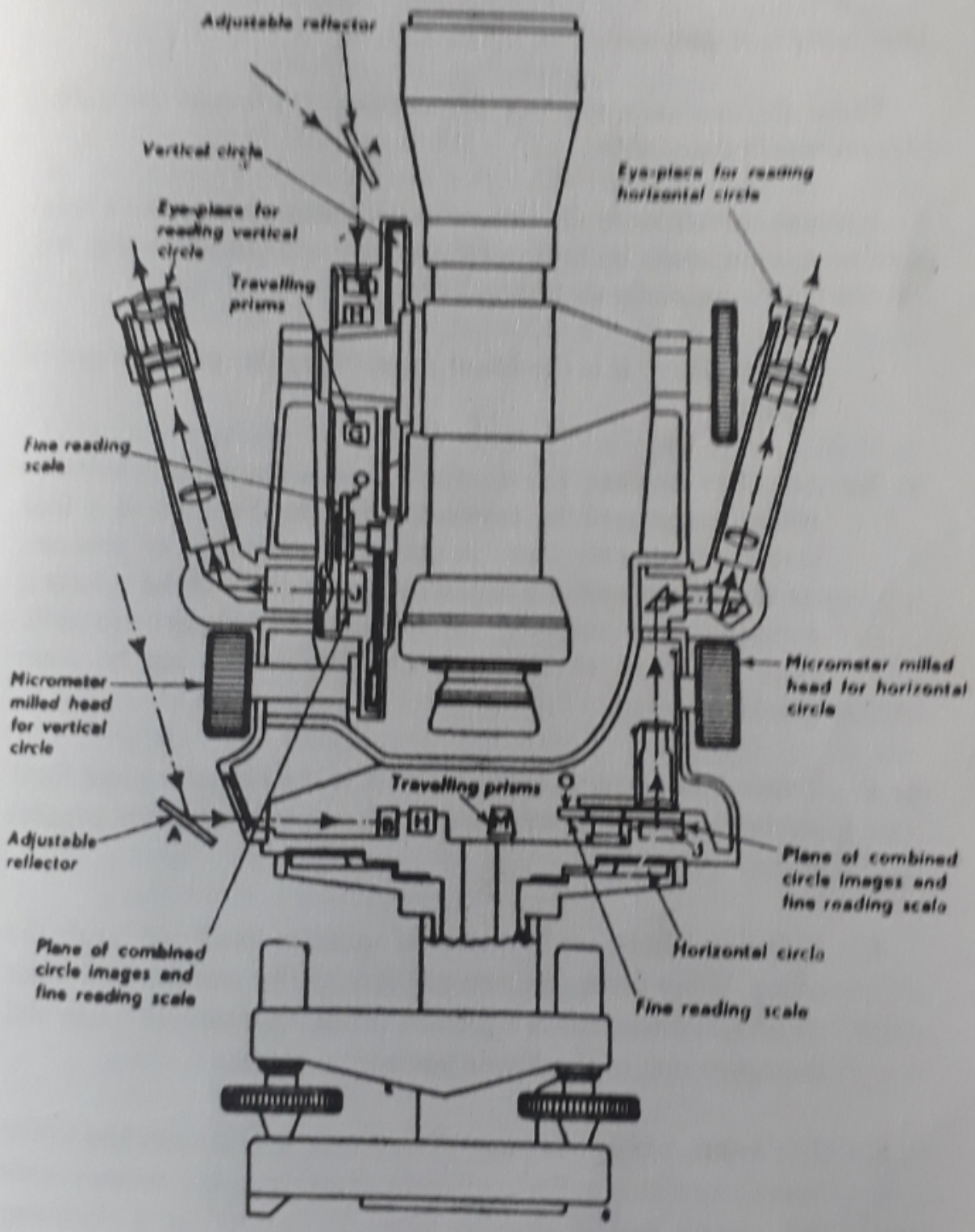
Fig. 86. Transit Theodolite




simple. Now we come to the method which can be used for both horizontal and vertical measurements and which is the most complex and accurate among the methods discussed so far. It is called

theodolite surveying. Theodolite is an instrument which can measure both horizontal and vertical angles and which has a telescope to facilitate the sighting of distant objects.

**Theodolite and its parts**

There are two main types of theodolities: (1) transit theodolite, (2) non-transit theodolite.

A transit theodolite is the one whose telescope can make a complete revolution about its horizontal axis in a vertical plane (fig. 86). It is the most commonly used theodolite.

1. *Trivate Stage*: It is the lower most triangular plate hinged to a tripod.

2. *Levelling Screws:* There are 3 or 4 screws fixed between trivate stage and the tribrach plate. In the case of a four screw instrument, there is uneven distribution of pressure on the screws and consequently wearing out of the screws is excessive. For stability, three points of support are sufficient. Besides, the three screw instruments can be more quickly levelled.

3. *Tribrach or upper parallel plate:* It is a triangular plate fixed above the levelling screws. It is also known as upper parallel plate.

4. *Spindles:* There are two conical spindles fixed one inside the other. They form the vertical axis of the transit. The inner spindle is attached to a vernier (upper horizontal) plate and the outer one to the lower horizontal plate.

5. *The lower horizontal plate:* The outer axis is attached to the lower plate also called the scale plate. Its edge or limb is silver plated and graduated from 0° to 360° in a clockwise direction. The horizontal circle may be graduated in (1) degrees and halfs of a degree (2) degree and thirds of a degree, or (3) degrees and sixths of a degree, depending upon the size of the instrument. The lower horizontal plate

is provided with (a) A clamp, and (b) tangent or slow motion screw, by means of which it can be fixed accurately at a desired position. When the clamp screw is tightened, the lowr plate is fixed to the upper tribrach or parallel plate and on turning the tangent screw, the lower plate and the upper part of the instrument can be rotated slightly.

6. *The Upper horizontal Plate:* This is also called the vernier plate: and is attached to the inner axis. A clamp and a tangent or slow motion screw are provided for the purpose of accurately fixing the vernier plate to the scale plate. This upper horizontal plate carries two verniers A and B with magnifiers placed 180° apart for reading horizontal angles to a minute or 20 seconds.

7. *Spirit levels:* Two spirit levels called plate levels placed at right angles to each other are fixed on the upper surface of the vernier plate for levelling the instrument.

8. *Standards*: There are two frames called standards to support the horizontal axis.

9. *Tube compass*: The compass box may be either of tubular type or of a trough type. The former is mounted on the vernier plate between the standards, while the latter is either fixed below the lower plate, or screwed to one of the standards. This compass is used in directing the telescope towards the magnetic north.

10. *The telescope*: The telescope is fixed at right angles to the horizontal axis. The telescope consists of (i) body, (ii) object glass, (iii) eye piece, (iv) diaphragm and (v) focussing screw.

11. *There Vertical circle:* It is attached to the inner axis and is placed vertically. It has two verniers called C and D. It is graduated in four quadrants of 0° to 90° each. There are magnifiers to facilitate the reading of the scale. It is also provided with a clamp screw and a slow motion tangent screw. This plate, combined with the telescope of the theodolite, is called the alidade of the theodolite. It is used