clamp	16	Lower housing	28	Nut	40	Machine screw (4)	51	Contact ring
5	Clamp shoe	17	Setscrew	29	Knob	41	Foot spike (3)	52	Pin
6	Machine screw (2)	18	Setscrew (4)	30	Spacer	42	Machine screw (2)	53	Lock bolt
7	Connector plate	19	Plate insulator	31	Pin	43	Insulator heating (2)	54	Nut
8	Cable	20	Contact spring	32	Axis	44	Contact bushing (2)	55	Nut
9	Machine screw (2)	21	Insulator bushing	33	Sleeve	45	Plug	56	Connector
10	Machine screw (2)	22	Machine screw	34	Machine screw	46	Inner base	57	Contact plate
11	Plug	23	Insulator plate	35	Knob	47	Round nut (3)	58	Setscrew (2)
12	Cable	24	Contact spring	36	Pin				

Figure 5-6. Horizontal clamp, horizontal slowmotion screw, horizontal circle housing and inner base housing assemblies; removal, disassembly, assembly, and installation.

(3) Remove the horizontal circle prism assembly (para 5-10).

(4) Refer to figure 5-7 and remove the horizontal circle housing and inner base as a unit.

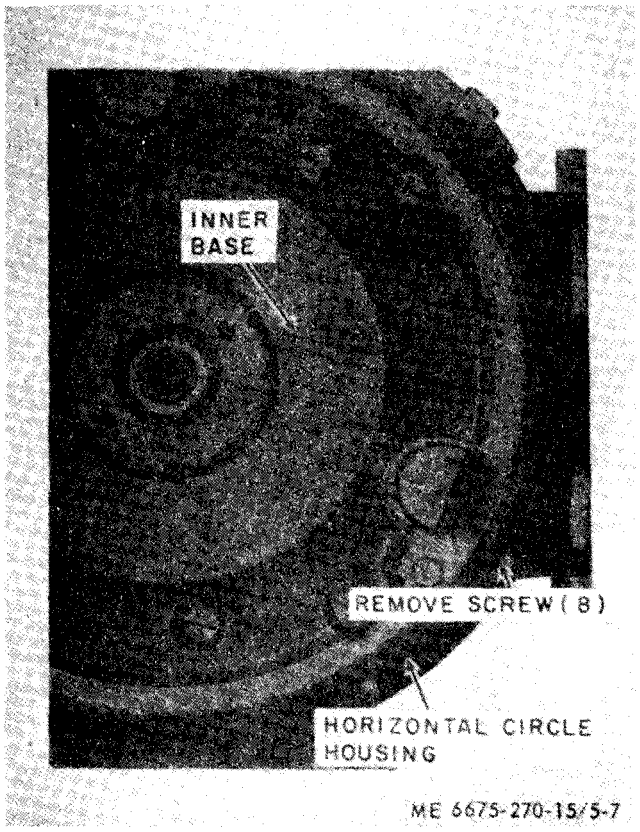


Figure 5-7. Horizontal circle housing and inner base, removal and installation.

b. Installation.

(1) Refer to figure 5-7 and install the horizontal circle housing and inner base as a unit.

(2) Install the horizontal circle prism assembly (para 5-10).

(3) Install the horizontal circle clamp assembly (para 5-19).

(4) Install the tribrach assembly (para 4-30).

5-13. Horizontal Clamp Assembly

a. Removal

(1) Remove the horizontal circle housing (para 5-12).

(2) Refer to figure 5-6 and remove the horizontal clamp assembly.

b. Installation.

(1) Refer to figure 5-6 and install the horizontal clamp assembly.

(2) Install the horizontal circle housing (para 5-12).

5-14. Horizontal Circle Assembly and Outer Vertical Axis

a. Removal.

(1) Remove the horizontal circle housing (para 5-12).

(2) Refer to figure 5-8 and remove the horizontal circle assembly and outer vertical axis as a unit.

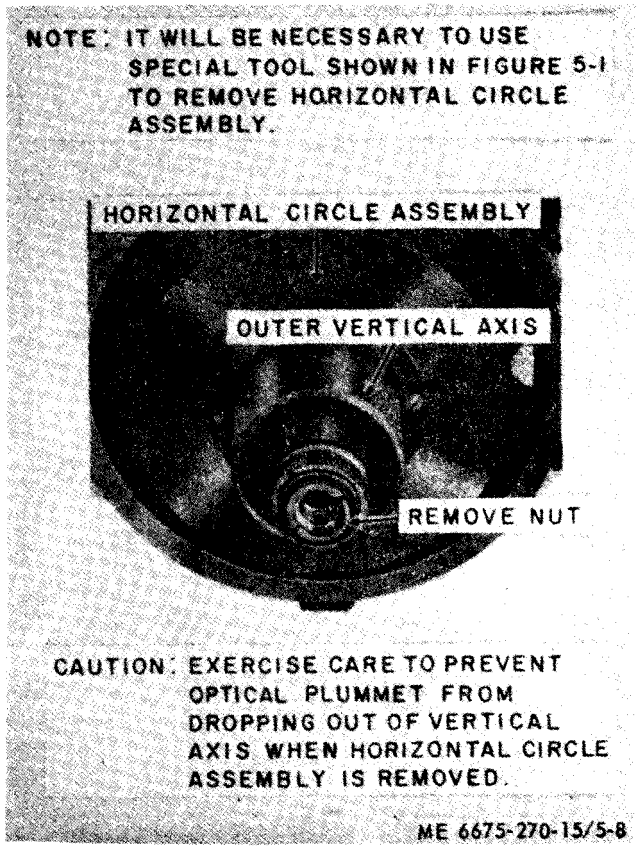


Figure 5-8. Horizontal circle assembly and outer vertical axis, removal and installation.

b. Installation.

(1) Refer to figure 5-8 and install the horizontal circle assembly and outer vertical axis.

(2) Install the horizontal circle housing (para 5-12).

5-15. Optical Plummet

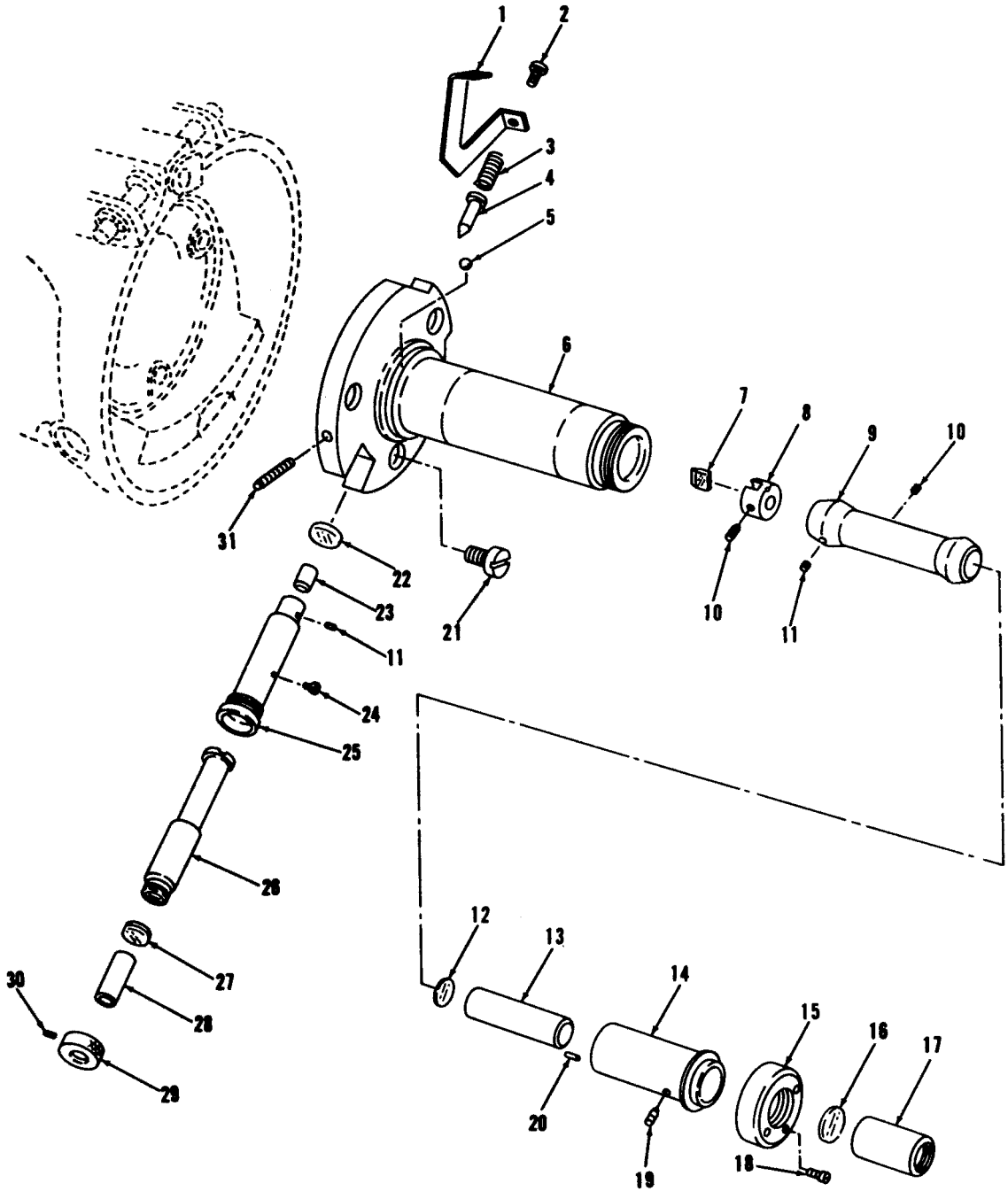
a. Removal.

(1) Remove the horizontal circle assembly (para 5-14).

(2) Refer to figure 5-9 and remove the optical plummet.

b. Installation.

(1) Refer to figure 5-9 and install the optical plummet.



ME 6675-270-15/5-9

1	Axis plate	9	Prism holder	17	Lens mount	25	Tube
2	Machine screw (2)	10	Setscrew (2)	18	Machine screw	26	Tube
3	Spring	11	Setscrew	19	Setscrew	27	Lens assembly
4	Detent plunger	12	Optical reticle	20	Pin	28	Sleeve spacer
5	Ball set, bearing	13	Sleeve mount	21	Machine screw (3)	29	Locking ring
6	Inner vertical axis	14	Sleeve spacer	22	Lens	30	Setscrew
7	Prism	15	Round nut	23	Lens housing	31	Machine screw (2)
8	Prism housing	16	Lens	24	Machine screw		

Figure 5-9. Optical plummet and eyepiece assembly and inner vertical axis; removal, disassembly, assembly, and installation.

(2) Install the horizontal circle assembly (para 5-14).

5-16. Optical Plummet Eyepiece Assembly

a. Removal. Refer to figure 5-9 and remove the optical plummet eyepiece assembly.

b. Installation. Refer to figure 5-9 and install the optical plummet eyepiece assembly.

c. Adjustment. Adjust the optical plummet (para 2-9).

5-17. Inner Vertical Axis

a. Removal.

(1) Remove the horizontal circle assembly (para 5-14).

(2) Remove the optical plummet (para 5-15).

(3) Remove the optical plummet eyepiece assembly (para 5-16).

(4) Refer to figure 5-9 and remove the inner vertical axis.

b. Installation.

(1) Refer to figure 5-9 and install the inner vertical axis.

(2) Install the optical plummet eyepiece assembly (para 5-16).

(3) Install the optical plummet (para 5-15).

(4) Install the horizontal circle assembly (para 5-14).

5-18. Plate Level Assembly

a. Removal. Refer to figure 5-10 and remove the plate level assembly.

b. Installation. Refer to figure 5-10 and install the plate level assembly.

c. Adjustment. Adjust the plate level (para 2-9).

5-19. Clamp Pins

a. Removal. Refer to figure 5-11 and remove the clamp pins.

b. Installation. Refer to figure 5-11 and install the clamp pins.

5-20. Right-Side Support Cover

a. Removal. Refer to figure 5-12 and remove the right-side support cover.

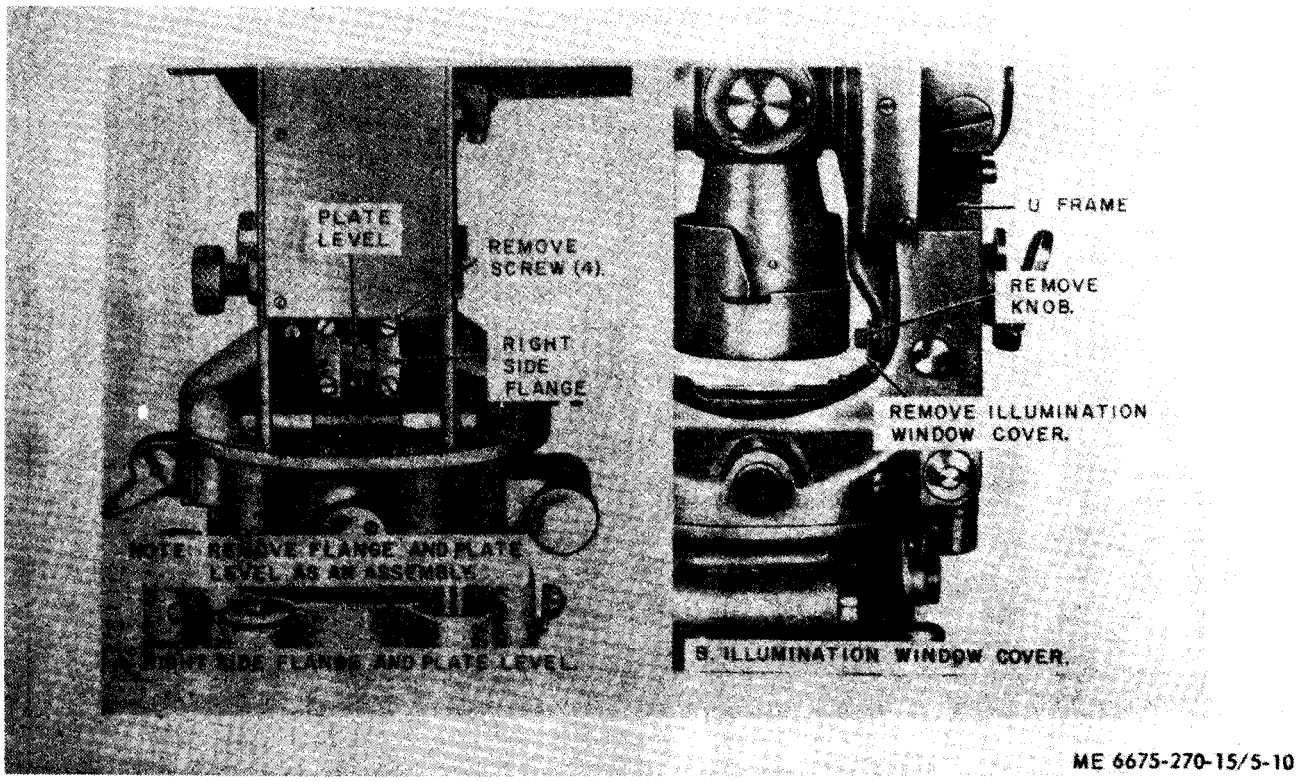


Figure 5-10. Plate level assembly, removal and installation.

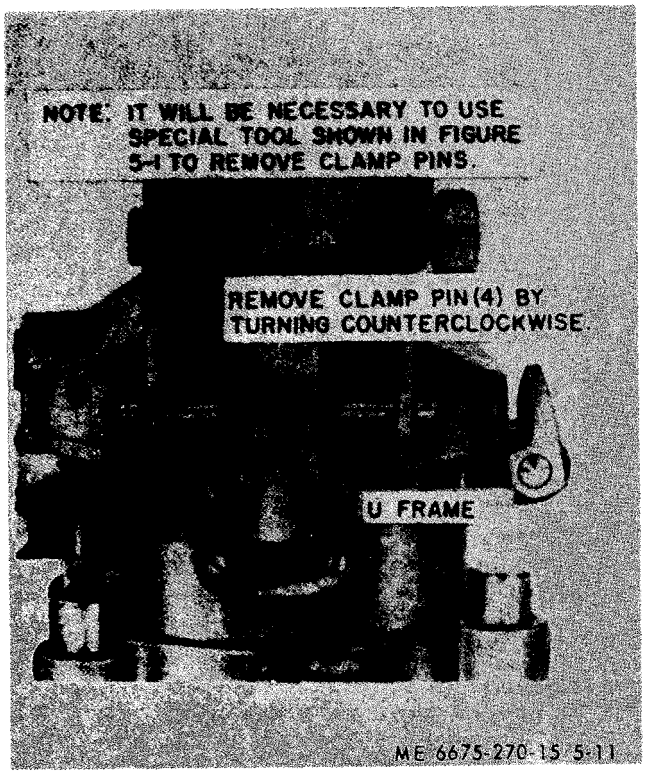


Figure 5-11. Clamp pins, removal and installation.

b. Installation. Refer to figure 5-12 and install the right-side support cover.

5-21. Vertical Clamp Assembly

a. Removal.

(1) Remove the right-side support cover (para 5-20).

(2) Refer to figure 5-12 and remove the vertical clamp assembly.

b. Installation.

(1) Refer to figure 5-12 and install the vertical clamp assembly.

(2) Install the right-side support cover (para 5-20).

5-22. Vertical Slowmotion Screw

a. Removal. Refer to figure 5-12 and remove the vertical slowmotion screw.

b. Installation. Refer to figure 5-12 and install the vertical slowmotion screw.

c. Adjustment. Adjust the vertical slowmotion screw (para 2-9).

5-23. Vertical Collimation Level Assembly

a. Removal.

(1) Remove the collimation level cover (para 5-7).

(2) Refer to figure 5-13 and remove the vertical collimation level assembly.

b. Installation.

(1) Refer to figure 5-13 and install the vertical collimation level assembly.

(2) Install the collimation level cover (para 5-7).

c. Adjustment. Adjust the collimation level para 2-9).

5-24. Left-Side Support Cover Assembiy

a. Removal.

(1) Remove the collimation level cover (para 5-7).

(2) Refer to figure 5-14 and remove the left-side support cover assembly.

b. Installation

(1) Refer to figure 5-14 and install the left-side support cover assembly.

(2) Install the collimation level cover (para 5-7).

5-25. Vertical Collimation Housing and Vertical Collimation Lever Assemblies

a. Removal.

(1) Remove the collimation level mirror (para 5-7).

(2) Remove the left-side support cover (para 5-24).

(3) Remove the vertical collimation level assembly (para 5-23).

(4) Remove the collimation slowmotion screw assembly (para 5-27).

(5) Refer to figure 5-15 and remove the vertical collimation housing and vertical collimation lever as an assembly.

b. Installation.

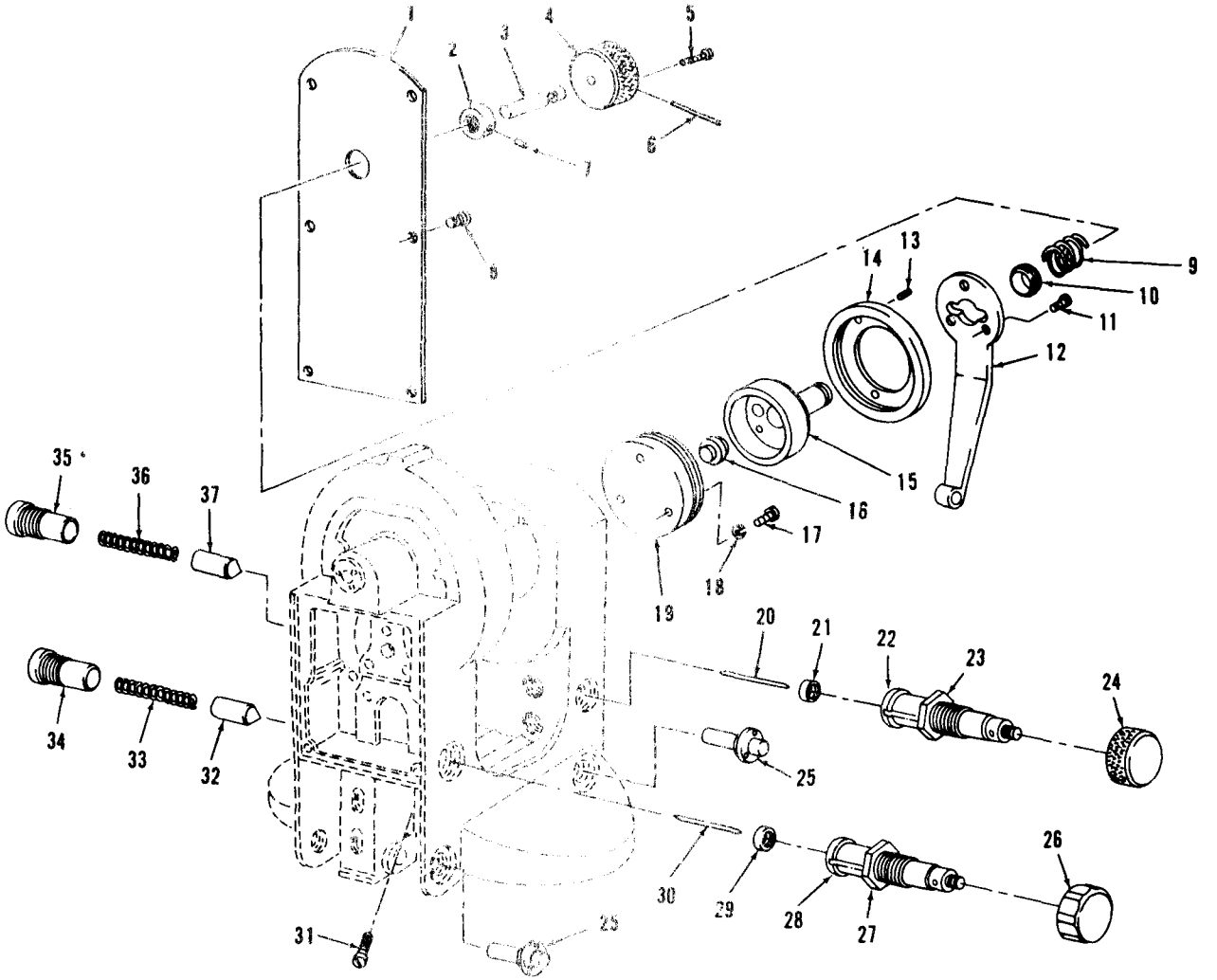
(1) Refer to figure 5-15 and install the vertical collimation housing and vertical collimation lever as an assembly.

(2) Install the collimation slowmotion screw (para 5-27).

(3) Install the vertical collimation level assembly (para 5-23).

(4) Install the left-side support cover (para 5-24).

(5) Install the collimation level mirror (para 5-7).



ME 6675-270-15/5-12

1 Right cover
2 Stop ring
3 Clamp screw
4 Knob
5 Machine screw
6 Pin
7 Setscrew (2)
8 Machine screw (6)
9 Spring (2)
10 Bushing
11 Machine screw (3)
12 Clamp lever
13 Setscrew (3)
14 Lockring
15 Sleeve
16 Clamp shoe
17 Machine screw (3)
18 Spring washer (3)
19 Clamp housing
20 Pin
21 Stop nut
22 Screw-nut assembly, vertical slowmotion
23 Nut
24 Knob
25 Support bolt (4)
26 Knob
27 Nut
28 Screw-nut assembly, collimation slowmotion
29 Stop nut
30 Pin
31 Adjusting screw (2)
32 Plunger
33 Spring
34 Spring housing
35 Spring housing
36 Spring
37 Plunger

Figure 5-12. Vertical clamp, vertical slowmotion screw, collimation slowmotion screw, and right cover; removal, disassembly, assembly, and installation.

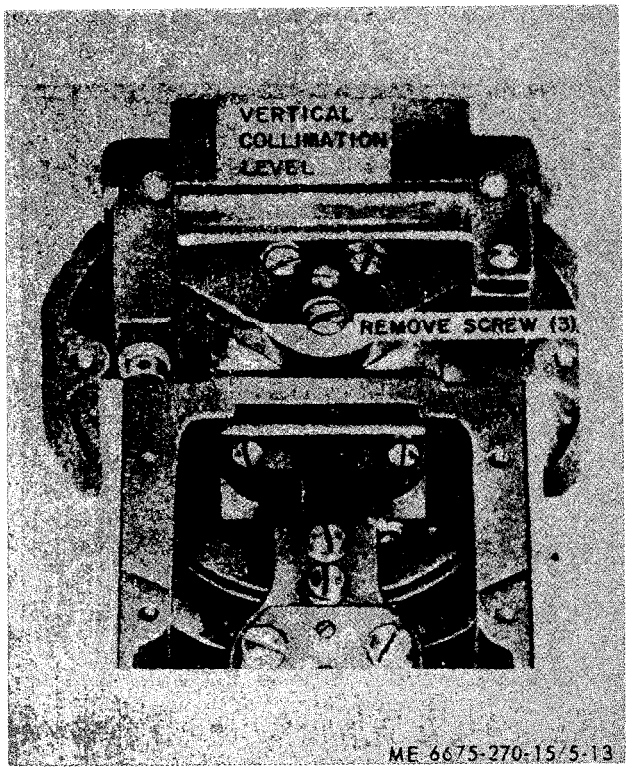
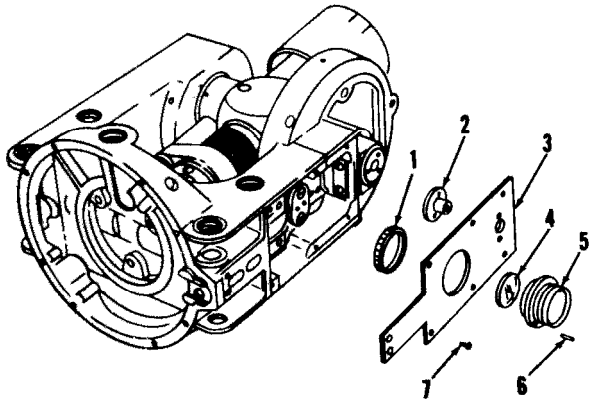


Figure 5–13. Vertical collimation level assembly, removal and installation.



1	Lockring	5	Illumination mirror housing
2	Flange	6	Setscrew
3	Left cover	7	Machine screw (10)
4	Glass window		

Figure 5-14. Left-side support cover assembly; removal, disassembly, assembly, and installation.

5-26. Vertical Circle Assembly

a. Removal.

(1) Remove the vertical collimation housing (para 5-25).

(2) Refer to figure 5-16 and remove the vertical circle assembly.

b. Installation.

(1) Refer to figure 5-16 and install the vertical circle assembly.

(2) Install the vertical collimation housing (para 5-25).

5-27. Collimation Slowmotion Screw Assembly

a. Removal. Refer to figure 5-12 and remove the collimation slowmotion screw assembly.

b. Installation. Refer to figure 5-12 and install the collimation slowmotion screw assembly.

c. Adjustment. Adjust the collimation slowmotion screw (para 2-9).

5-28. Reading Lens Assemblies

a. Removal.

(1) Remove the horizontal circle prism assembly (para 5-10).

(2) Remove the vertical collimation housing and vertical collimation lever assemblies (para 5-25).

(3) Refer to figure 5-17 and remove the reading lens assemblies.

b. Installation.

(1) Refer to figure 5-17 and install the reading lens assemblies.

(2) Install the vertical collimation housing and vertical collimation lever assemblies (para 5-25).

(3) Install the horizontal circle prism assembly (para 5-10).

5-29. Illumination Lens Assembly

a. Removal.

(1) Remove the horizontal circle assembly (para 5-14).

(2) Refer to figure 5-17 and remove the illumination lens assembly.

b. Installation.

(1) Refer to figure 5-17 and install the illumination lens assembly.

(2) Install the horizontal circle assembly (para 5-14).

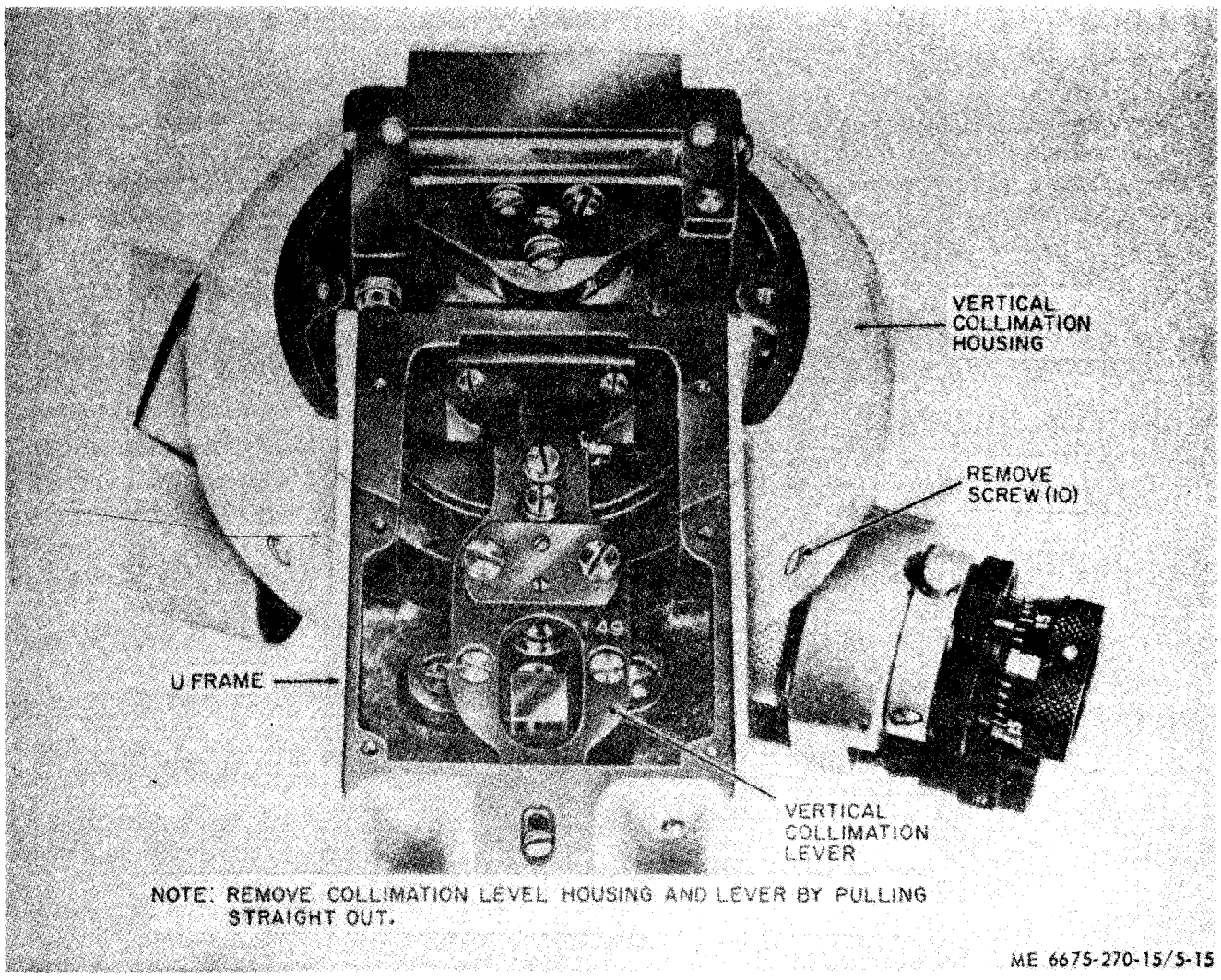


Figure 5-15. Vertical collimation housing and vertical collimation lever assemblies, removal and installation.

5-30. Combination Prism and Lens Assembly

a. Removal.

(1) Remove the vertical circle assembly (para 5-26).

(2) Refer to figure 5-17 and remove the combination prism and lens assembly.

b. Installation.

(1) Refer to figure 5-17 and install the combination prism and lens assembly.

(2) Install the vertical circle assembly (para 5-26).

5-31. Microscope Assembly

a. Removal. Refer to figure 5-18 and remove the microscope assembly.

b. Installation. Refer to figure 5-18 and install the microscope assembly.

5-32. Telescope Eyepiece and Reticle Assemblies

a. Removal.

(1) Remove the microscope assembly (para 5-31).

(2) Remove the telescope level assembly, if applicable (para 4-36).

(3) Refer to figure 5-19 and remove the telescope eyepiece and reticle assemblies.

b. Installation.

(1) Refer to figure 5-19 and install the telescope eyepiece and reticle assemblies.

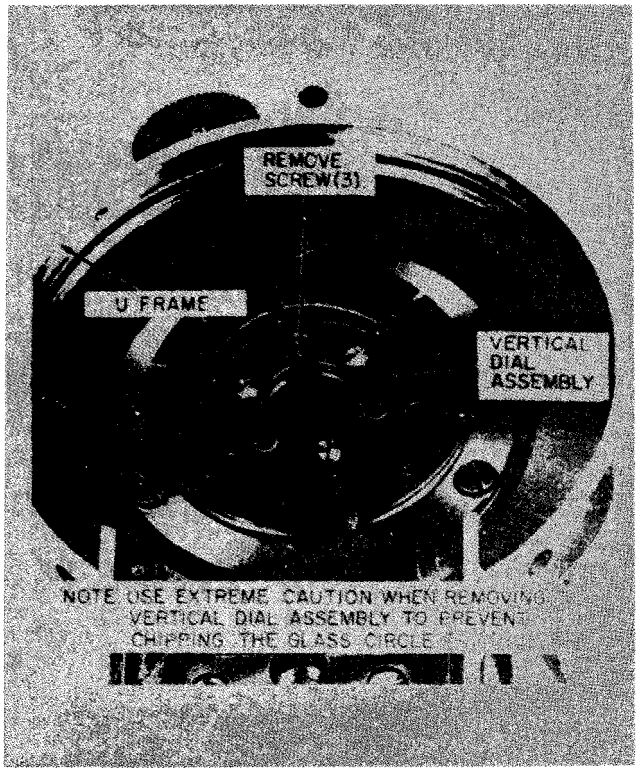


Figure 5-16. Vertical circle assembly, removal and installation.

(2) Install the telescope level assembly, if applicable (para 4-38).

(3) Install the microscope assembly (para 5-31).

c. Adjustment. Adjust the reticle to compensate for horizontal collimation error (para 2-9).

5-33. Telescope Focus and Objective Assemblies

a. Removal.

(1) Remove the telescope eyepiece and reticle assemblies (para 5-32).

(2) Refer to figure 5-20 or 5-21, as applicable, and remove the telescope focus and objective assemblies.

b. Installation

(1) Refer to figure 5-20 or 5-21, as applicable, and install the telescope focus and objective assemblies.

(2) Install the telescope eyepiece and reticle assemblies (para 5-32).

5-34. Telescope Axis and 90° Prism Assemblies

a. Removal.

(1) Remove the verticai clamp (para 5-21).

(2) Remove the vertical circle assembly (para 5-26).

(3) Remove the reticle mirror assembly (para 5-8).

(4) Remove the telescope focus and objective assemblies (para 5-33).

(5) Refer to figure 5-22 and remove the telescope axis and 90° prism assemblies from the U-frame.

NOTE

It will be necessary to use special tool shown in figure 5-1 to remove bracket (4, fig. 5-22).

b. Installation.

(1) Refer to figure 5-22 and install the telescope axis and 90° prism assemblies in the U-frame.

(2) Install the telescope focus and objective assemblies (para 5-33).

(3) Install the reticle mirror assembly (para 5-8).

(4) Install the verticle circle assembly (para 5-26).

(5) Install the verticle clamp (para 5-21).

5-35. U-Frame Assembly

a. Removal.

(1) Remove the compass bracket (para 5-6).

(2) Remove the inner vertical axis (para 5-17).

(3) Remove the telescope axis assembly (para 5-34).

(4) Remove the plate level assembly (para 5-18).

(5) Remove the reading lens assemblies (para 5-28).

(6) Remove the illumination lens assembly (para 5-29).

(7) Remove the clamp pins (para 5-19).

b. Installation

(1) Install the clamp pins (para 5-19).

(2) Install the illumination lens assembly (para 5-29).

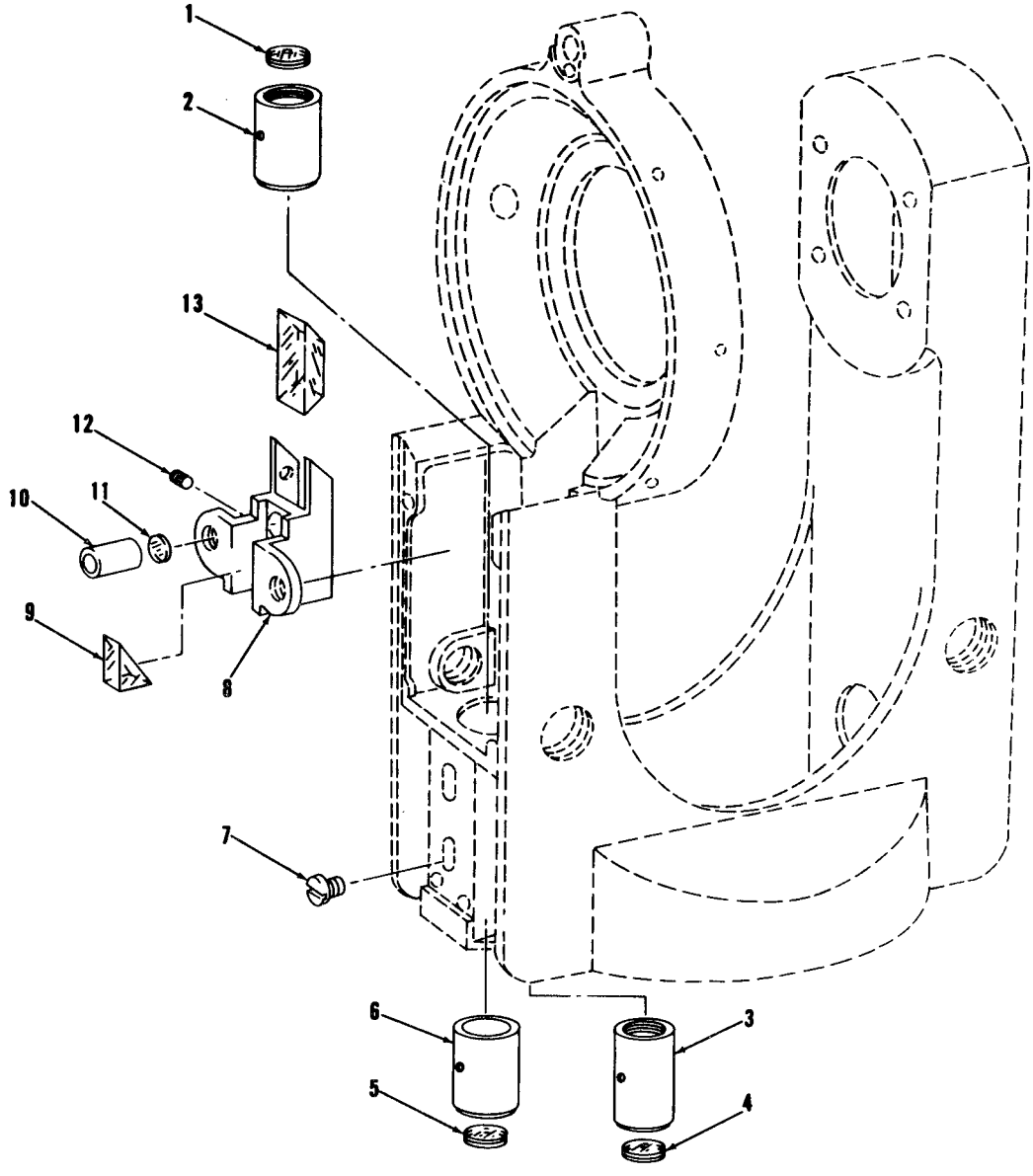
(3) Install the reading lens assemblies (para 5-28).

(4) Install the plate level assembly (para 5-18).

(5) Install the telescope axis assembly (para 5-34).

(6) Install the inner vertical axis (para 5-17).

(7) Install the compass bracket (para 5-6).



ME 6675-270-15/5-17

1 Upper reading lens
2 Lens housing
3 Lens housing
4 Illumination lens
5 Lower reading lens
6 Lens housing
7 Machine screw (2)
8 Prism and lens mount
9 Vertical circle illumination prism
10 Lens mount
11 Vertical circle illumination lens
12 Setscrew (3)
13 Vertical circle illumination prism

Figure 5-17. Reading lens, illumination lens, and combination prism and lens assemblies; removal, disassembly, assembly, and installation.

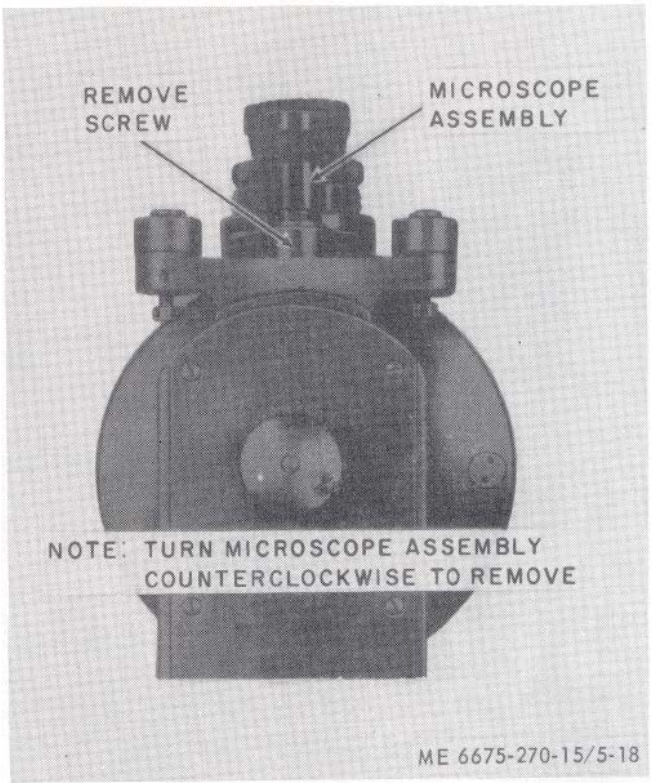


Figure 5-18. Microscope assembly, removal and installation.

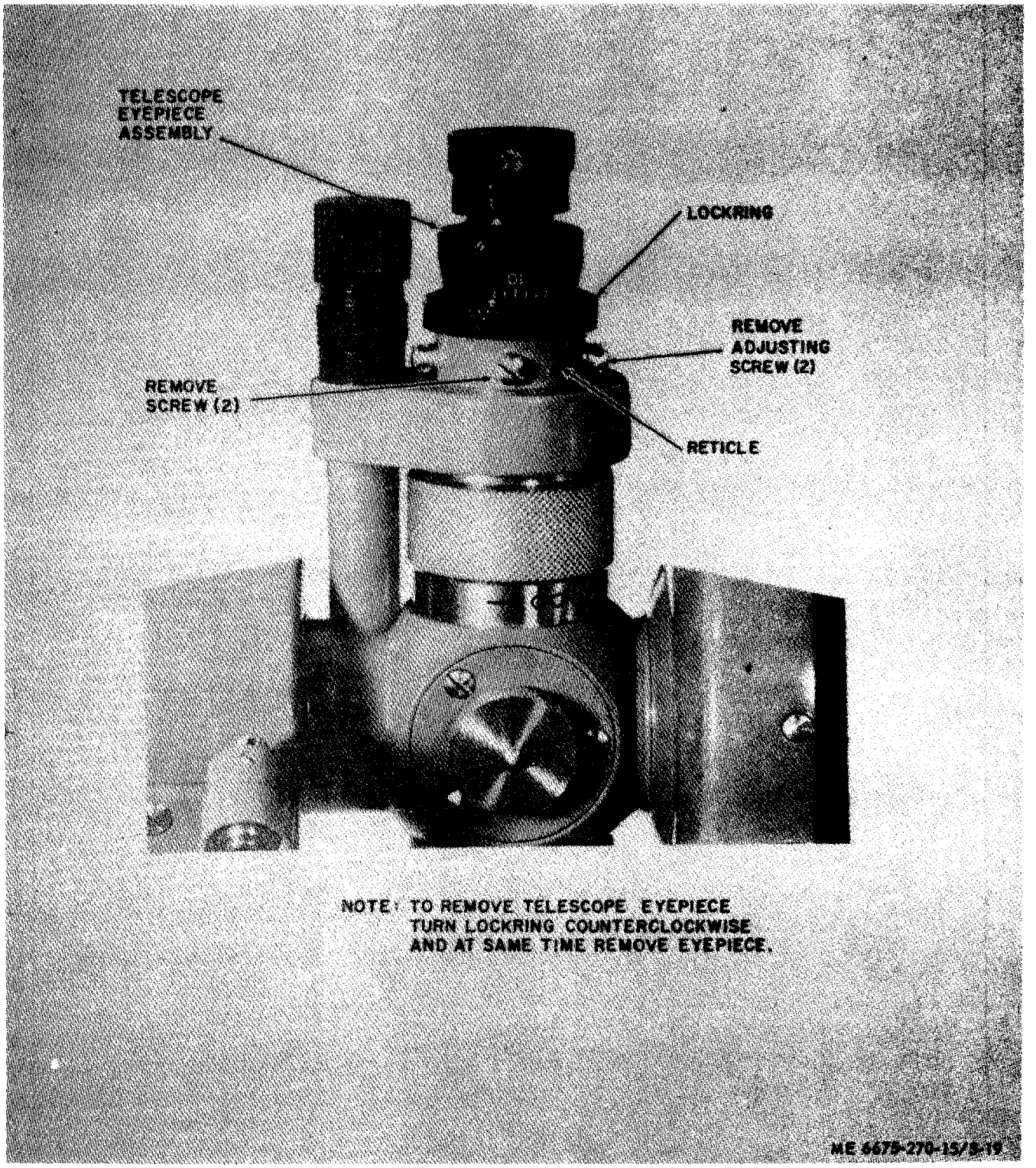


Figure 5-19. Telescope eyepiece and reticle assemblies, removal and installation.

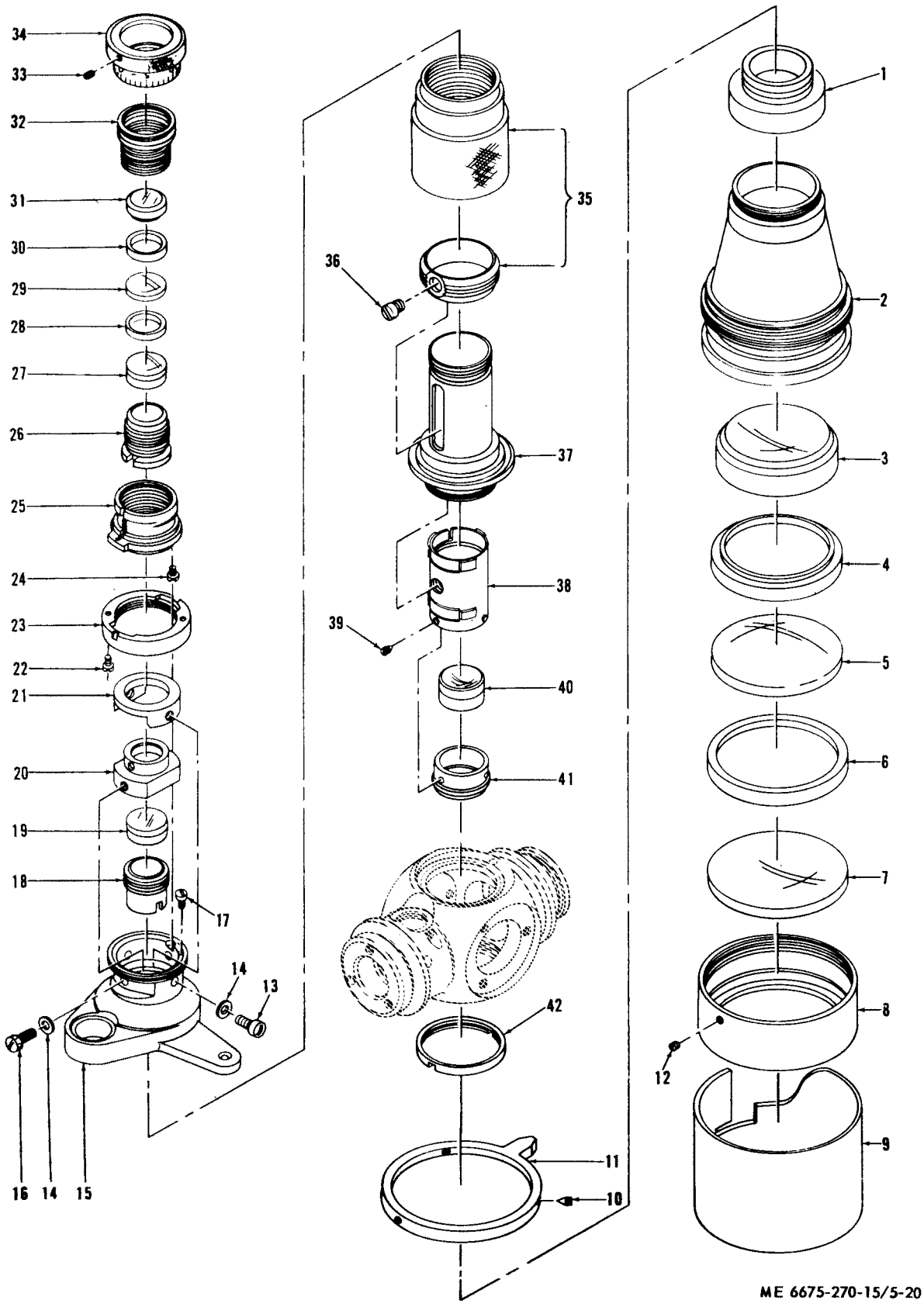


Figure 5-20. Telescope focus, objective, reticle, and eyepiece assemblies; removal, disassembly, assembly, and installation (Model T16-MIL66).

1 Spacer
2 Housing
3 Lens
4 Distance ring
5 Lens
6 Distance ring
7 Lens
8 Cap
9 Sunshade
10 Setscrew (3)
11 Key washer
12 Machine screw
13 Machine screw (2)
14 Washer (4)
15 Bracket
16 Machine screw
17 Machine screw
18 Lockring
19 Optical reticle
20 Housing
21 Sleeve
22 Machine screw
23 Lockring
24 Machine screw
25 Flange
26 Lens housing
27 Lens
28 Spacer
29 Lens
30 Spacer
31 Lens
32 Sleeve
33 Setscrew (3)
34 Scale dial
36 Focus drive
36 Setscrew
37 Tube
38 Sleeve
39 Setscrew (3)
40 Lens
41 Lens housing
42 Lockring

Figure 5-20. Telescope focus, objective, reticle, and eyepiece assemblies; removal, disassembly, assembly, and installation (Model T16-MIL66)- Continued

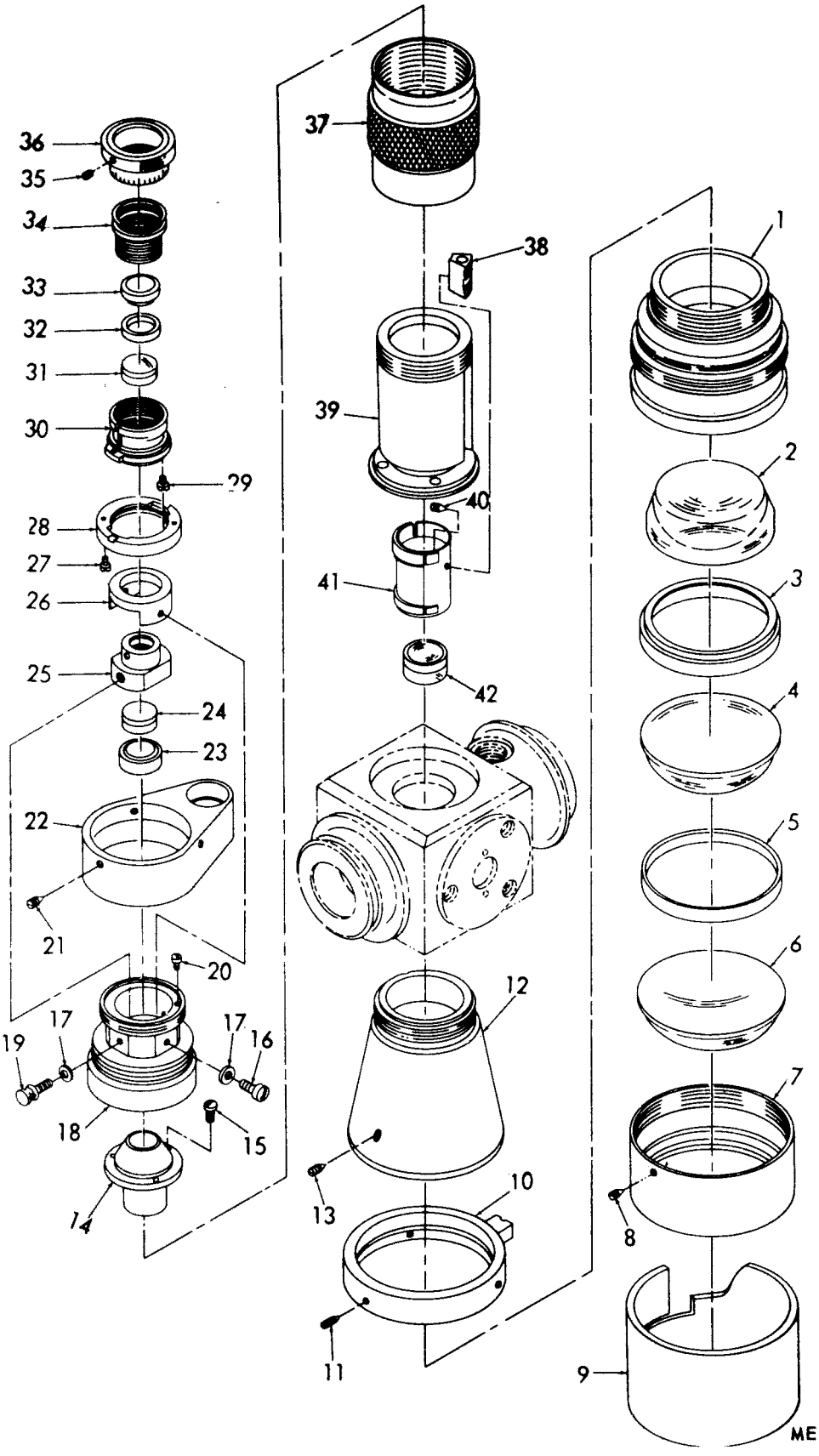
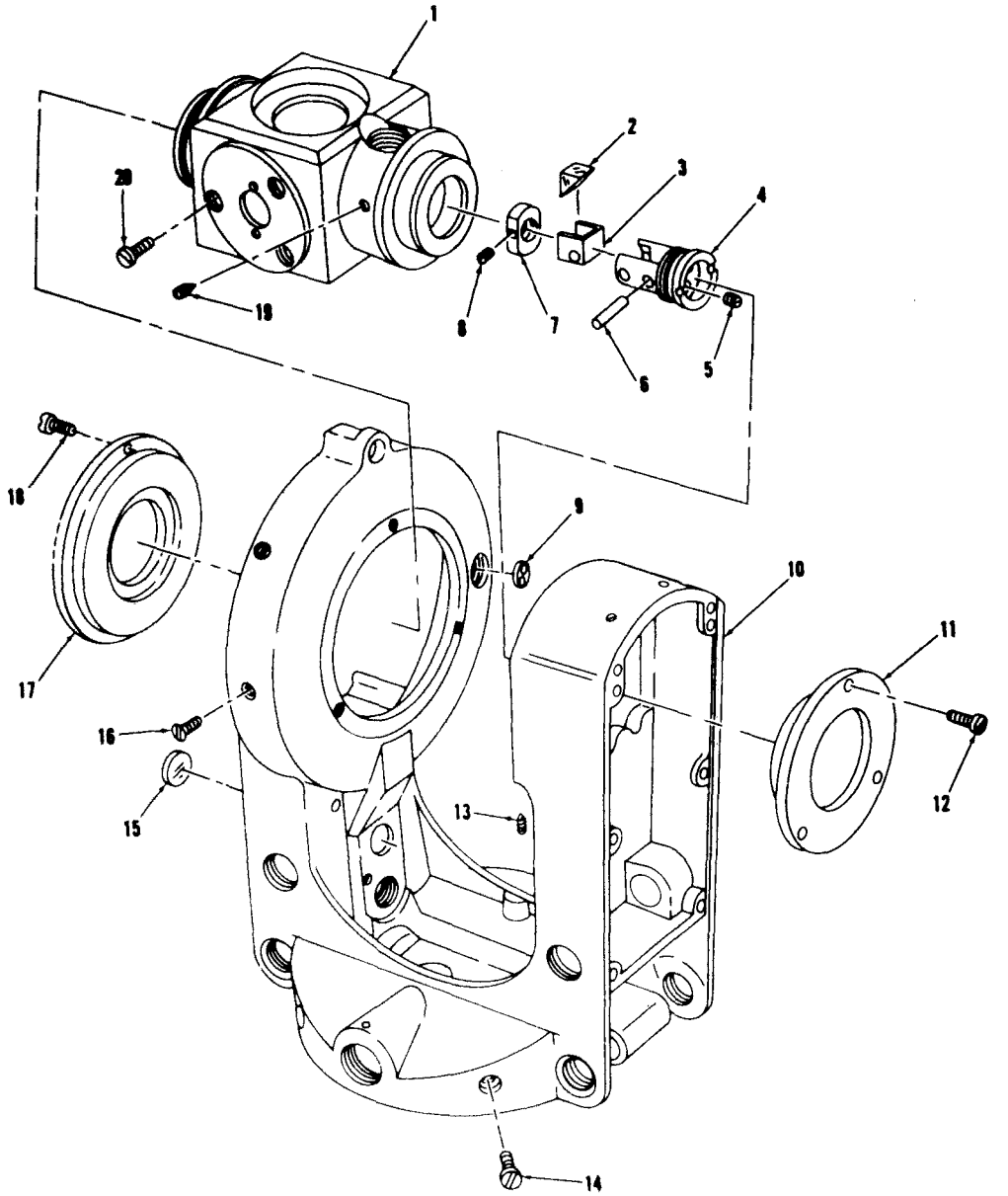


Figure 5-21. Telescope focus, objective, reticle, and eyepiece assemblies; removal, disassembly, assembly and installation (Models T16-MIL68 and T16-68DEG).

1 Housing
2 Lens
3 Distance ring
4 Lens
5 Distance ring
6 Lens
7 Cap
8 Setscrew
9 Sunshade
10 Key washer
11 Setscrew (3)
12 Housing
13 Setscrew
14 Counterweight
15 Machine screw (3)
16 Machine screw (2)
17 Washer (4)
18 Bracket
19 Machine screw (2)
20 Machine screw
21 Setscrew
22 Sleeve
23 Lockring
24 Lens
25 Housing
26 Sleeve
27 Machine screw
28 Lockring
29 Machine screw
30 Flange
31 Lens
32 Spacer
33 Lens
34 Sleeve
35 Setscrew (3)
36 Scale dial
37 Focus sleeve
38 Slide
39 Tube
40 Setscrew
41 Lens housing
42 Lens

Figure 5-21. Telescope f ecus, objective, reticle, and eyepiece assemblies; removal, disassembly, assembly and installation (Models T16-MIL68 and T16-68DEG)-Continued



1	Telescope axis	6	Pin	11	Bearing	16	Cover screw (2)
2	Prism	7	Mask	12	Machine screw (3)	17	Bearing
3	Prism housing	8	Machine screw	13	Setscrew (2)	18	Machine screw (3)
4	Bracket	9	Screw	14	Machine screw (2)	19	Setscrew (3)
5	Setscrew (2)	10	U-frame	15	Window	20	Machine screw (2)

Figure 5-22. Telescope axis, 90° prism, and U-frame assemblies; removal, disassembly, assembly and installation.

CHAPTER 6

REPAIR INSTRUCTIONS

Section I. COMPASS AND COMPASS BRACKET ASSEMBLY

6-1. General

The compass, provided with the theodolite, enables the operator to rapidly orient the target with magnetic north.

6-2. Disassembly

a. Remove the compass from the theodolite (para 5-6).

b. Refer to figure 6-1 and disassemble the compass and compass bracket assembly.

NOTE

It will be necessary to use special tool shown in figure 5-1 to remove locking ring (40, fig. 6-1).

6-3. Cleaning, Inspection and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean and polish the prism and lens with lens tissue moistened in grain alcohol or acetone. Clean the window with an approved glass cleaner. Brush all threaded surfaces free of dirt and foreign matter.

b. Inspection. Inspect all threaded surfaces for damage or wear. Inspect the compass base, housing, and compass legs for bends, breaks, dents, or burs. Inspect the needle bearing for excessive wear. Inspect the prism and lens for cracks, chips, or breaks.

c. Repair. Chase all threaded parts having minor thread damage. Smooth out burs. Replace unserviceable parts with serviceable ones.

6-4. Assembly

a. Refer to figure 6-1 and assemble the compass bracket assembly.

b. Install the compass on the theodolite (para 5-6).

Section II. TRIBRACH ASSEMBLY

6-5. General

The tribrach, leveling screw, and base plate assembly form a leveling base between the bottom of the theodolite and the tripod head. The tribrach contains the circular level, which shows whether the tribrach (and therefore, the theodolite itself) is level. The leveling screws are mounted in the three mounting lobes of the tribrach, with their other ends clamped snugly against the base plate. Adjusting one or more of the leveling screws either up or down will bring the tribrach to a level position.

6-6. Disassembly

a. Remove the tribrach assembly (para 4-28).

b. Refer to figure 6-2 or 6-8, as applicable, and disassemble the tribrach assembly.

6-7. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean the circular level glass with a soft cloth or tissue.

b. Inspection. Inspect all threaded parts for worn or damaged threads. Inspect the base plate and spring plate for dents, cracks, breaks, and burs. Inspect the tribrach for cracks and breaks. Inspect the clamp lever for burs and wear. Inspect the leveling screw components for binding or loose fit.

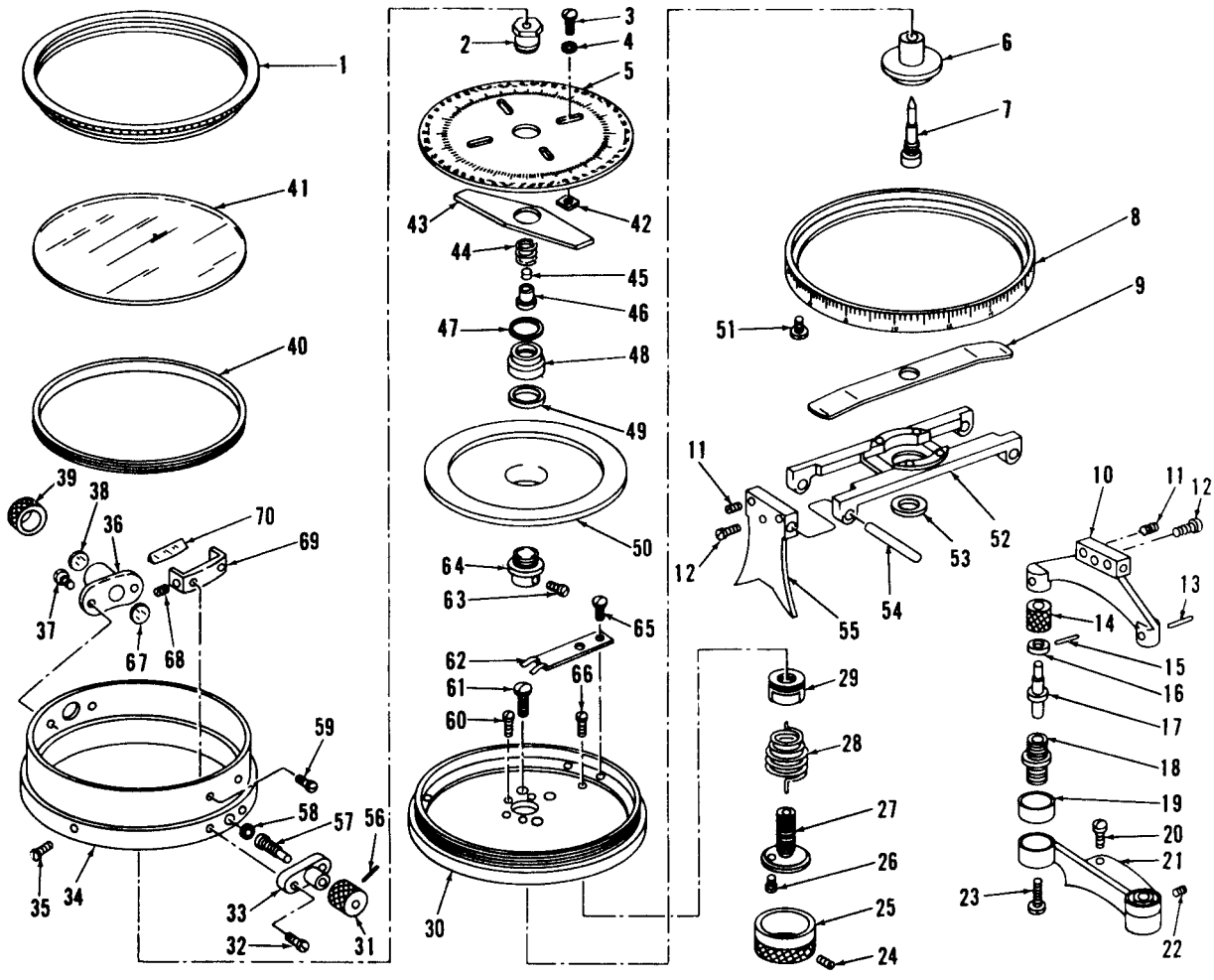
c. Repair. Remove all burred edges and minor dents. Chase threaded parts having minor thread damage. Replace defective parts that cannot be repaired.

6-8. Assembly

a. Refer to figure 6-2 or 6-3, as applicable, and assemble the tribrach assembly.

b. Install the tribrach assembly (para 4-30).

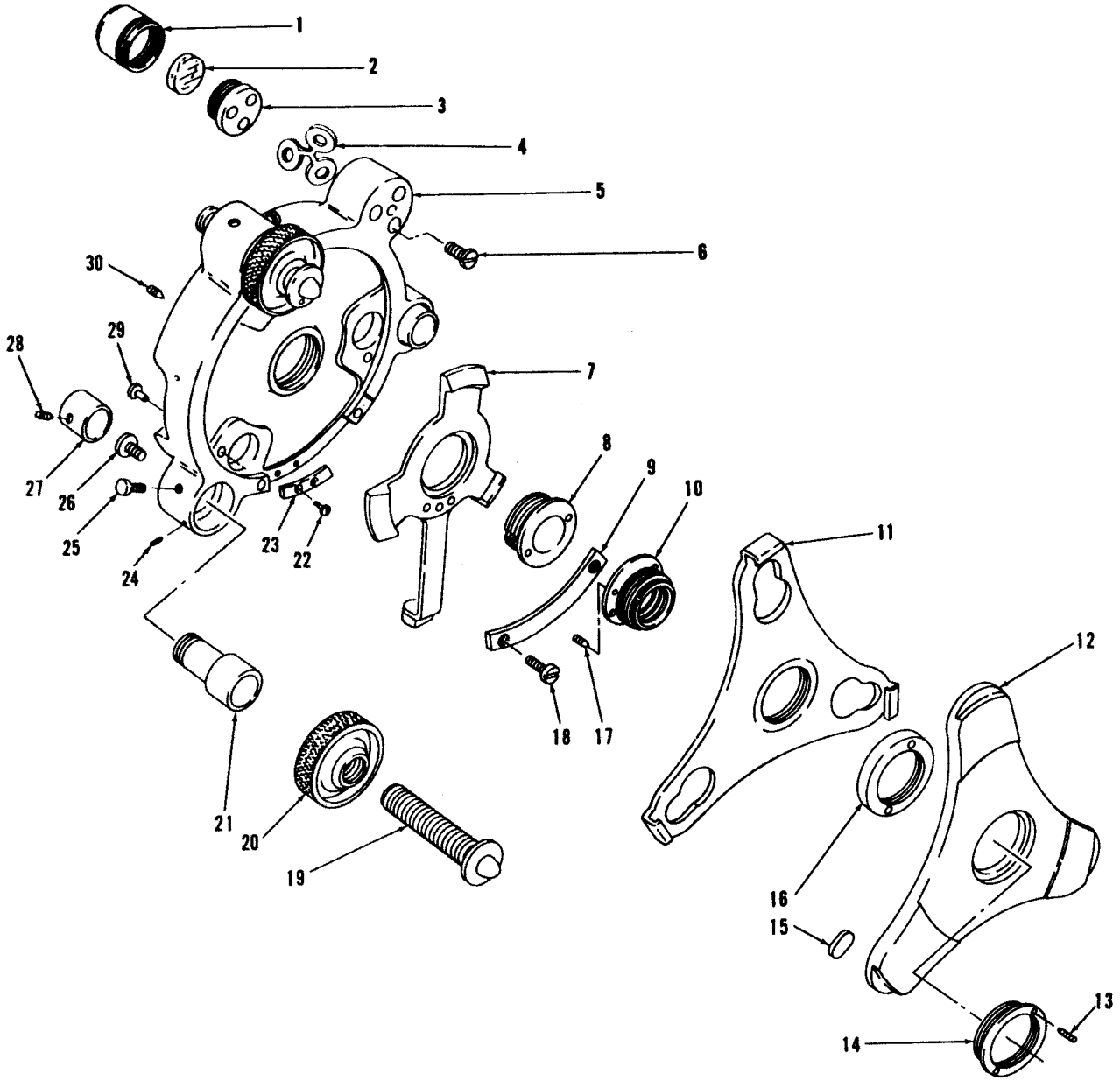
c. Adjust the circular level (para 2-9).



ME 6675-270-15/6-1

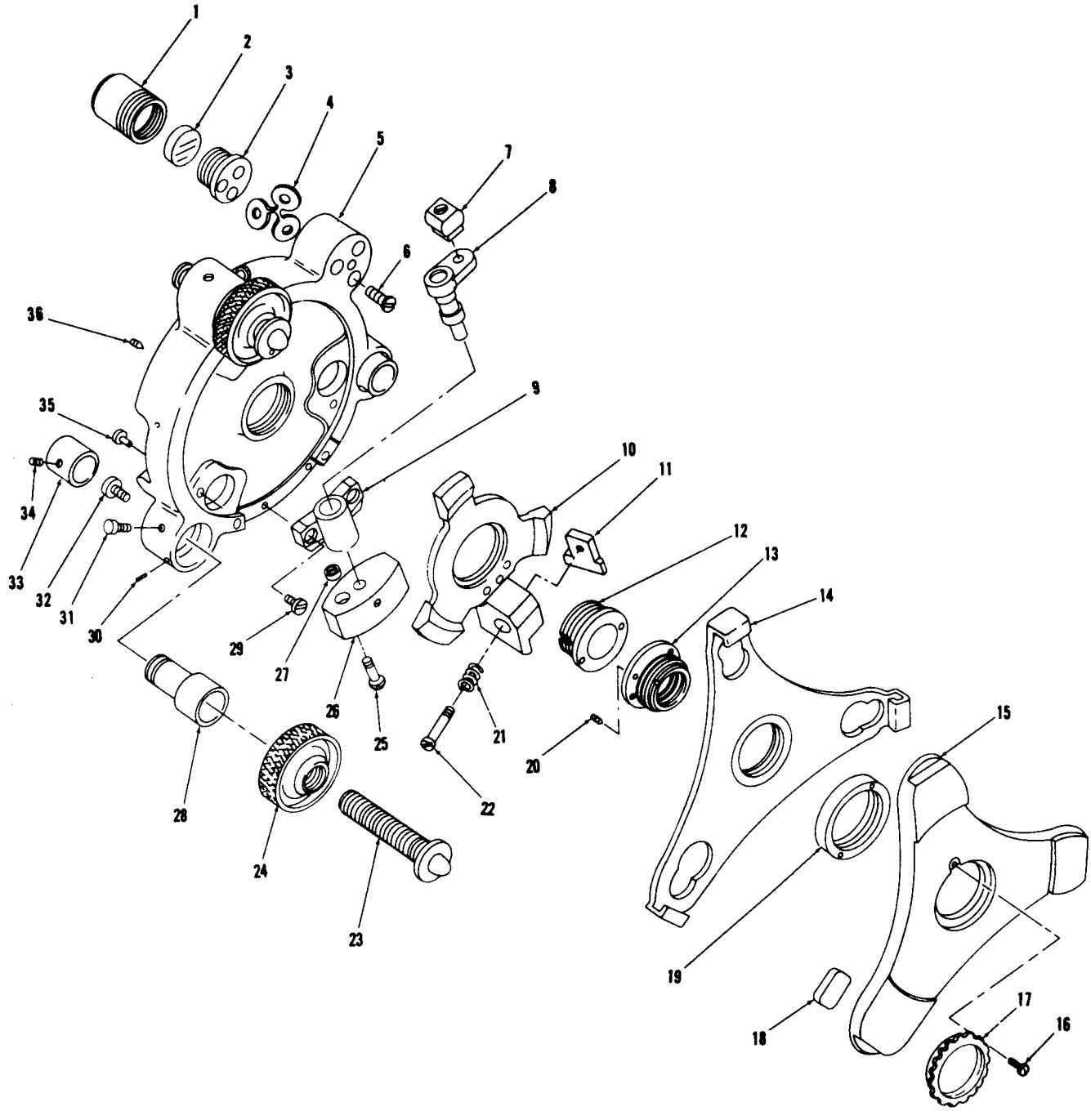
1	Housing	18	Bushing (2)	35	Machine screw (3)	53	Round nut
2	Locknut	19	Cover (2)	36	Eyepiece housing	54	Pin (2)
3	Machine screw (4)	20	Machine screw (2)	37	Machine screw (2)	55	Pin
4	Washer (4)	21	Bracket	38	Lens	56	Pin
5	Scale dial	22	Setscrew (2)	39	Locking ring	57	Screw
6	Spacer	23	Machine screw (2)	40	Locking ring	58	Clamp shoe
7	Bearing needle assembly	24	Setscrew (3)	41	Glass cover	59	Machine screw (2)
8	Circle ring	25	Knob	42	Counterweight (4)	60	Machine screw (3)
9	Flat spring	26	Machine screw	43	Magnet	61	Machine screw (4)
10	Leg	27	Bolt	44	Spring	62	Spring plate
11	Setscrew (2)	28	Spring	45	Sapphire	63	Machine screw
12	Setscrew (2)	29	Bushing	46	Bearing housing	64	Bushing
13	Pin (2)	30	Compass base	47	Spring washer	65	Machine screw
14	Locknut (2)	31	Caging knob	48	Locknut	66	Machine screw
15	Pin (2)	32	Machine screw (2)	49	Locknut	67	Lens
16	Stop ring (2)	33	Clamp bracket	50	Damp-ring	68	Setscrew
17	Threaded pin (2)	34	Compass housing	51	Machine screw (3)	69	Prism mount
				52	Plate	70	Prism

Figure 6-1. Compass and compass bracket assembly, disassembly and assembly.



1	Level housing	9	Stop plate	17	Setscrew	24	Setscrew (3)
2	Level	10	Flange nut	18	Machine screw (2)	25	Machine screw (3)
3	Level base	11	Spring plate	19	Screw assembly (3)	26	Machine screw (3)
4	Spring	12	Base plate	20	Knob (3)	27	Cover (3)
5	Base	13	Setscrew	21	Round nut (3)	28	Setscrew (3)
6	Machine screw (3)	14	Lockring	22	Machine screw (2)	29	Rivet (3)
7	Lock spring assembly	15	Foot pad	23	Safety plate	30	Setscrew
8	Flange nut	16	Round nut				

Figure 6-2. Tribrach assembly, disassembly and assembly (Model T 16-MIL 66).



1	Level housing	10	Lock spring assembly	19	Round nut	28	Round nut (3)
2	Level	11	Shoe	20	Setscrew	29	Machine screw (2)
3	Level base	12	Flange nut	21	Spring	30	Setscrew (3)
4	Spring	13	Flange nut	22	Adjusting screw	31	Machine screw (3)
5	Base	14	Spring plate	23	Screw assembly (3)	32	Machine screw (3)
6	Machine screw (3)	15	Base plate	24	Knob (3)	33	Cover (3)
7	Head	16	Lockscrew	25	Stopscrew	34	Setscrew (3)
8	Lever	17	Lockring	26	Knob	35	Rivet (3)
9	Bracket	18	Foot pad	27	Round nut	36	Setscrew

Figure 6-3. Tribrach assembly, disassembly and assembly (Models T16-MIL-68 and T16-68 DEG).

Section III. COLLIMATION LEVEL COVER AND COLLIMATION LEVEL MIRROR

6-9. General

The collimation level cover is located on the left side of the U-frame directly below the collimation level mirror. The collimation level mirror enables the operator to observe the position of the vertical collimation level bubble.

6-10. Disassembly

Refer to figure 5-3 and remove and disassemble the collimation level cover and collimation level mirror.

6-11. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Polish the metal mirror and glass windows with a soft cloth or tissue.

b. Inspection. Inspect parts for burred edges and dents. Inspect the screws or threaded parts for worn or damaged threads. Inspect the mirror and windows for scratches or etching.

c. *Repair.* Remove burs and any minor dents. Polish the mirror with a non-abrasive polishing compound. Chase threaded parts having minor thread damage. Replace all defective parts that cannot be repaired.

6-12. Assembly

Refer to figure 5-3 and assemble and install the collimation level mirror and collimation level cover.

Section IV. ILLUMINATION MIRROR AND RETICLE MIRROR ASSEMBLIES

6-13. General

The illumination mirror assembly is located on the left-side cover of the U-frame. It is used to light the vertical and horizontal circles during daylight operations. The reticle mirror assembly is located on top of the telescope axis and provides illumination of the reticle when the electric illumination system is used.

6-14. Disassembly

Refer to figure 5-3 and remove and disassemble the illumination mirror and reticle mirror assemblies.

6-15. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean the glass mirror with a soft cloth moistened with acetone or grain alcohol. Polish the metal mirror with a soft cloth or tissue.

b. Inspection. Inspect the mirrors for cracks, breaks, scratches, and loose backing. Inspect the mirror housing and sleeve for bends, cracks, and scored or worn bearing surface. Inspect the hardware for worn or damaged threads. Inspect the pin for wear and scoring.

c. *Repair.* Remove burred edges and minor dents. Lubricate the hinge pin sparingly, Chase threaded parts having minor thread damage. Replace a broken mirror and all defective parts that cannot be repaired.

6-16. Assembly

Refer to figure 5-3 and assemble and install the illumination mirror and reticle mirror assemblies.

Section V. HORIZONTAL CIRCLE CLAMP ASSEMBLY

6-17. General

The horizontal circle clamp assembly is located in the upper part of the horizontal circle housing at the rear of the theodolite. Its function is to clamp the horizontal circle in position for reference during operation of the theodolite.

6-18. Disassembly

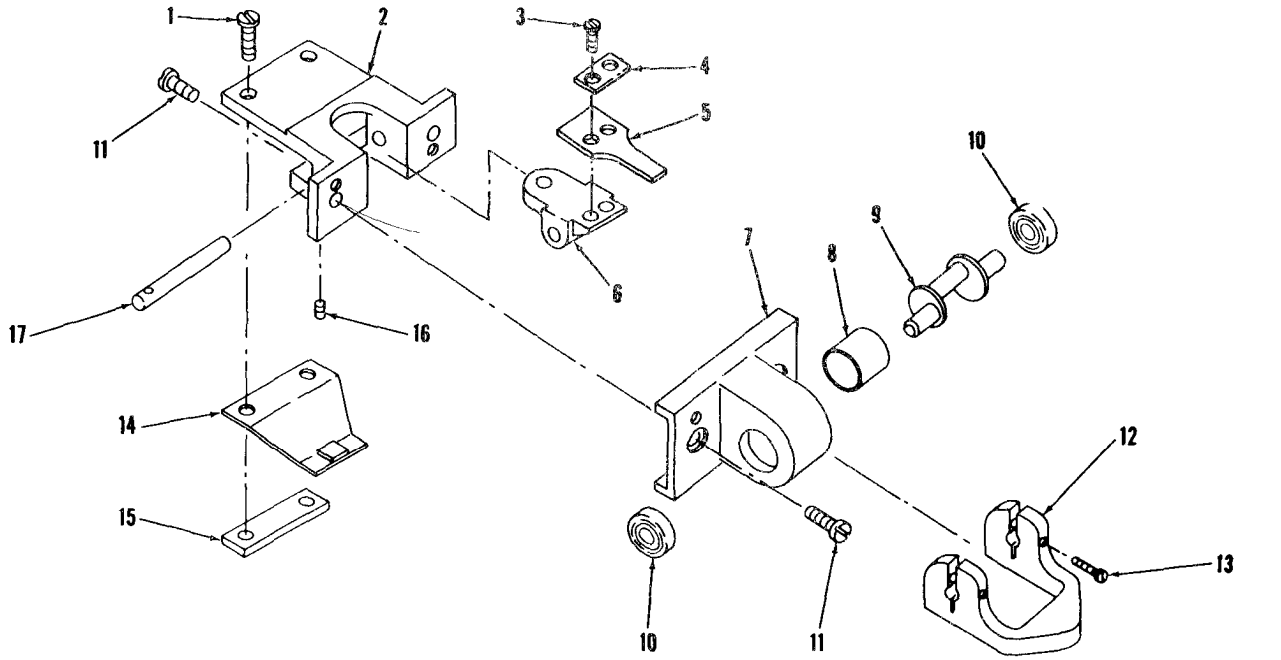
a. Remove the horizontal circle clamp assembly (para 5-9).

b. Refer to figure 6-4 and disassemble the horizontal circle clamp assembly.

6-19. Cleaning, Inspection, and Repair

a. Cleaning. Clean all parts with a cleaning solvent.

b. Inspection. Inspect the springs for excessive wear or damage. Inspect all hardware for excessive wear and damaged threads. Inspect the clamp lever and bearing for burs, dents, and



1 Machine screw (2)
2 Clamp housing
3 Machine screw (2)
4 Cover plate
5 Spring plate (2)
6 Clamp shoe
7 Housing cover
8 Bushing
9 Clamp lever axis
10 Ball bearing
11 Machine screw (2)
12 Clamp lever
13 Machine screw (2)
14 Clamp spring
15 Plate
16 Setscrew
17 Pin

Figure 6-4. Horizontal circle clamp assembly, disassembly and assembly.

scratches. Inspect the lever axis for wear and rough surfaces.

c. Repair. Remove all burs and minor dents. Chase threaded parts having minor thread damage.

6-20. Assembly

a. Refer to figure 6-4 and assemble the horizontal circle clamp assembly.

b. Install the horizontal circle clamp assembly (para 5-9).

Section VI. HORIZONTAL CIRCLE PRISM ASSEMBLY

6-21. General

The horizontal circle prism assembly is located on the left side of the theodolite in the upper part of the horizontal circle housing. It consists of a cover, prism housing, metal prisms, glass prism, and adjusting and attaching hardware. This prism assembly transmits the horizontal circle scale readings to the reading lens assembly.

6-22. Disassembly

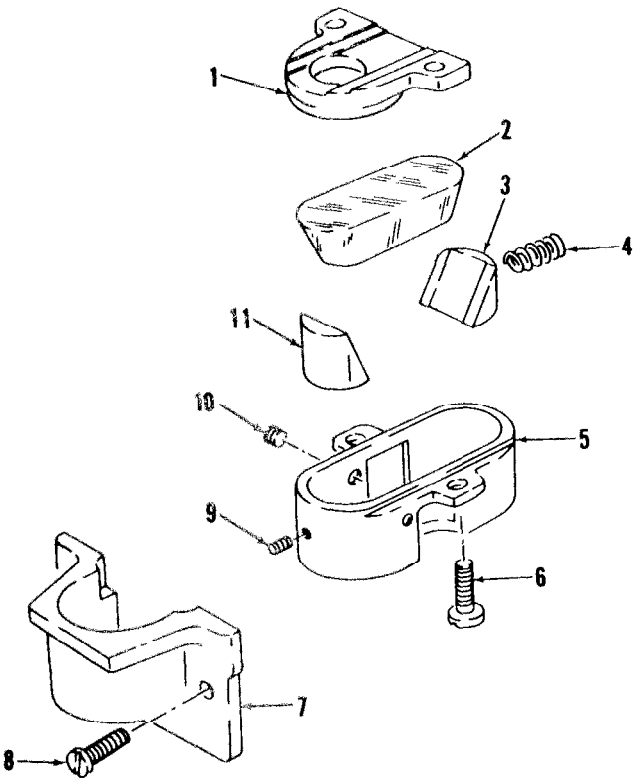
a. Remove the horizontal circle prism assembly (para 5-10).

b. Refer to figure 6-5 and disassemble the horizontal circle prism assembly.

6-43. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean and polish the glass prism with a soft cloth or lens tissue.

b. Inspection. Inspect the prisms and prism housings for cracks, burs, and damaged surfaces. Inspect all hardware for worn or damaged threads.



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1 Prism housing	4 Spring	7 Housing	10 Setscrew
2 Glass prism	5 Prism housing	8 Machine screw (2)	11 Metal Prism
3 Metal prism	6 Machine screw (2)	9 Setscrew	

Figure 6-5. Horizontal circle prism assembly, disassembly and assembly.

c. Repair. Remove all burs. Chase threaded parts having minor thread damage. Replace defective parts that cannot be repaired.

6-24. Assembly

a. Refer to figure 6-5 and assemble the horizontal circle prism assembly.

b. Install the horizontal circle prism assembly (para 5-10).

Section VI. HORIZONTAL SLOWMOTION SCREW ASSEMBLY

6-25. General

The horizontal slowmotion screw assembly permits the operator of the theodolite to make slow and precise lateral corrections to the azimuth of the telescope after making a rough sighting to the target.

6-26. Disassembly

Refer to figure 5-6 and remove and disassemble the horizontal slowmotion screw assembly.

6-27. Cleaning, Inspection, and Repair

a. Cleaning. Clean all parts with a cleaning solvent and dry thoroughly. Remove all grease and foreign matter from inside the housing, spring, and spring housing. Thoroughly clean the lead screw, stop nut, and threaded bushing.

b. Inspection. Inspect all threaded surfaces for worn or damaged threads. Inspect the spring for wear, breaks, and collapsed coils. Inspect the pin and housing for burs, cracks, and bends. Inspect

the lead screw and stop nut for burs, wear, and damage.

c. *Repair*. Remove all burs. Chase threaded parts having minor thread damage. Replace all defective parts that cannot be repaired.

6-28. Assembly

a. Refer to figure 5-6 and assemble and install the horizontal slowmotion screw assembly.

b. Adjust the horizontal slowmotion screw (para 2-9).

Section VIII. HORIZONTAL CIRCLE HOUSING AND INNER BASE

6-29. General

The horizontal circle housing and inner base include the instrument receptacles, contacts and electrical connections for nighttime operation, the horizontal clamp assembly, and the vertical axis assembly, Components of the horizontal circle are also included. The horizontal circle housing and inner base, when installed on the instrument are located between the tribrach assembly and the U-frame.

6-30. Disassembly

a. Remove the horizontal circle housing and the inner base (para 5-12).

b. Refer to figure 5-6 and disassemble the horizontal circle housing and inner base.

6-31. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent and dry thoroughly. Remove dirt and foreign matter from the electrical receptacles, cables, and contacts.

b. Inspection. Inspect the horizontal circle housing and inner base for cracks, burs, dents, and other damage. Inspect the electrical cables for damaged insulation and broken or frayed wires. Inspect the receptacles for cracks, breaks, and damaged terminals. Inspect the clamp assembly for burs and excessive wear. Inspect all hardware for damaged threads and heads.

c. *Repair*. Remove all burs and minor dents, Chase threaded parts having minor thread damage. Replace defective parts that cannot be repaired.

6-32. Assembly

a. Refer to figure 5-6 and assemble the horizontal circle housing and inner base.

b. Install the horizontal circle housing and inner base (para 5-12).

Section IX. HORIZONTAL CLAMP ASSEMBLY

6-33. General

The horizontal clamp assembly, located on the right side of the horizontal circle housing assembly, serves to lock the rotatable U-frame in any horizontal position until the clamp is released.

6-34. Disassembly

Refer to figure 5-6 and remove and disassemble the horizontal clamp assembly.

6-35. Cleaning, Inspection, and Repair

a. Cleaning. Clean all parts with a cleaning solvent.

b. Inspection. Inspect the knob, bushing, pin, horizontal clamp, clamp jaw, and tube connector for burs, dents, and excessive wear. Inspect the lockring, clamp, and clamp lever for cracks and breaks.

c. Repair. Remove all burs, dents, and nicks. Replace defective parts that cannot be repaired.

6-36. Assembly

Refer to figure 5-6 and assemble and install the horizontal clamp assembly.

Section X. HORIZONTAL CIRCLE ASSEMBLY AND OUTER VERTICAL AXIS

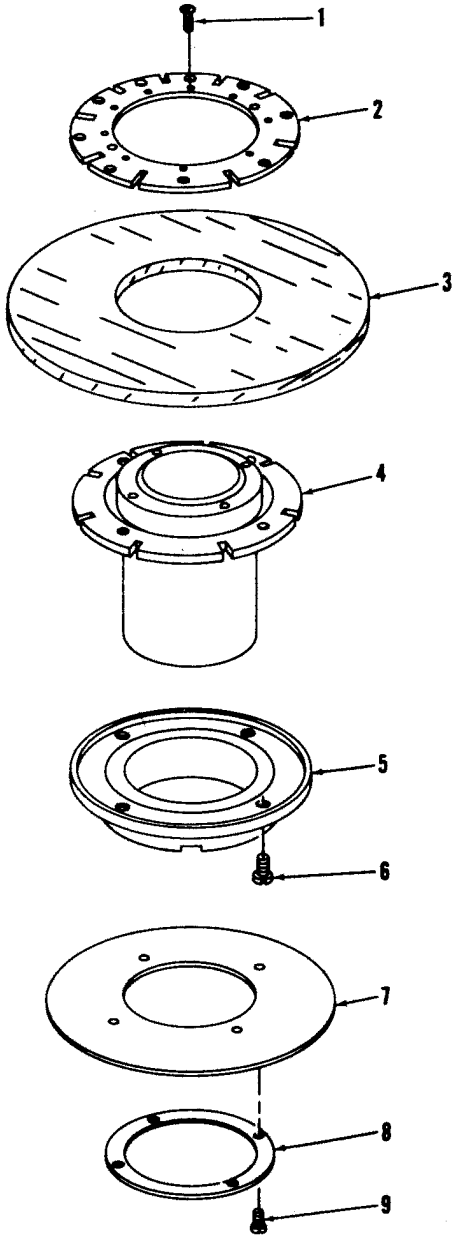
6-37. General

The horizontal circle assembly is a glass circle graduated in degrees or roils, depending on the model, and is used to measure azimuth angles.

6-38. Disassembly

a. Remove the horizontal circle assembly and outer vertical axis (para 5-14).

b. Refer to figure 6-6 and disassemble the horizontal circle assembly and outer vertical axis.



ME 6675-270-15/6-6

1 Machine screw (4)
2 spring plate set
3 Horizontal circle
4 Sleeve spacer
5 Sleeve spacer
6 Machine screw (4)
7 Clutch plate
8 Ring spacer
9 Machine screw (4)

Figure 6-6. Horizontal circle assembly and outer vertical axis, disassembly and assembly.

6-39. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean the horizontal circle assembly with a clean, soft cloth moistened with grain alcohol or acetone.

b. Inspection. Inspect the circle for breaks, cracks, etching, or other damage. Inspect hardware for damaged threads. Inspect the disk spring for cracks, breaks, and bends.

c. Repair. Replace a defective part that cannot be repaired.

6-40. Assembly

a. Refer to figure 6-6 and assemble the horizontal circle assembly and outer vertical axis.

b. Install the horizontal circle assembly and outer vertical axis (part 5-14).

Section XI. OPTICAL PLUMMET

6-41. General

The optical plummet prism, reticle, and magnifying lens assemblies with associated sleeves and housings, comprise the optical plummet. The inner vertical axis of the theodolite houses the optical plummet.

6-42. Disassembly

a. Remove the horizontal circle assembly (para 5-14).

b. Refer to figure 5-9 and remove and disassemble the optical plummet.

6-43. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent and dry thoroughly. Clean the lenses and prisms with grain alcohol or acetone.

b. Inspection. Inspect the lenses and prisms for scratches, chips, and cracks. Inspect all threaded parts for worn or damaged threads. Inspect the prism housing and lens holder tubes for cracks, burs and breaks.

c. Repair. Remove all burs. Replace defective parts that cannot be repaired.

6-44. Assembly

a. Refer to figure 5-9 and assemble and install the optical plummet.

b. Install the horizontal circle assembly (para 5-14).

Section XII. OPTICAL PLUMMET EYEPIECE ASSEMBLY

6-45. General

The optical plummet eyepiece assembly is located on the front of the U-frame near the bottom. It enables the operator to center the instrument accurately over the station point.

6-46. Disassembly

Refer to figure 5–9 and remove and disassemble the optical plummet eyepiece assembly.

6-47. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean the lens with lens tissue moistened with grain alcohol or acetone.

b. Inspection. Inspect the lens for scratches, chipping, and cracks. Inspect all threaded parts for worn or damaged threads. Inspect the lens holder tube for burs, dents, cracks, and breaks.

c. Repair. Remove all burs. Replace defective parts that cannot be repaired.

6-48. Assembly

a. Refer to figure 5-9 and assemble and install the optical plummet eyepiece assembly.

b. Adjust the optical plummet (para 2-9).

Section XIII. INNER VERTICAL AXIS

6-49. General

The inner vertical axis is fastened to the bottom of the U-frame and serves as the pivot upon which the U-frame turns. It provides mounting for the optical plummet described in paragraph 6-41. The inner vertical axis also houses two adjusting screws and spring-actuated pins which are used to position and hold the optical plumb prism in alinement.

6-50. Disassembly

a. Remove the inner vertical axis (para 5-17).

b. Refer to figure 5-9 and disassemble the inner vertical axis.

6-51. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean the 25 bearing balls with a lint-free cloth moistened with a cleaning solvent.

b. Inspection. Inspect the axis for damaged threads, burs, nicks, and wear. Inspect the bearing balls for flat spots, roughness, and other signs of wear.

c. Repair. Remove all burs and nicks. Chase threaded parts having minor thread damage.

6-52. Assembly

a. Refer to figure 5-9 and assemble the inner vertical axis.

b. Install the inner vertical axis (para 5-17).

Section XIV. PLATE LEVEL ASSEMBLY

6-53. General

The plate level assembly is mounted on the base of the U-frame between the upright members. It indicates when the theodolite has been brought to a horizontal position during adjustment of the leveling screws.

6-54. Disassembly

a. Remove the plate level assembly (para 5-18).

b. Refer to figure 6-7 and disassemble the plate level assembly.

6-55. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent and dry thoroughly. Wipe the vial and plastic vial cover with a soft cloth moistened with grain alcohol.

b. Inspection. Inspect the vial for cracks, etching and defective bubble. Inspect the vial cover for cracks, splits, scratches, and chipping. Inspect the tube and bearing for cracks, burs, and breaks. Inspect the spring for wear and fatigue. Inspect the vial end caps for damage. Inspect the screws for worn or damaged threads.

c. Repair. Remove all nicks and burs. Replace defective parts that cannot be repaired.

6-56. Assembly

a. Refer to figure 6-7 and assemble the plate level assembly.

b. Install the plate level assembly (para 5-28).

c. Adjust the plate level (para 2-9).

Section XV. CLAMP PINS

6-57. General

The four clamp pins mounted on each corner of the U-frame are used to hold the theodolite securely in the base of the carrying case when engaged by the clamp levers.

6-58. Removal

Remove the clamp pins (para 5-19).

6-59. Cleaning, Inspection, and Repair

a. Cleaning. Clean the metal parts with a cleaning solvent.

b. Inspection. Inspect the clamp pins for burs, nicks, and damaged threads.

c. Repair. Remove all burs and nicks. Replace an unserviceable pin with a serviceable one.

6-60. Installation

Install the clamp pins (para 5-19).

Section XVI. RIGHT-SIDE SUPPORT COVER

6-61. General

The right-side support cover is located on the right-side of the theodolite near the top of the U-frame. The right-side support cover encloses components of the vertical clamp assembly except for the vertical clamp screw and stop ring. The vertical clamp screw and stop ring are accessible from outside the cover. The cover must be removed to gain access to the remaining components of the vertical clamp assembly.

6-62. Disassembly

Refer to figure 5-12 and remove and disassemble the right-aide support cover.

6-63. Cleaning, Inspection, and Repair

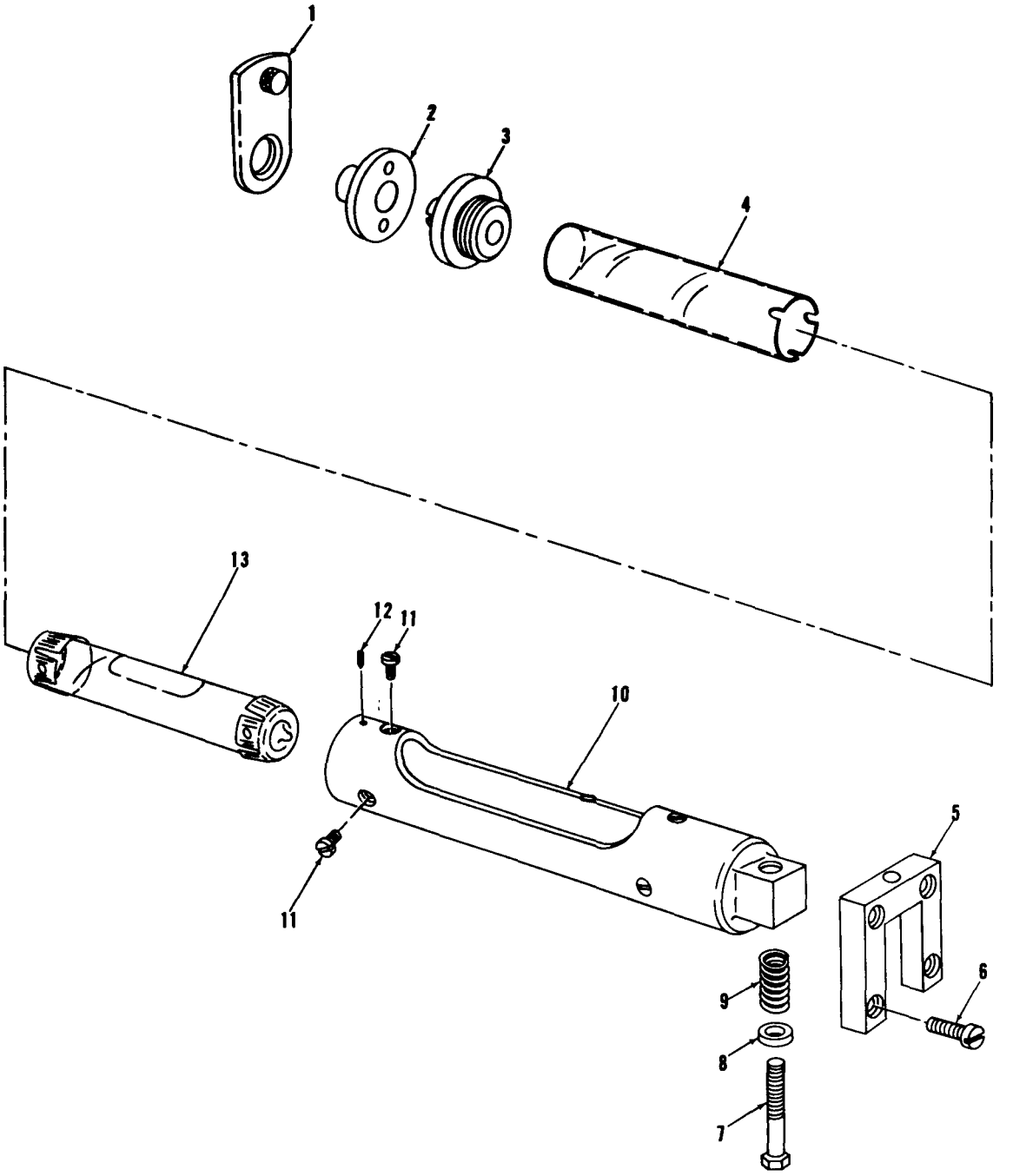
a. Cleaning. Clean the metal parts with a cleaning solvent and dry thoroughly.

b. Inspection. Inspect the threaded parts for damaged threads, burs, and nicks. Inspect the cover for dents, burs, cracks, and breaks.

c. Repair. Remove all burs, nicks, and minor dents. Replace a defective part that cannot be repaired.

6-64. Assembly

Refer to figure 5-12 and assembly and install the right-side support cover.



ME 6675-270-15/6-7

1 Cover
2 Sleeve
3 Sleeve
4 Plastic vial cover
5 Flange
6 Machine screw (4)
7 Adjusting screw
8 Washer
9 Spring
10 Tube
11 Machine screw (6)
12 Setscrew
13 Level assembly

Figure 6-7. Plate level assembly, disassembly and assembly.

Section XVII. VERTICAL CLAMP ASSEMBLY

6-65. General

The vertical clamp lever is mounted on the right side of the U-frame beneath the right side support cover. It transmits the action of the vertical slow-motion screw to the telescope axis while the operator makes fine vertical adjustments of the telescope. The vertical clamp, located behind the vertical clamp lever, serves to clamp the telescope firmly in position at any desired point in the vertical plane. The clamp also works in conjunction with the vertical slowmotion screw to permit slow and precise adjustments of the telescope in the vertical plane.

6-66. Disassembly

a. Remove the vertical clamp assembly (para 5-21).

b. Refer to figure 5-12 and disassemble the vertical clamp assembly.

6-67. Cleaning, Inspection, and Repair

a. Cleaning. Clean all parts with a cleaning solvent and dry thoroughly.

b. Inspection. Inspect the spring for wear and fatigue. Inspect the arm for dents, bum, and bends. Inspect the mounting screws for damaged threads. Inspect the clamp and clamp housing for cracks, dents, and wear.

c. *Repair*. Remove minor dents and burs. Replace defective parts that cannot be repaired.

6-68. Assembly

a. Refer to figure 5-12 and assemble the vertical clamp assembly.

b. Install the vertical clamp assembly (para 5-21).

Section XVIII. VERTICAL SLOWMOTION SCREW

6-69. General

The vertical slowmotion screw is located on the right-side of the U-frame. It is used by the operator to make precise and final adjustments of the telescope position in the vertical plane.

6-70. Disassembly

Refer to figure 5-12 and remove and disassemble the vertical slowmotion screw.

6-71. Cleaning, Inspection, and Repair

a. Cleaning. Clean all parts with a cleaning solvent. Remove all grease and foreign matter from the inside of the spring housing. Thoroughly clean the lead screw, split nut, and screw bushing.

b. Inspection. Inspect all threaded surfaces for worn or damaged threads. Inspect the spring for wear or fatigue. Inspect the pin and housing for burs, cracks, and bends. Inspect the adjusting screw and split nut for burs, wear, and damage.

c. Repair. Remove all burs. Replace defective parts that cannot be repaired.

6-72. Assembly

a. Refer to figure 5-12 and assemble and install the vertical slowmotion screw.

b. Adjust the vertical slowmotion screw (para 2-9).

Section XIX. VERTICAL COLLIMATION LEVEL ASSEMBLY

6-73. General

The vertical collimation level is provided to enable the operator to establish an exact horizontal plane and to make precise measurements relative to that plane. It is located on the upper left-side of the U-frame.

6-74. Disassembly

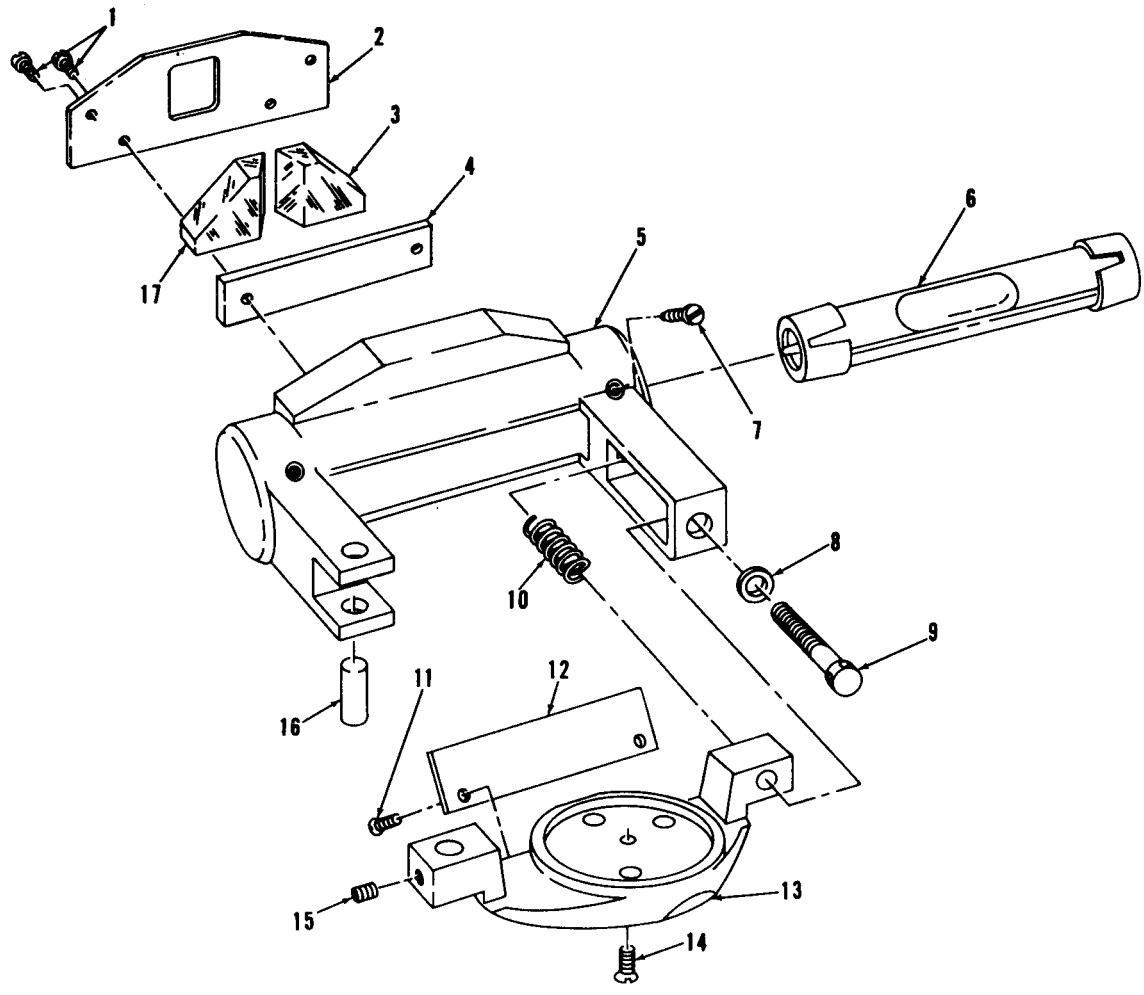
a. Remove the vertical collimation level assembly (para 5-23).

b. Refer to figure 6-8 and disassemble the vertical collimation level assembly.

6-75. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean and polish the prisms with lens tissue dipped in grain alcohol or acetone.

b. Inspection. Inspect the prisms for chips, scratches, and etchings. Inspect the housing, beam, vial cover, and prism plate for dents, burs, breaks,



1 Machine screw (4)
2 Plate
3 Right side prism
4 Metal prism
5 Housing
6 Level vial
7 Machine screw (6)
8 Washer
9 Machine screw
10 Spring
11 Machine screw (2)
12 Reflector
13 Bracket
14 Machine screw
15 Setscrew
16 Pin
17 Left side prism

Figure 6-8. Vertical collimation level assembly, disassembly and assembly.

and excesive wear. Inspect the vial for cracks and etchings.

c. Repair. Remove all burs. Replace defective parts that cannot be repaired.

6-76. Assembly

a. Refer to figure 6-8 and assemble the vertical collimation level assembly.

b. Install the vertical collimation level assembly (para 5-23).

c. Adjust the collimation level (para 2-9).

Section XX. LEFT-SIDE SUPPORT COVER ASSEMBLY

6-77. General

The left-side support cover assembly contains the illumination mirror mount and plug-in lamp bushing. The left-side support cover also protects the collimation level arm assembly.

6-78. Disassembly

a. Remove the left-side support cover assembly (para 5-24).

b. Refer to figure 5-14 and disassemble the left-side support cover assembly.

6-79. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean the glass window with lens tissue.

b. Inspection. Inspect the mirror mount, cover, and plug-in lamp bushing for dents, breaks, and excessive wear. Inspect all threaded surfaces for damaged threads and wear.

c. Repair. Remove all burs. Replace defective parts that cannot be repaired.

6-80. Assembly

a. Refer to figure 5-14 and assemble the left-side support cover assembly.

b. Install the left-side support cover assembly (para 5-24).

Section XXI. VERTICAL COLLIMATION HOUSING AND VERTICAL COLLIMATION LEVER ASSEMBLIES

6-81. General

The vertical collimation housing and vertical collimation lever assemblies are located in the left-side of the U-frame. They contain the upper and lower vertical circle reading prisms and lens assemblies, the upper horizontal circle reading prism assembly, prisms and lenses.

6-82. Disassembly

a. Remove the vertical collimation housing and the vertical collimation lever as an assembly (para 5-25).

b. Refer to figure 6-9 and disassemble the vertical collimation housing and vertical collimation level assemblies.

6-83. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean and polish the prism and lenses with a lens tissue dipped in grain alcohol or acetone.

b. Inspection. Inspect the housing, bearing shell, and sleeve for cracks, dents, and excessive wear.

c. Repair. Replace defective parts that cannot be repaired.

6-84. Assembly

a. Refer to figure 6-9 and assemble the vertical collimation housing and vertical collimation lever assemblies.

b. Install the vertical collimation housing and vertical collimation lever assemblies (para 5-25).

Section XXII. VERTICAL CiRCLE ASSEMBLY

6-85. General

The vertical circle assembly is located on the left side of the U-frame and is connected to the telescope axis to provide vertical readinga for the operator.

6-86. Disassembly

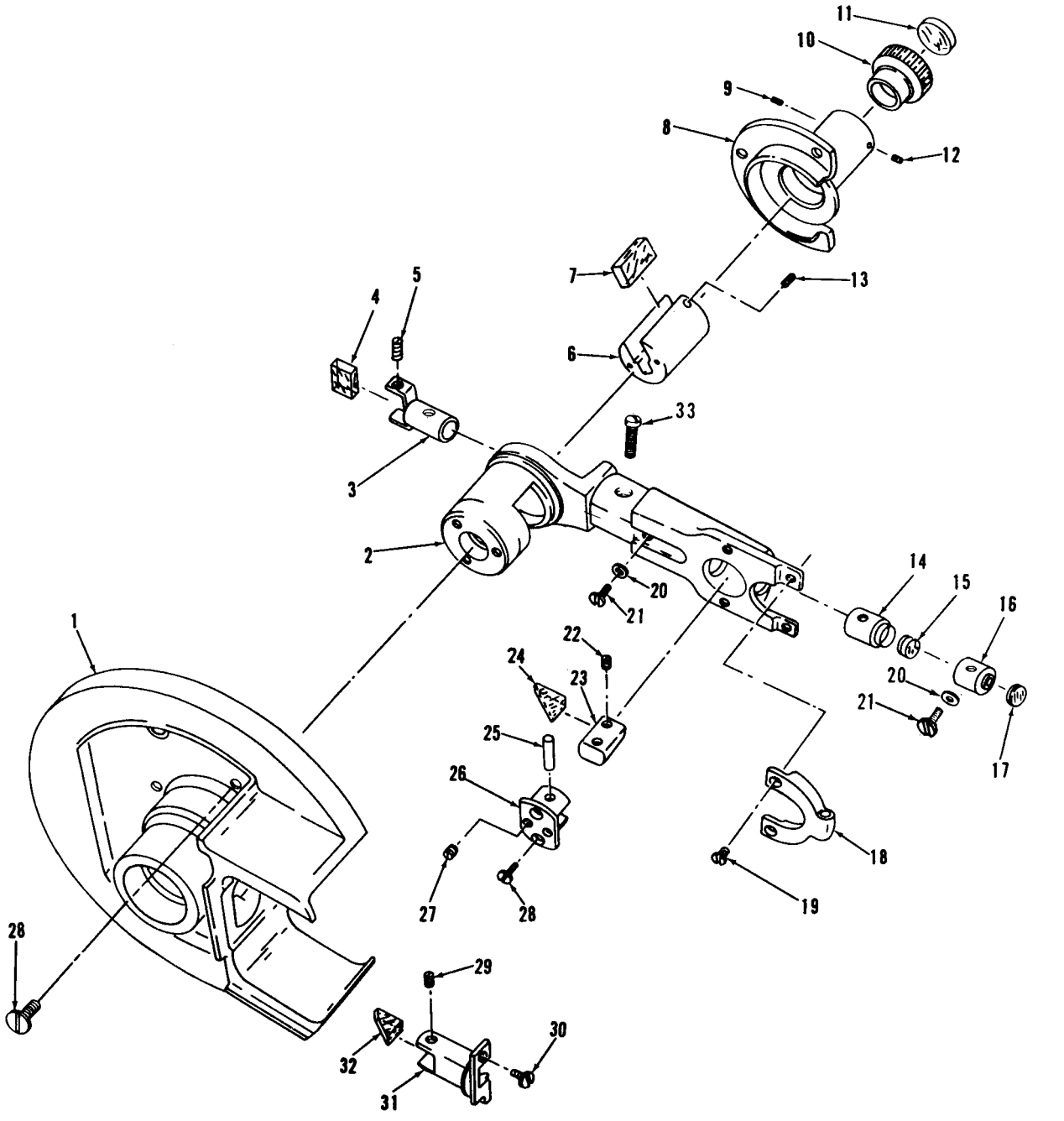
a. Remove the vertical circle assembly (para 5-26).

b. Refer to figure 6-10 and disassemble the vertical circle assembly.

6-87. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean the vertical circle with a clean, soft cloth moistened with a cleaning solvent, or use lens tissue. (Clean all threaded surfaces with a brush moistened in cleaning solvent.

b. Inspection. Inspect the circle for breaks, etchings, or other visible damage. Inspect the hardware for damaged threads.



1	Housing	12	Setscrew	23	Prism mount
2	Lever	13	Setscrew	24	Prism
3	Prism mount	14	Lens housing	25	Pin
4	Prism	15	Lens	26	Sleeve
5	Setscrew	16	Lens housing	27	Setscrew (2)
6	Prism mount	17	Lens	28	Machine screw (5)
7	Prism	18	Collimation lever	29	Setscrew
8	Mount	19	Machine screw (2)	30	Machine screw (2)
9	Setscrew	20	Washer (2)	31	Prism mount
10	Housing	21	Machine screw (2)	32	Prism
11	Mask	22	Setscrew	33	Capstan screw

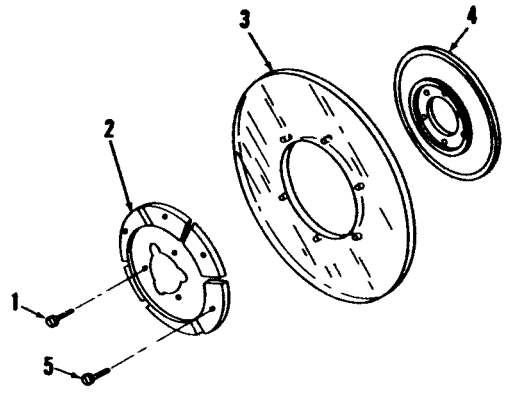
Figure 6-9. Vertical collimation housing and vertical collimation lever assemblies, disassembly and assembly.

c. Repair. Straighten all bent or dented parts and smooth all rough surfaces. Replace all damaged or worn parts that cannot be repaired.

6-88. Assembly

a. Refer to figure 6-10 and assemble the vertical circle assembly.

b. Install the vertical circle assembly (para 2-26).



ME 6675-270-15/6-10

1 Machine screw (3)
2 Spring plate
3 Scale dial
4 Sleeve
5 Machine screw (3)

Figure 6-10. Vertical circle assembly, disassembly and assembly.

Section XXIII. COLLIMATION SLOWMOTION SCREW ASSEMBLY

6-89. General

The collimation slowmotion screw is used to determine an exact horizontal line of sight for the telescope. The screw is designed to travel slowly so that the operator can make precise adjustments.

6-90. Disassembly

Refer to figure 5-12 and remove and disassemble the collimation slowmotion screw assembly.

6-91. Cleaning, Inspection, and Repair

a. Cleaning. Clean all parts with a cleaning solvent. Brush all threaded surfaces thoroughly with a small brush dipped in a cleaning solvent. Remove any grease or foreign matter from the housings with a cotton swab moistened with a cleaning solvent. Thoroughly clean the inside of the lead screw, stop nut, and bushing.

b. Inspection. Inspect all threaded surfaces for worn or damaged threads. Inspect the spring for wear, breaks, and fatigue. Inspect the pin and housings for burs, cracks, and bends. Inspect the adjusting screws and split nut for burs, wear, and damage.

c. Repair. Remove all burs. Stretch the spring to provide better tension if it shows signs of fatigue. Replace defective parts that cannot be repaired.

6-92. Assembly

a. Refer to figure 5-12 and assemble and install the collimation slowmotion screw assembly.

b. Adjust the collimation slowmotion screw (para 2-9).

Section XXIV. READING LENS ASSEMBLIES

6-93. General

The reading lens assemblies are located in the left side of the U-frame below the collimation lever. The reading lens assemblies magnify the readings of the horizontal circle obtained by the horizontal circle prism.

6-94. Disassembly

a. Remove the reading lens assemblies (para 5-28) .

b. Refer to figure 5-17 and disassemble the reading lens assemblies.

6-95. Cleaning, Inspection, and Repair

a. Cleaning. Clean the lens mounts with a cleaning solvent. Clean and polish the lenses with lens tissue dipped in grain alcohol or acetone.

b. Inspection. Inspect the lens mounts for cracks or breaks. Inspect the lenses for chips, breaks, and etching.

c. Repair. Replace defective parts.

6-96. Assembly

a. Refer to figure 5-17 and assemble the reading lens assemblies.

b. Install the reading lens assemblies (para 5-28).

Section XXV. ILLUMINATION LENS ASSEMBLY

6-97. General

The illumination lens assembly is located above the horizontal circle assembly on the left-side of the U-frame. The illumination lens assembly lights up the horizontal circle for reading purposes.

6-98. Disassembly

a. Remove the horizontal circle assembly and outer vertical axis (para 5-14).

b. Refer to figure 5-17 and disassemble the illumination lens assembly.

6-99. Cleaning, Inspection, and Repair

a. Cleaning. Clean the lens mount with a cleaning solvent. Clean and polish the lenses with lens tissue dipped in grain alcohol or acetone.

b. Inspection. Inspect the lens mount for cracks or breaks. Inspect the lens for chips, breaks, and etching.

c. Repair. Replace defective parts.

6-100. Assembly

a. Refer to figure 5-17 and assemble the illumination lens assembly.

b. Install the horizontal circle assembly and outer vertical axis (para 5-14).

Section XXVI. COMBINATION PRISM AND LENS ASSEMBLY

6-101. General

The combination prisms and lens assembly consists of the horizontal circle illumination prism, vertical circle illumination prism, and vertical circle illumination lens assembly. It is located beneath the vertical circle on the left-side of the U-frame.

6-102. Disassembly

a. Remove the combination prism and lens assembly (para 5-30).

b. Refer to figure 5-17 and disassemble the combination prism and lens assembly.

6-103. Cleaning, Inspection, and Repair

a. Cleaning. Clean the prism mount and lens housing with a cleaning solvent. Clean and polish the prisms and lenses with lens tissue dipped in grain alcohol or acetone.

b. Inspection. Inspect the prism mount and lens housing for cracks and breaks. Inspect the prisms and lenses for chips, cracks, and etchings.

c. Repair. Replace defective parts.

6-104. Assembly

a. Refer to figure 5-17 and assemble the combination prism and lens assembly.

b. Install the combination prism and lens assembly (para 5-30).

Section XXVII. MICROSCOPE ASSEMBLY

6-105. General

The microscope assembly is used to focus in and read the vertical and horizontal circle scales.

6-106. Disassembly

a. Remove the microscope assembly (para 5-31).

b. Refer to figure 6-11 (model T16-MIL66) or 6-12 (models T16-MIL68 and T16-68DEG), as applicable, and disassemble the microscope assembly.

6-107. Cleaning, Inspection, and Repair

a. Cleaning. Clean metal parts with a cleaning solvent. Clean the lenses with grain alcohol or acetone and lens tissue.

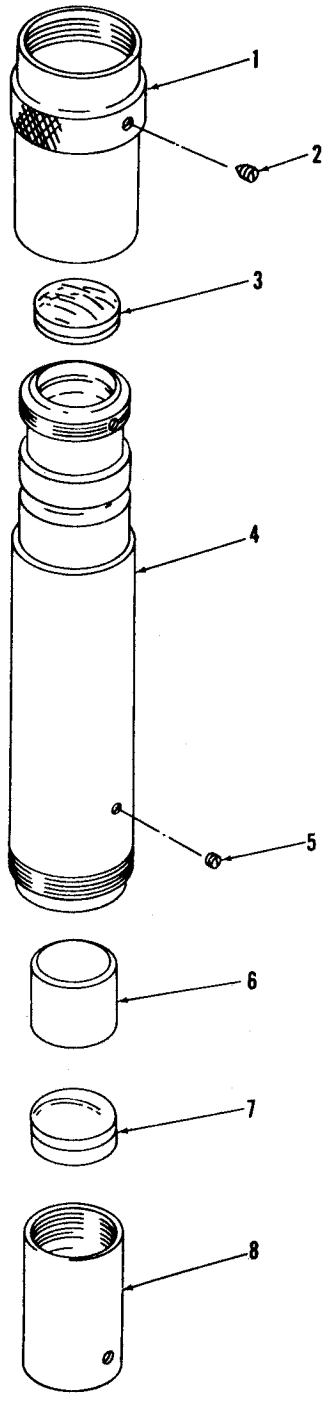
b. Inspection. Inspect the tubes, housing, and washer for dents, and burs. Inspect the lenses for chips, cracks, scratches, and etchings.

c. Repair. Remove any burs and straighten minor dents. Replace defective parts that cannot be repaired. Paint all metal surfaces where the paint is scratched or worn off.

6-108. Assembly

a. Refer to figure 6-11 or 6-12, as applicable, and assemble the microscope assembly.

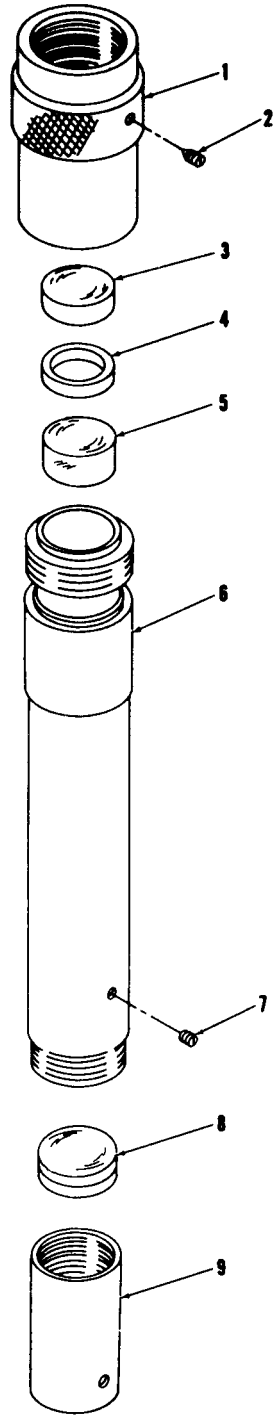
b. Install the microscope assembly (para 5-31).



ME 6675-207-15/6-11

1	Eyepiece lens sleeve	5	Setscrew
2	Setscrew	6	Spacer
3	Eyepiece	7	Lens assembly
4	Tube and mount	8	Lens mount

Figure 6-11. Microscope assembly, disassembly and assembly (Model T16-MIL66).



ME 6675-270-15/6-12

1	Eyepiece	6	Tube and mount
2	Setscrew	7	Setscrew
3	Ocular lens	8	Lens assembly
4	Spacer	9	Lens mount
5	Eyepiece		

Figure 6-12. Microscope assembly, disassembly and assembly (Models T16-MIL-68 and T16-68-DEG).

Section XXVIII. TELESCOPE LEVEL ASSEMBLY

NOTE

The telescope level assembly applies to models T16-MIL-68 and T16-68-DEG only.

6-109. General

The telescope level assembly is mounted on the underside of the telescope. It is used to determine when the telescope is alined in a horizontal position.

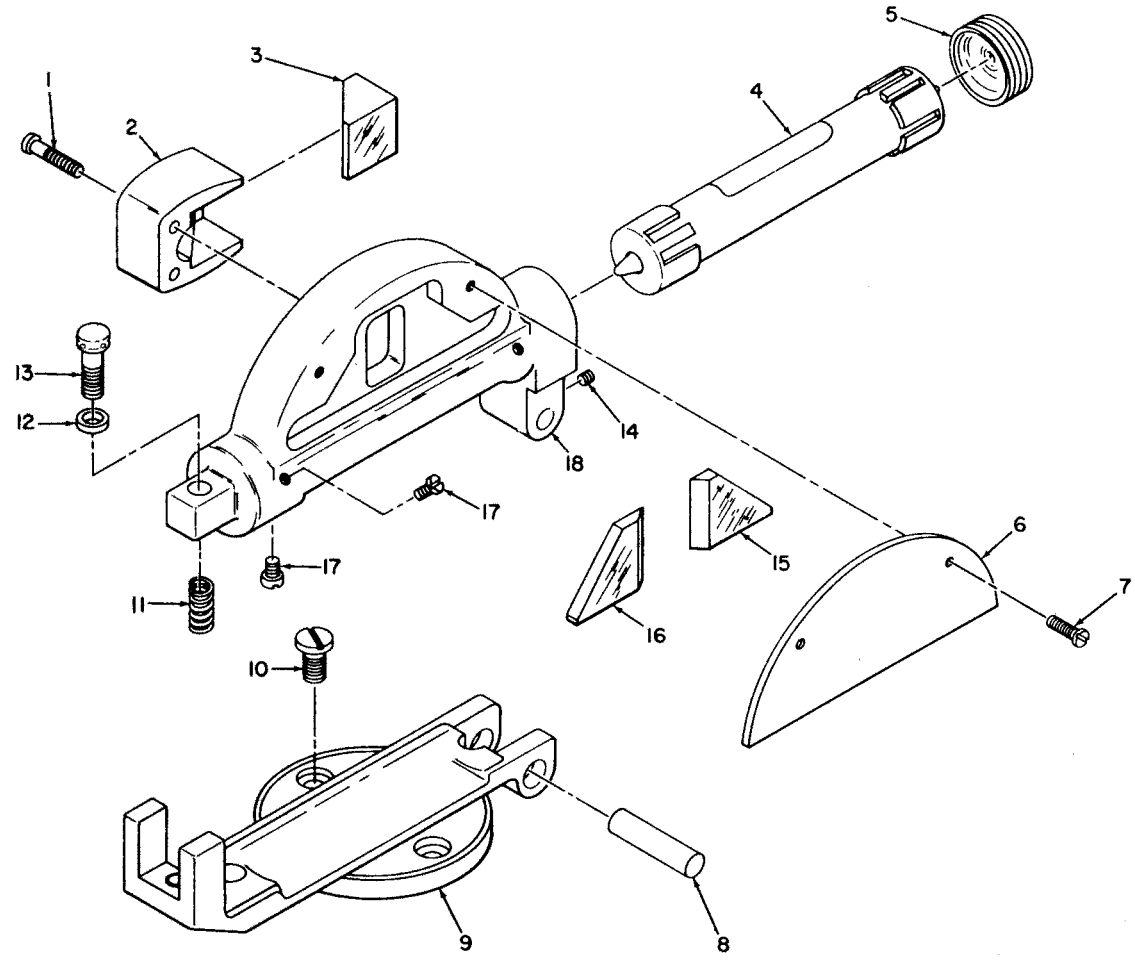
6-110. Disassembly

a. Refer to figure 4-6 and remove the telescope level assembly.

b. Refer to figure 6-13 and disassemble the telescope level assembly.

6-111. Cleaning, Inspection, and Repair

a. Cleaning. Clean all parts with a cleaning solvent. Clean the prisms and level vial with a soft cloth moistened with grain alcohol.



ME 6675-270-15/6-13

1 Screw	7 Screw	13 Screw
2 Housing	8 Pin	14 Setscrew
3 Prism	9 Base	15 Prism
4 Vial assembly	10 Screw	16 Prism
5 Cover	11 Spring	17 Screw
6 Cover	12 Washer	18 Housing

Figure 6–13. Telescope level assembly, disassembly and assembly (Models T16–MIL–68 and T16–68–DEG).

b. Inspection. Inspect all metal parts for burred edges and dents. Inspect all threaded parts for worn or damaged threads. Inspect the prisms for cracks, scratches, and etching.

c. Repair. Remove all burs and minor dents. Replace defective parts which cannot be repaired.

6-112. Assembly

a. Refer to figure 6-13 and assemble the telescope level assembly.

b. Refer to figure 4-6 and install the telescope level assembly.

Section XXIX. TELESCOPE EYEPIECE AND RETICLE ASSEMBLIES

6-113. General

The telescope eyepiece assembly is used to bring the lines of the reticle into focuse and to focus in the objective point.

6-114. Disassembly

a. Remove the telescope eyepiece and reticle assemblies (para 5-32).

b. Refer to figure 5-20 or 5-21, as applicable, and disassemble the telescope eyepiece and reticle assemblies.

6-115. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with an approved solvent. Wipe the lenses clean with lens tissue moistened with grain alcohol or acetone. Brush all threaded parts with a small brush dipped in cleaning solvent. Dry all parts thoroughly with a clean, soft cloth.

b. Inspection. Inspect all threaded surfaces for worn or damaged threads. Inspect the housings and bushings for dents, cracks, and breaks. Inspect the lenses for chips, scratches, and etching.

c. *Repair.* Remove all burs. Straighten minor dents and bends. Paint all metal surfaces where the paint is scratched or worn off. Replace all defective parts that cannot be repaired.

6-116. Assembly

a. Refer to figure 5-20 or 5-21, as applicable, and assemble the telescope eyepiece and reticle assemblies.

b. Install the telescope eyepiece and reticle assemblies (para 5-32).

c. Adjust the reticle to compensate for horizontal collimation error (para 2-9).

Section XXX. TELESCOPE FOCUS AND OBJECTIVE ASSEMBLIES

6-117. General

The objective end of the telescope collects and concentrates a larger beam of light than is possible with the naked eye. The objective lens assemblies also magnify the sighted object into sharp focus for the operator.

6-118. Disassembly

a. Remove the telescope focus and objective assemblies (para 5-33).

b. Refer to figure 5-20 or 5-21, as applicable, and disassemble the telescope focus and objective assemblies.

6-119. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Clean the lens with a soft, lint-free cloth moistened in grain alcohol or acetone.

b. Inspection. Inspect the lens for scratches, chips, cracks, and etching. Inspect the focusing tubes, lens mount, and housings for burs, cracks, breaks, and worn or damaged threads.

c. Repair. Remove all burs and minor dents. Replace defective parts that cannot be repaired.

6-120. Assembly

a. Refer to figure 5-20 or 5-21, as applicable, and assemble the telescope focus and objective assemblies.

b. Install the telescope focus and objective assemblies (para 5-33).

Section XXXI. TELESCOPE AXIS AND 90° PRISM ASSEMBLIES

6-121. General

The telescope axis assembly acts as a mount for the telescope objective, focus, reticle, and eyepiece assemblies, microscope assembly, 90° prism, and associated parts. It is supported in the U-frame by two axis bearings. The 90° prism directs the horizontal and vertical circle scale readings and illumination from the left side of the U-frame to the microscope lens assembly.

6-122. Disassembly

a. Remove the telescope axis and 900 prism assemblies (para 5-34).

b. Refer to figure 5-22 and disassemble the telescope axis and 90° prism assemblies.

NOTE

The telescope axis (1, fig. 5-22) on model T16-MIL 66 has an oval shape; that on models T16-MIL 68 and T16-68 DEG is square shaped.

6-123. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts in a cleaning solvent. Clean and polish the prism with lens tissue dipped in grain alcohol or acetone.

b. Inspection. Inspect the prism sleeve, prism mount, and frame for dents and breaks. Inspect the prism for chips, breaks, scratches, and etchings. Inspect the telescope axis and bearings for cracks, breaks and burs.

c. Repair. Remove all burs. Paint all metal surfaces where the paint has been scratched or worn off. Replace defective parts that cannot be repaired.

6-124. Assembly

a. Refer to figure 5-22 and assemble the telescope axis and 900 prism assemblies.

b. Install the telescope axis and 90° prism assemblies (para 5-34).

Section XXXII. U-FRAME ASSEMBLY

6-125. General

The U-frame assembly consists of the U-frame, right- and left-side support covers, horizontal circle reading and illumination lens assemblies, plate level illumination window, and associated hardware. The U-frame assembly forms a supporting and housing structure for the telescope and vertical circle assemblies and associated controls.

6-126. Disassembly

Remove and disassemble the U-frame assembly (para 5-35).

6-127. Cleaning, Inspection, and Repair

a. Cleaning. Clean the U-frame with a cleaning solvent.

b. Inspection. Inspect the frame for cracks, breaks, and burs. Inspect threaded surfaces for damaged or worn threads.

c. Repair. Chase threaded parts having minor thread damage. Remove burs. Replace a defective U-frame.

6-128. Assembly

Assemble and install the U-frame assembly (para 5-35).

Section XXXIII. BATTERY BOX

6-129. General

The battery box stores the batteries which furnish power to the hand light and electrical illumination assembly.

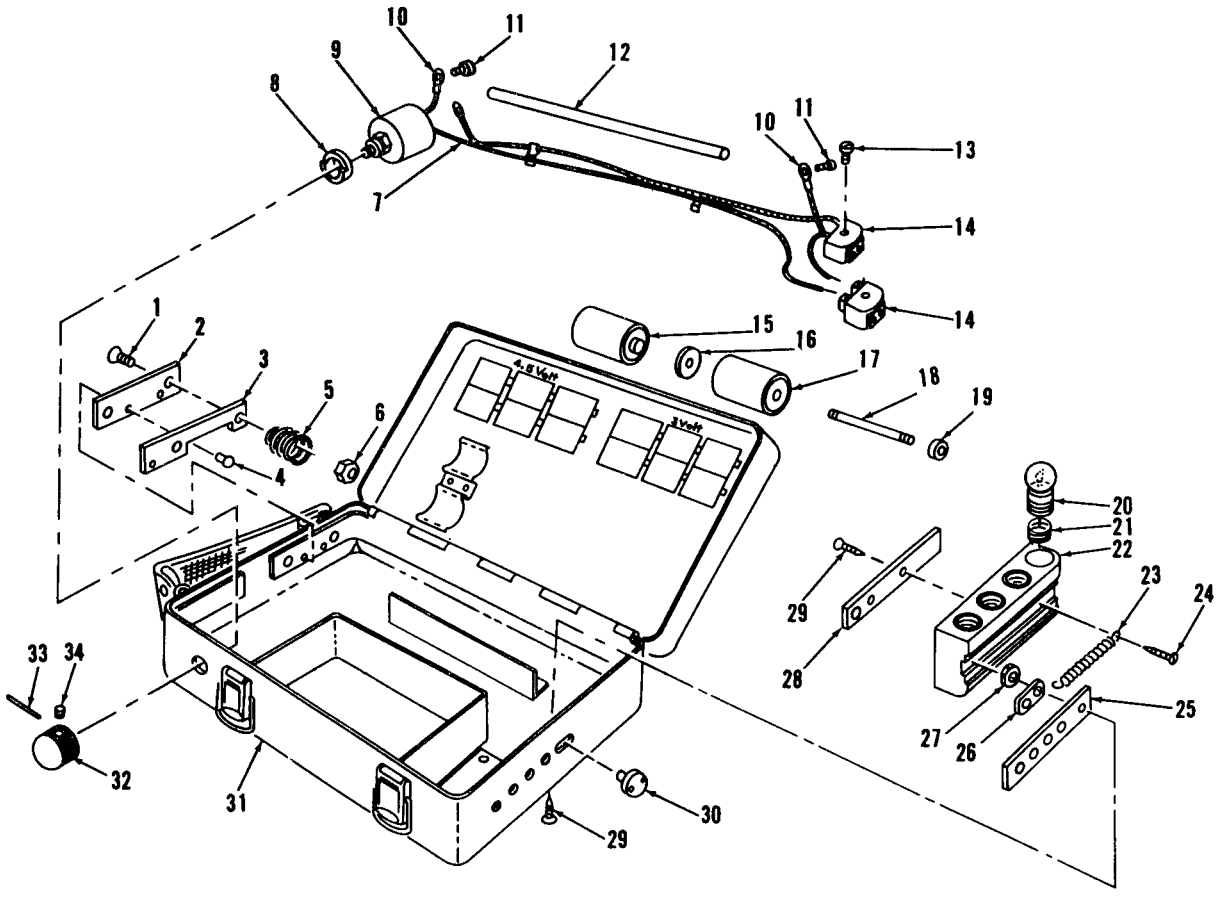
6-130. Disassembly

Refer to figure 6-14 and disassemble the battery box.

6-131. Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with a cleaning solvent. Remove all corrosion from terminals and contacts. Wipe dirt and foreign matter from cables, trunk, rheostat, springs, and washers. Clean the battery box, with a soft cloth moistened with a cleaning solvent and dry thoroughly.

b. Inspection. Inspect the cables for damaged insulation, broken wires, and defective terminals. Inspect the springs for bends, breaks, and fatigue. Inspect the trunk for splits, cracks, and other damage. Inspect the rheostat for improper operation and damage. Inspect the sockets for cracks



1	Machine screw (2)	13	Machine screw (2)	24	Machine screw (3)
2	Insulator plate	14	Plug (2)	25	Mounting plate
3	Contact plate	15	Dummy battery (2)	26	Contact
4	Rivet (2)	16	Washer (2)	27	Nut
5	Spring (2)	17	Battery block (2)	28	Contact
6	Nut (2)	18	Battery axis (2)	29	Machine screw (2)
7	Cable	19	Nut (2)	30	Knob
8	Key washer	20	Lamp (4)	31	Carrying case
9	Rheostat	21	Socket (4)	32	Knob
10	Cable clip (2)	22	Wood trunk	33	Pin
11	Machine screw (2)	23	Spring	34	Machine screw
12	Insulating tube				

Figure 6–14. Battery box, disassembly and assembly.

and damage. Inspect the contacts and lever for burs, bends, and wear. Inspect the battery box for dents, cracks, and defective clamps. Inspect the screws and pins for burs and damaged threads.

c. Repair. Tape cracked insulation on cables. Stretch slightly fatigued springs to provide better holding tension. Smooth out all burred surfaces and straighten minor bends. Paint all metal surfaces where the paint has been scratched or worn off. Replace all parts that cannot be repaired.

6-132. Assembly

Refer to figure 6-14 and assemble the battery box.

Section XXXIV. HAND LIGHT AND CABLE ASSEMBLY

6-133. General

The hand light is used to illuminate the circular level and to provide general illumination for nighttime and dark day operation.

CAUTION

Do not use the hand light in close proximity to the compass.

6-134. Disassembly

Refer to figure 6-15 and disassemble the handlight and cable assembly.

6-135. Cleaning, Inspection, and Repair

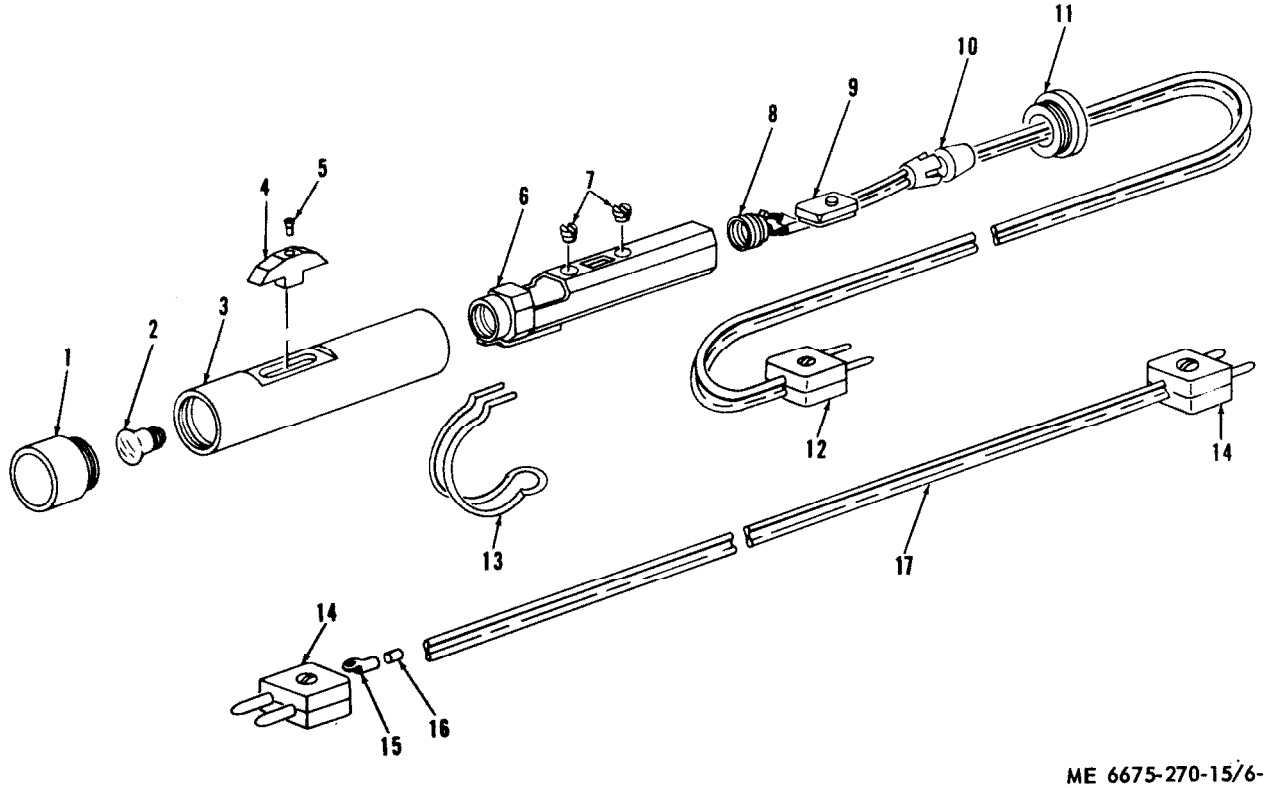
a. Cleaning. Clean all metal parts with a cleaning solvent. Wipe the cable clean with a soft cloth. Clean the corrosion from the terminals and contacts. Brush all threaded surfaces free of dirt and foreign material.

b. Inspection. Inspect the tubes and housings for dents, cracks, and breaks. Inspect all insulation for wear and damage. Inspect all contacts for corrosive damage and breaks. Inspect the terminals for burs, bends and breaks. Inspect the levers for bends and damage.

c. Repair. Repair minor insulation damage to the cable with tape. Straighten out all dents and bends. Remove all burs. Replace defective parts that cannot be repaired.

6-136. Assembly

Refer to figure 6-15 and assemble the hand light and cable assembly.



1 Cover
2 Lamp
3 Housing
4 Switch slide
5 Machine screw
6 Insulator
7 Machine screw (2)
8 Lampholder
9 Switch
10 Cable assembly
11 Cover
12 Plug connector
13 Hook
14 Plug connector (2)
15 Tubular contact
16 Insulating tube (4)
17 Cable

Figure 6–15. Hand light and cable assembly, disassembly and assembly.

Section XXXV. ELECTRICAL ILLUMINATION ASSEMBLY

6-137. General

The electrical illumination assembly is used to permit night and dark day reading of plate and collimation levels and to illuminate the horizontal and vertical circles.

6-138. Disassembly

Refer to figure 6-16 and disassemble the electrical illumination assembly.

6-139. Cleaning, Inspection, and Repair

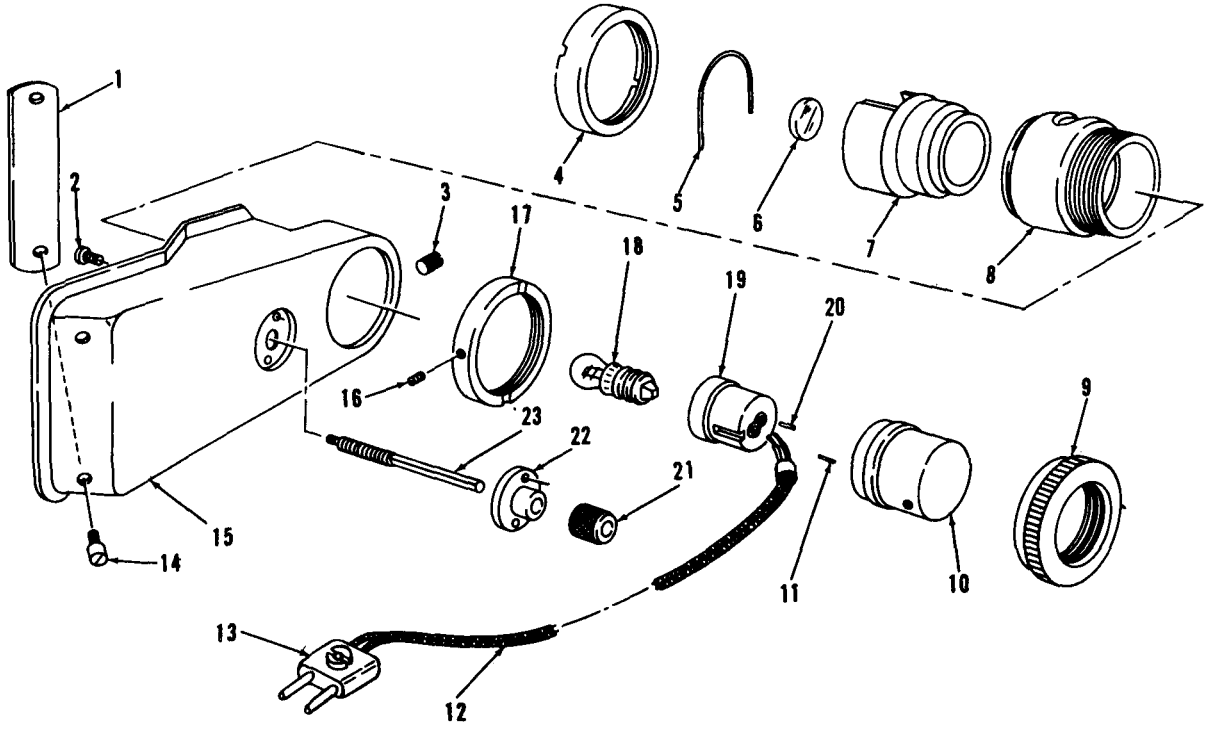
a. Cleaning. Clean all metal parts with a cleaning solvent. Wipe the electrical cable clean with a cloth. Clean and polish the window with lens tissue moistened in grain alcohol or acetone. Brush all threaded surfaces free of dirt and foreign matter. Clean any corrosion from the connector contact pins.

b. Inspection. Inspect the lens for cracks or chips. Inspect the lampholder, light cover, and knob for cracks, breaks, and dents. Inspect the electrical cable insulator for wear or deterioration.

c. Repair. Smooth out minor dents. Repair minor insulation damage to the cable with tape. Replace defective parts that cannot be repaired.

6-140. Assembly

Refer to figure 6-16 and assemble the electrical illumination assembly.



ME 6675-270-15/6-16

1 Metal mirror
2 Machine screw (2)
3 Machine screw
4 Cover
5 Spring
6 Filter
7 Housing
8 Bushing
9 Locknut
10 Lampholder
11 Pin
12 Cable
13 Plug connector
14 Machine screw (2)
15 Housing
16 Setscrew
17 Lockring
18 Lamp
19 Bushing
20 Insulating tube
21 Knob
22 Sleeve
23 Bolt

Figure 6–16. Electrical illumination assembly, disassembly and assembly.

CHAPTER 7

ADMINISTRATIVE STORAGE AND INSTRUCTIONS FOR DESTRUCTION OF MATERIEL TO PREVENT ENEMY USE

Section I. ADMINISTRATIVE STORAGE

For administrative storage procedures, refer to TM 740-90-1.

Section II. DESTRUCTION OF MATERIEL TO PREVENT ENEMY USE

For destruction of materiel to prevent enemy use, refer to TM 750-244-3.

APPENDIX A

REFERENCES

A-1. Painting

TM 9-213	Painting Instructions for Field Use

A-2. Lubrication

C9100 IL	Fuels, Lubricants, Oils and Waxes

A-3. Maintenance

TM 5-232	Elements of Surveying
TM 5-6675-270-25P	Organizational, Direct Support, General Support, and Depot Maintenance Repair Parts and Special Tool Lists, Theodolite
TM 10-269	General Repair for Canvas and Webbing

A-4. Shipment and Storage

TB 740-93-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage
TM 740-90-1	Administrative Storage of Equipment

A-5. Destruction of Army Materiel

TM 750-244-3	Procedure for Destruction of Equipment to Prevent Enemy Use

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section 1. INTRODUCTION

B-1. General

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

B-2. Explanation of Columns in Section II

a. Group number, Column (1). The assembly group is a numerical group assigned to each assembly in a top down breakdown sequence. The applicable assembly groups are listed on the MAC in disassembly sequence beginning with the first assembly removed in a top down disassembly sequence.

b. Assembly Group, Column (2). This column contains a brief description of the components of each assembly group,

c. Maintenance Functions, Column (3). This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these functions. The symbol designations for the various maintenance categories are as follows:

C-Operator or crew
O-Organizational maintenance
F-Direct support maintenance
H-GeneraI support maintenance
D-Depot maintenance

The maintenance functions are defined as follows:

A-Inspect. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

B-Test. To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

C-Service. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

D-Adjust. To rectify to the extent necessary to bring into proper operating range.

E-Aline. To adjust specified variable elements of an item to bring to optimum performance.

F-Calibrate. To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

G-Install. To set up for use in an operational environment such as an emplacement, site, or vehicle.

H-Replace. To replace unserviceable items with serviceable like items.

I-Repair. Those maintenance operations necessary to restore an item to serviceable condition through correction of material damage or a specific failure. Repair may be accomplished at each category of maintenance.

J-Overhaul. Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

K-Rebuild. The highest degree of materiel maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by oper-

ational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component thereof, has been in use.

d. Tools and Equipment, Column (4). This column is provided for referencing by code the special tools and test equipment, (sec. III) required to perform the maintenance functions (sec. II).

e. Remarks, Column (5). This column is provided for referencing by code the remarks (sec. IV) pertinent to the maintenance functions.

B-3. Explanation of Columns in Section III

a. Reference Code. This column consists of a number and a letter separated by a dash. The number references the T and TE requirements column on the MAC. The letter represents the specific maintenance function the item is to be used with. The letter is representative of columns A through K on the MAC.

b. Maintenance Category. This column shows the lowest level of Maintenance authorized to use the special tool or test equipment.

c. Nomenclature. This column lists the name or identification of the tool or test equipment.

d. Tool Number. This column lists the manufacturer's code and part number, or Federal stock number of tools and test equipment.

B-4 Explanation of Columns in Section IV

a. Reference Code. This column consists of two letters separated by a dash, both of which are references to Section II. The first letter references Column 5 and the second letter references a maintenance function, Column 3, A through K.

b. Remarks. This column lists information pertinent to the maintenance function being performed, as indicated on the MAC, Section II.

Section II-MAINTENANCE ALLOCATION CHART

(1) Group no.	(2) Assembly group	(3) Maintenance function A Inspect	B Test	C Service	D Adjust	E Aline	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and equipment	(5) Remarks
01	Theodolite	--	--	C	C	--	--	--	--	--	--	D	1, 2	A
02	Tribrach	C	--	--	--	--	--	--	O	F	--	D		B
03	Compass	C		--	--	--	--	C	O	F	H			C
04	Tripod	C	--	--	--	--	--	C	O	O			3	D
05	Carrying Case	C	--			--	--	--	O	O				E
06	Transportation Case	C	--	--	--	--	--	--	O	O				F
07	Accessories	C	--	--	--	--	--	--	C	O				G

Section III. SPECIAL TOOL AND TEST EQUIPMENT REQUIREMENTS

Reference code	Maintenance category	Nomenclature	Tool number
1–A	C, D	Screwdriver, flat tip	5120–446–2860
2–A	C, O, F, D	Pin, adjusting	6675–353–4103
3–E	C, O	Wrench, Tripod	5120–378–9520

Section IV. REMARKS

Reference code	Remarks
A–C	External
B–A	External
C–A	External
D–A	External
E–A	External
F–A	External
G–A	External

APPENDIX C

BASIC ISSUE ITEMS LIST

Section I. INTRODUCTION

C-1. Scope

This appendix lists items which accompany the Theodolite or are required for installation, operation, or operator's maintenance.

C-2. General

This Basic Issue Items List is divided into the following sections:

a. Basic Issue Items-Section II. A list of items which accompany the Theodolite and are required by the operator/crew for installation, operation, or maintenance.

b. Maintenance and Operating Supplies-Section III. (Not Applicable.)

C-3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items, Section II.

a. Source, Maintenance, and Recoverability Codes (SMR):

(1) Source code indicates the selection status and source for the listed item. Source codes are:

Code	*Explanation*
P	Repair parts which are stocked in or supplied from the GSA/DSA, or Army supply system and authorized for use at indicated maintenance categories.
M	Repair parts which are not procured or stocked, but are to be manufactured in indicated maintenance levels.
A	Assemblies which are not procured or stocked as such, but are made up of two or more units. Such component units carry individual stock numbers and descriptions, are procured and stocked separately and can be assembled to form the required assembly at indicated maintenance categories.
X	Parts and assemblies which are not procured or stocked and the mortality of which normally is below that of the applicable end item or component. The failure of such part or assembly should result in retirement of the end item from the supply system.
X1	Repair parts which are not procured or stocked. The requirement of such items will be filled by use of the next higher assembly or component.
X2	Repair parts which are not stocked. The indicated maintenance category requiring such repair parts will attempt to obtain them through cannibalization. Where such repair parts are not obtainable through cannibalization, requirements will be requisitioned, with accompanying justification, through normal supply channels.
G	Major assemblies that are procured with PEMA funds for initial issue only as exchange assemblies at DSU and GSU level. These assemblies will not be stocked above GS and DS level or returned to depot supply levels.

(2) Maintenance code indicates the lowest category of maintenance authorized to install the listed item. The maintenance level code is:

Code	*Explanation*
C	Operator/crew

(3) Recoverability code indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are expendable. Recoverability codes are:

Code	*Explanation*
R	Applied to repair parts (assemblies and components) which are considered economically repairable at direct and general support maintenance levels. When the maintenance capability to repair these items does not exist, they are normally disposed of at the GS level. When supply considerations dictate, some of those repair parts may be listed for automatic return to supply for depot level repair as set forth in AR 710-50. When so listed, they will be replaced. by supply on an exchange basis.
S	Repair parts and assemblies which are economically repairable at DSU and GSU activities and which normally are furnished by supply on an exchange basis. When items are determined by a GSU to be economically repairable they will be evacuated to a depot for evaluation and analysis before final disposition.
T	High dollar value recoverable repair parts which are subject to special handling and are issued on an exchange basis. Such repair parts are normally repaired or overhauled at depot maintenance activities.

Code	Explanation
U	Repair parts specifically selected for salvage by reclamation units because of precious metal content, critical materials, or high dollar value reusable casings or castings.

b. Federal Stock Number. This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Description. This column indicates the Federal item name and any additional description of the item required. The abbreviation "w/e", when used as a part of the nomenclature, indicates the Federal stock number includes all armament, equipment, accessories, and repair parts issued with the item. A part number or other reference number is followed by the applicable five-digit Federal supply code for manufacturers in parenthesis. Repair parts quantities included in kits, sets, and assemblies are shown in front of the repair part name.

d. Unit of Measure (U/M). A 2 character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

e. Quantity Incorporated in Unit. This column indicates the quantity of the item used in the assembly group. A "V" appearing in this column in lieu of a quantity indicates that a definite quantity cannot be indicated (e.g., shims, spacers, etc.).

f. Quantity Furnished With Equipment. This column indicates the quantity of an item furnished with the equipment.

g. Illustration. This column is divided as follows :

(1) *Figure number.* Indicates the figure number of the illustration in which the item is shown.

(2) *Item number.* Indicates the callout number used to reference the item in the illustration.

C-4. Abbreviations

ea ----------each
in.----------inch
v----------volt

C-5. Federal Supply Code for Manufacturers

Code	Manufacturer
89905--	----------Wild Heerbrugg Instruments, Inc.

Section II. BASIC ISSUE ITEMS

(1) SMR Code	(2) Federal stock number	(3) DESCRIPTION Ref no. & mfr code / Usable on code	(4) Unit of meas	(5) Qty inc in unit	(6) Qty furn with equip	(7) Illustration (A) Fig no.	(7) Illustration (B) Item no.
		GROUP 01—ACCESSORIES					
PC	8330–965–1722	CHAMOIS LEATHER KK–C00300 (81348)	ea		1		
PC	6675–378–9401	COVER, Instrument NT2–549A (89905)	ea		1		
		GROUP 02—PUBLICATIONS					
		DA TECHNICAL MANUAL TM 5–6675–270–15	ea		1		
		GROUP 03—REPAIR PARTS					
PC	6135–120–1020	BATTERY, DRY, 1.5V BA30 (83642)	ea	4			
PC	6675–997–4333	CAP, DUST FOB–01090 (89905)	ea	1	1		
PC	6675–997–4335	HAND LAMP ASSEMBLY GEB1–00000–66 (89905)	ea	1	1		
PC	6675–997–4328	SUNGLASS G0F4–00001 (89905)	ea	1	1		
PC	6675–997–4338	SUNGLASS G0F5–00000 (89905)	ea	1	1		
		GROUP 04—TOOLS					
PC	7920–205–0565	BRUSH, DUSTING : MIL–B–43363 (81349)	ea		1		
PC	6675–353–4103	PIN, ADJUSTING 3A–55 (89905)	ea		2		
PC	5120–446–2860	SCREWDRIVER, JEWELER'S HDW1–10 (89905)	ea		1		
PC	5120–429–2948	SCREWDRIVER, JEWELER'S HDW1–5 (89905)	ea		1		
PC	5120–378–9520	WRENCH, TRIPOD 3A–29 (89905)	ea		1		

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By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

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THE METRIC SYSTEM AND EQUIVALENTS

'NEAR MEASURE

. Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

'VEIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

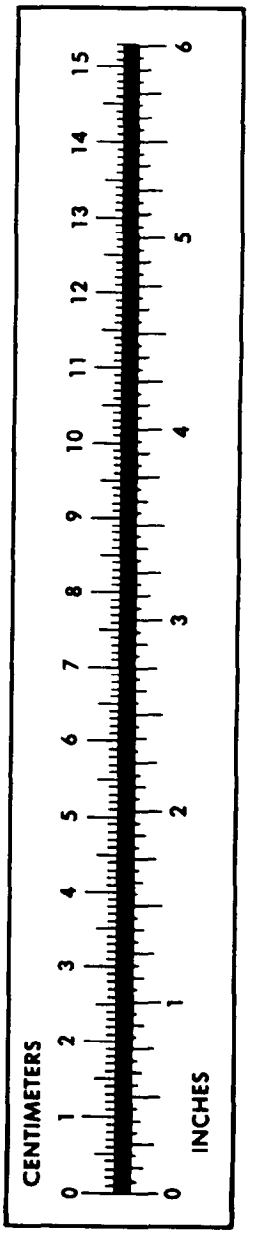
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
ıts	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
ers	Gallons	0.264
ms	Ounces	0.035
ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
lometers per Liter	Miles per Gallon	2.354
meters per Hour	Miles per Hour	0.621



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