

## A NEW MAP-PLOTTING INSTRUMENT (Kleinkoordinatograph).

by

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(Translated from the German).

There is no doubt that the technique of topographic surveying needs a serviceable plotting instrument. But it is just as indubitable that such mapping instrument will only then be appropriate for daily service if it can be set in a minimum of time on a measuring line given by its two end points, in actual fact, in so short a time that the customary use of triangle, scale, dividers and transverse scale is surpassed, though less as concerns accuracy than efficiency. This requirement may well be termed decisive as regards the serviceability of a map-plotting instrument.

The new plotting instrument dealt with hereunder is produced in two types of design (1). The plain type is intended for the plotting of intermediate points (abscissae measures), not of ordinates, and for this particular use, an instrument as simple and light as practicable is indicated, because this kind of plotting work is most frequent.

The plain type of instrument, in its essentials, corresponds to a small beam-compass which, for the sake of use as a mapping instrument, is provided with a graduation on the "beam" and an index on the slider of the moveable point for the laying off of the intercepted measure. The difference resides only in that in the plain instrument the "beam" lies on the paper like a flat rule, and the two compass points are replaced by free-falling vertical copying needles. The schematic layout in Fig. 1 shows the form of the plain instrument and the method of operation, which is self-explanatory.



Fig. 1.

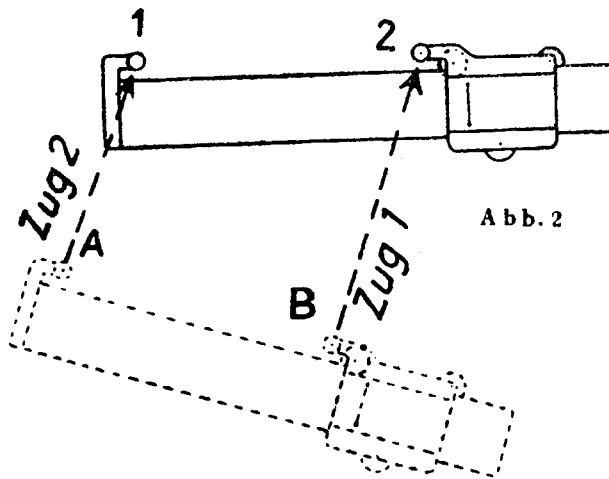
A and B are the two copying needles. The end copying needle B is attached to a small carriage which, in external appearance, resembles the cursor of a slide rule, but, instead of sliding, it rolls on three little rollers which, while running in lateral grooves, engage in the graduation. One of the rollers, that on the front side of the rule, is mounted elastically by means of a spring. The arrangement as carriage, instead of slider is essential for the handling of the instrument, as this carriage, for reasons which will be set forth later on, must move very easily, and, further, because the parallax between index-line and graduation, due to the accurate required scaling, can only in this way be kept as small as possible.

### *Method of Operation with the plain Plotting Instrument.*

Let a measuring line be given by two pricks in the paper, namely the zero prick 1 and the end prick 2 (Fig. 2). By means of two manipulations only the instrument is set to the

(1) Both types of design of the map-plotting instrument are manufactured by Messrs DENNERT & PAPE, Hamburg-Altona.

measuring line. The end copying needle B is set in the prick 2, and thereafter the zero needle in the zero prick. The instrument is now ready for the marking out of further intermediary measures.



• Fig. 2.

The time required by this procedure does not exceed four to five seconds, which is certainly not more time than that required for the setting of the two needle points of a pair of dividers, or the accurate placing of a scale for the purpose of determining the actual length of the measuring line. After setting the new instrument, the actual measure may be read straight off.

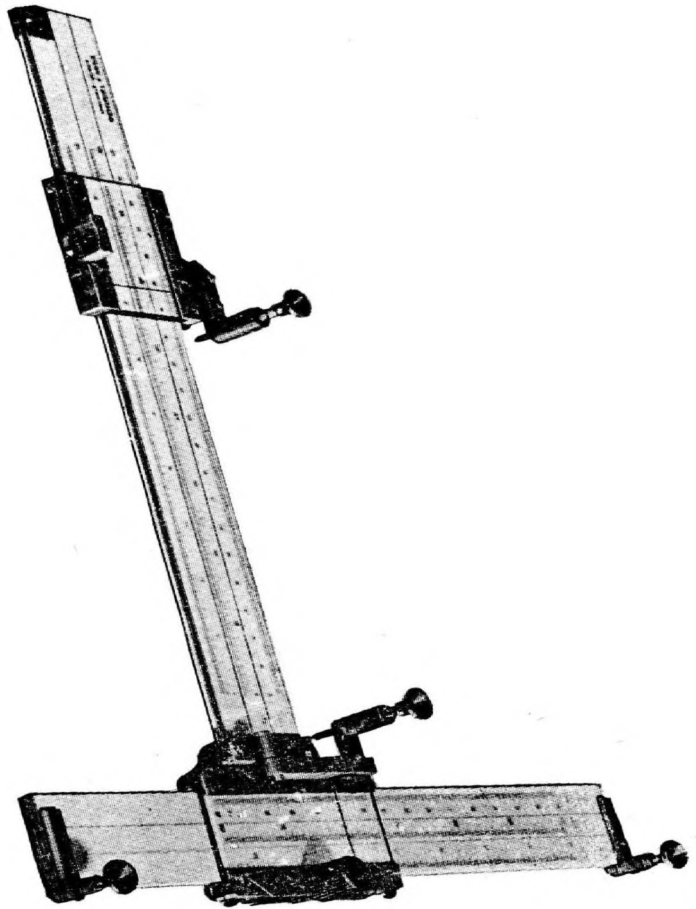
Contrary to the method of operation with the usual mapping apparatus, the exact connecting line between the two pricks needs not be drawn with the new instrument. The further intermediary pricks fall mechanically and accurately on the measuring line. By this token alone the superiority of the instrument over the dividers and scale should already be marked, but this superiority is apparent also in further respects. If an intermediary measure has to be pricked, the end copying needle is lifted by means of a small appliance and dropped again close by the approximate intermediate measure. Then only is the index line set on the exact measure, using for this purpose the elastically-sprung roller for fine adjustment, and the copying needle, standing already on the paper, pricked in. In this manner, one is assured that the prick occurs exactly on the measure set. This, as one knows, is very often not the case when using a pair of dividers, copying needle and scale, however great the care taken.

The zero needle can be hinged up, so that intermediate measures in the immediate vicinity of the zero point can also be plotted, i.e. about 0 to 12 mm.

It might of course be alleged that, through the direct use of the end pricks of a measuring line, these pricks are liable to widen out. Tests however have proven that, after some fifty odd settings of the rule over the same line, no widening out of the same is discernable, even with the aid of a magnifying glass. This is the reason why the end copying needle had to be affixed to an easily rolling carriage and not on a slider.

It is only by the direct use of the two end pricks that the instrument can be set on the measuring line in a few seconds.

At this point it is necessary to dwell on a minor detail which, however, is none the less of primary importance in using the instrument. It has been said that, when pricking the intermediate points, the end needle is dropped close by the approximate measure. During the subsequent setting of the accurate measure the needle-point slides over the paper until it reaches the exact point. This slipping of the needle-point produces on the paper such minute traces that viewed through a 4x magnifying glass they are hardly perceptible, even with unsized paper. The scratching of the copying needle acts, in a sense, as a brake on the easily running abscissae carriage, and any slipping away of the needle whilst pricking the gross measure is thus precluded.



*The complete Map-plotting Instrument. (Kleinkoordinatograph).*

After the description of the method of operation with the plain plotting instrument, the setting and use of the complete instrument for the plotting both of abscissae and ordinates will be easily understood.

The plain map-plotting instrument just described is adapted as abscissae rule to a fixed ordinate rule by means of a carriage and can thus move parallel to itself. See Fig. 3. At the extremity of the abscissae rule is a roller.

The complete instrument is placed in the same simple way on the measuring line as the plain instrument, viz. in zero setting on the ordinate rule, that is, in a position in which the index line on the ordinate carriage lies on zero of the plus — and minus — division. This position is held firm by a snap-spring. Once the complete instrument, in this zero setting, is placed on the measuring line (square grid), the two holding-needles are driven into the paper to secure the instrument against any slipping. (A pair, more or less, of pricks is actually immaterial, since the foot pricks of the ordinates themselves fall off anyhow). In order to plot a point according to abscissae and ordinate, the latter is first set on the ordinate carriage, and, thereafter only, the abscissa on the abscissa carriage.

The ordinate graduation ranges to  $+ 10$  cm. and  $- 5$  cm., whereby almost every case is covered. By means of the plus-ordinate graduation, all the points, such as polygon points and secondary points, can be plotted in two adjacent decimetre plane squares according to coordinates.

Although the complete instrument, owing to its light weight, may be set as quickly as the plain one, even on the smallest measuring lines, without damaging the pricks, the latter is nevertheless to be preferred in frequent plotting work without ordinates, because it is hereby still handier. With short measuring lines it is proper to first set, as usual, the *end* needle in the *end* prick, the rule is grasped by its end and so turned and shifted that the zero needle falls on the zero prick.

With the well-known accurate possibility of almost parallax-free setting of the fine index mark on the sharp graduation on white background of the slide rule, the point-error may, with some care, be held within 0.1 mm. To impose higher accuracy is useless since the drawing carrier, most often paper, is by no means scale-preserving. The greater part of the usual errors is done away with by the fact that the instrument works forcibly and mechanically from prick to prick and, therefore, is fully independent of inaccurately drawn connecting lines. The point-error is thus almost exclusively influenced by the setting-error of the graduations; adjustment-errors may be held as low as desired.

By the simplification and speeding-up of a day-to-day work, which the above-described devices warrant, no small a service has, no doubt, been rendered the technique of topographic surveying.

