DESCRIPTION OF AGA GEODIMETER, TYPE NASM-1 BERGSTRAND SYSTEM

GENERAL

The AGA geodimeter, type NASM-1, Bergstrand system, is based on the principles indicated by Mr Bergstrand in « Arvik för Fysik », Vol. 2, No. 15. As stated in this article, a laboratory model of the Bergstrand geodimeter was built by AGA and is at present being used by Mr Bergstrand for making certain measurements. A description of this laboratory model embodying the aforementioned principles may be obtained upon request.

The type of geodimeter to be manufactured differs from the previous laboratory model principally in two respects. Firstly the modulation frequency is kept constant during the measurements, and the adjustment of the instrument to the various distances is made by varying the phase of the voltage affecting the sensitivity of the photocell. Secondly the equipment has been designed with more consideration paid to transport possibilities even over rather impassable grounds.

The phase of the photocell voltage is varied by means of a variable delay line, the regularity of which, however, can not be made sufficient for the very accurate results desired — the allowable error must not exceed one tenth of one degree. It has thus been found necessary to calibrate the goniometer in connection with each measurement, using a light-path, built into the instrument and continually variable between one and nineteen metres, which is switched on between the Kerr cell and the photocell. In this way a check of the internal light-path is also obtained. The fact that a constant frequency is used when making the measurements makes it possible also to measure an unknown distance. For this purpose provision has been made for allowing measurements to be made at two different constant frequencies so that the unknown distance may be found by observing the phase variations for the two different wave-lengths corresponding to the two given frequencies.

The greater portability has been obtained by using a more efficient optical system permitting smaller mirrors and also by somewhat reducing the maximum distance measurable with the equipment.

DESCRIPTION OF THE ELECTRICAL EQUIPMENT.

Inasmuch as the accuracy of the measurements depends on the constancy of the modulation frequency it is important that this frequency be easily checked against recognized frequency standards, and it has therefore been given the value of 10000 kc/s. This value permits a direct comparison with the WWV frequency standard, which as a general rule may be heard over the radio during the darker part of the night on 30, 20 or 15 m. wave-lengths.

The geodimeter employs a cathode-oscillator connected with an automatic amplitude control. The frequency variations are less than one part in ten million even if the filament current and anode voltages vary within ± 10 %. The voltage across the crystal is less than one volt resulting in good stability with respect to ageing phenomena. The resonant frequency of the crystal is 2500 kc/s. The two frequency doubling stages are connected through band filters which effectively remove undesirable frequencies.

As previously mentioned, provisions have been made for using two different modulation frequencies which, to facilitate calibration, have been so chosen that the difference between them amounts to 1 % of the main frequency, 10 000 kc/s, or 100 kc/s. Both crystals are enclosed in an oven, the temperature of which is automatically kept at about 50° C.

The dimensions of the Kerr cell have been diminished as compared with that used in the earlier equipment. This change automatically diminishes the power requirement, which is of great help in making the equipment transportable. The frequency of the polarization voltage has been maintained at 50 c/s, but by using voltage limiting glow-lamps a more effective « flattening » of the sinusoidal voltage wave has been obtained resulting in a constant polarization voltage over an angle of about 120°. As a consequence hereof the operating conditions of the Kerr cell become more favourable resulting in better light efficiency.

The photocell circuit and the output amplifier are similar to those incorporated in the earlier design. Tube type 1P21 is used as photocell, EF39A as amplifier, and EF42 as measuring tube. The goniometer is designed as a delay line with eleven steps. Intermediate phase positions are obtained by means of a variable condenser. All high tension voltages are obtained from oil-cooled transformers, and selenium type rectifiers are used throughout. The total power required at 220 V, 50 c/s is about 175 W.

DESCRIPTION OF THE OPTICAL EQUIPMENT

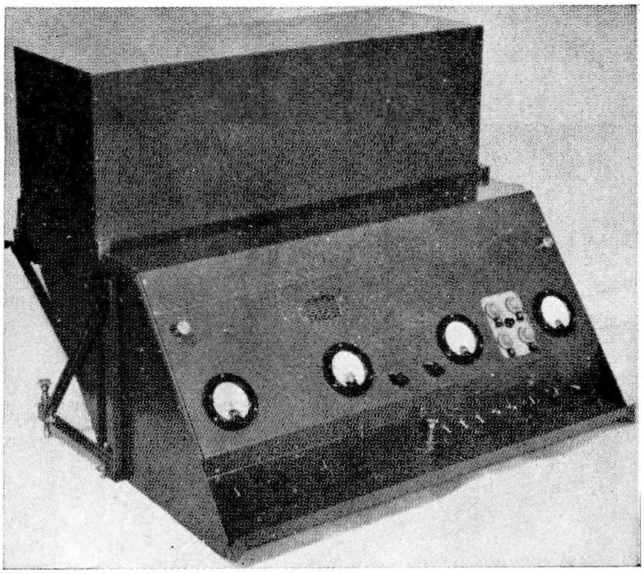
In principle the optical system has been maintained in its original form, but the dimensions of the spherical main mirrors have been diminished from 450-750 mm to 300/500 mm. The previously used focal ratio has thus been maintained. As before, the spherical aberration of the main mirrors has been compensated for by introducing special reflecting lenses. The dimensions of the filament incandescent lamp have been somewhat diminished thus diminishing the power requirements for the same light intensity.

In the new model polaroid filters will be used instead of Nicol prisms as polarizer and analyser.

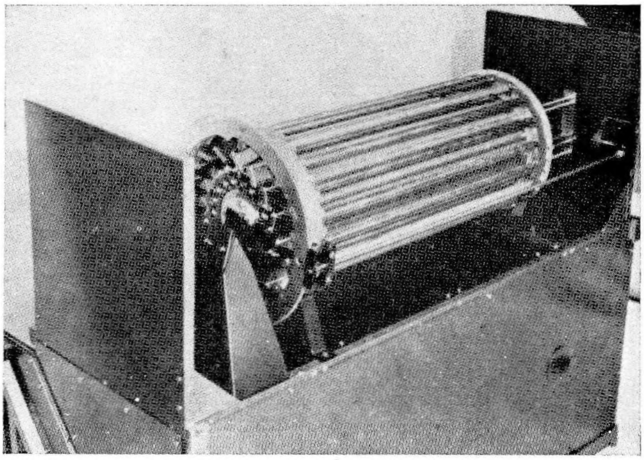
The preliminary lining up of the equipment is made by observing the picture which the receiving system projects on the white surface in which the diaphragm for the photocell is mounted.

The variable light-path previously mentioned consists of a number of metal tubes about 0.5 m long and polished on the inside, arranged in two concentrically mounted cylinder systems with eighteen tubes in each system. By means of thirty-six total reflecting right-angle prisms the light is conducted from tube to tube. One of the prism systems is rotatable and admits the projection of the light-beam on to a centrally located continuously variable light-path with a maximum length of one metre. For each step the prism system is turned the length of the light-path

AGA Geodimeter, Bergstrand system.



Front view.



Cover removed, showing
variable lightpath.

is changed by one metre, and therefore the whole assembly permits of a continual adjustment between zero and eighteen metres. Inasmuch as the loss of light depends on the length of the light-path and inasmuch as it is important that the photocell receive a constant light intensity, a series of absorption filters have been introduced with the result that the light passing through the system has approximately constant intensity. The adjustable light-path is switched in by means of a pair of plain mirrors which are introduced in the outgoing and incoming light-beams.

THE MECHANICAL ASSEMBLY

The electrical and optical equipments are built into two angle iron frame units. During transport the optical unit is placed above and beside the electrical unit, bat when in use it is moved in front of the latter. The locking arrangements are made so that the relative position between the two units is absolutely fixed. The two main mirrors are mounted on the inside of the optical unit, and the two reflecting lenses are placed on a beam attached to the front of the optical unit by means of ball and socket joints. This results in the position of the whole optical system being fixed with respect to the electrical unit, and the work of adjusting the equipment is thus reduced to a minimum.

The weight of the equipment is about 65 kg.