Adolf Martens
and his contributions to materials engineering

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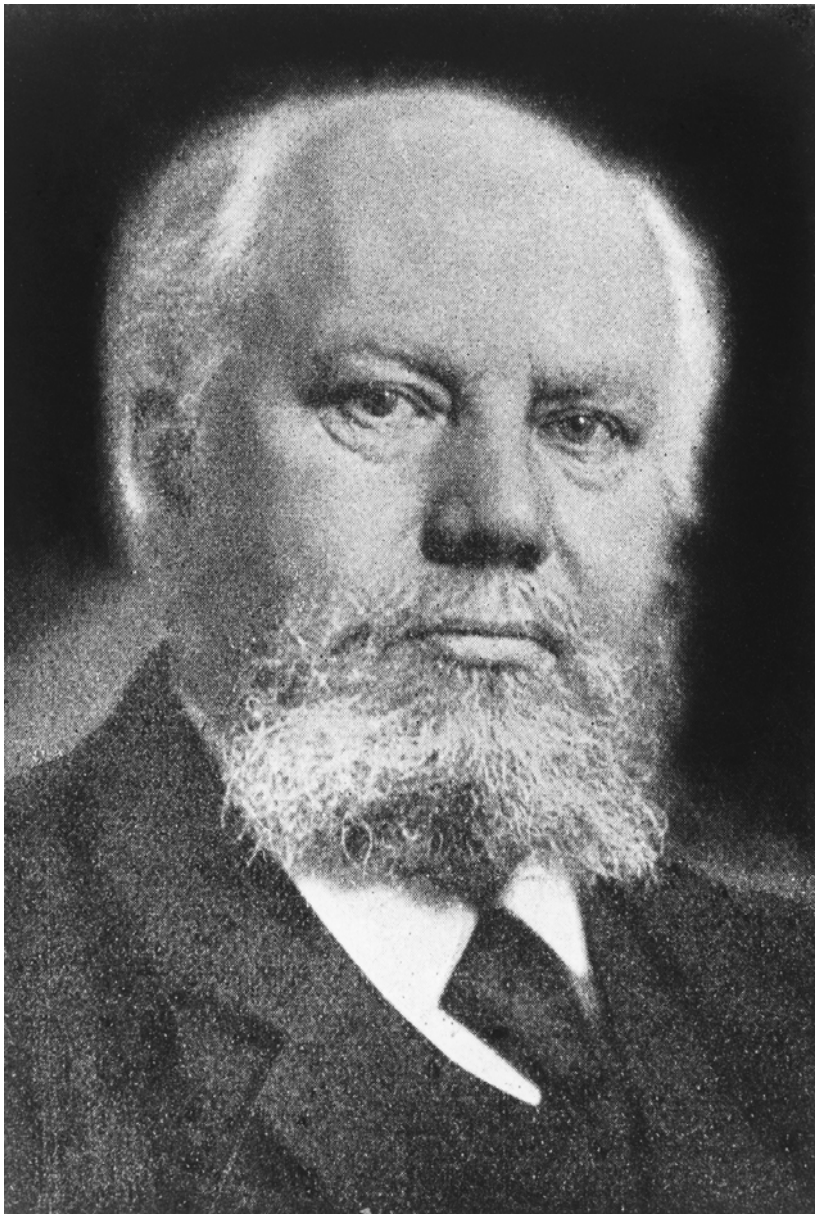
D-12200 Berlin, Germany

- **Adolf Martens, a biographical sketch**
- **his contributions to metallography**
- **his contributions to mechanical testing**
- **his contributions to materials engineering**

A biographical sketch



- **Adolf Martens was born on March 6th, 1850 in Backendorf, a small village near to Hagenow in Mecklenburg-Schwerin**
- **where his father was an estate tenant, a *Gutspächter*.**
- **Martens visited the *Realschule* (a form of secondary school) in Schwerin**
- **and started in 1867 as a locksmith, cabinet-maker and founder in the machine shop of Ernst Brockelmann in Güstrow.**

Ref. 6

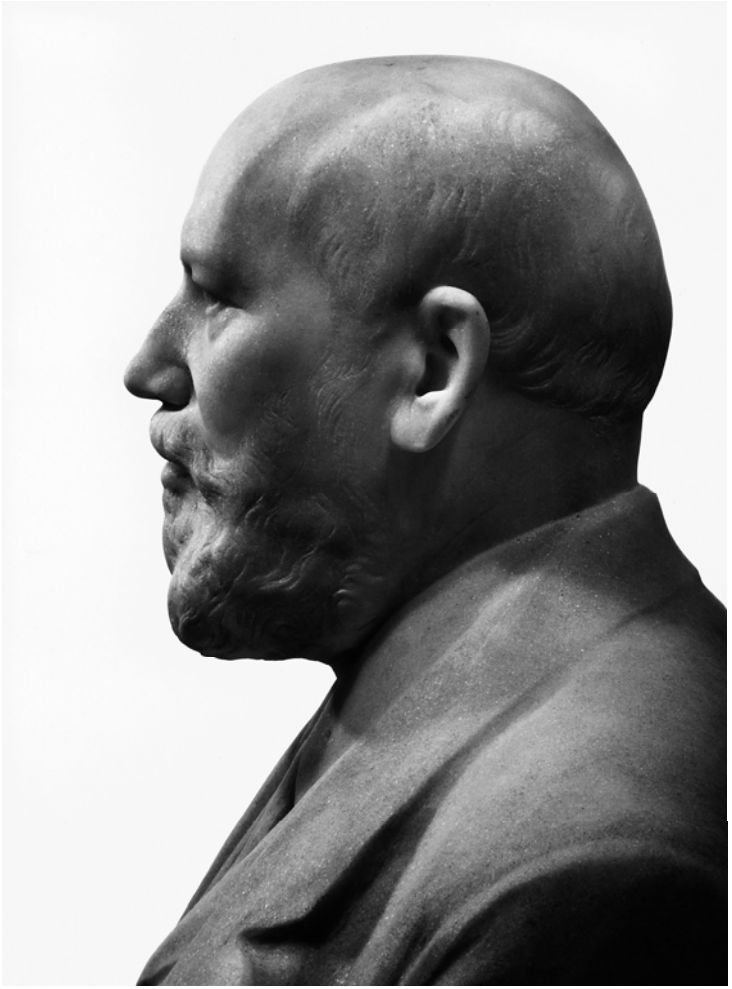
A biographical sketch

Königliche Gewerbeakademie (Royal Industrial Academy)
Berlin, 1878-1884

- **In 1868, Martens went to the Royal Industrial Academy at the Klosterstraße in Berlin**
- **and completed his formation as an engineer in 1871**

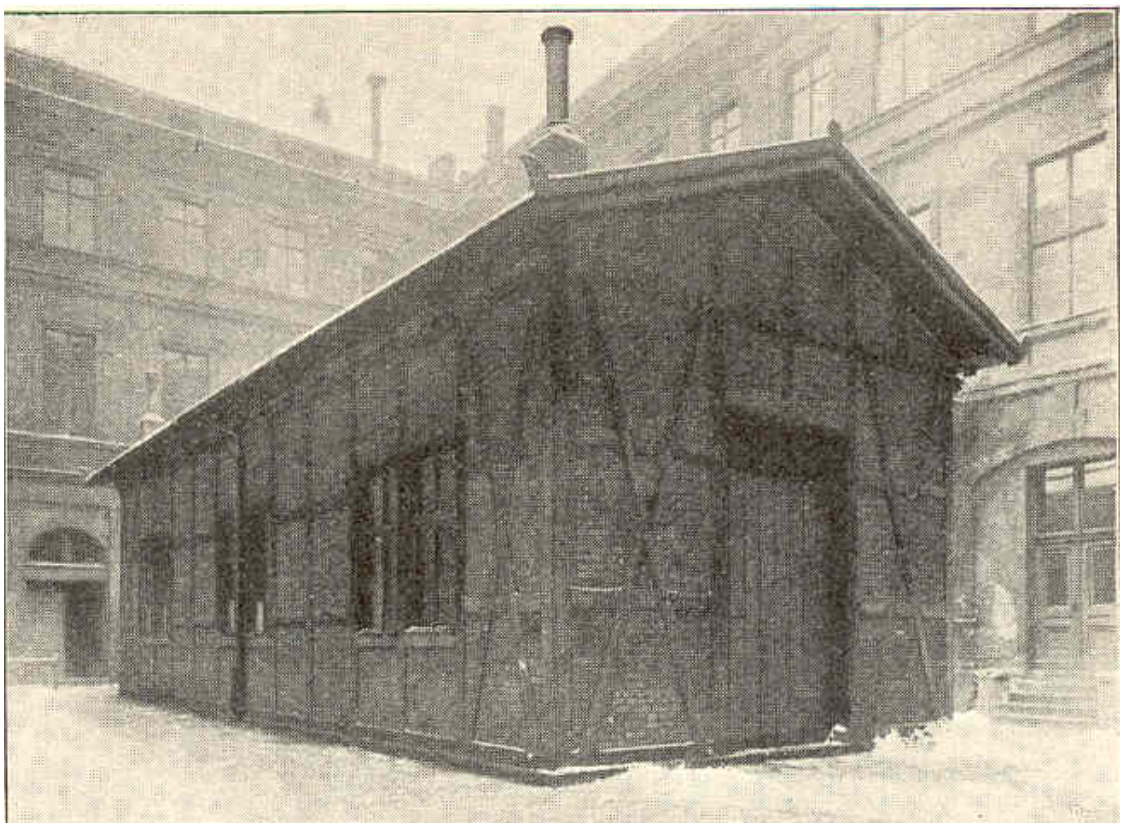
Ref. 5, p. 4

- **Martens was engaged at the Royal Prussian Railways and was initially at the *Ostbahn* (Eastern Railway) in Bromberg (today Bydgoszcz in Poland)**
- **where he was involved with bridges, metallic structures and construction supervision.**
- **In 1875, Martens changed to the Royal Railway Authority in Berlin-Blankenheim and got involved with the acceptance of rails and other steel products**
- **In this position he had intensive contacts to the iron and steel industry in Westphalia (Gutehoffnungshütte) and Silesia (Königs-Laurahütte).**



BAM, Headquarters, entrance hall

Ref. 5, p. 5



Mechanisch-Technische Versuchsanstalt (Mechanical Experimental Station), Berlin, 1878

in the courtyard of the Royal Industrial Academy

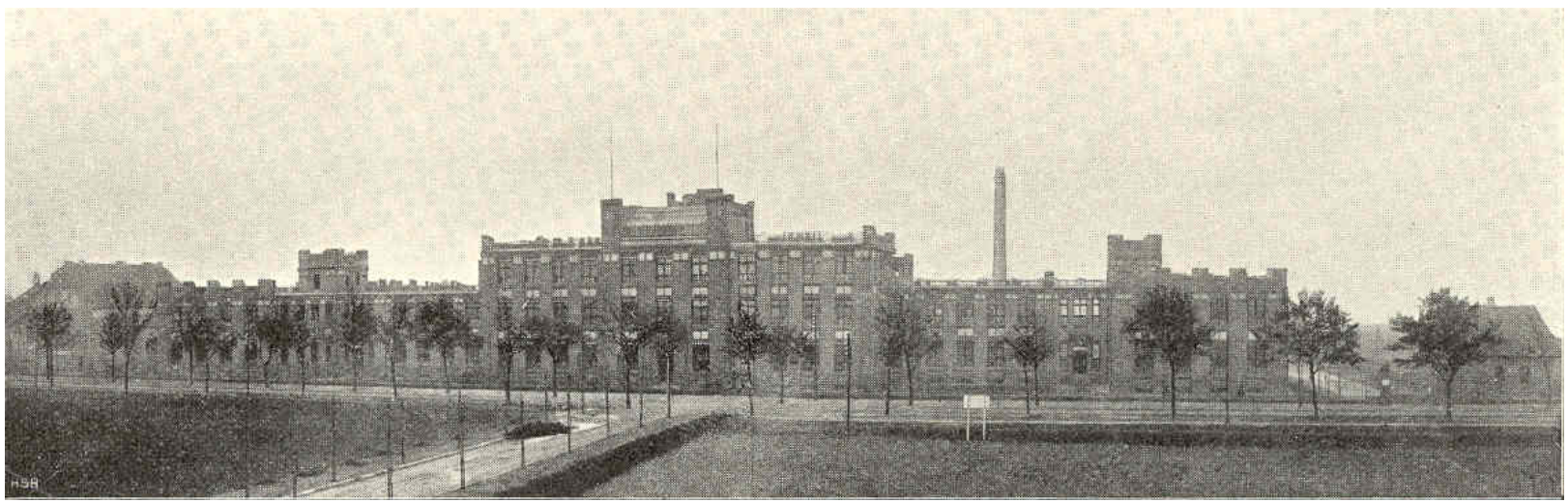
- **In 1880, Martens became an assistant of Professor Consentius at the Royal Industrial Academy in Berlin.**
- **On April 1st, 1884, he was nominated Head of the Royal Mechanical Experimental Station.**
- **His staff consisted of his assistant, Prof. Rudeloff, and two technicians.**

- **The new Royal Mechanical Experimental Station grew rapidly and diversified its activities**
- **In 1884, a new facility was established at the Technical University in Berlin-Charlottenburg, new departments for oil and paper technology were created**
- **In 1889, Martens was nominated as a Professor of the Technical University**

Ref. 5, p. 10

Königliche Mechanisch-Technische Versuchsanstalt (Royal Mechanical Experimental Station). Berlin-Charlottenburg, 1884 - 1904

- **In 1904, the new Institute for Materials Testing was created by merging several institutions under the direction of Professor Martens**
- **In the same year, a new headquarter was built in Berlin-Dahlem, which was expected to become a new scientific centre between Berlin and Potsdam**
- **Martens received in 1905 the title of a Dr.-Ing. E. h. by the Technical University in Dresden**



Ref. 5, p. 117

Materialprüfungsamt (Materials Testing Institute), Berlin-Dahlem, 1904

as seen from Potsdamer Chaussee

Federal Institute for Materials Research and Testing (BAM)

A biographical sketch

- **Martens was extremely successful, the new Institute prospered enormously**
- **In 1913, he fell seriously sick**
- **Martens passed away on the evening of July 24th, 1914; he lies buried in the cemetery of Dahlem between his son and his colleague Emil Heyn**

Ref. 7, p. 289

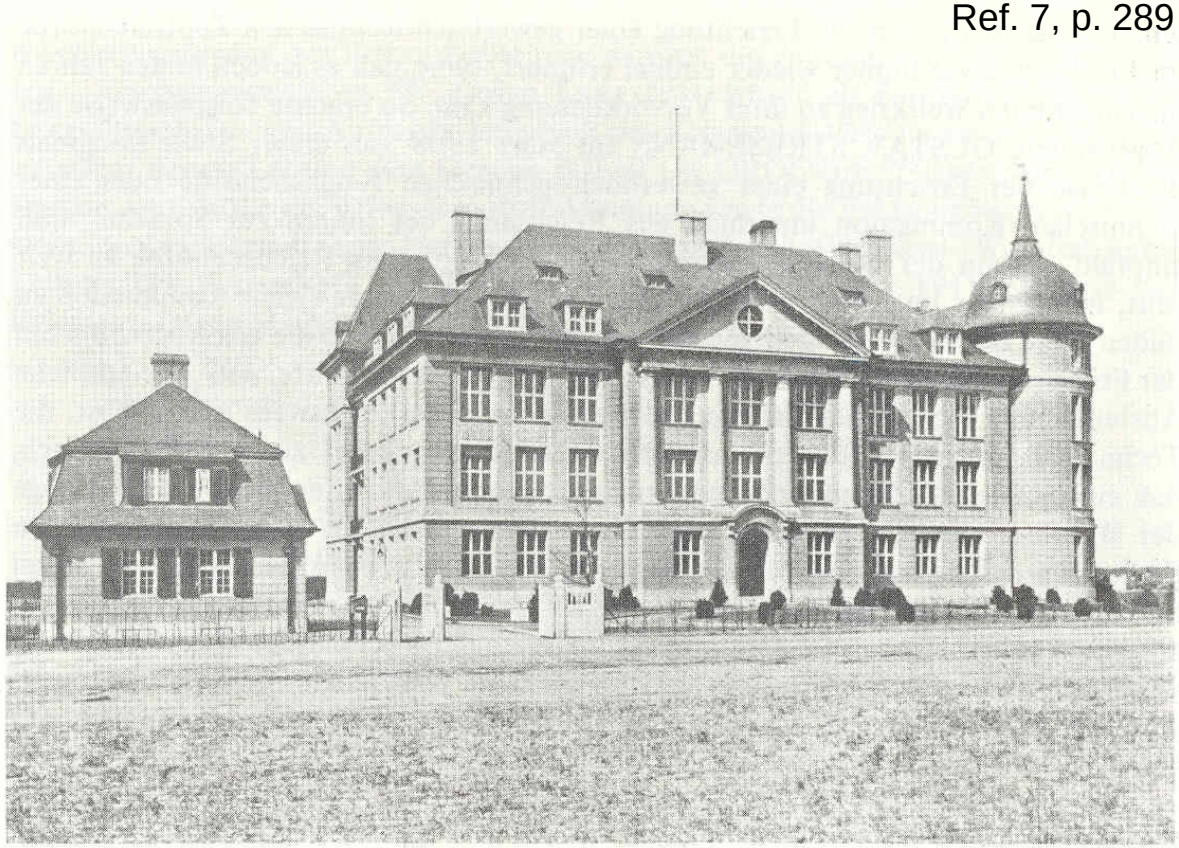


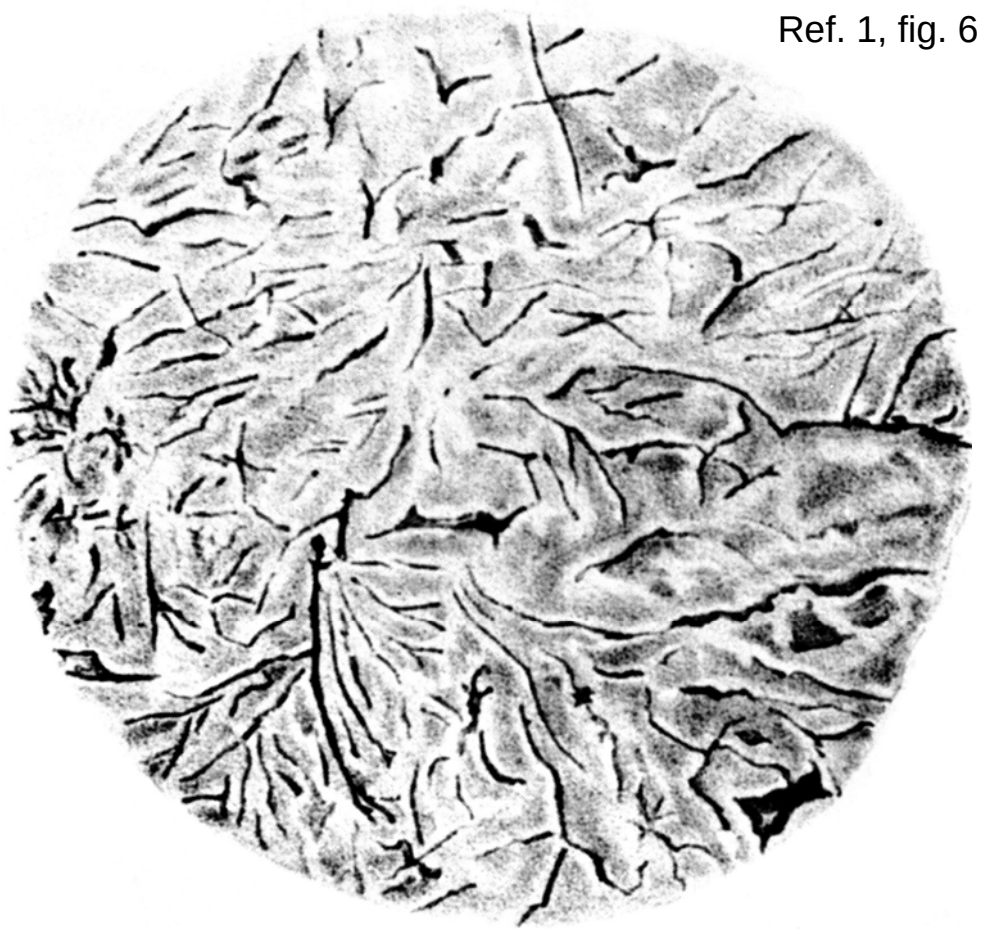
Abb. 157
Das Kaiser-Wilhelm-Institut für Chemie an der Thielallee 63–67 (Aufnahme aus dem Jahre 1912)

Kaiser-Wilhelm-Institut für Chemie
(Kaiser-Wilhelm-Institute for Chemistry), Berlin-Dahlem, 1912

Lise Meitner and Otto Hahn worked in this building

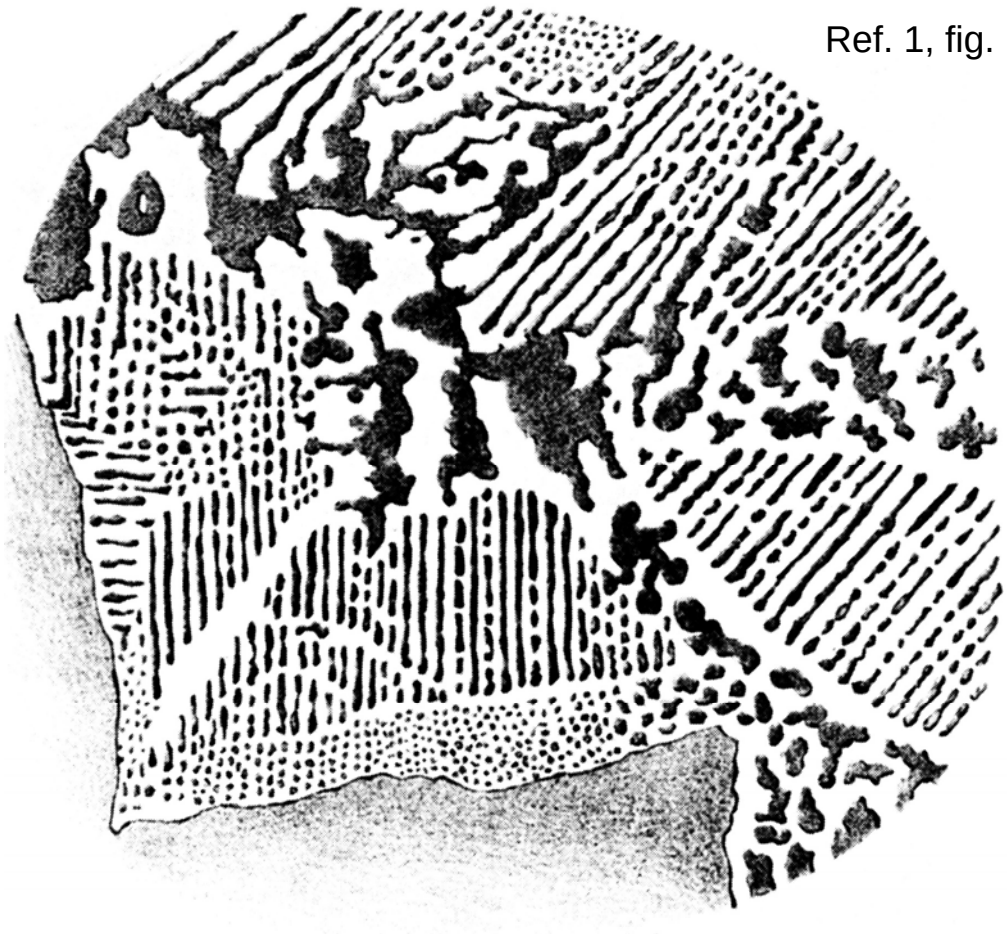
- **The pioneering work in metallography was done by Henry Clifton Sorby in Sheffield in the years from 1863 to 1887.**
- **The first activities in this field go back to the time he was in the Railway, apparently without any knowledge of the work of Sorby.**
- **His first papers were published by the journal of VDI in the year 1878.**
- **His approach to the characterization of the internal structure of metals and its relation to processing was strongly influenced by the natural sciences, especially mineralogy and botany.**

Ref. 1, fig. 6



Metallographical section of a mould made of gray iron
Martens, 1878

Ref. 1, fig. 10

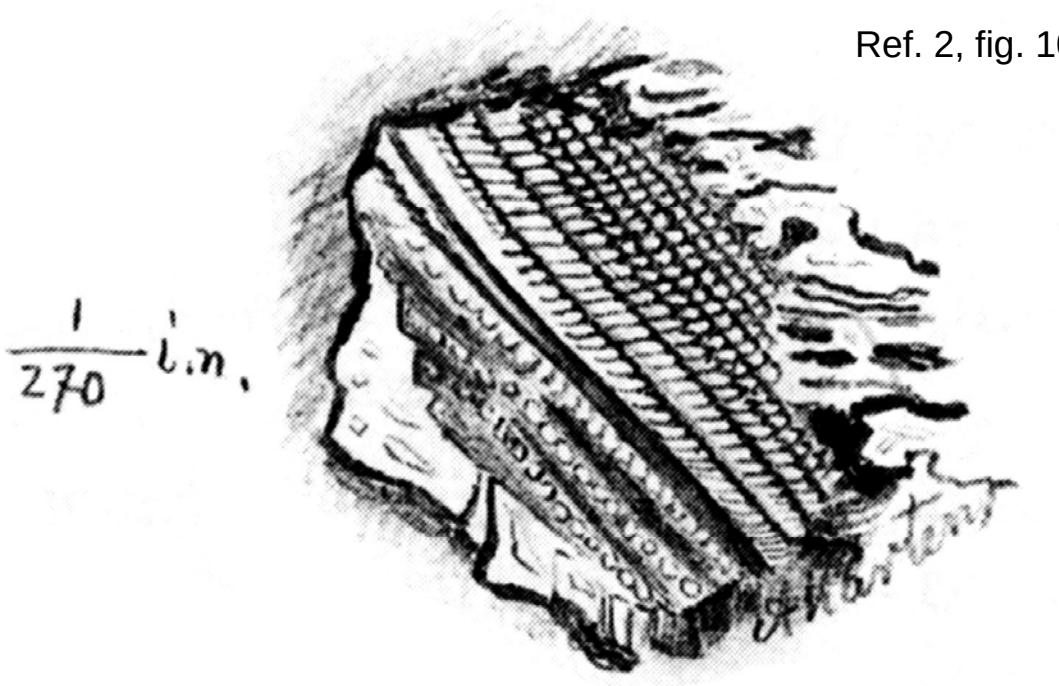


Metallographical section of a steel specimen with “Spiegeleisen” Martens, 1878

- **Martens described carefully the structures observed in the free surface of shrinkage cavities formed in cast pieces.**
- **He drew several conclusions from the dendrites, which he called “pinetreelike crystals“**
- **Another important element for his studies was the morphology of cleavage and of fracture surfaces**

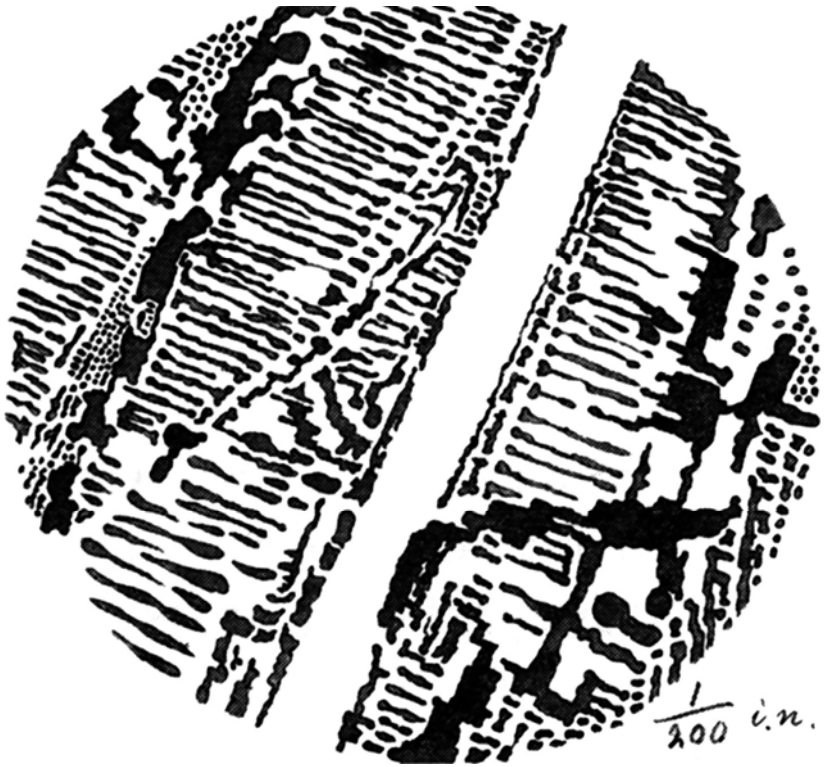
- **The most important innovation of Sorby and Martens was the investigation of sections of the pieces under investigation.**
- **The techniques for grinding and polishing were adopted from mineralogy.**
- **The importance of consumables for the quality and reproducibility of the results was carefully described in his papers**
- **Also the etching techniques were carefully developed, Martens described several chemical etchants and their applicability.**

Ref. 2, fig. 10



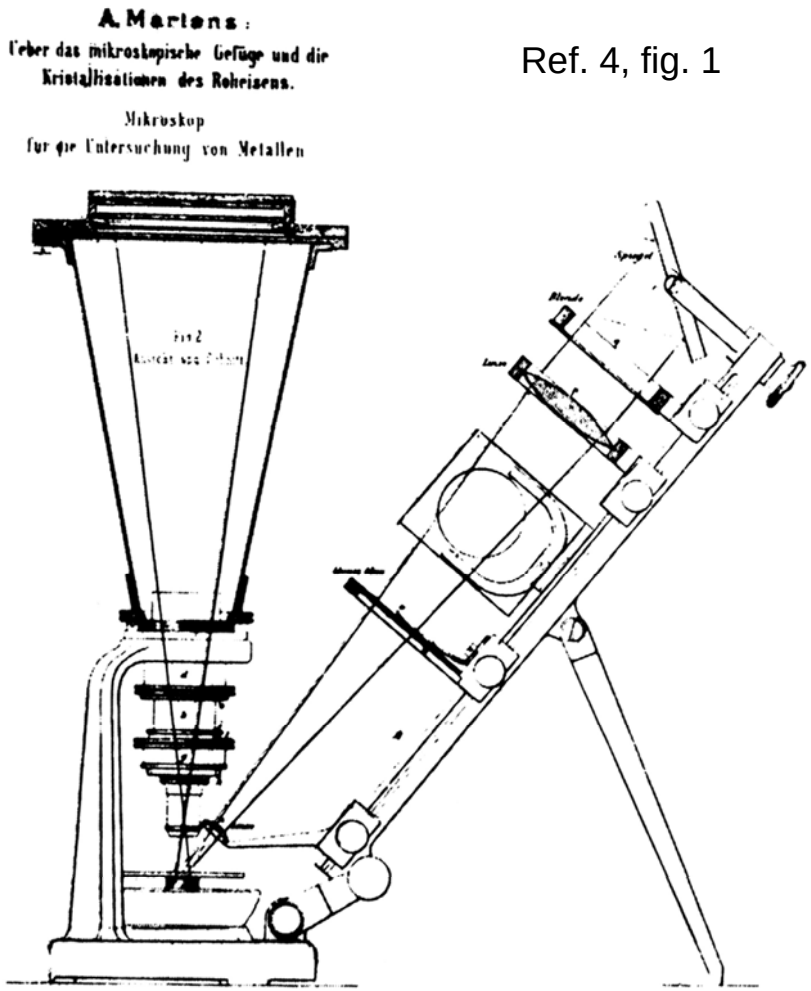
Fracture surface of a steel specimen with “Spiegeleisen”
Martens, 1878

Ref. 3, fig. 10



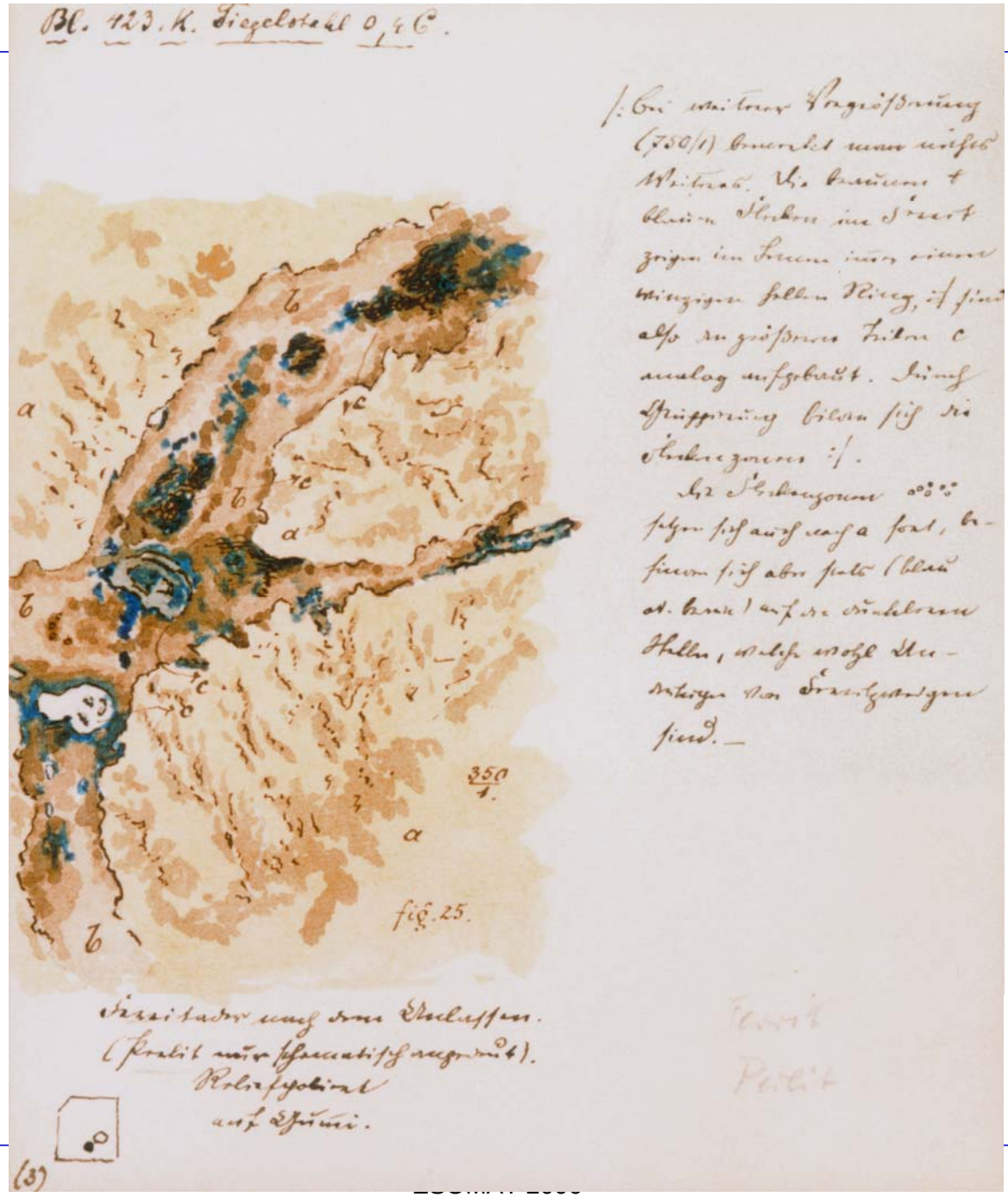
Metallographical section of a steel specimen with “Spiegeleisen” Martens, 1878

- **In 1898, Floris Osmond published in France a paper describing a general method for the microstructural analysis of carbon steels.**
- **Osmond described the characteristics of several metallographical constituents observed in steels.**
- **Following the mineralogical approach, he gave denominations to these constituents:**
  - **sorbite after Henry Clifton Sorby**
  - **troostite after Louis-Joseph Troost**
  - **martensite after Adolf Martens**

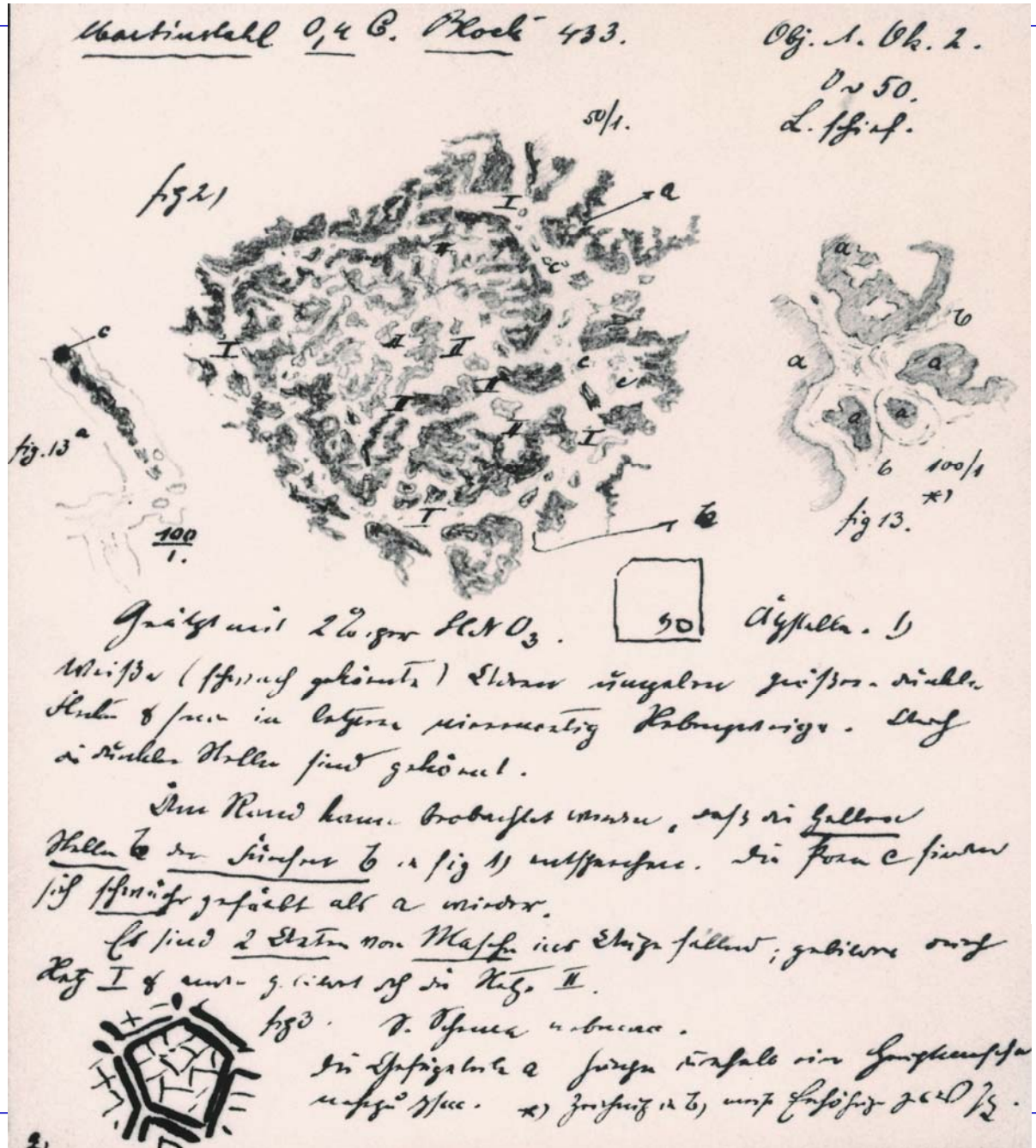


Ref. 4, fig. 1

- **In a paper published 1880 in the Journal of VDI, Martens described a new microscope suitable for the analysis of metallic sections at high magnification.**
- **An important element of this microscope was the oblique illumination of the specimen.**
- **Photographic plates could be directly exposed: Martens also gave practical advices for the deposition of adequate emulsions on glass plates.**
- **He was absolutely convinced of the much more powerful method of drawing the observed microstructure, which led to a more intense knowledge of the subject.**



Notebook of Adolf Martens, BAM, library

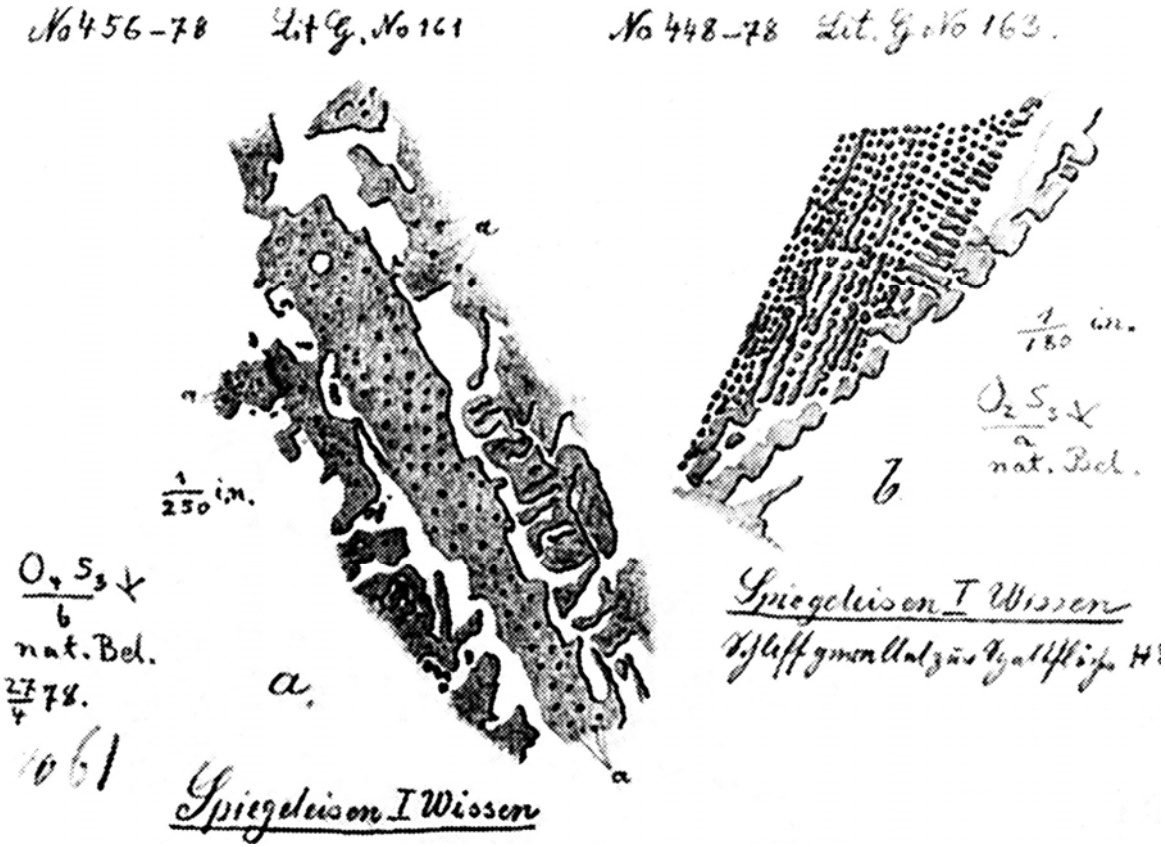


Notebook of Adolf Martens, BAM, library

Ref. 2, fig. 7

Cleavage surface of a steel specimen with “Spiegeleisen”
Martens, 1878

Ref. 3, fig. 8



Metallographical sections of a steel specimen with “Spiegeleisen”, Left hand of section normal to the cleavage surface, right hand parallel to it
Martens, 1878

Ref. 5, p. 305

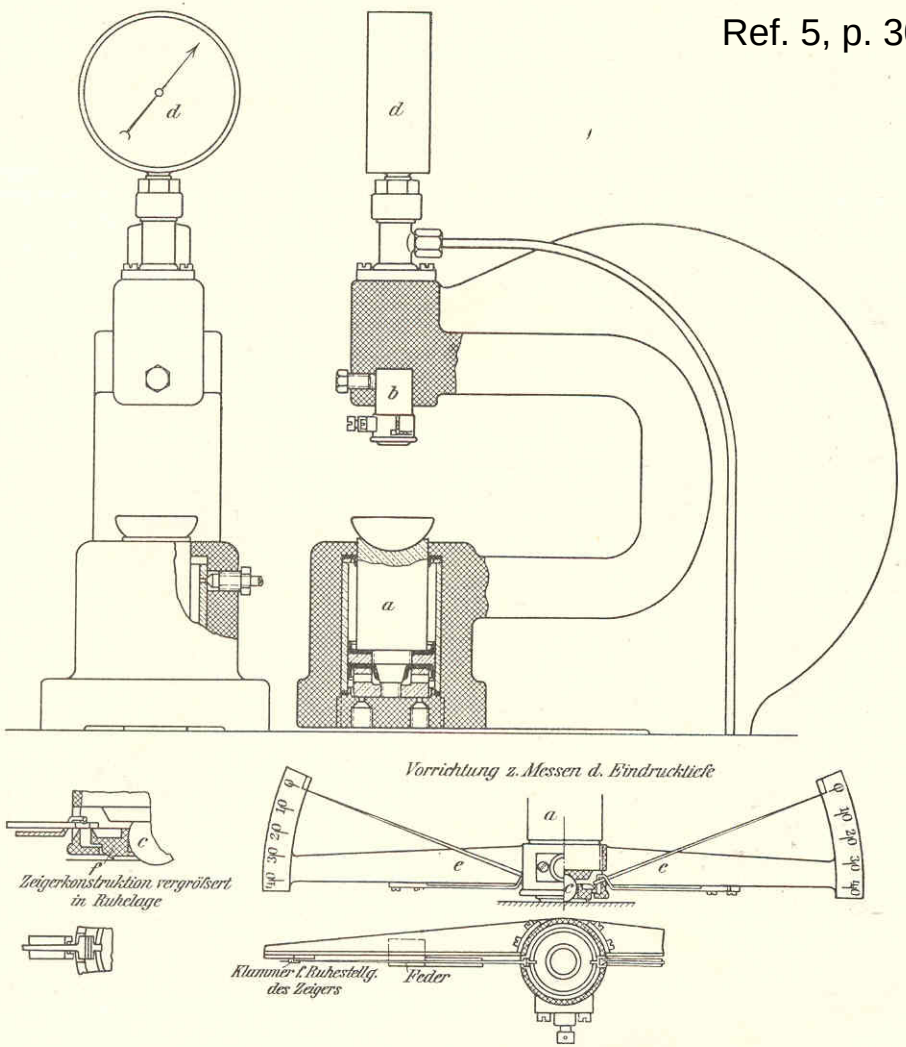


Fig. 238a. Brinelscher Härteprüfer von Martens. Werkstatt der Anstalt.

Ref. 5, p. 306

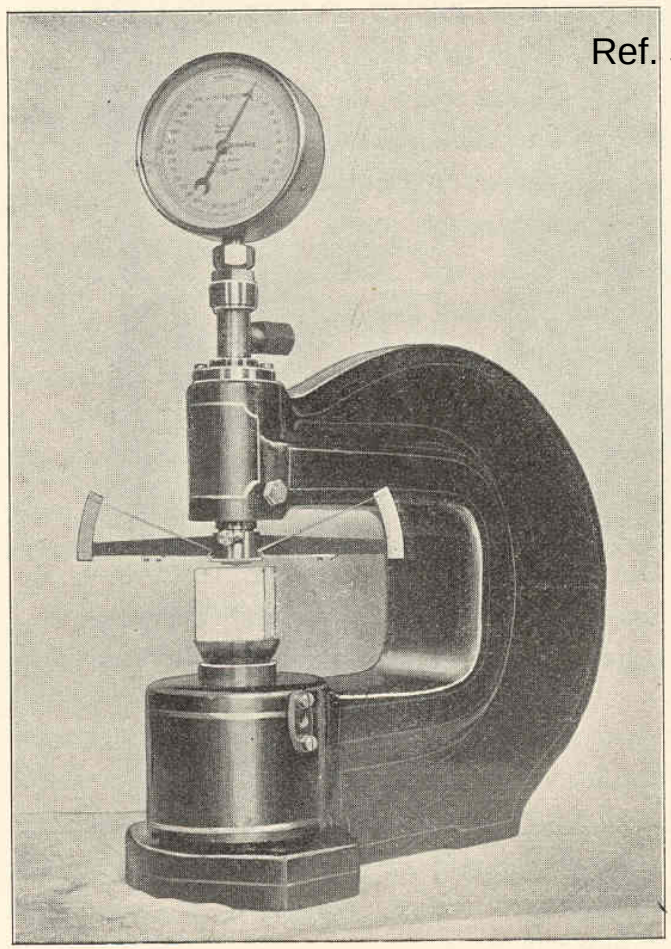


Fig. 238b. Brinelscher Härteprüfer von Martens. Werkstatt der Anstalt

Brinel hardness tester,

design by Martens, workshop

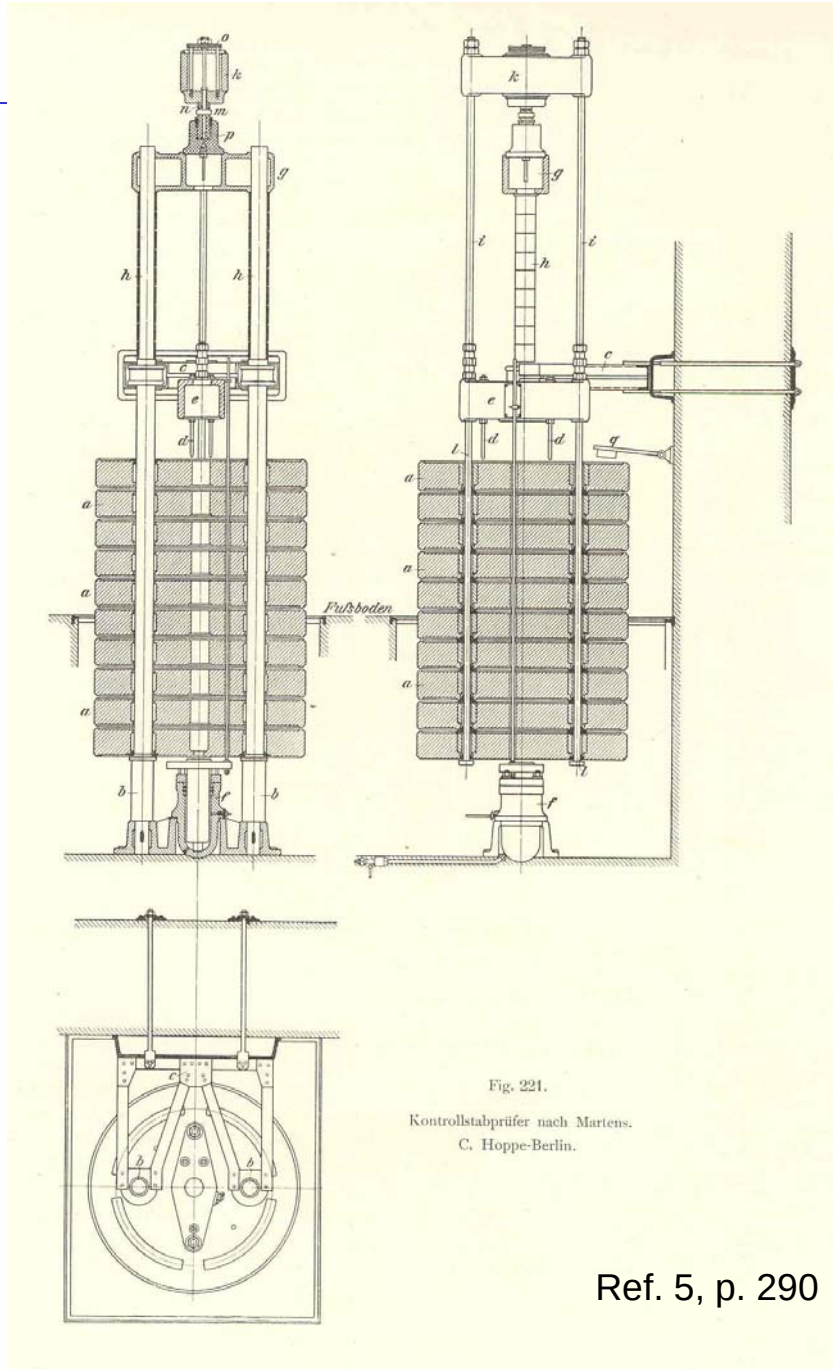


Fig. 221.

Kontrollstabprüfer nach Martens.
C. Hoppe-Berlin.

Ref. 5, p. 290

Ref. 5, p. 311

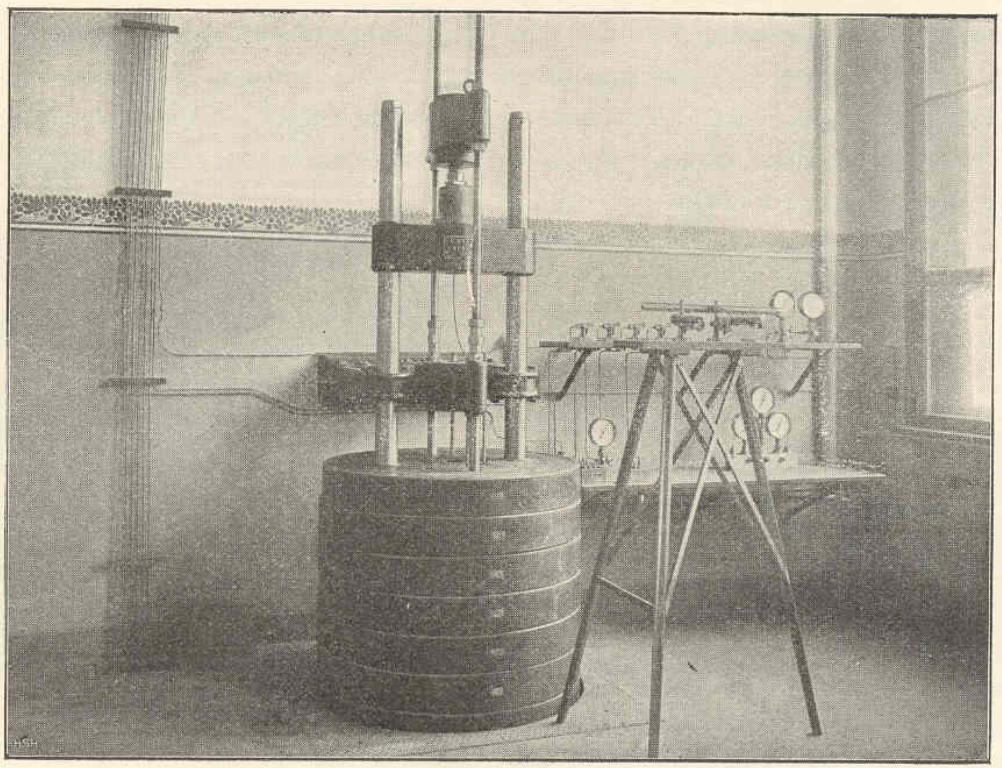


Fig. 248. Kontrollstab- und Manometerprüfung.

Calibration of load cells and manometers

10 plates of cast iron, 1.000 kg each

design by Martens, Co. Paul Hoppe, 1898

Mechanical testing - 4 MN compression testing system

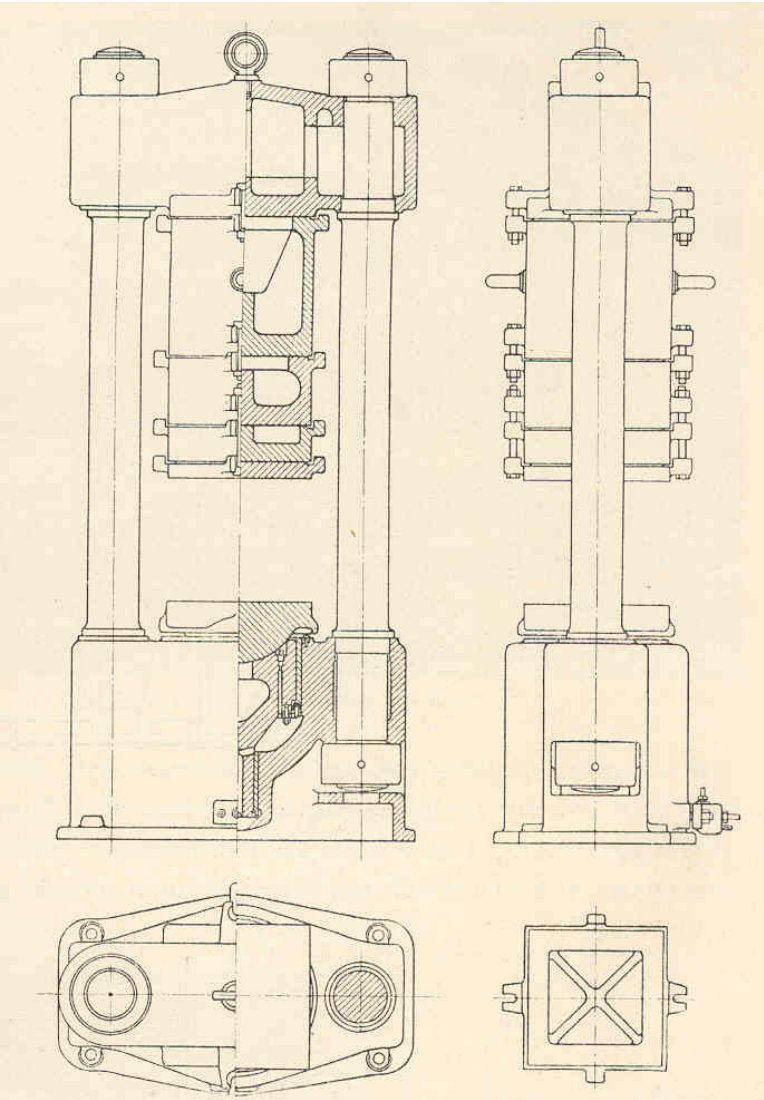


Fig. 322. 400 000 kg-Presse nach Martens.
Maschinenbaugesellschaft Nürnberg.

Ref. 5, p. 352

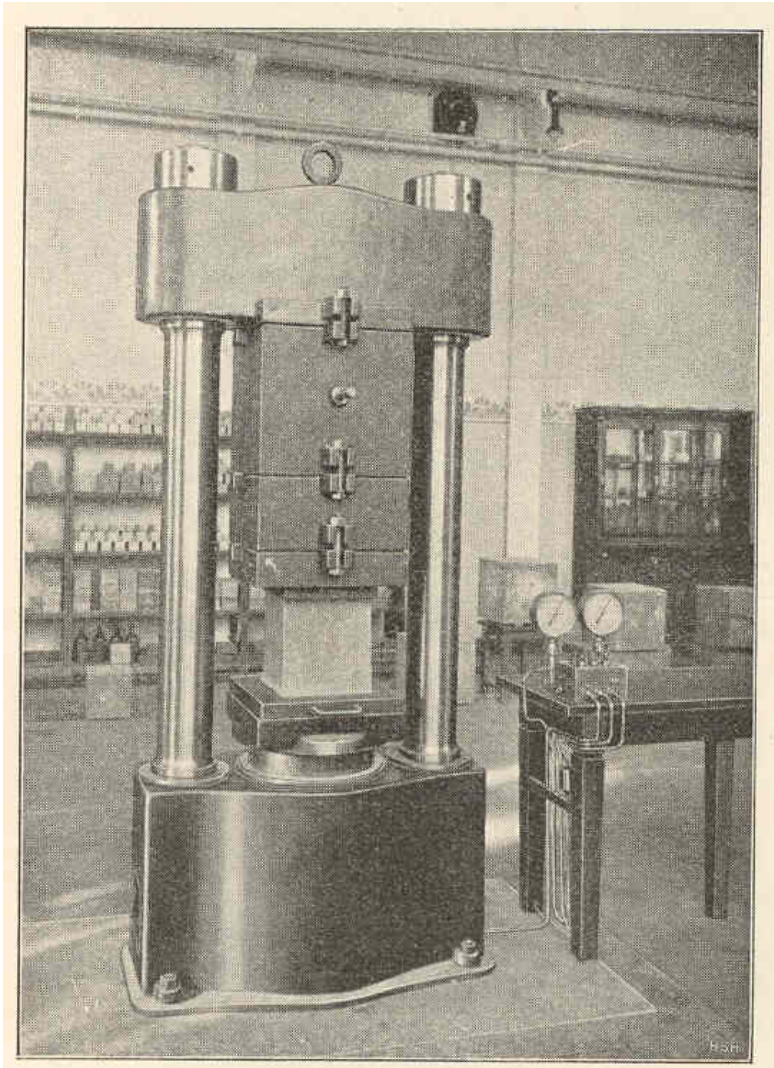


Fig. 321. 400 000 kg-Presse nach Martens.
Maschinenbaugesellschaft Nürnberg.

Mechanical testing - 500 kN testing systems

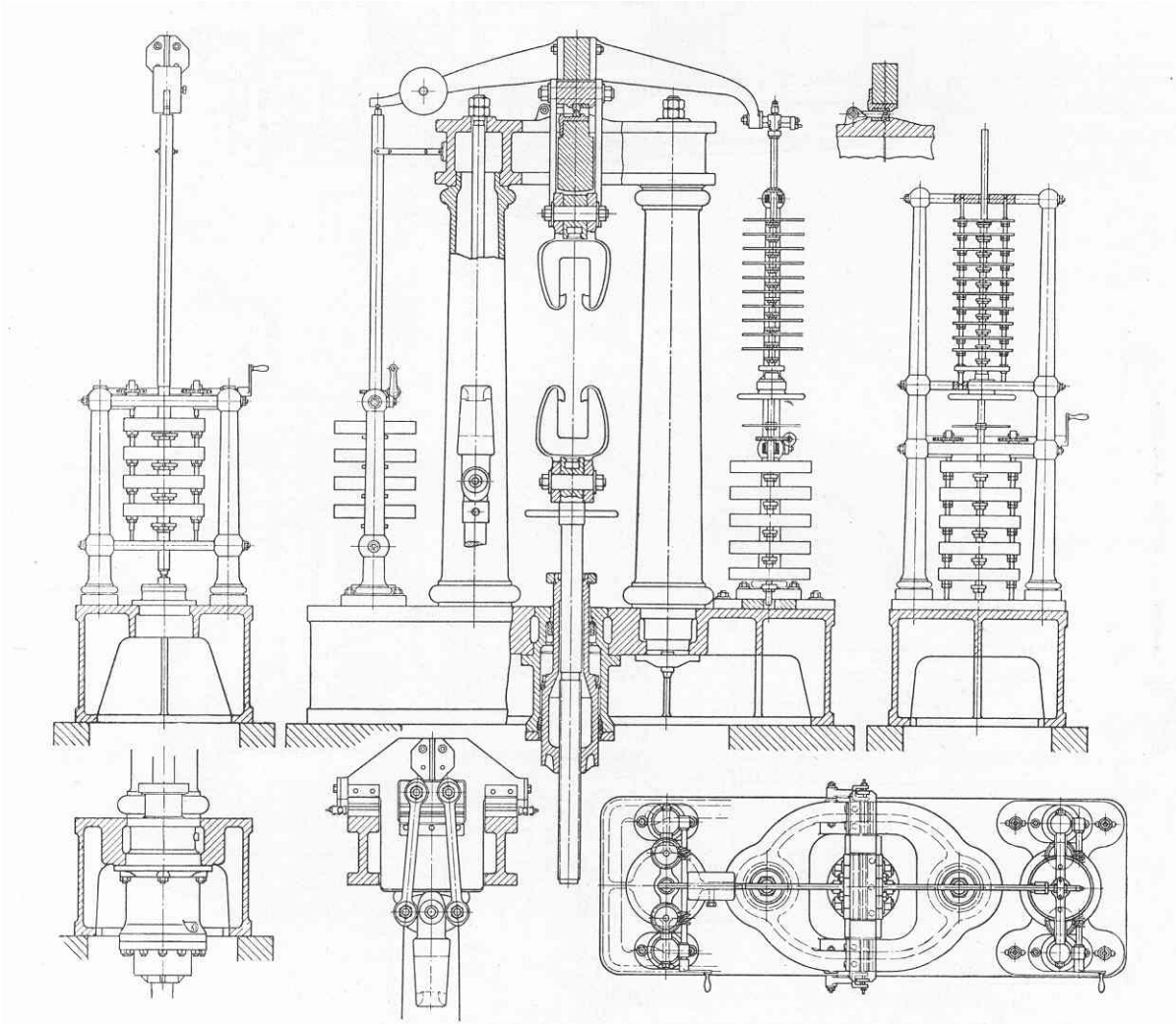


Fig. 260. Festigkeitsprobiermaschine für 50000 kg Leistung von Martens. Maschinenbaugesellschaft Nürnberg.

Ref. 5, p. 317

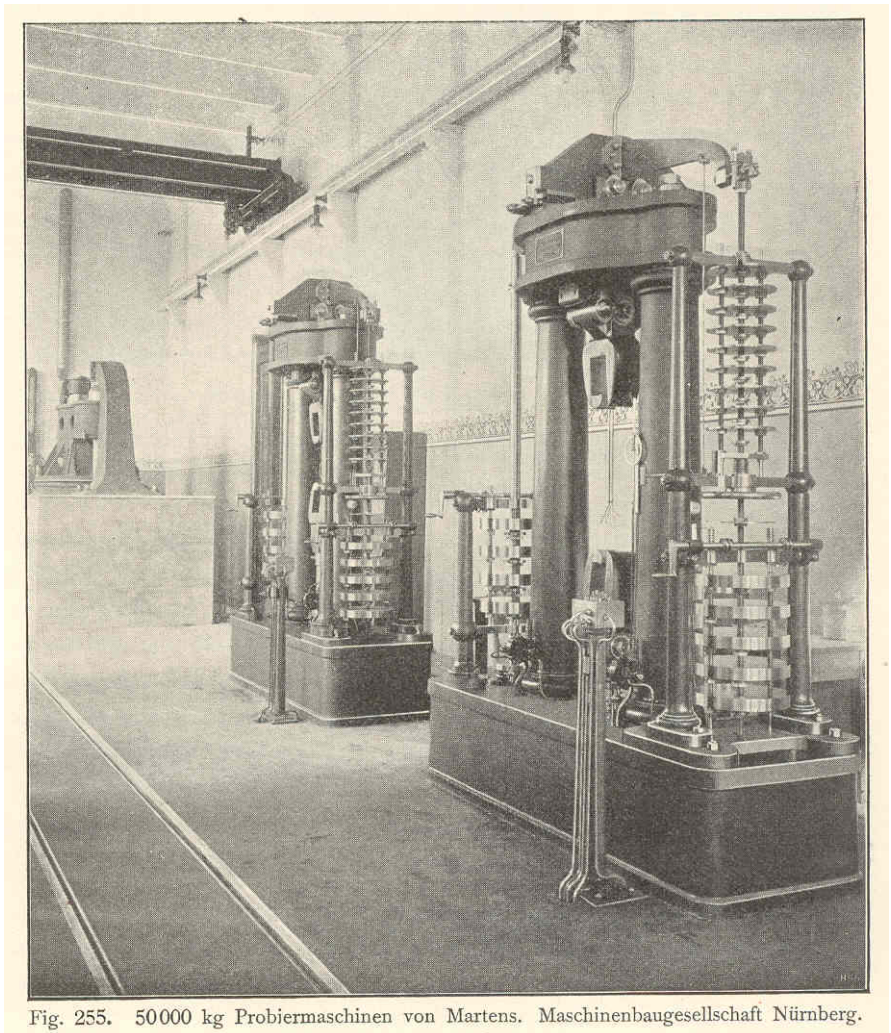


Fig. 255. 50000 kg Probiermaschinen von Martens. Maschinenbaugesellschaft Nürnberg.

Ref. 5, p. 314

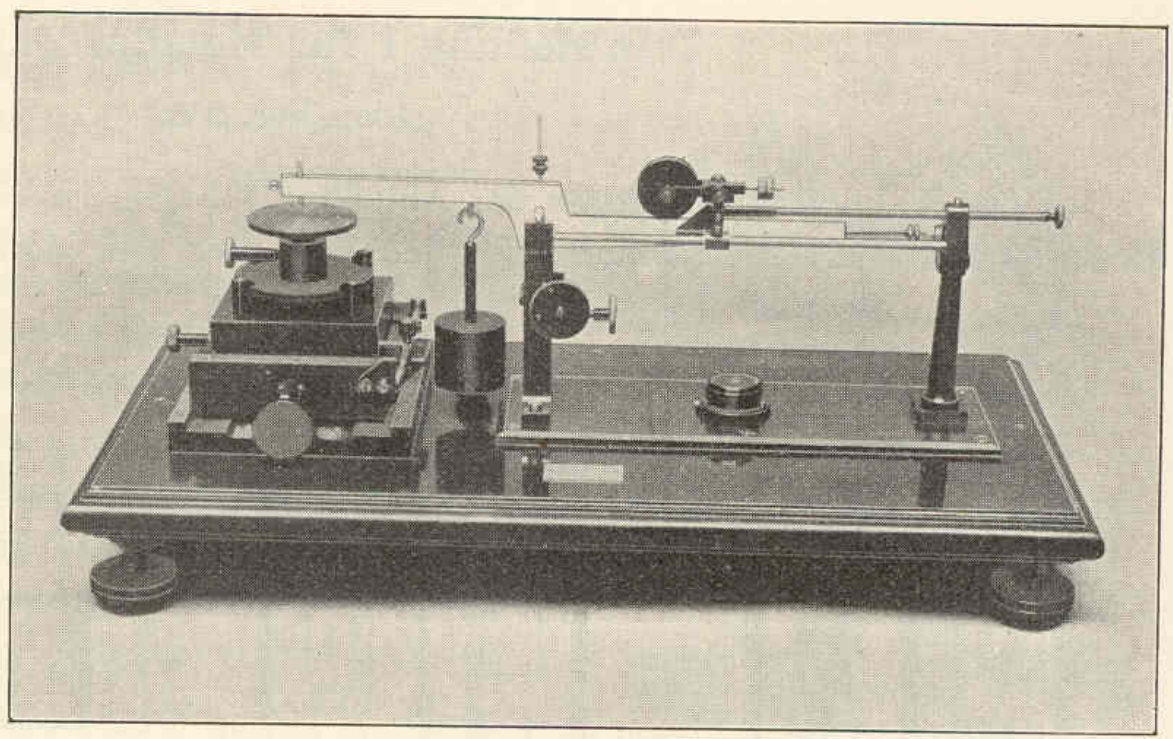


Fig. 236. Ritzhärteprüfer von Martens.
Anstalts-Mechaniker.

Ref. 5, p. 304

Scratch hardness tester

conical diamond, 90 °; varying load

design by Martens, workshop

Mechanical testing - Tensile testing system for cement

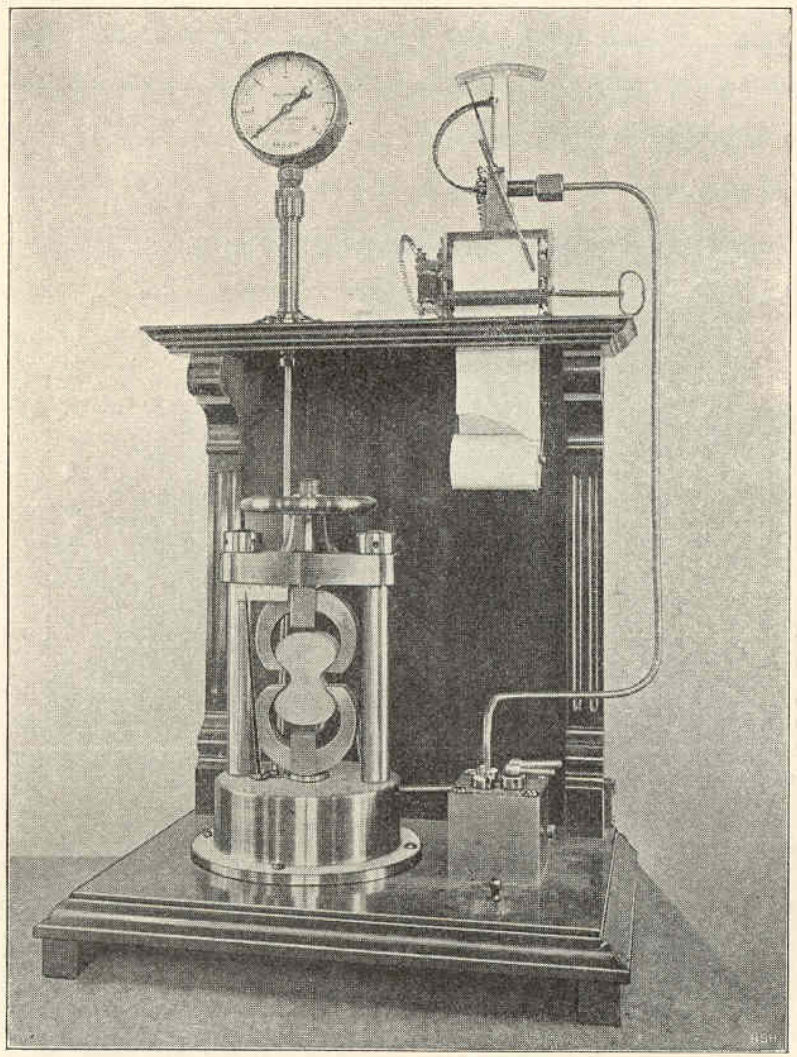


Fig. 327. Zugfestigkeitsprüfer für Zement von Martens.
Maschinenbaugesellschaft Nürnberg.
Ventile und Schreibmanometer von R. Gradenwitz-Berlin.

Ref. 5, p. 355

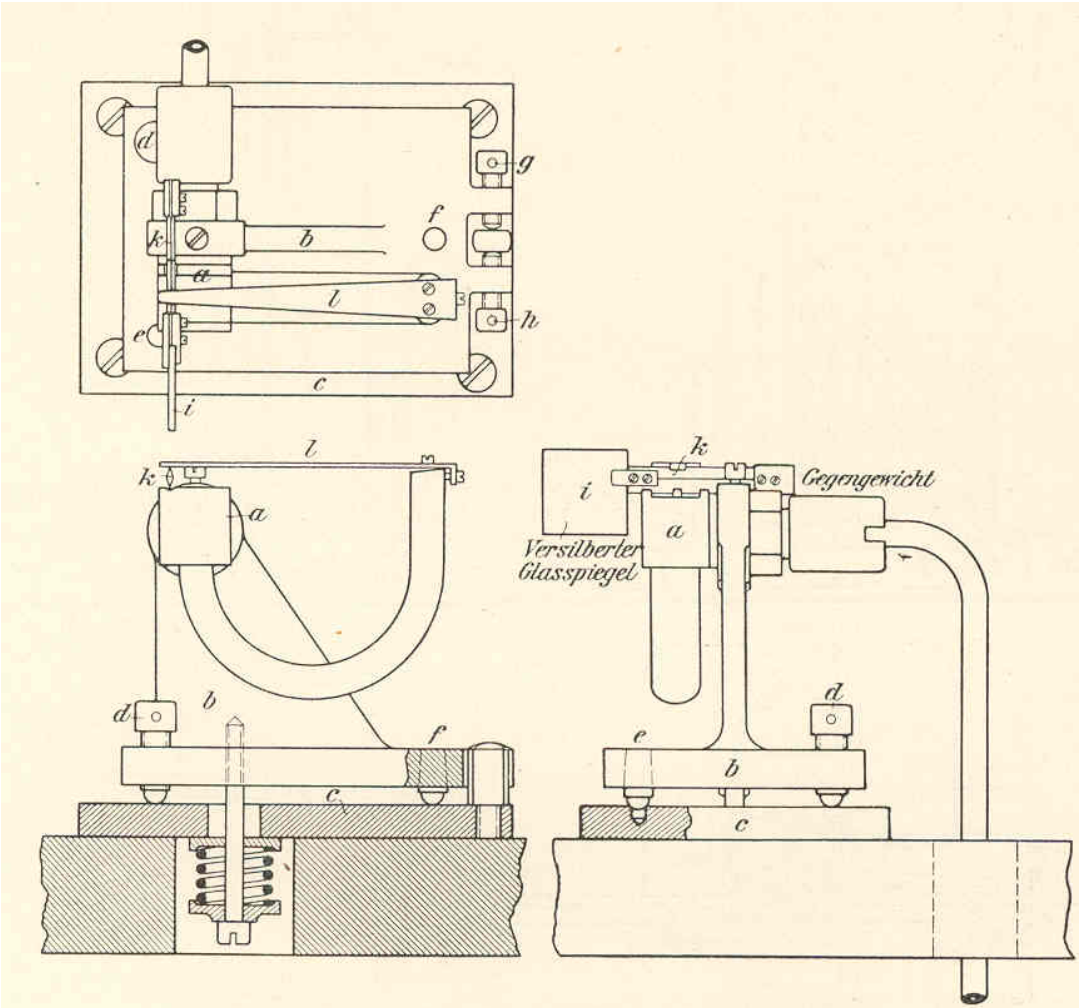


Fig. 226. Manometer mit Spiegelablesung von Martens. Schäffer & Budenberg-Buckau.

Ref. 5, p. 295

Manometer with mirror measurement, design by Martens

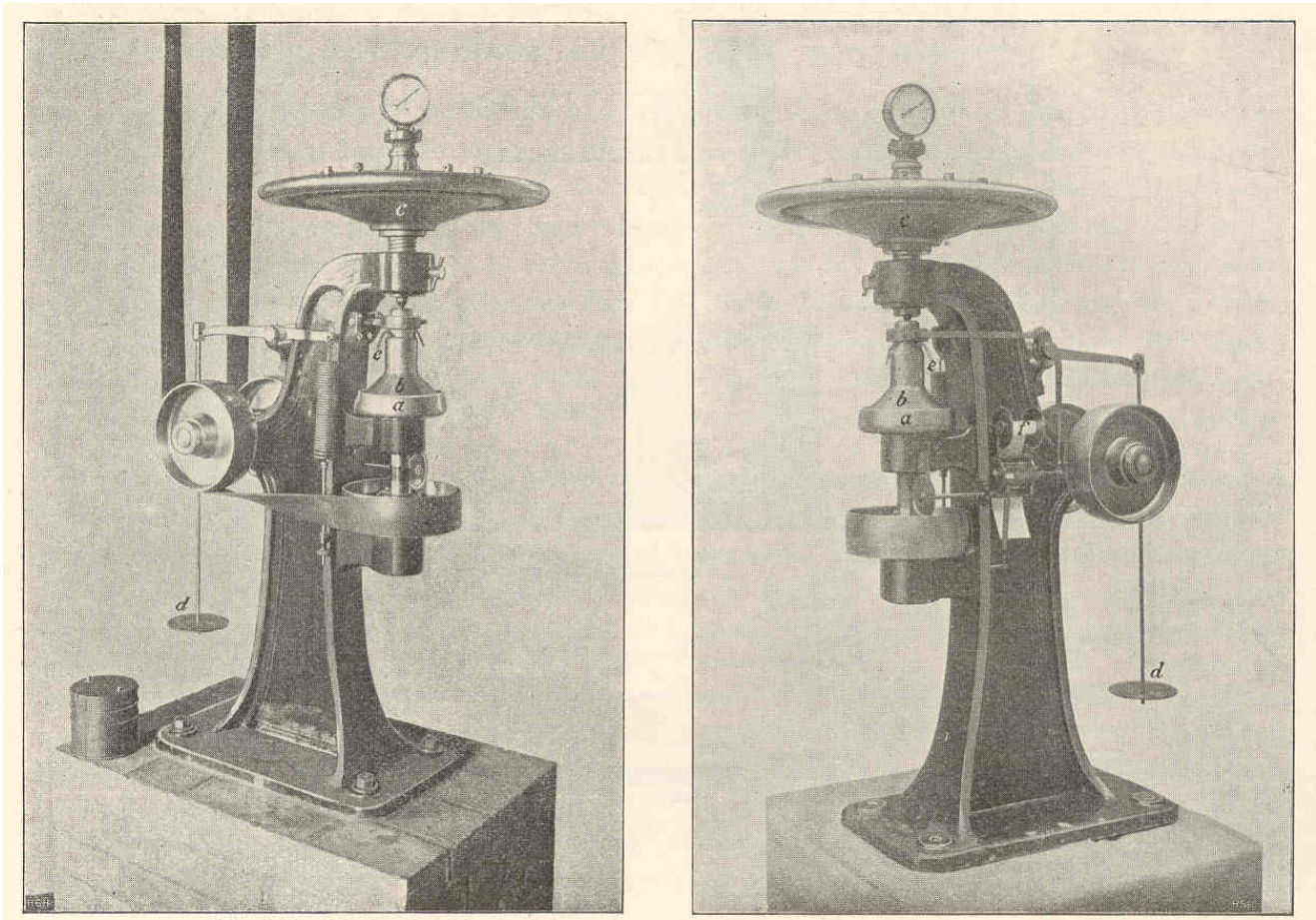


Fig. 240. Schmierölprobiermaschine von Martens. Mechanische Werkstatt der Anstalt.

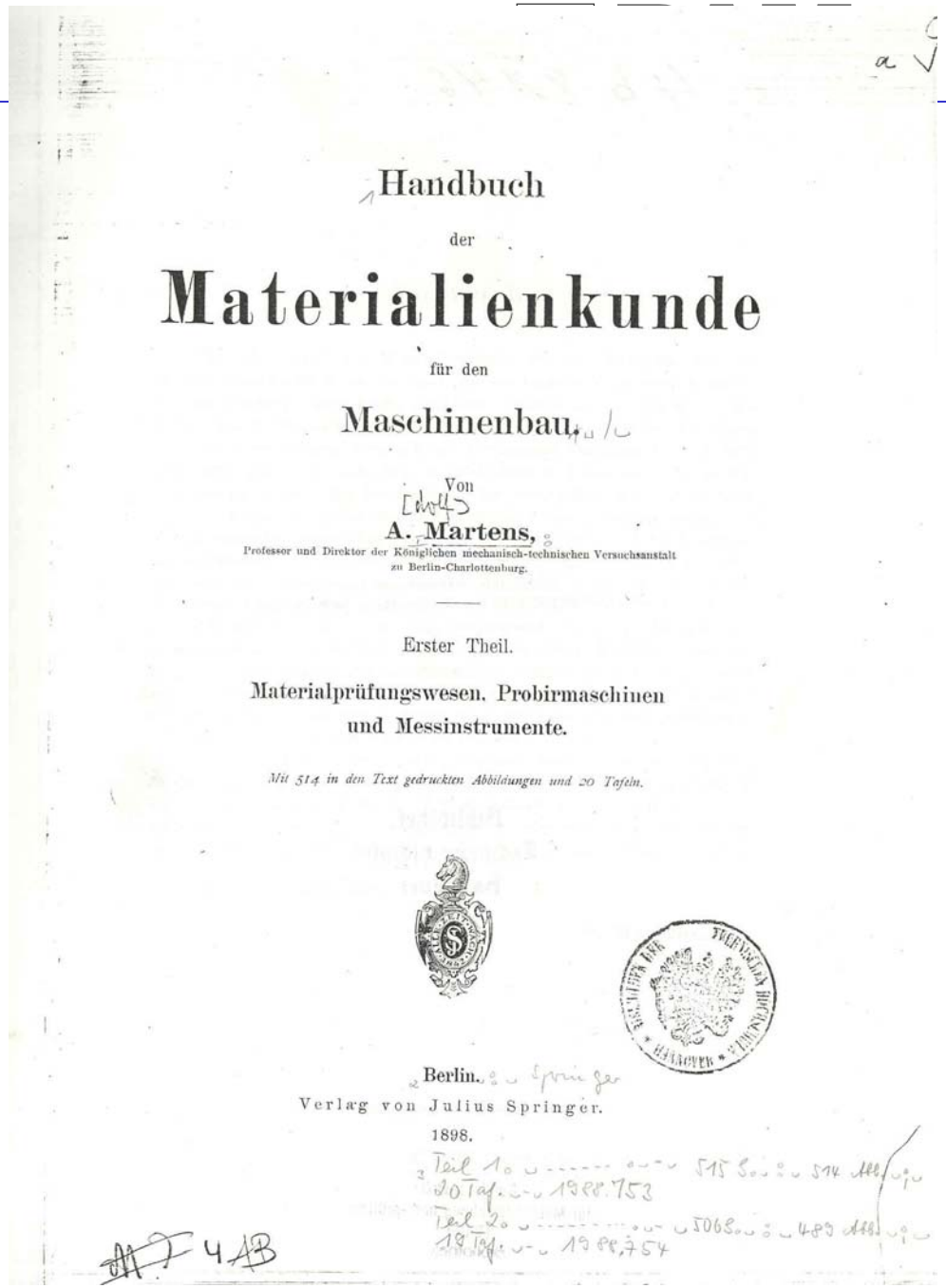
Ref. 5, p. 306

Testing of lubricant oil

change of viscosity under continuous loading, analysis of decomposition products

design by Martens, workshop

- **Adolf Martens**
  Handbook of Materials Technology for Mechanical Engineering
  Part I - Materials Testing
  Berlin: Julius Springer, 1898



Handbuch

der

Materialienkunde

für den

Maschinenbau.

Von

A. Martens,

Professor und Direktor der Königlichen mechanisch-technischen Versuchsanstalt zu Berlin-Charlottenburg.

Erster Theil.

Materialprüfungswesen. Probirmaschinen und Messinstrumente.

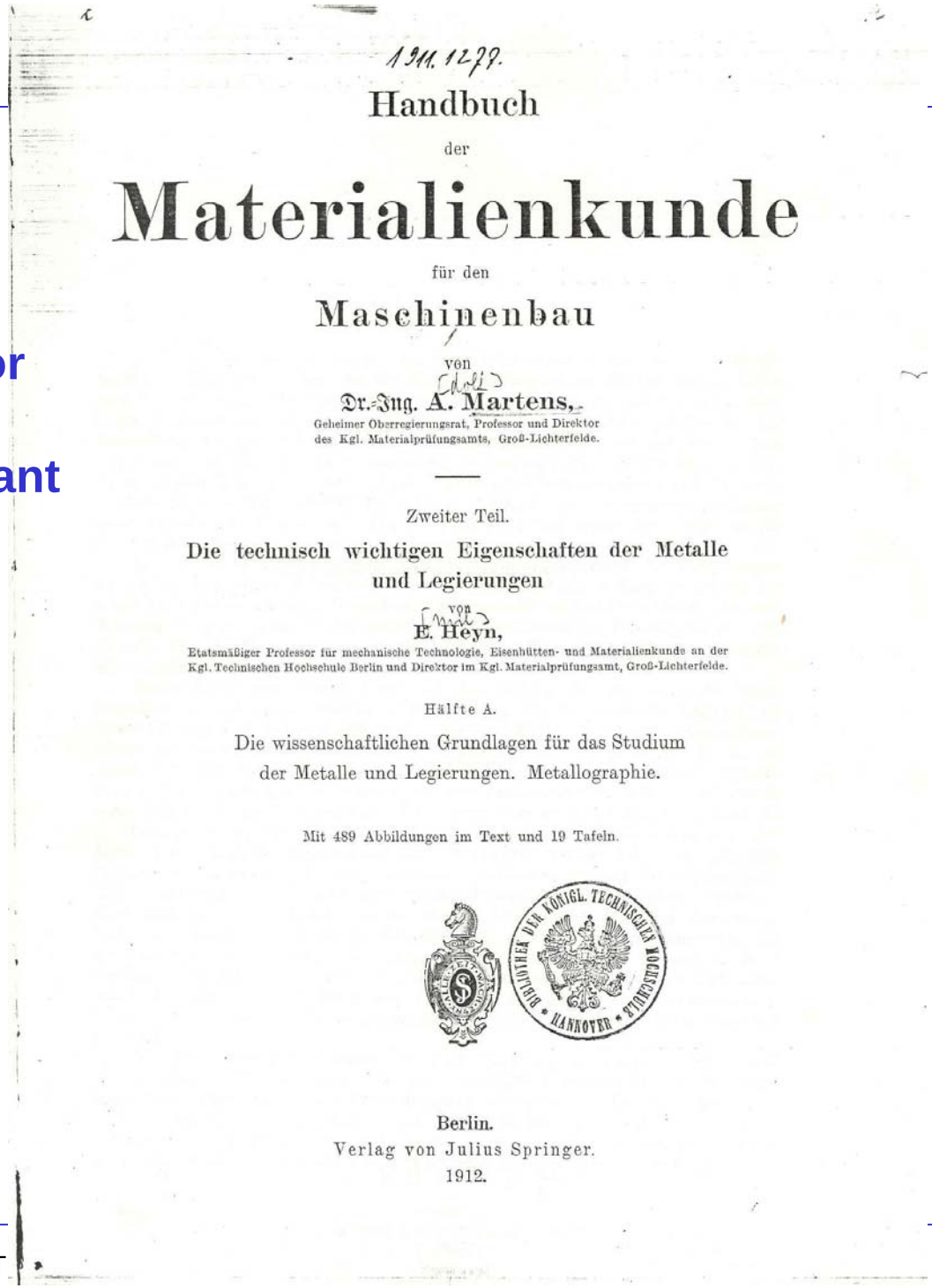
Mit 514 in den Text gedruckten Abbildungen und 20 Tafeln.

Berlin.

Verlag von Julius Springer.

1898.

- **Emil Heyn**
  Handbook of Materials Technology for Mechanical Engineering
  Part II - The technically most important properties of metals and alloys
  Edited by Adolf Martens
  Berlin: Julius Springer, 1912



1911. 1279.

Handbuch

der

Materialienkunde

für den

Maschinenbau

von

Dr.-Ing. A. Martens,

Geheimer Oberregierungsrat, Professor und Direktor des Kgl. Materialprüfungsamts, Groß-Lichterfelde.

Zweiter Teil.

Die technisch wichtigen Eigenschaften der Metalle und Legierungen

von

E. Heyn,

Etatsmäßiger Professor für mechanische Technologie, Eisenhütten- und Materialienkunde an der Kgl. Technischen Hochschule Berlin und Direktor im Kgl. Materialprüfungsamt, Groß-Lichterfelde.

Hälfte A.

Die wissenschaftlichen Grundlagen für das Studium der Metalle und Legierungen. Metallographie.

Mit 489 Abbildungen im Text und 19 Tafeln.

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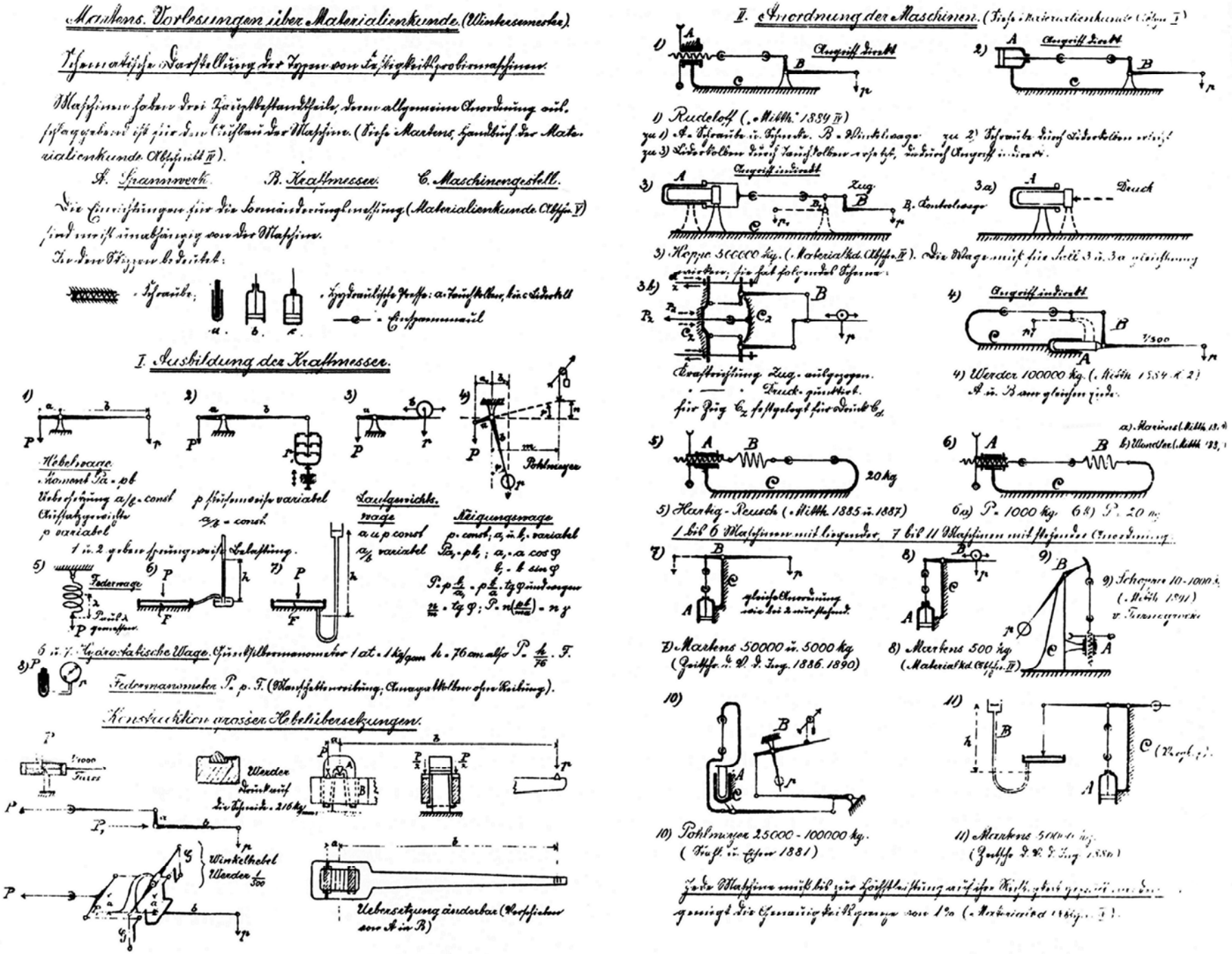
1912.


Martens. Vorlesungen über Materialienkunde. (Winkelmesser)
I. Ausbildung der Kraftmesser.
II. Anordnung der Maschinen.
A. Spannwerk
B. Kraftmesser
C. Maschinengestell
Hebelwage
Federwage
Pohlmeyer
Laufgewichts-wage
Neigungswage
Konstruktion grosser Hebelübersetzungen.
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Zug
Druck
Kappe 500000 kg.
Werder 100000 kg.
Harbig-Reusch
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Markens 5000 kg.

- **Adolf Martens made important contributions to materials engineering, especially in the fields of metallography and mechanical testing of materials**
- **His name is tightly connected to the martensitic transformation and to martensite, even though he did not work directly in this area**
- **His name is also directly connected to the instrumented indentation testing, the Martens hardness, HM (DIN EN ISO I4577-3, according to ISO/TC 164/SC 3 "Hardness Testing of Metals“, meeting on June 20th, 2000 in Berlin)**

[1] Adolf Martens, Ueber die mikroskopische Untersuchung des Eisens
Zeitschrift des Vereines Deutscher Ingenieure 22 (1878) 11-18

[2] Adolf Martens, Zur Mikrostructur des Spiegeleisens – Die Erscheinungen auf den Bruchflächen
Zeitschrift des Vereines Deutscher Ingenieure 22 (1878) 205-214

[3] Adolf Martens, Zur Mikrostructur des Spiegeleisens – Die Erscheinungen auf den Schliffflächen
Zeitschrift des Vereines Deutscher Ingenieure 22 (1878) 481-488

[4] Adolf Martens, Ueber das mikroskopische Gefüge und die Krystallisationen des Roheisens, speciell des grauen Eisens
Zeitschrift des Vereines Deutscher Ingenieure 24 (1880) 397-406

[5] Adolf Martens and Manfred Guth, Das Königliche Materialprüfungsamt der Technischen Hochschule Berlin auf dem Gelände der Domäne Dahlem beim Bahnhof Groß-Lichterfelde West – Denkschrift zur Eröffnung. Berlin: Verlag von Julius Springer, 1904

[6] Emil Heyn, Adolf Martens
Stahl und Eisen 34 (1914) 1393-1395

[7] Walter Ruske, Gerhard W. Becker and Horst Czichos, 125 Jahre Forschung und Entwicklung, Prüfung, Analyse, Zulassung, Beratung und Information in Chemie- und Materialtechnik. Berlin: BAM,1996.