A-7 SEXTANT

Hold the instrument in both hands. Your right hand operates the micrometer drum while your left, besides furnishing additional support, operates the shade glass holder and the astigmatizer knob. When you use the artificial horizon, move the horizon shutter knob to its extreme position in the direction opposite that of the arrow. This keeps any direct horizontal light from entering the telescope.

Operation

1. Before taking a reading with this sextant, be sure to set the ratchet of the averaging device at 0 and adjust the pencil properly to give fine legible lines.
2. Sight through the instrument and bring the image of the celestial body into horizontal coincidence with the bubble.
3. To record the observation, press the trigger by moving your right thumb backwards without taking that hand off the sextant.
4. Repeat this procedure, without re-setting the ratchet, until you have recorded the desired number of observations.
5. Note the number in the ratchet and select the middle reading.
6. Having determined the middle reading, locate its pencil mark on the micrometer drum cover.
7. Align the pencil mark of the average reading with the end of the pencil.
8. Note the reading on the worm scale dial and micrometer drum scale. This quantity is the average angular altitude determined by the observations. The time of the observation is the median time between the start and finish of your observation.

Bubble

The bubble assembly wnich forms the artificial horizon consists of a field lens, bubble chamber, bottom glass, and diaphragm chamber with cap. A vapor bubble forms in the bubble chamber which, together with the diaphragm chamber, is filled with xylene. The bubble is formed and controlled in size by the deflection of a flexible diaphragm, which forms a wall of the chamber on the side of the bubble assembly. Control the deflection by turning the nut on the diaphragm cover. Radioactive luminous material, painted on a metal ring surrounding the bubble, amply illuminates it.

Before you put the sextant away in its carrying case, return the bubble control knob to neutral, loose on the shaft.

Optics

The instrument optics is so designed that the matching of the bubble's image with that of the body does not have to take place in the middle of the field. It is best to use the astigmatizer for accurate work because the way it flattens the image makes it easier for you to estimate the center of the bubble.

The real field of the sextant is approximately 12°.

See T.O. 05-35-4 for additional instructions on operation and care of this sextant.

A-8A SEXTANT

Operation

You can use this sextant for direct or indirect sighting.

1. Before you take any readings you must set the averaging device in the zero position. Do this by turning the vernier disc as far clockwise as possible. Then use the sextant in the usual manner.
2. As soon as you have taken a shot, place your right index finger in the concave portion of the handle and push it as far counter-clockwise as possible. Then return the handle to its original position. This operation moves the vernier disc counter-clockwise an amount equal to one-eighth of the total recording.
3. Repeat this procedure until you have taken a total of eight shots.
4. Then read the counter disc and vernier disc to obtain the average of these eight settings in degrees and minutes.

The average time is the time of the average altitude reading.

If the 0 line of the vernier disc points between two lines of the counter disc, read the lower of the two as the number of degrees. Add to this the reading of the vernier disc, expressed in minutes of arc.

In reading the vernier, follow the vernier disc counter-clockwise until a line of the counter disc appears to be a continuation of a degree line. The number of divisions in the vernier disc from 0 to the point where the lines coincide is the number of minutes you add to the scale reading.

A pencil averaging device is now available. To have your sextant modified, send it to any one of the following service commands:

Fairfield Air Service Command,
Oklahoma City Air Service Command, or
Sacramento Air Service Command.

SECTION III

DETAILED DESCRIPTION

1. TELESCOPE ASSEMBLY.

The telescope assembly magnifies the field brought into view by the index and horizon prisms and also carries the artificial horizon system. It is made up of several minor assemblies subsequently described.

a. OBJECTIVE LENS ASSEMBLY.

(1) The objective lens assembly is made up of an objective mask, a horizon shutter and the objective lens system.

(a) The objective mask is a circular disc with an oblong opening cut symmetrically with the axis of the disc. Its function is to limit the field of the objective lens to the useful portion of the index and horizon prisms, to complete the housing of the horizon shutter, and to prevent the images of the prism holders from entering the field of view.

(b) The horizon shutter, which is directly behind the mask, is crescent shaped and has an outside radius the same as that of the objective mask. One end of the shutter is carried in a split ring which can be rotated in the objective tube by means of the shutter control knob. The outer end of the shutter is pivoted in the housing. By sliding the shutter control knob to the right, the crescent shaped shutter stands vertically across the oblong opening in the objective mask and obscures the horizon prism from view.

(c) The objective lens system is composed of a double convex lens separated by a spacing ring from a plano-concave lens. The lenses are held in place by a lens ring, which is slotted radially to make it flexible, and by a lock ring, which is threaded and screwed into the objective tube. The lenses are made up in a special crown-flint-achromatic combination.

(2) The objective lens assembly is fixed in the objective tube by a set screw.

b. ASTIGMATIZER ASSEMBLY. - The astigmatizer assembly houses an optical system capable of changing a round image into a narrow line. It is used to change the image of a celestial body into a narrow band of light to facilitate centering of the star and bubble. Whenever the astigmatizer lens is thrown out of the optical system it is replaced by a plane parallel plate glass to compensate for the change in focal length. These two glasses are held in place in the astigmatizer plate which can be rotated by the control knob. The ends of the slot, in which the knob moves, serve as stops for the rotation of the plate. Adjustment of the stop position of the astigmatizer is provided by means of the set screw in the control knob. The plate is held in place against either one of the two stops by an off-center spring.

c. TELESCOPE CASTING ASSEMBLY. - The astigmatizer plate is mounted in a bushing in the telescope casting. In this casting is also mounted the body prism held in place by the saddle-shaped holder. The form of this prism (a roof prism) is such that the light, entering one face travels through to one of the faces of the roof, is reflected to the other face of the roof and then from it, reflected upward. The path of light is thus bent through 90° and shifted over to the opposite side of the optical axis thereby reverting the image.

NOTE: The telescope casting for all types of sextants is sand cast with the exception of type A-7, Pioneer 3003-B, which is die cast.

d. ARTIFICIAL HORIZON. - (Refer to figures 8 and 9)

5. REMOVING THE BUBBLE.

In case it is desired to remove the bubble in order to make observations with the natural horizon, turn the control nut counterclockwise to put pressure on the liquid and leave it in that condition for a minute or two. Shaking the instrument from time to time forces the bubble to move and thereby speeds up the condensation of the vapor bubble.

6. COLLIMATION

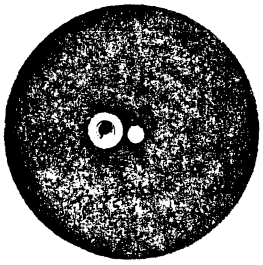

FIG. 14

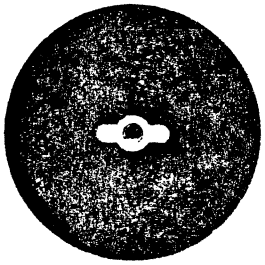

FIG. 15

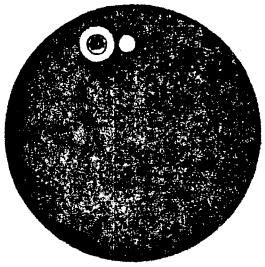

FIG. 16

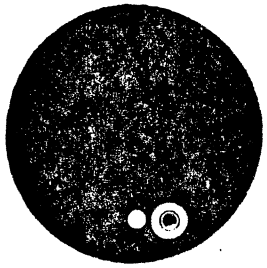

FIG. 17

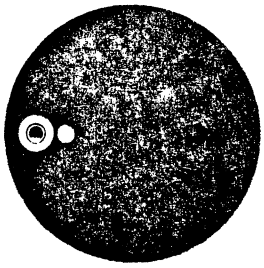

FIG. 18

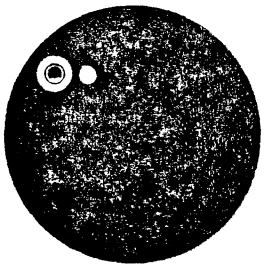

FIG. 19

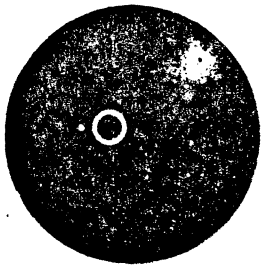

FIG. 20

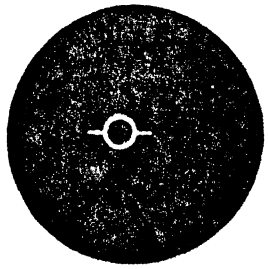

FIG. 21

Collimations

The instrument optics are so designed that the matching of the image of the bubble with that of the sun or star need not necessarily take place in the middle of the field. This matching, called "Collimation", is shown in figure 14, approximately in the center of the field. The image of the sun is brought alongside of the bubble so the center of the sun and that of the bubble are on the same horizontal line. It does not matter if the two images are collimated in the position shown in figure 16, or in figure 17. If the two are collimated, as shown in figure 18, the resulting error will be 5 minutes, while the example shown in figure 19 also gives an error.

a. Figure 15 shows collimation when the image of the sun is astigmatized. This method is preferable for accurate work because the symmetrical arrangement of the images makes it easier to estimate the center of the bubble.

b. Figure 20 shows the same work done with a star, and figure 21 with the astigmatized image of a star.

c. Stars are not as plainly visible or identifiable when astigmatized and, consequently, the best procedure is to bring them approximately in collimation before astigmatized and then throw in the astigmatizer for final adjustment.

d. The size of the bubble which gives the best results is a little over twice the apparent size of the sun as seen in the telescope, namely, approximately 1/10 of the size of the field. This diameter is given by the distance between the outer ends of the two horizontal lines etched on the field lens. This, however, is not a hard and fast rule. The smaller the bubble the more sluggish it will be, while a large bubble will tend to move faster. Depending on the conditions, the most suitable size of the bubble is selected, trying to avoid too small a bubble.

e. The horizon and index prisms are so placed that the fields through these prisms are visible simultaneously when the eye is placed approximately at the center of the eyepiece lens. If the eye is moved to the right side the index prism field is visible, and if moved to the left side, the horizon prism field comes into view. If the eye is moved from one side to the other there is a region in which both fields are visible.

7. NIGHT OPERATION.

a. TYPE A-5 AND A-7 (A-5A).

(1) For night operation, the light furnished by the radium luminous material is usually sufficient for illuminating the bubble. Should more illumination be necessary, electric illumination is provided on Type A-5 and A-7 (A-5A).

(2) The switch (14, figure 3), mounted on the back of the telescope controls the light. The disc (3, figure 3) when rotated varies this illumination. Only sufficient intensity should be used as to make the bubble clearly visible.

(3) The lamp for producing the illumination of the bubble is shown at (2, figure 3). The lamp bulb is removable by unscrewing it from the receptacle. A spare lamp bulb will be found in the box.

(4) A detachable lamp has been provided for illuminating the scale graduations and the record pad. It is controlled by the switch on the left side plate. The lamp holder will be found in a screw receptacle in the box. When needed, it should be screwed into the threaded hole (4, figure 4), under the micrometer drum.

(5) The battery (Bright Star No. 11 or equivalent) should be inserted into the holder under the telescope in the direction indicated on the clamp. It is not necessary to remove the paper jacket from the battery.

(6) The lamp cap should be turned so as to have the most suitable illumination, i.e., the large slot toward the data pad.

b. TYPE A-7 (Pioneer 3003-A AND 3003-B). - The illumination system for night observations on Type A-7 (3003-A and 3003-B) is essentially the same as that provided on Type A-5 except for the illumination of the bubble. The electrical system for bubble illumination has been eliminated. Also radioactive luminous material, instead of radium, has been painted on the metal ring surrounding the bubble.

8. CARE OF INSTRUMENT AFTER USE.

After using the instrument, turn the knurled nut controlling the diaphragm in counterclockwise direction until no resistance is felt. This is done to avoid useless strain on the diaphragm.