INDUSTRIAL REVIEW – ПРОМЫШЛЕННЫЙ ОБЗОР

THE FIRST INDUSTRIALLY MANUFACTURED DIRECT READING THERMOMETRIC ANALYSER

DIRECTHERMOM

Characteristic features — operation

DIRECTHERMOM is a universal analytical apparatus equally useful in both inorganic and organic quantitative analysis. The wide scale of its application is due to the fact that operation is based on the measurement of variations in temperature ensuing from the most general concomitant of chemical reactions: the release of the heat of reaction.

One of the greatest advantages of the DIRECTHERMOM is the direct reading of the concentration of the component in question in per cent or in any other practical concentration units (e.g. g/litre) on the basis of temperature variations.

The analysis procedure is extremely simple with the use of the DIRECTHERMOM, as it consists of only two essential steps: addition of the reagent and reading of the result. The simplicity and rapidity of the method make it most convenient for repetitive tests without the need for skilled operators.

With the apparatus several components can be determined in succession from the same solution and the determination time of one component reduced to two minutes.

In practical analysis, the reagent solution giving a selective reaction with the component to be determined is added to the sample solution in one portion and in excess. Upon addition of the reagent, the temperature of the solution changes in a degree proportional to the concentration of the component to be determined. The apparatus ensures in every respect the conditions under which the concentration of the component in question can be determined within wide limits (0.1 to 100 per cent) from a single measuring result: the variation in the temperature of the solution and this, in a period as short as 3 to 5 minutes.

The scope of the instrument is a twofold: in routine tests it measures in per cent the concentration of the component looked for, while in research work, after a simple switching over, it indicates directly the variations in the temperature of the solution under test in centigrades. If readings are taken in centigrades, temperature variations can be measured up to 10° C. This range is divided into several sub-ranges.

The calorifer provided with a variable series resistor has a doubly duty. In measurements of theoretical nature, it serves for the determination and calibration of the heat capacity of the system, in routine analysis it compensates for ambient effects. To this end, the temperature of the solution under test is adjusted to be equal to room temperatureat the start of the experiment. In this case the solutions cool down moderately due to evaporation. This cooling can be compensated by means of the heater, provided with an adjustable series resistor of sufficient sensitivity and dipping into the solution to bring environmental heat exchange to a value lower than 10^{-5} °C/sec within one minute which is generally enough to finish the measurement. Determinations are carried out in a quasi-adiabatic and quasi-isothermal system.

The reagents being added with a dipping pipette the temperature of the sample and reagent solutions need not be adjusted to the same value, by means of an ultrathermostatic bath which is relatively difficult to handle. By dipping the pipette filled with

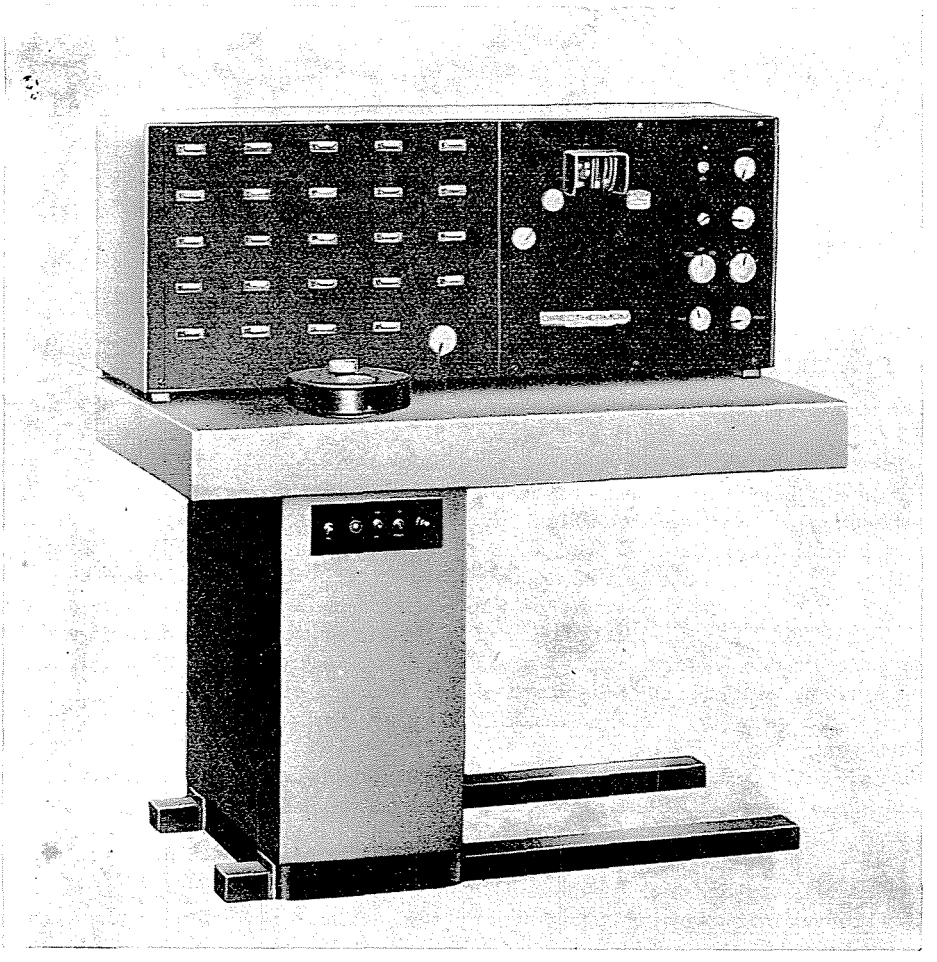

Fig. 1

reagent into the sample solution, the sample solution itself acts as thermostatic fluid for the reagent solution. Occasional differences in temperature are equalized in 2 to 3 minutes even at a starting temperature difference of as much as 3 centigrades. The dipping pipette prevents at the same time the two solutions to be mixed before the reaction has been started. At the start the reagent is pneumatically added to the sample solution by pressing a push button. As the apparatus permits the simultaneous dipping of several pipettes, it is possible to determine several components one after the other from the same solution.

A magnetic stirrer takes care of rapid heat equalisation and speedy mixing in the solution.

For the analysis special reagents — free of heat of dilution — are used.

The calibration of the instrument is simple. While analysing a standard solution of known composition the supply voltage of the measuring bridge or the galvanometer shunt is controlled with suitable variable resistors until the deflection of the sensing

instrument is proportional to the percentage of the component present in a standard solution of known concentration. E.g. if the concentration of the component to be determined in the standard is 2.56 per cent, the value of the calibrating resistor must be varied until the deflection of the galvanometer is equal to 256 units. The instrument is ready now to analyse samples of similar type in which the component looked for is present in an unknown concentration.

Each apparatus contains 24 variable resistors and can be programmed accordingly for the determination of 24 various components.