

BUBBLE SEXTANT MARK IXA

(Reference No. 6B/218)

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Minor errors corrected and new images produced
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APPLICATION.

The instrument is intended for use on aircraft for the purpose of obtaining the altitude of the sun or other celestial body.

DESCRIPTION.

The Mark IXA sextant comprises the standard Mark IX sextant and also a clockwork-driven averaging attachment.

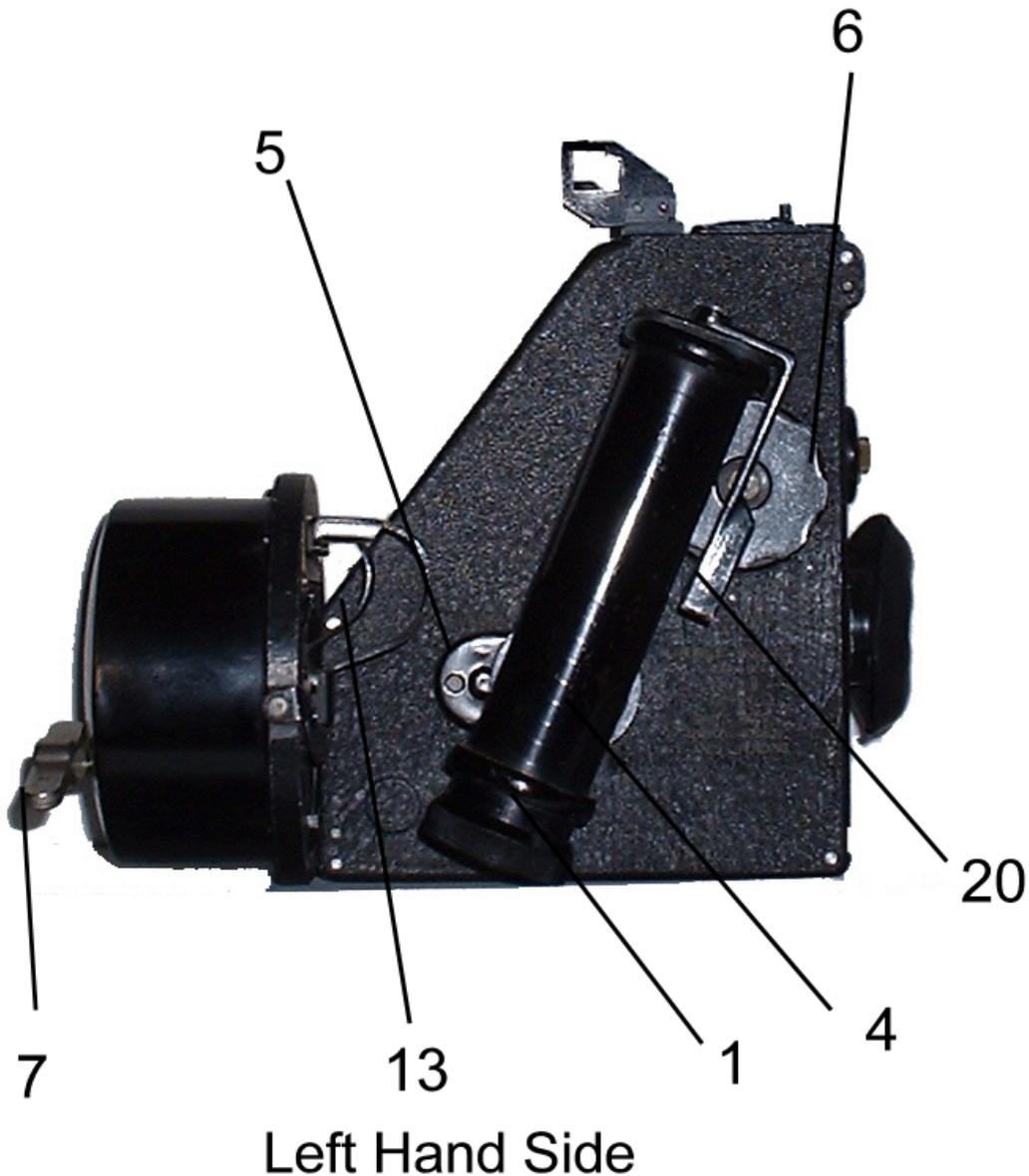
The Mark IX sextant is built in two halves, the plane of junction being approximately down the centre, and this plane serves as the reference plane of the instrument and is the plane of the line of sight. The attachment is secured to the front by screws entering the right half of the sextant case.

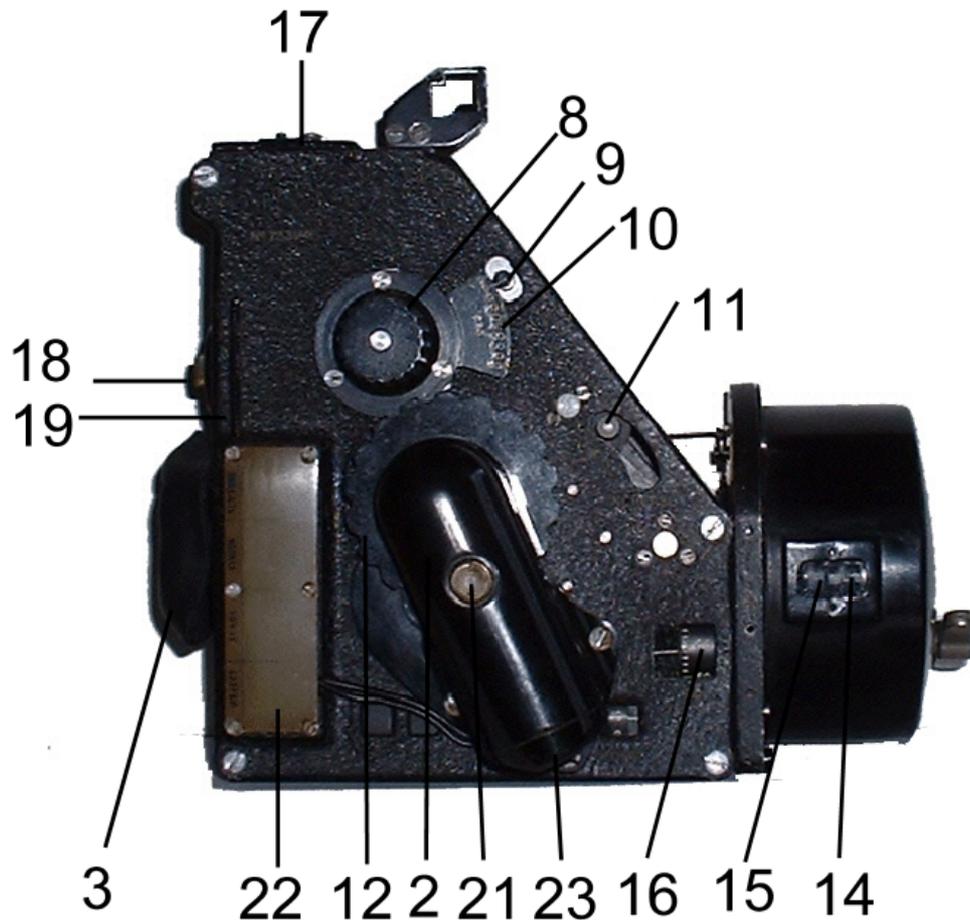
The left half of the sextant carries the bubble and its collimating system which together form the artificial horizon; it also carries the left handle which contains the dry battery or plug adaptor and the lighting control switch attached to the upper part of the handle.

The right half of the sextant carries the sextant proper, consisting of two mirrors together with the gear for measuring their rotation, sunshades, the altitude scales and the scale lighting lamp in the right handle. The scales on the right half of the sextant show the altitude of any single observation. The clockwork driven attachment is connected to the measuring gear in the right half of the sextant and gives the average of the altitude shown on the right half of the sextant at 60 intervals of time evenly spaced over a period of approximately 2 minutes, during which the observer follows the object to be observed in the sextant, maintaining coincidence with the bubble to the best of his ability.

A swivel clip is permanently affixed to the top of the instrument to enable it to be fitted to the suspension arm in the astrodome.

The transport case, which is also intended for use as a stowage case, contains two spare lamp bulbs, Ref. 5L/2274, space for two dry batteries, Ref. 5A/2067, and a plug adaptor, Ref. 6B/195.





Right Hand Side

In the accompanying photographs :

1. is the left handle.
2. is the right handle.
3. is the eyepiece.
4. is the shade selector knob.
5. is the shade number opening.
6. is the bubble control knob.
7. is the winding key.
8. is the 10 setting knob.
9. is the index of 10 scale.
10. is the 10 scale.
11. is the 5 altitude increase knob.
12. is the slow motion knob.
13. is the starting lever.
14. is the scale of additional degrees and minutes.
15. is the additional scale window.
16. is the single observation scale.
17. is the daylight lighting gear.
18. is the bubble lighting lamp.
19. is the night lighting control wheel.
20. is the lighting switch.
21. is the scale lighting lamp.
22. is the ivorine tablet.
23. is the wrist watch lighting prism.

INSTRUCTIONS FOR USE

The instrument is normally held with the left hand holding the handle 1 and the right hand holding handle 2, with the eye looking through the eyepiece 3 in the direction of the object to be observed. The lower edge of the instrument should be approximately horizontal.

Bubble Control.

To obtain a Bubble.

Holding the instrument as above described, rotate shade selector knob 4 to bring some figure other than nought to the opening 5. Rotate the bubble control knob 6 by moving the thumb downwards while looking through the eyepiece in a horizontal direction until a bubble appears in the field of view. This will probably be too large. Tilt the sextant slightly to the right and forwards so that the bubble appears about 10 o'clock in the field of view, and gradually ease back the control knob until the bubble has nearly disappeared; then tilt the sextant to the left to bring the bubble apparently about 2 or 3 o'clock, and finish releasing the tension, but do this slowly.

There should now be a nice-sized bubble in the field of view. The most suitable size of bubble is between one-third and one-half the distance between the lines seen in the field of view. The control knob should be eased fully when it is not being used in the actual production of a bubble.

To remove a Bubble.

Slightly screw up the control knob; bring the bubble to appear about 10 o'clock in the field of view; ease back the control knob and the bubble should disappear.

THE BUBBLE MUST BE REMOVED AND THE TENSION ON THE DIAPHRAGM RELAXED AFTER USING THE INSTRUMENT.

When it is required to produce a bubble at night, the left Hand should be moved a little further up the handle and the back of the first joint of the forefinger of the left hand used to push the lighting switch 20 towards the body of the instrument. This enables the thumb to operate the control knob 6.

Preparation for Observation.

After obtaining a suitable bubble, the winding knob 7 of the attachment is wound up by turning in a counter-clockwise direction till fully wound. Winding the attachment also sets the attachment scale to zero.

Measurement of Altitude.

The altitude of a celestial body is measured as the sum of two parts; the first part consists of the sum of a number of steps of 10 degrees each, -the number of steps being selected to bring the sum to the nearest 10 degrees below the altitude of the object.

The adjustment is carried out by pushing in the knob 8 and rotating it till the index mark 9 is opposite a suitable number of tens of degrees on the scale 10. This is the method used when the approximate altitude is known, should the approximate altitude not be known, the sextant is held in the left hand by the left handle 1, the right hand holding the right handle 2 with the base of the instrument approximately horizontal and facing in the direction of the object. The right forefinger and thumb are then used to push in the knob 8 which is then rotated till the image of the object appears in the field of view. This is then brought to coincide as nearly as possible with the bubble, and the knob 8 eased back in a clockwise direction until pins can be felt to enter into holes in the interior of the sextant. If, after doing this the object is a considerable distance from the bubble in the field of view, the knob 11 is pushed upwards, which will move the object 5 degrees towards the bubble. If the sun then passes the bubble or approximately coincides with it, the knob 11 should be pushed down again. The object must always be above the bubble before proceeding to the next operation.

The second part of the measurement of altitude consists of measuring the amount which the object is above the altitude set on the 10 degrees scale 10. In order to do this the observer rotates the slow motion knob 12 till the object and the bubble are in coincidence. When this is done he pulls the starting lever 13 and maintains coincidence until a shutter cuts off the light from the sun, or in the case of a star the bubble illumination is switched off. These operations are both carried out automatically by the clock gear in the attachment.

The length of time during which coincidence must be maintained as closely as possible is approximately two minutes, and will no doubt seem much longer to the observer, but it is essential that coincidence should be maintained as closely as possible until the object is cut off or the bubble illumination is extinguished. The altitude is then read, as regards tens of degrees, on the scale 10, and the remaining degrees and minutes on the scale 14 through the prismatic window 15.

Checking on the Ground.

When checking the results given by the sextant on the ground by measuring the attitude of a celestial body at a given position and time, the sextant may be supported on a post, in which case single observations may be taken without winding the clock *, by using the tens of degrees adjustment knob 8 and slow motion knob 12. In this case the degrees and minutes will be read on the scales 16 located on the right-hand half of the sextant proper.

*Editor's Note. It is necessary to wind the clock to open the shutter and to enable the bubble illumination.

Sun Shades.

Three sun glasses are fitted inside the sextant and are operated by means of knob 4. Various combinations can be used from no shades at all to all three together, and the combination in position at any moment is shown by the number in the opening 5, zero being no shade at all and six (or seven) being the maximum density. Owing to variations in various glasses from time to time, the sequence of shades is not quite regular and varies according to the particular supplies available.

Lighting System.

When observing the sun in daylight, the bubble is illuminated automatically, provided the sun is permitted to shine on the semicircular projection 17 at the top of the instrument inside which there is a prism system. This prism system automatically guides the sun's rays through a diffusing glass on to the bubble. At night the bubble is illuminated by the lamp 18 and the intensity of the illumination is controlled by the setting of the wheel 19. This wheel contains nine apertures, three of which are covered with red filter material; the six clear apertures are graded in size and the three apertures with filters are the same size as the three largest clear apertures.

Until experience has been gained, observations should always be started with the largest clear aperture, and proceeding to smaller sizes as may be found necessary.

After reaching the third or fourth largest aperture it will probably be advisable to go over to the tinted apertures. The general rule to be followed is that the fainter the star the smaller the aperture that has to be used to cut down the field illumination in the bubble sufficiently to enable the star to be seen clearly. To light the lamp 18, it is necessary to push the switch 20 with the left thumb towards the body of the instrument, when the bubble will be seen illuminated as a ring of light against a dark background. When observing the moon, it is usually necessary to use the largest aperture. In order to read the scales at night the instrument is held in the left hand, the switch lever 20 being pressed outwards away from the instrument by the left thumb; this feeds current to the lamp 21 in the right handle which illuminates the scales 10, 14, 16 through holes made conveniently for that purpose.

An ivory tablet 22 for recording the observations and times is placed on the right side of the instrument below the bubble lighting control wheel and is illuminated at the same time as the scales.

The time of the observation is observed on a watch strapped on the inside of the observer's left wrist, which is illuminated at the same time as the scales by light from the lamp 21 transmitted downwards through the handle and across to the observer's left wrist by means of a special prism 23.

Changing a Battery.

To change a battery, unscrew the bottom of the handle 1, when the battery will fall out. A new battery is inserted with the brass contact piece inwards and the cap screwed home again. If for any reason the old battery has swollen and sticks, the milled head at the top of the handle 1 should be unscrewed. This comes away complete with the switch lever 20 and reveals a 1/2" diameter hole inside the handle through which the battery can be poked out by means of a pencil or other suitable object. When refitting the top cap it is essential to hold the switch lever in its "off" or central position.

Instead of a battery, the plug adaptor may be used on aircraft with either 12-Volt or 24 volt circuits. For this purpose the battery cap forming the bottom of the handle 1 is removed as when changing a battery and is stowed, spring upwards, in the fitting in which the 2-pin plug of the adaptor was stowed. The plug adaptor is inserted in the handle 1 and screwed home and is ready for use after the 2-pin plug has been inserted in the nearest socket. All plug adaptors are issued ready for use on 12-volt circuits but can be altered to suit 24-volt circuits by removing the screw and spring washer seen through a hole in the side opposite an arrow where the plug adaptor has been stamped "For 24-V circuit remove screw and washer".

SPECIAL NOTES

Sun Observations.

When observing the sun, always start with a sufficiently high number at the shade selector knob opening at 5 to avoid damage to the eye because the mirrors in this sextant are fully silvered. The shade selector knob can be readily moved by the thumb and forefinger of the left hand.

Moon Observations.

When observing the moon at night, the intensity of the moon should be dimmed down as far as possible by means of the shade selector knob 4, and the electric light used to illuminate the bubble, as in the majority of cases the light from the moon is insufficient to illuminate the bubble sufficiently for it to be used for observation.

Star Observation.

When observing stars it will probably be found most convenient to place the bright star in the centre of the bubble; when observing faint stars, the star may be placed either centrally inside the bubble or level with the bubble close to it at one side; which of these two methods is preferable depends entirely upon the circumstances of the individual observation and on the preference of the observer.

All observations should be made with the object and the bubble between the two vertical lines seen in the field of view.

Bringing down an Object.

To bring down an object on the sextant set the sextant to zero, look through the sextant straight at the object, press in the knob 8 and rotate this very slowly, in a counter-clockwise direction while gradually bringing the sextant down to keep the object in the field of view. As the sight line approaches the horizontal, the bubble becomes free and the nearest group of holes is sought which will bring the object above the bubble and not below.

Method of using Approximate Altitudes.

When the approximate altitude of the object is known, either from estimation, planisphere, previous knowledge, or, in the case of Polaris, from the latitude, the nearest whole 10 degrees below this figure is set on scale 9, utilising the knob 11 to increase this by 5 degrees if necessary. It is then only necessary to face the object, raise the sextant to the eye and look straight into the eyepiece, when the object will be seen. When doing this in the case of stars at night it is advisable to pick up the star first and then to switch on the bubble lighting.

Apparent Failure of Bubble Lighting.

When observing at night the bubble lamp will not light until the clock has been wound by the key 7.

The wheel 19 is provided with a clicker system to enable the navigator to set it accurately to its several positions but it is possible to place it between these positions when it will prevent any light from the lamp reaching the bubble. Consequently in the case of an apparent failure of the bubble lighting examine the control wheel position.

ALWAYS REMOVE THE BUBBLE AFTER USE AND SEE THAT THE TENSION ON THE BUBBLE DIAPHRAGM IS RELAXED.

DO NOT REWIND THE ATTACHMENT UNTIL AFTER THE CLOCK HAS RUN DOWN. IF YOU DO YOU MUST IT RUN DOWN AGAIN AND THEN WIND OR YOUR NEXT OBSERVATION WILL HAVE AN UNKNOWN ERROR.

ALWAYS WIND THE CLOCK GENTLY OR YOU MAY GET AN ERROR.