A New Type Magnetometer. (The G. S. B. Type Magnetometer)

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A new type electromagnetic magnetometer for the purpose of field survey was designed and constructed at our institute of the Geographical Survey Bureau. By means of this instrument the geomagnetic force vector can be determined with the sufficient accuracy, i.e., with the error less than 0.1' in declination and inclination and 1 in horizontal intensity, while the time need for a set of observations of three components is about six minutes or less.

The instrument consists of a Helmhorz coil of 80mm in its mean radius and a small rotating coil as the detector. The Helmhorz coil is set on the theodolite so that its axis is perpendicular to both of the horizontal and vertical axes of the latter, while the rotating coil is set perpendicular to the axis of the theodolite. With the aid of an alternating current amplifier with a magic eye (6G5), the e.m.f. generated into the rotating coil by the geomagnetic force can be detected with the sufficient sensitivity. Declination and dip are simultaneously measured by adjusting successively the horizontal and vertical directions of the axis of the rotating coil so that the output of the amplifier becomes null.

The principle of measuring the horizontal intensity is shown in Fig. 1. Here, the constant magnetic field produced by the Helmhorz coil which is regulated by a current standard meter is superposed on the geomagnetic field. The direction of the resultant magnetic force is measured with the aid of the detector. Then, the horizontal intensity is given by

$$H = H_c \frac{\cos \varphi \cos I}{\cos (\varphi + I)}$$

where $H_c$, $I$ and $\varphi$ denote respectively the magnetic force of the Helmhorz coil, dip, and the angle between the vertical line and the axis of the rotating coil.
In this instrument, the standard resistance is prepared so that $\varphi$ may not exceed $4^\circ$, in order to minimize the errors due to the setting condition. In actual measurement of each component, four readings are taken corresponding to the symmetric positions in the instrument, in order to eliminate the systematic errors owing to various parts. Finally, the constant of the Helmholtz coil was determined by comparison with the standard value.

This magnetometer was practically used for the magnetic survey on Shikoku during three months in 1948, and it was proved that this instrument is sufficiently useful and quite safe for the field works.

Fig. 3. The magnetic theodolite in the G S B type magnetometer

- $C_1$: Helmholtz-Coil
- $C_2$: Rotating Coil
- $B$: Collector
- $G$: Bebel Gear
- $R$: Universal Joint to rotate the Rotating Coil
- $H. C$: Horizontal Circle
- $V. C$: Vertical Circle

Fig. 4. G S B magnetometer in the field work.

Left to right: magnetic theodolite, magic-eye, standard-cell and resistance, galvanometer and amplifier.