NATIONAL SCHOOL
SAILING ASSOCIATION

A MODEL SEXTANT

Curriculum Development Paper No 15

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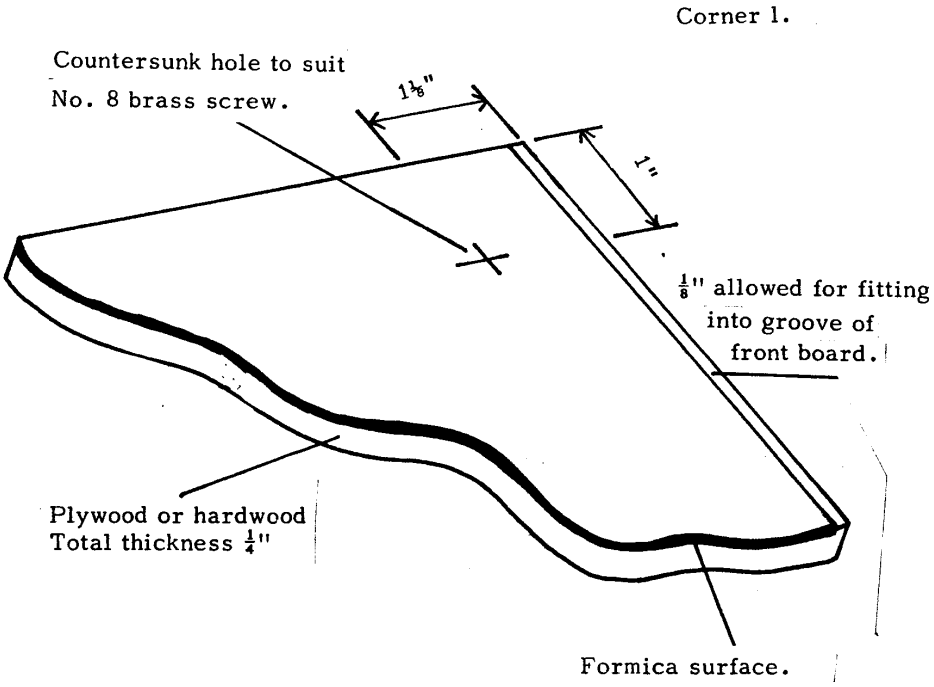
ON MAKING A MODEL SEXTANT

The design described here is one that has been found convenient and useful over a period of some years. It is robust and stows into its case very neatly and cannot come to any harm when being carried about. It has the additional advantage that it can be adapted for simple range finding work. It incorporates all the major sources of error to be found in the full scale instrument and has adjustments to eliminate them which operate in much the same way. Its only real drawback is the limited accuracy which can be attained. A commercial sextant with micrometer or vernier reading can measure to an accuracy of ± 10" of arc. This is quite beyond the powers of a hand calibrated scale and the best that can be hoped for is about 25' or ¼°. However both for demonstration and for the sort of work possible in small boats this is quite sufficiently accurate. Used in conjunction with a home-made celestial globe quite a surprising amount of Nautical Astronomy can be tackled. It is only when the exact calculation of spherical triangles is attempted that a greater precision is needed. Even so the difference in cost between a few pence plus a weekend at the bench compares very favourably with the £100 or so for a good commercial sextant.

The general arrangement drawings (Figs. 1 and 2) show how the sextant itself becomes a sliding lid to its own box—They also show the general design. The outside measurements for the box should be approximately 8" x 8" x 2". This allows for the plough groove to be set in ¼" from the top edge, ¼" for the thickness of both bottom and instrument plane and still leave 1¼" clear inside for the mirrors etc, to slide into. If the grooves are ⅛" deep, the outside measurements of the plane or lid are 7½" square and ¼" thick.

The best method of setting about the job is to make the box and sliding plane first. The latter can be of marine ply or hardwood faced with white formica. Then fit the front board just like a drawer front but do not glue it up at this stage.
Mark out the centre for the axis of the limb say 1"in from the top edge and in from the front board edge, thus:



Now arrange the cleats across the back of the plane and parallel to the front board. They should be about 1" x ¾" and just long enough to reach within ¼" of the edges of the plane. The plane should be screwed down to the cleats with 1" No. 6 brass screws (at least six). Be sure that the axis hole at corner (1) is clear of screws. It might be as well to omit the centre screw between corners 2 and 4 until later to avoid fouling the arc. It is however important that the upper cleat should centre under the axis hole as the axis screw will be sunk into it.

Fig 1

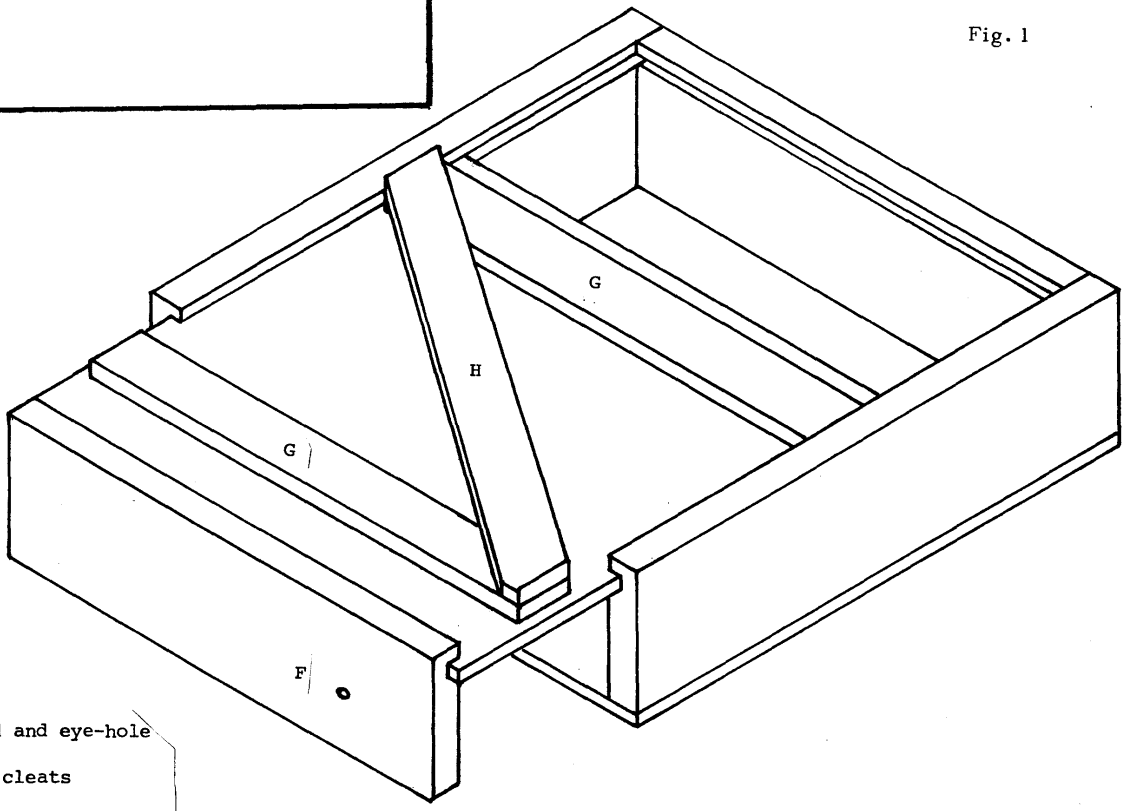
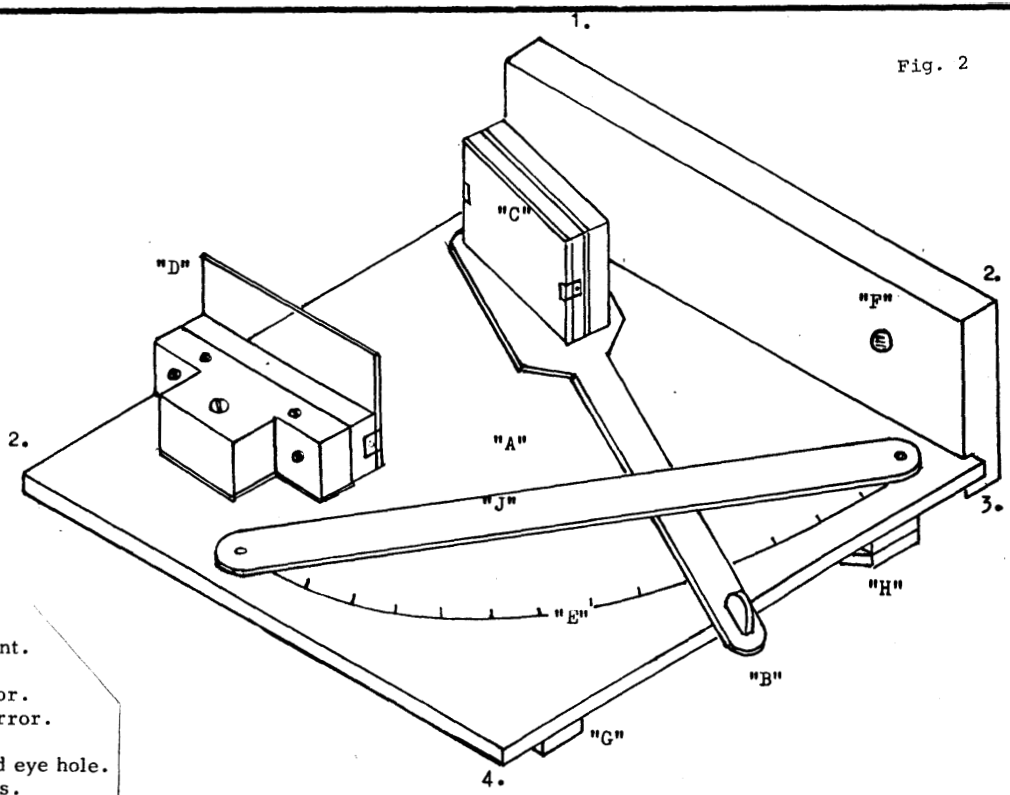


Fig. 1
G
H
G
F
F: Front board and eye-hole
G: Stiffening cleats
H: Handle

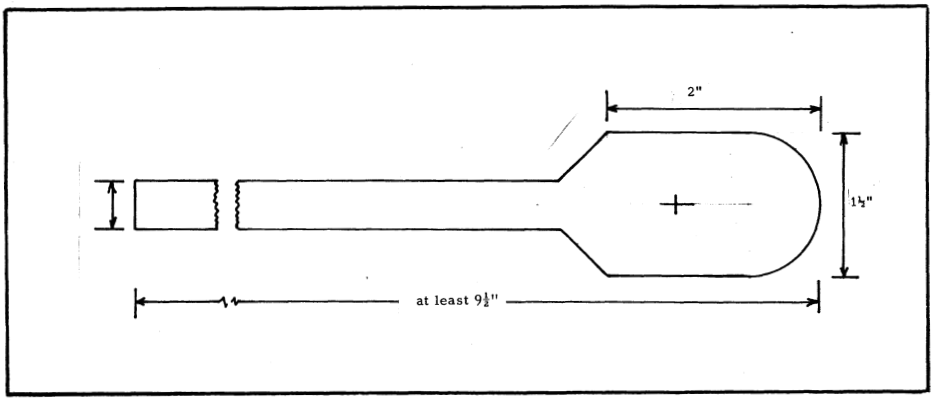
Corner reference
1. 2. 3. & 4.

Fig. 2



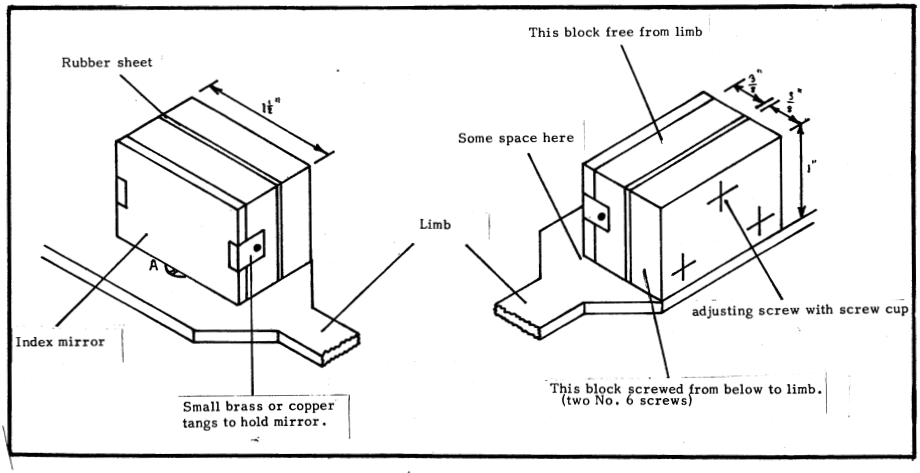
A: The plane
of the instrument.
B: The limb.
C: The index mirror.
D: The horizon mirror.
E: The arc.
F: Front board and eye hole.
G: Stiffening cleats.
H: Handle.
J: Holding down plate.

The next task is to make the limb out of strong transparent plastic or celluloid. Drill and countersink its turning centre to take a No. 8 brass screw.

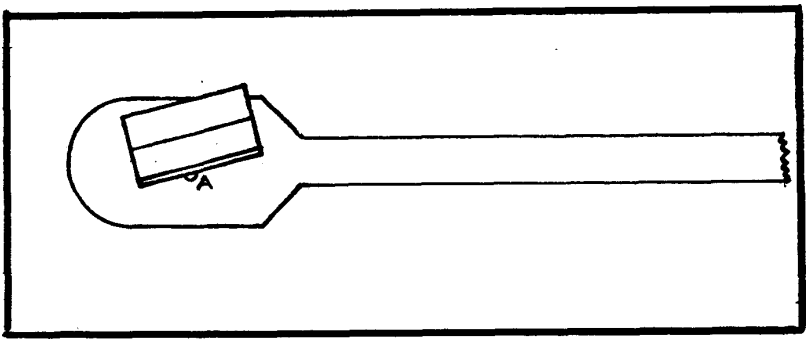


Wax the screw and screw down so that the limb is just free to turn fairly easily but not so that it will slip round. Dismantle.

The next stage is to make the index mirror mounting and fit it with its mirror .
The index mirror has to be free to adjust in one plane and so its mounting is made of two pieces of wood separated by a layer of india rubber sheet (off an old inner tube). These are held together by three screws arranged in an isosceles triangle so that adjusting the upper one will move the mirror.



The assembly shown above puts the index mirror parallel to the centre line of the limb which is the simplest position. There are, however, considerable advantages to be got from fitting it at an angle or about 15° to the centre line thus:



The optical experts will no doubt see the value of this at once.

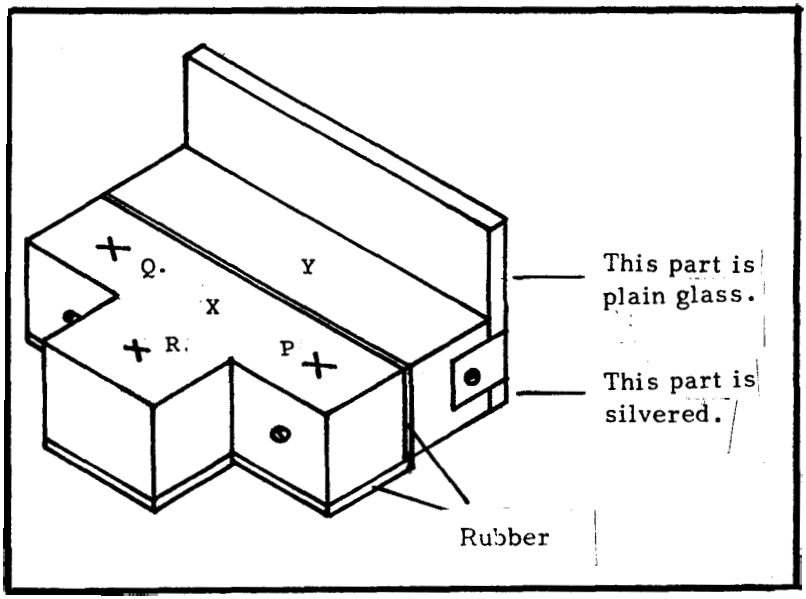
It is of course important that the two blocks of wood should be accurately squared before assembly.

Assembling the mirror and limb is done as follows:

1. The mirror is fitted firmly to the front block and put to one side.
2. The back block is screwed to the limb so that when all parts are assembled the back surface of the mirror will be over the centre of the screw in the index bar "A".
3. The limb is screwed through its axis hole to the plane.
4. The front block and rubber liner are screwed to the back block.

The next step is to mount the horizon mirror . This must adjust in two planes and must be silvered on only half its surface. It should measure about 2" x 1". It is as well to start by smoothing the edges down a little on an oilstone and removing the sharpness of the corners . Gauge a line down the middle of its length on

the back of the silvering and carefully scrape off one half up to the gauge line.



Block "Y" is 2" x ½" x ½". The mirror is secured to it with little copper tags as before.

Block "X" is T shaped and also ½" thick. The two blocks are separated by rubber sheeting. A screw at each end from X into Y will allow for adjustment in the horizontal plane.

Block "X" rests on a foundation of rubber sheet and is held in place by three screws. P and Q show the approximate positions of two screws which will later be driven up through the plane into block "Y". Screw R is a longer screw driven down through the plane into the stiffening cleat below . A good position is about 1" in from each edge of Corner 2, but this will depend upon the exact position of the cleat.

Prepare and assemble the parts and fit with ONLY SCREW R at this stage.

Dismantle.

Before going any further the arc must be drawn ready for calibrating.

Score a line down the centre of the underside of the limb with a marking gauge to act as a cursor and blacken with a little indian ink. Make a nick in the edge 6" from the centre of the axis screw hole. If you are going to engrave the arc use a sharp pointed scriber in this nick to scratch an arc right across the plane as shown at E on the general drawing. If you are going to apply a paper arc, use a sharp pencil . Mark a point near the right hand end for zero. Check that the -cur-_ sor line reaches it comfortably., Strip everything down to the bare plane before going any further.

Draw a ⅛" diameter circle and its centre on a scrap of sticky paper using a redius curve for the job. Centre the paper carefully over the axis screw hole on the plane and stick it down.

Use compasses to construct an angle of 60° from the zero mark. By successive bisections this can be split up into sectors of 7½°. Check them carefully by comparing the lengths of their chords with dividers. These sectors will provide check points for the rest of the work so that accuracy is important.

The sextant is an instrument of double reflection so that each 7½° of arc will represent 15° of scale and will have to be divided accordingly. A good way of doing this is to enlarge a protractor marked in half degrees by photography till it has a 6" radius . Cut out the arc of this and glue down to the plane ensuring that it matches exactly with the sector marks. This paper arc can be left permanently in place or better still the divisions on it used to engrave the plane with a scriber. If they are to be engraved, a false limb should be made with one edge cut to give a radial line from the axis screw. This makes ruling the divisions much easier.

Engraved lines should have a little indian ink or enamel rubbed in to them and should be labelled every 10° up to at least 90°.

Clean everything up and re-assemble ready for final fitting of the horizon mirror .

Make a mark 1½" from Corner 3 to represent the position of the eye hole. Set the instrument up horizontally with the limb at zero. Look from the eye hole mark through the clear part of the horizon mirror to a distant flagstaff or other vertical line.

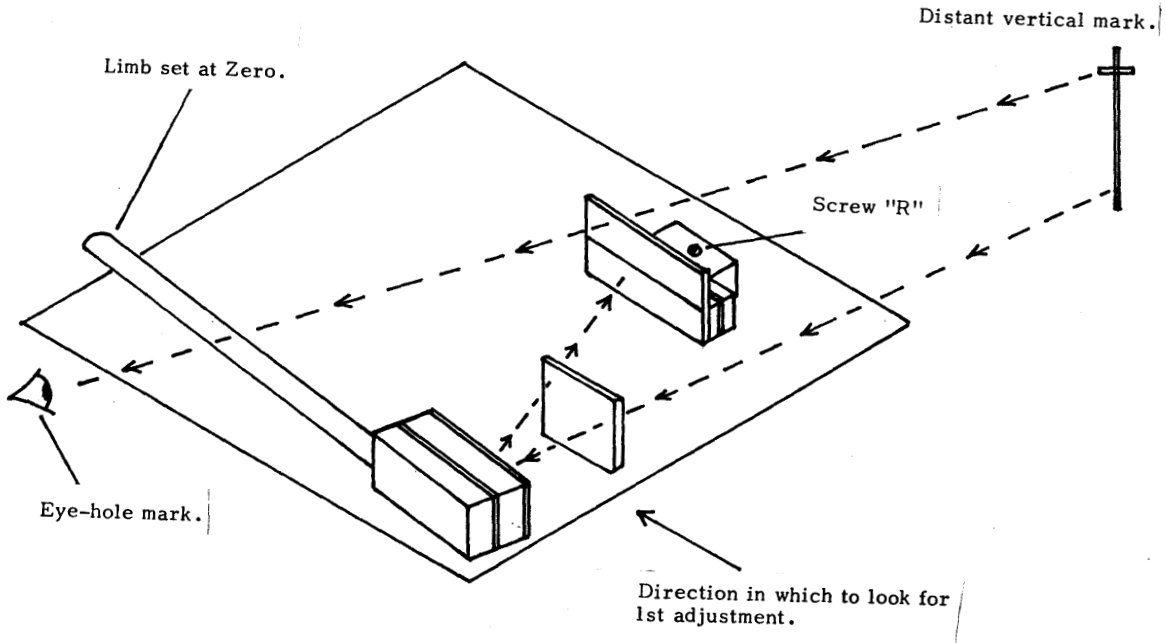
Twist the whole horizon mirror mounting around screw R until the distant mark is also seen reflected in the silvered part. Adjust until the direct and reflected views coincide. Mark the position of the mounting and fit screws P and Q to secure the mirror in its final position.

Fit the front board so that the instrument slides neatly into its box. Drill a ¼" eye hole through the front board so that it is in the line of sight to the horizon mirror and also over the pencil mark made previously . It will of course slant through the board.

Fit a strip of formica or wood as shown at J in the general arrangement drawing. An off cut from the material used in making the limb should be used as packing under each end to get this holding down plate at the correct height.

Trim the end of the limb neatly so that at its centre position it is just inside Corner 4. Add a small scrap of wood as a handle to it. Fit a handle diagonally across the back of the stiffening cleats from corner 1 to corner 4.

The sextant is now ready for final adjustment.


Distant vertical mark.
Limb set at Zero.
Screw "R"
Eye-hole mark.
Direction in which to look for
1st adjustment.

First Adjustment. This is to get the index mirror exactly perpendicular to the plane. Set the limb in a central position, look along it from the mirror end. Compare the direct and reflected views of the holding down plate. If they do not coincide the mirror is not perpendicular. Adjust with the upper screw at the back of its mounting.

Second Adjustment. This is to get the horizon perpendicular . Set the limb at zero and set the sextant up vertically. Look at a star or distant light. If the two images do not coincide adjust the limb until they are level and side by side. If they are still apart adjust screw R until they coincide.

Third Adjustment. This is to bring the two mirrors parallel with each other. Leave the sextant set up as before. Re-set to read 0°. The two images will now appear one above the other. Adjust the screws between the two parts of the horizon mirror mounting until the images exactly coincide.

CAUTION DO NOT USE THIS
INSTRUMENT FOR MEASURING
THE ALTITUDE OF THE SUN
UNLESS YOU FIT A DARK GLASS
BETWEEN THE INDEX MIRROR
AND THE HORIZON MIRROR.
See M for position in drawing.

B.W. Lucke.