

(NAVSHIPS 250-624-11)

**MANUAL FOR
OVERHAUL, REPAIR, AND HANDLING OF
MARINE MERCURIAL BAROMETERS
WITH PARTS CATALOG**

Contract NObs-47863

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DEPARTMENT OF THE NAVY
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MARINE MERCURIAL BAROMETERS, WELCH MAKE

This publication will be known as: "Manual for Overhaul, Repair, and Handling of Marine Mercurial Barometers, Welch Make, with Parts Catalog."

This manual, prepared with the assistance and cooperation of certain U. S. Navy repair activities and W. M. Welch Manufacturing Company, Chicago, Illinois, is promulgated for the information and guidance of all personnel in the Naval Establishment engaged in the servicing, repair, and testing of mercurial barometers.

This manual is available for public sale through the Superintendent of Documents, Washington 25, D. C.

A handwritten signature in black ink, appearing to read "H. N. Wallin". The signature is written in a cursive style with a large initial "H" and "N".

H. N. Wallin,
Chief, Bureau of Ships

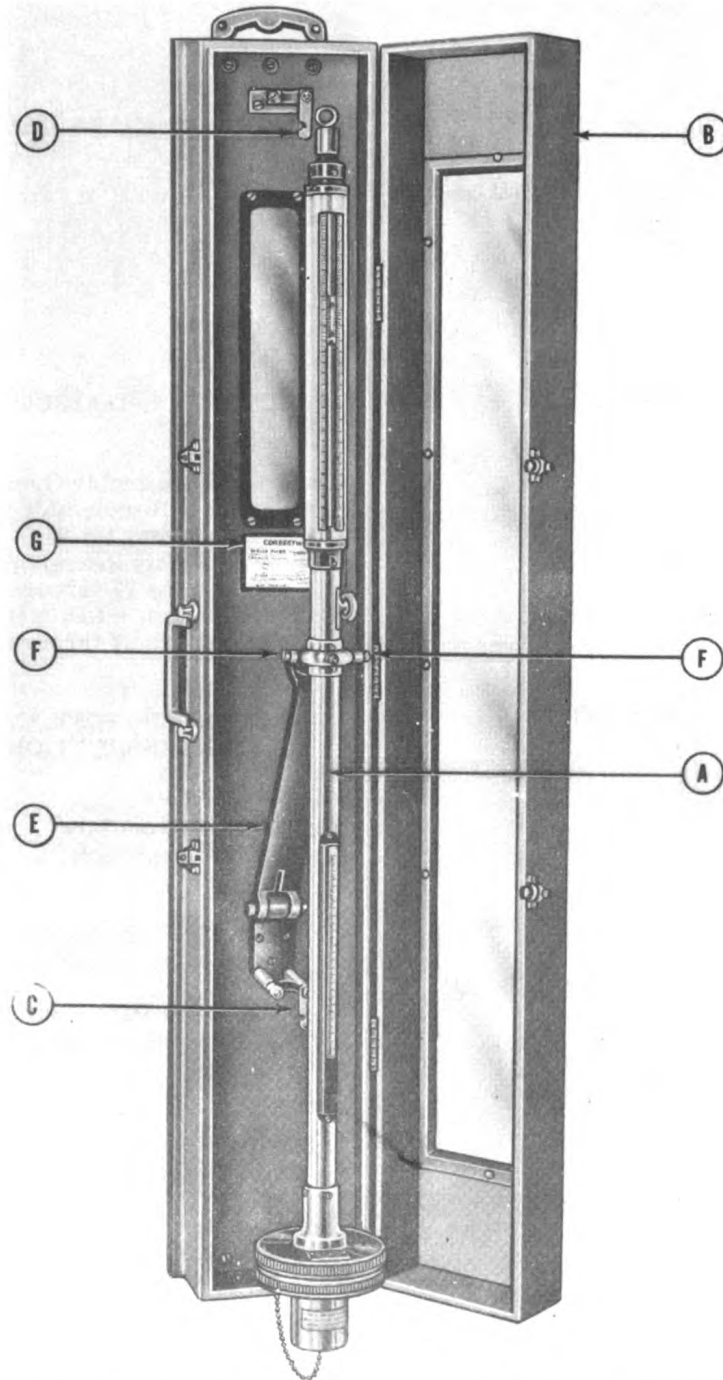
TABLE OF CONTENTS

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TABLE OF CONTENTS

SECTION I—INTRODUCTION		SECTION V--REASSEMBLY PROCEDURE	
	Page No.		Page No.
Types of Mercurial Barometers	1	Order of Reassembly Operations	36
Outline of Repair Procedure	2	Subassembly Reassembly Operations	38
Personnel Requirements	3	Operations 1 through 76	
Civilian Personnel Skill		Major-assembly Reassembly Operations	55
Requirements and Advancement	3	Operations 77 through 86	
		Barometer Case—Reassembly Operations	57
		Operations 87 through 99	
 SECTION II—DESCRIPTION		 SECTION VI—TEST, CALIBRATION AND FINAL INSPECTION PROCEDURE	
Principles of Operation	5	Test Procedure	60
Performance Requirements	8	Calibration Procedure	61
Critical Points of Repair	9	Final Shop Inspection	66
Mercurial Barometer Differences	10		
 SECTION III—DISASSEMBLY PROCEDURE		 SECTION VII—MAINTENANCE PARTS CATALOG	
Order of Disassembly Operations	11	Explanation of Part Listings	67
Pre-disassembly Inspection Operations	12	Group Assembly Parts List and	
Major-assembly Disassembly Operations	14	Exploded Views	69
Operations 1 through 8			
Subassembly Disassembly Operations	17	 SECTION VIII—SPECIAL SERVICE TOOLS AND TEST APPARATUS	
Operations 9 through 49		Acknowledgment of Source	79
Barometer Case Disassembly Operations	25	Naval Repair Facilities	79
Operations 50 through 61		Beneficial Suggestion Program	79
		Enlisted Personnel	79
		Instrument Manufacturers	79
 SECTION IV—PARTS INSPECTION REPAIR AND CLEANING		 SECTION IX—MERCURIAL BAROMETER SPECIAL SERVICE BULLETINS	
Parts Inspection Operations	28	Introduction	83
Parts Repair Operations	30		
Cleaning Operations	35		

MERCURIAL BAROMETERS



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|------------------------|------------------------|
| A. Barometer Assembly | D. Upper Support Latch |
| B. Barometer Case | E. Gimbal Arm |
| C. Lower Support Latch | F. Gimbal Pivot Screw |
| | G. Correction Card |

Figure 1—Marine Mercurial Barometer

SECTION I

INTRODUCTION

PURPOSE AND PLAN OF REPAIR MANUALS FOR NAVIGATIONAL INSTRUMENTS

Each of these manuals on the repair of navigational instruments has several purposes:

1. To make an adequate record of know-how at the time the information was prepared.
2. To establish standard practice for the particular instrument.
3. To provide a manpower training tool for newcomers to the field, especially in cases of national emergency, when working forces must be expanded rapidly.
4. To form a foundation or base from which the quality of repair may be constantly improved, and the cost of repair reduced.

This standard repair practice manual will provide the groundwork for establishing standard allowable repair times by which performance may be judged.

Methods Employed

Prior to the preparation of this manual, an engineering survey of repair methods was conducted in Naval shipyards and in the plants of manufacturers. Consequently, the methods selected as standard repair practice are an integration of the best and most modern in

Naval repair activities and those used by instrument manufacturers.

Methods Improvement

This handbook, as you see it, is by no means the final word. It is hoped that it will be subject to continuous change.

The Navy wishes each one working with navigational instrument repair to become "methods-conscious." It would like you to contribute ideas for further improvements to standard practice. Your suggestions should be cleared with your foreman and he will then submit them to the Beneficial Suggestions Committee. The Committee will forward each suggestion to the navigational instruments authority of the Bureau of Ships. There, it will be properly evaluated and, if adopted, you will be given credit and the appropriate portion of this manual will be changed.

Why is this opportunity being offered? Because everyone wants to do his or her share in improving methods and reducing repair costs. After this standard practice has first been put into effect, nobody but a person using it is in the best position to recommend improvement. You are the expert, so put your ideas to work. Take advantage of this chance to better your own position and, at the same time, increase the efficiency of instrument repair.

This manual contains instructions for the overhaul, repair and handling of marine mercurial barometers currently in use in the Navy. The instrument covered in this manual was manufactured to joint Army-Navy specification JAN-B-84 by the W. M. Welch Mfg. Company, Chicago, Illinois. See the parts list in Section VII, "Maintenance Parts Catalog," for the instrument's stock number.

Under the heading "Barometer Differences" in Section II of this manual a barometer manufactured by the Friez Instrument Division of the Bendix Aviation Corporation, Baltimore, Maryland, is compared to the Welch make barometer. This comparison is made so that the overhaul procedure outlined in this manual for the Welch make can be employed for the repair of Friez

barometers, providing the differences between the two are kept in mind.

Each barometer bears a name plate which is engraved as follows.

U.S.NAVY, BU.SHIPS
(Serial number) (Date)

MANUFACTURED BY
(Name of manufacturer)
(Address)

The present allowances of mercurial barometers to the vessels and ships of the Navy are indicated on the ship's allowance list.

MERCURIAL BAROMETERS

Preparation for Repair

The preliminary classification of the instruments awaiting repair in the Instrument Control Center is of fundamental importance in instrument repair. Barometers should be sorted by make into lots of similar instruments to be processed through the different phases of the repair procedure at the same time. Since mercurial barometers are a comparatively low allowance item, the lots available for processing will be small. To process even a few barometers at one time, however, will allow the benefits of flow-line production.

A pre-disassembly inspection of each instrument will determine whether the instrument is worth repairing and, if so, the extent of repair required. The repair procedures are arranged to provide convenient instruction for overhauling an entire instrument or for repairing merely a component.

A general description of the mercurial barometer and of the points which are of special importance in repair work may be obtained by reference to Section II of this manual. All repair personnel should become thoroughly familiar with the information contained in that section.

OUTLINE OF REPAIR PROCEDURE

The repair work itself is divided into four main classes of activity:

- (1) Disassembly (Section III)
- (2) Parts Inspection, Repair and Cleaning (Section IV)
- (3) Reassembly (Section V)
- (4) Test, Calibration and Final Inspection (Section VI)

The "Maintenance Parts Catalog," Section VII, and the index of "Special Service Tools and Test Apparatus," Section VIII, are supplementary to the repair operation sections. The material in Section II on "Performance Requirements" and "Critical Points of Repair" contains information which is of great value to all repair personnel.

An additional and important supplement is the Bureau of Ships Navigational Instrument Control Manual. All general procedures and techniques are set forth in that volume. Its section entitled "Navigational Instrument Repair Inspection Standards" specifies the inspection standards and authorizes repairs. This volume will be referred to as the "Control Manual." Use its index to all material pertinent to the particular references in the repair operations.

The repair instructions in any of the major operation sections of this manual may be carried out by one or more persons. After the

work is completed the barometer, or its component parts, will be returned to the Instrument Control Center.

If the volume of work is sufficient, barometers may flow directly from one section of operations to the next without returning to the Instrument Control Center. The decision to set up a flow-line is left to the discretion of the supervisor.

The Instrument Control Center, referred to in the preceding paragraphs, is the clearing house for all work within the repair facility. It serves to level off and control the flow of work. The personnel of the Center receive the instruments in for repair and they perform the initial sorting, by make, into lots for processing through the repair operations. Repair personnel draw their work (whole instruments or the parts of single instruments in parts trays) from the Center and return it to the Center upon completion of their work. After final inspection, the completed instrument is returned to the Center where it is processed for shipment or storage.

Disassembly

A pre-disassembly inspection is performed to determine whether the barometer is to be overhauled, or surveyed and its parts salvaged. If it is to be overhauled, the extent of disassembly necessary to allow for correction of defects is determined. Inspection decisions and the required disassembly are to be recorded on a route ticket. This ticket will accompany the barometer throughout the repair procedures. All repair personnel who work on the barometer will sign the route ticket. During the pre-disassembly inspection, performance and usage data is collected by the inspector. This information will be of value to the Bureau of Ships as a basis upon which to develop and redesign mercurial barometers.

The subassemblies are removed and broken down as indicated on the route ticket by the pre-disassembly inspector. The disassembled parts and all components of each mercurial barometer are placed in an individual parts tray and returned to the Instrument Control Center.

Parts Inspection, Repair and Cleaning

The parts inspector draws the disassembled parts from the Instrument Control Center. The parts are inspected and replaced, or repaired, if found to be defective. The "Parts Inspection Standards" in the Control Manual authorize the allowable repair time for all parts; these standards are a basis for deciding when to repair and when to replace. Additional data on wear, defects and failure of parts is recorded by the parts inspector. This data supplements that already collected by pre-disassembly inspector.

INTRODUCTION

The parts inspector has the responsibility of preparing a complete set of serviceable parts for the reassemblers. After repairs and replacements have been made, all the mechanical parts are cleaned, including those parts contaminated by mercury. The parts tray containing a full set of parts is then returned to the Instrument Control Center.

Reassembly

The reassembly procedure is in the form of step-by-step operations. Special emphasis is placed upon the reassembly of critical parts. Positioning operations on the inch and millibar scales are carried out during the test and calibration operations—for this reason these parts are assembled loosely. The glass guard is not reassembled, neither is the barometer assembly reassembled in its case, until the instrument has been processed through the test and calibration operations in Section VI. The partially assembled mercurial barometer is returned to the Instrument Control Center.

Test, Calibration and Final Inspection

The mercurial barometer is inspected for cleanliness, overall condition and completeness of parts to make certain that previous work has been carried out correctly, and before any time is invested in test and calibration. The barometer is then tested and calibrated to insure that it meets the "Performance Requirements" as outlined in Section II of this manual. It is then coded in accordance with the specifications listed under "Coding" in the Control Manual.

If the instrument will not meet the performance requirements, the mercury tube must be replaced and the barometer retested. If the instrument fails the initial inspection, it indicates poor workmanship. The instrument is returned

for correction to the individual concerned, as determined by the route ticket.

The completed barometer is forwarded to a navigational instrument inspector who gives it a final independent inspection. If it passes this final inspection, the instrument is cleared through the Instrument Control Center and packed for shipment or storage in accordance with instructions in the Control Manual.

During the entire repair procedure, the route ticket accompanying each barometer is signed by the persons performing the various operations. This provides a complete work history of the instrument's overhaul.

The intent and purpose of the repair procedure outlined in the foregoing paragraphs is to raise and maintain all mercurial barometers at the highest authorized performance and serviceability levels. The procedure is designed to afford the opportunity to plan the flow of work and to utilize the best in methods and techniques so as to lower repair costs.

PERSONNEL REQUIREMENTS

The efficiency of the repair of navigational instruments depends to a large extent upon the proper utilization of various personnel skills. The required levels of personnel skills, for the operations within each section of this manual, are listed in the introductory material to each section. The skills so designated are the lowest economic levels that can be utilized to perform successfully the technicalities involved.

The following Table I is a general outline of the required skills which can be used successfully, without interim instruction. Where higher

TABLE I—CIVILIAN PERSONNEL SKILL REQUIREMENTS

SECTION	CIVILIAN PERSONNEL
Disassembly Procedure	
Pre-disassembly Inspection Operations	Instrument Repairman, Senior Grade
Disassembly Operations	Mechanical Instrument Assembler, Junior Grade
Parts Inspection, Repair and Cleaning	Instrument Repairman, Junior Grade
Reassembly Procedure	Mechanical Instrument Assembler, Senior Grade
Test, Calibration and Final Inspection Procedure	Instrument Repairman, Junior Grade

MERCURIAL BAROMETERS

or lower skill levels are applicable or necessary for particular operations, they are designated in the text of this manual at the appropriate point.

To provide the basis for a continuous training program, a training path is outlined in Table

II. The listed skills in the "From" column can be used under supervision for the specific operations. Such a program will provide a pool of "key personnel" for rapid expansion of repair staffs in times of national emergency.

TABLE II

TRAINING STEPS	CIVILIAN PERSONNEL ADVANCEMENT	
	From	To
Disassembly Operations (Not Inspection)	Mechanical Instrument Assembler, Trainee	Mechanical Instrument Assembler, Junior Grade
Reassembly Operations	Mechanical Instrument Assembler, Junior Grade	Mechanical Instrument Assembler, Senior Grade
Parts Inspection and Repair Operations and Test, Calibration and Final Inspection Operations	Mechanical Instrument Assembler, Senior Grade	Instrument Repairman, Junior Grade
Pre-disassembly Inspection Operations	Instrument Repairman, Junior Grade	Instrument Repairman, Senior Grade

It is important that all repair personnel, and especially trainees at the beginning of their training period, acquire an understanding of the information contained in Section II of this

manual. Section II tells HOW a mercurial barometer works, WHY certain test requirements must be met and WHAT to look out for when repairing barometers.

SECTION II

DESCRIPTION

This section tells you, as a repairman, how a mercurial barometer works, and how it is used to determine atmospheric pressures. The performance requirements which the instrument must meet, in order that it will give accurate readings, are also outlined for your reference.

To further aid you in your work, those repair operations which require special attention are outlined in this section under the heading "Critical Points of Repair."

The repair procedure set forth in this manual is for the Welch make mercurial barometer. However, if you study the information under "Barometer Differences" in this section, you will be able to apply this repair procedure to the Friez make mercurial barometer.

PRINCIPLES OF OPERATION

The marine mercurial barometer is primarily a weather instrument. It is used to detect the local rise and fall of atmospheric pressure (air pressure) which accompanies a change in weather conditions. It is also used as a reference in checking and correcting various instruments that depend upon atmospheric pressure for their operation. The aerologist can foretell a change in the weather and the severity of an approaching storm by observing the rate of rise or fall of the mercury column in the barometer.

The principle of the mercurial barometer of today is essentially that perfected by Torricelli in 1643. He took a glass tube, sealed at one end and filled it with mercury. By inverting the open end of the tube into a dish filled with mercury, he found that the level of the mercury in the tube fell until it reached a certain height. The weight of the column of mercury remaining in the tube he knew to be sustained by the downward pressure of the air upon the surface of the mercury in the dish. The height of the top of the mercury column above the surface of the mercury in the dish was

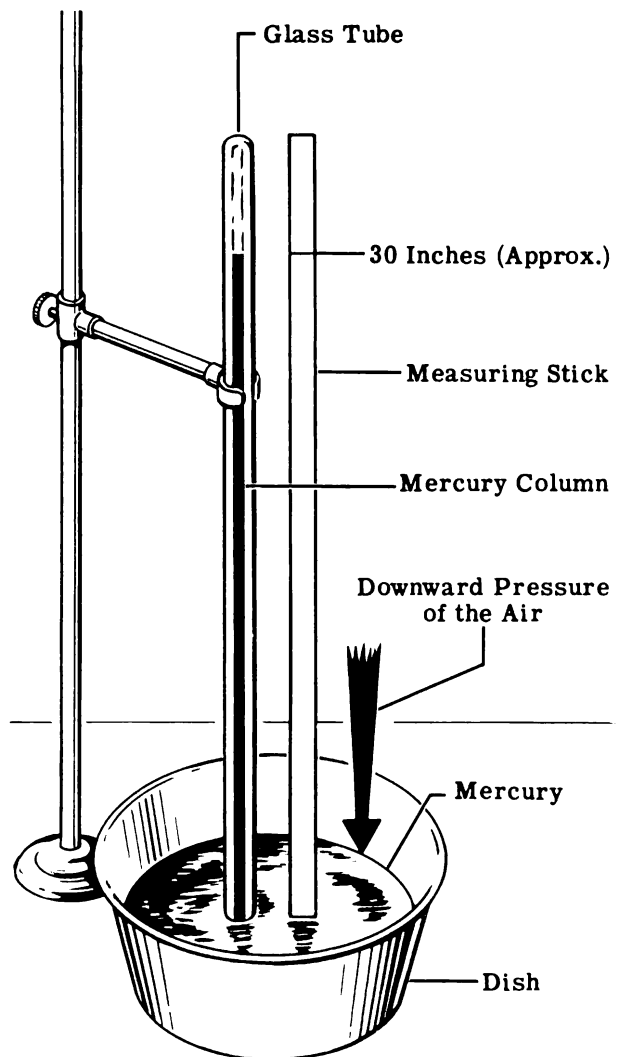


Figure 2

therefore a measure of the air pressure, or atmospheric pressure. See Fig. 2.

Normal atmospheric pressure, that is at sea-level, he found would support a column of mercury approximately 30 inches in height.

MERCURIAL BAROMETERS

The mercurial barometer that you will have to repair is basically the same as the one Torricelli built with certain features added. These features increase the accuracy of the readings and the stability of the mercury column. They also greatly increase the ease with which the barometer may be moved from one location to another.

Glass Tube

The glass tube is very similar to the one Torricelli used. Certain refinements have been added, however, to increase the accuracy of readings taken from the barometer. The tube is made of well-seasoned lead glass and is blown to specified dimensions within close tolerances. These close tolerances are necessary to insure that the tube will perform within certain standards of test and calibration that have been set.

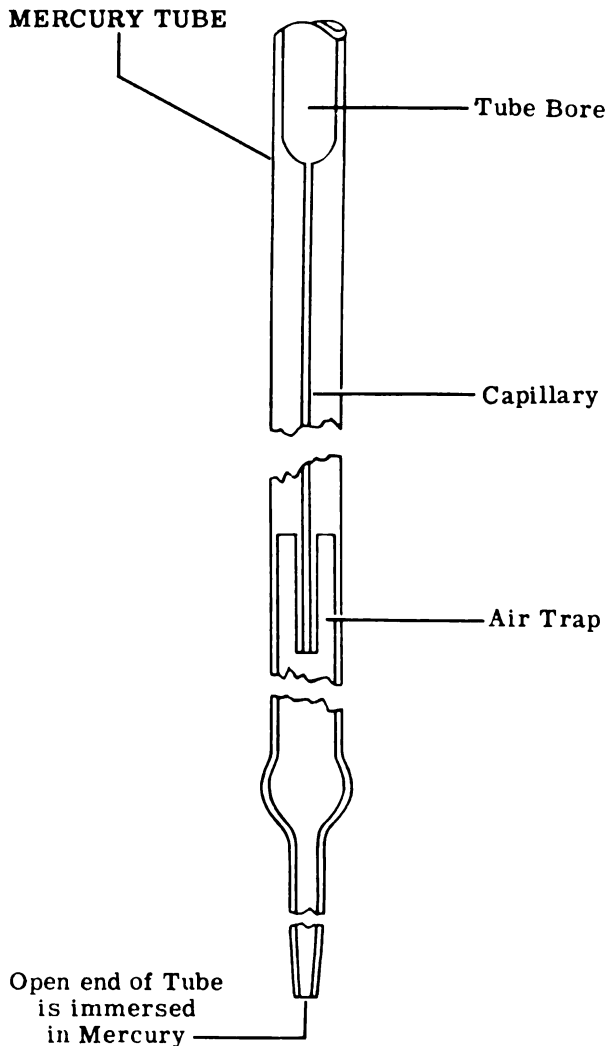


Figure 3

Refer to "Performance Requirements" in this section. As shown in Fig. 3, the lower portion of the tube bore has been narrowed down to form a capillary. This capillary permits a relatively slow change in the mercury column due to a change in atmospheric pressure, but guards against a rapid rise of the mercury column due to the roll or pitch of a ship. The open end of the tube is immersed in mercury contained in a cistern. An air trap is also provided in the glass tube to catch any small air bubbles that may find their way into the tube and which, if allowed to enter the column of mercury, may destroy the vacuum above the mercury.

Cistern Assembly

This assembly takes the place of the dish in the Torricelli barometer. The cistern assembly consists of a top and a bottom cistern, joined together by a doeskin cistern seal. See Fig. 45 in Section V of this manual.

The doeskin cistern seal acts as a flexible joint between the top and bottom cisterns, containing the mercury within the system and at the same time permitting air to pass through so that the pressure of the atmosphere can act on the surface of the mercury. The flexibility of the doeskin cistern seal also allows the top and bottom cisterns to be moved together, thus forcing the column of mercury to the top of the tube. This is done so that there will be no swishing back and forth of the mercury column with possible damage to the glass tube while the barometer is being transported. Movement of the bottom cistern up to the top cistern is accomplished by means of a cistern adjusting screw. See the exploded view, Fig. 64, in Section VII of this manual.

There is a smaller doeskin tube-to-top cistern seal between the glass tube and the upper cistern of the cistern assembly. This forms a seal which can easily be renewed should the substitution of a new glass tube be necessary. See Fig. 46 in Section V of this manual.

Cistern Covers

A metal housing is used to protect the cistern assembly from damage. This housing consists of a top cistern cover and a bottom cistern cover which screw together. The bottom cover is so constructed as to receive the cistern adjusting screw which is used to raise and lower the bottom cistern of the cistern assembly, as mentioned in the preceding paragraph.

Indicating System

In order to obtain accurate readings of the height of the mercury column, two scales replace the measuring stick used with the Torricelli barometer. These scales are mounted on the tube housing. One of these scales is divided into inches and the other one is divided into units called "millibars." The millibar is the unit of atmospheric pressure used by the U. S. Weather Bureau and the British. It is the one-thousandth part of a bar, a bar being a measure of barometric pressure equal to that of a column of mercury 29.531 inches in height, measured at 32 degrees F and 45 degrees latitude. Between the two scales is a sliding vernier scale which permits a more accurate reading of either scale. See the exploded view, Fig. 65 in Section VII, for these parts.

Taking a Reading from the Barometer

Before taking a reading, tap the barometer lightly with your finger tips; this will round the mercury meniscus and break loose any mercury particles clinging to the mercury tube.

Using the vernier pinion knob, raise the vernier scale above the mercury meniscus. Then lower it until the bottom of the vernier scale is brought exactly tangent with the highest point of the mercury meniscus. When the vernier scale is properly adjusted, two areas very nearly triangular in shape will be seen to the left and right of the mercury summit. See Fig. 4. The height of the mercury column can now be read from the barometer scales.

Reading the Inch Scale—Read the value on the inch scale first. Take the full scale value of the first graduation BELOW the zero index line at the bottom of the vernier scale. In the case of the vernier scale setting shown in Fig. 4, the scale reading is 29.250 inches.

Next, follow the inch scale and the vernier scale with your eye until a point of coincidence of graduations on both scales is seen. In Fig. 4 the vernier scale reading is 0.042 inch at the point of coincidence. The total observed barometer reading is 29.292 inches ($29.250 + 0.042$).

Reading the Millibar Scale—This reading is taken in a similar manner to that previously described. The full scale value of the first graduation on the millibar scale BELOW the zero index line of the vernier scale is 990 millibars. The point where the vernier scale and millibar scale graduations coincide gives a value of 1.9 millibars on the vernier scale. The total observed barometer reading is 991.9 millibars ($990 + 1.9$).

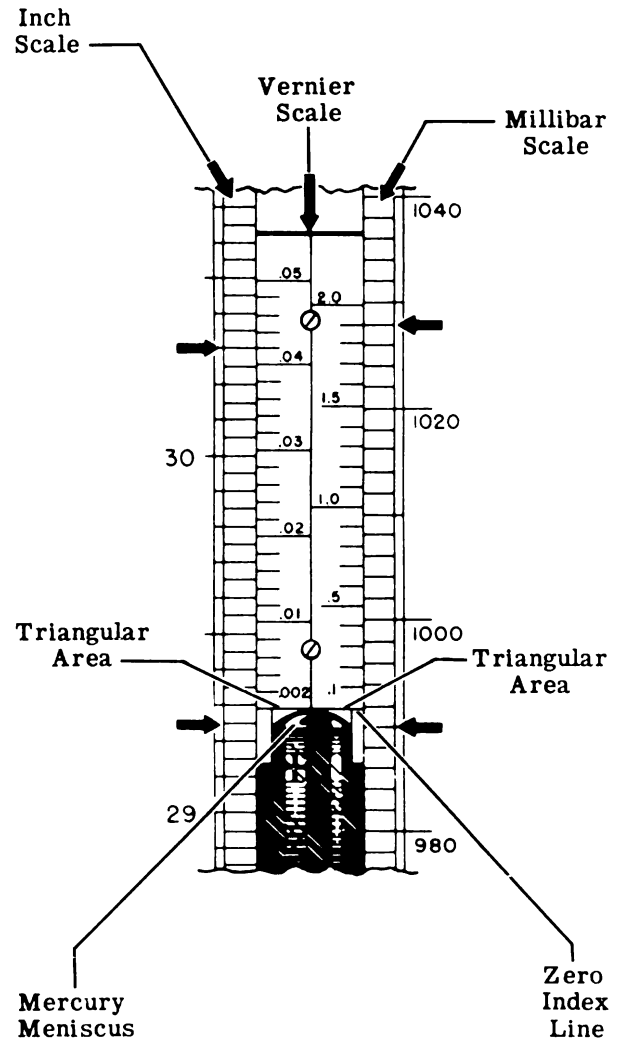


Figure 4

Barometer Case Assembly

A metal case is provided to house the barometer. It is designed so that the barometer, mounted in the case, can be secured to a wall or to the bulkhead of a ship. The barometer is mounted in a gimbal ring attached to a gimbal arm that permits the barometer to remain in a vertical position in spite of the motion of the ship in a rough sea. When not in use, the barometer can recede into the case where it is secured by an upper and a lower support latch. There is a window in the cover of the case permitting the height of the mercury column to be observed when the barometer is secured. Accurate readings, however, can only be obtained when the barometer has been swung forward out of the case. A reflector glass is mounted in the case in back of the barometer so that the top of the mercury column may be more easily observed. See the frontispiece, and the exploded view, Fig. 63, in Section VII.

MERCURIAL BAROMETERS

PERFORMANCE REQUIREMENTS

There are certain performance requirements which each marine mercurial barometer must meet if it is to give accurate readings when in use. These requirements are set forth in the following paragraphs for your information. The thoroughness with which all repair operations are carried out has a marked effect on the barometer's performance and length of serviceable life.

Accuracy of Barometer Readings

The mercurial barometer is used by Naval ships and shore establishments as a reference in checking and correcting various pressure instruments and in discerning slight pressure changes. Since decisions involving many human lives and much valuable equipment are often based upon the readings of these instruments and the readings of the mercurial barometer, itself, the need for a high degree of accuracy can be appreciated.

In order to record the actual variation between the barometer reading and the true atmospheric pressure, the repaired barometer is calibrated against a secondary standard barometer. The errors (difference in readings between the standard and repaired barometer) are noted at pressures of 30, 28, and 26 inches and recorded on a calibration card.

The inch scale must be positioned so that all the indicated readings of the repaired barometer will agree with those obtained from a standard barometer within ± 0.012 inch. The millibar scale is aligned with the inch scale after the inch scale is correctly positioned.

See "Calibration Procedure" in Section VI for a detailed discussion of the methods employed. Refer also to "Positioning the Millibar Scale" in the same section and "Purpose of Calibration" for details of the secondary standard barometer.

Response of the Mercury Column

A test of the steadiness of the mercury column in rough weather is made on the barometer by raising it vertically two feet and then lowering it; this is repeated evenly and smoothly six or eight times, at the rate of two seconds rising time and two seconds falling time. The height of the column is noted while the motion is taking place. For a satisfactory performance, the height of the column must not vary more than 0.10 inch above or below the true reading.

Reaction Time Test

A further check is made on the response of the mercury column by moving the bottom of the barometer a distance of 16 inches quickly to one side and noting the time interval required for the mercury column to pass designated scale graduations. The first two readings taken are the times required for the mercury to rise from 30 to 31 inches, and from 30 to 32 inches. The barometer is then returned quickly to a vertical position and the times recorded for the mercury to fall from 32 to 31 inches, and from 32 to 30 inches. The mercury column must resume its former true level within ± 0.005 inch in not more than 240 seconds. This test should be made when the barometric pressure is approximately 30 inches, which is generally the normal pressure at sea level. Table III outlines the allowable time limits for the designated

TABLE III

CHANGE IN COLUMN HEIGHT	TIME LIMIT
Rise from 30 to 31 inches (or 1 inch from initial height)	8 to 18 seconds
Rise from 30 to 32 inches (or 2 inches from initial height)	16 to 44 seconds
Fall from 32 to 31 inches (or 1 inch from top level)	12 to 30 seconds
Fall from 32 to 30 inches (or 2 inches from top level) to within ± 0.005 inch of former true level	240 seconds maximum

scale graduations. Details of the manner in which this test is performed are given under "Test Procedure" in Section VI of this manual.

Consistency

The barometer must be checked for consistent readings at the same atmospheric pressure by disturbing the mercury column and recording the time necessary for it to return to the original reading. The barometer is tilted to bring the column 0.10 inch above its reading in the vertical position and then returned to the vertical position. The mercury column must return to its former true level within ± 0.005 inch in not more than 240 seconds.

CRITICAL POINTS OF REPAIR

The instructions within the repair sections of this manual are complete; however there are certain critical points in the repair procedure with which you should be acquainted. Knowing them in advance will make the repair job easier for you and others who may perform the rest of the repair operations. Remember that there are some parts in the barometer that were fitted and matched by the manufacturer. Keep the parts of each barometer together for reassembly with each other.

Matched Parts

The top and bottom cistern covers are locked together by a cistern cover set screw. The hole for this screw was drilled and tapped by the manufacturer after the covers were assembled. A clearance of 1/32 inch is allowed between the covers, and the necessary number of cistern cushioning washers were assembled to hold the top cistern tightly in place. Keep the top and bottom cistern covers together with the cistern cushioning washers, or washer. If any but original parts are assembled, a new hole for the cistern cover set screw will have to be drilled and tapped. See the exploded views, Figs. 64 and 65, in Section VII for details of the parts mentioned here.

The cistern adjusting screw and the adjusting screw knob are locked together by the knob set screw. The hole for this screw is drilled and tapped by the manufacturer after the parts are assembled. Keep the parts together. If other than original parts are reassembled the hole for the lock screw will not align; this will necessitate drilling and tapping of a new hole. See the exploded view, Fig. 64, in Section VII for details of the parts mentioned here.

Mercury-filled Tube

If a new mercury-filled tube is to be assembled, it must be cut to the correct length. Great care must be taken to insure that during the cutting process no foreign matter is allowed to find its way to the top of the mercury column.

Health Hazard

Mercury is poisonous; do not expose yourself and your fellow workers to unnecessary hazards from spilled mercury or from its fumes. When mercury is burned off from contaminated parts, the burning should always be carried out under an exhaust hood which is vented to the outside atmosphere. Be sure to wash your hands after handling anything that has been in contact with mercury.

Handling of Mercury

Mercury amalgamates (combines) very readily with certain metals, especially gold and silver. All watches and rings should be removed, to avoid possible damage to them, while repairing mercurial barometers.

Mercury is costly, so salvage all you can from damaged barometers and be sure to retrieve any that spills in handling.

Cleanliness

A most important factor in the accuracy of the barometer is the cleanliness of the mercury, the mercury tube, the top and bottom cisterns and the cistern seal. Since mercury is very dense, dirt and foreign particles will float to the surface, thereby interfering with the accuracy of a reading at the meniscus. Mercury, if exposed to air over a period of time, oxidizes and forms a black powder which will cling to the glass tube. Thus the mercury used in the barometer must be chemically pure and free from air bubbles, and all surfaces in contact with it must be clean. Mercury will be procured from the manufacturer in a chemically pure state. Make sure that the containers into which you may put it are absolutely clean.

Cistern Seal and Tube-To-Top Cistern Seal

The utmost care must be exercised in replacing the cistern seal, and the tube-to-top cistern seal. Mercury will leak out if the seals are not tied tightly, or if there are wrinkles in the seals. Applying the linen thread binders

MERCURIAL BAROMETERS

too tightly introduces the danger of cutting into the seals and causing a break in them. It is important that a new seal be thoroughly inspected for cracks or pinholes. Remember that neat and careful work will produce a good seal. A sloppy or careless job, while it may give temporarily satisfactory results, will eventually cause trouble. See the exploded view, Fig. 66, in Section VII for parts.

Handling of the Barometer

When moving the barometer from one location to another, be sure that the mercury column has been raised to the top of the tube by means of the cistern adjusting screw knob. This will prevent damage to the mercury tube. Consider, also, that the vacuum above the mercury column can be lost if the tube is tilted too far (more than 30 degrees) to one side with the cistern adjusting screw in the down position.

Modifications

Vernier Pinion Spring Washer—A vernier pinion spring washer is to be assembled between the vernier pinion and the vernier rack and pinion bearing.

Spotfacing the Vernier Rack and Pinion Bearing

—The vernier rack and pinion bearing is to be spotfaced so as to provide a flat surface for the vernier pinion knob. With the vernier pinion spring washer assembled between the vernier pinion and the vernier rack and pinion bearing, the vernier pinion knob seats firmly on the spotfaced area when assembled. This prevents side shake and end play in the vernier pinion.

Stop Screw—Some Naval repair facilities added a stop screw in the lower rim of the bottom cistern cover to prevent the cistern adjusting screw knob from being turned too far. This screw if assembled is to be removed and is not to be reassembled.

Modification A—This modification consists of the addition of two parts to the bottom cistern cover and adjusting screw assembly. These parts are a thrust plate and an adjusting pad. The adjusting pad is made of rubber and supports the thrust plate which bears against the bottom cistern when assembled. The adjusting pad prevents excess pressure being applied to the bottom cistern by the cistern adjusting screw and so minimizes the danger of breakage to the mercury tube. In addition to the parts mentioned, a modified type of cistern adjusting screw is assembled which has a hole in it to

accommodate the adjusting pad. Also, a larger bottom cistern cover and adjusting screw cover are used. If the barometer received for repair does not have the modified bottom cistern cover and adjusting screw assembly, it must be modified by the parts repairman. Refer to Fig. 8 in Section III of this manual for details of the parts mentioned here and a comparison of the modified and unmodified assemblies.

Test, Calibration and Final Inspection

The test and calibration operations bring the mercurial barometer up to the authorized performance requirements. The instrument will be only as accurate as you make it in performing the calibration operations. All the previous work is wasted if the barometer is not carefully and correctly calibrated. The final inspection is the last opportunity to make sure that the barometer has been repaired properly.

The critical points of repair will have full meaning to you when you have carried out these repair operations on several barometers. Refer back to them from time to time to insure that you have them firmly fixed in your mind.

BAROMETER DIFFERENCES

The barometer made by the W. M. Welch Mfg. Company of Chicago, Model 18-B-990, is treated in this manual. This marine mercurial barometer is basically identical in design with Bendix-Friez Model 751-B. The Welch barometer is mainly used by BuShips and the Friez by BuAer.

The first 100 barometers furnished to the Navy by the Welch Company were made exactly like the Friez, then several minor changes were made, mainly to the case. The mercury cistern was changed from steel to bakelite. Friez now uses a bakelite cistern. Their earlier cistern was made of cast iron. The Welch barometer has no filler bushing and screw projecting through the cistern cover, as does the Friez. This filler bushing is used only at the time of manufacture or when a new tube is installed. The upper barometer support in the Welch barometer case is a casting with a latch to lock the barometer in the case. The Friez barometer uses a spring clip. For a detailed description of the Friez barometer see handbook AN 50-30FR-4 entitled "Handbook of Overhaul Instructions with Parts Catalog for Mercurial Barometer Bendix Friez Model 751-B."

The next section, Section III, concerns the start of the Disassembly Operations.

SECTION III

DISASSEMBLY PROCEDURE

**Skill Levels: Pre-disassembly Inspection—
Instrument Repairman,
Senior Grade**

**Major-assembly Disassembly
Operations (Nos. 1 through 8)—
Mechanical Instrument Assembler,
Junior Grade**

**Subassembly Disassembly Opera-
tions (Nos. 9 through 49)—
Mechanical Instrument Assembler,
Junior Grade**

**Disassembly Operations—Barom-
eter Case (Nos. 50 through 61)—
Mechanical Instrument Assembler,
Junior Grade**

INTRODUCTION

The operations in this section describe the standardized procedure for the efficient disassembly of the Welch make marine mercurial barometer.

This disassembly procedure can also be applied to the Friez make barometer, providing certain differences between this latter make and the Welch make are kept in mind. Before attempting the disassembly of a Friez make barometer, read the material contained under "Barometer Differences" in Section II of this manual.

The Welch make barometer is used as the subject of all illustrations in this section.

The procedure for a pre-disassembly inspection is also included in this section. This inspection is to determine whether an instrument is to be overhauled, or surveyed and salvaged for parts. If it is to be overhauled, the extent of disassembly required is determined and entered on the route ticket.

It will be most helpful to you if you are able to recognize and identify the different subassemblies and parts which are referred to in this section. These subassemblies and parts are listed and illustrated in the "Maintenance Parts Catalog," Section VII. Carefully study the appearance, names and relative position of the parts before commencing the disassembly operations.

Those operations that require the use of special tools and fixtures (other than common shop tools) include a reference by name and number to the "Special Service Tool List" in Section VIII. Use these special tools in all cases where they are provided. They were designed to help prevent damage and to make your job easier. If you have any ideas for improving the special tools or originating ones more adapted to the work, request permission from your supervisor to develop them under the Beneficial Suggestion Program.

The order of operations within this section is: Pre-disassembly inspection, removal of subassemblies, and disassembly of subassemblies to their component parts.

MERCURIAL BAROMETERS

PRE-DISASSEMBLY INSPECTION OPERATIONS

Skill Level: Instrument Repairman,
Senior Grade

Introduction

This pre-disassembly inspection is designed to raise the overall efficiency of repair operations. The results of this inspection are the basis for determining whether an instrument is worth repairing and its defects. For any instrument which is to be repaired, the extent of disassembly and the necessary repairs are recorded on the instrument's route ticket. Those instruments judged not worth repairing are to be surveyed and salvaged for usable subassemblies and parts.

The basis for the pre-disassembly inspection decision is that set forth in "Pre-disassembly Inspection Standards" in the Control Manual.

For the specific performance requirements and other detailed information on the marine mercurial barometer, see Section II.

Route Ticket

A route ticket will be attached to each barometer being inspected and processed for overhaul. You will record the findings of your inspection on the route ticket. This is to include the decision to repair or survey, all defects, indicated replacements, required disassembly and other pertinent data. A simple code system based on common defects and referenced to the repair operations within this manual should prove to be convenient.

You will sign each route ticket upon completion of your inspection. All personnel who perform repair operations on the instrument will also sign the route ticket upon completion of their work.

Performance and Usage Data

While performing pre-disassembly inspections you are in a good position to obtain data on service failures, defects and performance of barometers.

This data is invaluable to the navigational instrument section of the Bureau of Ships as a basis for redesign and development of the instrument. Collect such data and record it in statistical form. Information will be requested periodically of you on the specific "Usage Data

Check Points" as set forth in the Control Manual. If you observe any conditions that you feel to be important, report them to your supervisor. Your efforts in collecting and reporting this data will be greatly appreciated by the Bureau of Ships.

The parts inspector collects similar data on the parts he inspects. His report will be integrated with yours by the shop supervisor in all reports to the Bureau of Ships.

Standards and Disposition

As pre-disassembly inspector, you must be familiar with the "Pre-disassembly Inspection Standards" as outlined in the Control Manual. These define the inspection standards and the course of action to be taken to correct any defects which may be noted. Likewise, you must know the "Performance Requirements" peculiar to barometers which are given in Section II of this manual.

You must also be familiar with the inspection techniques as set forth in the Control Manual under "Inspection."

INSPECTION OPERATIONS

If a barometer is processed through all the applicable inspection operations which follow, all defects should be revealed. However, since certain defects are interdependent, all tests will not necessarily be performed in each case. In general, perform only those tests which are independent of defects already found.

Record appropriate instructions on the route ticket for correction of the defects that are revealed by the inspection.

1. Examine the barometer assembly, and its case assembly, for signs of mercury that may have leaked out of the mercury tube and cistern assembly. Collect any such mercury in a clean glass jar. If mercury is found, it is an indication that one or more of the following defects may exist:
 - A. A broken mercury tube
 - B. A split or leaky tube-to-top cistern seal, or cistern seal
 - C. A cracked top or bottom cistern
2. Inspect the mechanical parts of the barometer assembly and its case assembly for

DISASSEMBLY PROCEDURE

appearance, condition of finishes and legibility of all engraved markings. Check the external parts of the barometer and its case for signs of mercury contamination. The inspection standards and disposition of defects are defined as "Appearance Standards" under "Mechanical Test Standards—Pre-disassembly Inspection" in the Control Manual.

NOTE

No prejudgment of the instrument's serviceability shall be made on the results of the appearance inspection. The functional efficiency will be determined solely on the basis of the following functional tests.

3. Suitably support the barometer case assembly in a vertical position by means of the case wall brackets. Swing the barometer assembly out of its case. Check the movement of the barometer assembly in the gimbal ring assembly. It should move smoothly and freely.
4. Check the action of the cistern adjusting screw. When it is rotated to the right, the mercury column should rise to the top of the tube. If the mercury column does not rise to the top of the tube, mercury may have leaked from the mercury tube and cistern assembly. See the possible defects outlined in Operation 1.

NOTE

Operation 4 is a check on the functioning of the cistern adjusting screw. A final check on the height of the mercury column in the tube, when the top and bottom cisterns are compressed together, will be made in Operation 10.

5. Examine the mercury tube at the meniscus for signs of dirt or scum on its inside surface. If dirt or scum is present, it indicates oxidation of the mercury. Indicate replacement of the mercury-filled tube if this condition exists.
6. Check the action of the vernier rack and support and the vernier pinion, by rotating the vernier pinion knob so as to move the vernier scale up and down the inch and millibar scales. The vernier rack and support should move smoothly without binding.

There should be no detectable play or slack at the vernier pinion.

7. Check the thermometer to see that it is reading correctly. Insure that its mercury tube is intact.
8. Check that the barometer calibration card is in place, and is filled out in a correct manner.
9. Using a suitable feeler gauge check the clearance between the top and bottom cistern covers. It should be approximately 1/32 inch. If the clearance is too small, indicate additional packing to be placed between the top cistern cover and the top cistern, in the form of an extra cistern cushioning washer or suitable paper washers.

NOTE

In order that you may perform Operation 10 which follows, have the disassemblers remove the barometer assembly from its case, and the guard glass from over the inch and millibar scales of the barometer.

10. If at this stage of your inspection there are no apparent defects in the barometer assembly that will affect its functioning, then perform the operations outlined under "Positioning the Inch Scale" and "Calibration Operations" in Section VI of this manual. If the barometer meets all requirements, except that it is reading low, then air may have entered the top of the mercury tube. Operation 11 which follows will confirm if this is the reason.

If the barometer fails to meet requirements other than the reading requirements, then the mercury-filled tube must be replaced.

11. To check the condition of the mercury tube and cistern assembly proceed as follows:
 - A. Have the mercury tube and cistern assembly disassembled from the tube housing assembly, as outlined in Operations 1 through 7, under "Major-assembly Disassembly Operations" in this section.
 - B. Examine the mercury tube and cistern assembly for visible defects. Check the cistern seal between the top and bottom cisterns, and the tube-to-top cistern

MERCURIAL BAROMETERS

seal, for signs of pin holes or slits. Check the top and bottom cisterns for cracks. See Fig. 20 in this section for location of these parts. If the mercury in the mercury-filled tube is less than 1/2 inch from the bottom end of the capillary in the mercury tube, refer to "Mercury Level" in the Control Manual for the disposition of the mercury-filled tube.

- C. If there are no visible defects, mount the mercury tube and cistern assembly on the cistern clamping fixture, Tool No. 1. Compress the cistern assembly, as shown in Fig. 5. The mercury column should be at the top of the tube when the top and bottom cisterns are in contact.

If readings taken from the barometer during Operation 10 were consistently low when compared to the standard barometer, you may expect an air bubble to form at the top

of the tube. This will explain the reason for the low readings; air has entered the tube and destroyed the vacuum above the mercury. Indicate removal of the air bubble.

If readings taken from the barometer during Operation 10 meet the performance requirements and the mercury does not reach the top of the tube, this means that there is insufficient mercury in the cistern assembly. Indicate on the route ticket that mercury should be added to that already in the cistern assembly. Also, examine the cistern assembly again very carefully for signs of a possible leak.

12. Check that all modifications outlined under "Modifications" in Section II of this manual have been carried out. Indicate on the route ticket the required degree of disassembly, if any, to carry out such modifications.
13. From the results of your pre-disassembly inspection, determine whether the barometer is to be overhauled, or surveyed and salvaged for usable parts. The "Survey and Salvage Standards" in the Control Manual are the basis for this decision.

If the barometer is to be surveyed, indicate on the route ticket the disassembly required to salvage serviceable assemblies for parts. All salvaged components should be turned in to the Instrument Control Center for stocking as available replacements.

After completion of the foregoing operations, the inspected barometer assembly, with its route ticket marked to indicate all inspection decisions and instructions, should be returned to the Instrument Control Center. The disassemblers will draw lots of similar instruments for processing together through the disassembly operations.

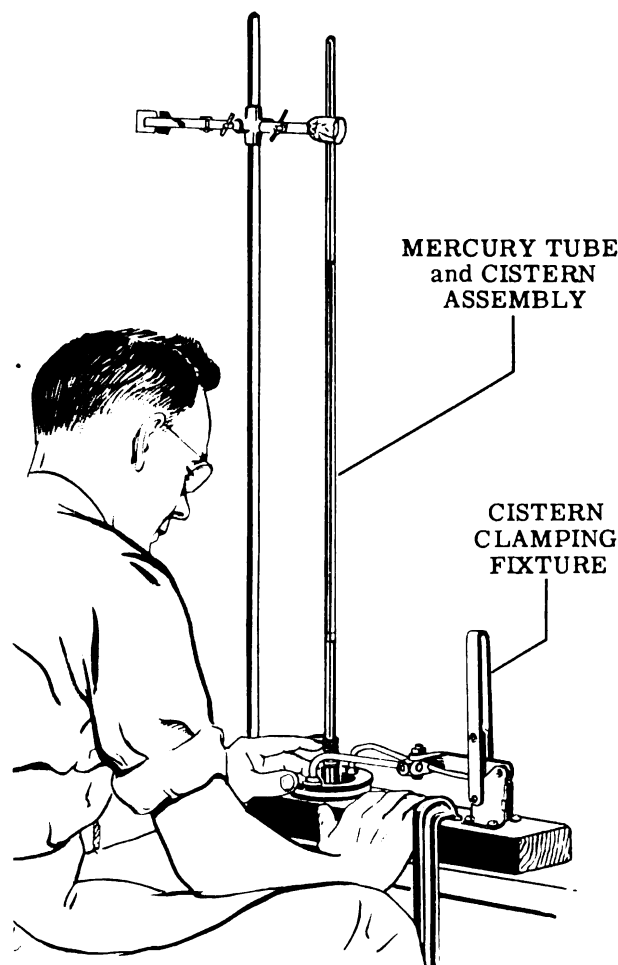


Figure 5

MAJOR-ASSEMBLY DISASSEMBLY OPERATIONS

Skill Level: Mechanical Instrument Assembler,
Junior Grade

Route Ticket

Each barometer is accompanied by its own route ticket, on which the pre-disassembly inspector has written specific instructions telling you what to disassemble. Perform only the indicated disassembly, no more. The instructions which follow show you how to disassemble; the route ticket tells you what to disassemble.

DISASSEMBLY PROCEDURE

If a part is damaged during disassembly, note it on the route ticket. The parts inspector will make the necessary repair or replacement.

Take care not to mix parts of one barometer with those of another. Keep the parts of each individual barometer in a separate parts tray for reassembly to each other. Insure that you have a thorough knowledge of the instructions in this section before attempting to carry them out. If you come across frozen or corroded parts, do not try to force them apart. Techniques to use in the disassembly of such parts are outlined under "Disassembling Frozen Parts" in the Control Manual.

WARNING

When handling mercury observe the same precautions as if you were working with active chemicals. Mercury is poisonous. Wash your hands thoroughly after working with it. Do not allow it to come in contact with any open wound. Do not wear rings, watches or jewelry; mercury will damage them.

REMOVING THE BAROMETER ASSEMBLY FROM THE CASE ASSEMBLY

CAUTION

If the mercury tube is intact, insure that the mercury column is raised to the top of the tube. If it is not at the top, breakage may result during handling. See "Critical Points of Repair" in Section II of this manual.

1. Place the marine mercurial barometer, complete with case, on your work bench. Then open the cover and release the upper and lower support latches. See Fig. 1.
2. Lift the barometer assembly out of the case, as far as the gimbal arm will allow. Place a support block (Tool No. 2) at each end of the case under the barometer. Allow the barometer assembly to rest on the support blocks. See Fig. 1, and refer to the "Special Service Tool List" in Section VIII for details of the special tool employed here.
3. Remove the two gimbal pivot screws. Then lower the gimbal arm to the bottom of the case. See Fig. 1.

4. Carefully lift the barometer assembly to an upright position. Hang the barometer assembly on a suitable hook, in readiness for further disassembly. See Fig. 6.

Place the barometer case assembly aside. It will be disassembled later if so required.

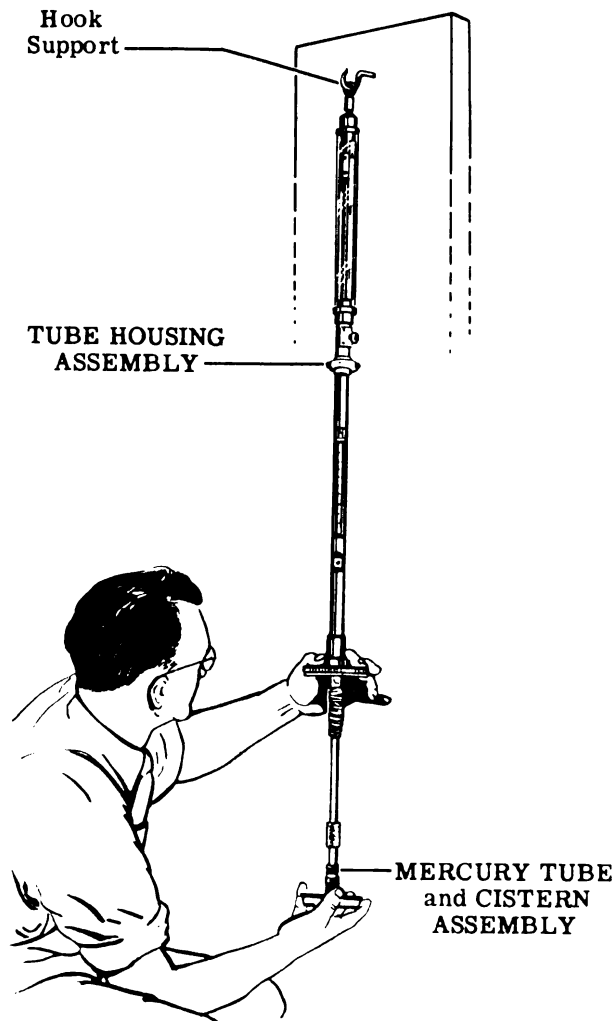


Figure 6

REMOVING THE MERCURY TUBE AND CISTERN ASSEMBLY FROM THE TUBE HOUSING ASSEMBLY

NOTE

Place a glass dish under the barometer to catch any loose mercury that may be present, before performing the operations which follow.

MERCURIAL BAROMETERS

5. Unscrew the adjusting screw cover assembly from the underside of the bottom cistern cover. Rotate the cistern adjusting screw knob to the left, as far as it will go. Then screw the adjusting screw cover assembly back on the bottom cistern cover. See the exploded view, Fig. 7.
6. Scribe a guide mark for reassembly purposes on the front of the top and bottom cistern covers. Remove the cistern cover set screw. See the exploded view, Fig. 7.

NOTE

Before performing Operation 7, read it thoroughly and insure that you understand it fully.

7. Carefully unscrew the bottom cistern cover and adjusting screw assembly from the top cistern cover. When you feel the assembly coming free, lower it slowly; the mercury tube and cistern assembly will be resting upon it.

Slip your fingers under the bottom of the mercury tube and cistern assembly to sup-

port it. Allow the mercury tube and cistern assembly to slide slowly out of the tube housing assembly. If it does not slide down of its own weight, grasp it by the cistern assembly and pull it gently from the housing, as shown in Fig. 6. See the exploded view, Fig. 7, for parts.

If the mercury tube is intact, place the mercury tube and cistern assembly on the mercury tube support rack, Tool No. 3. See the "Special Service Tool List" in Section VIII for details of the special tool used here.

NOTE

The pre-disassembly inspector will complete his inspection of the mercury tube and cistern assembly. Authorization for further disassembly of this assembly, if required, will then be indicated on the route ticket by the pre-disassembly inspector.

8. Remove the cistern cushioning washer from the top cistern cover. See the exploded view, Fig. 7.

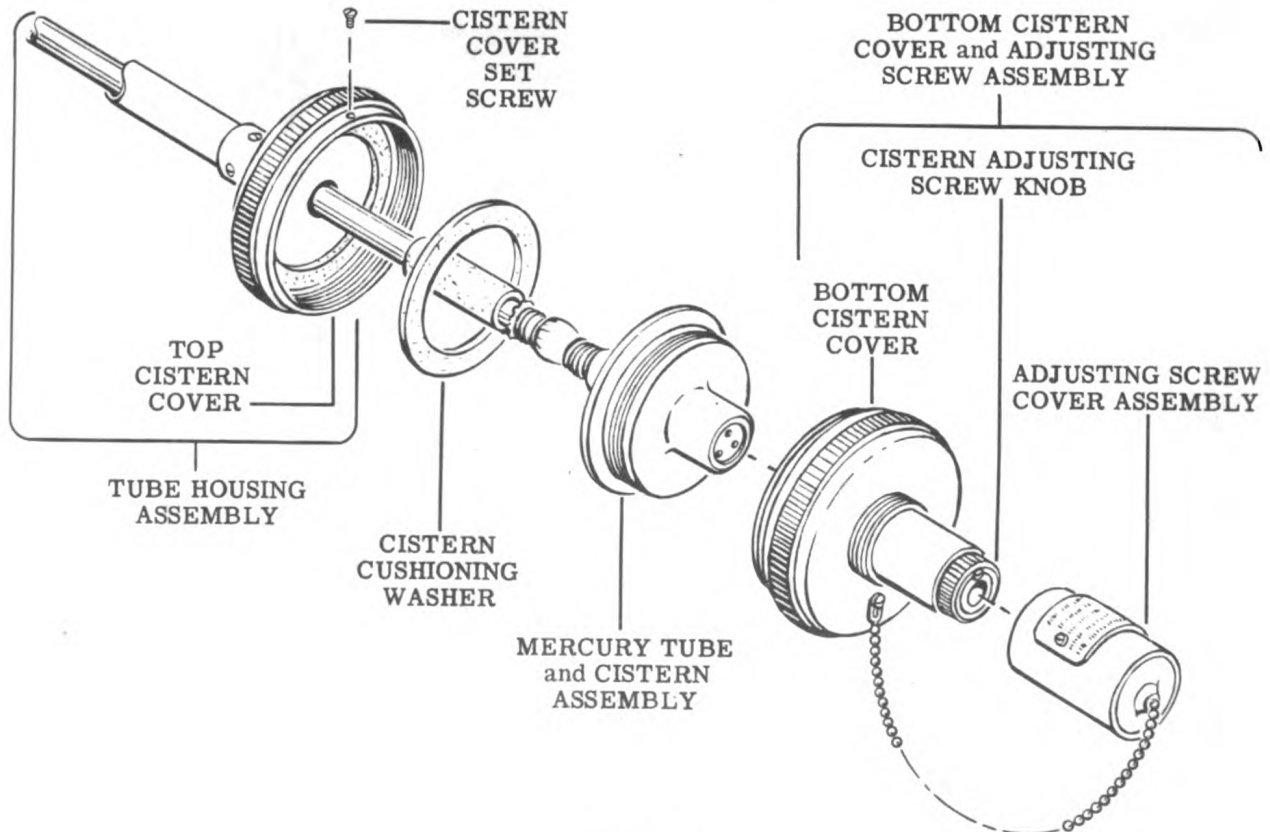


Figure 7

SUBASSEMBLY DISASSEMBLY OPERATIONS

Skill Level: Mechanical Instrument Assembler,
Junior Grade

DISASSEMBLING THE BOTTOM CISTERN COVER AND ADJUSTING SCREW ASSEMBLY

The barometer assembly you are working on may be equipped with a modified type or an unmodified type of bottom cistern cover and adjusting screw assembly. Refer to "Barometer

Differences" in Section II of this manual for details of "Modification A," and see Fig. 8 in this section.

Determine the type of assembly you are about to disassemble. If the assembly is modified, carry out all of the operations which follow; for an unmodified assembly, omit Operation 9.

9. Lift the thrust plate along with the adjusting pad out of the cistern adjusting screw. Remove the thrust plate from the adjusting pad. See the exploded view, Fig. 8, top.
10. Remove the cover chain screw, and unscrew the adjusting screw cover assembly from the bottom cistern cover. See the exploded view, Fig. 8.

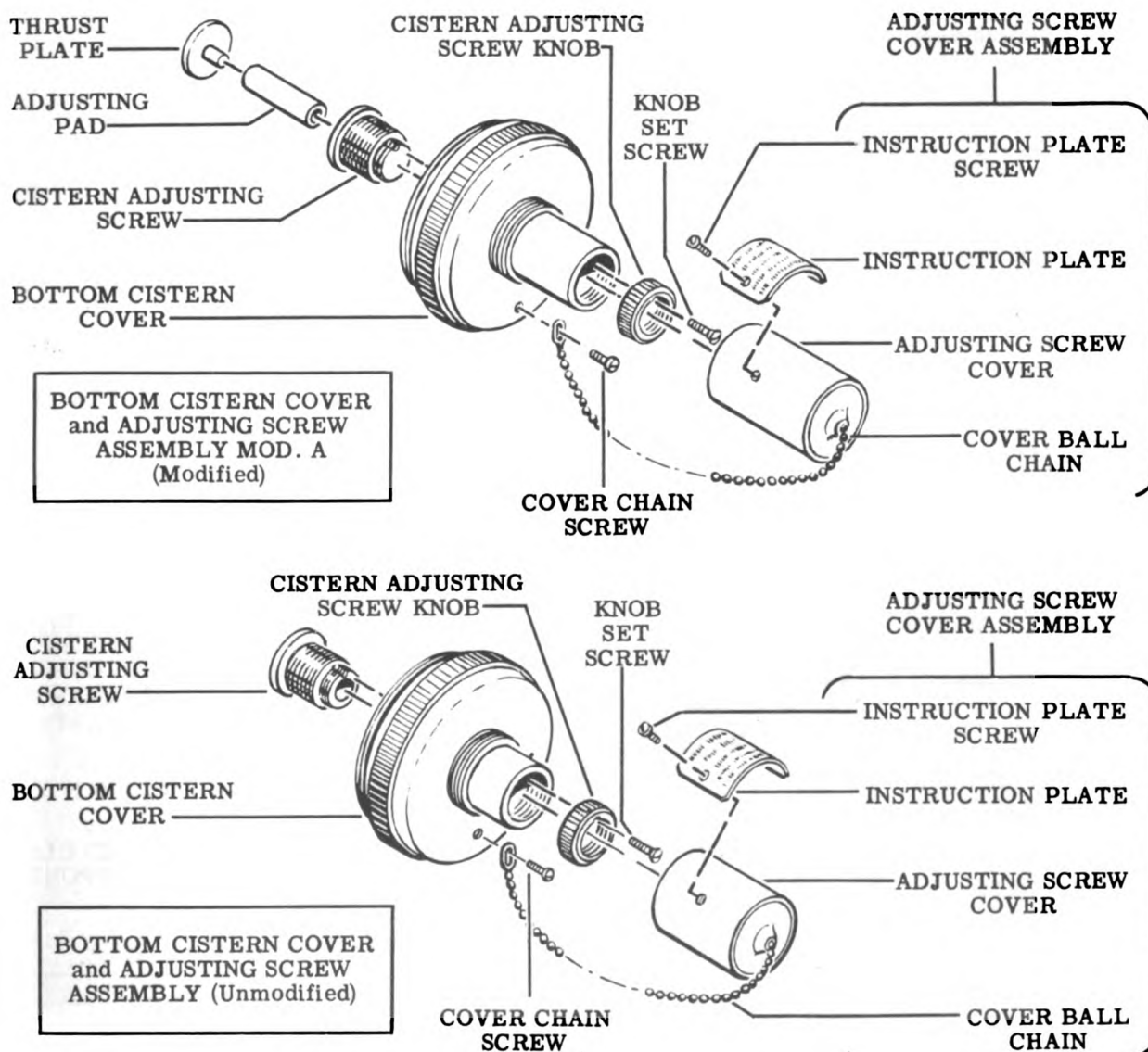


Figure 8

MERCURIAL BAROMETERS

11. Remove the knob set screw, then unscrew the cistern adjusting screw knob from the cistern adjusting screw. See the exploded view, Fig. 8.
12. Remove the cistern adjusting screw from the bottom cistern cover. See the exploded view, Fig. 8.

Disassembling the Adjusting Screw Cover Assembly

The adjusting screw cover assembly is not normally disassembled unless the adjusting screw cover, or its chain, need to be refinished, or parts have to be replaced. If disassembly is authorized, proceed as follows.

13. Remove the instruction plate by unscrewing the two instruction plate screws. See the exploded view, Fig. 8.

DISASSEMBLING THE TUBE HOUSING ASSEMBLY

14. Place the tube housing assembly in a horizontal position on the two support blocks, Tool No. 2. See the "Special Service Tool List" in Section VIII for details of the special tool used here.

Removing the Cap and Hanger Ring Assembly and the Guard Glass

15. Remove the four cap screws from the cap and hanger ring assembly. Pull the assembly off the end of the tube housing, then remove the guard glass washer from inside the assembly. See the exploded view, Fig. 9.

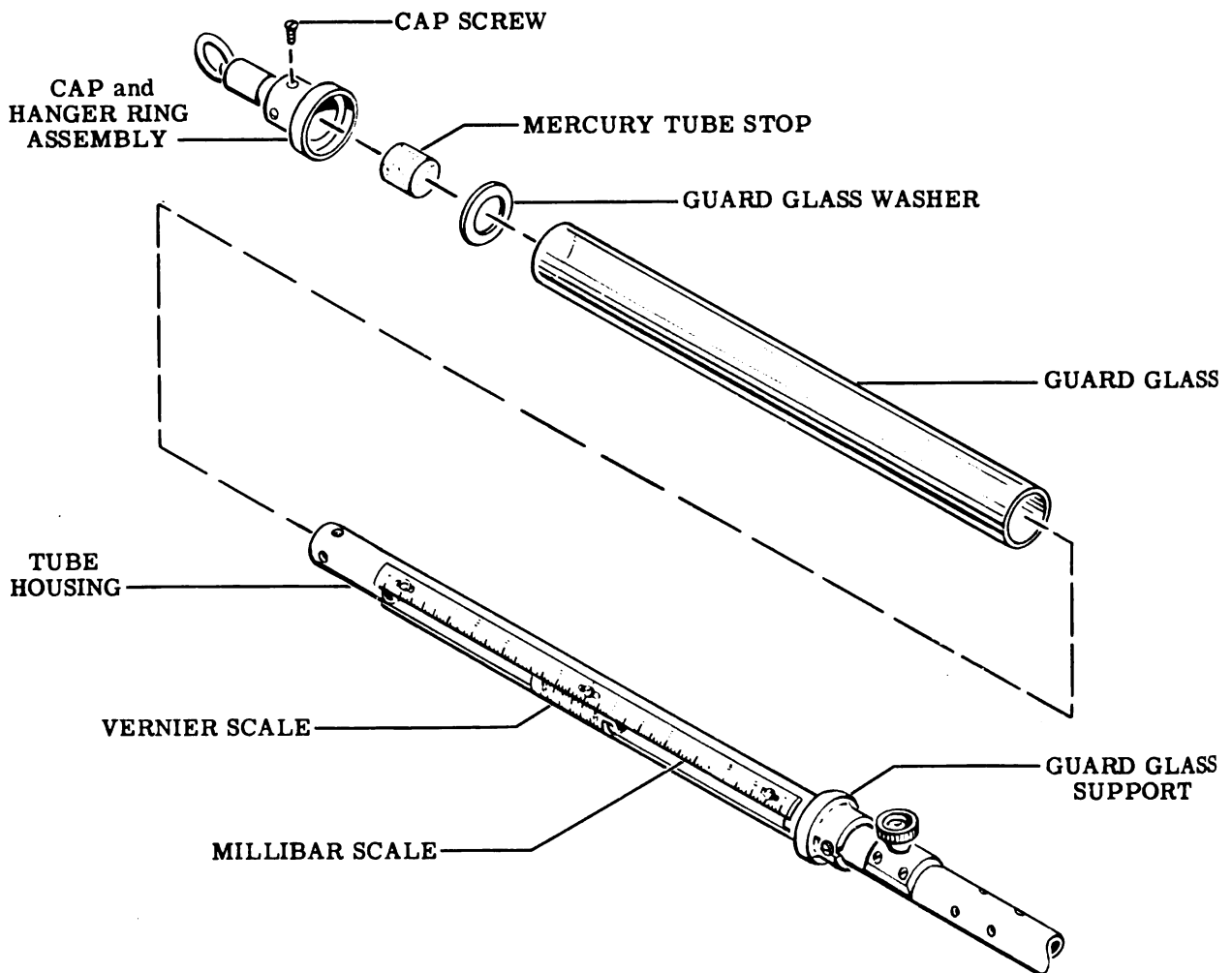


Figure 9

DISASSEMBLY PROCEDURE

16. If it has not already been removed, slip the guard glass out of the guard glass support, and remove it from over the barometer scales. See the exploded view, Fig. 9.
17. Remove the mercury tube stop from inside the tube housing. See the exploded view, Fig. 9.

Removing and Disassembling the Thermometer Assembly

18. Remove the two thermometer mount screws. The thermometer assembly will now come free from the tube housing. See the exploded view, Fig. 10.
19. Remove the two thermometer strap screws from the thermometer mount and remove the thermometer strap. Lift the thermometer carefully out of the mount. See the exploded view, Fig. 10.

Removing and Disassembling the Top Cistern Cover

20. Scribe a reassembly guide mark on the top cistern cover and the tube housing. Remove the four top cistern cover screws. Then remove the top cistern cover from the bottom end of the tube housing. See the exploded view, Fig. 10.

21. Remove the name plate from the top cistern cover by unscrewing the two name plate screws. See the exploded view, Fig. 10.

Removing the Scales

22. Remove the three millibar scale screws. Then lift the millibar scale from the tube housing. See the exploded view, Fig. 11, and also Fig. 12.
23. Remove the three inch scale screws, then lift the inch scale from the tube housing, in a similar manner to the millibar scale. See the exploded view, Fig. 11.

Removing and Disassembling the Vernier and Rack Assembly

NOTE

If the mercury tube was broken, be on the lookout for contaminated parts. Place any such parts aside as a precautionary measure.

24. Using a suitable diameter rod, press down on the upper tube support so that the shellac seal securing it to the tube housing is broken. Remove the upper tube support

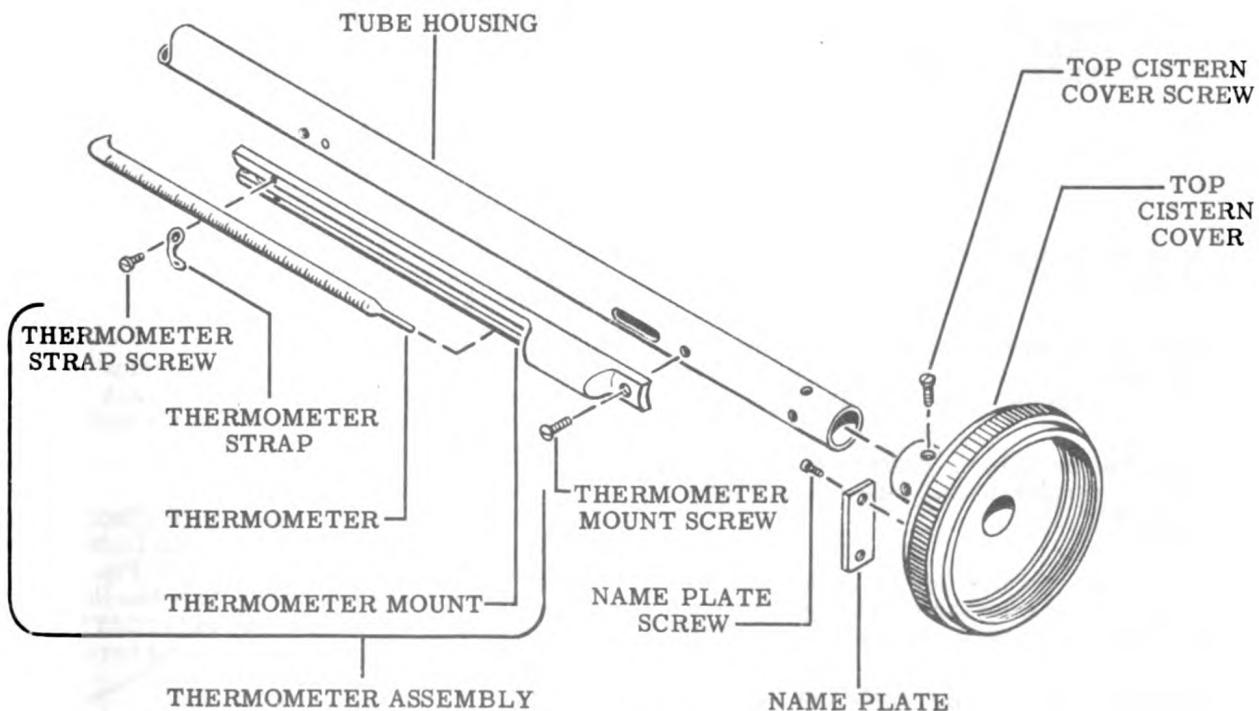


Figure 10

MERCURIAL BAROMETERS

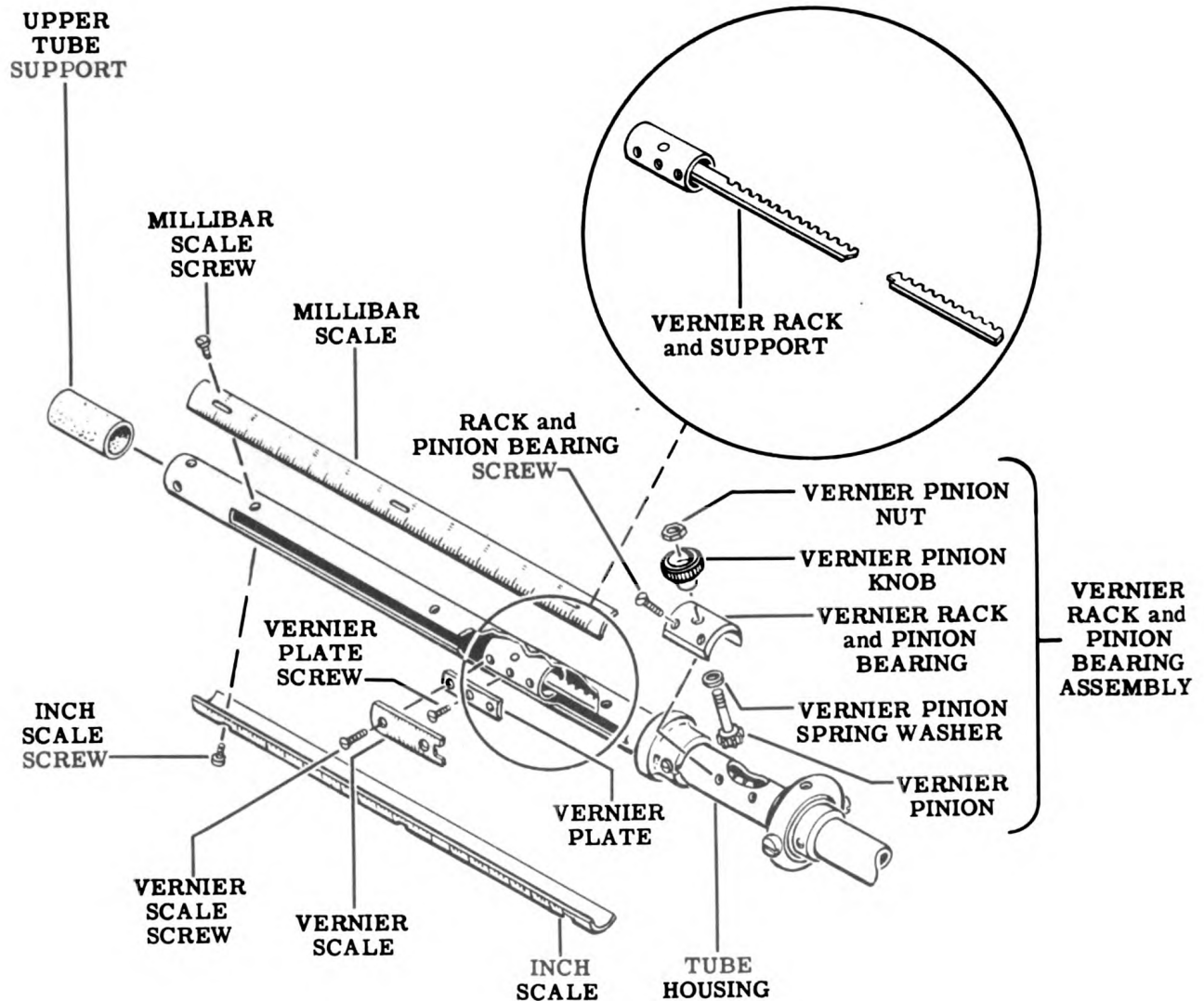


Figure 11

from inside the tube housing. See the exploded view, Fig. 11.

25. Remove the two vernier scale screws and lift the vernier scale off the vernier plate. See the exploded view, Fig. 11.
26. Remove the vernier plate screw and lift off the vernier plate. See the exploded view, Fig. 11.
27. Rotate the vernier pinion knob until the rack teeth of the vernier rack and support are clear of the vernier pinion. See Fig. 13.
28. Withdraw the vernier rack and support from the end of the tube housing. See Fig. 14 and the exploded view, Fig. 11.

Removing and Disassembling the Vernier Rack and Pinion Bearing Assembly

29. Remove the four rack and pinion bearing screws. Then lift the vernier rack and pinion bearing assembly out of the tube housing. See the exploded view, Fig. 11.
30. Using the pinion nut wrench (Tool No. 4) remove the vernier pinion nut from inside the vernier pinion knob. See Fig. 15, and the exploded view, Fig. 11. See the "Special Service Tool List" in Section VIII for details of the special tool used here.
31. Unscrew the vernier pinion knob from the vernier pinion. Remove the vernier pinion

DISASSEMBLY PROCEDURE

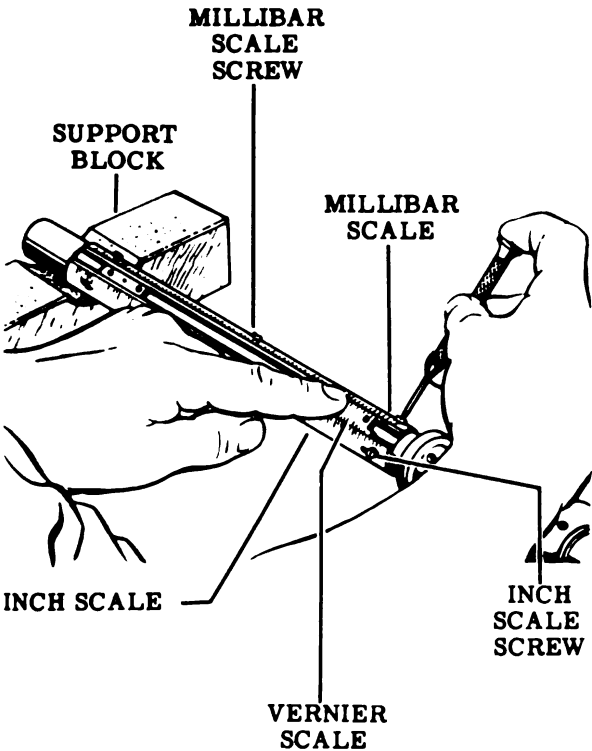


Figure 12

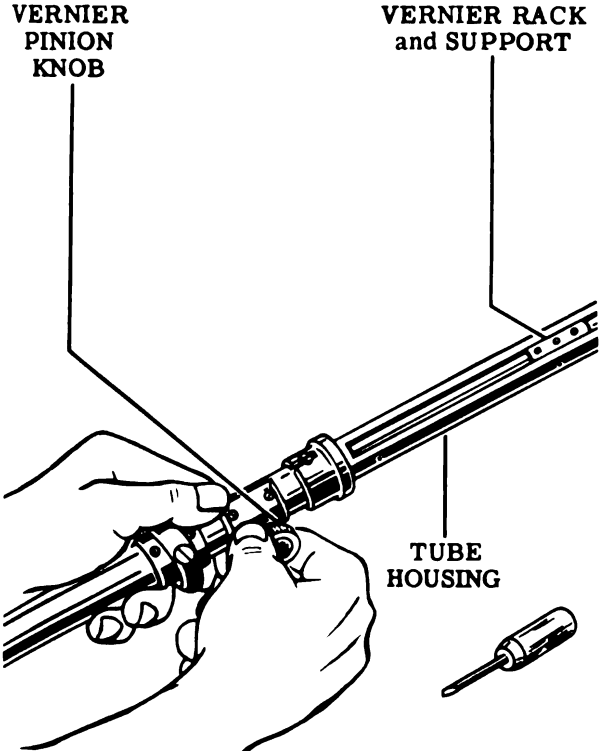


Figure 13

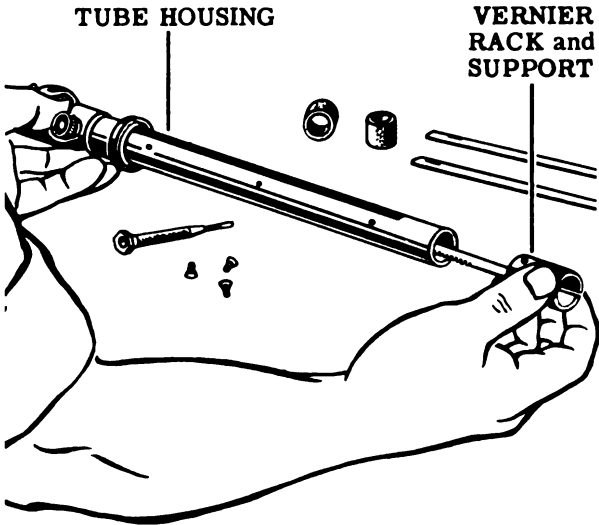


Figure 14

from the vernier rack and pinion bearing. See the exploded view, Fig. 11.

NOTE

The vernier pinion will, in some cases, have a spring washer assembled under it. This washer takes up play in the vernier pinion and knob. If assembled, remove the washer from the vernier pinion during disassembly. Keep it with the pinion in the parts tray for reassembly.

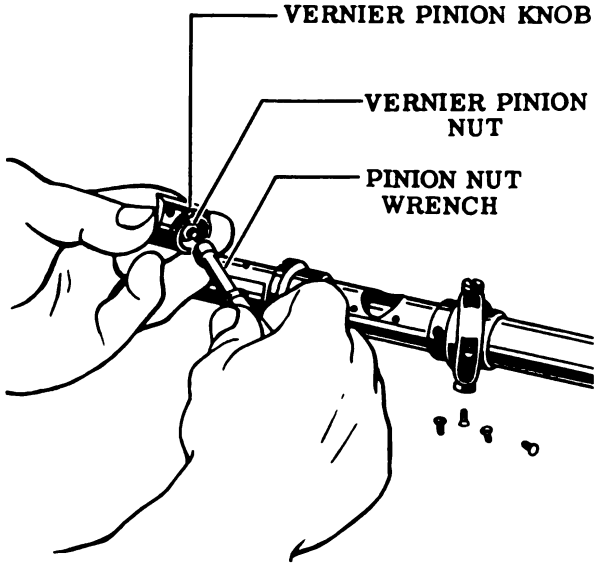


Figure 15

MERCURIAL BAROMETERS

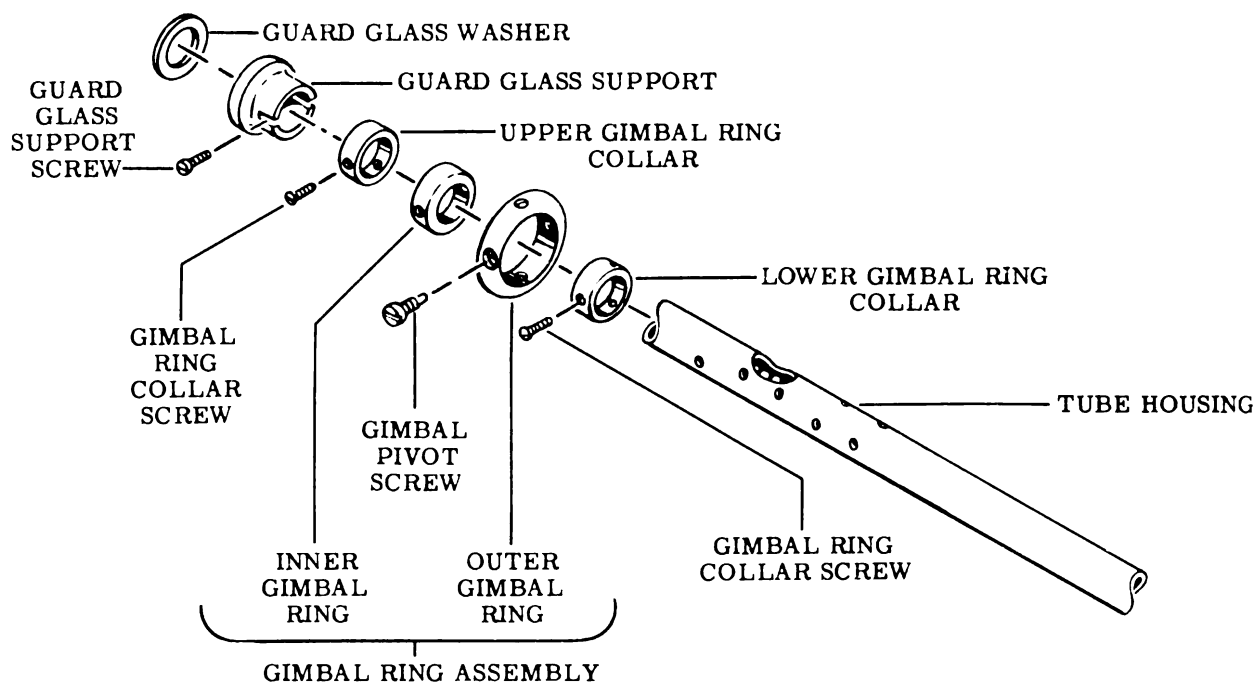


Figure 16

Removing the Guard Glass Support and the Gimbal Ring Assembly

32. Remove the two guard glass support screws. Slide the guard glass support off the scale end of the tube housing. Then remove the guard glass washer from inside the support. See the exploded view, Fig. 16.
33. Remove the six gimbal ring collar screws from the upper and lower gimbal ring

collars. See Fig. 17, and the exploded view, Fig. 16.

34. Slide the gimbal ring collars and the gimbal ring assembly off the scale end of the tube housing. If the rings are tight, squeeze the tube housing very slightly with your fingers to facilitate their removal. See Fig. 18, and the exploded view, Fig. 16.
35. Remove the two gimbal pivot screws from the outer gimbal ring to disassemble it from the inner gimbal ring. See the exploded view, Fig. 16.

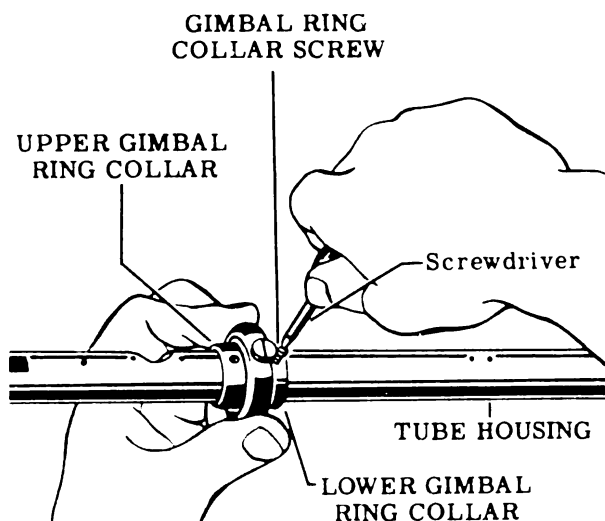


Figure 17

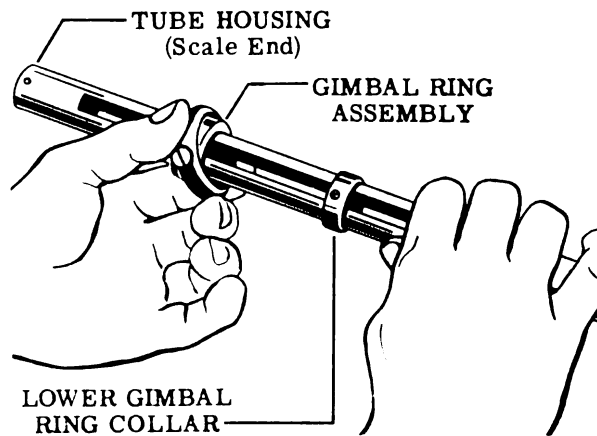


Figure 18

DISASSEMBLY PROCEDURE

Disassembling a Broken Mercury Tube

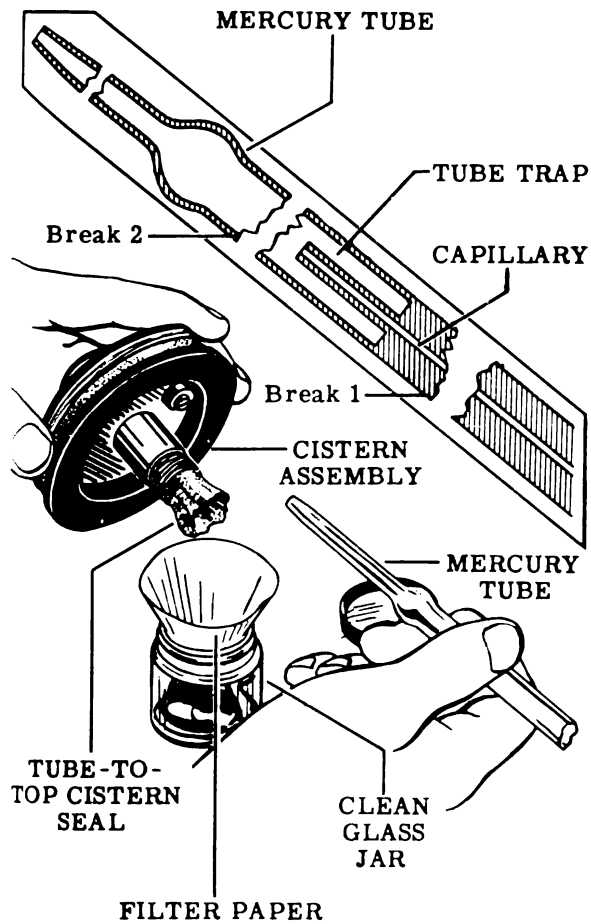


Figure 19

DISASSEMBLING THE MERCURY TUBE AND CISTERN ASSEMBLY

CAUTION

Thoroughly read the operations which follow before performing them. If the mercury tube is broken below the tube trap, be especially careful. See Break 2 in the pullout, Fig. 19. Glass splinters may have entered the cistern assembly. If you do not remove these splinters before disassembling the cistern assembly, the cistern seal may be pierced and ruined.

The cistern seal and the tube-to-top cistern seal may be used again if they are pliable and in good condition. Insure that you do not damage them while performing these disassembly operations.

36. Cut the linen thread which secures the tube-to-top cistern seal to the mercury tube. Grasp the loose ends of the thread and unwind it. See the exploded view, Fig. 20.
37. Carefully separate the tube-to-top cistern seal from the mercury tube. Gently pull the remaining portion of the mercury tube from the cistern assembly. See Fig. 19 and the exploded view, Fig. 20.

NOTE

Salvage the lower tube support from the broken portion of the mercury tube. It may be used again if in a serviceable condition. Do not salvage the cotton packing.

Procedure for Mercury Tube Broken below Trap

If the mercury tube is broken below the tube trap (see Break 2 in the pullout, Fig. 19), then proceed as follows.

38. Punch two holes in a filter paper, using a steel needle. Form the filter paper into a cone, and place it in the neck of a clean jar. Invert the cistern assembly and pour any remaining mercury into the jar. See Fig. 19. Any splinters of glass that may have entered the cistern assembly will be caught in the filter.
39. Pour a small amount of mercury into the cistern assembly and flush it around. Repeat the preceding operation, using a clean filter. Continue flushing out the cistern assembly until no further traces of glass are seen in the filter.

When this has been accomplished, disassemble the cistern assembly as described under "Disassembling the Cistern Assembly" in this section.

Procedure for Mercury Tube Broken above Trap

If the mercury tube is broken above the tube trap (see Break 1 in the pullout, Fig. 19), then proceed as follows.

MERCURIAL BAROMETERS

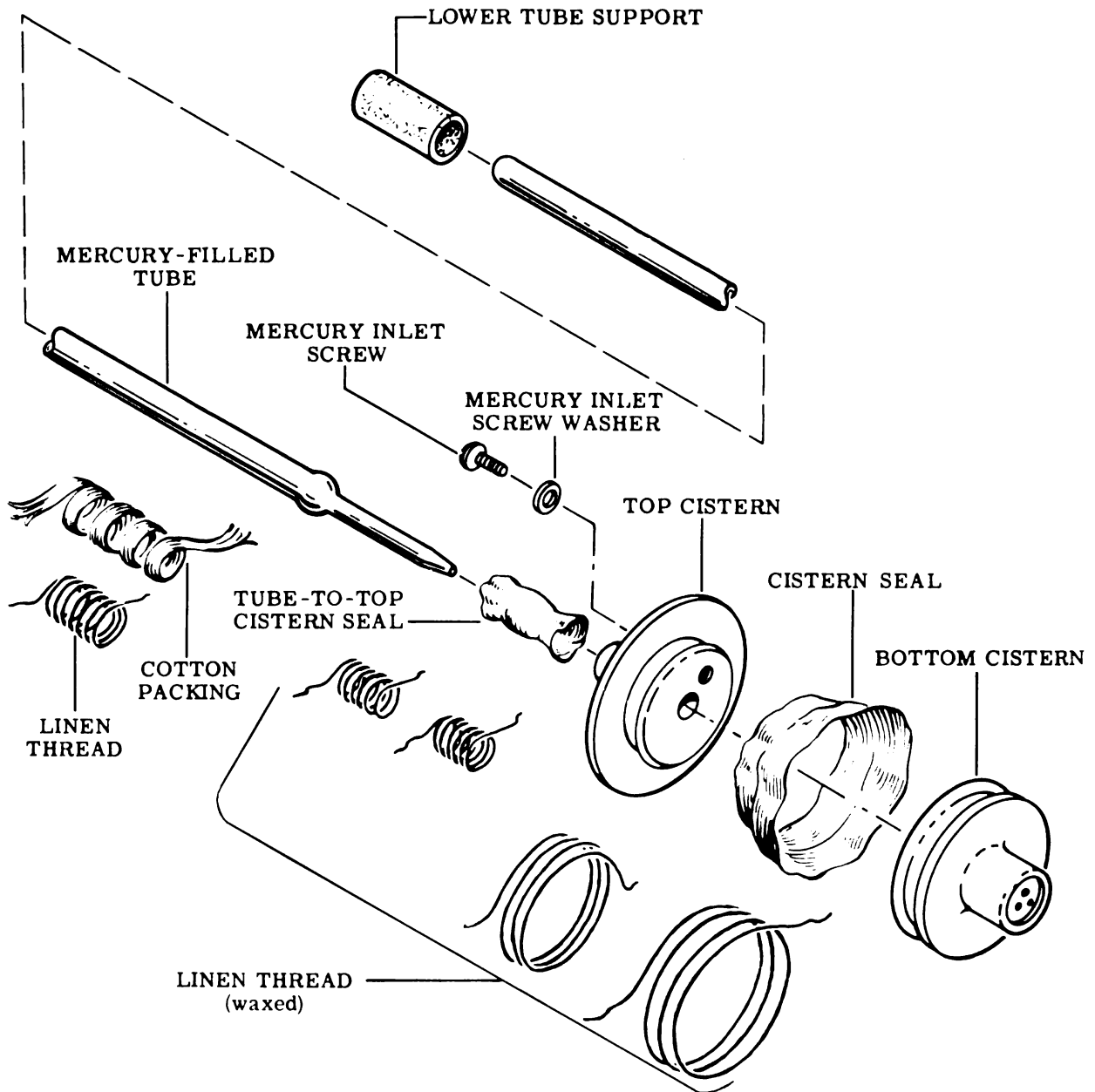


Figure 20

40. Invert the cistern assembly and pour any remaining mercury into a clean jar. Filtering is not necessary in this case since glass splinters would be kept from the cistern assembly by the capillary. See Fig. 19 and the pullout.

NOTE

Unless parts of the cistern assembly are to be replaced, further disassembly will not be required.

Procedure for Disassembling an Intact Tube

If the mercury tube is still intact, and the mercury has not all leaked out of the cistern assembly, proceed with the following operations.

41. Invert the mercury tube and cistern assembly, cistern end up, over a glass jar. Use the vertical support rack (Tool No. 5) to hold the assembly in position. See the

DISASSEMBLY PROCEDURE

"Special Service Tool List" in Section VIII for details of this special tool.

The mercury will now completely fill the mercury tube.

42. Carefully cut and remove the thread from around the tube-to-top cistern seal at the mercury-filled tube. This will allow the mercury to drain from the cistern assembly into the glass jar. See the exploded view, Fig. 20, for parts.
43. When all the mercury has drained out of the cistern assembly, carefully lift the assembly clear of the mercury tube. Leave the mercury-filled tube in the vertical support rack, Tool No. 5. Place a protecting cap (Tool No. 16) over the open end of the tube. See the "Special Service Tool List" in Section VIII for details of the special tools referred to in this operation. See the exploded view, Fig. 20, for parts.

NOTE

Unless the cistern seal or the top and bottom cisterns are to be replaced, only Operation 49 under "Disassembling the Cistern Assembly" in this section will be performed on the cistern assembly.

If the mercury tube is intact, but a defect in the cistern assembly has caused leakage of the mercury, then proceed with the following operations.

44. Drain any remaining mercury from the cistern assembly into a clean glass jar.
45. Cut the linen thread which secures the tube-to-top cistern seal to the mercury tube. Grasp the loose ends of the thread and unwind it. See the exploded view, Fig. 20.
46. Carefully separate the tube-to-top cistern seal from the mercury tube. Gently pull the mercury tube out of the cistern assembly. See the exploded view, Fig. 20.

Disassembling the Cistern Assembly

47. Cut the linen thread which secures the tube-to-top cistern seal to the top cistern and unwind it. If the seal is to be used again, remove it carefully from the top cistern so as not to stretch it. See the exploded view, Fig. 20.
48. To remove the cistern seal, carefully cut and unwind the linen thread which secures it to the top and bottom cisterns. Then remove the cistern seal from the top and bottom cisterns, taking care that the seal is not stretched during removal. See the exploded view, Fig. 20.
49. Remove the mercury inlet screw from the top cistern. Then remove the mercury inlet screw washer from the mercury inlet screw. See the exploded view, Fig. 20.

BAROMETER CASE DISASSEMBLY OPERATIONS

Skill Level: Mechanical Instrument Assembler,
Junior Grade

DISASSEMBLING THE BAROMETER CASE ASSEMBLY

50. To remove the gimbal arm and support assembly, unscrew the three lower barometer support screws from the bottom of the case. Lift the assembly out of the case. See the exploded view, Fig. 21.
51. Remove the latch knob screws along with the latch knobs from the lower barometer support. The lower support latch can now be removed from the lower barometer support. Unscrew the latch knob from each latch knob screw. See the exploded view, Fig. 21.
52. Disassemble the gimbal arm from the lower barometer support by removing the gimbal arm hinge screw, the hinge screw nut and the lock washer. Use the hinge screw nut wrench (Tool No. 6) and place the head of the hinge screw in a vise. See the exploded view, Fig. 21, for parts and the "Special Service Tool List" in Section VIII for details of the special tool used here.
53. Remove the two upper barometer support screws from the base of the upper barometer support. Lift the upper barometer support assembly out of the case. See the exploded view, Fig. 21.
54. Remove the latch knobs, latch knob screws and the upper support latch from the upper barometer support, in a manner similar to that outlined in Operation 51 for the lower support. See the exploded view, Fig. 21.

MERCURIAL BAROMETERS

LEGEND

1. Cover Glass Frame Screw
2. Barometer Case Cover
3. Cover Glass
4. Cover Glass Gasket
5. Cover Glass Frame
6. Cover Glass Frame Nut
7. Upper Barometer Support Assembly
8. Latch Knob Screw
9. Latch Knob
10. Upper Support Latch
11. Upper Barometer Support
12. Upper Barometer Support Screw
13. Fastener Screw Nut
14. Upper Fastener
15. Fastener Screw
16. Gimbal Arm and Support Assembly
17. Latch Knob Screw
18. Latch Knob
19. Lower Support Latch
20. Lock Washer
21. Hinge Screw Nut
22. Lower Barometer Support
23. Gimbal Arm
24. Gimbal Arm Hinge Screw
25. Fastener Screw Nut
26. Lower Fastener
27. Fastener Screw
28. Handle Pivot Post Nut
29. Reflector Holder Screw
30. Reflector Holder
31. Reflector Glass
32. Wall Bracket Screw
33. Hinge Retaining Screw
34. Case Hinge
35. Barometer Case (Bottom Half)
36. Case Wall Bracket
37. Handle Support Bracket Screw
38. Handle Support Bracket
39. Case Handle
40. Handle Pivot Post
41. Lower Barometer Support Screw

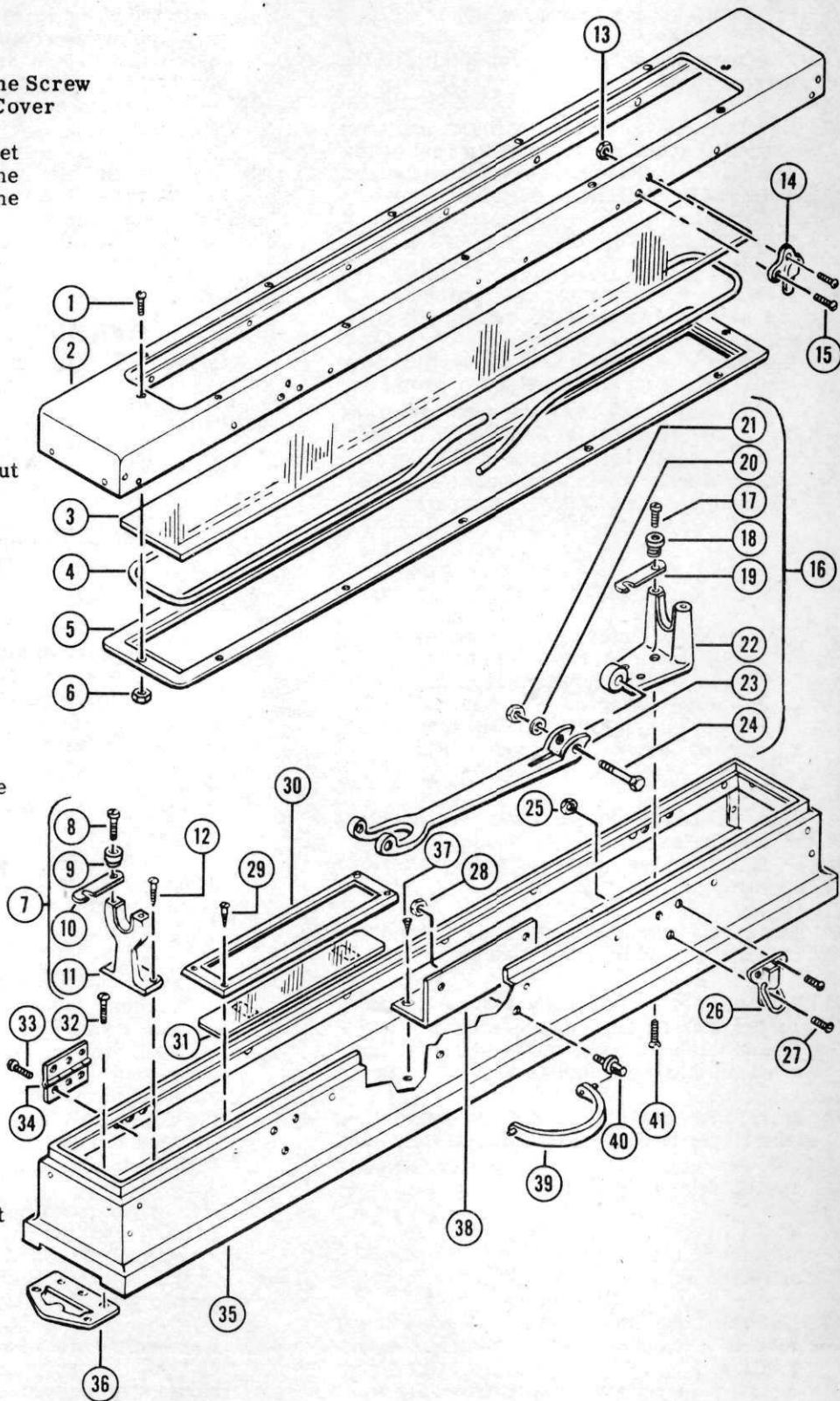


Figure 21

55. To remove the cover glass from inside the barometer case cover, remove the twelve cover glass frame nuts and screws. Use the cover glass frame and fastener nut wrench, Tool No. 7. Then lift the cover glass frame, the cover glass gasket and the cover glass clear of the cover. See the exploded view, Fig. 21, and refer to the "Special Service Tool List" in Section VIII for details of the special tool used here.
 56. Remove the top three hinge retaining screws from each of the three case hinges. The barometer case cover will then come free of barometer case (bottom half). Remove the remaining hinge retaining screws from each hinge and disassemble the hinges from the case. See the exploded view, Fig. 21.
 57. Remove the two upper fasteners from the barometer case cover and the two lower fasteners from the barometer case (bottom half) in the following manner: Remove the fastener screw, which has a nut assembled upon it, from each fastener. Then remove the two remaining fastener screws from each fastener. The fasteners will now come free from the cover and case (bottom half). Use the cover glass frame and fastener nut wrench (Tool No. 7) to remove the fastener screw nuts. See the exploded view, Fig. 21, and the "Special Service Tool List" for details of the special tool used here.
 58. Remove the case handle by unscrewing the two handle pivot post nuts from the two handle pivot posts. Use the pivot post nut wrench, Tool No. 8. Remove the case handle and its pivot posts from the case. Slip the handle pivot posts off each end of the handle. See the exploded view, Fig. 21, and the "Special Service Tool List" in Section VIII for details of the special tool used here.
 59. Remove the three handle support bracket screws from the base of the handle support bracket. Lift the bracket out of the barometer case (bottom half). See the exploded view, Fig. 21.
 60. Remove the three wall bracket screws from each of the two case wall brackets. Then remove the two case wall brackets from the bottom of the case. Suitably mark the brackets, upper and lower, for reassembly purposes. See the exploded view, Fig. 21.
 61. To remove the reflector glass, unscrew the four reflector holder screws. Then lift the reflector holder and the reflector glass out of the case. See the exploded view, Fig. 21.
- At this point a barometer, and its case, would have been completely disassembled, if so specified on the route ticket. When each instrument has been disassembled to the extent indicated on the route ticket, place the instrument as disassembled, and all its parts, in a parts tray. Return the parts tray, with the route ticket attached, to the Instrument Control Center where it will await "Parts Inspection, Repair and Cleaning," Section IV.
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SECTION IV

PARTS INSPECTION, REPAIR AND CLEANING

Skill Levels: Parts Inspection Operations—
Instrument Repairman,
Junior Grade

Repair Operations—Instrument
Repairman, Junior Grade

Cleaning Operations—Cleaner

Introduction to Parts Inspection

The procedure set forth in this section is so designed as to insure that a complete set of clean and serviceable parts is prepared for easy and efficient reassembly. The mercurial barometer was given a pre-disassembly inspection to determine the defects and to specify what disassembly was necessary. This disassembly has now been carried out and you receive a partially or completely disassembled mercurial barometer.

From the route ticket ascertain the defects which were found to exist during the pre-disassembly inspection. Then carefully examine each disassembled part to "troubleshoot" the original defect by detection of the malfunctioning or damaged parts.

Those parts and assemblies which are not disassembled have been judged to be serviceable by the pre-disassembly inspector. The guard glass is a possible exception to this rule; it may be disassembled only to facilitate test and adjustment operations, or for cleaning. In all cases the pre-disassembly inspector will have had the mercury tube and cistern assembly disassembled from the barometer housing assembly for inspection; his comments on the route ticket will indicate its condition.

The decision to repair or replace a part shall be based on the allowable repair time specified for each part in the Control Manual under "Parts Inspection Standards." If a part is not listed, no time shall be spent on repair. The inspection standards also set forth a basis upon which to judge the serviceability of parts.

You should be thoroughly familiar with the standard procedures and techniques for "Overhaul and Repair" and "Inspection" as set forth in the Control Manual.

Performance and Usage Data

In your capacity as parts inspector you are in an excellent position to collect data on the frequency and nature of defects common to the mercurial barometer. This information is invaluable to the navigational instrument authority in the Bureau of Ships as a basis for redesign and development. From time to time such information will be requested from you. However, record any data you may obtain and, if any special conditions come to your attention that seem important, report them to your supervisor.

The pre-disassembly inspector also collects similar data during his inspections. In all cases your supervisor will consolidate your data with his and submit it as a joint report to the Bureau of Ships.

PARTS INSPECTION OPERATIONS

Skill Level: Instrument Repairman,
Junior Grade

WARNING

Remember that the parts you are examining may be contaminated with mercury. Mercury is poisonous. Be careful not to allow it to come in contact with any open wound. Wash your hands thoroughly after completion of your work.

Refer to the exploded views and parts list in the "Maintenance Parts Catalog," Section VII, for the identity of the parts and their stock

numbers when requisitioning replacements. The parts list also indicates those parts which must be replaced as a subassembly or in matched sets and not individually.

MECHANICAL PARTS

Functional Inspection

The applicable inspection standards for mechanical parts are set forth in the Control Manual under "Parts Inspection Standards." The authorization to repair or replace and the allowable repair time for all individual parts are set forth therein.

1. Inspect the mechanical parts of the barometer assembly and its case assembly for material defects such as dents, burrs, distortions, wear and damaged threads that affect the function of the part, not its appearance. Examine each part carefully for signs of mercury contamination, and any corrosion which may be due to such contamination. On the basis of the "Parts Inspection Standards" determine the disposition of the parts. Write on the route ticket the required repairs and the allowable repair time for the individual repairs. Have the repair work and cleaning of mercury-contaminated parts done by the parts repairman. See "Parts Repair Operations" in this section.
2. If the mercury tube and cistern assembly is completely assembled when you receive it for inspection, there are only two possible defects which may exist, either separately or together, in the assembly. These defects are as follows:
 - A. The mercury-filled tube has an air bubble above the trap.
 - B. There is insufficient mercury in the assembly.

Read the route ticket to ascertain if the pre-disassembly inspector has indicated such defects exist. If either or both defects are indicated, send the assembly to the parts repairman for correction.
3. If the pre-disassembly inspector has indicated replacement of the mercury-filled tube, procure a new tube from stock. Forward the new mercury-filled tube to the parts repairman for preparation for re-assembly.
4. Examine the cistern seal and the tube-to-top cistern seal for signs of deterioration.

Check the pliability of each seal, and inspect in front of a strong light for signs of pin holes or other defects. The disposition of each seal will be decided on the basis of the "Inspection Standards—Doeskin Seals" as set forth in the Control Manual.

5. Examine the vernier rack and pinion bearing to see if it has been modified. See "Spotfacing the Vernier Rack and Pinion Bearing" under "Modifications" in Section II of this manual. If the modification has not been carried out, forward the part to the parts repairman for spotfacing.

Check the parts in the instrument parts tray to see if a vernier pinion spring washer is included. If it is not, procure one from stock.
6. Check the lower rim of the bottom cistern cover to see if provision has been made for insertion of a small stop screw. Some Naval repair facilities added this screw to act as a stop against turning the cistern adjusting screw too far. This screw, if assembled, is to be removed and is not to be reassembled.
7. Check to see that "Modification A" has been carried out on the bottom cistern cover and adjusting screw assembly of the instrument you are inspecting. If it has not, then procure the necessary parts from stock and forward a complete set of parts to the parts repairman for fitting operations. Refer to "Modification A" in Section II of this manual for details of this modification.
8. If a new top or bottom cistern cover is to be assembled, send both the top and bottom cistern covers, along with the cistern cushioning washer, and the cistern cover set screw to the parts repairman. A hole has to be drilled and tapped in the covers for the set screw, and the cistern cushioning washer correctly fitted.

In addition, if a new top cistern cover is to be assembled, the barometer name plate screw holes must be drilled and tapped in it. If a new bottom cistern cover is to be assembled, a hole for the chain screw must be drilled and tapped.
9. If the adjusting screw cover is to be replaced, send the new cover to the parts repairman along with the instruction plate and the two instruction plate screws. Holes have to be drilled and tapped in the cover for the screws. The repairman will also require the bottom cistern cover so that, when the adjusting screw cover is assembled to it, the instruction plate may be aligned with the scribe mark (made during

MERCURIAL BAROMETERS

- disassembly) on the front of the bottom cistern cover.
10. If either the cistern adjusting screw or the cistern adjusting screw knob, or both, are replaced, a hole must be drilled and tapped in these parts for the knob set screw. Send the parts to the parts repairman to have the necessary fitting operations carried out.
 11. Check the guard glass and the thermometer to insure that they are intact.

MECHANICAL PARTS APPEARANCE INSPECTION

12. Inspect the appearance and finish of all the parts. If mercury has leaked from the barometer, check the parts for evidence of mercury contamination. Set aside contaminated parts for cleaning by the parts repairman. The allowable times for correction of appearance defects are given in the "Parts Inspection Standards" in the Control Manual. Indicate on the route ticket the extent of the correction of appearance and finish defects and the allowable time for the individual parts. Have such work done in accordance with the applicable procedures in the Control Manual.

GENERAL INSTRUCTIONS

As parts inspector it is your responsibility to insure that a complete set of serviceable parts is prepared for the reassemblers. Your work is not complete until you have inspected all repaired parts and made sure that proper and complete replacements have been made. The following additional operations will complete your inspection procedure.

13. Have all those parts which are not mercury-contaminated cleaned by the cleaner. Those parts which were contaminated will have been forwarded to the parts repairman for cleaning. Reference to the standard cleaning procedure and instructions for the cleaner are given under "Cleaning Operations" in this section. The cleaning work is to include chasing all threads and the removal of undesired paint, lacquer and corrosion as necessary for easy reassembly.
14. The parts are to be returned to you after repair and cleaning. Re-inspect them as required to fulfill your responsibility.

15. When you are satisfied with the repaired parts, obtain the necessary replacements to complete the set of parts. Then return the complete parts tray to the Instrument Control Center.

PARTS REPAIR OPERATIONS

Skill Level: Instrument Repairman,
Junior Grade

The parts inspector will send you parts that are in need of repair, with information on what repairs are to be made and the allowable repair time.

Parts may also be forwarded to you for modification and for fitting. Where parts have been found to be contaminated by mercury, these parts will also be forwarded to you for special cleaning.

Familiarize yourself with the allowable repair time for the individual parts, as specified under "Parts Inspection Standards" in the Control Manual. If, in your judgment, you cannot complete a satisfactory repair in the authorized time, report to your supervisor. He will resolve the question with the parts inspector.

Common repair techniques are described in the Control Manual. The following procedures are those peculiar to mercurial barometers.

Removing Air from the Mercury-filled Tube

If air has found its way into the mercury-filled tube, it must be removed in order for the barometer to give accurate readings. The procedure for removal of this air is as follows:

1. Place the mercury tube and cistern assembly horizontally on your bench. Then carefully lift the cistern assembly with one hand so that the mercury-filled tube slopes. At the same time, support the mercury-filled tube just below the cistern assembly with your other hand.
2. With a gentle snapping motion of the bottom cistern against the top cistern, force the mercury to the end of the tube. This will displace the air and allow it to travel up the side of the tube towards the capillary. Keep up the snapping motion while, at the same time, rotating the tube until the air bubble nears the capillary. Then very carefully invert the tube completely. By continuing the snapping and rotating motion,

bring the air bubble as close to the capillary as possible.

CAUTION

Remember that mercury is very heavy. Be careful when inverting the tube that the top of the tube is not smashed by the impact of the mercury.

Place the mercury tube and cistern assembly, still in an inverted position, in the vertical support rack, Tool No. 5. See the "Special Service Tool List" in Section VIII for details of the special tool employed here.

3. Disassemble the cistern assembly from the mercury-filled tube, following the "Procedure for Disassembling an Intact Tube" as outlined in Section III of this manual.
4. Carefully place the mercury-filled tube in the bell jar, Tool No. 18. Its open end will be immersed in the mercury contained in the glass jar which is part of the special tool. By means of the vacuum pump, extract air from the bell jar (Tool No. 18) so that the mercury in the tube falls. This will cause the air bubble to be forced through the capillary by the downward moving mercury. Do not allow the mercury to fall below 1/2 inch from the end of the capillary. See the "Special Service Tool List" in Section VIII for details of the special tool used here.
5. Slowly allow air to re-enter the bell jar, Tool No. 18. The mercury in the tube will now return to its original position, and the air bubble will be caught in the air trap at the bottom of the mercury tube.
6. Remove the mercury-filled tube from the bell jar, Tool No. 18. Be extremely careful to prevent any more air entering the tube. Invert the mercury-filled tube very carefully and place it in the vertical support rack, Tool No. 5. Using a piece of clean iron wire, draw the air bubble out of the air trap. See Fig. 52 in Section V of this manual. When the air bubble is removed, place a protecting cap (Tool No. 16) over the end of the tube. See the "Special Service Tool List" in Section VIII for details of the special tools mentioned in this operation.
7. Return the mercury-filled tube and the cistern assembly to the Instrument Control Center for processing through the reassembly operations.

Adding Mercury to the Mercury Tube and Cistern Assembly

If the pre-disassembly inspector indicated on the route ticket that there is insufficient mercury in the mercury tube and cistern assembly, then mercury must be added to the cistern assembly through the mercury inlet screw hole.

1. Place the mercury tube and cistern assembly on the cistern clamping fixture, Tool No. 1. See Fig. 54 in Section V of this manual.
2. Slowly apply pressure to the top of the cistern assembly by means of the double-pronged clamp on the cistern clamping fixture, Tool No. 1. Continue to apply pressure until the top and bottom cisterns come together. See Fig. 54 in Section V of this manual.
3. Examine the top of the mercury tube to see how much mercury is required to be added. Then release the pressure applied by the double-pronged clamp on the cistern assembly.

Fill the glass syringe equipped with hypodermic needle (Tool No. 15) with sufficient mercury to fill to the tube. Add this mercury to the cistern assembly through the mercury inlet screw hole. Replace the mercury inlet screw and its washer. See the "Special Service Tool List" for details of the special tool mentioned here.

4. Again, slowly raise the mercury to the top of the mercury tube by means of the double-pronged clamp. Continue to apply pressure until the mercury reaches the top of the tube. See Fig. 56 in Section V of this manual. If the mercury still does not reach the top of the tube, repeat Operation 3.
5. Loosen the mercury inlet screw very slightly and allow mercury to escape until there is a space at the top of the tube about the size of a pin head. See Fig. 56 in Section V. The top and bottom cisterns should also be in contact. If too much mercury escapes, repeat Operations 3 and 4.

Return the mercury tube and cistern assembly in its rack to the parts inspector.

Preparing a New Mercury-filled Tube for Reassembly

1. Remove the mercury-filled tube from its container by first taking off the container cap and shaking out the sawdust into a

MERCURIAL BAROMETERS

basket. Pull the tube out from the bottom of the container.

2. Cut the wire over the rubber seal on the end of the mercury-filled tube. Then, suitably supporting the sealed end of the tube, and using a razor blade, slit the rubber seal along its entire length. Remove the rubber seal from the end of the tube. See Fig. 22.
3. Remove the wax seal and the round toothpick from the end of the tube. Wipe off the end of the tube with a clean dry cloth. See Fig. 22.
4. Measure the distance from the center of the bulb on the mercury-filled tube to the open end of the tube. This distance should not be greater than $2\frac{5}{8}$ inches. Also, the distance from the start of the bulb to the end of the tube should not be greater than $2\frac{1}{4}$ inches. See the pullout, Fig. 22.

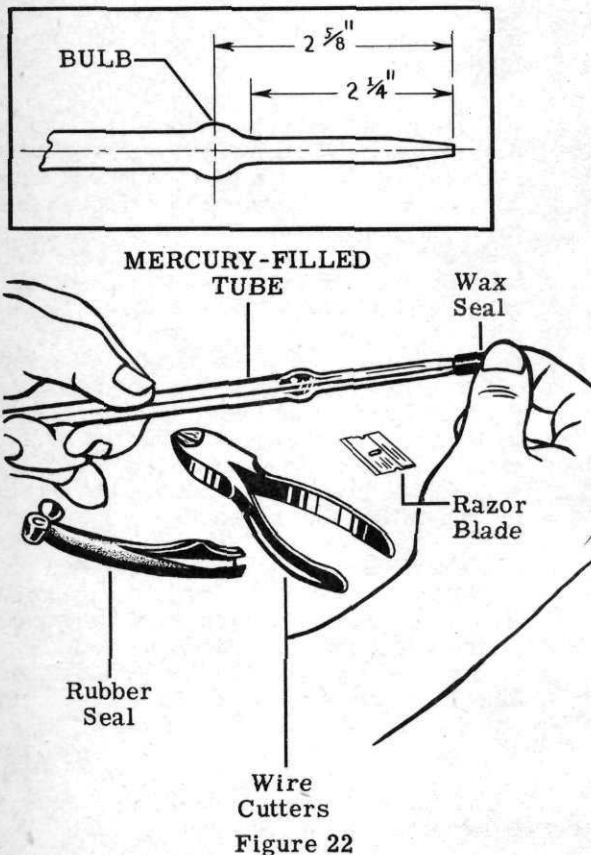


Figure 22

5. If the mercury-filled tube is over length, then it must be cut to the desired dimensions. First, fill the tube to the top with mercury before cutting. Use the glass syringe equipped with hypodermic needle, Tool No. 15. See Fig. 48 in Section V.

Using the carborundum wheel (Tool No. 20), cut the mercury-filled tube to the dimension specified in Operation 4. The carborundum wheel (Tool No. 20) should be dressed to a sharp point for this operation. See the "Special Service Tool List" in Section VIII for details of the special tools employed here.

6. Remove any carborundum or glass dust that may have found its way into the top of the mercury-filled tube. Use the glass syringe equipped with hypodermic needle (Tool No. 15) to insert mercury into the tube so that the mercury overflows. Any carborundum or glass dust that may be in the tube will be floated out on the excess mercury.

Thoroughly clean the end of the mercury-filled tube and place a protecting cap (Tool No. 16) over the open end to prevent entry of dirt. Place the tube on its rack. See the "Special Service Tool List" in Section VIII for details of the special tool used here.

Spotfacing the Vernier Rack and Pinion Bearing

The vernier rack and pinion bearing is to be spotfaced. This provides a flat bearing surface for the vernier pinion knob and, in conjunction with the vernier pinion spring washer, permits the vernier pinion to be assembled with a minimum of play and shake in its action. Proceed as follows.

1. Place the vernier rack and pinion bearing on a flat steel block. Then, using the spotfacing drill (Tool No. 21), spotface the outer surface of the bearing. See Fig. 23 and refer to the "Special Service Tool List" in Section VIII for further details of the tool employed here.

Fitting the Top and Bottom Cistern Covers

If the top or bottom cistern covers have been replaced, the hole for the cistern cover set screw must be drilled and tapped.

1. Place the cistern cushioning washer in the top cistern cover. Then place a top cistern on top of the washer. See the exploded view, Figs. 64 and 66, in Section VII for parts.

NOTE

Keep a spare top cistern on hand for this fitting operation.

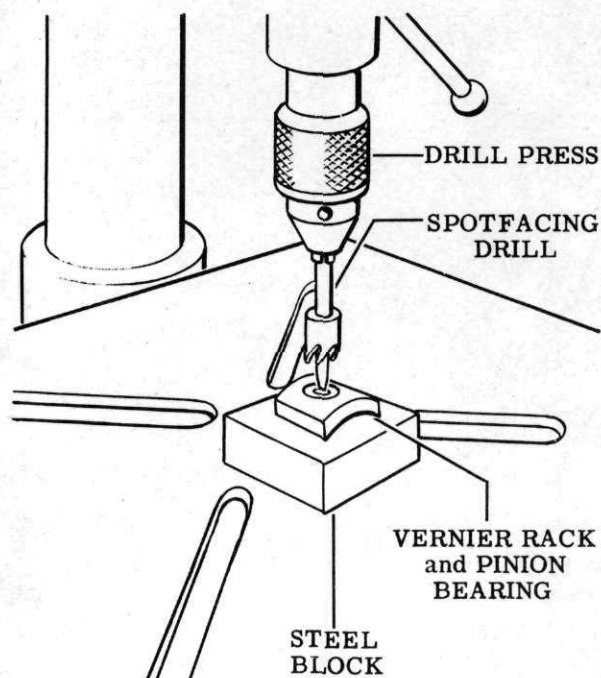


Figure 23

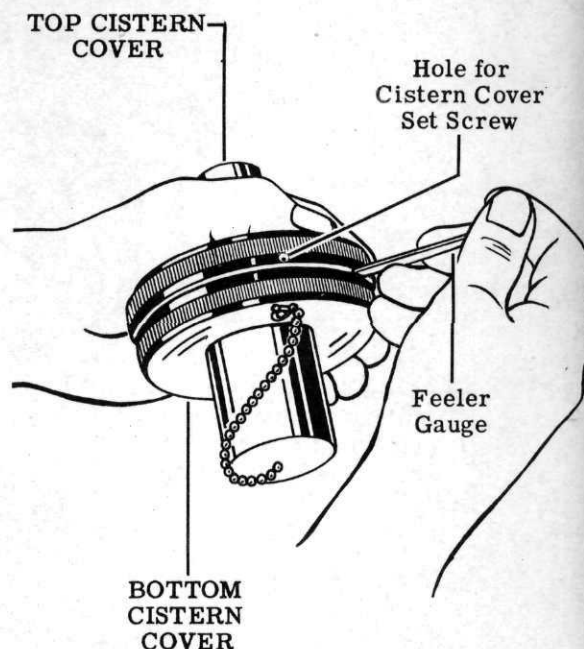


Figure 24

2. Assemble the bottom cistern cover to the top cistern cover and screw them together. The bottom cistern cover will enter the top cistern cover until it is stopped by the flange on the top cistern. When the bottom cistern will turn no further, the top cistern is held firmly between the top and bottom cistern covers. See the exploded view, Figs. 64 and 66, in Section VII for parts.
3. Using a suitable feeler gauge, check the clearance between the top and bottom cistern covers, as shown in Fig. 24. The clearance should be approximately $1/32$ inch. If the clearance is less than $1/32$ inch, another cistern cushioning washer may be assembled in the top cistern cover. If this would provide too great a clearance, paper washers of the required thickness may be assembled.
4. Drill a hole in the position shown in Fig. 24, through the top and bottom cistern covers, using a No. 50 (0.070 inch diameter) drill. Tap the hole for a No. 2-56 thread. Then countersink the hole in the top cover.
5. Scribe reassembly guide marks on the front of the top and bottom cistern covers, and on the neck of the top cistern cover if so required. Disassemble the top and bottom cistern covers. Remove the top cistern and the cistern cushioning washer, or washers, from the top cistern cover.

6. If the bottom cistern cover has been replaced a hole must be drilled for the cover chain screw. Drill this hole with a No. 50 drill (0.070 inch diameter) and tap for a No. 2-56 thread. See the exploded view, Fig. 25.
7. If the top cistern cover has been replaced, the name plate must be assembled. Locate the name plate so that it will be in front of the barometer when assembled and so that it will be easily readable. Spot drill two holes for the name plate screws with a No. 50 drill (0.070 inch diameter) and tap the holes for a No. 2-56 thread. See the exploded view, Fig. 65, in Section VII for parts.

Fitting a New Cistern Adjusting Screw or Cistern Adjusting Screw Knob

If the cistern adjusting screw or the cistern adjusting screw knob or both are replaced, then a hole must be drilled and tapped for the knob set screw. Proceed as follows.

1. Screw the cistern adjusting screw knob onto the cistern adjusting screw. See the exploded view, Fig. 25.
2. If only the cistern adjusting screw is replaced, a hole will already exist in the cistern adjusting screw knob for the knob set screw. Using this hole as a guide, drill a hole in the cistern adjusting screw

MERCURIAL BAROMETERS

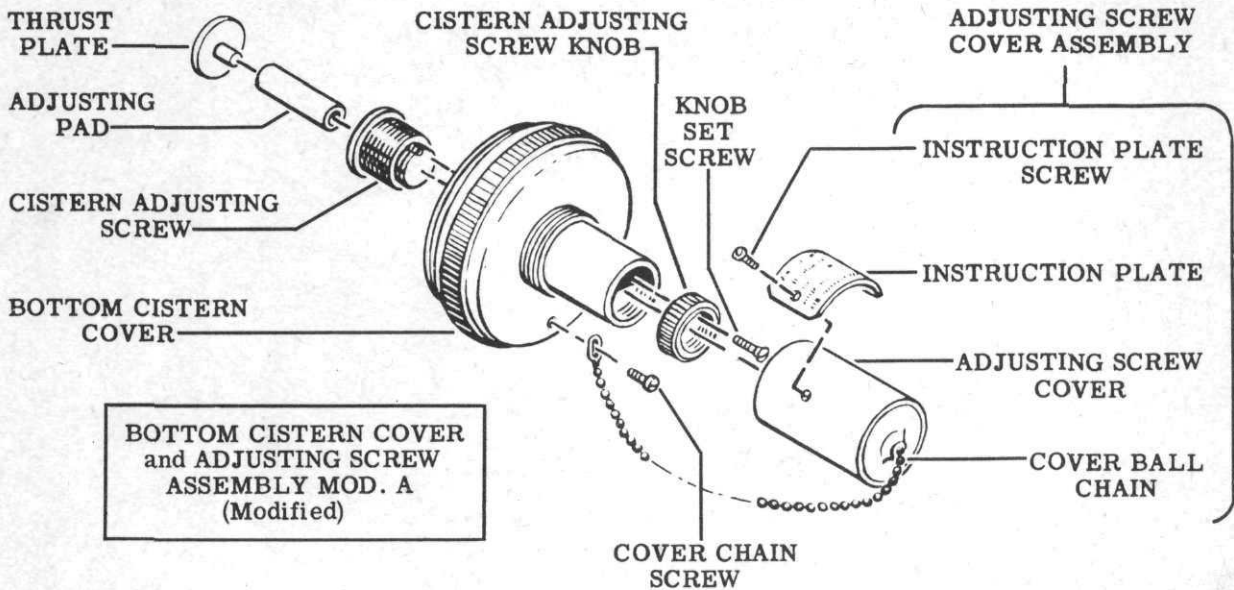


Figure 25

for the knob set screw with a No. 51 drill (0.067 inch diameter). Drill the hole to a total depth of 0.25 inch, and tap for a No. 2-56 thread.

3. If only the cistern adjusting screw knob is replaced, drill and tap a hole for the knob set screw so that it is exactly centered on the mating line of the threads of the adjusting screw and knob. Countersink the hole so that the knob set screw is flush with the top of the cistern adjusting screw knob when assembled. Insure that the new hole in the cistern adjusting screw is displaced a suitable distance from the existing one.
4. If both the cistern adjusting screw and its knob are replaced, proceed in a manner similar to that outlined in Operation 3.

Fitting a New Adjusting Screw Cover

If a new adjusting screw cover is fitted, the instruction plate must be positioned, and holes drilled and tapped for the two instruction plate screws. Proceed as follows.

1. Assemble the adjusting screw cover onto the bottom cistern cover. Mark a line on the adjusting screw cover corresponding to the scribe mark made on the front of the bottom cistern cover during the disassembly operations. This mark will be the center line of the instruction plate, so that when the adjusting screw cover is assembled on the barometer the instruction plate

will be in front and easily readable. See the exploded view, Fig. 25.

2. Position the instruction plate on the adjusting screw cover and mark the location of the two instruction plate screws. Drill two holes for the screws, using a No. 50 drill (0.070 inch diameter), and tap for a No. 2-56 thread. See the exploded view, Fig. 25.

Modification of the Bottom Cistern Cover and Adjusting Screw Assembly

If the barometer being processed through this overhaul procedure has not been equipped with a new type bottom cistern cover and adjusting screw assembly, the pre-disassembly inspector will indicate that it be modified.

This Modification A is outlined under "Modifications" in Section II of this manual. Refer to that section for details of Modification A before attempting to carry out the operations which follow.

1. Fit the modified bottom cistern cover to the existing top cistern cover, and drill a hole for the cover chain screw. Follow the procedure outlined under "Fitting the Top and Bottom Cistern Covers" in this section.
2. Screw the existing cistern adjusting screw knob onto the modified cistern adjusting screw. Drill and tap the hole for the knob set screw as outlined in Operation 2 under "Fitting a New Cistern Ad-

justing Screw or Cistern Adjusting Screw Knob," in this section.

3. Fit the modified adjusting screw cover to the bottom cistern cover, and drill and tap holes in the adjusting screw cover for the two instruction plate screws. Follow the procedure outlined under "Fitting a New Adjusting Screw Cover" in this section.

Upon completion of these operations, the bottom cistern cover and adjusting screw assembly will be completely modified and ready for reassembly.

Cleaning Mercury from Contaminated Parts

WARNING

The operation which follows describes how to remove mercury from contaminated parts by vaporization. Remember, mercury fumes are poisonous. Always carry out the removal of mercury under an exhaust hood vented to the outside atmosphere.

1. Place screws and small metal parts in the perforated container (Tool No. 19) and hold them over a Bunsen burner for a sufficient length of time, to allow the mercury to vaporize. See the "Special Service Tool List" in Section VIII for details of the special tool used here.
2. Larger parts may be placed in an oven and heated to a temperature of 680 degrees F to vaporize the mercury, or they may be held over a Bunsen burner. It may be advantageous in some instances to play the Bunsen burner flame onto the parts, as in the case of contamination of the barometer case assembly.
3. When the mercury is removed the part must be refinished. In the case of the barometer

case assembly, it may be necessary to re-solder some of the joints in the assembly.

CLEANING OPERATIONS

Skill Level: Cleaner

The parts of each barometer will be contained in an individual parts tray for each instrument. Such assemblies which cannot be easily or safely placed in a parts tray are suitably supported in a particular rack in the Instrument Control Center. The rack is so designated as to be easily associated with the parts tray in which any other remaining parts of the particular barometer are placed. Keep the parts of each barometer together. Do not mix up the parts of different instruments.

1. Clean all the disassembled mechanical parts. The standard procedure is set forth under "Cleaning Mechanical Parts" in the Control Manual.
2. Carefully clean the guard glass, the thermometer and the outer surface of the mercury-filled tube, using a dry clean cloth.
3. Clean off any paint or lacquer from surfaces where it would interfere with easy reassembly or spoil the function or appearance of the barometer and its case.
4. Chase the threads in tapped holes and on parts where necessary to remove paint and corrosion. Use commercial thread chasers and old taps. Be sure to check the thread size and tool type with the parts inspector. The wrong size tool will ruin the thread.

NOTE

Cleanliness of all parts which will be in contact with the mercury is of the utmost importance. After cleaning the top and bottom cistern, the tube-to-top cistern seal or the cistern seal, always wrap these parts in tissue.

SECTION V

REASSEMBLY PROCEDURE

Skill Levels: Subassembly Reassembly Operations (Nos. 1 through 76)—Mechanical Instrument Assembler, Senior Grade

Major-assembly Reassembly Operations (Nos. 77 through 86)—Mechanical Instrument Assembler, Senior Grade

Reassembly Operations—Barometer Case (Nos. 87 through 99)—Mechanical Instrument Assembler, Junior Grade

The operations within this section describe the standardized procedure for the reassembly of the Welch make marine mercurial barometer. The reassembly procedure is also applicable to the Friez make barometer, providing the differences between these two makes of instrument are kept in mind. Before attempting to assemble a Friez make instrument, refer to "Barometer Differences" in Section II of this manual.

Complete reassembly instructions are given, although each instrument, when it reaches this phase of the overhaul procedure, may vary as to the actual extent of its disassembly. This depends upon the results of the pre-disassembly inspection which were recorded on the route ticket for the guidance of the disassemblers and all personnel who work on the instrument.

The order of reassembly procedure is as follows: First, the individual component parts are reassembled to make up subassemblies; then, the subassemblies so formed are attached to each other to form the major assembly.

Before commencing the reassembly operations, familiarize yourself with the information contained in "Description," Section II; "Maintenance Parts Catalog," Section VII; and "Special Service Tools and Test Apparatus," Section VIII of this manual. The information contained

in these sections will enable you to associate the names, physical appearance and relationship of various parts and subassemblies.

Special Tools

Those operations which require the use of special tools—that is, other than common tools in normal shop use—include a reference by name and number to the correct tool to employ. The tools listed were each designed for a special purpose and are so constructed as to help prevent damage to parts. If you find that improvements can be made to these tools, submit your proposals to your shop supervisor. Request permission to develop your ideas under the "Beneficial Suggestion Program."

Cleanliness

In the barometer parts tray which you take from the Instrument Control Center, there will be a complete set of clean and serviceable parts. Keep them clean.

Be especially careful in your handling of mercury. Insure that the glass container into which you place it is absolutely clean.

Insure that parts which come into contact with the mercury are free from dirt and dust. Any dust particles in the cisterns, for example, will soon find their way to the inside surface of the mercury tube, which would result in the instrument becoming unserviceable in a very short period of time.

Owing to the conditions under which the barometer is used, there is a tendency for parts to corrode and "seize" together. To prevent this, anti-seize lubrication is to be applied to such parts. Reference will be made to the specific places where anti-seize lubricant is to be used in the operation concerned. Refer to "Anti-seize Lubrication" as indexed in the Control Manual.

Reassembly of Original Parts

The original and replaced parts for each instrument are contained in a separate parts tray. Do not mix parts of different instruments. There are definite advantages to be gained by reassembling original parts. The "Critical Points of Repair" in Section II of this manual are important—make sure you have a thorough knowledge of them.

General Precautions

You are responsible for your work. Read each operation through completely before performing it. Then perform the work carefully. Check your work with the illustration referred to in the text at each step. When your name goes on the route ticket, indicating completion of your work, be sure the job has been well done.

Lubrication

To permit smooth functioning of the mechanical parts of the barometer, lubricants have to be used. The Navy and manufacturers have performed research on the types of lubricants that may best be employed. Never use ordinary greases or lubricants; use only the lubricant indicated in the manual and specified in the Control Manual under "Lubrication." Follow the procedure outlined in this section of the Control Manual when applying the lubricant.

Route Ticket

Each barometer assembly has a route ticket upon which the pre-disassembly inspector has indicated the required disassembly. Depending upon the results of the pre-disassembly inspection, the extent to which they have been disassembled will vary. The instructions within this section tell you how to reassemble; the initial condition of the barometer will have determined what needs to be reassembled.

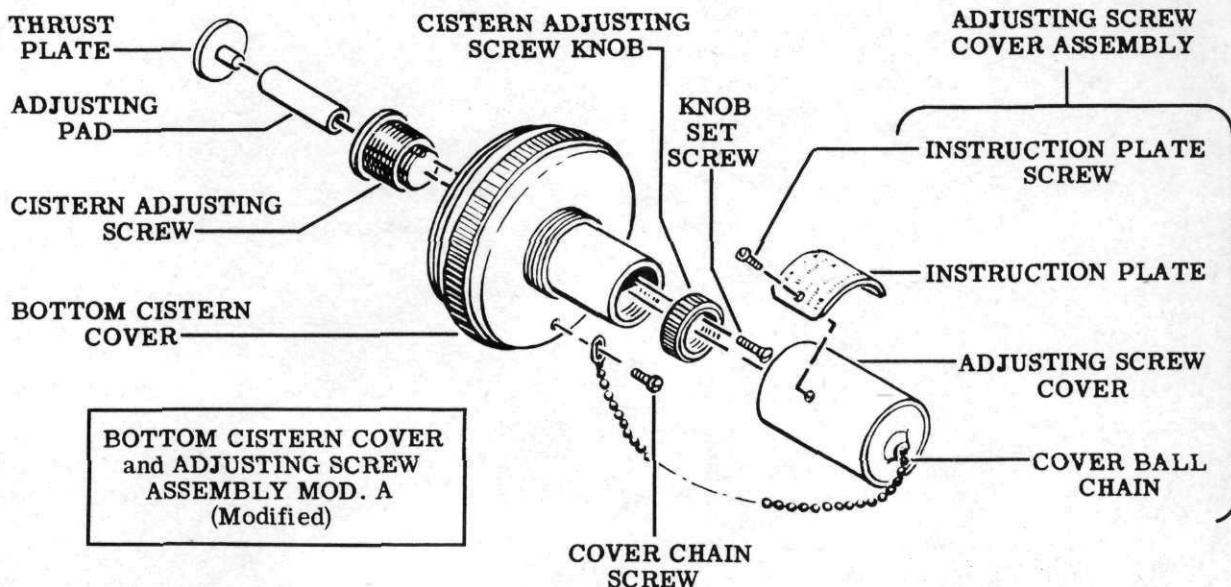


Figure 26

MERCURIAL BAROMETERS

All personnel who work on an instrument are required to sign the route ticket upon completion of their work.

SUBASSEMBLY REASSEMBLY OPERATIONS

Skill Level: Mechanical Instrument Assembler, Senior Grade

REASSEMBLING THE BOTTOM CISTERN COVER AND ADJUSTING SCREW ASSEMBLY MOD A

This reassembly procedure gives instructions for the reassembly of a modified type of bottom cistern cover and adjusting screw assembly. If the original barometer assembly was not equipped with a modified type of this assembly when received for overhaul, the parts inspector will have had the necessary parts procured, and the required fitting operations carried out. See "Modification of the Bottom Cistern Cover and Adjusting Screw Assembly" in Section IV of this manual.

1. Assemble the cistern adjusting screw into the bottom cistern cover by screwing it into the cover from the inside. See the exploded view, Fig. 26.

2. Apply a thin coating of anti-seize lubrication to the inner thread of the cistern adjusting screw knob. See "Anti-seize Lubrication" in the Control Manual. Assemble the cistern adjusting screw knob on the end of the cistern adjusting screw which protrudes from the bottom of the cistern cover. Align the holes in the adjusting screw and knob for assembly of the knob set screw; then screw in the knob set screw. See the exploded view, Fig. 26.

3. Assemble the instruction plate to the adjusting screw cover with two instruction plate screws. The cover ball chain being already assembled in the cover, this operation will complete the assembly of the adjusting screw cover assembly. See the exploded view, Fig. 26.

4. Assemble the cover ball chain to the bottom cistern cover with the cover chain screw. Screw the adjusting screw cover onto the bottom cistern cover. See the exploded view, Fig. 26.

5. Press the adjusting pad into the hole provided for it in the cistern adjusting screw. Insure that it is seated on the bottom of the hole. Then assemble the thrust plate in the exposed end of the adjusting pad. See the exploded view, Fig. 26.

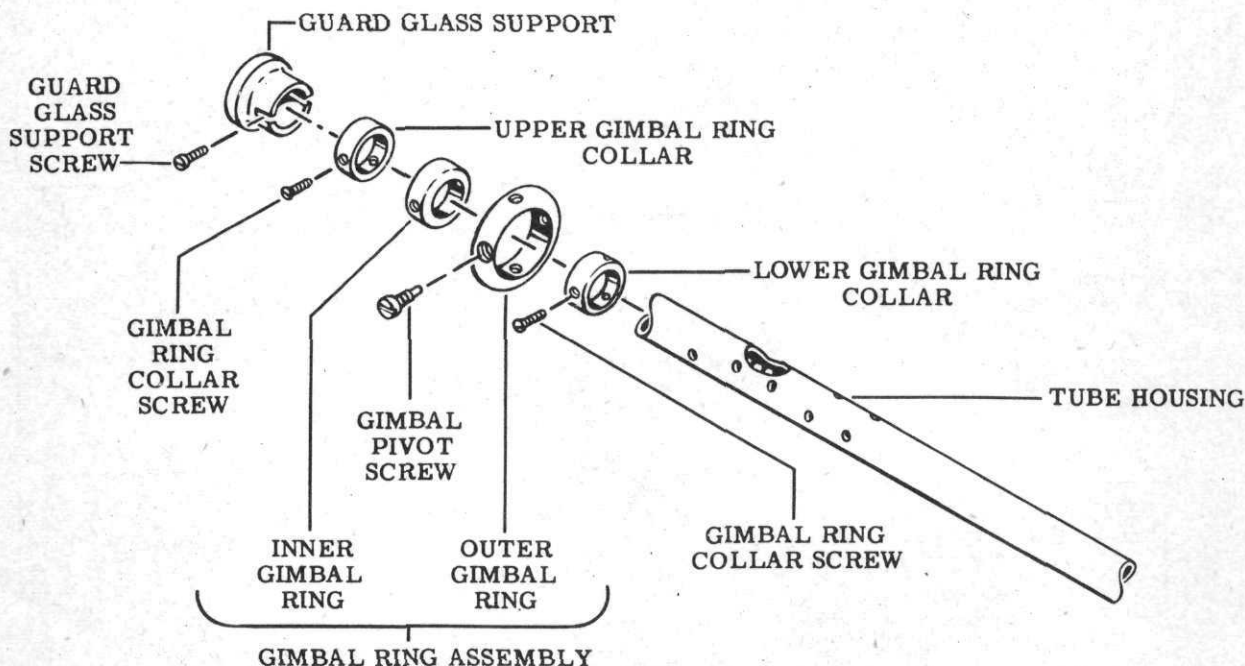


Figure 27

REASSEMBLING THE TUBE HOUSING ASSEMBLY

Assembling the Gimbal Ring Assembly and Guard Glass Support

NOTE

The tube housing has a lacquer finish on its exterior surface. To prevent damage to this finish, apply a thin coating of suitable lubricant on the inside surfaces of the guard glass support, inner gimbal ring and the two gimbal ring collars prior to assembly.

6. Slide the lower gimbal ring collar over the scale end of the tube housing and secure it loosely to the tube housing with three gimbal ring collar screws. See the exploded view, Fig. 27.
7. Apply a coating of pivot screw grease to the bearing surfaces of two gimbal pivot screws. See "Lubrication" in the Control Manual. Then assemble the outer gimbal ring to the inner gimbal ring with the two gimbal pivot screws. Insure that the outer gimbal ring moves smoothly without binding on the pivot screws. See the exploded view, Fig. 27.
8. Apply a coating of gimbal ring grease to the surfaces of the inner gimbal ring which bear against the upper and lower gimbal ring collars. Then slide the gimbal ring assembly onto the tube housing until it

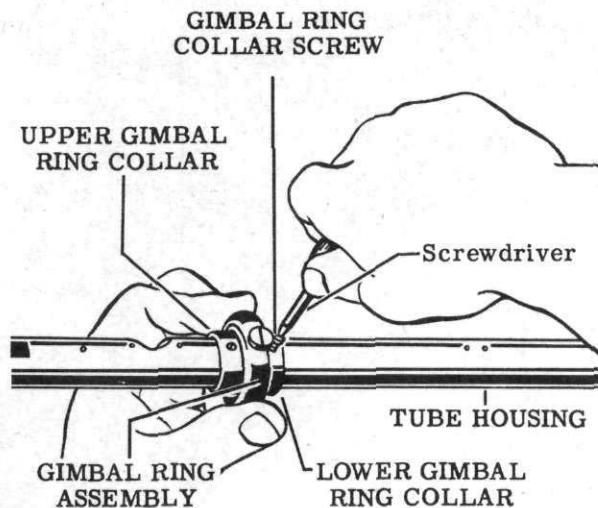


Figure 28

comes up against the lower gimbal ring collar. See the exploded view, Fig. 27.

9. Slide the upper gimbal ring collar over the tube housing and up to the gimbal ring assembly. Secure it loosely to the tube housing with three gimbal ring collar screws. See the exploded view, Fig. 27.
10. Place the tube housing in a horizontal position on the two support blocks, Tool No. 2. Tighten the three gimbal ring collar screws in each of the gimbal ring collars. Push the gimbal ring assembly against each collar as the screws are tightened to insure that the inner gimbal ring turns freely between the two collars. Wipe off any excess grease with a clean cloth. See Fig. 28.
11. Slide the guard glass support onto the tube housing, locate it in position, and assemble the two guard glass support screws. See the exploded view, Fig. 27.

Assembling the Vernier Rack and Pinion Bearing Assembly

12. Apply a coating of vernier pinion grease to the bearing surface of the vernier pinion. Assemble the vernier pinion in the vernier rack and pinion bearing. See the exploded view, Fig. 29.

NOTE

A vernier pinion spring washer will be provided in the parts tray. Assemble this washer on to the vernier pinion before assembling the pinion into the vernier rack and pinion bearing. See the exploded view, Fig. 29.

13. Assemble the vernier pinion knob and the vernier pinion nut onto the vernier pinion. Tighten the vernier pinion nut down firmly using the pinion nut wrench, Tool No. 4. See Fig. 30. Final tightening will be done when the vernier pinion has been checked for freedom of rotation.
14. Engage the rack teeth of vernier rack and support with the vernier pinion, and slide the rack into the bearing slot in the vernier rack and pinion bearing. See Fig. 31. Check the rack for free-running with the vernier pinion. If no binding or play exists, tighten the vernier pinion nut, using the pinion nut wrench, Tool No. 4.
15. The tube on the end of the vernier rack and support should be concentric with the inner

MERCURIAL BAROMETERS

curved surface of the vernier rack and pinion bearing for all positions of the rack relative to the bearing. Sight through the tube on the end of the vernier rack and support. You should see a pattern as shown in the pullout in Fig. 31. Rotate the vernier pinion knob to move the vernier rack and support in or out of the vernier rack and pinion bearing. Check the pattern at several points. If lack of concentricity is seen, it can be corrected by grasping the rack with pliers, as shown in Fig. 32, and twisting the rack in opposite directions.

When the rack is correctly aligned, remove it from the vernier rack and pinion bearing.

16. Assemble the vernier rack and pinion bearing assembly to the tube housing with the

four rack and pinion bearing screws. See the exploded view, Fig. 29.

Assembling an Original Vernier Rack and Support

17. Apply a thin coating of rack grease to the teeth of the vernier rack and support and along the edge of the rack opposite the teeth. See "Lubrication" in the Control Manual. Insert the rack in the tube housing and engage it in the vernier rack and pinion bearing assembly. Insure that the rack teeth mesh correctly with the vernier pinion; check the movement of the rack and pinion by rotating the vernier pinion knob. See Fig. 33 and the exploded view, Fig. 29.

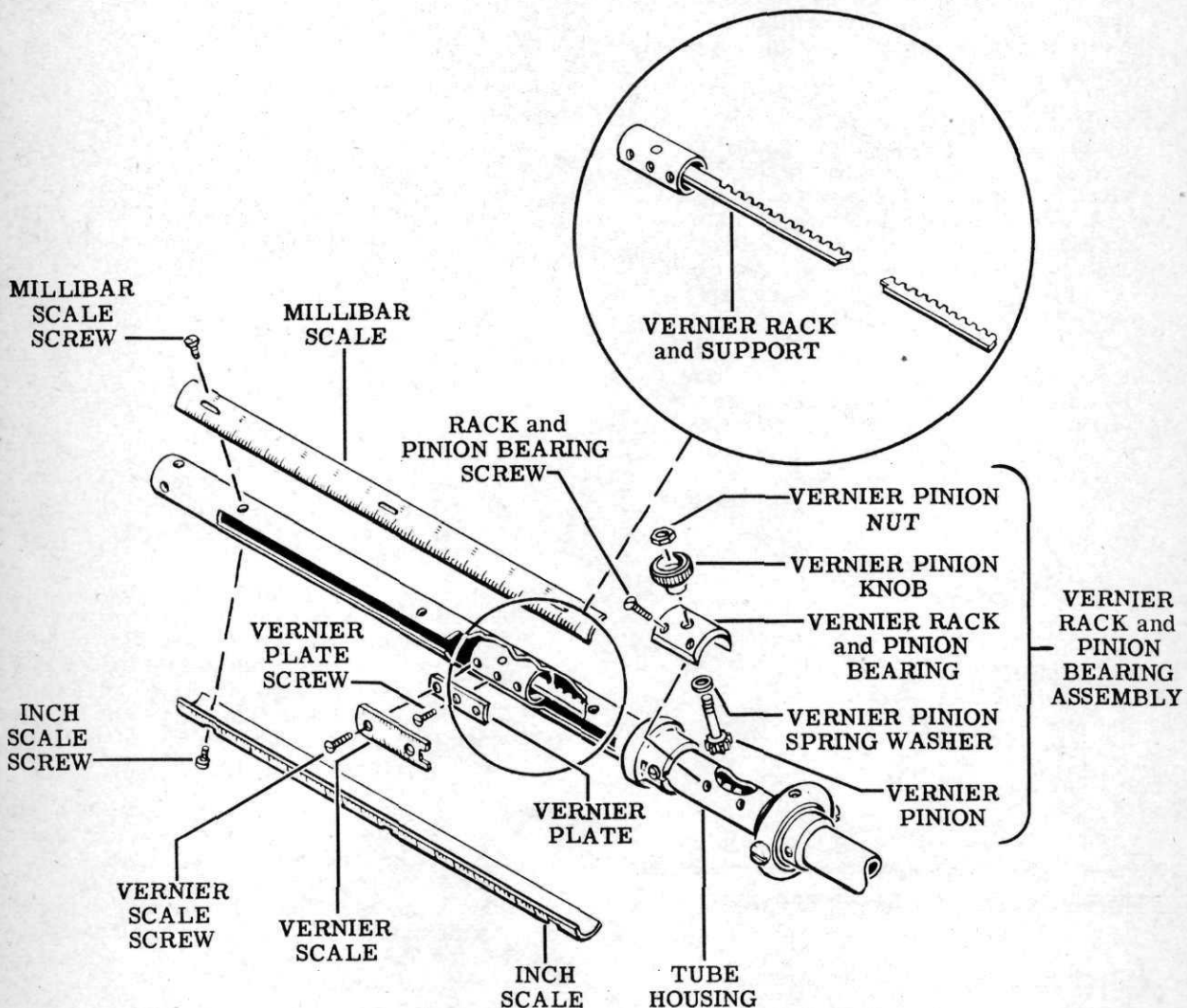


Figure 29

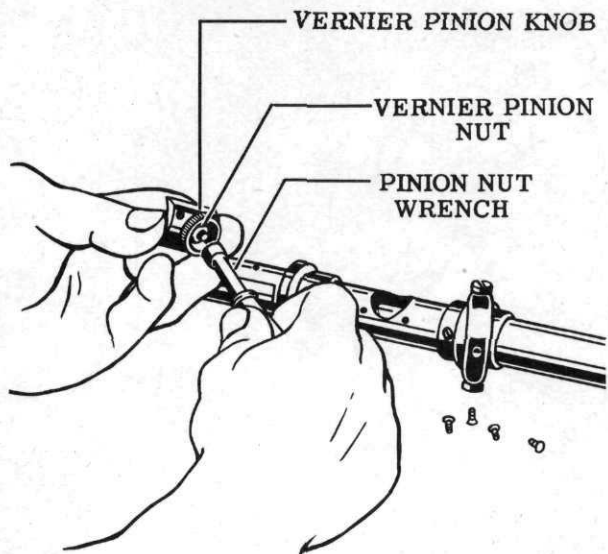


Figure 30

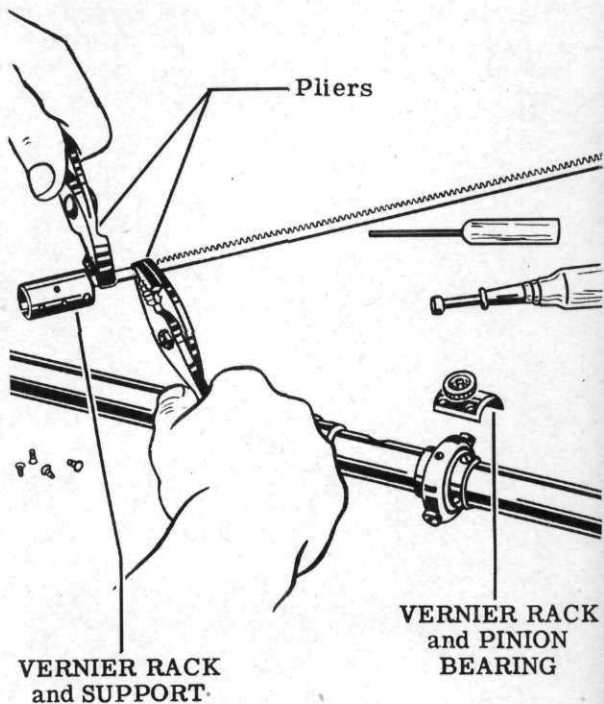


Figure 32

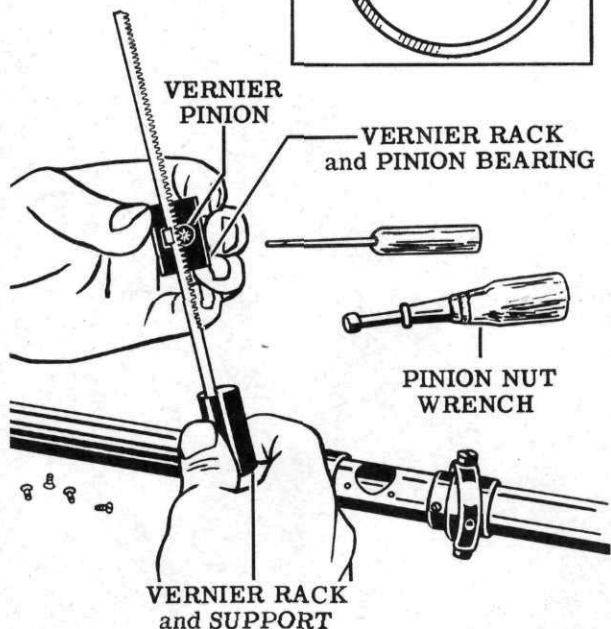
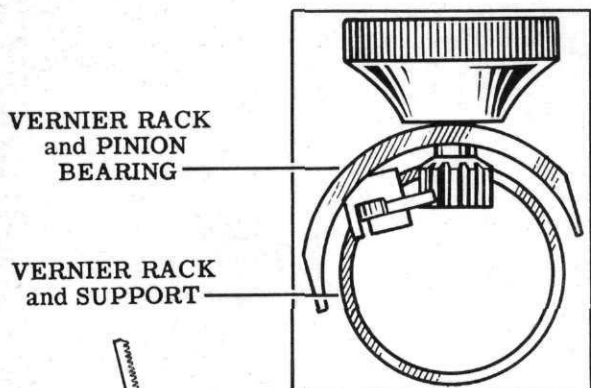


Figure 31

18. Check that the three holes in the tube at the end of the vernier rack and support are exactly centered in the slot in the tube housing for all positions of the vernier rack and support. See Fig. 34. If they are not centered, then adjustment may be made by inserting two small screwdrivers into the

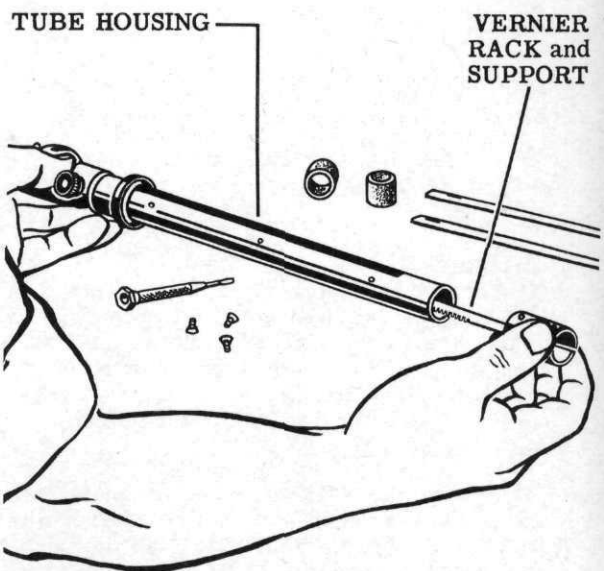


Figure 33

MERCURIAL BAROMETERS

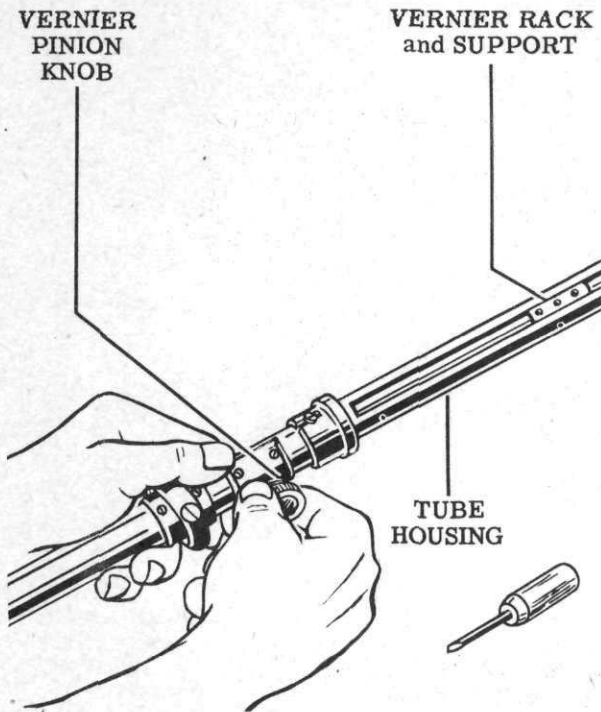


Figure 34

two outer holes and twisting the rack. Check the vernier rack and support again for freedom of movement.

NOTE

Take care not to damage the threads in the holes of the vernier rack and support when performing Operation 18.

Assembling a New Vernier Rack and Support

19. Assemble the vernier rack and support following the procedure outlined in Operation 17.
20. Scribe a line down the center of the vernier rack and support, exactly centered in the slot in the tube housing. See Fig. 35. Then check the travel of the vernier rack and support to insure that the scribe line remains centered in the slot for all positions of the vernier rack and support in the tube housing.
21. Assemble the vernier scale and plate drill jig (Tool No. 9) on the end of the vernier rack and support. Supporting the tube housing in a two-spindle drill press, drill the two outside holes in the support with a No. 35 drill and the hole in the center with a

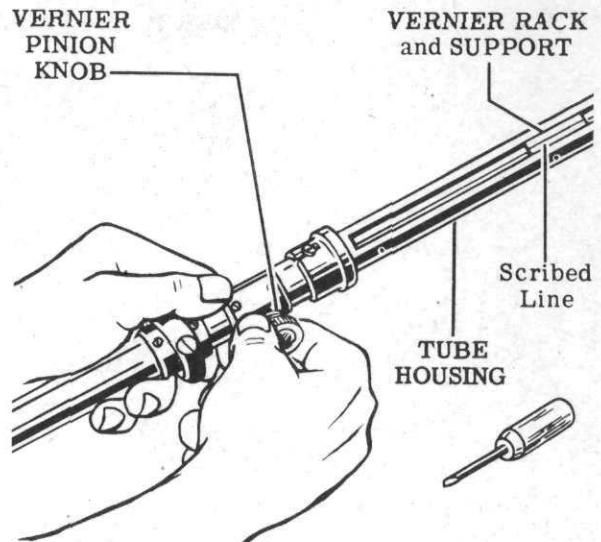


Figure 35

No. 49 drill. Remove the drill jig. See Fig. 36. (If a single-spindle drill is used, drill all three holes with the No. 49 drill. Then, after removing the part from the drill jig, redrill the two outside holes with a No. 35 drill.) Tap the center hole for a 2-56 thread.

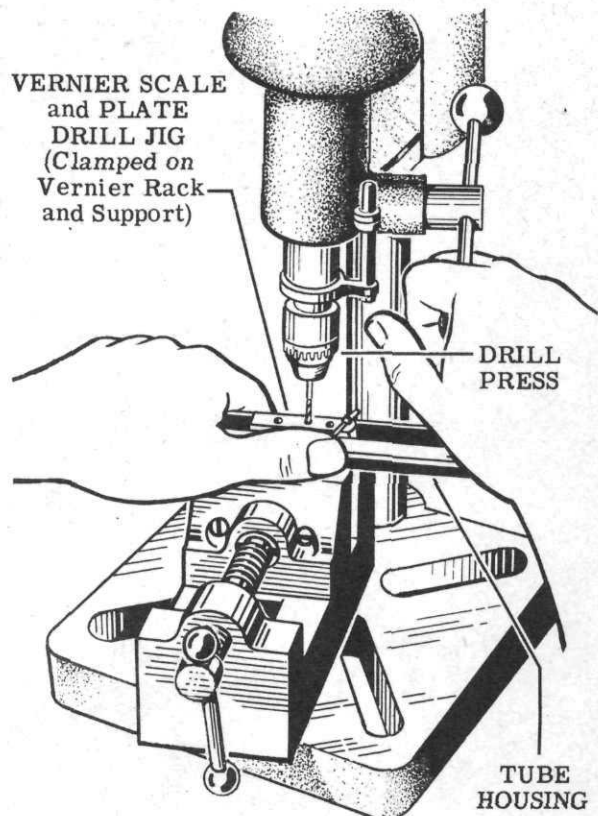


Figure 36

Reassembling the Inch and Millibar Scales

22. Assemble the inch and millibar scales to the tube housing with the three inch-scale screws, and the three millibar-scale screws. Do not tighten these screws too tightly as further adjustments have yet to be made. See the exploded view, Fig. 29.
23. Place the vernier scale between the inch and millibar scales. Adjust the position of the inch and millibar scales until the vernier scale is a snug sliding fit between them. Then tighten the screws. Insure that the vernier scale is exactly centered with respect to the tube housing slot in all positions along the inch and millibar scales. Remove the vernier scale. See Fig. 37.

NOTE

If the vernier scale is a slack fit over the center portion of the inch and millibar scales, press the tube housing slightly at the point of slackness. Re-adjust the inch and millibar scales, if necessary, to insure a snug sliding fit of the vernier scale over their entire length.

24. Move the vernier rack and support up and down the scales by means of the vernier pinion knob. Insure that the inch or millibar scale screws do not protrude into the tube housing sufficiently to interfere with the movement of the vernier rack and support. If they do interfere, disassemble the vernier rack and support. Then, using the half round file with extension handle (Tool No. 10), file down the ends of the screws flush with the inner surface of the tube housing. Reassemble the vernier rack and support. Refer to the "Special Service Tool List" in Section VIII for details of the special tool employed here.

Reassembling the Vernier Scale and Vernier Plate

25. Assemble the vernier plate to the vernier rack and support with the flat-headed vernier plate screw. See the exploded view, Fig. 29. Check that the head of the vernier plate screw does not protrude above the vernier plate. If it does protrude, then remove the vernier plate screw and file down its head the required amount. Reassemble the screw and check it again.

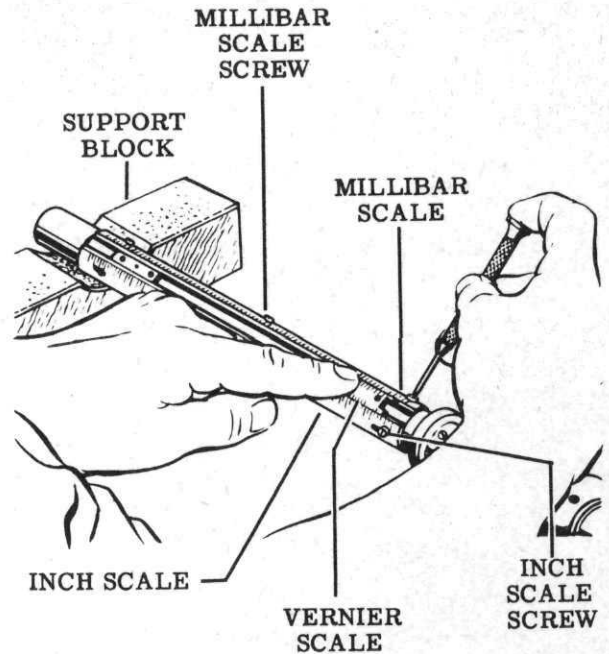


Figure 37

26. Assemble the vernier scale over the vernier plate with the two vernier scale screws. See the exploded view, Fig. 29. Check the movement of the vernier scale over the entire length of the inch and millibar scales. There should be no gaps between the vernier scale and the inch and millibar scales at any point. Any required adjustments can be made by moving the appropriate scale or by pressing the tube housing in. Refer to Operation 23 and its associated "Note" in this section.

Assembling the Top Cistern Cover

27. Assemble the name plate to the top cistern cover with the two name plate screws. See the exploded view, Fig. 38.
28. Assemble the top cistern cover on the tube housing, taking care to align the reassembly guide marks which were made during disassembly, on the tube housing and the cistern cover. Screw in the four top cistern cover screws. File the screws flush with the inner surface of the tube housing. Use the half round file with extension handle, Tool No. 10. Refer to the "Special Service Tool List" for details of this special tool. See the exploded view, Fig. 38.
29. Apply orange shellac to the cistern cushioning washer, or washers, at two or three

MERCURIAL BAROMETERS

places. See "Sealing Compounds" in the index of the Control Manual. Allow the shellac to become tacky; then assemble the washer, or washers, into the top cistern cover. Insure that the washer, or washers, firmly adhere to the cistern cover. See the exploded view, Fig. 38.

REASSEMBLING THE THERMOMETER ASSEMBLY

NOTE

If the thermometer assembly has been completely disassembled, perform Operation 32 using the thermometer mount only. Then reassemble the thermometer assembly as outlined in Operations 30 and 31.

30. Place the thermometer carefully in the thermometer mount with its bulb end down. See the exploded view, Fig. 38.
31. Assemble the thermometer strap to the thermometer mount with the two thermometer strap screws. Insure that the thermometer scale is correctly positioned. See the exploded view, Fig. 38.

32. Assemble the thermometer assembly to the tube housing with two thermometer mount screws. File off these screws flush with the inner surface of the tube housing. Use the half round file with extension handle, Tool No. 10. See the exploded view, Fig. 38, and refer to the "Special Service Tool List" in Section VIII for details of the special tool employed here.

So as to reduce the possibility of breakage, remove the thermometer assembly from the tube housing and place it in the parts tray along with its thermometer mount screws. This assembly will be reassembled to the tube housing at the end of these reassembly operations.

The cap and hanger ring assembly, the mercury tube stop and the upper tube support will be assembled after the mercury tube and cistern assembly has been assembled in the tube housing. The guard glass and its washer will be assembled after the barometer has been calibrated and adjusted.

REASSEMBLING THE CISTERN ASSEMBLY

Before proceeding with the reassembly of the cistern assembly, refer to the material con-

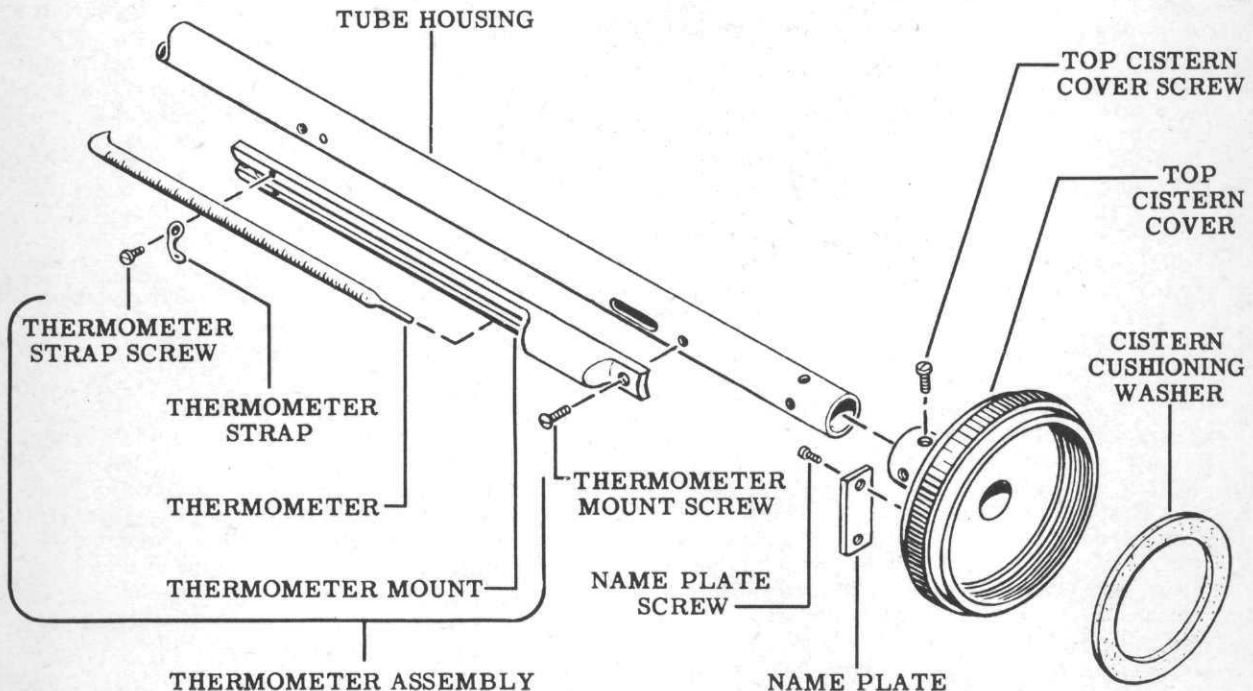


Figure 38

tained under "Cleanliness" in the introduction to this section. Before assembling any part of this assembly, blow off any dust or dirt that may exist with an air hose. It is most important that the cistern assembly be perfectly free from any traces of dust or dirt.

33. Assemble the mercury inlet screw washer onto the mercury inlet screw. Then assemble the screw into the top cistern. See the exploded view, Fig. 39.
34. Using the waxing rod (Tool No. 11), apply a thin even film of cistern sealing wax to

the top and bottom shoulders of the top cistern. See Fig. 40 (and also Fig. 45) for the position of these shoulders. Apply a similar coating of cistern sealing wax to the shoulder on the periphery of the bottom cistern. See "Sealing Compounds" in the Control Manual.

The wax is applied by heating the waxing rod (Tool No. 11) and then placing it in the cistern sealing wax. The heated wax is then transferred to the cistern shoulder

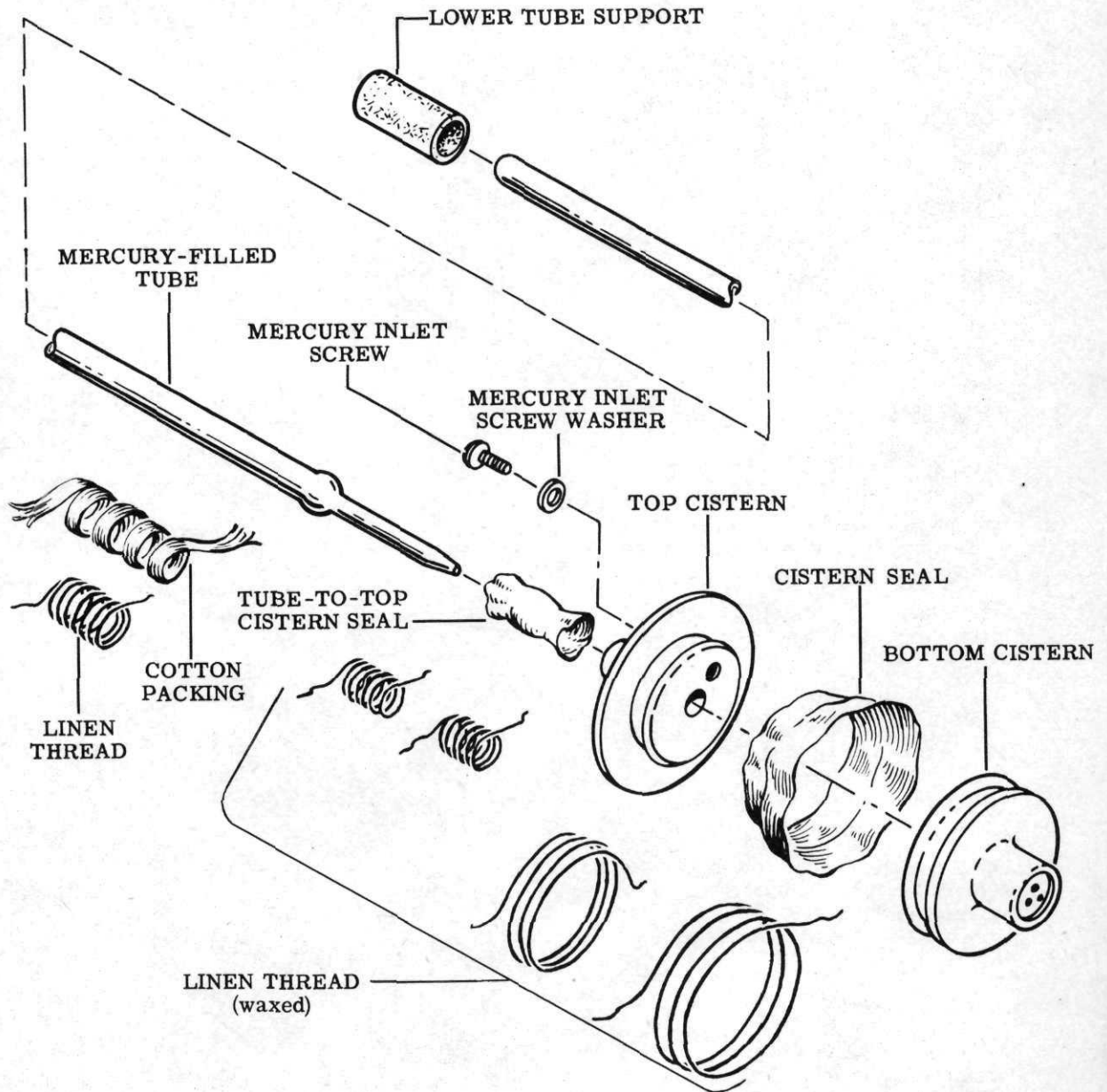


Figure 39

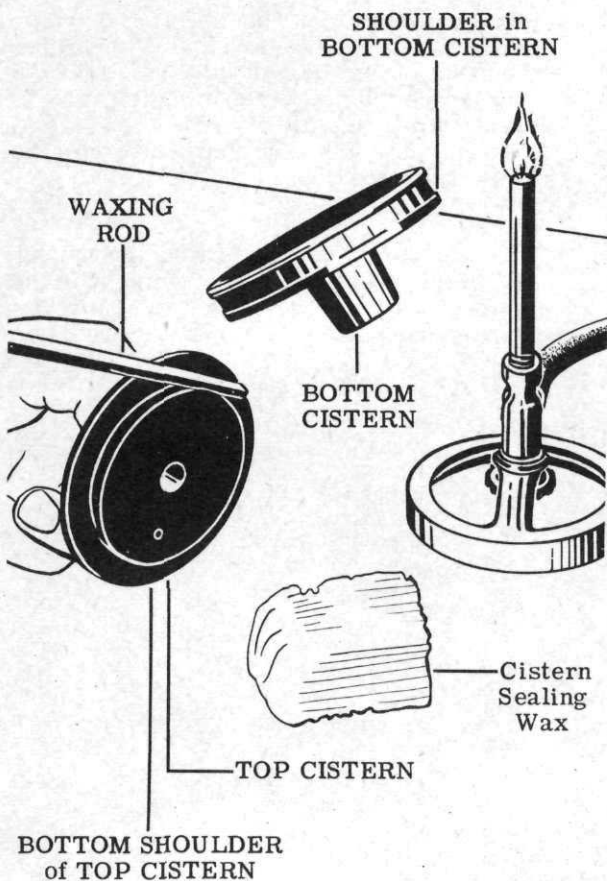


Figure 40

and spread thinly and evenly over its surface. Any excess wax or drippings are to be removed. See Fig. 40.

35. Suitably protect the neck of the top cistern and place the cistern in a vise. See Fig. 41.

CAUTION

Take care not to tighten the vise jaws excessively or the cistern neck may be damaged.

36. Inspect the cistern seal for signs of pin holes or other defects by stretching it gently, and holding it in front of a strong light. See the exploded view, Fig. 39.

NOTE

The untanned surface of the doeskin cistern seal is to be on the outside when the seal is assembled.

37. Stretch the cistern seal carefully over the bottom shoulder of the top cistern. See Fig. 41.

If the cistern seal is new, it will be supplied to you in the form of a disc, with a 1-3/4-inch-diameter hole in the center. Form the disc into the shape of a bowl by stretching the hole until it is approximately 2-1/4 inches in diameter, and at the same time forming the skin with your fingers. After shaping, the cistern seal may be assembled to the top cistern. See Fig. 41.

38. Using the forming tool (Tool No. 12), press the cistern seal down to the flat flange on the top cistern. See Fig. 41 and the exploded view, Fig. 39.
39. Fold the outer edge of the cistern seal carefully over the center of the top cistern and place a suitable weight on the seal to hold it down. See Fig. 42. Insure that the seal forms smoothly around the shoulder of the top cistern over which it has been stretched.
40. Cut a length of linen thread approximately 10 feet long. Then wax it thoroughly with cistern sealing wax. See "Sealing Compounds" in the Control Manual.



Figure 41

Starting at the center of the thread, and holding the thread taut, wind it tightly around the cistern seal. Start at the bead on the top cistern shoulder. See Fig. 42 and the pullout on the same figure. Cross the first turn of thread and pull it tight. After making the next turn, tie a single knot. See Fig. 43.

Continue to wind the thread tightly around the cistern seal, making a crossover at each turn. Stagger the crossover slightly on every turn. Insure that the thread is under even tension all the time that you are winding it around the seal, and that each turn is tight up against the previous turn. As the winding proceeds, be sure that no wrinkling of the cistern seal occurs.

41. Make a single knot next to the last turn, and then tie a double box knot. Using

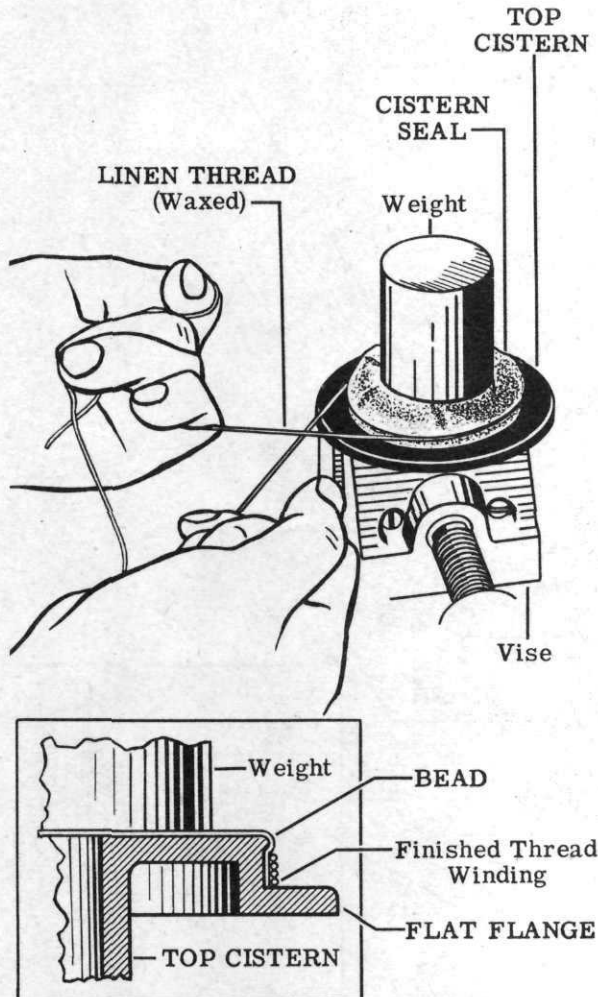


Figure 42

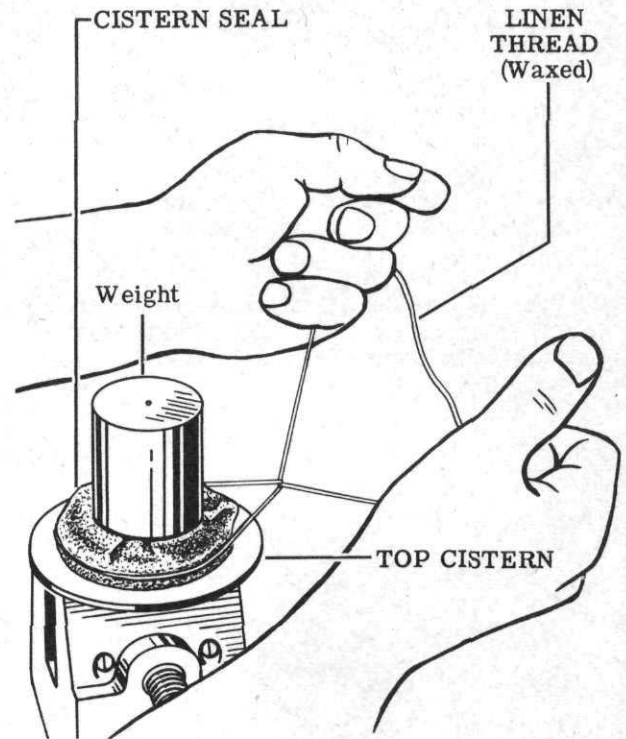


Figure 43

scissors, cut off the excess lengths of thread. The thread winding when completed should extend from the bead on the top cistern shoulder down to the flat flange. See the pullout on Fig. 42.

NOTE

Inspect the thread winding carefully after Operation 41. Check for any wrinkles in the cistern seal under the winding, or excessive gaps between the turns of thread. If there are wrinkles present, or the thread has not been wound evenly, then mercury may leak from the cistern when it is filled. Repeat Operations 40 and 41 if necessary to insure that no leaking will occur on final assembly.

42. With the forming tool (Tool No. 12) push down the knots to form a smooth surface all around the seal. Then remove the weight and remove the top cistern from the vise. See Fig. 43.
43. Suitably protect the bottom cistern and place it in a vise so that it is held by the stem which protrudes from the bottom of

MERCURIAL BAROMETERS

the cistern. See Fig. 44, and the exploded view, Fig. 39.

CAUTION

Take care not to tighten the vise jaws excessively or the cistern stem may be damaged.

44. Spread out the cistern seal assembled to the top cistern. Then place the top cistern on the bottom cistern. See Fig. 44.

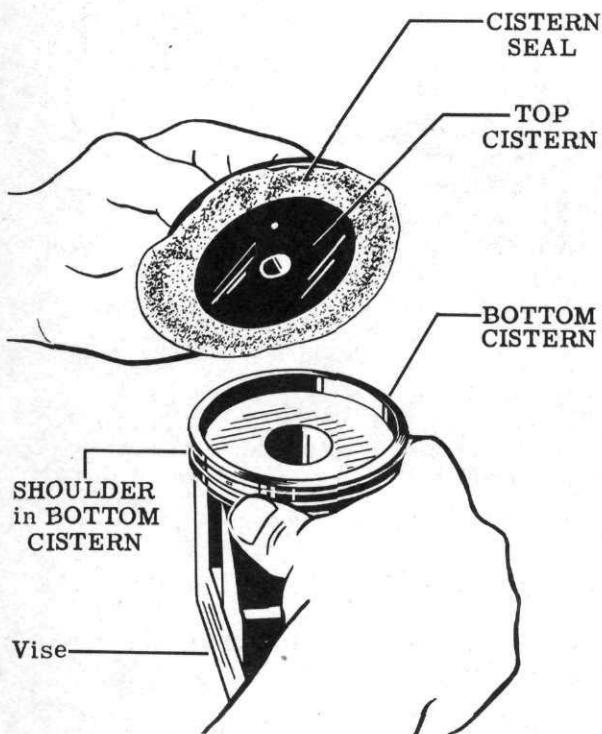


Figure 44

45. Pull the cistern seal down gently over the shoulder on the bottom cistern, and hold it in place with a rubber band. See Fig. 45.
46. When the forming operation which follows is completed, the top cistern should be exactly centered in the bottom cistern.

Form the cistern seal over the shoulder of the bottom cistern so that it fits smoothly with no signs of wrinkling. Use the forming tool (Tool No. 12) and the flat-nosed tweezers (Tool No. 13) to accomplish this. There should be just enough material left between the shoulders on the top and bottom cisterns so that there is no slack when

the two cisterns are in contact. Any slack that may exist can be pulled up by means of the flat-nosed tweezers, Tool No. 13. See Fig. 45.

47. Cut a length of linen thread approximately 10 feet long. Wax the thread thoroughly with cistern sealing wax. See "Sealing Compounds" in the Control Manual.

Start winding over the seal at the top bead on the bottom cistern shoulder. See the pullout in Fig. 45. Employ the same method as outlined in Operations 40 and 41. The rubber band may be removed after the second turn of thread has been completed.

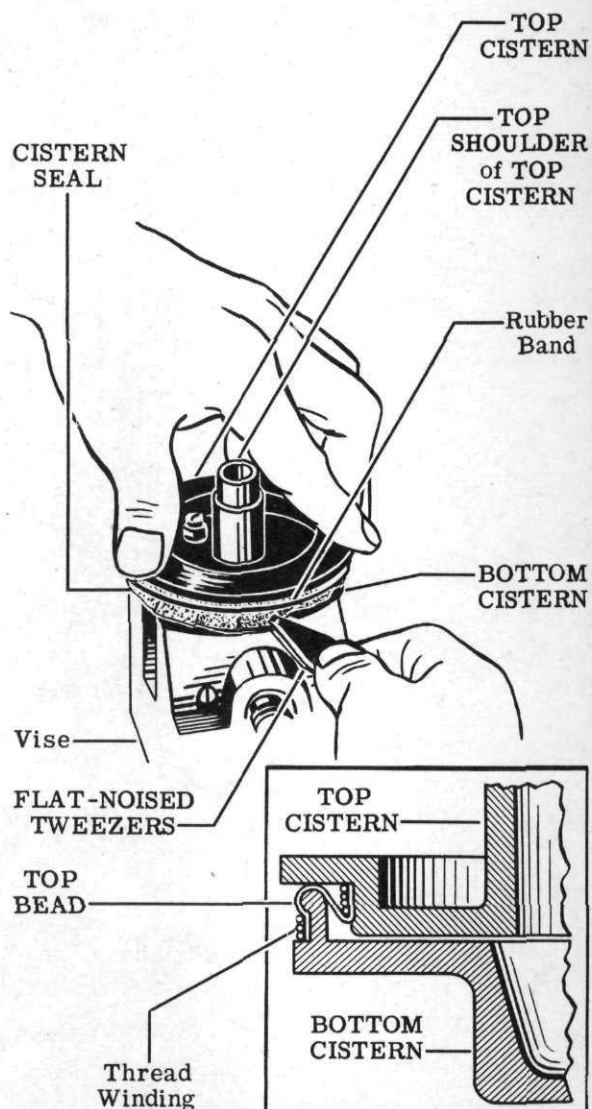


Figure 45

The thread winding when completed should extend from the top bead for a distance of approximately 1/4 inch.

NOTE

Inspect the thread winding carefully in a manner as outlined in the previous "Note" for the top cistern and cistern seal. Insure that the top cistern is exactly centered in the bottom cistern.

48. Using a sharp pointed scissors (Tool No. 14), trim off any excess length of cistern seal. Push down the knots to form a smooth surface all around the seal. Use the forming tool, Tool No. 12. See the exploded view, Fig. 39, and refer to the "Special Service Tool List" in Section VIII for details of the special tools used here.

REASSEMBLING THE TUBE-TO-TOP CISTERN SEAL

NOTE

The untanned surface of the doe-skin tube-to-top cistern seal is to be on the outside when the seal is assembled.

49. Inspect the tube-to-top cistern seal for signs of pin holes or other defects by stretching it gently, and holding it in front of a strong light. Blow off any dirt or dust with an air hose. See the exploded view, Fig. 39.
50. With the cistern assembly held in a vise, stretch the tube-to-top cistern seal over the neck of the top cistern. Using the forming tool (Tool No. 12), push the seal down to the bottom of the shoulder on the top cistern neck. See Fig. 46. Hold the top of the seal closed by means of a rubber band. This will prevent entrance of dirt or dust into the cistern assembly.
51. Cut a length of linen thread approximately three feet long. Starting at the center of the thread and holding the thread taut, wind it tightly around the seal. Begin at the bottom of the shoulder on the top cistern neck and work up to the bead. See Fig. 47 and the exploded view, Fig. 39. Cross the first turn of thread and pull it tight. Then tie a single knot in the next turn.

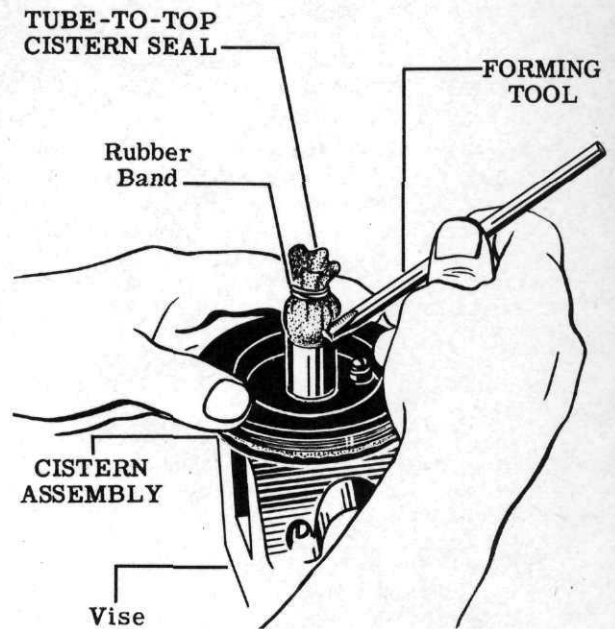


Figure 46

Continue to wind the thread tightly around the tube-to-top cistern seal, making a crossover at each turn. Stagger the crossover slightly on every turn. Insure that the thread is under even tension all the time that you are winding it around the seal and

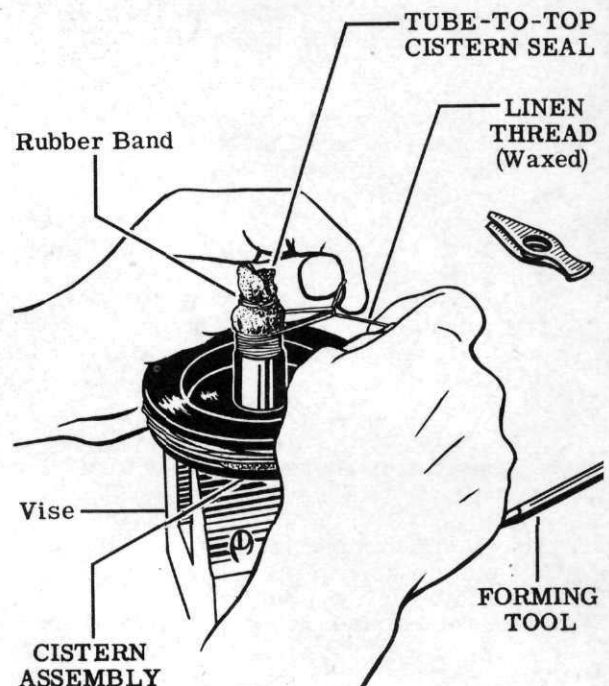


Figure 47

MERCURIAL BAROMETERS

that each turn is tight up against the previous turn. As the winding proceeds be sure that no wrinkling of the tube-to-top cistern seal occurs.

52. When the winding reaches the bead on the top cistern neck, make a single knot next to the last turn and then tie a double box knot. Using scissors, cut off the excess lengths of thread. Flatten the knots to form a smooth surface all around the seal, using the forming tool, Tool No. 12. See Fig. 47.

NOTE

Inspect the thread winding carefully after Operation 52. Check for any signs of wrinkling in the tube-to-top cistern seal under the thread winding, or excessive gaps in the turns of thread. Remember, mercury may leak from the seal if it is not properly tied.

53. Wrap the cistern assembly in tissue paper and place it in a safe place in the parts tray. Leave the rubber band around the top of the tube-to-top cistern seal. This will give added protection against entry of dust or dirt.

REASSEMBLING THE MERCURY TUBE AND CISTERN ASSEMBLY

54. Apply a thin coating of tube wax to the bulb of the mercury tube. Start the coating approximately halfway up the bulb and continue it for about 1/2 inch up towards the top of the mercury tube. The mercury tube can be left in the vertical support rack (Tool No. 5) during this operation. See the exploded view, Fig. 39, and refer to the "Special Service Tool List" in Section VIII for details of the special tool referred to in this operation.
55. Remove the tissue paper from the cistern assembly, and remove the rubber band from the tube-to-top cistern seal. See Fig. 47.
56. Pour a small amount of clean mercury into the cistern assembly. Roll the mercury around to flush out the cistern. Discard the mercury. Repeat as often as it is necessary to insure a perfectly clean cistern.
57. Compress the top and bottom cisterns and fill the cistern assembly with clean mer-

cury. Allow the mercury to come level with the top of the neck on the top cistern.

Lift the top cistern very slightly so that the mercury can fill out the cistern seal. Again pour in mercury to bring the level up to the top of the top cistern neck.

58. Fill the glass syringe equipped with a hypodermic needle (Tool No. 15) with about 1 CC of clean mercury. Remove the protecting cap (Tool No. 16) from the top of the mercury-filled tube. Using the syringe, insert mercury into the tube so that there is a meniscus protruding out of the top of the tube. See Fig. 48. During this operation the mercury tube assembly will remain supported in the vertical support rack, Tool No. 5.

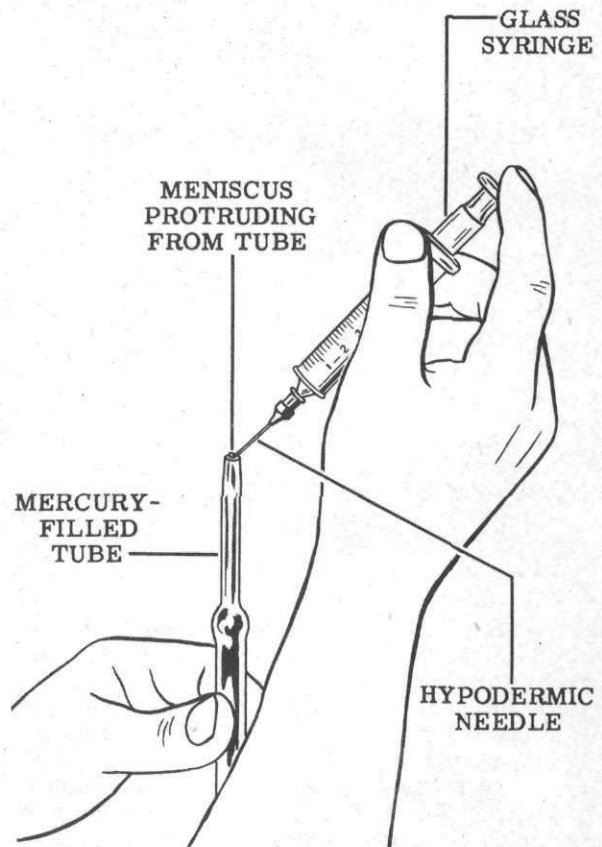


Figure 48

59. Remove the mercury-filled tube from the vertical support rack, Tool No. 5. Hold the tube with the right hand just below the trap, and let the end of the tube rest on your elbow. See Fig. 49. Tilt the cistern assembly with your left hand, while at the same time compressing the cisterns slightly

the cistern assembly to remove any air that may have been trapped in it.

NOTE

For skillful performance of Operation 60, considerable practice is required. So if at first you experience some difficulty in performing this operation, do not be discouraged.

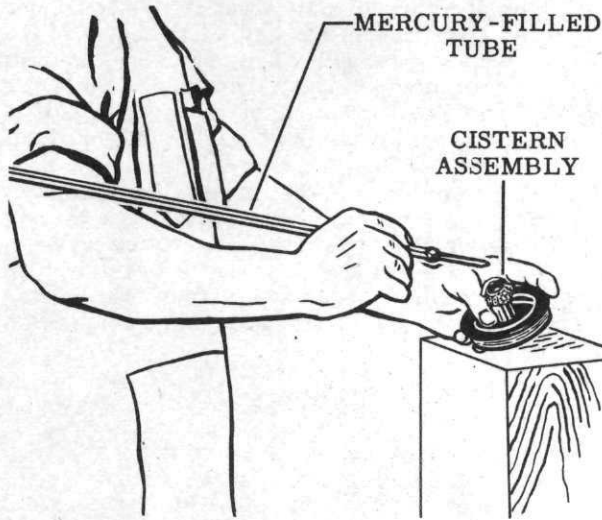


Figure 49

to bring the mercury right up to the top. See Fig. 49.

60. Slowly tilt the mercury-filled tube and join the mercury in the tube with the mercury in the cistern assembly. When you have raised the mercury-filled tube to an angle of about 45 degrees (see Fig. 50), invert it completely into the cistern assembly. In- sure that no air enters the mercury tube during this operation. See Fig. 51.

To avoid spilling mercury, gradually re- lease the cisterns immediately after the mercury in the tube and in the cistern as- sembly has been joined. Tap the bottom of

61. Inspect the tube trap for signs of air bub- bles. Refer to Fig. 19 in Section III of this manual for details of the construction of this trap.

If air has entered the trap, then slowly tip the mercury tube over to an angle of about 45 degrees, until the mercury runs to the end of the tube. Then remove the tube from the cistern assembly.

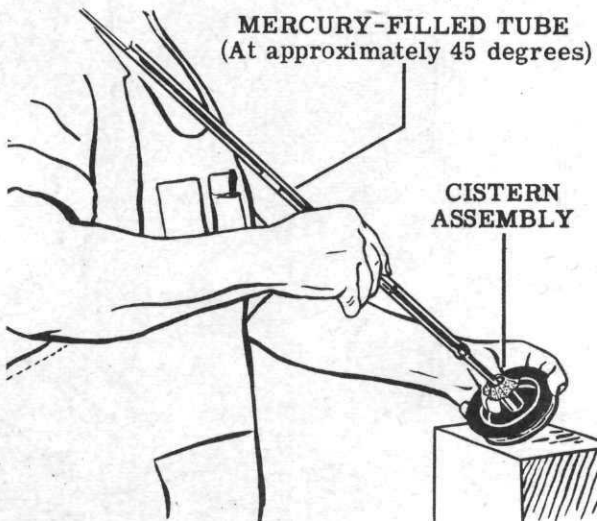


Figure 50

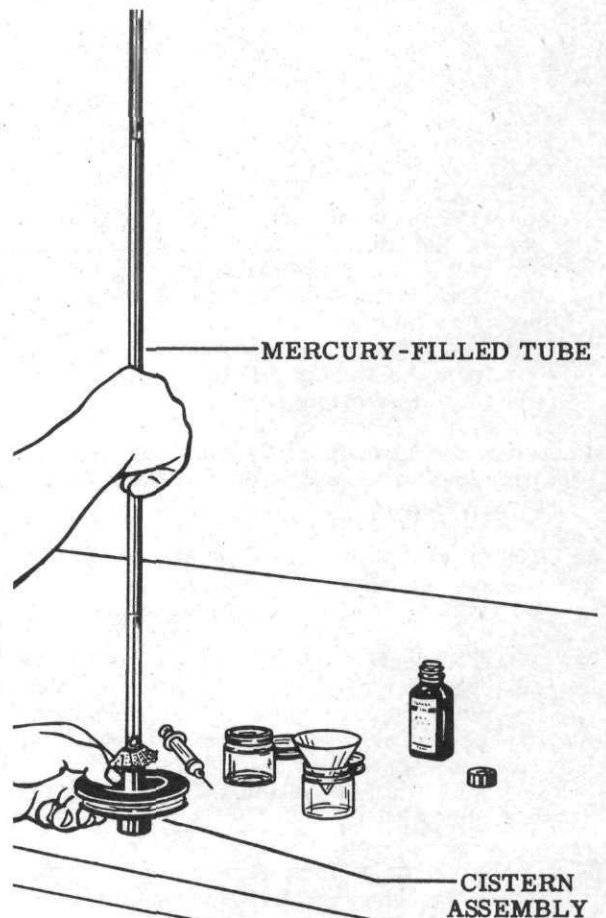


Figure 51

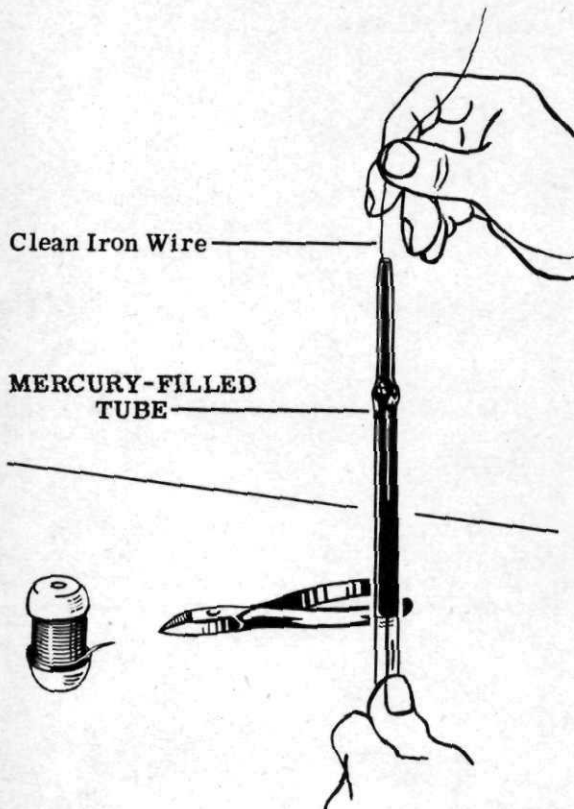


Figure 52

Insert a piece of clean iron wire into the end of the mercury tube and draw out the air bubbles from the trap. See Fig. 52. If this operation is not successful, return the mercury tube to the Parts Repairman for removal of the air bubbles. See "Removing Air from the Mercury-filled Tube" in Section IV of this manual.

When the mercury-filled tube has had all air removed from it, repeat Operations 58 through 60.

62. The mercury tube and cistern assembly will now be supported in the cistern clamping fixture, Tool No. 1. See Fig. 53.
63. Wrap a piece of wire loosely around the tube-to-top cistern seal above the bulb in the mercury tube. Using the flat-nosed tweezers (Tool No. 13), pleat the seal evenly all around the tube. See the "Special Service Tool List" in Section VIII for details of this special tool.
64. Cut a length of linen thread approximately three feet long. Wax it thoroughly with cistern sealing wax. See "Sealing Compounds" in the Control Manual.

Starting at the center of the thread and holding the thread taut, wind it tightly around the seal. Begin just below the center of the mercury tube bulb. The center of this bulb can be determined by touch. See Fig. 39. Cross the first turn of thread and pull it tight. Then tie a single knot in the next turn.

Continue to wind the thread tightly around the seal, making a crossover at each turn. Stagger the crossover slightly on every turn. Keep an even, but not excessive, tension on the thread at all times, and insure that each turn is tight up to the previous turn.

CAUTION

Do not apply excessive tension to the thread since, if it should break on one side, the mercury tube will most likely be broken by the excessive pull on the other side of the thread.

65. When the winding is two-thirds of the way towards the end of the seal, remove the temporary wire binder. When the winding is at the end of the seal, make a single knot next to the last turn and then tie a double box knot. Using scissors, cut off the excess lengths of thread. See Fig. 53.

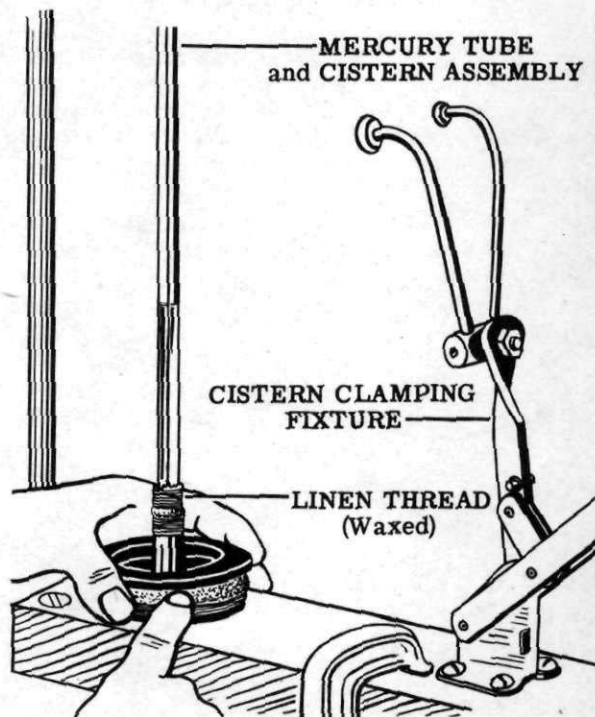


Figure 53

66. Trim off the end of the seal neatly with the sharp, pointed scissors, Tool No. 14. With the forming tool (Tool No. 12), flatten the knots to form a smooth surface all around the seal. See Fig. 53. See the "Special Service Tool List" in Section VIII for details of the special tools used here.
67. Clean off the top of the cistern assembly with a clean cotton cloth. Carefully clean up any spilled mercury from the areas in which you have been working.

Checking the Mercury Tube and Cistern Assembly for Leaks

68. Slowly apply pressure to the top of the cistern assembly by means of the double-pronged clamp on the cistern clamping fixture, Tool No. 1. Continue to apply pressure until the mercury reaches the top of the tube. See Fig. 54.

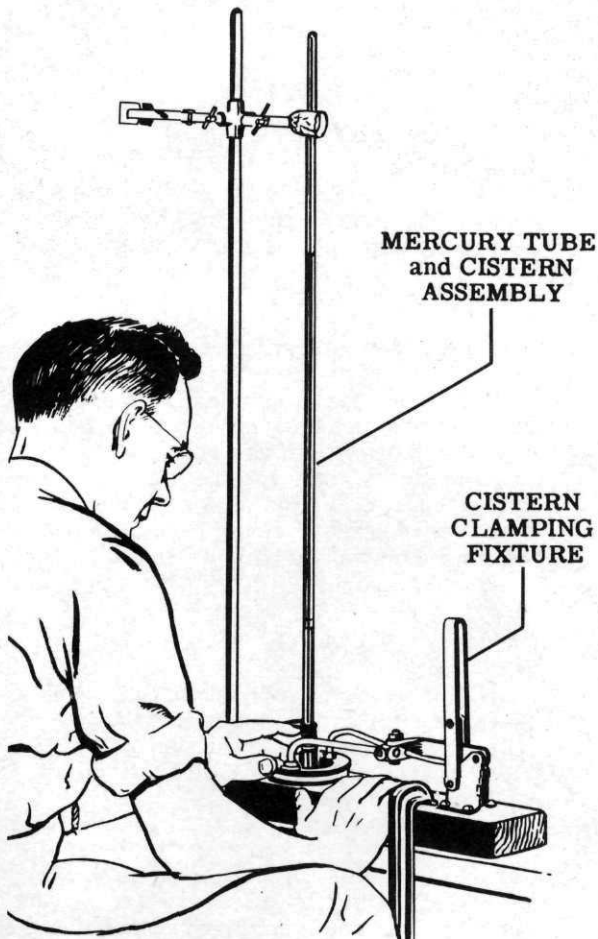


Figure 54

CAUTION

Excessive pressure on the cistern assembly may result in the mercury being forced through the end of the mercury tube.

69. Carefully examine the surfaces of the top and bottom cisterns, the mercury inlet screw and the seals for signs of leaking mercury. See Fig. 54 and the exploded view, Fig. 39 for the parts referred to in this operation.
70. Release the pressure applied by the double-pronged clamp on the cistern assembly. Then slacken the clamp holding the mercury tube. Lift the top cistern and carefully check for signs of leaks all around the cistern seal. See Fig. 55.

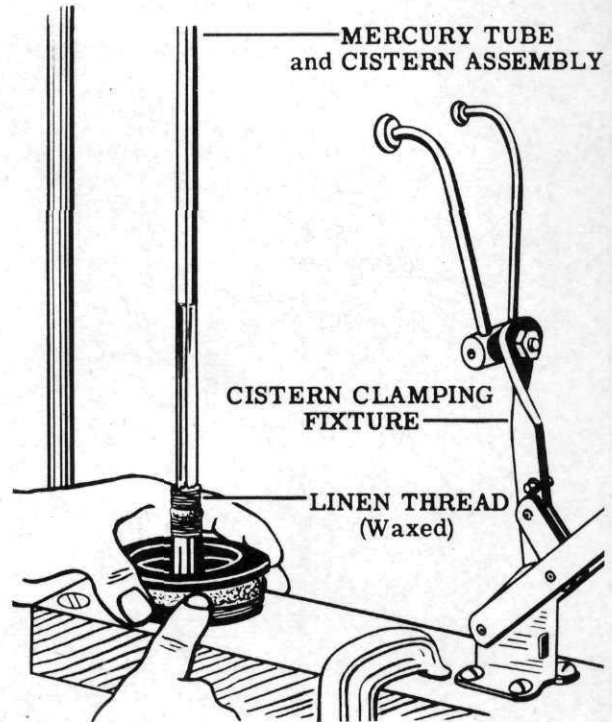


Figure 55

Final Adjustment of the Mercury Column

71. Again raise the mercury to the top of the mercury tube as outlined in Operation 68.
72. Loosen the mercury inlet screw very slightly and allow mercury to escape until there is a space at the top of the tube about

MERCURIAL BAROMETERS

the size of a pin head, when the top and bottom cisterns are in contact. See Fig. 56.

NOTE

It may be necessary to stand on a chair in order to observe the top of the mercury tube.

73. If too much mercury is allowed to escape, release the double-pronged clamp and add mercury through the mercury inlet screw hole. Use the glass syringe equipped with hypodermic needle (Tool No. 15) to add this mercury. Recheck the space at the top of the mercury column. See Fig. 56 and refer to the "Special Service Tool List" in Section VIII for details of the special tool used here.
74. Thoroughly clean the top of the cistern assembly, removing all traces of mercury. Clean up any spilled mercury in the area in which you have been working.

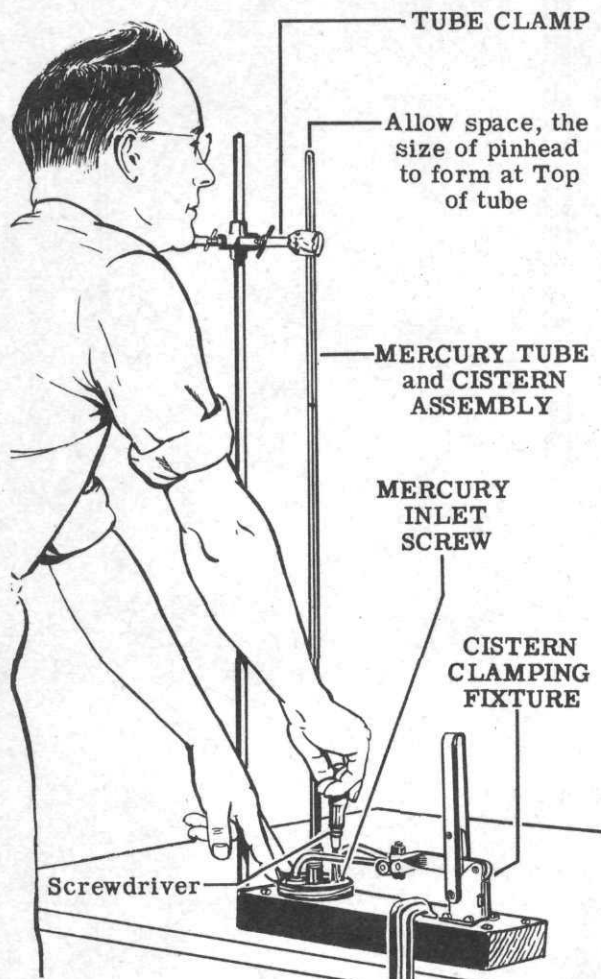


Figure 56

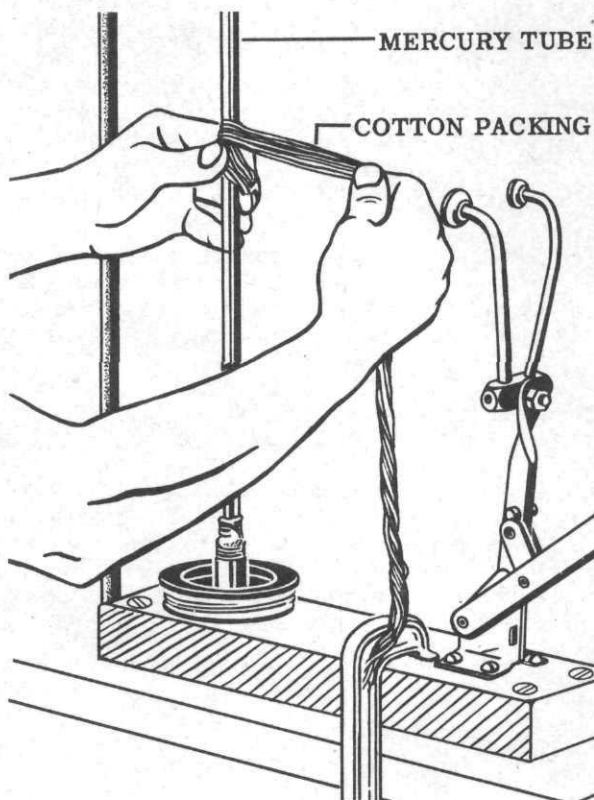


Figure 57

75. Release the double-pronged clamp from the top of the cistern assembly, and remove the tube clamp of the cistern clamping fixture (Tool No. 1) from the mercury tube. See Fig. 56 and Fig. 57.

Slide the lower tube support over the top of the mercury tube. See Fig. 39. Then support the tube again by means of the tube clamp. Apply orange shellac (for a distance of 1-1/2 inches) halfway between the bulb in the mercury tube and the top of the trap in the tube. Slide the lower tube support down into position over the shellac. See "Sealing Compounds" in the index of the Control Manual.

NOTE

If a new lower tube support is fitted, it may be necessary to ream out the bore of the support so that it will be a sliding fit over the mercury tube.

76. Further support is given to the mercury tube by a winding of cotton packing. The cotton packing is to be wound around the mercury tube, commencing at approximately nine inches above the mercury tube trap, and finishing approximately six inches

above. Wind the cotton wrapping back and forth until sufficient layers have been built up to give the required diameter. Secure the packing in place by a criss-cross wind of linen thread, tie a knot in the thread and cut off excess thread. See Fig. 57 and the exploded view, Fig. 39.

The completed wrapping should be of such a diameter as to fit snugly in the tube housing.

MAJOR-ASSEMBLY REASSEMBLY OPERATIONS

Skill Level: Mechanical Instrument Assembler, Senior Grade

REASSEMBLING THE MERCURY TUBE AND CISTERN ASSEMBLY INTO THE TUBE HOUSING ASSEMBLY

- 77. Apply a thin coating of anti-seize lubrication to the thread of the bottom cistern cover. See "Anti-seize Lubrication" in the Control Manual.

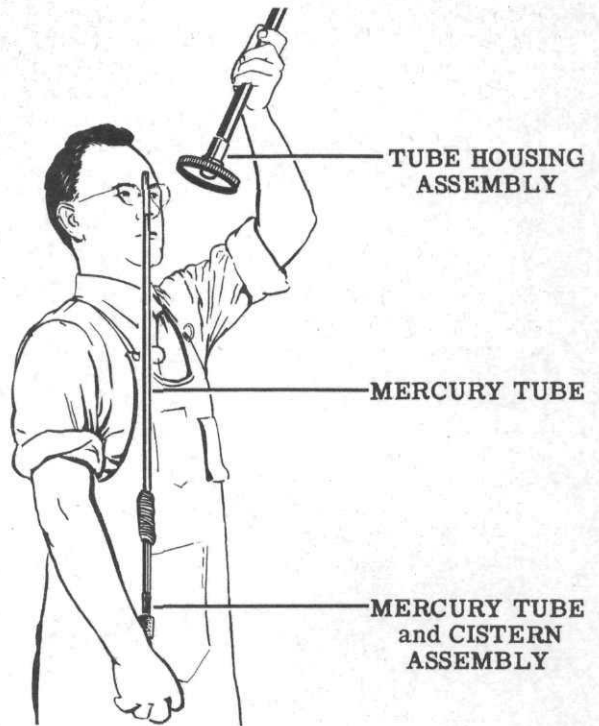


Figure 58

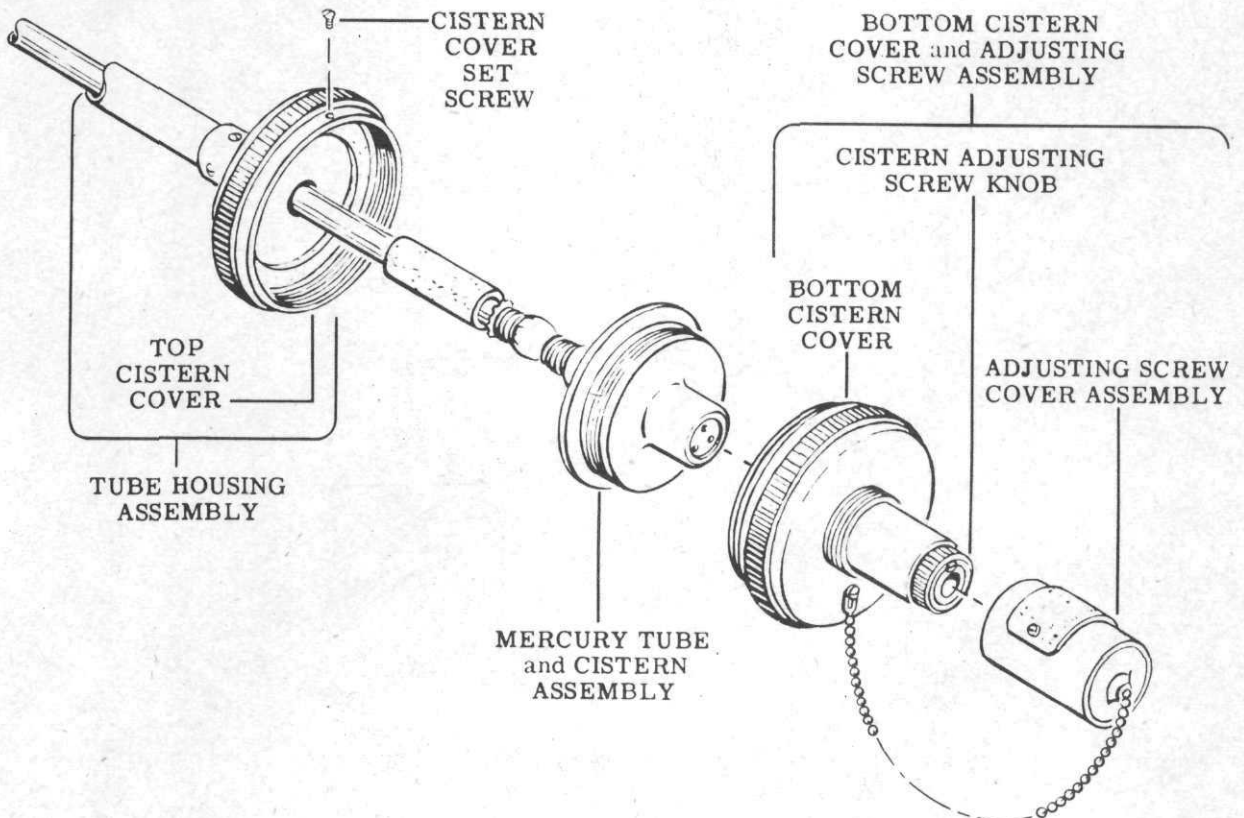


Figure 59

MERCURIAL BAROMETERS

78. Remove the mercury tube and cistern assembly from the cistern clamping fixture (Tool No. 1), or from the mercury tube support rack (Tool No. 3) if it had not been disassembled. Holding the assembly in your right hand, let the tube rest on your chest. See Fig. 58. Refer to the "Special Service Tool List" in Section VIII for details of the special tools mentioned in this operation.
79. Place the bottom cistern cover and adjusting screw assembly under the mercury tube and cistern assembly. The mercury tube and cistern assembly will now be supported in the bottom cistern cover and adjusting screw assembly in your right hand. See the exploded view, Fig. 59.
80. Raise the tube housing assembly in your left hand as high as possible. Then lower it over the mercury tube. Screw up the top and bottom cistern covers for three or four threads. See Fig. 58 and the exploded view, Fig. 59.
81. Place the barometer assembly on the floor stand, Tool No. 17. See the "Special Service Tool List" in Section VIII for details of this special tool. Apply a thin coating of orange shellac to the inside surface of the tube housing to a depth of approximately one inch. See "Sealing Compounds" in the index of the Control Manual. Slide the upper tube support into the housing and over the mercury tube. The support should be so positioned as to be level with the top of the mercury tube. See the exploded view, Fig. 60.
82. Place the mercury tube stop in the top of the tube housing. This cork, if replaced, may be too long. If so, cut material from the end of the stop so that it protrudes not more than 1/16 inch out of the tube housing. See the exploded view, Fig. 60.
83. Assemble the cap and hanger ring assembly to the tube housing with the four cap screws. Hang the barometer assembly up on a suitable supporting hook. See the exploded view, Fig. 60.
84. Remove the adjusting screw cover assembly and rotate the cistern adjusting screw

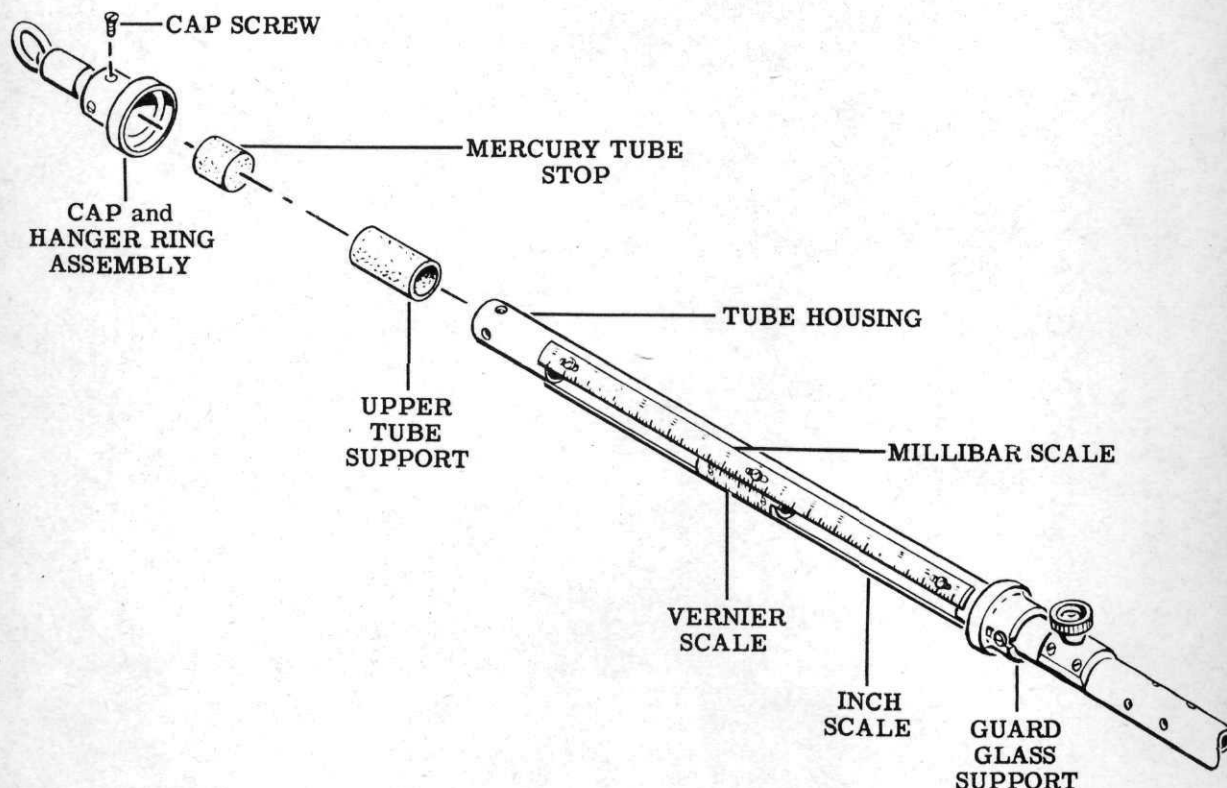


Figure 60

knob as far as it will go to the left. Tighten the top and bottom cistern covers and align the reassembly guide marks made during disassembly on the front of each cover. Assemble the cistern cover set screw. See the exploded view, Fig. 59.

85. Rotate the cistern adjusting screw knob to bring the mercury column to the top of the mercury tube. Assemble the adjusting screw cover assembly. See the exploded view, Fig. 59.
86. Assemble the thermometer assembly to the tube housing with the two thermometer mount screws. See the exploded view, Fig. 38.

The assembled mercurial barometer is now ready for the "Test, Calibration and Final Inspection Procedure" operations; see Section VI in this manual. The guard glass and its washers will be assembled after the barometer has been calibrated and adjusted. Return the barometer, with its route ticket attached, to the Instrument Control Center.

BAROMETER CASE REASSEMBLY OPERATIONS

Skill Level: Mechanical Instrument Assembler,
Junior Grade

REASSEMBLING THE BAROMETER CASE ASSEMBLY

87. Assemble a case wall bracket at each end of the barometer case (bottom half). Use three wall bracket screws to secure each bracket in place. See the exploded view, Fig. 61.
88. Place the reflector glass in the barometer case (bottom half) with the two felt pads attached to the reflector glass facing downwards. Assemble the reflector holder over the reflector glass with the four reflector holder screws. See the exploded view, Fig. 61.
89. Assemble the handle support bracket in the barometer case (bottom half) with the three handle support bracket screws.

90. Assemble the two handle pivot posts on the ends of the case handle. Slide the threaded portions of the handle pivot posts into the holes provided for them in the barometer case (bottom half). Using the pivot post nut wrench (Tool No. 8), assemble the two handle pivot post nuts on the handle pivot posts. See the exploded view, Fig. 61, and refer to the "Special Service Tool List" in Section VIII for details of the special tool used here.
91. Assemble each of the two lower fasteners to the barometer case (bottom half) with three fastener screws. A fastener screw nut is to be assembled on the bottom fastener screw of each lower fastener. Use the cover glass frame and fastener nut wrench (Tool No. 7) to tighten these nuts. See the exploded view, Fig. 61, and refer to the "Special Service Tool List" in Section VIII for details of the special tool used here.
92. Assemble each of the three case hinges to the barometer case (bottom half) with three hinge retaining screws. See the exploded view, Fig. 61.
93. Assemble the gimbal arm to the lower barometer support by means of the gimbal arm hinge screw, the lock washer and the hinge screw nut. Hold the head of the gimbal arm hinge screw in a vise and use the hinge screw nut wrench (Tool No. 6) to tighten the nut.

Assemble a latch knob on each of two latch knob screws. Then assemble the lower support latch to the lower barometer support, using the two latch knob screws upon which the two latch knobs have been assembled.

This completes the assembly of the gimbal arm and support assembly. See the exploded view, Fig. 61, and refer to the "Special Service Tool List" in Section VIII for details of the special tool used here.

94. Assemble the gimbal arm and support assembly in the barometer case (bottom half) with the three lower barometer support screws. See the exploded view, Fig. 61.
95. Assemble a latch knob on each of two latch knob screws. Then assemble the upper

MERCURIAL BAROMETERS

LEGEND

1. Cover Glass Frame Screw
2. Barometer Case Cover
3. Cover Glass
4. Cover Glass Gasket
5. Cover Glass Frame
6. Cover Glass Frame Nut
7. Upper Barometer Support Assembly
8. Latch Knob Screw
9. Latch Knob
10. Upper Support Latch
11. Upper Barometer Support
12. Upper Barometer Support Screw
13. Fastener Screw Nut
14. Upper Fastener
15. Fastener Screw
16. Gimbal Arm and Support Assembly
17. Latch Knob Screw
18. Latch Knob
19. Lower Support Latch
20. Lock Washer
21. Hinge Screw Nut
22. Lower Barometer Support
23. Gimbal Arm
24. Gimbal Arm Hinge Screw
25. Fastener Screw Nut
26. Lower Fastener
27. Fastener Screw
28. Handle Pivot Post Nut
29. Reflector Holder Screw
30. Reflector Holder
31. Reflector Glass
32. Wall Bracket Screw
33. Hinge Retaining Screw
34. Case Hinge
35. Barometer Case (Bottom Half)
36. Case Wall Bracket
37. Handle Support Bracket Screw
38. Handle Support Bracket
39. Case Handle
40. Handle Pivot Post
41. Lower Barometer Support Screw

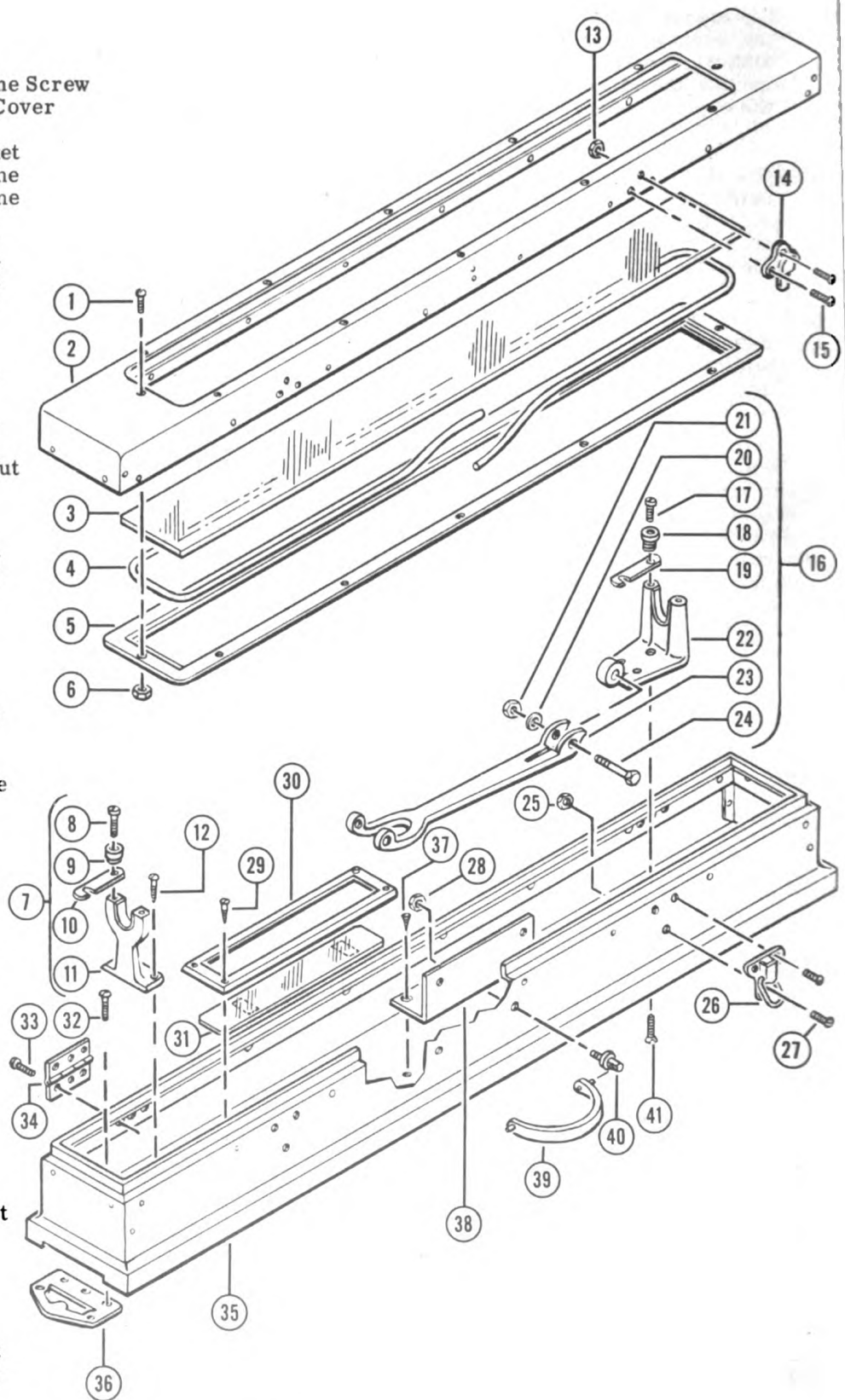


Figure 61

REASSEMBLY PROCEDURE

support latch to the upper barometer support, using the two latch knob screws on which the latch knobs have been assembled. This completes the assembly of the upper barometer support assembly. See the exploded view, Fig. 61.

96. Assemble the upper barometer support assembly in the barometer case (bottom half) with the two upper barometer support screws. See the exploded view, Fig. 61.
97. Assemble each of the two upper fasteners to the barometer case cover in a similar manner as outlined for the two lower fasteners in Operation 91. See the exploded view, Fig. 61.
98. Place the cover glass carefully in the barometer case cover. Then assemble the cover glass gasket and the cover glass frame over the cover glass. Secure the cover glass frame to the barometer case

cover with twelve cover glass frame screws and nuts. Use the cover glass frame and fastener nut wrench (Tool No. 7) to tighten the nuts. See the exploded view, Fig. 61, and refer to the "Special Service Tool List" in Section VIII for details of the special tool used here.

99. Place the barometer case cover over the barometer case (bottom half) and align the holes in the case hinges with those in the cover for the hinge retaining screws. Assemble three hinge retaining screws in each of the case hinges. See the exploded view, Fig. 61.

The barometer case assembly is now completely assembled. However, until the barometer assembly has been subjected to the "Test, Calibration and Final Inspection Procedure" operations, as outlined in Section VI of this manual, it will not be assembled into the case. Therefore, return the barometer case assembly to the Instrument Control Center, with its route ticket attached.

SECTION VI

TEST, CALIBRATION AND FINAL INSPECTION PROCEDURE

Skill Level: Instrument Repairman,
Junior Grade

INTRODUCTION

The partially reassembled mercurial barometer has to be adjusted and tested to meet the "Performance Requirements" outlined in Section II. The remaining parts of the barometer will be assembled after the instrument has been calibrated.

A final repair inspection will be made preliminary to the start of the test and calibration operations as a check on the work already performed. Also, a final shop inspection will be made before the completed mercurial barometer is inspected by the navigational instrument inspector. The standards for these inspections which make up the final inspection are defined as "Final Inspection Standards" in the Control Manual. Also see "Lubrication" in Control Manual for lubricating techniques.

Any condition of the barometer that causes difficulty in performing the test and calibration operations should be referred back to the person who is responsible. The names of such persons can be determined from the route ticket. By calling such faults to the attention of the individuals responsible, they will become aware of points to be especially careful of when performing their work. Instrument repair is one constant training process wherein people learn most by being allowed to correct their own mistakes.

FINAL REPAIR INSPECTION

The following inspection is intended to catch defects in workmanship before any time is invested in test and calibration of the barometer.

1. Inspect the finishes of all parts and the legibility of all engravings. Examine the general physical appearance of the ba-

rometer. The "Final Inspection Standards" referenced in the Control Manual apply.

2. Check the action of the cistern adjusting screw. Insure that the name plate and instruction plate are to the front of the barometer.
3. Check the action of the vernier scale by rotating the vernier pinion knob. The vernier scale should move smoothly without indications of binding or sticking.

If the barometer passes inspection, proceed with the test and calibration operations. If you note any defects, consult the route ticket for the responsible person and return the barometer to him for correction.

TEST PROCEDURE

NOTE

When calibrating and testing the barometer, the cistern adjusting screw must be screwed out so that it is down as far as it will go.

Response of the Mercury Column

Holding the barometer by the cap and hanger ring assembly in a vertical position, it should be raised a distance of two feet and then lowered. This should be done with a smooth and even motion, at the rate of two seconds for the rise and two seconds for the fall.

Repeat this procedure six or eight times, maintaining the barometer in a vertical position and noting the height of the mercury column during the rise and fall. The height of the mercury column in the tube should not vary more than $1/10$ of an inch above or below its original position.

TEST, CALIBRATION AND FINAL INSPECTION PROCEDURE

Failure of the barometer to meet the requirements will mean that the mercury-filled tube must be replaced.

Reaction Time Test of the Mercury Column

This check of the reaction time of the mercury column must be performed at a time when the atmospheric pressure is approximately 30 inches of mercury.

NOTE

During this test do not tap or jar the barometer to help the mercury rise or fall, or the test will be meaningless.

Hang the barometer from a suitable hook by means of its hanger ring. Then quickly move the barometer a distance of 16 inches to one side. Using a watch, measure the time taken for the mercury column to rise from 30 inches (or its initial level) to 31 inches (or one scale inch above its initial level); also measure the time for it to rise from 30 inches (or its initial level) to 32 inches (or two scale inches above its initial level).

When the mercury column reaches 32 inches (or two scale inches above its initial level), quickly return the barometer to a vertical position. Measure the time taken for the mercury to fall from the 32 inch mark to the 31 inch mark, and from the 31 inch mark to the 30 inch level. Again equivalent scale distances may be taken based on the initial level of the mercury column.

The time measured in each test should be within the limits specified in Table III under "Performance Requirements" in Section II of this manual. The mercury column should also return to within ± 0.005 inch of its former true level within the time specified in that table.

If the barometer fails to meet the requirements, the mercury-filled tube must be replaced.

Consistency of Readings

To check the consistency of the barometer readings, perform the following test. Tilt the barometer so that the mercury column rises 0.10 inch above its initial level in the vertical position. Then quickly return the barometer to its vertical position. The mercury column must return to its initial level with ± 0.005 inch in not more than 240 seconds.

Failure of the barometer to meet any of the above requirements indicates that the bore of the mercury tube is not within the specified tolerance and that the tube must be replaced.

CALIBRATION PROCEDURE

Purpose of Calibration

The purpose of the calibration procedure is to make certain that all mercurial barometers used in the Navy give the same reading at any designated atmospheric pressure. This is accomplished by having all mercurial barometers agree, within specified limits, with a primary standard barometer which is kept at the National Bureau of Standards.

This primary standard barometer is the standard reference for all official pressure determinations. Mercurial barometers that are compared directly with this primary standard barometer are called secondary standard barometers.

Each Naval facility engaged in the repair of mercurial barometers should use a secondary standard barometer as a reference. This secondary standard should be compared and calibrated with the primary standard at the National Bureau of Standards every 18 months. The secondary standard barometer should be kept in a location where nearly constant temperature is maintained, and where it will be free from vibration.

Extreme care must be taken in reading the scales, in determining the height of the mercury column and in applying the proper correction factors during the calibration procedure. This becomes obvious when it is realized that an error in calibration might easily cause an error in every reading taken when the barometer is in actual use later on.

The deviations in the readings of any mercurial barometer from those of the primary standard barometer (or, in practice, the secondary standard barometer which gives the same readings as the primary standard when certain correction factors are applied) are due to imperfections, however slight they may be, in the mercury tube of the barometer. When you calibrate a mercurial barometer, you are, in effect, calibrating the glass tube.

The Welch Company provides a calibration card with each replacement tube it supplies. A permanent record is kept by Welch of the calibration data on all the tubes it manufactures.

MERCURIAL BAROMETERS

A record of this data will be supplied by Welch for your reference for any tube it manufactured, if the serial number of the tube is forwarded with the request to the Bureau of Ships.

Pressure Chamber Used in Calibration

The pressure chamber to be used for calibration of mercurial barometers shall be of the type approved by the Bureau of Ships Navigational Instruments Authority. Upon application to this Authority through your supervisor, complete specifications and details of the pressure chamber will be made available to you.

CALIBRATION OPERATIONS

Positioning the Inch Scale

The repaired barometer and a secondary standard barometer (Tool No. 22) are placed together in a location where the temperature is controlled and allowed to remain there for 24 hours. This is to allow the mercury column in each instrument to reach equilibrium. The repaired barometer should be hung at the same level as the secondary standard barometer, with which the comparison is to be made.

The inch scale on the repaired barometer is now set in the following manner.

1. Adjust the vernier scale so that the bottom of the vernier scale just touches the top of the meniscus of the mercury column. Without disturbing this vernier scale setting, loosen the screws holding the inch scale and set it so that the reading agrees with the corrected reading obtained from the secondary standard barometer, Tool No. 22.

CAUTION

You must be sure to consider the known errors of the secondary standard barometer (Tool No. 22) when obtaining the reading from it. These errors have been recorded on the instrument's correction card. The inch scale should be set to agree with the corrected standard barometer reading. See "Correction Factors" in this section.

2. Now tighten the screws that hold the inch scale in place. Recheck the secondary standard barometer (Tool No. 22) reading with the reading on the repaired barometer to be sure that the inch scale has been correctly positioned.

NOTE

The millibar scale is not positioned until after the calibration operations are completed.

Calibration Operations

1. Place the barometer to be calibrated in the pressure chamber along with the secondary standard barometer, Tool No. 22.
2. Adjust the pressure in the pressure chamber until the reading taken from the secondary standard barometer, after correction, is exactly 30 inches of mercury.

The correction factors to be applied to the secondary standard barometer are as follows:

- A. The correction factor taken from the instrument's "Correction Card."
- B. Correction factor for temperature taken from the "Temperature Correction Table."
- C. Correction factor for latitude taken from the "Reduction to Latitude 45 Degrees" table.

An example of how these factors are applied (and extracts of a typical "Correction Card," along with extracts of the tables) is outlined under "Correction Factors" in this section.

3. When the pressure is set at 30 inches, record the observed readings—of the barometer being calibrated and the secondary standard barometer. Record these readings.

Adjust the pressure in the pressure chamber for 28 and then 26 inches of mercury. Allow a period of 2 minutes to elapse after each adjustment of pressure, then record the observed readings of the barometers.

TEST, CALIBRATION AND FINAL INSPECTION PROCEDURE

TABLE IV

Pressures at Which Readings Were Taken	Readings of Barometer Being Calibrated	* Corrected Readings of Secondary Standard Barometer	Difference
30	30.006	30.002	+ .004
28	28.001	28.002	- .001
26	26.006	26.005	+ .001

* See paragraph 2 under "Calibration Operations" in the second column on page 62.

- Applying the correction factors shown on the secondary standard barometer (Tool No. 22) "Correction Card" to its readings, tabulate the corrected values in a suitable manner. Readings of the barometer being calibrated should also be tabulated, along with the pressures at which the pressure chamber was set. See Table IV.

be recorded as plus correction factor. Table V shows the transfer of values shown in Table IV to a typical correction card. The serial number of the barometer you are calibrating should also be entered on this card.

NOTE

Correction factors for temperature and latitude are not applied to either barometer since these correction factors are the same for both the barometer being calibrated and the standard. You are only interested in the difference between the readings in the two barometers.

TABLE V

Instrument Serial No. X-0000	Date
Pressure in Inches Hg.	Correction in Inches
30	- .004
28	+ .001
26	- .001

+ Correction to be added to barometer reading.
- Correction to be subtracted from barometer reading.

- Obtain the difference between the readings of the secondary standard barometer (Tool No. 22) and the barometer being calibrated. See Table IV. The difference between the readings at any one pressure should not exceed ± 0.012 inch, according to the performance requirements.

If the difference is greater than ± 0.012 inch, then check the setting of the inch scale. If the scale setting is found to be in order and the difference is greater than ± 0.012 inch, the mercury tube must be replaced. If the difference is greater than ± 0.012 inch, then air may have entered the mercury tube; have this checked.

- If the barometer meets the performance requirements, enter the correction factors on the instrument's correction card. A plus difference will be recorded as a minus correction factor, and a minus difference will

When the correction card is completely filled out, affix it under the reflector holder in the back of the barometer case. See Fig. 1 in this manual.

Positioning the Millibar Scale

To set the millibar scale to agree with the inch scale, move the vernier scale so that the zero line on the vernier scale is exactly opposite 29.5 on the inch scale. Loosen the screws that hold the millibar scale so that 999 on the millibar scale is exactly opposite the zero line on the vernier scale. Tighten the screws to secure the millibar scale, being careful not to move the scale. Be sure to recheck the position of the millibar scale after it has been secured.

MERCURIAL BAROMETERS

TABLE VI

Observed Reading of the Barometer in Inches															
Degrees F	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
							ADD								
20	.013	.014	.015	.016	.016	.017	.018	.019	.020	.020	.021	.022	.023	.024	.024
							SUBTRACT								
40	.018	.019	.020	.021	.022	.023	.024	.025	.026	.027	.028	.029	.030	.031	.032

TABLE VII

Reading of the Barometer in Inches														
Latitude		18	19	20	21	22	23	24	25	26	27	28	29	30
Degrees	Degrees													
30	60	.023	.025	.026	.027	.028	.030	.031	.032	.034	.035	.036	.038	.039

CORRECTION FACTORS

Temperature Correction

Table VI shows a typical extract from a temperature correction table for a mercurial barometer. The correction factors are added for temperatures of 28 degrees F and below, and subtracted for temperatures above 28 degrees F.

Latitude Correction

Table VII shows a typical extract from a reduction-to-latitude correction table. In this case for latitudes above 45 degrees, the values shown in the tables are to be added, and below 45 degrees, subtracted.

Altitude Correction

This correction factor is very small and need not be taken into account at all if the barometer is not above 260 feet above mean sea level. The correction factor at 1220 feet above mean sea level, and at 31 inches of mercury, is - 0.003. Tables are provided for these correction factors, if required.

Correction Card

A correction card is provided with all mercurial barometers. This card shows how the readings of the particular barometer vary with respect to the primary standard barometer. Table VIII shows a typical extract from a set of correction factors that may be found on the correction card of a secondary standard barometer, or a barometer in use in the Fleet.

TABLE VIII

Pressure in Inches	Correction in Inches
30	- .003
28	- .004

Example of Applying Correction Factors to the Secondary Standard Barometer

Assume that the true reading of a secondary standard barometer is required as, for example, when in a pressure chamber as outlined under "Calibration Operations" in this section.

TEST, CALIBRATION AND FINAL INSPECTION PROCEDURE

If the following conditions are known to exist:

- (1) The overhaul shop is 250 feet above mean sea level.
- (2) The temperature of the secondary standard barometer, as shown by its thermometer, is 40 degrees F.
- (3) The latitude of the overhaul shop is 60 degrees.
- (4) The correction factor shown in Table VII of this section is applicable to the secondary standard barometer that is being used.
- (5) A pressure of 30 inches of mercury is required in the pressure chamber.

Then the correction factors are as follows:

- (1) Since the overhaul shop is below 260 feet, the "Altitude Correction" is zero.
- (2) "Temperature Correction" at 40 degrees F from Table VI is - 0.031 at 30 inches of mercury.
- (3) "Latitude Correction" at 60 degrees from Table VIII is + 0.039 at 30 inches of mercury.
- (4) Correction factor for this particular barometer is given in Table VIII as - 0.003.

Correction factors are applied to the observed reading of a mercurial barometer on board ship in a similar manner to that outlined here.

The sum of these correction factors is - 0.011. This means the secondary standard barometer will read 30.011 in the pressure chamber when a pressure of 30 inches of mercury exists.

FINAL REASSEMBLY OPERATIONS

Reassembling the Guard Glass

After the millibar scale has been positioned, the guard glass should be reassembled. Place the barometer on the floor stand, Tool No. 17. Remove the four cap screws from the cap and hanger ring assembly and lift the assembly off. Reassemble the guard glass over the scale with a guard glass washer between the bottom of the

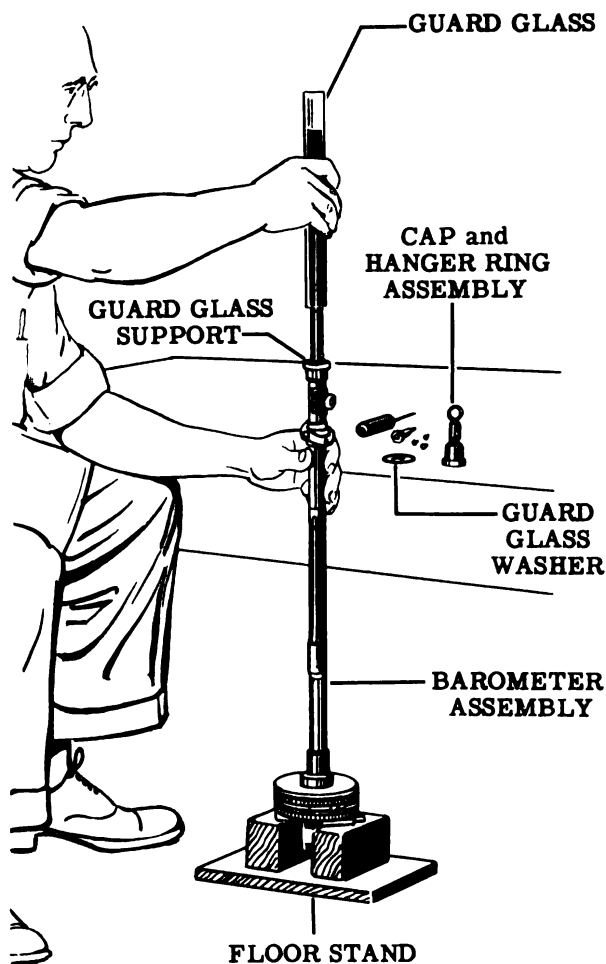


Figure 62

guard glass and the guard glass support. Place a guard glass washer at the top end of the guard glass and reassemble the cap and hanger ring assembly to the tube housing. The barometer is now ready to be reassembled into its case. See Fig. 62.

Replacing the Barometer into its Case

To assemble the barometer to the gimbal arm, place a support block (Tool No. 2) at each end of the barometer case. Carefully rest the barometer assembly on the blocks. Lift the gimbal arm and locate it so that the two gimbal pivot screws may be assembled. Apply a coating of pivot screw grease to the two gimbal pivot screws and then screw them into place. Check the gimbal ring assembly to see that the barometer pivots freely. Swing the barometer into the case and hook the upper and lower support latches to keep the barometer securely fixed in the case. The barometer is now ready for final inspection. See Fig. 63 in Section VII

MERCURIAL BAROMETERS

for these parts and refer to the "Special Service Tool List" for details of the special tool employed here.

CAUTION

At all times, except when the barometer is in actual use, the mercury column should be raised to the top of the tube. The cistern adjusting screw should be turned in slowly to force the mercury to the top of the tube.

FINAL SHOP INSPECTION

Skill Level: Instrument Repairman,
Junior Grade

The mercurial barometer has been completely reassembled, tested and calibrated to a serviceable condition ready for use aboard ship. This final shop inspection is intended to catch any details that may have been overlooked. See the "Final Inspection Standards" in the Control Manual.

1. Check the barometer assembly and its case for completeness of parts.
2. Check the parts for finish, tightness in assembly and legibility of engravings. Make sure that all screws are secure.
3. Check that a correction card is attached to the inside of the barometer case under the reflector holder, and that the correction card has been filled out correctly.
4. When you are satisfied with the barometer, code the instrument in accordance with the "Coding" instructions in the Control Manual. Complete the route ticket and sign it.
5. Return the completed mercurial barometer and its case to the Instrument Control Center. Make sure you have screwed in the cistern adjusting screw. The navigational instrument inspector will take it out for a complete inspection before packaging for shipment or storage. See the "Navigational Instrument Inspector's Final Inspection Standards and Procedure" in the Control Manual.

SECTION VII

MAINTENANCE PARTS CATALOG

INTRODUCTION

This maintenance parts catalog serves as a convenient source of stock numbers, and provides easy identification of all maintenance parts of the Welch make marine mercurial barometer. All maintenance parts are under the cognizance of the Ships Parts Control Center, Mechanicsburg, Penna.

This catalog consists of: A Group Assembly Parts List which lists all assemblies, subassemblies and component parts. A series of exploded views indexed to the parts list illustrate all listed assemblies, subassemblies and parts.

The order of listing in the Group Assembly Parts List and the exploded views follows the order of disassembly as in Section III. The "Part Name" column in the parts list is indented to show the relationship of each component to its next higher assembly. However, the attaching parts for each assembly are listed directly following that assembly before it is broken down into its component parts.

Footnote references for particular parts will be found on the page of the parts list on which the referenced parts appear.

The following information applies to all numbers listed under the "BuShips Inventory Control Number" column in the parts list.

- a. Assemblies and subassemblies which as such are not procured as maintenance parts from the Ships Parts Control Center have

been assigned a "BuShips Inventory Control No." These parts do not have an "SPCC Number" nor a "BuShips Plan & Piece Number." The BuShips inventory control numbers are to be used for purposes of inventory control, cost analysis and work control. They will serve as stock numbers for handling and storage in the Instrument Control Center. Also, the navigational instrument section of the Bureau of Ships will recognize these numbers in inventory control and maintenance cost analysis.

- b. Those parts which did not have BuShips plan and piece numbers at the time of publication of this manual have been assigned BuShips inventory control numbers.

When assignment is made of BuShips plan and piece numbers, changes will be issued to this manual to supersede the temporary inventory control numbers.

Part Names and Requisitioning Parts

The part names used were derived from normal nautical terms, official Navy usage and manufacturers' names. They are essentially functional.

When ordering parts refer to the Catalog of Navy Material, Bureau of Ships Section, No. 28015, for requisitioning requirements and the standard stock names; these names are to be used on all requisitions.

MERCURIAL BAROMETERS

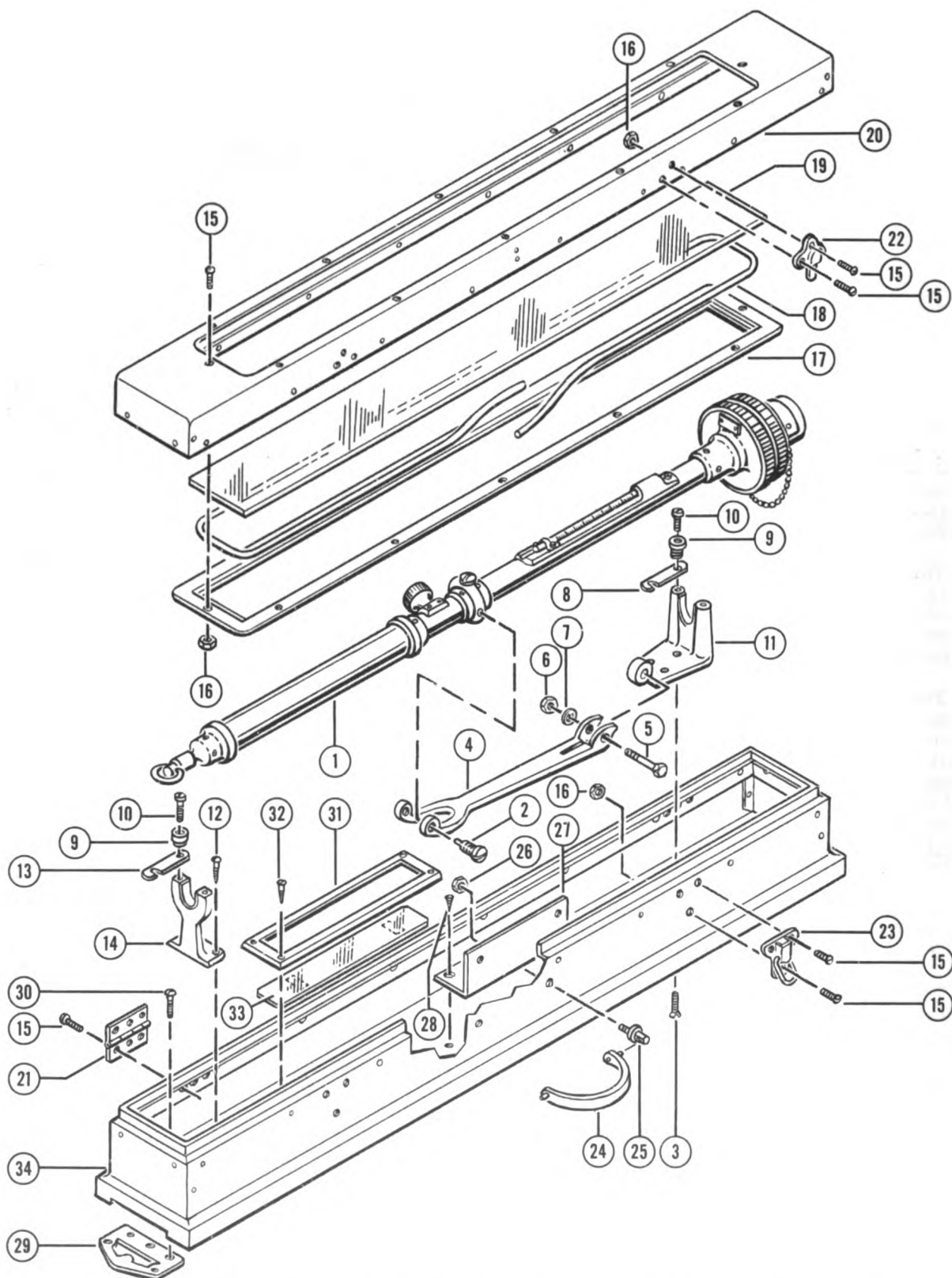


Figure 63—Marine Mercurial Barometer—Complete with Case—Exploded View

WELCH MAKE MERCURIAL BAROMETTER
GROUP ASSEMBLY PARTS LIST

Fig. & Index Number	SPCC Number	BuShips Plan & Piece Number*	BuShips Inventory Control No.*	1	2	3	4	5	6	7	Part Name	Units Per Assy.
63-1	†18-B-990		533399-107	Barometer—Marine mercurial, complete with case								1
63-2	H18-WELC-10028	533399-2	533399-108	Barometer Assembly, complete, less case								1
				Screw—Gimbal pivot								2
63-3		533406-93	533406-109	Case Assembly—Barometer, complete								1
			533408-110	Arm and Support Assembly—Gimbal								1
				Screw—Barometer support, lower, No. 12-24NC-2 fl. hd. mach., 3/4 inch lg.								3
63-4		533408-78		Arm—Gimbal								1
63-5		533408-76		Screw—Gimbal arm hinge								1
63-6		533408-75		Nut—Hinge screw								1
63-7		533406-96		Washer—Lock, 1/4-inch standard								1
63-8		533408-77		Latch—Support, lower								1
63-9		533407-68		Knob—Latch								2
63-10		533407-69		Screw—Latch knob								2
63-11		533408-80		Support—Barometer, lower (complete with felt strip)								1
63-12	43-S-21447	533406-92	533407-111	Support Assembly—Barometer, upper								1
				Screw—Barometer support, upper, No. 8 rd. hd. wood screw, 1/2 inch lg.								2
63-13		533407-67		Latch—Support, upper								1
63-9		533407-68		Knob—Latch								2
63-10		533407-69		Screw—Latch knob								2
63-14		533407-66		Support—Barometer, upper (complete with felt strip)								1

* To complete the BuShips plan and piece numbers and the BuShip inventory control numbers, prefix 52104-S2407- to all numbers listed.

† This is a stock number identified in the General Stores Section of the Catalog of Navy Material.

MERCURIAL BAROMETERS

WELCH MAKE MERCURIAL BAROMETER
GROUP ASSEMBLY PARTS LIST

Fig. & Index Number	SPOC Number	BuShips Plan & Piece Number*	BuShips Inventory Control No.*	1	2	3	4	5	6	7	Part Name	Units Per Assy.
63-15		533406-87	533408-112								Cover and Cover Glass Assembly—Barometer case	1
											Screw—Cover glass frame, rd. hd. mach. No. 6-32NC-2	12
63-16	H18-WELC-10045	533406-88									Nut—Cover glass frame, hex No. 6-32NC-2	12
63-17		533408-74									Frame—Cover glass	1
63-18		533406-95									Gasket—Cover glass, 3/16 inch O.D. (rubber)	AR
63-19	H18-WELC-10051	533406-62									Glass—Cover, 4-9/16 inch x 32-13/16 inch x 1/8 inch (clear glass)	1
63-20			533408-113								Cover—Barometer case, complete with riveted parts	1
63-21		533406-86									Hinge—Case	3
63-19		533406-87									Screw—Hinge retainin _g , rd. hd. mach. No. 6-32NC-2	18
63-22	H18-WELC-10026	533406-89									Fastener—Case (upper and lower part)	2
63-23			533406-114								Fastener—Upper	2
63-15		533406-87	533406-115								Fastener—Lower	2
63-16	H18-WELC-10045	533406-88									Screw—Fastener, rd. hd. mach. No. 6-32NC-2	12
63-24	H18-WELC-10023	533407-72									Nut—Fastener screw, hex No. 6-32NC-2	12
63-25		533407-73									Handle—Case, with pins	1
			533407-116								Post—Handle pivot, complete with nut	2
63-26			533407-117								Post—Handle pivot	2
											Nut—Handle pivot post	2

* To complete the BuShips plan and piece numbers and the BuShip inventory control numbers, prefix 52104-S2407- to all numbers listed.

WELCH MAKE MERCURIAL BAROMETER
GROUP ASSEMBLY PARTS LIST

Fig. & Index Number	SPCC Number	BuShips Plan & Piece Number*	BuShips Inventory Control No.*	1	2	3	4	5	6	7	Part Name	Units Per Assy.
63-27		533406-91									Bracket--Handle support	1
63-28		533406-90									Screw--Handle support bracket No. 10 fl. hd. wood, 1/2 inch lg.	3
63-29		533406-63									Bracket--Case wall	2
63-30		533406-83									Screw--Wall bracket No. 10-32NF-2, 17/32 inch lg.	6
63-31		533407-71									Holder--Reflector	1
63-32		533406-94									Screw--Reflector holder, No. 2 rd. hd. wood, 1/2 inch lg.	4
63-33	H18-WELC-10050	533407-70									Glass--Reflector, 1-9/16 inch x 10 inch x 1/32 inch, opal glass (complete with two felt strips)	1
	†H27-F-368-35		533406-136								Strip--Felt	AR
63-34			533406-118								Case--Barometer, bottom half, complete with riveted parts	1

* To complete the BuShips plan and piece numbers and the BuShip inventory control numbers, prefix 52104-S2407- to all numbers listed.

† The felt strip, Part No. 533406-136, will be cut to the size required to replace the felt pads glued to the upper and lower barometer supports, and to the reflector glass, if those pads are damaged and are found to be in need of replacement.

MERCURIAL BAROMETERS

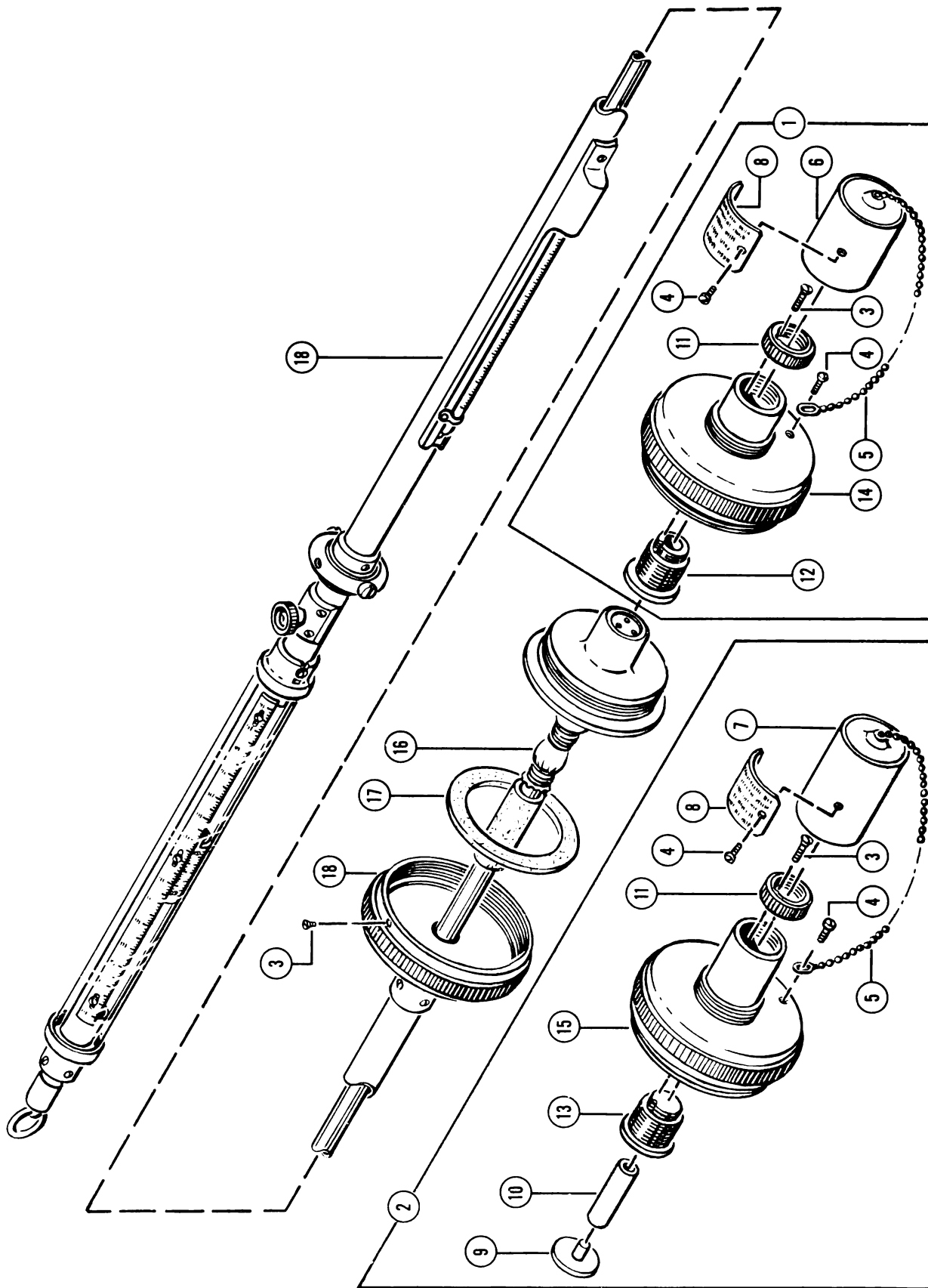


Figure 64—Barometer Assembly—Complete—Exploded View

WELCH MAKE MERCURIAL BAROMETER
GROUP ASSEMBLY PARTS LIST

Fig. & Index Number	SPCC Number	BuShips Plan & Piece Number*	BuShips Inventory Control No.*	1	2	3	4	5	6	7	Part Name	Units Per Assy.	Ref.
63-1			533399-108								Barometer Assembly, complete	1	Ref.
64-1			†533399-119								Screw Assembly—Bottom cistern cover and adjusting	1	1-Ref.
64-2			533399-120								Screw Assembly—Bottom cistern, Mod "A" cover and adjusting	1	
64-3	H43-S-8485-9	533404-42	†533399-121								Screw—Cistern cover set	1	
			533399-122								Cover Assembly—Adjusting screw	1-Ref.	
64-4	H43-S-6998-425	533401-16									Cover Assembly—Adjusting screw, Mod "A"	1	
64-5		533404-43									Screw—Cover chain	1	
64-6			†533399-123								Chain—Cover ball	1	
64-7			533399-124								Cover—Adjusting screw	1-Ref.	
64-8	H18-WELC-10029	533404-45									Cover—Adjusting screw, Mod "A"	1	
64-4	H43-S-6998-425	533401-16									Plate—Instruction	1	
64-9		533405-55									Screw—Instruction plate	2	
64-10		533405-57									Plate—Thrust, Mod "A"	1	
64-11	H18-WELC-10058	533400-10									Pad—Adjusting, Mod "A"	1	
64-3	H43-S-8485-9	533404-42									Knob—Cistern adjusting screw	1	
64-12	H18-WELC-10059	†533400-9									Screw—Knob set	1	
64-13		533405-58									Screw—Cistern adjusting	1-Ref.	
64-14	H18-WELC-10009	†533402-24									Screw—Cistern adjusting, Mod "A"	1	
64-15		533405-54									Cover—Cistern, bottom	1	
64-16			533399-125								Cover—Cistern, bottom, Mod "A"	1	
64-17	H18-WELC-10019	533403-32									Mercury Tube and Cistern Assembly	1	
64-18			533399-126								Washer—Cistern cushioning (cork)	1	
											Housing Assembly—Tube	1	

* To complete the BuShips plan and piece numbers and the BuShip inventory control numbers, prefix 52104-S2407- to all numbers listed.

† Not recommended for stocking. To be superseded by corresponding Mod "A" part.

MERCURIAL BAROMETERS

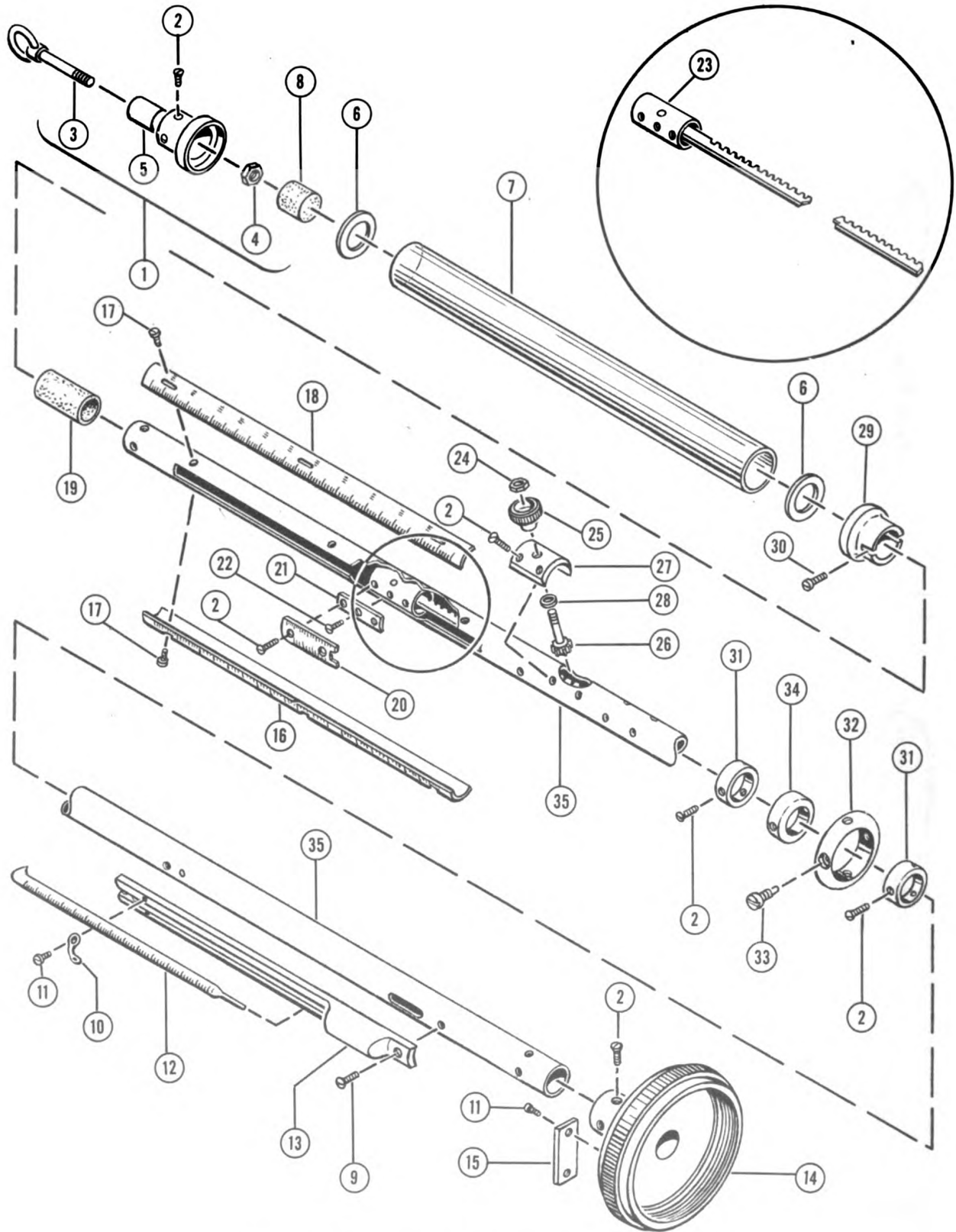


Figure 65--Tube Housing Assembly--Exploded View

WELCH MAKE MERCURIAL BAROMETER
GROUP ASSEMBLY PARTS LIST

Fig. & Index Number	SPCC Number	BuShips Plan & Piece Number*	BuShips Inventory Control No.**	1	2	3	4	5	6	7	Part Name	Units Per Assy.	Ref.
64-18			533399-126								Housing Assembly—Tube	1	
65-1			†533399-127								Cap and Hanger Ring Assembly	1	
65-2	H43-S-8485-9	533404-42									Screw—Cap	4	
65-3	H18-WELC-10048	†533400-4									Ring—Hanger	1	
65-4	H18-WELC-10047	†533404-50									Nut—Hanger ring	1	
65-5	H18-WELC-10041	†533400-3									Cap—Barometer housing	1	
65-6	H18-WELC-10060	533403-36									Washer—Guard glass (felt)	1	
65-7	H18-WELC-10049	533402-28									Glass—Guard	1	
65-8	H18-WELC-10015	533402-21									Stop—mercury tube (cork)	1	
			533399-128								Thermometer Assembly	1	
65-9	H43-S-11332-8500	533404-48									Screw—Thermometer mount	2	
65-10	H18-WELC-10036	533401-19									Strap—Thermometer	1	
65-11	H43-S-6998-425	533401-16									Screw—Thermometer strap	2	
65-12	H18-WELC-10053	533401-15									Thermometer—10 degrees to 120 degrees F. range	1	
65-13	H18-WELC-10004	533401-12									Mount—Thermometer	1	
65-14	H18-WELC-10010	533402-20									Cover—Cistern, top	1	
65-2	H43-S-8485-9	533404-42									Screw—Cistern cover, top	4	
65-15		533404-39									Plate—Name	1	
65-11	H43-S-6998-425	533401-16									Screw—Name plate	2	
65-16	H18-WELC-10032	533400-5									Scale—Inch	1	
65-17	H18-WELC-10052	533404-49									Screw—Inch scale	3	
65-18	H18-WELC-10033	533400-6									Scale—millibar	1	
65-17	H18-WELC-10052	533404-49									Screw—millibar scale	3	

* To complete the BuShips plan and piece numbers and the BuShip inventory control numbers, prefix 52104-S2407- to all numbers listed.

† The end of the hanger ring thread, Part No. 533400-4, is swaged by the manufacturer after the hanger ring nut, Part No. 533404-50, is assembled. If any component part of the cap and hanger ring assembly needs replacement, order a complete cap and hanger ring assembly.

MERCURIAL BAROMETERS

WELCH MAKE MERCURIAL BAROMETER
GROUP ASSEMBLY PARTS LIST

Fig. & Index Number	SPCC Number	BuShips Plan & Piece Number*	BuShips Inventory Control No.*	1	2	3	4	5	6	7	Part Name	Units Per Assy.
65-19	H18-WELC-10040	533403-35									Support—Tube, upper (cork)	1
			533399-129								Vernier and Rack Assembly	1
65-20	H18-WELC-10034	533400-7									Scale—Vernier	1
65-2	H43-S-8485-9	533404-42									Screw—Vernier scale	2
65-21	H18-WELC-10030	533401-18									Plate—Vernier	1
65-22	H43-S-7812-25	533404-47									Screw—Vernier plate, flat head	1
65-23	H18-WELC-10031	533403-37									Rack and Support—Vernier	1
65-2	H43-S-8485-9	533404-42									Bearing Assembly—Vernier rack and pinion	1
65-24	H18-WELC-10046	533401-14									Screw—Rack and pinion bearing	4
65-25	H18-WELC-10025	533401-13									Nut—Vernier pinion	1
65-26	H18-WELC-10020	533401-11									Knob—Vernier pinion	1
65-27											Pinion—Vernier	1
65-28			533403-130								Bearing—Vernier rack and pinion	1
65-6	H18-WELC-10060	533403-36									Washer—Vernier pinion spring	1
65-29	H18-WELC-10038	533402-27									Washer—Guard glass (felt)	1
65-30	H43-S-6998-430	533401-17									Support—Guard glass	1
											Screw—Guard glass support	2
65-31	H18-WELC-10008	533402-26									Ring Assembly—Gimbal	1
65-2	H43-S-8485-9	533404-42									Collar—Gimbal ring, upper	1
65-32	H18-WELC-10022	533402-25									Screw—Gimbal ring collar	3
65-33	H18-WELC-10028	533399-2									Ring—Gimbal, outer	1
65-34	H18-WELC-10021	533404-40									Screw—Gimbal pivot	2
65-31	H18-WELC-10008	533402-26									Ring—Gimbal, inner	1
65-2	H43-S-8485-9	533404-42									Collar—Gimbal ring, lower	1
65-2	H43-S-8485-9	533404-42									Screw—Gimbal ring collar	3
65-35	H18-WELC-10024	533399-1									Housing—Tube	1

* To complete the BuShips plan and piece numbers and the BuShip inventory control numbers, prefix 52104-S2407- to all numbers listed.

MAINTENANCE PARTS CATALOG

WELCH MAKE MERCURIAL BAROMETER
GROUP ASSEMBLY PARTS LIST

Fig. & Index Number	SPCC Number	BuShips Plan & Piece Number*	BuShips Inventory Control No.**	1	2	3	4	5	6	7	Part Name	Units Per Assy.	Ref.
64-16			553399-120								Mercury Tube and Cistern Assembly		
66-1	H18-WELC-10018	†533403-33	533399-132								Tube Assembly—Mercury	1	1
66-2	H18-WELC-10043	533399-52									Seal—Tube-to-top cistern (doeskin)	1	1
66-3	H18-WELC-10027	533399-51									Thread—Linen (V-T-291)	AR	AR
66-2	H18-WELC-10043	533399-52									Packing—Cotton (33P24)	AR	AR
66-4	H18-WELC-10037	533403-34									Thread—Linen (V-T-291)	AR	AR
66-5			553399-133								Support—Tube, lower (cork)	1	1
66-5											Tube—Mercury-filled	1	1
66-5	51-M-810	†533399-53									Mercury (JAN-M-191)	AR	AR
66-7	H18-WELC-10057	533404-41									Tube—Mercury	1	1
66-8	H18-WELC-10007	533403-30									Cistern Assembly	1	1
66-8	H18-WELC-10007	533403-30									Cistern—Top	1	1
66-9	H18-WELC-10056	533404-44									Screw—Mercury inlet	1	1
66-10	H18-WELC-10055	533404-45									Washer—Mercury inlet screw (leather)	1	1
66-11	H18-WELC-10017	†533403-31									Seal—Cistern (doeskin)	1	1
66-2	H18-WELC-10043	533399-52									Thread—Linen (V-T-291)	AR	AR
66-12	H18-WELC-10006	533403-29									Cistern—Bottom	1	1
	51-M-840	†533399-53									Mercury (JAN-M-191)	AR	AR

- * To complete the BuShips plan and piece numbers and the BuShips inventory control numbers, prefix 52104-S2407- to all numbers listed.
- † To prevent deterioration the manufacturer suggests that spare doeskins be stored in sealed cans at 72 degrees F. and 50 percent humidity.
- § The mercury tube, Part No. 533404-41 is not recommended for stocking. Only the mercury-filled tube, No. 533399-133, will be stocked for replacement purposes.
- ‡ Chemically pure mercury, Part No. 533399-53, will be obtained only from the manufacturer for stocking purposes.

MERCURIAL BAROMETERS

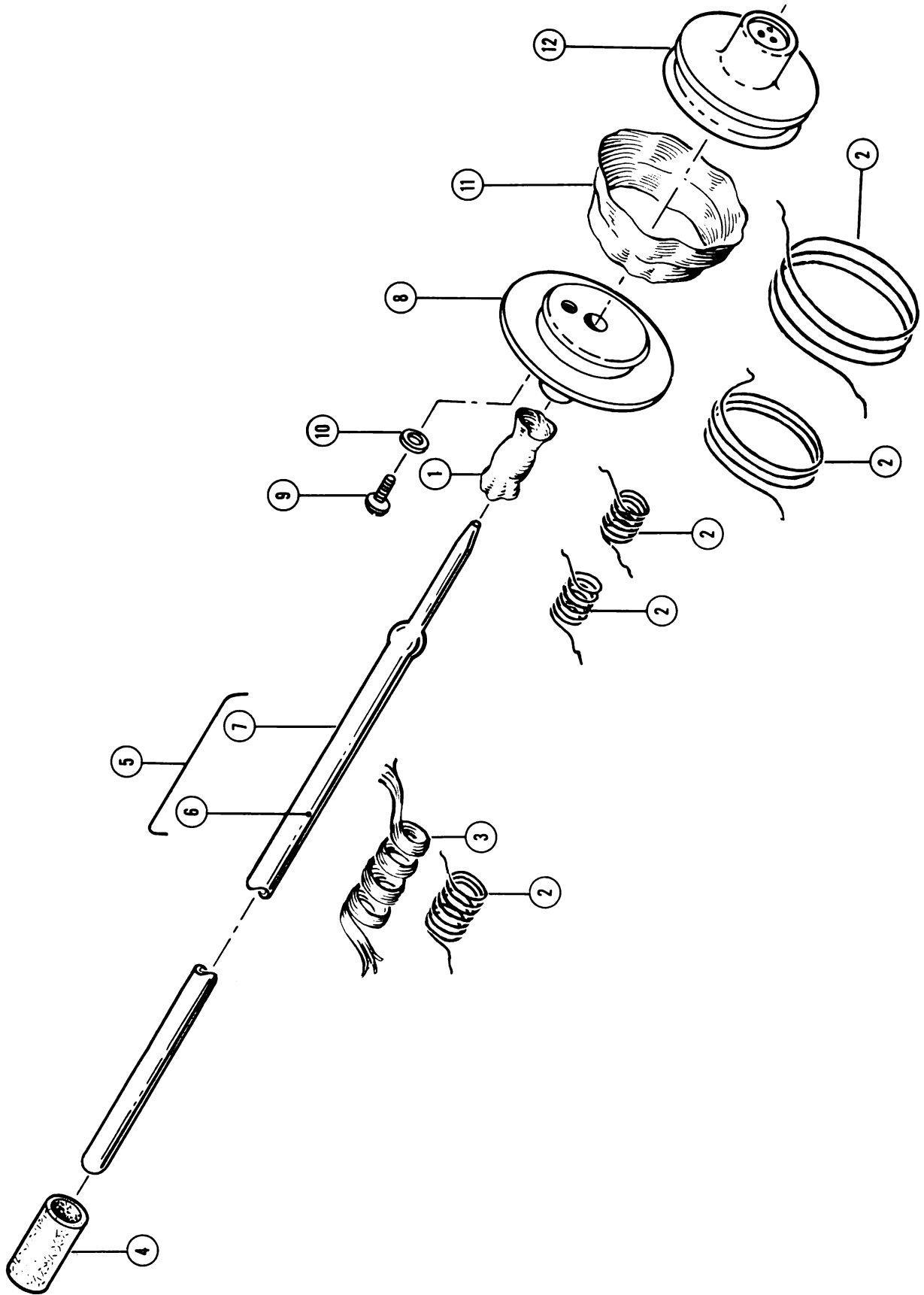


Figure 66—Mercury Tube Assembly—Exploded View

SECTION VIII

SPECIAL SERVICE TOOLS AND TEST APPARATUS

INTRODUCTION

The standard practice for the repair of Welch make marine mercurial barometers, as set forth in this manual, is the result of the best and latest methods employed by both instrument manufacturers and Naval repair facilities. This section catalogs the special service tools, fixtures and test apparatus which were selected to:

- a. Implement standard practice.
- b. Reduce skill levels to that of the personnel ratings indicated.
- c. Prevent damage to parts during repair operations.

The tools and testing devices are listed numerically in the Special Service Tool List by their tool numbers. The name assigned to each tool was selected on a functional basis to suggest the use of the tool.

Where tools and testing devices were suggested by a particular manufacturer or Naval facility, acknowledgment is made in the "Source" column of the tool list.

Isometric drawings of the tools and test fixtures are included in this section and they are referenced by tool and figure numbers in the tool list. However, the cistern clamping fixture (Tool No. 1), the vernier scale and plate drill jig (Tool No. 9), and the hypodermic syringe (Tool No. 15) are not illustrated here-

in, but are referenced to operational illustrations in Sections III and V. The Control Manual contains a section entitled, "Navigational Instrument Test Apparatus" wherein the various types of test apparatus are described. Also, see the section "Navigational Instrument Service Tools and Fixtures" in that volume; it is an index of the special service tools for all navigational instruments.

These tools and fixtures are only the best to date. They can be improved upon and new tools devised that will save time, make your job easier and promote the efficiency of the repair work.

You are in an excellent position to use the benefits of your experience in actually doing the work toward improving on the existing tools. The Beneficial Suggestion Program in shipyards was devised to encourage new ideas by rewarding those who make acceptable suggestions. Enlisted personnel aboard repair ships are also invited to submit their suggestions.

Become method-conscious and constantly analyze your job and the tools you are using. See what improvements you can suggest. If you get an idea that requires time and material to develop, ask your supervisor for permission to work on it. Clear all suggestions through your supervisor and Beneficial Suggestion Committee for transmittal to the navigational instrument authority of the Bureau of Ships.

Your special efforts in this direction will make your job more interesting and profit you personally. The Navy will appreciate your interest.

MERCURIAL BAROMETERS

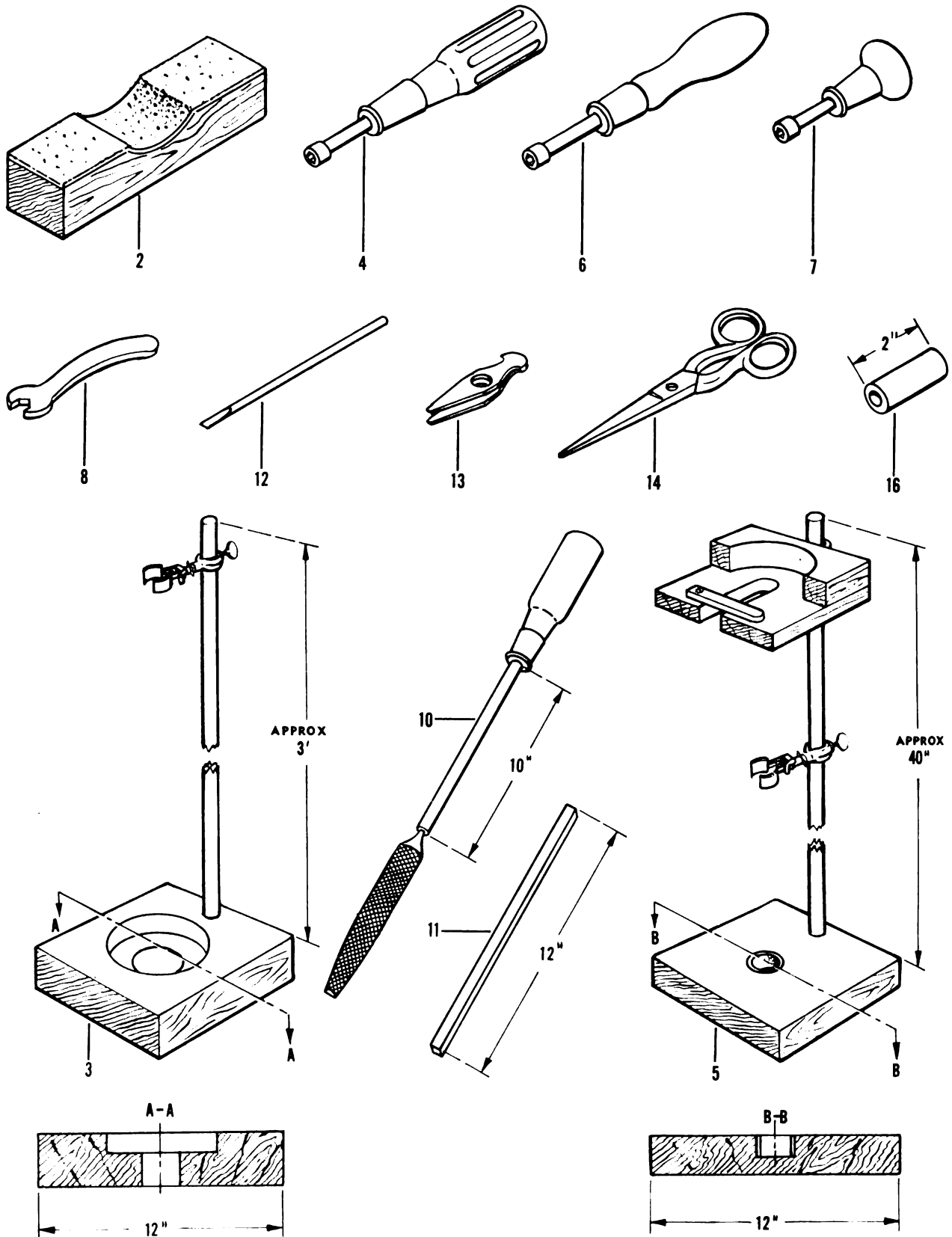


Figure 67—Special Tools and Test Apparatus

SPECIAL SERVICE TOOLS AND TEST APPARATUS

MERCURIAL BAROMETER
SPECIAL SERVICE TOOL LIST

Fig. & Index No.	Tool No.	Tool Name	Source
5	1	Fixture—Cistern clamping	Welch
67-2	2	Block—Support (two)	
67-3	3	Rack—Mercury tube support	
67-4	4	Wrench—Pinion nut	
67-5	5	Rack—Vertical support	
67-6	6	Wrench—Hinge screw nut	
67-7	7	Wrench—Cover glass frame and fastener nut	
67-8	8	Wrench—Pivot post nut	
36	9	Jig—Vernier scale and plate drill	Welch
67-10	10	File—Half round, with extension handle	Welch
67-11	11	Rod—Waxing	Welch
67-12	12	Tool—Forming (fiber)	Welch
67-13	13	Tweezers—Flat-nosed	Welch
67-14	14	Scissors—Sharp pointed	
48	15	Syringe—Glass, 5 CC, equipped with a hypodermic needle	Welch
67-16	16	Cap—Protecting	
68-17	17	Stand—Floor	Welch
68-18	18	Jar—Bell	Welch
68-19	19	Container—Perforated	
68-20	20	Wheel—Carborundum (National 3" x 3/32" x 5/16" A180 P 10BB 80B4)	Welch
68-21	21	Drill—Spotfacing	
68-22	22	Barometer—Secondary standard	
	23	Chamber—Barometer calibration	

MERCURIAL BAROMETERS

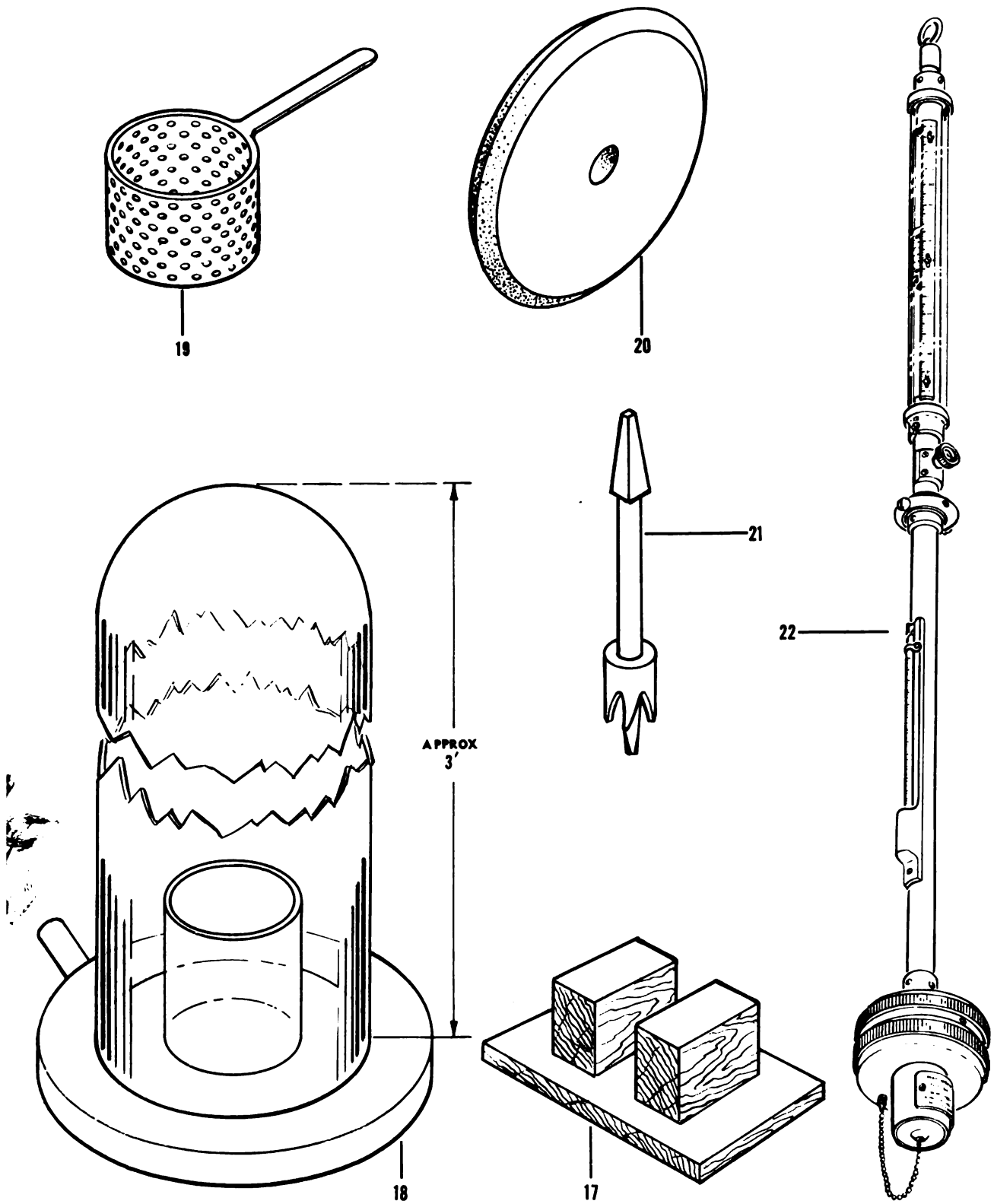


Figure 68—Special Tools and Test Apparatus

SECTION IX

MERCURIAL BAROMETER
SPECIAL SERVICE BULLETINS

INTRODUCTION

This section is provided for the manual as a place to incorporate the various service bulletins for mercurial barometers as they are issued by the Bureau of Ships. It is contemplated that such bulletins will be the medium by which navigational instrument repair facilities are informed of changes and developments in the overhaul and repair procedures of these instruments. Hence, it is important that all such information peculiar to the repair of mercurial barometers be placed immediately in this section of the manual. Changes affecting general navigational instrument standard repair procedures and techniques, inspection standards, etc. will be issued as supplementary service bulletins to the Bureau of Ships Navigational Instrument Control Manual.

All repair personnel should appreciate the importance of keeping up to date on all such changes. Good work can come only from well-informed personnel who are experienced in performing their duties.