OPERATION INSTRUCTIONS

FOR USE OF

KOLLSMAN

HANDHELD AIRCRAFT SEXTANT

(BUBBLE TYPE)

KOLLSMAN TYPE NO.	AIR FORCE TYPE	AIR FORCE STOCK NO.
1972-01	MA-2	6225-1972-01

KOLLSMAN INSTRUMENT CORPORATION
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S385-1100-257

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SECTION I
INTRODUCTION

1-1. This publication covers the description, operation, and the operating instructions for the Kollsman type 1972-01, Handheld Aircraft Sextant, Air Force Stock No. 6225-1972-01, manufactured by the Kollsman Instrument Corporation, Elmhurst, New York (See figure 1-1).

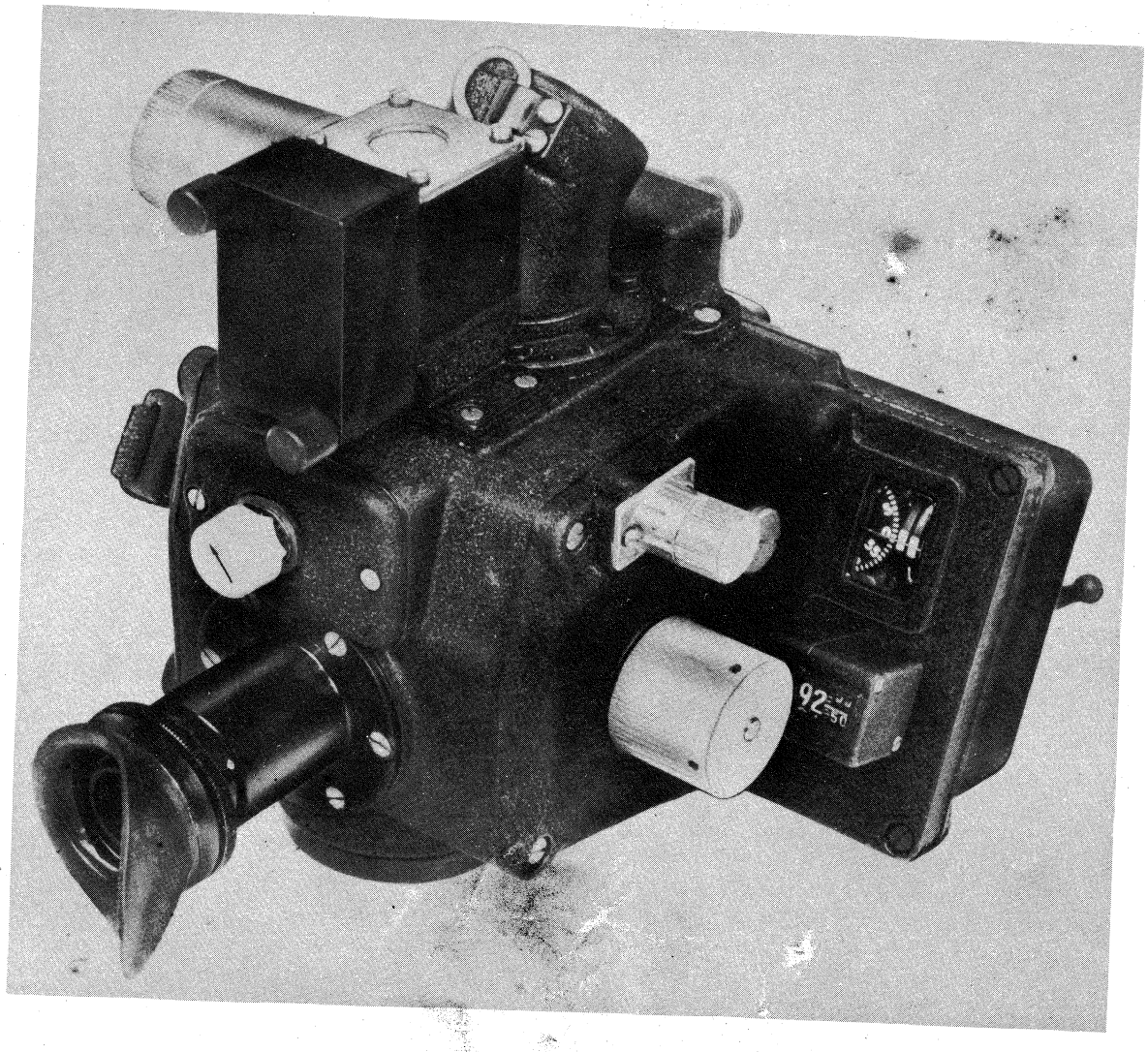

Figure 1-1. Handheld Aircraft Sextant, Kollsman Type 1972-01, Air Force Type MA-2

SECTION II
DESCRIPTION

2-1. GENERAL.

2-2. The Handheld Aircraft Sextant is designed to give accurate indication of the angular altitude of celestial bodies for navigation of aircraft where space considerations do not permit the use of automatic or periscopic installations.

HANDHELD AIRCRAFT SEXTANT
(Bubble Type)

Kollsman Type No.	Air Force Stock No.	Range	Description
1972-01	6225-1972-01	−10° to +92° in elevation	Field: 12.5° Illumination: 28v Altitude counter turns 5°/Rev. of altitude knob. Sealed against moisture and fungus.

2-3. DETAILED.

2-4. The Handheld Aircraft Sextant is capable of measuring angles, relative to the artificial horizon from —10° to +92° in elevation. The optical system of the Sextant provides two power magnification with a true field of 12.5°. This wide field facilitates the location and identification of celestial bodies. Light losses caused by reflection are minimized by a magnesium fluoride coating on all glass air surfaces. The eyepiece is adjustable to focus from —2 to +2 diopters.

2-5. Filtering glasses of eight values are provided for selective use in the optical system.

2-6. An artificial horizon in the form of an air bubble is located at the top of the body of the Handheld Aircraft Sextant. Provision for artificial illumination from a 28V lamp with controllable intensity is made for cases where there is insufficient daylight for direct illumination of the bubble. The bubble may be formed and adjusted in size, while in the field of view, by means of an "INCREASE BUBBLE" knob on the side of the chamber. The bubble chamber is compensated for ambient pressure and temperature changes encountered in normal operation. The bubble is superimposed in the field of view with the celestial body and, by keeping both in the center relative to a set of crosshairs, the horizontal position of the Sextant is determined and the elevation of the body relative to the horizontal is accurately computed.

2-7. To prevent condensation and fogging of the optics during rapid temperature changes, the inner chambers of the sextant are filled with dry nitrogen and sealed. As a further precaution a silica gel desiccator is provided to absorb any moisture which might penetrate the casting or gaskets. Although the silica gel may turn from blue to pink or white indicating that it has absorbed moisture, it does not necessarily mean that excessive moisture is present in the sextant. The outer tube encases the index prism and mechanism, thus protecting them from shock due to normal handling. Also it lessens the effects of changing ambient temperatures.

2-8. COATED LENSES.

2-9. When light passes from air to a transparent material, a fraction of the incident light is reflected from the surface. The amount of light lost by reflection at a single glass-air surface is from 4 percent to 6 percent. If the lenses were not coated the transmitted light would be reduced by approximately 75 percent. The thickness of the coating on each glass surface is one quarter of a wave-length of light which, in inches, is approximately six millionths (0.000006) of one inch.

2-10. AVERAGER.

2-11. The mechanism is designed to interpret the action of a moving ball across a rotating disc and, as a result of this movement, accurately compute an average angle for any time interval up to two minutes. The action of only one lever winds the averager mechanism, sets the indices (used in determining the average angle), sets the half-time dial to zero, and clears the field of view. Operation commences when a second actuating lever is depressed. The observation period may be terminated at any time after 30 seconds by depressing the actuating lever a second time. If the mechanism is allowed to run for the complete cycle, an automatic device causes a shutter to block the optical path after two minutes thus indicating that the observation has been concluded. By resetting the indices, the average altitude angle is indicated on a counter. The half-time of observation is also indicated.

2-12. A strap is placed on the left hand side of the Sextant to insure a firm grip and a steady reading. A bracket at the top of the outer tube provides a hanger so that the sextant can be suspended from the center of the dome for steadier sighting.

SECTION III
OPERATION

3-1. PRINCIPLES OF OPERATION.

3-2. MECHANICAL SYSTEM.

3-3. The line of sight is rotatable in elevation by tilting the reflecting surface of the index prism located at the entrance window of the sextant. The rotation of the index prism is controlled by a worm and sector in the body of the sextant, their motion being transferred by means of a rod and levers. These are controlled by a knob that is operated to displace the objective image. Geared to the drive shaft is a counter on which the altitude angle is indicated in the degree and minutes. Observations are made as compared to an artificial horizon.

3-4. OPTICAL SYSTEM. (See figure 3-1.)

3-5. Light, entering the objective window, passes through the index prism, objective lens system, and filters. It is then directed to the eye by means of a penta-roof fixed prism and forms a real image at the focal plane of the field lens. On the field lens is a reticle consisting of a vertical and horizontal line which indicates the center of the field. The focal plane of the eyepiece lens system coincides with that of the field lens and reticle.

3-6. The bubble chamber may prevent the entrance of sufficient daylight for direct illumination, therefore artificial illumination provided by a 28V lamp with controllable intensity is usually required. The image of the

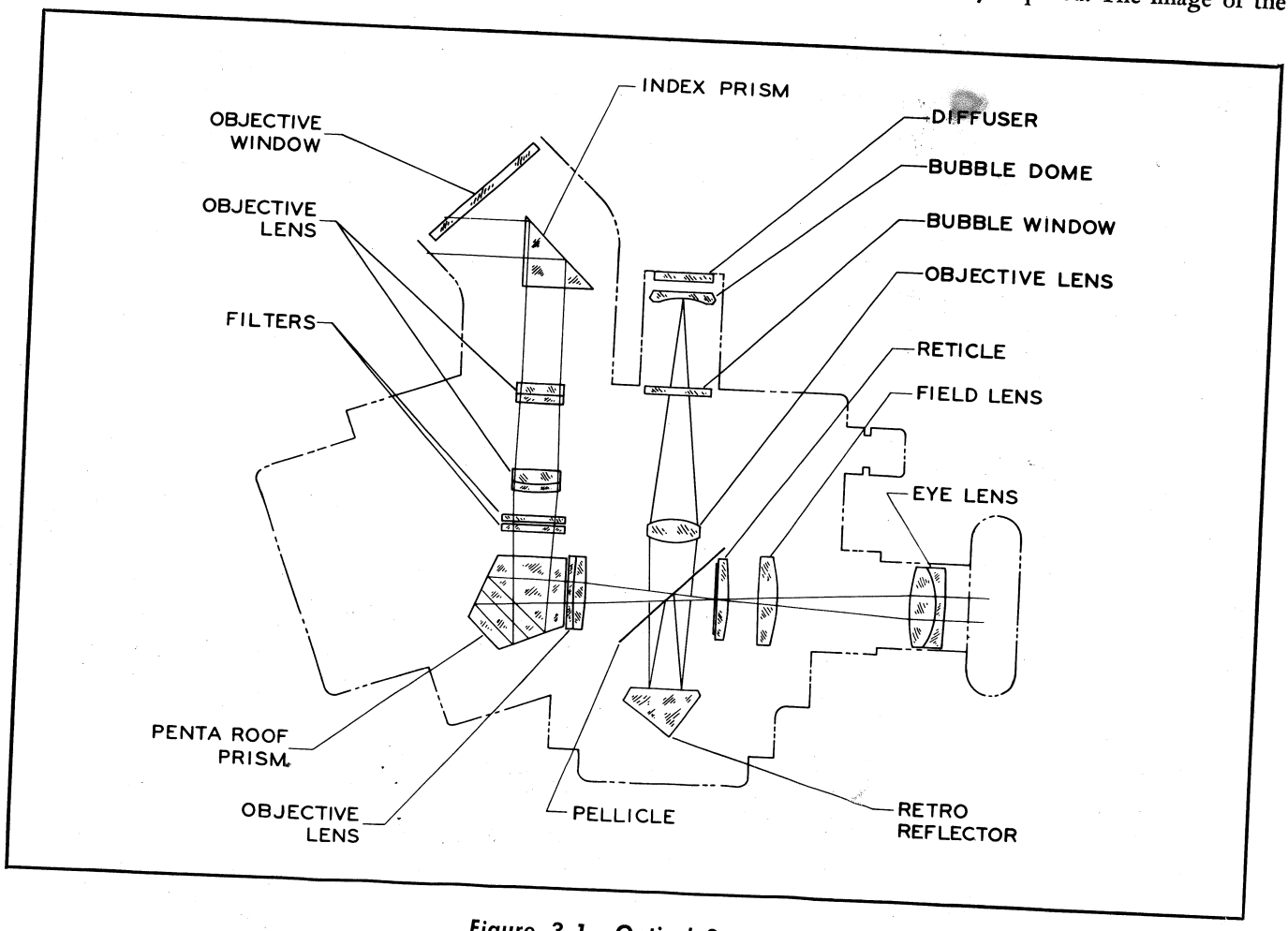

Figure 3-1. Optical System

bubble passes downward through an objective lens and through the pellicle to a retroreflector. It is then reflected to the pellicle which in turn reflects it to the focal plane of the main optical system.

3-7. AVERAGER.

3-8. The usual practice in using a sextant is to make a number of observations and to average the resulting readings. This is of primary importance when using an artificial horizon, since aircraft accelerations cause the bubble to indicate a false vertical. In the handheld sextant the averaging is performed by a Deimel-Black ball integrator which effects a continuous moving average over any observations period up to two minutes. Because it is continuously integrating altitude against elapsed time, after at least 30 seconds have gone by, it may be stopped at any time up to two minutes as circumstances dictate. The average altitude angle is obtained at the end of an observation by recentering the averager indices by means of the altitude knob. The average altitude angle may then be read directly from the counter. A time dial graduated in seconds indicates the half time of the observation, which indication may be added directly to the time of start to give the mean time of the observation. At the end of two minutes of observation, the averager actuates a shutter which drops across the field of view indicating that the observation has been concluded.

3-9. ACCURACY.

3-10. The overall accuracy in altitude measurements is better than 2 minutes of arc. The average will indicate the elapsed time of observation with an accuracy of 1 second or better.

3-11. ILLUMINATION. (See figure 3-2.)

3-12. By plugging the sextant into a power source, illumination is provided for the dial and counter, and separately for the bubble unit. Vertical reference illumination is controllable by means of a 250-ohm rheostat located just above the eyepiece assembly. The dial and counter light is not controllable.

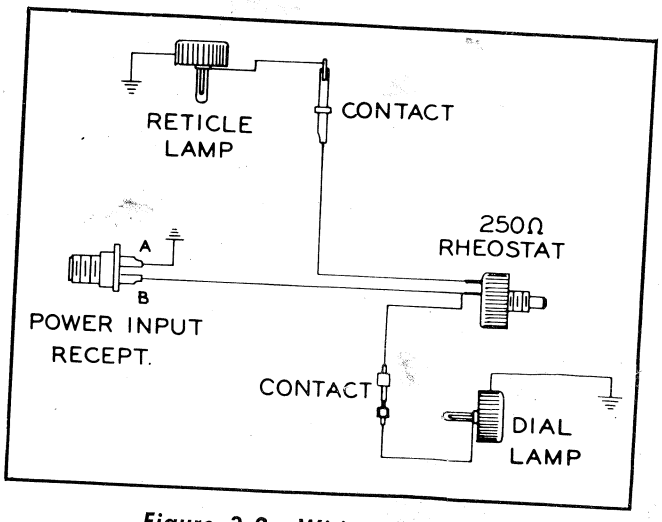

Figure 3-2. Wiring Diagram

3-13. OPERATION.

3-14. PRE-FLIGHT INSTRUCTIONS.

3-15. FORMING A BUBBLE (see figure 3-3).

a. Set INCREASE BUBBLE knob (14) to minimum position. Tilt sextant to left and slowly rotate knob. A bubble will be formed at the notch, visible on the right hand side of the field of view. Rotate knob slowly, back and forth, until proper size bubble is formed.

Note

The suggested size of the bubble is about 1½ to 2°. (The sun appears to subtend about 1°.)

b. Move sextant to vertical position, i.e., when the bubble is in the center of the field of view. Slowly rotate knob to maximum increase position and focus bubble by turning eyepiece.

c. Check to be sure the INCREASE BUBBLE knob is in the maximum position.

3-16. BUBBLE IN FIELD OF VIEW TOO LARGE.

a. With the sextant in the vertical position, rotate INCREASE BUBBLE knob (14) to maximum position.

b. Tilt sextant to the left and center bubble in the notch.

c. Slowly rotate the knob to reduce the size of the bubble.

d. If the travel of the knob is reached without reducing the bubble to the desired size, repeat the cycle.

e. When the desired bubble size is obtained, move sextant to vertical position (bubble located near intersection of reticle) and slowly rotate to maximum increase position.

3-17. BUBBLE IN FIELD OF VIEW TOO SMALL.

a. Rotate INCREASE BUBBLE knob (14) to minimum with sextant in vertical position.

b. Tilt sextant to left and center bubble in notch.

c. Slowly rotate the knob to increase the size of bubble.

d. If travel of knob is reached without increasing bubble to the desired size, repeat cycle.

e. When desired bubble size is obtained, return sextant to vertical position and slowly rotate knob to maximum increase position.

Note

Little or nothing will happen to the bubble unless it is resting in the notch when the knob is turned. Tilting the sextant will permit the fluid level in the air chamber to uncover the transfer port allowing air to be drawn into the bubble chamber. In the vertical position the fluid level in the air chamber will be above the transfer port and fluid instead of air will be drawn into the bubble chamber.

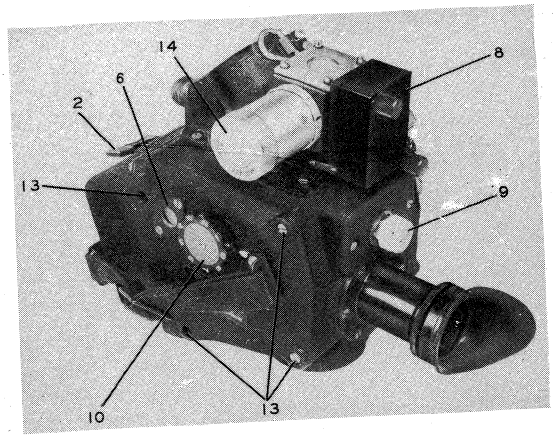

Figure 3-3A. Handheld Sextant, Left Side

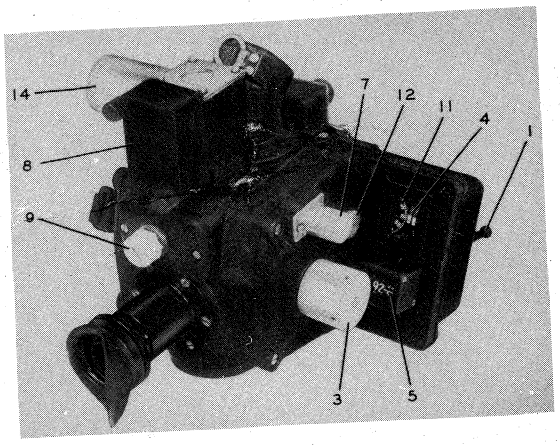

Figure 3-3B. Handheld Sextant, Right Side

Except when adjusting the bubble, the INCREASE BUBBLE knob is to be kept at its maximum position, indicated by arrows, at all times. The knob encloses a compensation system for changes and variation in temperature and pressure. At the maximum position, the knob has its full range.

3-18. CHECKING THE SEXTANT. (See figure 3-3.)

3-19. AVERAGER.

a. Depress averager winding lever (1).

b. Sight through eyepiece and determine that the shutter has moved from the line of sight.

c. Depress actuating lever (2) and allow averager to run for its full two minute period. The shutter should fall across the field of view at the end of this period.

d. Rewind averager and depress actuating lever.

e. After 30 seconds and before the averager runs its full two minutes, depress actuating lever again. The averager should stop operating.

f. When the averager has been fully wound (allow time for an averager to run to zero) rotation of the altitude control knob (3) should not cause the averager indices (4) to move more than twice the width of the index line.

g. Rewind averager and position altitude at some appropriate reading.

h. Start the averager.

i. At one minute quickly change the altitude to some new reading and allow averager to finish its cycle.

j. Determine the averager reading mathematically and compare this with the computed average reading. The reading should be the same.

3-20. SEXTANT. (See figure 3-3.)

a. Be sure the altitude knob (3) turns freely and that indication of altitude angle (5) changes as the knob turns.

b. Check the desiccator (6) and see that the silica gel crystals are blue in color. Color change indicates that moisture has been present.

c. Plug the sextant into a power source and check the dial light (7), the bubble lamp (8) and the rheostat (9) operation.

3-21. FLIGHT INSTRUCTIONS.

a. Locate the selected body for observation previous to reading by determining its approximate relative bearing and altitude from appropriate tables (Air Almanac, HO. 218, etc.).

b. Set the sextant altitude counter to the approximate computed altitude of the body.

c. Depress the averager winding lever (1) to clear the shutter from the field of view.

d. Sighting through the sextant, locate the body to be shot.

Note

Allow at least four seconds for the averager to run to its starting position after being wound, before starting the observation.

e. Adjust the filters with the filter knob (10) for the sun or night time observation to suit.

f. Note the time. Start at the beginning of a minute. Commence operation by depressing the averager actuating lever (2).

g. While shooting, keep the bubble image and the sighted body as close to the center of the cross hairs as possible. This is accomplished by varying the tilt of the sextant and the position of the altitude knob.

h. If it is desired to terminate the observation before two minutes have elapsed, the lever (2) may be depressed and released at any time after 30 seconds have expired, thus dropping the shutter across the field and stopping the averager.

i. At the end of the two-minute period, the shutter will automatically fall across the field of view, blocking out the celestial body. A more accurate observation

is obtained during the full period of two minutes for two reasons:

1. The areodynamic acceleration cycle of most aircraft is of the order of a minute and a half.

2. The resetting of the averager is more accurate as the ratio between altitude knob rotation and averager rotation diminishes; that is, as the averager nears the end of its full period of operation.

j. To obtain the mean altitude angle at the end of an observation, both of the averager indices (figure 3-4) must be returned to zero and the left index aligned with the reference line by means of the altitude knob (3). If there is too great a disparity between the initial and final altitude angles, the index disappears from view, and the small arrows on the indicator's right drum will show the direction in which that drum must be rotated to align the reference marks on the drum with the reference on the window. (See figure 3-4.)

k. The resetting of the averager indices has automatically set the mean altitude on the sextant's counter, from which it may be read directly.

l. The half time dial of the averager (11) indicates in seconds, half the time of the observation, which may be either added to the G.C.T. at the start or subtracted from the G.C.T. at the finish to establish the mean time of the observation

m. Determine aircraft position in the regular manner using appropriate tables.

3-22. STOWING THE SEXTANT.

3-23. When not in use keep the sextant in the carrying case to protect it from damage.

3-24. Before placing the sextant in the carrying case always press the actuating lever (2, figure 3-3) allowing the averager to run down.

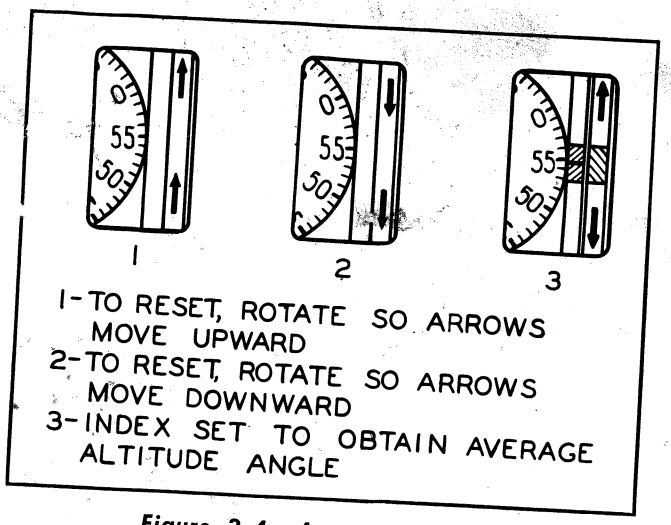

Figure 3-4. Averager Indices