THE NEW CHASSELON AZIMUTH CIRCLE WITH TWO MICROSCOPES

(Extract from the REVUE D'OPTIQUE N° 2, Paris, February 1938, p. 70).

(Translated from the French.)

Since 1920 the firm of CHASSELON has had occasion to manufacture for both French and foreign Services azimuth circles of appreciably different kinds.

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Two different models of such azimuth circles have been designed:—
Circles with two microscopes, radius of limb 220 mm. (9in.)
Circles with four microscopes, radius of limb 270 mm. ($10^3/_4$ in.)

ELEVATION.

The *Service Géographique de l'Armée* possesses an instrument of the latter type. Others have been delivered to foreign countries (in particular to Czecho-Slovakia).

An idea of the extreme accuracy obtained with this instrument can be formed by examination of the results recently published in a Paper submitted to the *Académie des Sciences* by Lt-Colonel SCHMERBER, Commander TARDI and Captain CAILLOL on the use of a method of angle measurement by "répétitions fractionnées" (group repetitions).

In 1936 the Shereefian Topographical Service (Director: Mr. BOULLIER, Rabat), requested the firm to undertake the construction of a high precision azimuth circle, instructing us to collaborate in the matter with Lt.-Colonel SCHMERBER, who for several years had been studying and experimenting on the use of cylindrical axes guided by ball-bearings. The instrument designed under the direction of Lt.-Colonel SCHMERBER is therefore entirely different in concept from those previously manufactured.

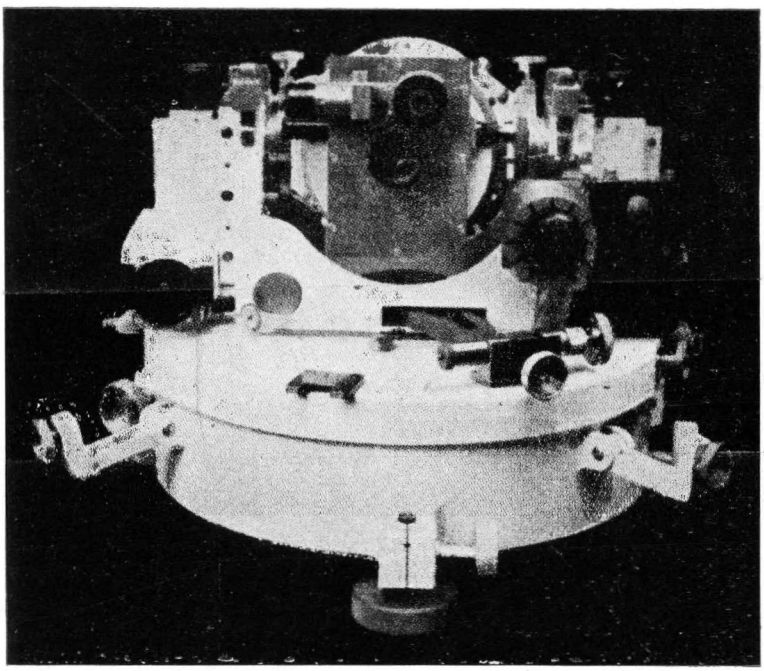
A summary description of it follows:—

The axis is in hardened steel, cylindrical, diameter 50 mm. (2 in.); alidade part supported by a thrust-bearing having balls of large diameter (which fixes the *direction* of the axis); the centring in *position* being assured by three 120° studs, one of which is movable and acted upon by a spring which presses against the axis and causes it to bear against the other two studs. An advantage of this device is the appreciable reduction of systematic eccentricity, obtained by slight manipulations carefully carried out, and, also, the almost total elimination of fluctuating eccentricities.

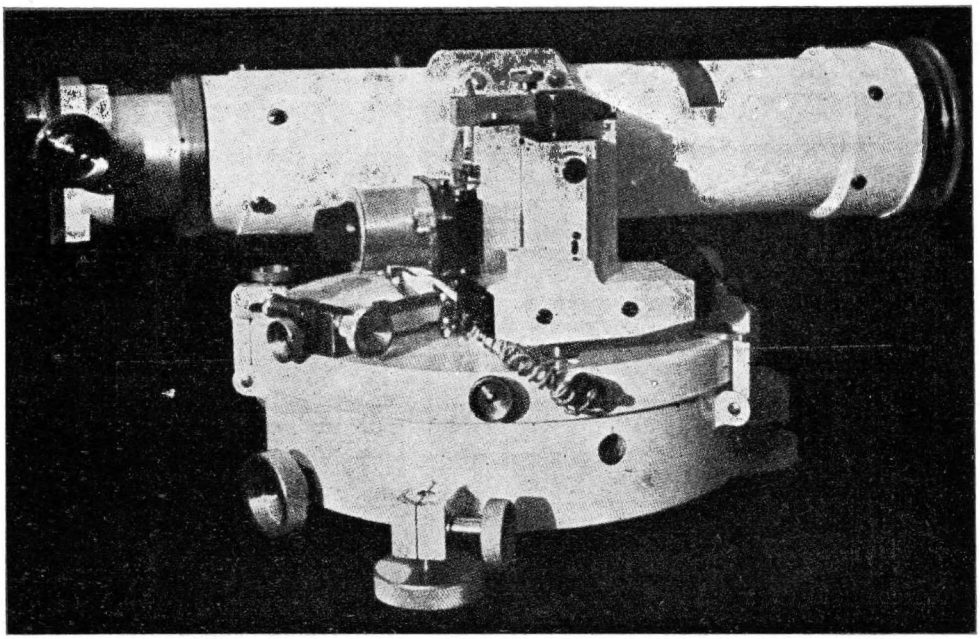
The *base support* consists of a special bronze ring (hardness Brinell 80); this ring carries only three very short lugs, in which the levelling screws are fitted. A special clamping device permits the rigid blocking of these levelling screws after installation at the station. In the prolongation of these lugs, radial arms are connected-up to the central nut in the sleeve of which the steel axis is permanently fixed. The upper part of this base carries two concentric roller paths, absolutely perpendicular to the axis. On the first revolves the divided limb; on the second, the alidade carrying the microscopes and the telescope.

The circle is of bronze, in one solid piece, of the same hardness as the base support. A silver circle of 4 mm. ($^1/_6$ in.) thickness, is adjusted horizontally and soldered onto the bronze piece; it is graduated in tenths of a degree — each degree numbered (1). The centring of the circle on the axis is ultimately assured by grinding the 120° studs previously mentioned. This operation, carried out by Captain CAILLOL of the *Service Géographique*, was effected to an accuracy of 3 microns. The repetition movement is obtained by means of a milled cap fixed on the lower part of the limb and manipulated by a pinion (the button of which is, besides, removable).

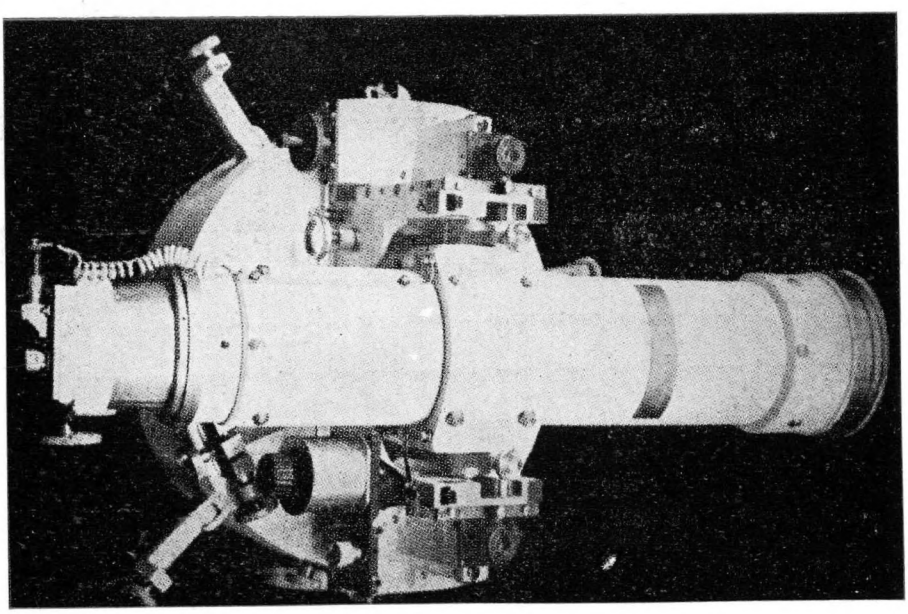
The *alidade* is of duraluminum manufactured from a one-piece forging, thus reducing the weight. It is centred on the steel axis by a second series of three 120° studs; so far as this is concerned, it is no longer here a question of rigorous centring but simply of the elimination of all fluctuating eccentricity. By means of an arm which may be rigidly secured to the axis, a slow-motion clamping screw may be installed before the alidade is permanently blocked by the movable stud. Sighting is thus greatly facilitated. The support of the telescope and microscopes is also in forged duraluminum.



Vue côté oculaire.
View from ocular side.



Elévation. — Elevation.



Vue en plan. — Plan view.

The microscopes are of the internal deflecting lens direct-reading type. They are fitted in the alidade piece with screw for correct setting in elevation. They also carry a device for setting the orientation (2). They permit a direct reading to the 1/100th of second (1/10th second estimated).

The *telescope* is composed of a cylindrical tube of large diameter in duraluminum ; the spindle being of forged steel and rectified. The micrometer with movable hair (manufactured after the design of Captain CAILLOL) is an internal reading micrometer, comprising the reproduction by a magnifying optical system of the image of the fine graduations on the scale divided in tenths of a millimetre. The 10 1/100th seconds are read directly while the second is very readily estimated. The optical characteristics of the telescope proper are similar to those of azimuth circles of previous makes. (3)

The *lighting* of the microscopes and micrometer is assured by a plug distributor with adjusting rheostat.

The weight of the apparatus at station is 40.500 kg. (90 lbs), 34 kg. (75 lbs) for the support and 6.500 kg. (15 lbs) for the telescope. Encased instruments are in two cases, the total weight of which is 94 kg. (207 lbs), 70 kg. (154 lbs) for the case containing the circle and 24 kg. (53 lbs) for case with telescope.

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The construction of cylindrical axes on ball bearings of large diameter has shown the incontestable superiority of this concept over that of conical axes of any diameter whatever.

FOOTNOTES :

(1) The circle was divided by the *Société d'Optique et de Mécanique de haute précision* (S.O.M.)
(2) The microscopes were designed by the *Maison Secrétan*, with *Stiassnie* lens.
(3) The optical equipment of the telescope was studied and designed by the *Société Générale d'Optique* (S.G.O.)