LINK BUBBLE SEXTANT

(OCTANT)

MODEL A-12

HANDBOOK

DESCRIPTION - OPERATION
USE - ADJUSTMENT

LINK AVIATION DEVICES INC.
BINGHAMTON, N.Y.

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LINK SEXTANT. MODEL A-12

FIG. 1

SECTION I

INTRODUCTION

The Link Sextant, model A-12, is of the median type and uses a bubble as an artificial horizon. It is designed to fill the urgent need for a low priced Bubble Sextant which is both accurate and easy to use. This instrument is light in weight, mechanically simple, rugged, compact in size, and shaped to the hand. It has practically no protruding handles and parts to make it bulky and subject to easy damage. Particular attention has been paid to weight distribution, so that the instrument feels well balanced when held in the hand. This combination of light weight and correct balance eliminates muscular exertion and makes accurate observations easier to obtain. The Sextant is so engineered as to permit easy interchange of essential parts.

The use of spring loaded split gears eliminates backlash, and any possible wear as a result of long periods of service is also compensated for by these gears. Thus, at no time can backlash or lost motion develop between the revolving drum and the arm which carries the Vernier scale.

The A-12 Sextant employs only one index mirror of plane parallel glass which is actuated by the arm carrying the vernier scale. The use of the single index mirror simplifies the construction of the instrument as well as insuring accurate results with a minimum of maintenance and expense.

A series of sights on one or more bodies may be taken, and the approximate altitude (to the nearest degree or two) marked on the plastic drums (one drum for each body.) The navigator may then retire to his table where under better working conditions he can obtain the median (average) Sextant reading. This is done by setting the arm to the nearest whole degree altitude, as previously recorded on the drum, and then setting the pencil mark representing the median shot beneath the marker. Thus the same reading is obtained as when the sight was taken.

SECTION II

GENERAL DESCRIPTION

The model A-12 Sextant is a one piece frame of heat-treated aluminum, resulting in a rigid and durably constructed instrument unlikely to warp and strong enough to withstand shocks caused by rough handling. Naturally, however, an instrument of which accuracy is required should be handled with extreme care at all times. The Sextant itself is housed in a compact case providing space for extra batteries, bulbs, drums, and a spare bubble assembly.

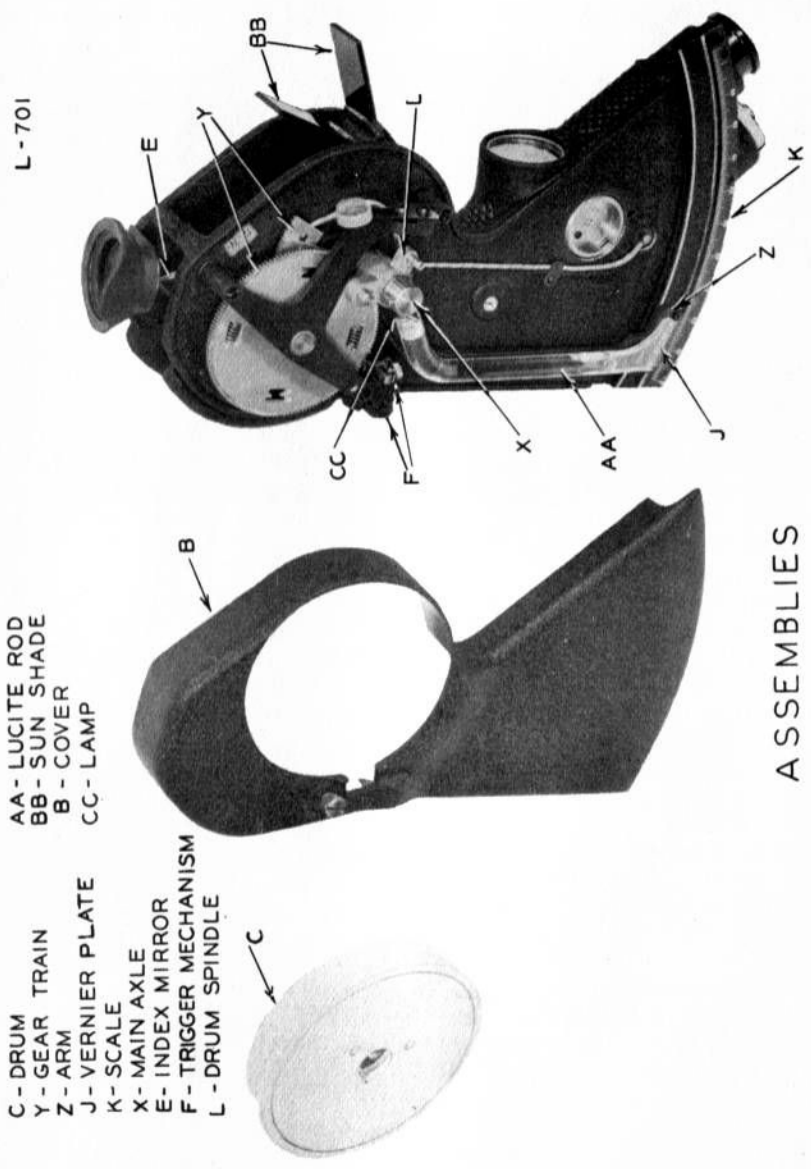
The design and construction is such that the revolving of the white plastic recording drum "C" (Figure 2) actuates a gear train "Y" which in turn gives motion to an arm "Z" upon which is fastened the vernier "J". The vernier scale "J" is read against a segment of a circle "K" which carries graduations indicating from 0 to 90 degrees. The arc scale is graduated in half degree divisions, and the vernier plate in two-minute divisions. These two-minute divisions are far enough apart so that interpolations to one minute or less may be read.

The shaft to which the arm is secured also carries the plane parallel glass index mirror "E"; consequently, there can be no lost motion between the index glass and the scale. Passing through the inside of the arm shaft is the main axle "X" to which is attached the spindle "L" which holds the drum. A pencil trigger mechanism "F" can be actuated so that by pressing the trigger a pencil mark will be recorded on the drum. Each time a sight is taken, the trigger is operated; therefore, it can be seen that a series of sights will result in a row of marks on the drum, the median or approximate average of which may then be determined by rotating the drum and aligning the middle mark beneath the pencil point. The reading thus obtained is the median or approximate average reading. The procedure is described more fully in the section dealing with "Operating Instructions".

The bubble assembly unit (figure 2A) is carefully adjusted at the factory and locked in position. With reasonable care of this unit it is unlikely that further adjustment should be necessary. Provision for such adjustment is made, however, and can be utilized whenever it becomes necessary. See Section VII - Adjustments.

The bubble assembly which is easily removed comprises a bubble housing, two lenses with seals and locking rings, a filler hole, and the bubble fluid.

Illumination of the bubble for night observations is obtained by use of a self-contained readily removable lamp assembly "O"



C - DRUM
Y - GEAR TRAIN
Z - ARM
J - VERNIER PLATE
K - SCALE
X - MAIN AXLE
E - INDEX MIRROR
F - TRIGGER MECHANISM
L - DRUM SPINDLE
AA - LUCITE ROD
BB - SUN SHADE
B - COVER
CC - LAMP

ASSEMBLIES

FIG.2

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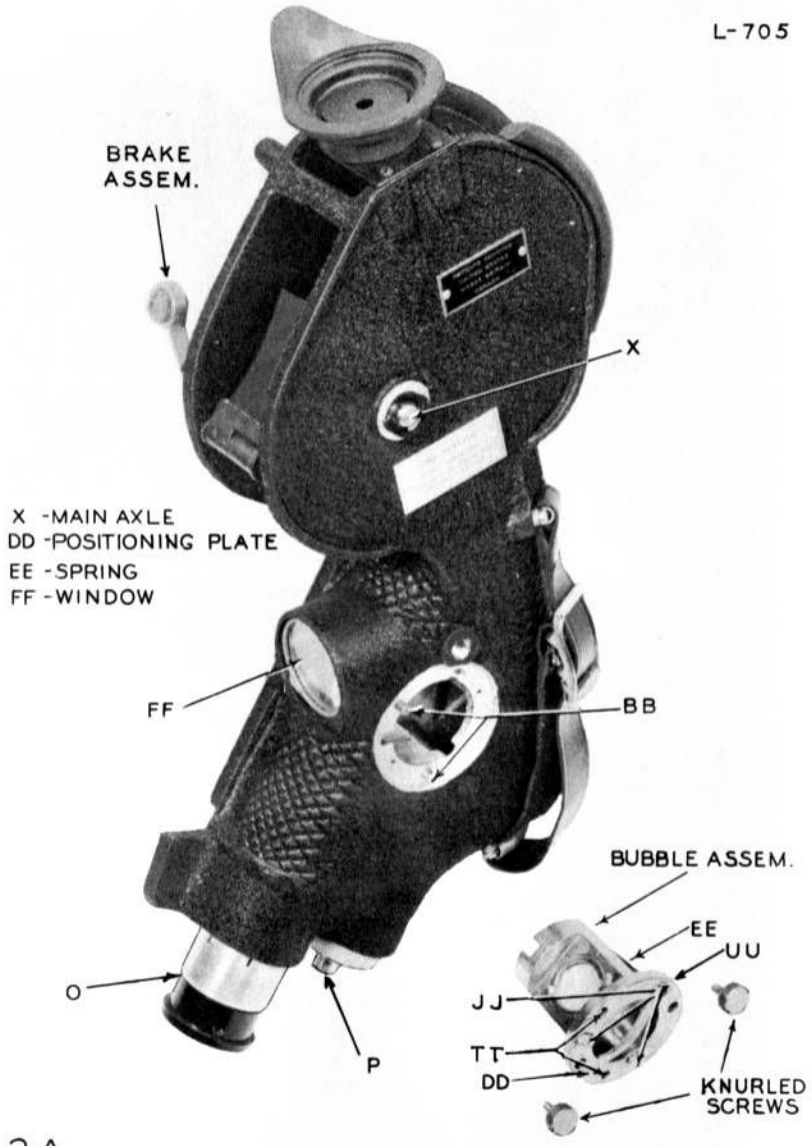

FIG. 2A

(Figure 2A) which includes a lamp, battery, battery case, switch, and rheostat. Daylight illumination of the bubble is obtained through a circular glass window "FF" (Figure 2A) located in the top of the Sextant.

Illumination of the scale and vernier is accomplished by means of a separate lighting system. A lamp "CC" (Figure 2) is located under the semi-transparent drum to illuminate the sight marks made on the drum. A lucite rod "AA" (Figure 2) also uses light from this bulb and transmits it to a point where the vernier plate and the adjacent section of the scale are illuminated. The bulb is turned off or on by a push button located below the bubble housing lighting assembly. This push button housing "P" (Figure 2A) is also a readily removable unit and contains space for a battery.

Two sun shades "BB" (Figure 2) are provided for reducing glare, one of which passes 10 percent of the light, and the other 1 percent of the light. These shades are mounted in a swinging bracket which enables them to be placed in the desired position where they are then held by friction.

A tubular lens-mirror assembly (Figure 3 and 5) is contained within the Sextant, the purpose of which enables proper focusing of the bubble and its reflection to the eye as shown in Figure 3. It can here be seen that a movement of the Sextant arm and consequently the index glass also, enables the star to be brought into a position so that the two objects (bubble and star) appear as one.

Figure 4 shows two positions of the eye in viewing celestial bodies. One is a direct view of the star and the other is an indirect view of the star. For sighting stars, the direct view facilitates finding the desired body, while on the other hand the eye piece and sun shades adapt themselves comfortably in sighting the sun.

The function of the split type-spring loaded gear is shown in Figure 2. It can be seen that if the two halves of the gear are offset in opposite directions, a definite tension will be imposed upon the springs. If a pinion is meshed with the gear while the tension is maintained, it is quite evident that when the tension is released the pinion will be under constant pressure, and any lost motion between the two is absolutely eliminated. Also, any wear that occurs from long period of service is immediately taken up by this spring loading. The tension is regulated so that no binding exists between the pinion and gear.

It will be noted that both the large gear and the sector gear on the arm are of the split type.

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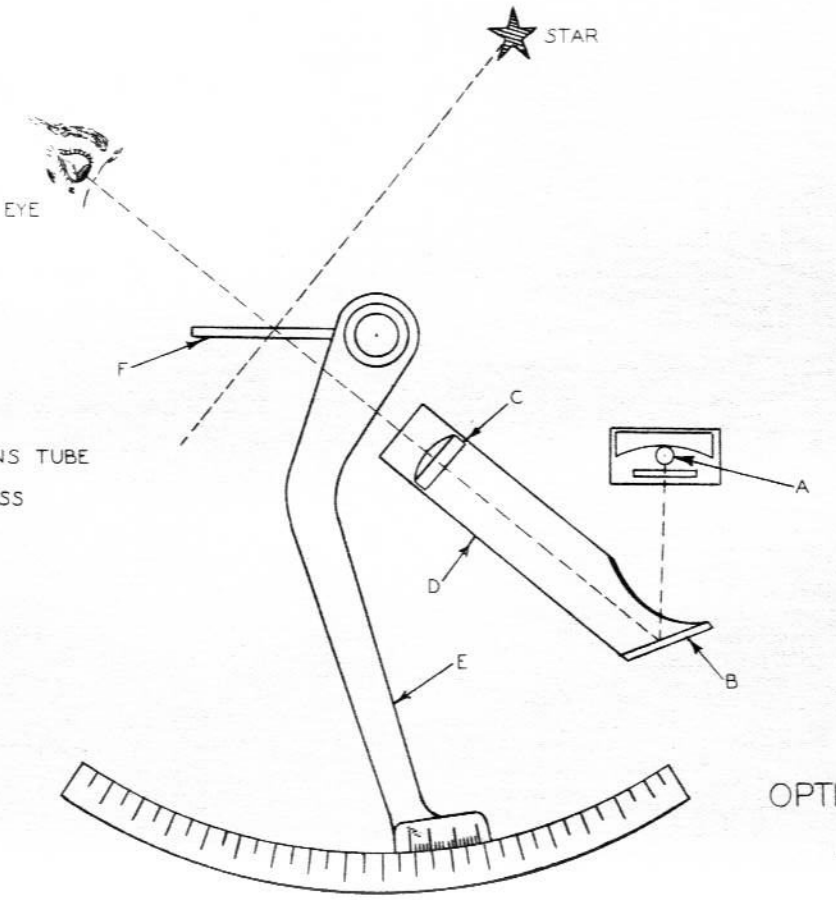

A - BUBBLE
B - MIRROR
C - LENS
D - MIRROR LENS TUBE
E - ARM
F - INDEX GLASS

OPTICAL SYSTEM
FIG 3

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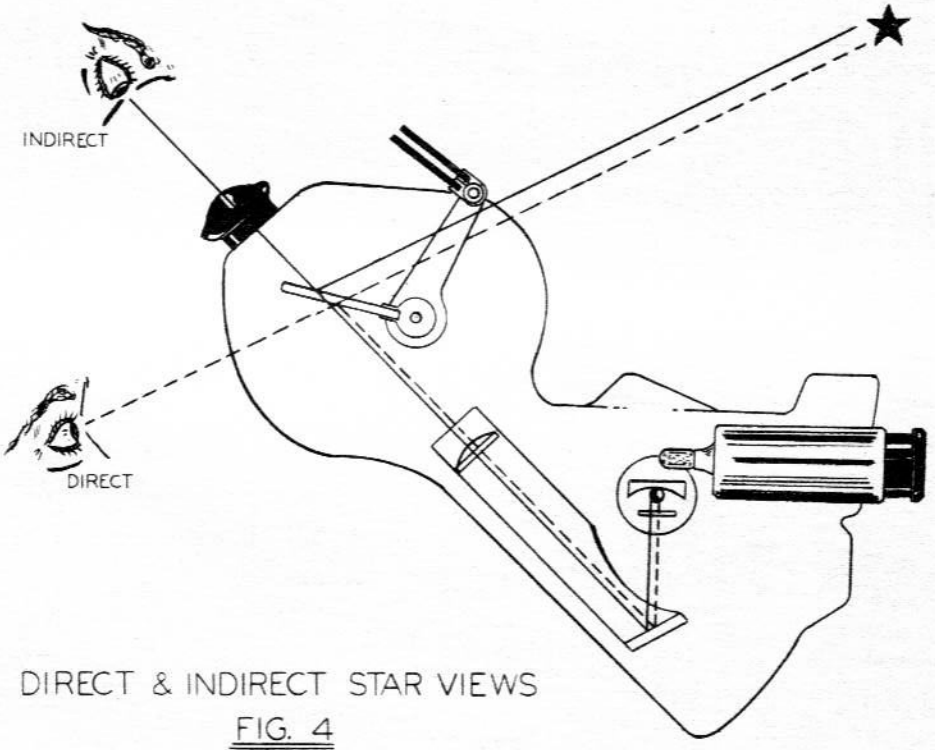


DIRECT & INDIRECT STAR VIEWS
FIG. 4

SECTION III

DETAILED DESCRIPTION

1. Housing
2. Scale
3. Vernier
4. Arm
5. Gear Train
6. Drum
7. Marking Pencil & Trigger
8. Index Mirror
9. Sun Shades
10. Bubble Assembly
11. Lens Tube Assembly
12. Bubble Illumination
13. Scale Illumination

1. HOUSING (Figure 1).

The housing or frame of the entire Sextant is cast in one piece. Openings and recesses for the various sub-assemblies and accessories are then machined, and lastly, after suitable masking, the finish is baked on.

2. SCALE (Figure 2).

The scale is of duralumin, carefully shaped and ground to size. It is then engraved, polished, anodized, and the engraving filled with white. Its position on the housing is determined and fixed by the mounting screw holes in the housing which are drilled in a jig.

3. VERNIER (Figure 2).

The vernier plate is manufactured similarly to the scale and is held in place on the Sextant arm by two screws. The screw holes in the vernier are elongated to facilitate final adjustments.

4. ARM (Figure 2).

The Sextant arm which carries the vernier plate in its movement along the scale is secured to a solid shaft, which fits holes..machined for the purpose..in the Sextant housing. This shaft to which the arm is secured also carries the index mirror, thus obviating any possibility of lost motion between the two parts.

5. GEAR TRAIN (Figure 2).

Travel of the arm along the scale is accomplished by means of a train of reduction gears actuated by a recording drum. The gears are the split type with sufficient spring tension between the two halves of each gear to prevent any backlash developing, either as a result of irregularities in the gears themselves or as a result of wear during service.

6. DRUM (Figure 1).

The drum by means of which the arm is set during use of the Sextant also serves as a recording drum. As each observation is made, a penciled line is recorded on the edge of this drum. Several sights thus may be made in a short time and recorded on the drum to be read later. The drum is removable and so arranged that additional drums may readily be used for obtaining several sights on each of additional stars. Each drum may later be replaced on the Sextant to obtain its reading as outlined in "Operating Instructions".

7. MARKING PENCIL AND TRIGGER (Figure 1).

A trigger is conveniently located to the left thumb. This trigger actuates a slide which carries a short pencil lead. When the trigger is depressed, a pencil line is left on the rim of the drum.

8. INDEX MIRROR (Figure 5).

The index mirror is clear glass optically flat and parallel. By means of a die cast clamp, it is solidly secured to the same shaft that carries the Sextant arm. Once adjusted properly, as described later, there can be no lost motion between the arm and this mirror.

9. SUN SHADES (Figure 5).

The sun shade assembly comprises two adjustable optically flat glass screens. One allows one percent and the other allows ten percent of the light to be transmitted. Both shades are mounted on a bracket in such a manner that either or both may be used. This bracket swings on the index mirror shaft with sufficient friction to hold it in whatever position it is placed.

10. BUBBLE ASSEMBLY (Figure 2A and 12)

The bubble assembly, which is readily removable from the Sextant housing, consists of a main brass housing which is machined to take the component parts of the bubble assembly and the positioning plate. The bottom of the bubble chamber is a clear lens, ground and polished optically flat and parallel. This lens is held in place by a lead seal and screw type lock ring. The top lens of the bubble chamber is ground and polished to the proper curvature on its inner surface, and is also held in place by a screw type lock ring and lead seal. The chamber is filled to the correct point with Xylene. A filler hole, plugged by a small Bristo type screw, is located in the end of the bubble assembly housing opposite the positioning plate.

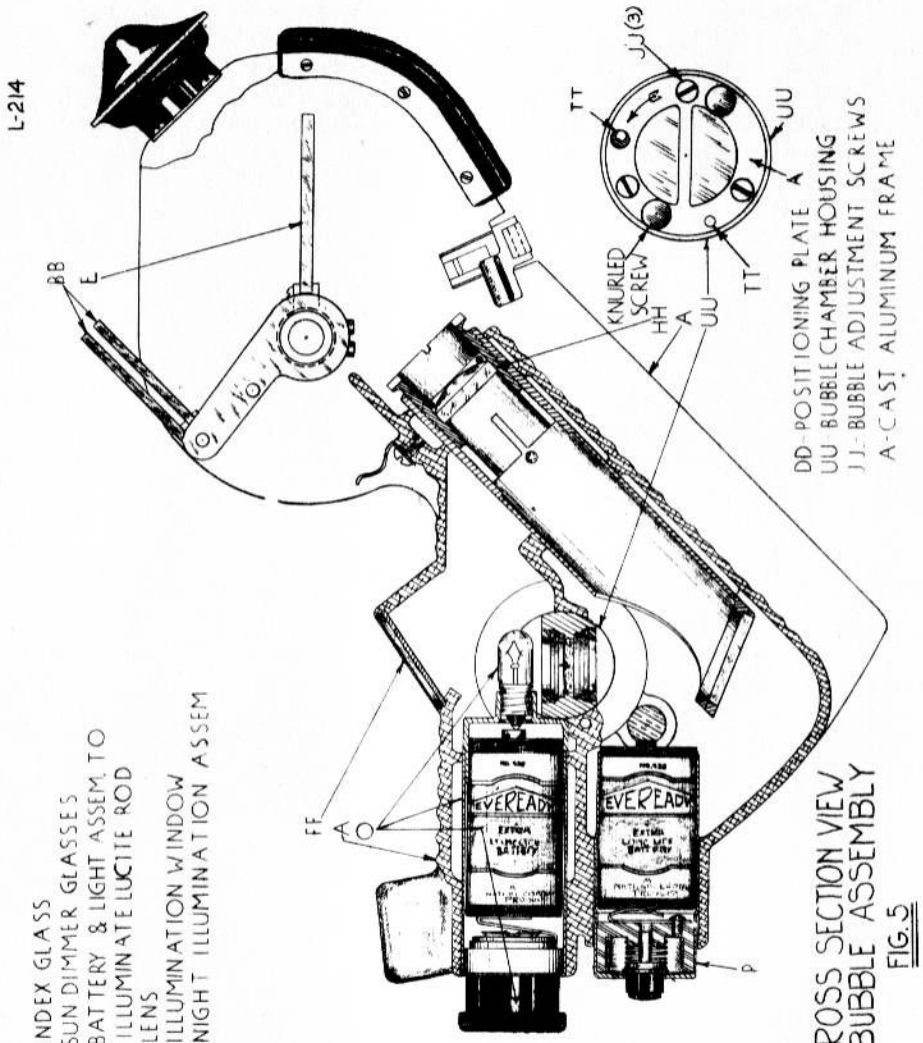
The positioning plate "DD" (Figure 2A) embodies five screws and two dowel pin holes "TT". This plate fits into the bubble chamber housing "UU", and with the three screws "JJ" loose, the housing can be rotated slightly in either direction around the positioning plate. NOTE: This facilitates an important adjustment and will be discussed in the section - Adjustments. The two large knurled screws "E" enable the entire housing plate assembly unit to be removed from the Sextant. This entire unit also has a limited circular movement within the Sextant housing itself as governed by the dowel pins. The one dowel pin and hole (without arrow) are closely machined and allows the bubble housing assembly to be placed in only one position relative to the Sextant housing. However, due to the fact that the other dowel pin hole is larger than the pin itself, the bubble housing can still be rotated slightly even though the assembly is in place. Therefore, for the correct final position,it is always necessary to see that the side of the dowel hole bearing the arrow is against the pin. This is automatically compensated for by means of the spring "EE" on the side of the bubble housing (Figure 2A). It will be seen that when the assembly is inserted into the Sextant housing, the spring will exert a tension in such a direction as to always rotate the arrow side of the positioning plate against the dowel pin.

11. LENS TUBE ASSEMBLY (Figure 5).

The lens tube assembly is used to transmit the image of the bubble downward vertically from the bubble assembly and then up at an angle, to the index mirror and viewpoint of the observer, (Figure 3). The assembly comprises an aluminum tube with a mirror at the bottom end under the bubble assembly, and the objective lens at the other, upper end. The end of this tube which carries the lens is threaded. The lens is held by a snap ring in a bushing which is threaded to fit the lens tube. Focusing or collimation of this lens (described later) is accomplished by screwing the lens and bushing assembly in or out as necessary.

12. BUBBLE ILLUMINATION

Daylight illumintion of the bubble is obtained through a glass window located in the top of the Sextant housing and held in place by a snap ring. Night illumination is provided by a lamp, battery, switch,and rheostat, (Figure 5). These items are parts of a readily removable assembly which consists of an aluminum tube with the lamp socket and lamp on one end, space within it for the battery, and a combination switch and rheostat on the other end. This assembly is removable as a unit for replacement of bulb or battery or for use as an auxiliary flashlight.



CROSS SECTION VIEW & BUBBLE ASSEMBLY

FIG. 5

13. SCALE ILLUMINATION

Both the scale and the semi-transparent recording drum are illuminated by one lamp, (Figure 2). This lamp is located under the recording drum and illuminates it directly. A portion of the light is carried along a lucite rod to the vernier plate and the adjacent area of the scale. A separate battery is provided for this lamp so that the illumination of the recording drum and the scale is entirely independent of the bubble illumination system.

SECTION IV

OPERATING INSTRUCTIONS

1. GENERAL OPERATION

To operate the Sextant, slip the left hand through the strap with the heel of the hand firmly against the housing. The fingers should extend well over the top, with the middle finger over the window which illuminates the bubble by daylight. The amount of daylight permitted to go through is controlled by raising or lowering this finger.

The thumb of the left hand should rest lightly but comfortably on the marking trigger. The top part of the case on which the fingers of the left hand rest should be horizontal when the Sextant is being used. The thumb and fingers of the right hand lightly grasp the operating drum which is then rotated as necessary to bring the celestial body and the bubble into coincidence. The correct position as seen in the Sextant should be such that the bubble and the body appear as one object in the center of the circular chamber. In learning to use the Sextant, it is excellent practice to merely attempt the centering of the bubble without sighting a body. Such practice promotes skill in controlling the bubble and positioning it wherever desired.

The Sextant can be used in either of two ways in sighting celestial bodies. (Refer to Figure 4). For observation of the sun, the eyepiece and sun shades should be used. This is referred to as observing the body indirectly because the body is reflected to the eye from the index glass. For observation of the stars, the direct method of sighting is preferred. This simplifies star finding and eliminates the possibility of observing the wrong star.

In both methods it is only necessary to have the body in the center of the bubble (bubble not touching the sides of the bubble housing) to obtain a correct altitude shot.

To use the Sextant for sighting the sun, hold the instrument in the normal manner and face in the direction of the sun. Position the sun shades so that no glare will be reflected to the eye when the body is in the field of vision. Place the right eye against the rubber eye piece and look through the small round

opening in it. With the right hand, revolve the drum until the sun is seen in the field of vision. It may be necessary to move the Sextant around somewhat to facilitate finding the objective, but this offers no difficulty if it is held in a position which is in line with the sun.

Movement of the scale end of the Sextant in the vertical plane, using the eye as the pivot point, causes the bubble to travel toward the 90 degree end of the altitude scale with upward motion. Downward motion of the scale end causes the bubble to fall to the zero end of the altitude scale. Rocking the Sextant from side to side causes the bubble to rise to the high side of the bubble chamber.

The indirect view, as described above, offers difficulty if used to sight the stars, this being due to the fact that there are countless stars in the sky, and indirect sighting through the Sextant gives no accurate indication as to which star is being observed. Also, the sizes of the nightly bodies are relatively small and difficult to see unless viewed directly through the index glass. To sight through the Sextant directly, again hold the instrument in the normal position and with the head turned up toward the star to be observed, place the Sextant against the front of of the face in such a way that the right eye lies between the rubber strips on the Sextant housing. The eye thus looks directly through the index glass at the star. It will now be seen that a complete vision of the stars is possible, and the selection of a particular one for observation is relatively easy. To bring the star into the field of vision, turn on the bubble chamber illumination to a point where the star and bubble are both visible and revolve the drum until the correct bubble-star position is obtained.

The bubble travels opposite to Sextant movement in this case as upward movement of the scale and produces bubble movement toward the zero end of the scale. Downward movement of the scale end causes the bubble to travel toward the 90 degree end of this scale.

2. MEDIAN (AVERAGE) SIGHTS

To obtain the median reading the procedure is as follows: A series of sights should be taken, pressing the marking lever each time the celestial body appears to be in the proper position relative to the bubble. These sights should be only a few seconds apart, and an odd number such as 11, 15, or 21 observations made. If eleven sights are to be taken, the time should be recorded at the instant of marking the sixth shot or, if preferred, the time can be marked at the first sight then again at the last, in this case using the mid-time. Upon completion of the series of shots, the median reading is obtained as follows: Note that if eleven shots were made, eleven pencil marks will be found around the rim of the

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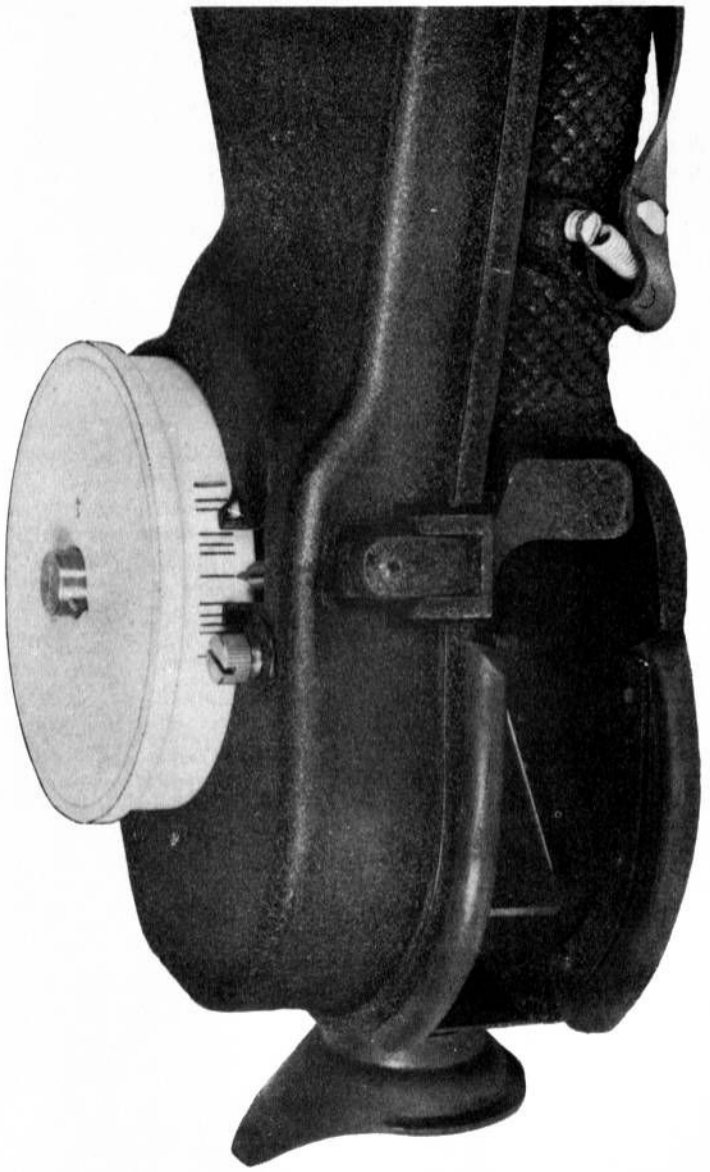


DRUM & SIGHT MARKS

FIG. 6

operating drum (Figure 6). Count along these marks to the sixth one, (the middle one on the drum), rotate the operating drum so that this mark is under the marking pencil, then read the scale. This reading will be the median (approximate average) of the eleven shots.

3. TO CHANGE DRUMS

Lift the drum straight off the Sextant. It will be noted that the drum is fitted to a flange (Figure 11) which has three studs. Two of these studs are small and long enough to extend through the operating drum. The remaining stud is shorter and larger so that it is impossible to put the drum on in the wrong position.

Observations may be taken on two or more celestial bodies using one drum for each body, after which the drums can be pocketed for later reference. Before removing the drum, the name of the celestial body, the time of observation, and the approximate scale reading should be written on the drum in pencil.

CAUTION: One complete revolution of the operating drum covers approximately 5 degrees on the scale. Therefore, if the approximate scale reading is not noted, it would be possible to return the drum to the original markings, but with an error of multiples of 5 degrees.

After observations have been taken on two or more stars, using a separate drum for each star, the navigator may return to his work table, and under conditions of comparative comfort, replace the drums one by one, return the drum to the median mark, and then read the median altitudes from the scale. (Be sure to return the vernier to the approximate reading marked on the drum before turning to the middle mark.)

4. ILLUMINATION, BUBBLE

The black bakelite knob (Figure 8) on the end of the Sextant away from the observer is a rheostat which controls the intensity of bubble lighting for night observations. With this rheostat fully rotated to the left (counterclockwise), the switch is off. Rotation in the other direction closes the switch and regulates the intensity. The lower the light can be turned, (and still see the bubble) the more visible the star will be. The entire illuminating housing assembly may be removed from the Sextant by pulling straight out on the rheostat. With the unit withdrawn, the bulb or battery may be replaced, or the assembly can be used as an emergency flashlight. To replace a battery, merely pull the bulb end of the case off the cylindrical part. When placing a battery in the case DO NOT drop the battery in the rheostat end. Push the

battery into the bulb end FIRST and then push the rheostat end over the battery and bulb end case. Excess pressure or movement of the copper contact results in an open circuit in this unit. The bulb is a screw-in type which is changed in a normal manner.

5. ILLUMINATION, SCALE

Illumination of the operating drum and vernier scale is obtained by a separate battery and switch (Figure 8). A push button switch is located directly below the rheostat for the bubble illuminating system. This push button switch will stay in the "on" position when depressed and moved slightly sideways. To release the switch, merely press the button and move it to the center position and release. To obtain access to the battery, grasp the switch housing with the thumb and finger and draw it straight out of the Sextant. The operating drum is illuminated by a bulb located under it, and light from the same bulb is transmitted through the lucite rod to the vernier plate and adjacent scale.

6. BATTERIES

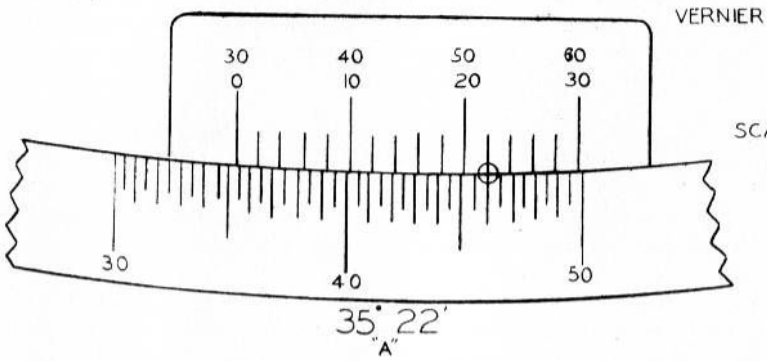
As all navigators know, batteries do not last long in a Sextant that is being used. Therefore, although the A-12 Sextant has two batteries, spare batteries should always be available. CAUTION: Never put the Sextant away after use without first removing the batteries. Even if the Sextant is to be used the following night, remove the batteries before putting it away.

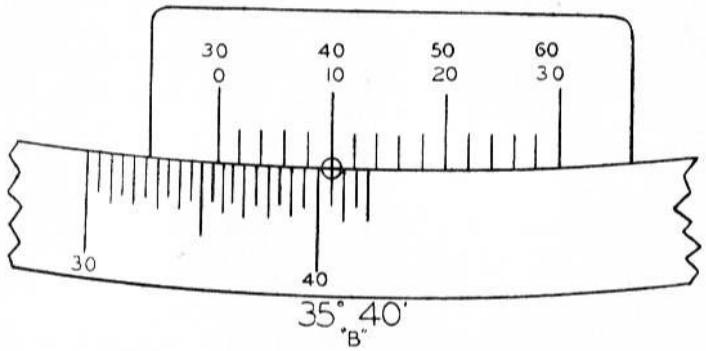
7. ALTITUDE SCALE AND VERNIER

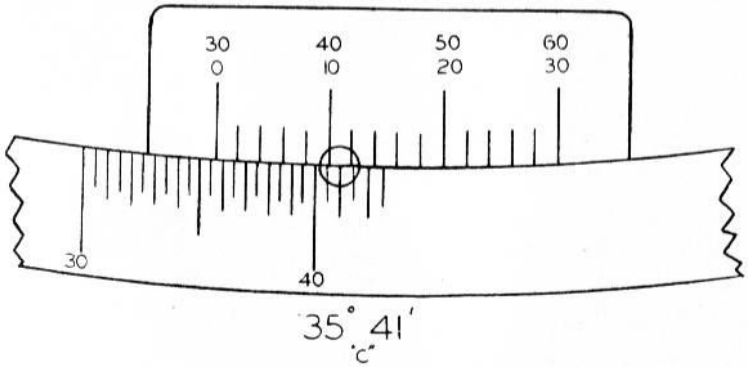
On the lower scale the degree numeral appears each ten degrees; these are the longest lines on the scale. Between these long lines are medium length lines each of which represents five degrees, and the next to the shortest lines are the one degree marking lines. The shortest lines represent half degrees or 30 minutes, and these appear midway between each whole degree. To read the scales, first note the degree reading which appears to the left of the long 0-30 vernier line, this represents the number of whole degrees. Next, to obtain the number of minutes, note whether the 0-30 vernier line is to the left or to the right of the half degree mark. This will determine whether the minute reading is less or more than 30 minutes.

In order to spread out the markings and facilitate reading, two rows of figures are used on the vernier scale. The lower row of figures (0, 10, 20, 30, Figure 7) covers the conditions where the altitude reading ends in 30 minutes or less.

Find the line on the vernier scale which most nearly agrees







VERNIER SCALE READING
FIG. 7

with a line on the large scale. As an example, let it be assumed that the 0-30 vernier line is to the left of the half degree (30 minute) mark. Immediately it is known that the minute reading is less than 30 and, therefore, by reading the lower row of figures on the vernier scale, the minute reading is obtained "A" (Figure 7).

Example: "A" (Figure 7) reads 35 degrees 22 minutes. It will be noted that each division on the vernier represents 2 minutes.

The upper row of figures (30, 40, 50, 60) covers the remaining condition where altitudes have endings between 30 minutes and 60 minutes.

Taking this condition where the 0-30 vernier line is to the right of the half degree mark (or more than 30 minutes) the procedure is exactly the same with the exception that the upper row of figures on the vernier scale is used. See "B" (Figure 7), reading 35 degrees 40 minutes.

Example: "B" (Figure 7) reads 35 degrees 40 minutes. Here again each division represents 2 minutes. As an example, the third short division from the long 0-30 line would read either 6 minutes or 36 minutes, depending upon where the 0-30 line was located with respect to the lower scale as described previously.

If no two lines coincide, but two lines on the vernier scale appear to be the same distance from two lines on the large scale, the reading on the vernier scale is interpolated between those two lines.

Example: "C" (Figure 7) shows that the reading is more than 35 degrees 40 minutes but less than 35 degrees 42 minutes, in this instance the interpolation being 35 degrees 41 minutes.