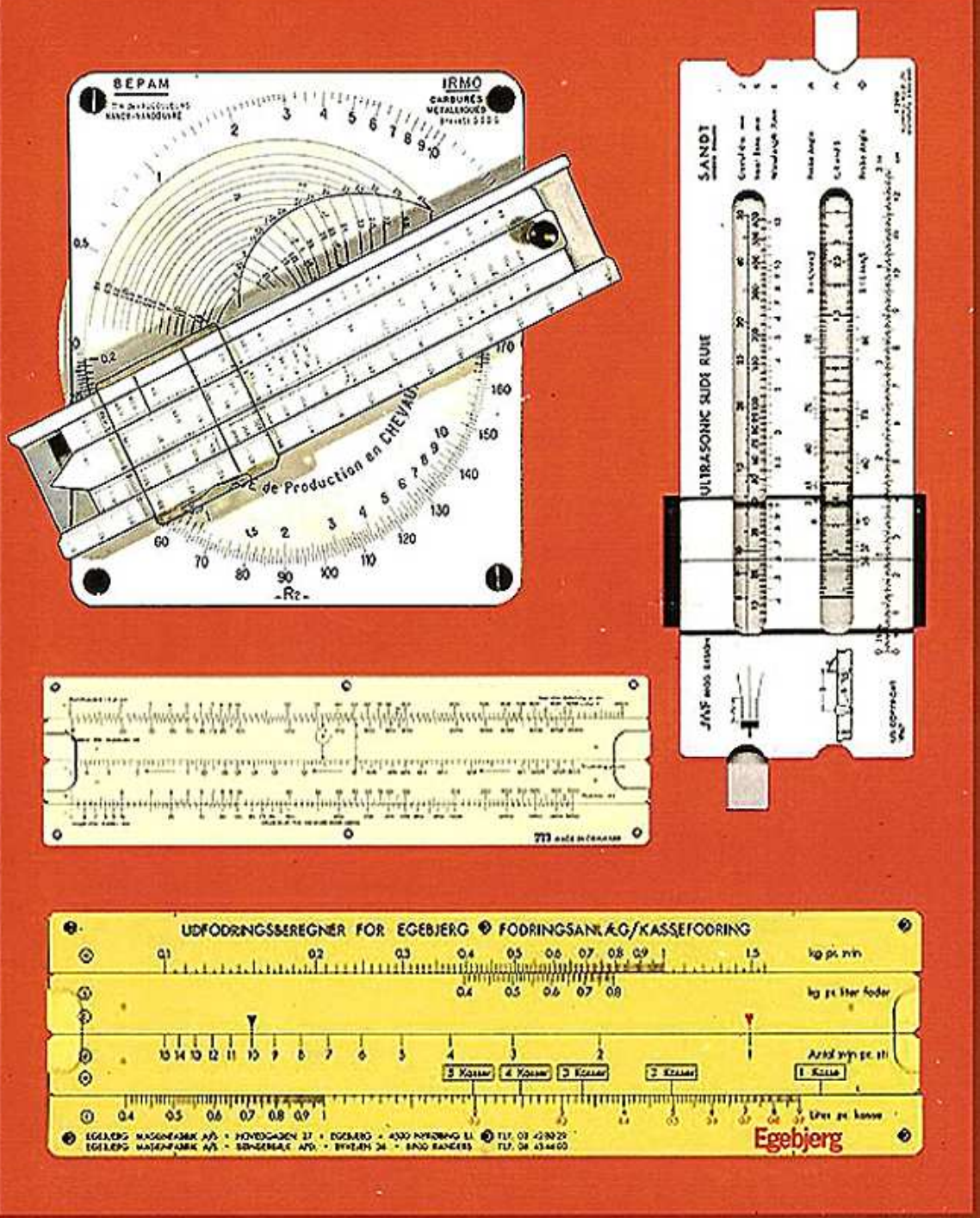
THE SLIDE RULE

TECHNICAL CULTURAL HERITAGE



HISTORY, PATENTS,
SPECIALIST SLIDE RULES,
EXHIBITION POLICY AND
SELECTED MANUFACTURERS
AN ANALYSIS

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3.8 - MILLING AND CUTTING

IRMO - R2

Introduction
Any collector of slide rules will have a slide rule in his collection to be used for milling and cutting. Normally these slide rules have scales for calculating the adjustments needed for lathe and milling equipment and for calculating the time and labour aspects. Mostly, collectors are unfamiliar with this speciality and are limited to what they can learn from the descriptions in the manuals, if they have a copy. Nevertheless, these slide rules are interesting objects in a collection, especially because of their kind of scales and the way in which they are combined. Having the opportunity to spend time studying the manuals and published material one will quickly understand the background, and gain some insight and special knowledge needed to make optimum use of this slide rule. Not all questions will be answered. Professional knowledge in the use of the machinery and the materials to be processed remains a prerequisite.

inventor
It was the Frenchman Roger Grandadam from Vandoeuvre, Meurthe-et-Moselle, who noted this and developed a combination of circular and straight slide rule which was better suited to do these calculations than previously known slide rules. The design and patent granted to him for his invention opens up the ability to calculate optimum labour procedures, procedures in which the best use of machine and labour time has been obtained. Previously used calculations from estimations were analysed by him and shaped to formulas, and these reshaped into scales. He notes in his patent that it removes the previous dependency on education and experience for estimating premises, replacing this with the ability to adjust, using special scales, gauge points and coefficients.

name: IRMO
Mr. Grandadam was a French engineer and university teacher at the University of Nancy. His apparatus was given the name IRMO, this being composed from the first characters of: Indicateur de Rendement pour Machines-Outils. The accompanying booklet mentions as main point of this object, the ability to ascertain the optimum working conditions for all metalworking activities except grinding.

better than tables and diagrams
Furthermore he states that it is time consuming to consult tables and diagrams which are composed of facts and data from laboratory studies and experiments on all kind of metalworking, and that many operators in this speciality do not have the knowledge and experience needed to consult and interpret these correctly. Consequently many fall back on estimating and this never leads to optimum solutions.

used data
Shortly formulated, the following data is used in the calculations in these metal work activities:

- sizes of unprocessed piece of work.
- final sizes.
- metal-properties of the piece of work.
- hardness of cutting tools.
- turning speeds.
- turning time.
- machine capacity and power.
- efficiency of the machinery.
- distribution of the workload.

shape
Due to the mentioned problematic nature of this activity only a short description is given. The shape is rather particular, it is a combination of a slide rule and a disc. The slide rule is made up of a body and, instead of a slide, a second slide rule is fitted. This combined slide rule is fixed to the disc and rotatable on top of this disc. The construction and scales are patented (Germany, Nr. 1035945, dated Aug. 7 - 1958, and earlier in France, June 29 - 1950).
The construction and the scales are explained here but not the calculation examples. Those interested are advised to study the German patent.

construction

First the construction. The same letters and numbers are used as in the patent, although the patent description differs a little from the finished product.

- the baseplate A, 139 x 154 x 6 mm is made from 4 layers, 3 made of PVC and 1 of metal; these are from top to under-part:
  - a transparent upperplate
  - a white plate with two circle shaped scales and inside these, a circular disc B with several scales and diagrams, also white.
  - a metal plate used for strength; on the reverse side on a white surface, various tables.
  - a transparent under-plate.
- these 4 plates are kept together by 4 screw bolts on the four rounded corners.
- the disc in front has an eccentric axle; we can see this by the difference in space left and right of the disc. This disc is rotatable using its toothed rim which reaches beyond the baseplate A.
- the slide rule is fitted on a central axle, seen at under-side. This consists of a body, in the patent indicated by the numbers 8 and 10, connected by its transparent bottom part.
- this slide rule has a second slide rule, used like a slide, but having its own body and slide. This last slide is movable by a bronze knob.
- this slide rule combination is provided with a cursor with two hairlines, one of full-length, the other of half-length.
- the slide in the inner slide rule has at its top a protruding tip.

Abb.1

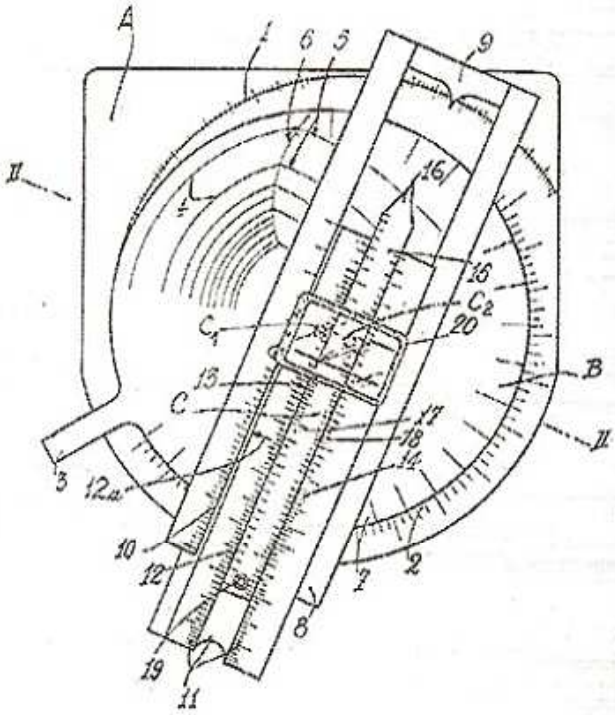
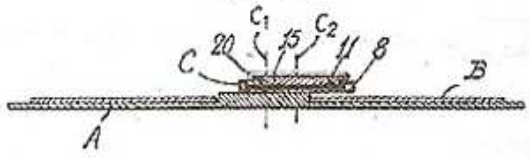


Abb.2



So far the construction.

text

The text at top, left and right, is:

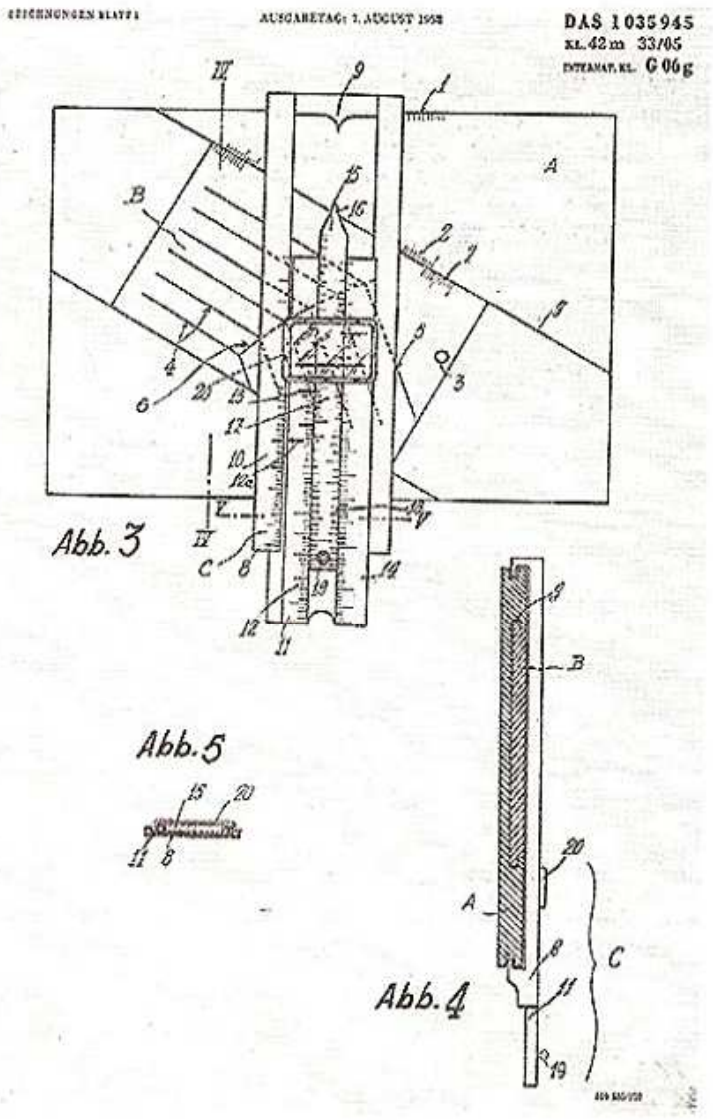
- left: B.E.P.A.M, 11 R de VAUCOULEURS, NANCY-VANDOEUVRE
- right: CARBURES METALLIQUES, Breveté S.G.D.G.
- in the middle lower down is: R2, probably a code number.

We see on the rotatable disc:

- PUISSANCE de Production en CHEVAUX.

The tables on the underside are not illustrated here.

function of the scales
To understand the function of the scales I have copied the text of the German patent.



Die Skala 1 auf der Grundplatte A weist eine logarithmische Teilung auf und gilt als Spantiefeskala. Die zweite auf der Grundplatte A vorgesehenen Skala 2 weist metrische oder logarithmische Teilung auf und stellt beispielsweise den Koeffizienten R_2 dar, der für das bearbeitete Material in Abhängigkeit vom Werkzeug charakteristisch ist. Die Kurve 4 auf der beweglichen Platte B besteht aus einer Anordnung von kreisförmigen Kurven, die radial fortschreitend mit Zahlen versehen wird. Diese Kurvenanordnung repräsentiert die richtige Benutzung eines Werkzeuges.
Die Scheibe B trägt die zweite Kurve 5, welche ebenfalls aus einer Schar von Linien besteht, wobei die Linien in Kreisrichtung fortschreitend beziffert sind. Sie stellen die totale Nutzbarmachung der Leistungsfähigkeit der Maschine dar. Gewisse Linien dieser Kurvenschar tragen charakteristische Merkpunkte zur Einstellung des Gerätes, und zwar für die Entscheidung über Probleme bei halbstarren oder nachgebenden Werkstücken oder Spanneinrichtungen. Die Kurve 6 verbindet die Punkte, an denen die Linien dieser beiden Kurvenscharen 4 und 5 aneinanderstoszen. Die Skala 7, die sich auszerdem noch auf der beweglichen Platte B befindet, ist logarithmisch geteilt und bezieht sich auf die Produktionsleistung bzw. Verspanungsleistung.
Der Index 9 des Grundlineals 8 dient zum Ablesen der Spantiefe. Die Skala an seiner Längsseite ist metrisch oder logarithmisch geteilt und gibt die Koeffizienten R_1 an, die für die Werkzeuge hinsichtlich der Bearbeitung der Materialien charakteristisch sind. Die Skala 12 auf einer Seite des Schiebers 11 ist als Geschwindigkeitsskala logarithmisch geteilt, ihre Merkzeichen 12a und 13 dienen zur Ablesung des Koeffizienten R_1 bzw. der Schnittgeschwindigkeit in Meter pro Minute. Die auf die andere Seite des Schiebers eingravierte Skala 14 ist mit logarithmischer Teilung die Skala für die Bearbeitungszeit. Die Teilung 17 der Zunge 15 ist logarithmisch ebenso wie die Teilung 18. Die Skala 17 bezieht sich auf Durchmesser und Länge von Drehteilen, die Skala 18 auf Vorschübe für die Zeitberechnung.
Die Rückseite des Gerätes trägt eine Tafel der Koeffizienten R_1 und R_2, die zur Auswahl der Werkzeuge hinsichtlich des zu bearbeitenden Skalen 10 und 2 entsprechen. Diese Tafel trägt gleichzeitig Anleitungen zum Einstellen des Gerätes für die Bearbeitung halbstarrer und sich durchbiegender Werkstücke oder bei auskragender Einspannung.

So far this scale description.

information to find

The description of the construction and scales illustrates just how very particular the design is. Once again, to fully understand the method of calculation, it is advisable to consult the German patent. It includes 5 pages of text and 2 pages of drawings, too much and too complicated to summarise in a short description.

More information can be found in an article in the Dutch technical magazine "Polytechnisch Tijdschrift", "Een nieuwe rekenschijf voor de metaalbewerking, IRMO." - 681.143:621.9., page 915a, 916a.