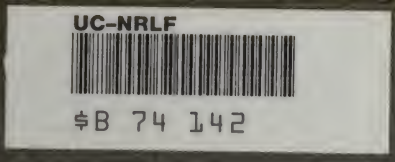

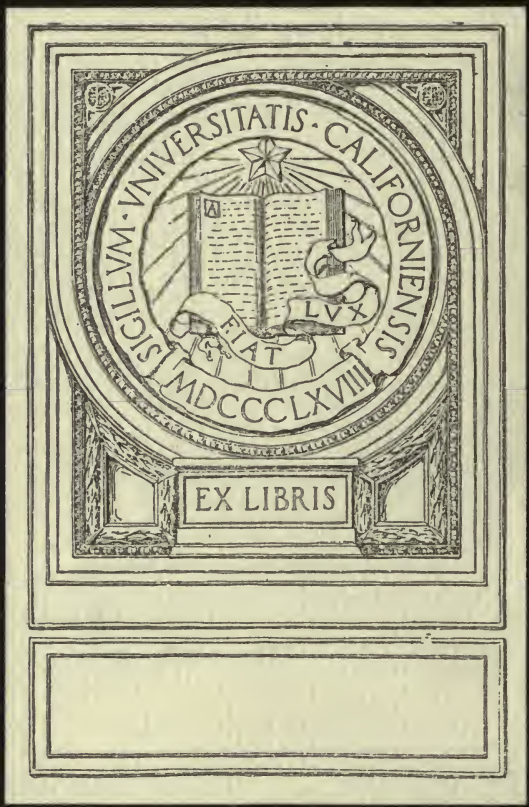
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SERVICE HANDBOOK

OF THE

ALTIMETER, MODEL OF 1916

PREPARED IN THE OFFICE OF
THE CHIEF OF ORDNANCE

April, 1922

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

CERTIFICATE: By direction of the Secretary of War, the matter contained herein is published as administrative information and is required for the proper transaction of the public business.

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WAR DEPARTMENT,
WASHINGTON, *April 13, 1922.*

The following publication, entitled "Service Handbook of the Altimeter, Model of 1916," is published for the information and guidance of all concerned.

[A. G. 062.1 (3-28-22).]

BY ORDER OF THE SECRETARY OF WAR:

JOHN J. PERSHING,
General of the Armies,
Chief of Staff.

OFFICIAL:

ROBERT C. DAVIS,
Acting The Adjutant General.

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GENERAL DESCRIPTION OF THE ALTIMETER, MODEL OF 1916.

The altimeters, model of 1916, are instruments employed in anti-aircraft gunnery to measure the height of the target above the fire-control station by projecting its altitude into the vertical plane containing the base line of the bilateral stations. Two instruments known respectively as the battery commander's and distant station instruments are required and are placed one at each end of a base line of known length. This model of altimeter has been superseded by altimeters, models of 1917 and 1920 (War Dept. Doc. No. 1105).

INSTRUCTIONS FOR MOUNTING.

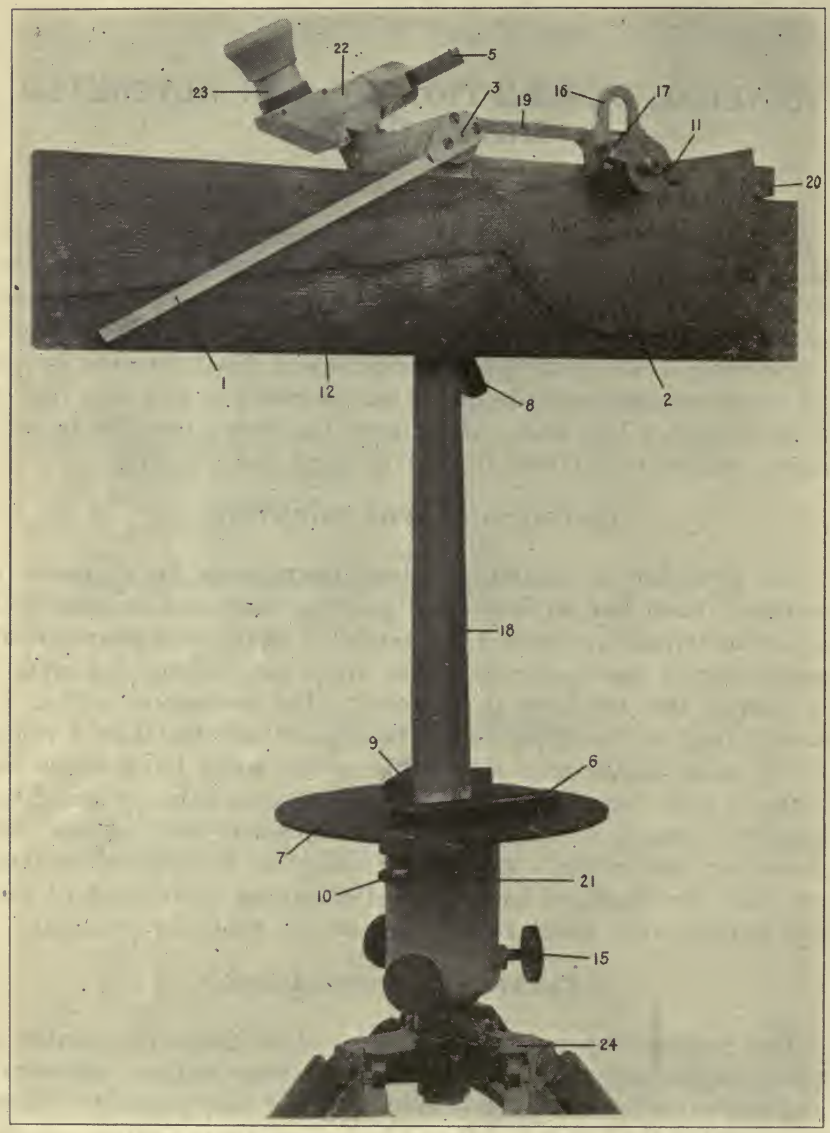
The procedure in establishing both instruments for operation is similar. Each has its individual packing chest and canvas hood, while the tripods are carried separately. The tripod legs are spread and set firmly into the ground, after which the staff bushing support is inserted into the head and clamped. The instrument is then removed from its chest, placed in the support and the three leveling screws manipulated until the bubbles of the spirit levels are in the center of their run. The instruments are oriented either by use of the magnetic compass or upon some point common to both stations. On the battery commander's station instrument, the necessary corrections are made for length of base line and difference in elevation of base end stations, after which the instruments are ready for operation.

FUNCTION AND OPERATION.

The principle upon which this type of altimeter is operated is termed direct altimetry (as distinguished from indirect altimetry) and employs what is commonly known as the " roof principle " where the height of the target is obtained by projecting its position into the vertical plane passing through the base line.

In setting up the instruments, the orientation error should not exceed 5 mils. If there is a difference in elevation between base end stations, P and O, Figure 1, a correction is made by setting the full

PLATE I



ALTIMETER, MODEL OF 1916.

Battery Commander's Station Instrument.

correction on the battery commander's station instrument. Thus, if the distant station is found to be 500 yards higher than the battery commander's station instrument, the elevation slide is clamped within the guides of the base length slider to the graduation —5 on the vertical scale. This correction reproduces the altimeter triangle in smaller scale on the instrument.

A represents the target position and B its horizontal projection into the vertical plane passing through the base line PO. The altitude of A, therefore, will be the same as that of B. By means of the telescopes, two planes of sight are directed on the airplane A

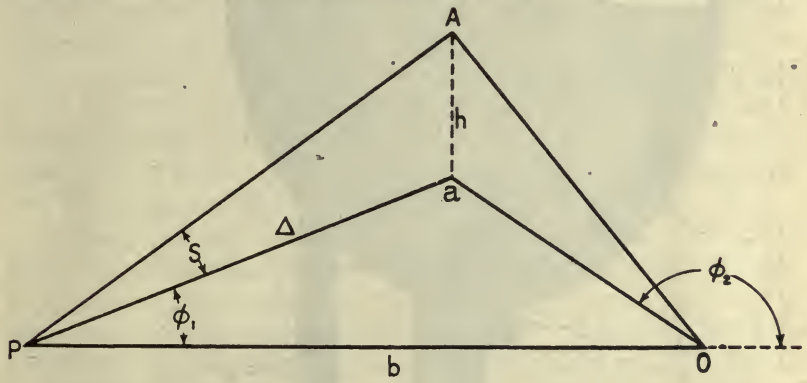
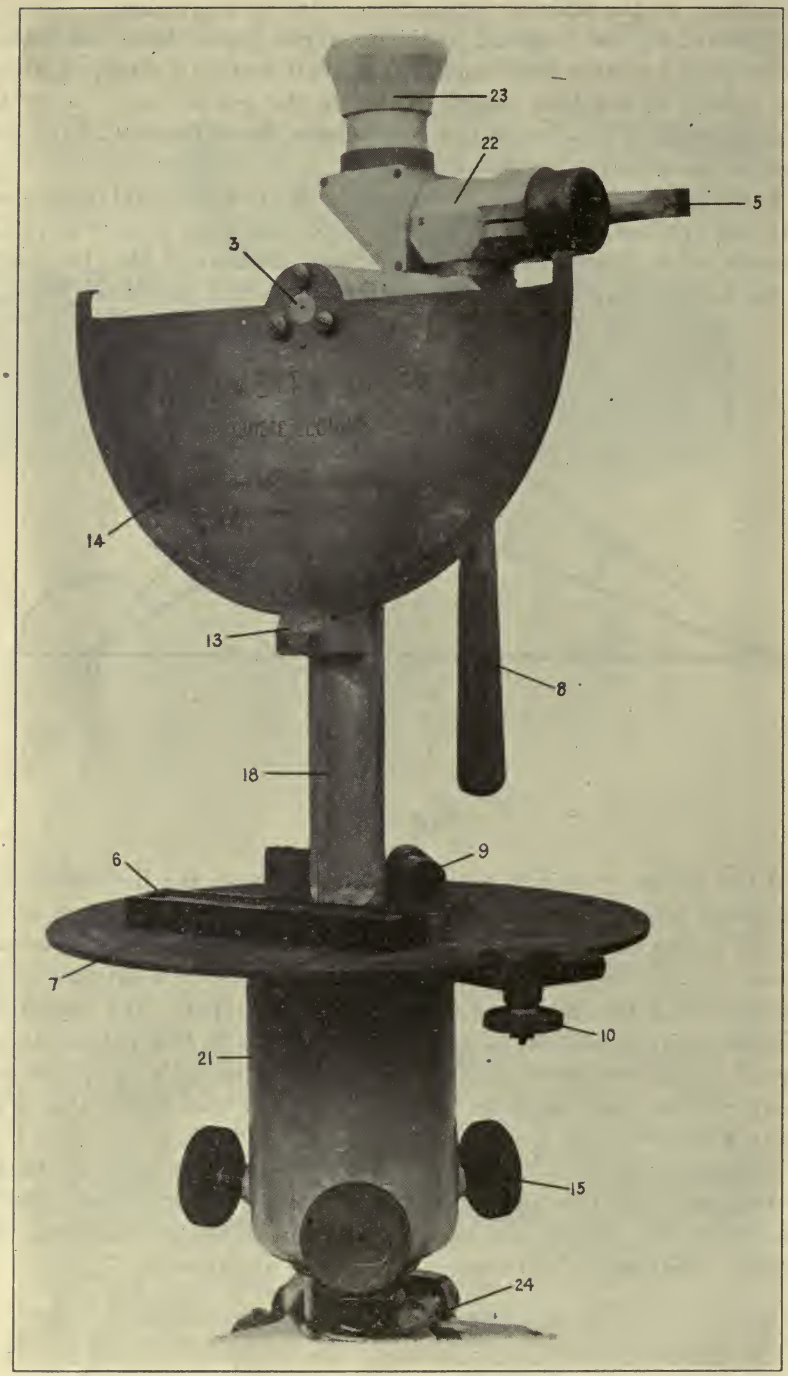


Fig. 1.

and the angles Φ_1 and Φ_2 which they make with the horizontal, are measured simultaneously. The angle read at 0, 180°—Φ_2, is transmitted to the battery commander station instrument. The operator there swings the protractor alidade about its axis until this angle registers with the index line on the alidade support. The protractor alidade is previously set in a direction opposite to the distant station and at a distance from the center of the horizontal axis of the primary alidade equivalent to the length of the base line. The scale bears a proportion to the base line of 1 to 40,000.

When the angle Φ_2 from the distant station has been set on the instrument and the telescope of the battery commander's station trained on the target, the altitude of the target is read from the altitude plate at the intersection of the two alidades.



ALTIMETER, MODEL OF 1916.

Distant Station Instrument.

DETAILED DESCRIPTION OF THE BATTERY COMMANDER'S STATION INSTRUMENT.

The staff (18) which is the main support of the instrument, seats and rotates in the staff bushing (4). The bushing in turn seats in the staff bushing support (21) in the manner of a ball and socket, allowing it motion in all directions by manipulation of the three leveling screws (15). The lower end is so shaped that when the leveling screws are adjusted, the bushing is held in its seat as well as leveled. An arm attached by screws to the upper surface of the bushing, bears an engraved index line for reading azimuth graduations and accommodates the locking stud holding the index clamp and thumb nut (10). The staff bushing support is inserted in the head of the tripod (24) furnished with the instrument, which is of French design and manufacture.

A flange on the staff supports the azimuth dial (7), the latter bearing graduations in mils around its circumference. It also has engraved on its top surface a scale of amplitude $\pm 16°$, over which the pointer on the compass box (6) passes. A slotted hole provides means for quickly attaching or detaching the compass. The dial is secured to the under surface of the flange while on its upper surface is mounted two spirit levels (9) set at right angles to each other.

The upper portion of the staff has a bracket extension mounting the altitude plate support (19) to which the altitude plate (12) is attached. The latter, a rectangular brass plate, has engraved upon its face parallel lines numbered from 10 to 50 and corresponding to altitudes ranging from 1,000 to 5,000 yards. Above the plate and on the center line of the staff is finished a horizontal bearing in which the telescope axis (3) turns. A support (22) mounting an observation or elbow telescope (23) is attached to one end of the axis.

A vertical axis through the support terminating at its lower end in a handle (8) provides for movement of the telescope in elevation and twisting of it in the plane of site. A collimator (5) is supported by a bracket clamped to the telescope tube to aid in quickly bringing the line of sight on the target.

Affixed to the opposite end of the telescope axis in a direction at right angles to the line of sight, is the primary alidade (1) which moves over the altitude plate upon rotation of the telescope about the horizontal. A spring clutch is interposed between the telescope and alidade in order that the alidade might be shifted so that it will always register against the plate whether the airplane is "coming" or "going."

The bracket at the upper end of the staff is also provided with a slot in which the base length slider (16) can be moved a distance proportional to the length of the base line between stations. A scale engraved from 15 to 50, corresponding to 1,500 to 5,000 yards, appears above the slot, against the graduations on which the slider is set and clamped by a wing nut. This slider has a vertical slot graduated ± 5, representing hundreds of yards in difference of station level. In this slot an elevation slider (17) is guided and when conditions require, is clamped by wing nut (11) against the graduation corresponding to the difference in height between stations. The elevation slide has pivoted to it the protractor alidade support (20) to which is secured the protractor alidade (2). The support projects beyond the right side of the protractor, forming an index against which the mil scale on the protractor is read. The protractor bears an arm or alidade which in conjunction with the primary alidade forms an intersection at which the altitude is read from the altitude plate.

DISTANT STATION INSTRUMENT.

The lower half of the distant station instrument is identical with the battery commander's station instrument. The staff, however, is shorter and terminates at its upper end in a horizontal bearing finished to receive the telescope axis (3). One end of the axis mounts a semicircular protractor (14) graduated in mils to correspond with the protractor alidade on the battery commander's station instrument, while the opposite end has attached to it a support to which is clamped an observation telescope. Like the battery commander's station instrument the telescope may be moved in angle of sight as well as twisted in the plane of sight. A collimator secured to a bracket clamped to the telescope aids in directing the telescope on the target. For reading angles of sight from the protractor, an index plate (13) is attached by screws to the staff.

ADJUSTMENTS.

Both the battery commander's and distant station instruments are so machined and assembled in the shop that no field adjustments are required. However, care must be exercised in handling the alidades as they are not of such rugged construction that they will withstand bending forces.

A set screw passing through the support and bearing against the tube of the telescope permits adjustment of the horizontality and verticality of the reticule.

NOMENCLATURE.

To assist in identifying parts of the instruments the following list is provided and numbers corresponding to parts enumerated therein are marked on Plates I and II:

1. Alidade, primary.
2. Alidade, protractor.
3. Axis, telescope.
4. Bushing, staff.
5. Collimator.
6. Compass, magnetic.
7. Dial, azimuth.
8. Handle.
9. Levels.
10. Nut, thumb.
11. Nut, wing.
12. Plate, altitude.
13. Plate, index.
14. Protractor.
15. Screws, leveling.
16. Slider, base length.
17. Slider, elevation.
18. Staff.
19. Support, altitude plate.
20. Support, protractor alidade.
21. Support, staff bushing.
22. Support, telescope.
23. Telescope.
24. Tripod.

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