

***Operating manual Mk IX sextant.***

*(This has been re-typed in a font similar to the original and the original lay out of paragraphs retained. The original prints have been replaced with modern photographs.)*

**BUBBLE SEXTANT  
Mark IX.**

**Instructions for use.**

Detailed instructions inside.  
Abbreviated drill on back cover

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## **BUBBLE SEXTANT MARK IX.**

### **APPLICATION**

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

### **DESCRIPTION**

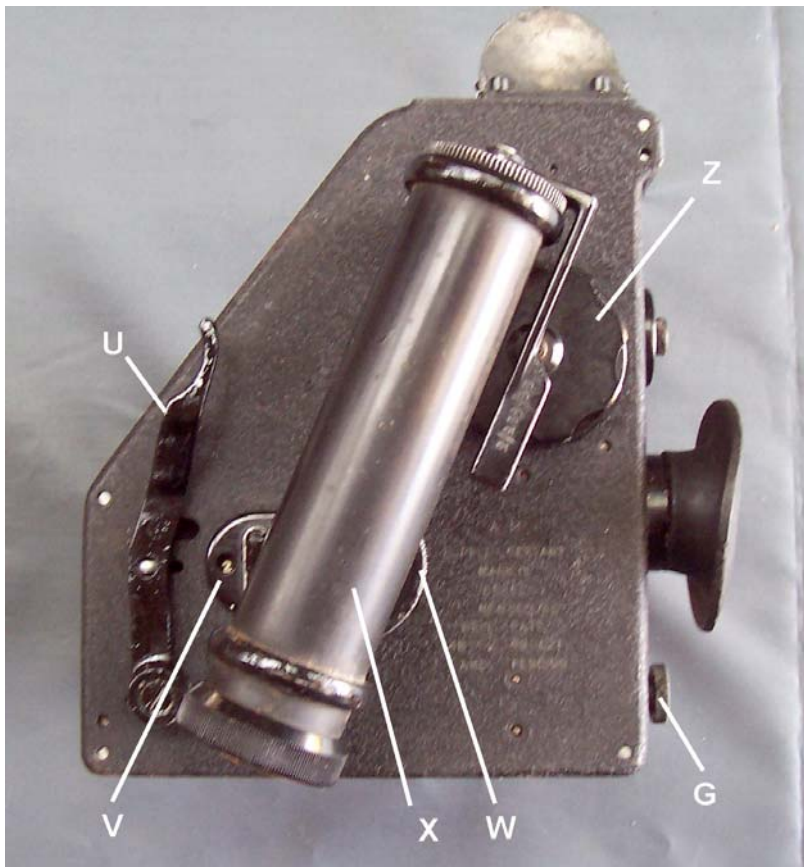
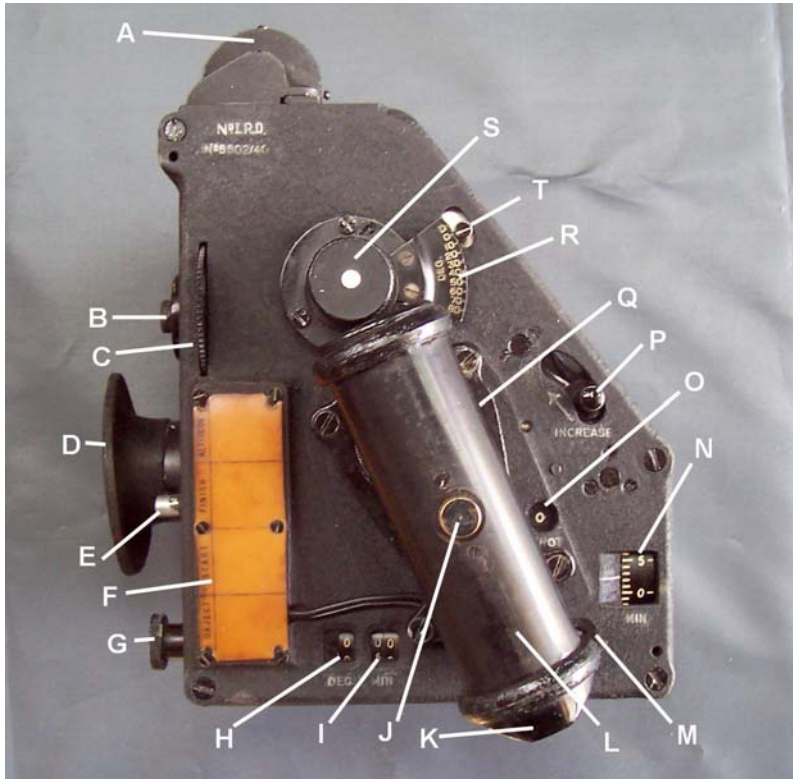
The instrument is built in two halves, the plane of junction being approximately down the centre, and this plane serves as the reference plane of the instrument and is the plane of the line of sight.

The left half of the sextant carries the bubble and its collimating system, the clutch lever, the left handle containing the dry battery and also the lighting 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, which is scaled in terms of altitude, the averaging gear and necessary lighting for the scales, together with such other necessary details as will be described later.

In the accompanying photographs:

- A. is the daylight prism housing.
- B. is the bubble lighting lamp.
- C. is the night lighting aperture control wheel.
- D. is the eyepiece.
- E. is the shot counter clearing knob.
- F. is the ivorine tablet.
- G. is the totaliser resetting knob.
- H. is the totaliser degree drum.
- I. is the totaliser minute drum.
- J. is the scale lighting lamp.
- K. is the watch lighting prism.
- L. is the right-hand handle.
- M. is the single altitude degree drum.
- N. is the single altitude minute drum.
- O. is the shot counter.
- P. is the knob for actuating  $5^{\circ}$  altitude increase.
- Q. is the slow motion knob.
- R. is the  $10^{\circ}$  scale.
- S. is the coarse altitude setting knob.
- T. is the index of the  $10^{\circ}$  scale.
- U. is the clutch operating lever.
- V. Is the shade number window.
- W. is the shade selector knob.
- X. is the left-hand handle.
- Y. is the lighting switch.
- Z. is the bubble control knob.



## INSTRUCTIONS FOR USE

The instrument is normally held with the left hand holding the handle **X** and the right hand holding the handle **L**, with the eye looking through the eyepiece **D** 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 **W** to bring some figure other than nought to the opening **V**. Rotate the bubble control knob **Z** by moving the thumb downwards and look 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 the bubble is between one third and one half of 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 **Y** towards the body of the sextant. This enables the thumb to operate the control knob **Z**.

### **Setting to zero**

Holding the instrument in the left hand by the left handle **X**, rotate the slow motion knob **Q** in a counter-clockwise direction until it will go no further. The scales **M** and **N** will now read either **0° 0'** or **5° 0'**. In the latter case the knob **P** will be at the top end of its slot and should be moved to the lower end of its slot. This brings the scale **M** to zero. Holding the instrument by the handle **X**, depress the clutch lever **U**; this will cause the totaliser clearing knob **G** to be moved further outward

from the body of the instrument. This knob can now be conveniently grasped by the forefinger and thumb and should be pulled out to its fullest extent and rotated in the direction of the arrow engraved on the instrument until the scales **H** and **I** read zero. Now release the clutch lever from pressure by the thumb, and the knob **G** will spring back towards the body of the instrument. Then, with a finger press the knob **E** which will reset the shot counter **O** to zero. Finally, holding the handle **X** in the left hand, with the right thumb and forefinger press the coarse setting knob **S** inwards and rotate it in a clockwise direction to bring the figure nought of the scale **R** opposite the index **T**. In doing this, care should be taken that the knob **S** is gently released, so that the user should feel the mirror base plate pins seating properly in the hole of the plate fixed to the instrument casing. If the scale **R** is flush with the index **T**, the pins are home in the holes, and this can always be felt with the finger.

The sextant is now completely zeroed and ready for use, provided a suitable bubble has been obtained.

### **Single altitude observations of the sun**

To take a single measurement of the sun's altitude, set to zero as already described; turn the shade selector knob **W** till a suitable shade number, such as 4 or 5, appears at the opening **V**; then, holding the left handle **X** with the left hand, and the right handle **L** with the right hand, face the direction of the sun and look into the eyepiece **D** horizontally. The bubble will be seen in the field of view, but probably no sun. Keep the line of sight horizontal in the direction of the sun; slide the right hand up the handle **L** until the thumb and forefinger can grasp knob **S**, which is pushed inward and slowly rotated in a counter-clockwise direction until the sun appears in the field of view. The sun is then brought to coincide as near as possible with the bubble and the knob **S** eased backwards in a clockwise direction until the pins can be felt to enter a group of holes. If, after doing this, the sun is a considerable distance from the bubble in the field of view the knob **P** is pushed upwards, which will move the sun  $5^{\circ}$  towards the bubble. If the sun then passes the bubble or practically coincides with it, the knob **P** should be pushed down again. The object must always be above the bubble before proceeding to the next operation. Next, move the right hand down the handle **L** until the thumb and forefinger are placed conveniently to the slow motion knob **Q**. Rotate this knob in a clockwise direction to bring the centre of the sun to the centre of the bubble. When this is done, the altitude of the sun will be shown on the scales **R**, **M** and **N** (the tens being shown on scale **R**, the degrees on scale **M** and the minutes on scale **N**) When taking single altitudes, the scales **H** and **I** are not used. Should the knob **P** have been placed in the upper position where it adds  $5^{\circ}$  to the altitude, it will be seen that the scale **M** has changed by  $5^{\circ}$  so that no change need be made in the method of reading, and the position of the knob **P** can be entirely disregarded when reading the scale **M**. It will be seen by moving the knob **P** slowly that the scale **M** really consists of two scales, one of which is  $5^{\circ}$  larger than the other. It will also be seen that opposite each figure is a thin horizontal line, and that the shutter that covers the unwanted scale also has a line engraved on it.

If, for example, the reading is  $1^{\circ} 35'$ , the position of the line shows quite definitely that the number of degrees is between 1 and 2, so that the observer will read  $1^{\circ} 35'$ . If the angle increases to  $1^{\circ} 50'$ , the figure 1 has nearly disappeared, but the index line on the shutter is still below 2 to remind the observer that the angle is  $1^{\circ} 50'$  and not  $2^{\circ} 50'$ . This is still the case at  $1^{\circ} 55'$ . At  $2^{\circ}$  the line comes close to 2, and it is quite obvious that the reading is  $2^{\circ} 0'$ . Similarly for other angles.

### **Group of Six Observation of the Sun**

Proceed as for a single observation as far as making the coincidence between object and bubble. Then depress the clutch lever **U** with the second finger of the left hand, and, holding it down, turn the slow motion knob **Q** counter-clockwise until it comes back to its stop. Release the clutch lever. Without removing the eye from the instrument, rotate the slow motion knob **Q** in a clockwise direction to obtain a second coincidence when the clutch lever is again held down, while the slow motion knob is returned to zero once more. This process is repeated until, when the clutch lever is depressed for the sixth time, the sun disappears from view owing to the action of the cut-off shutter. The slow motion knob is then returned to zero as before and the series is complete.

The average of the six observations included in the group is read on the scales **R**, **H** and **I** (the tens of degrees on the scale **R** opposite the index **T**, the unit degrees on the scale **H**, and the minutes on the scale **I**). As the scales **M** and **N** are already at zero, the instrument is cleared by holding it by the left handle **X**, depressing the clutch lever and rotating the totaliser clearing knob **G** until the scales **H** and **I** show zero, releasing the clutch lever and pressing the shot counter clearance knob **E**.

### **Lighting System**

When observing the sun in daylight, the bubble is illuminated automatically, provided the sun is permitted to shine on the semi-circular projection **A** 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 **B** and the intensity of the illumination is controlled by the setting of the wheel **C**; this wheel contains six apertures, the largest of which is in use when the figure 1 appears at the side of the instrument level with the lamp, and all observations should be started - at least until experience has been gained - with the figure 1 showing opposite the lamp **B**. Pressing the switch **Y** with the left thumb towards the instrument, the bubble will be seen illuminated as a ring of light against a dark background.

For observing the moon, the figure 1 should be brought opposite the lamp **B**; for first magnitude stars, the figure 2 is probably preferred, while for fainter stars the figures 3 and 4 should be used. The figure 4 is generally suitable when

observing Polaris. Still further reductions of light can be obtained by using figures 5 and 6, but it is not considered that figure 6 will often be required.

When it is required to read the scales at night, the instrument is held in the left hand, the switch lever **Y** being pressed outwards away from the instrument by the left thumb. This feeds current to the lamp **J** in the right handle which illuminates all the necessary scales through holes made conveniently for that purpose. An ivory tablet **F** 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 **J** transmitted downwards through the handle and across to the observer's left wrist by means of a special prism **K**.

**To change a battery**, unscrew the bottom of the handle **X**, 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 **X** should be unscrewed. This comes away completely with the switch lever 20 and reveals a  $\frac{1}{2}$  " 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.

## **SPECIAL NOTES**

### **Sun Observations.**

When observing the sun, always start with a sufficiently high number at the shade selector knob opening at **V** 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 **W**, 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 Observations.**

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.

#### **Case of Fewer than Six Observations.**

Owing to unforeseen circumstances, such as cloud movement or other causes, it may sometimes occur that the series of six observations cannot be completed within a reasonable time. In such a case the observations made need not be wasted but can be utilised. In order to utilise these observations, return the slow motion knob **Q** to its zero stop, read the instrument in the usual manner as for a group of six, and multiply this value by six and divide by the number of observations actually made, which is shown by the shot counter **O**. The result is the average of those observations already taken.

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 **S** 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 **R**, utilising the knob **P** 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.

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



# MARK IX SEXTANT DRILL

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## **To clear the sextant**

1. Return to zero by slow motion knob.
2. Depress clutch lever.
3. Clear totaliser.
4. Release clutch lever.
5. Push shot counter clearing knob.

## **To make a bubble.**

1. Put up a suitable dark shade.
2. Look horizontally into the sextant and screw up bubble control knob till bubble appears.
3. Put bubble at 10 o'clock and reduce bubble to correct size by very slowly easing the bubble control knob.
4. Tilt the sextant to bring the bubble to 3 o'clock and slowly unscrew bubble control till free.

## **Single Observations.**

1. Clear the sextant.
2. Set coarse adjustment to nearest position with object above the bubble.
3. Try increase to see if it is wanted.
4. Use slow motion to make coincidence between the lines.
5. Read the scales.

## **When using averaging gear.**

1. Clear the sextant.
2. Set coarse adjustment to nearest position with object above the bubble.
3. Try increase to see if it is wanted.
4. Use slow motion to make coincidence; then pull back clutch lever, then return slow motion to zero stop and finally release clutch lever.
5. Repeat 4 till object disappears owing to operation of cut-off; read scales.