# The Pantograph Demythologized

*Or,*

*Half an Hour of Heresy*

Dr. David M. MacMillan
Circuitous Root
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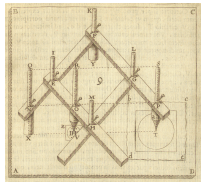
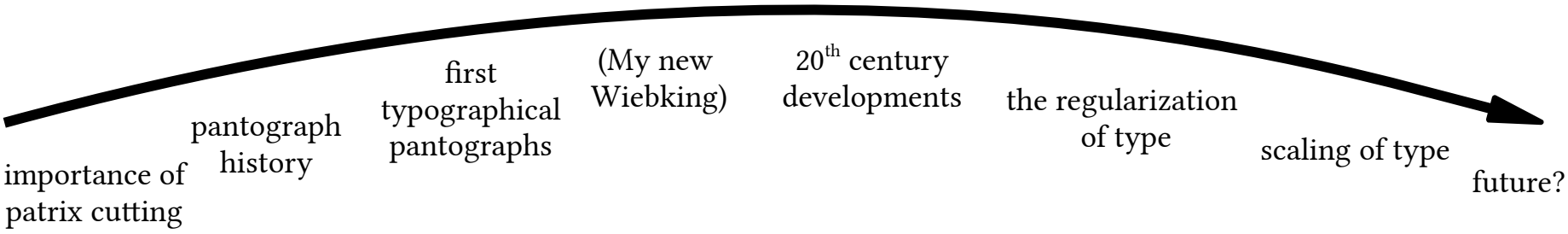


2018

# A large-scale argument questioning the accepted history of the mechanization of type-making



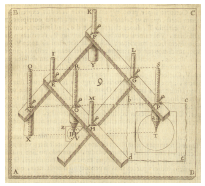

120+ slides
(Yikes!)

*Way* too much for a half-hour talk

This is the full version, for your reference.
I'll do a highly abbreviated version for the talk.

Online at:

www.CircuitousRoot.com/artifice/letters/pantocut/index.html



# A Different Perspective

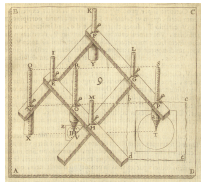
Mine is an outsider's view.

I was not trained in printing or the graphic arts, but in literature (Ph.D.) and computer programming (the family profession for sixty years).


1960. My father, Vernon MacMillan (1937–2012), is fifth from the left.

So I have had no instructor in type.
I've never had to give the correct answer on a test.
I just read the books and examine the evidence.

Frequently, I find that they do not match.



# One Such Area

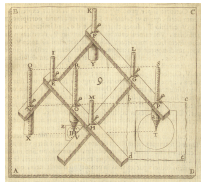
## The Mechanization of Matrix-Making

Two random modern examples of the canonical story:

> Punch-cutting was finally mechanized in 1885 with the invention of Linn Boyd Benton's punch-cutting pantograph.
>
> - Simon Eliot. *A Companion to the History of the Book.* (2011)

> In 1885 Linn Boyd Benton ... invented ... the Benton punchcutting machine ... it did not cut punches but instead engraved matrices ... via pantograph.
>
> - Paul Shaw. *Revival Type.* (2017)

The problem: Everything in these statements is false.



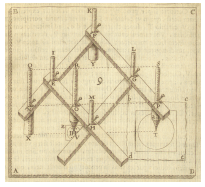
# No Easy Fix

The problem is not in the detailed errors, which would be easy to fix (e.g., 1885 vs. the real patent filing date in February 1884).

> **The problem is that this story misrepresents what was really going on with high-technology and type-making in the 1880s.**

This presentation explores:

- What really happened
- The consequences of both:
  - The mechanization of type-making
  - Our misunderstanding of it

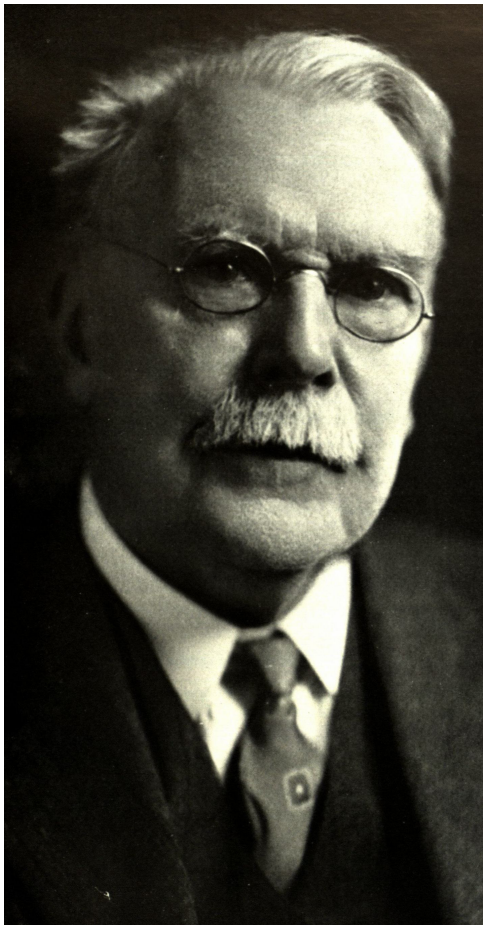


# An Important Disclaimer

Many times I'll say "Benton didn't…" or "Benton wasn't…"

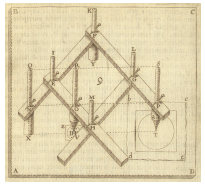
I'm not Benton-bashing. His work was extraordinary, important, and extremely influential.

It's just that there was so much more and so much before.



Linn Boyd Benton. 1844–1932

*The Inland printer.* Vol. 89, No. 5 (Aug. 1932).



To tantalize: By the time the evidence shows that Benton was engraving matrices, you could purchase matrix engraving services on the open market and a number of important faces had already been cut.

# *A Quick Map of what Follows*

Technology…

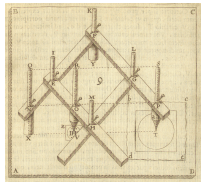
- Patrices and Electroforming
- Early Pantographs & Related Devices
- Nontypographical Pantographs, 19th & 20th C.
- Typographical Pantographs, 1880 onward
- Spotlight: The Wiebking Pantographs

… and Its Discontents

- The Evolution of the Concept of a "Typeface"
- Type Body Size and Hand & Machine Cutting
- "Law Unto Itself": Updike. Harry Carter.
- The Algorithmic Design of Type

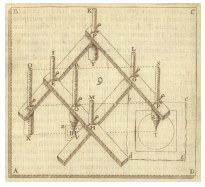
Appendices

- List of Typographical Pantographs
- Census of Surviving Machines [incomplete]
- Wiebking/Hardinge Survival



# Part 1:

# Technology …



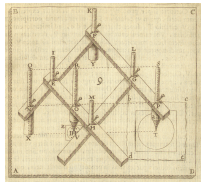
# Why Look at Patrix Cutting First?

- It is an extremely important aspect of
  the general mechanization of matrix making in the 19th century.

- If we don't understand just how common hand patrix cutting was, we will:

  - Underestimate the pre-1880s production capacity for matrices.

  - Misunderstand the use of some of the earliest pantographs
    (especially Benton's) for cutting both punches and patrices.



# Quick Technical Review

(Simplified)

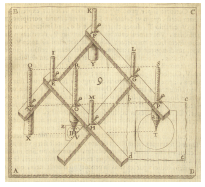
Three major methods of creating a matrix from a new design:

Engrave a **punch** in steel, harden the steel punch,
then **strike** (or press) a matrix (and then **justify** it).
With or without the use of **counterpunches**, depending on your tradition.
Cutting/engraving either by hand or by rotary-spindle pantograph.

Engrave a **patrix** (pattern letter) in soft metal (near-typemetal, or brass),
then **electroform** (aka "electrotype") a matrix.
Cutting/engraving either by hand or by rotary-spindle pantograph.
(A patrix is very much like a punch, but in soft metal.)

Engrave a **matrix** directly,
Done only by rotary-spindle pantograph, not by hand.

Other methods not considered here:
- Sand casting (for large letters, 18th century and earlier)
- Hand cut punches, intermediate lead matrices, and sand-cast brass matrices finished by repunching (for large types; see Nelson & Mosley)
- "Sanspareil" matrices (hand-cut and assembled, late 18th century)
- Composite methods (Rimmer: Punch, cast type, trim beard, electroform new mat)
- CNC matrix engraving

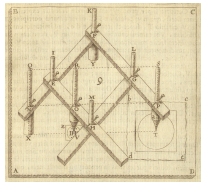


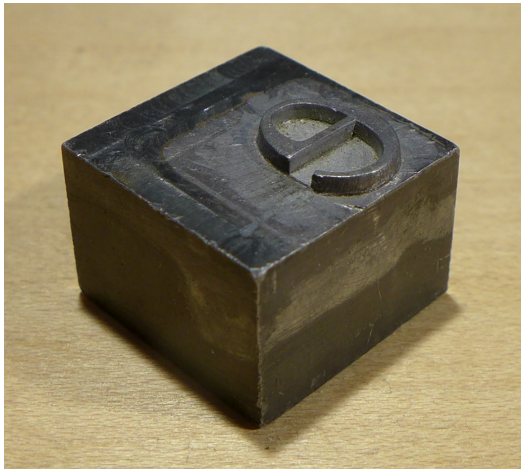
# Punch, Patrix, Matrix

(2016)

A hand-cut punch

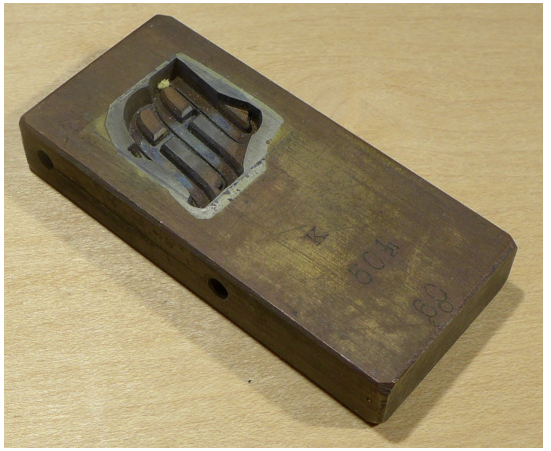
A punch, probably hand-cut.
Thompson Type Machine Co.
(Early 20th c.)



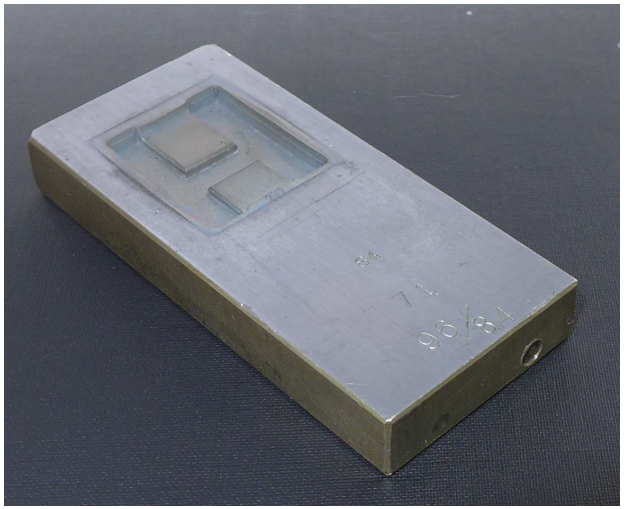


*Probably* a patrix. (20th c.)
Provenance unknown.

A machine-cut punch. (1917)
Lanston series 61, Cochin.
12 pt for composition.



An Electroformed Matrix. (1922)
ATF Series 476 Goudy Handtooled Italic.
60 point. For the Barth Type Caster.



A Directly Engraved Matrix. (1930+)
ATF Series 530 Bernhard Gothic Heavy.
96pt / 84pt titling. For a pivotal type caster.

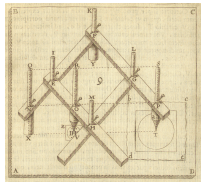
# Terminological Notes

There is no standard terminology
(not a surprising problem in a field that nobody talks about).

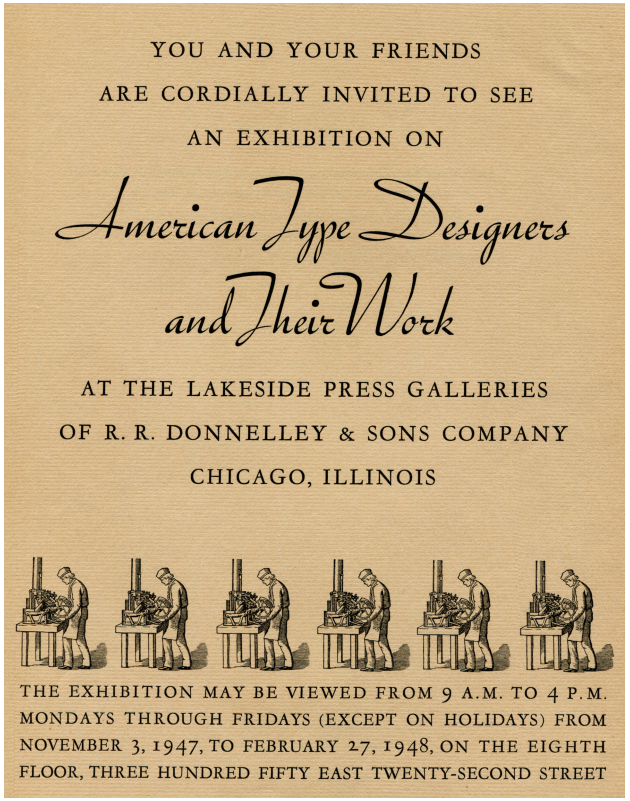
I'll say "patrix" (patrices), because logically it fits well with "matrix." It was also what Jim Rimmer called them - if it's good enough for him, it's good enough for me.

I'll say "electroforming," though that word was not used at the time. It is the term in modern industry for what this process is (heavy electroplating to produce a formed object).
At the time the term used was often "electrotype," but this is confusing as it also means something else (an electrotype plate).

The material used was simply called "metal," meaning something close to typemetal, but not steel. Sometimes they'd say "soft metal." When they meant punches in steel, they said "steel." The metal seems to have been slightly softer than regular typemetals.

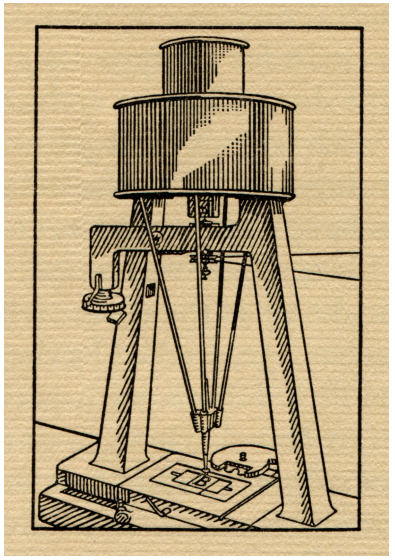


# Patrix Cutting and Matrix Electroforming

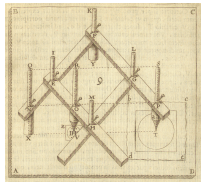



"[in Abel Buell's time / 1759] the making of type was entirely a hand operation. ... It was not until the invention of the Benton pantograph punch-cutting machine in 1885 that any other method was known. All type made before 1885 was therefore dependent on hand punch cutting, ..."

- Carl Purington Rollins (1947)

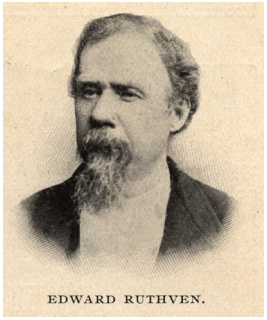


Rollins' list of who designed which type remains the basis for all such lists today.*
He knew his type.
Yet he did not know that patrix cutting existed.



* Partial earlier lists appeared in *The Inland Printer* in 1927 & 1898-1900 (Loy).

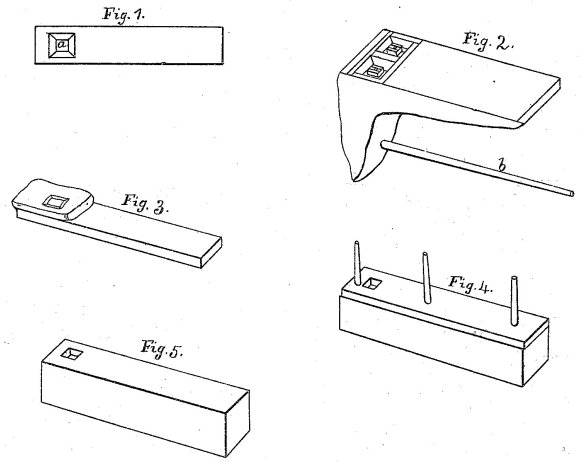
# Origins of Matrix Electroforming



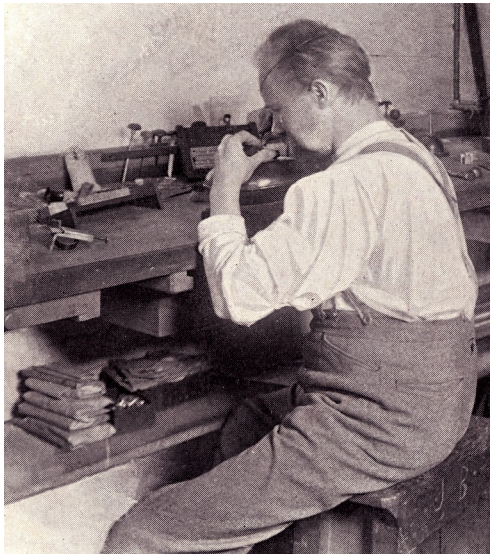

At the Johnson, Bruce, Keystone, and Inland Foundries


At the Ryan Foundry and ATF. Co-founded Compositype

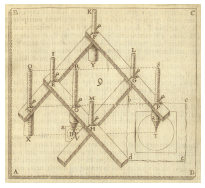
Conner's foundry, circa 1840.
Widespread in America by 1844.
Thomas W. Starr patent 1845.
In Europe by 1846
(Enschedé, also in Germany).




From Starr's 1845 patent



Hand patrix engraving at the Philadelphia foundry (C) of ATF (ex-MSJ).
From *One Hundred Years* (1896).



See Silver's "Trans-Atlantic Crossing" (1974), but that concerns both regular electrotyping and matrix making. See Saxe's 2016 article on the Bruce Pivotal for a study of the history and significance of matrix electroforming.

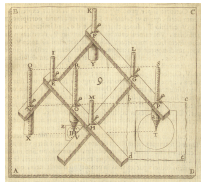
# Widespread Use for New Types

"The discovery of the electrotype process … became an incentive to type founders to create new faces, … This made it possible to bring out new styles at a moderate cost, as the pattern letters are cut on soft metal and electrotyped, instead of the old method of cutting everything on steel."

- William E. Loy (1898)

"The present practice is to cut letters larger than 14-point in soft metal"

- Harry Carter (*Fournier*, 1930). Q.E.D.



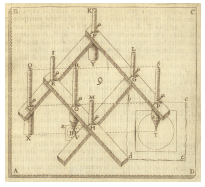
See Saxe's 2016 article for a study of the role of patrix cutting and the pivotal type caster in enabling 19th century ornamented types.

# But Forgotten in the US (and England?)

Recall what Rollins said in 1947: "[no] other method was known."

Few people in the later 20th century knew type better than Mac McGrew, but…

> "WEDDING TEXT … It is recorded that the 12-point size was cut in type metal in that year [1901], instead of cutting punches or engraving matrices directly. Electrotype matrices were then made from these cuttings. *It is uncertain whether this new method of cutting delicate faces resulted in unusual problems and delays*, but the face was hailed as 'new' in 1907 and again in 1909.
>
> - McGrew. (1993) [italics mine]



# Misidentification of Images

Many of illustrations commonly identified as showing “punchcutting” are of patrix cutting.

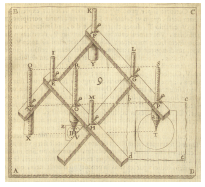
Example: Lane & Lommen (*Dutch Typefounders’ Specimens*, 1998) illustrate the engraving room of Typefoundry Amsterdam in 1948. They explain the presence of “hand punchcutters” (who shouldn’t exist alongside pantographs) by saying that they “probably finished details that were difficult to make with a pantograph.” In fact, they are clearly patrix engravers.


Willi Harwerth, *Klingspor Kalendar* (for 1924), January.

Gerald Cinamon, in his biography of Rudolf Koch, says that this shows a punchcutter. The tools are those of the patrix cutter.

This one confused me to no end until I learned about patrix cutting.

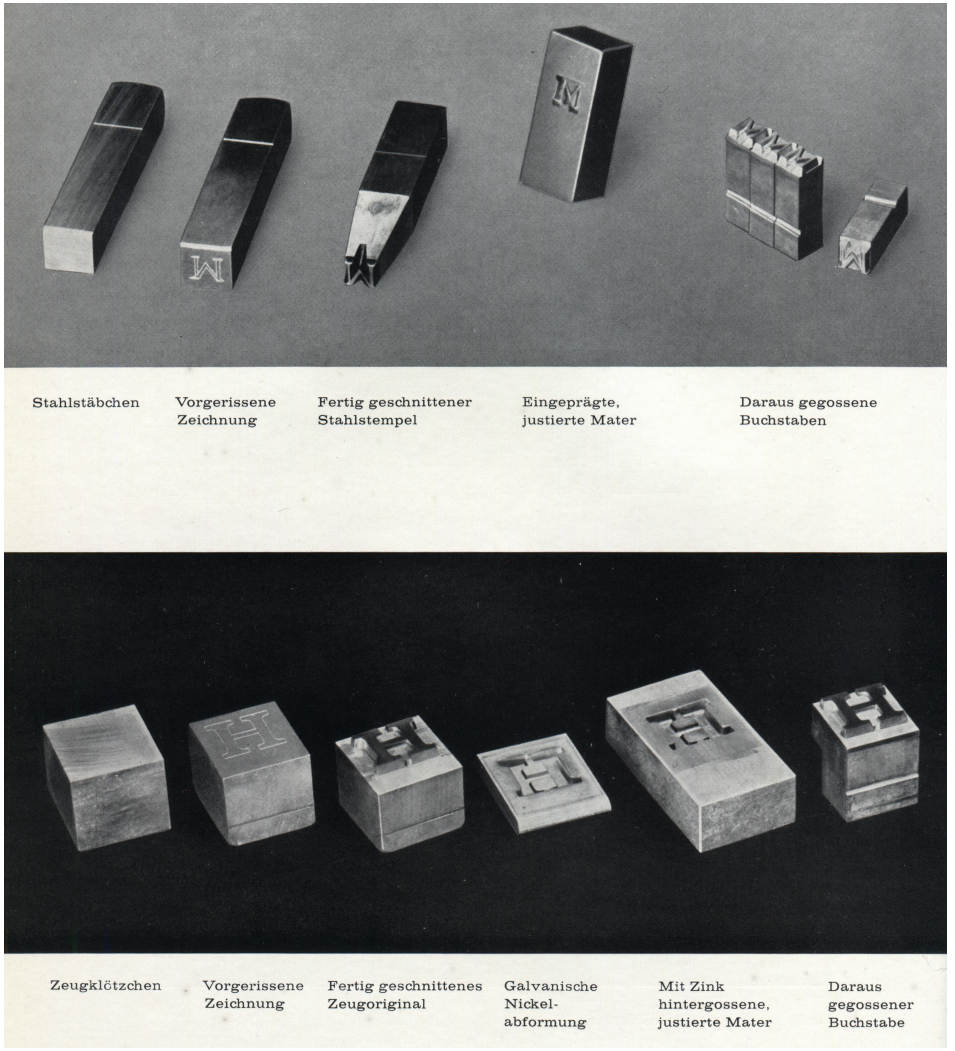
Mahr. *Der Druckbuchstabe* [*Printing Type*] (1928). “Der Stempelschneider.”
But Mahr correctly says “in harten Stahl, in weiches Blei” [in hardened steel, in soft lead]



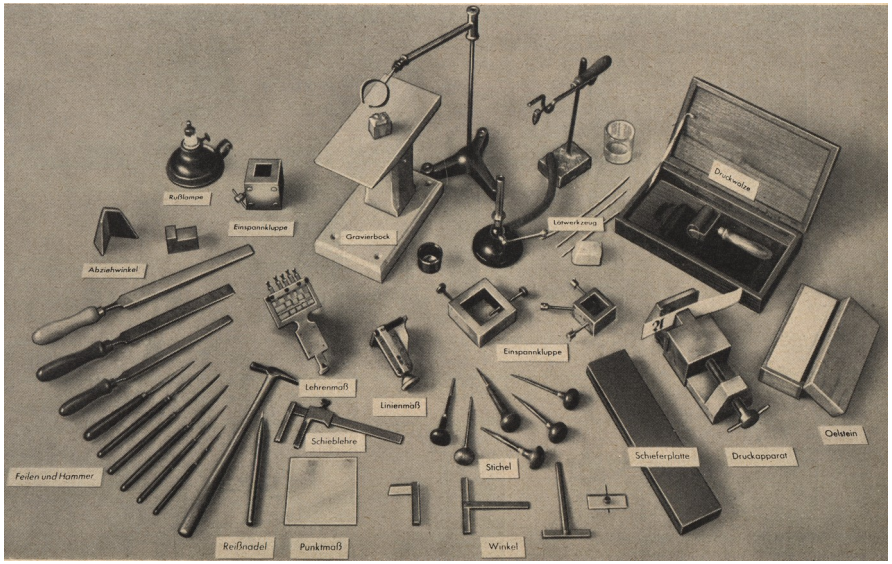
“Stempelschneider” means either.

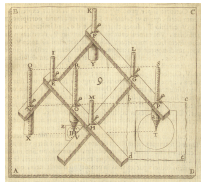
# Not Forgotten in Europe

Left and right. From Konrad Bauer, *Wie eine Buchdruckschrift entsteht* [How a Printing Type is Created], 1953 version.




Below. From Gustav Bohadti, *Die Buchdruck Letter*, 1954.



In his 1956 apprenticeship at Enschedé, Carl Dair was given the choice of learning to cut by hand in “steel, brass or ‘spacing’ (lead).” He ended up not liking the latter.

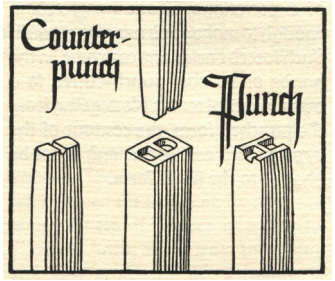
# Why Forgotten?

Electroforming was used for piracy; it was something the foundries didn't really want to talk about.

Type-making wasn't talked about much anyway until the 20th century. In 1898 Loy had to apologize:

> "It is hoped that the publication … may awaken an interest in the subject, … the purpose being rather to put on record, before it is too late, such facts … as may be worthy of record."

R. Koch, Kredel, Chappell (1932)




Romantic

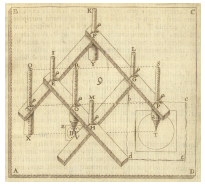
But two important 20th century reasons:

Some of the best known accounts of how type was made were written by people associated with punchcutting businesses (example: Beatrice Warde, writing in *The Dolphin,* 1935, contrasts only hand vs. machine punchcutting).

The entire emergence of type as a historically studied field, from William Morris onward, was prompted by romanticism. (See the Kochs, Hammer, Chappell, etc.) Hand punchcutting has romance written all over it. Electricity and acid baths do not.

ATF (MSJ) Foundry C (1896)

Not Romantic



# Relevance to Pantographs

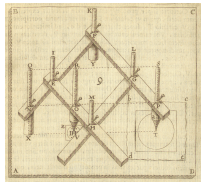
If we don't realize how common patrix cutting was in the 19th century, we will misinterpret the use of the typographical pantograph.

Patricia Cost's book on the Bentons is excellent and will remain the standard work on the subject for many years. But she was misled by:

- Not realizing that patrix cutting was a common technology
- Trying to integrate William Gregan's reconstructions of Benton's early work into a punch-to-pantograph worldview
- Believing Henry Lewis Bullen's fantasy about P. T. Dodge convincing Benton to try to cut punches

> "To summarize, the first version of Benton's pantograph machine was engraving type metal originals at Benton, Waldo & Co. in Milwaukee by 1884. The second version of the machine cut the sample steel punch for Dodge. Benton received a patent for the third version in 1885."
>
> - Cost (2011), p. 68.

These were actually all the same machine. The real distinction is between this machine and his second vertical machine of circa 1899.

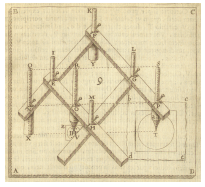


# Further Research

We need to examine surviving 19th and early 20th century matrices to see if they were electroformed.

If they are, and if they can be shown to be the originals, then we have physical evidence of patrix cutting.

Note: It is not always easy to tell if a matrix is electroformed, especially if it has been ground (making rivets invisible) and is dirty/discolored. X-Ray Fluorescence (XRF) or Proton-Induced X-Ray Emissions (PIXE) testing would be useful, as the grown portion will be pure copper.



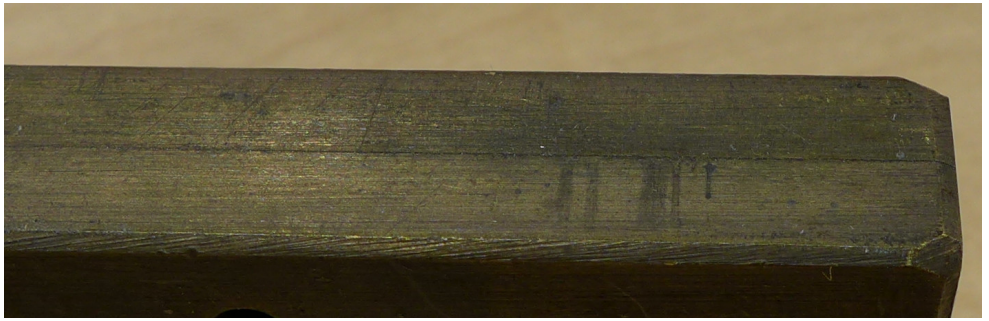
# Factoid

The 60 point Barth mats for ATF Series 476
Goudy Handtooled Italic (1922) are electroformed.

(Please pardon the distortions produced
by my low-end photomicrographic setup.)

‘&’

‘&’



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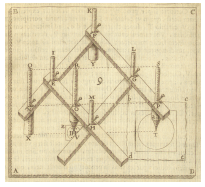
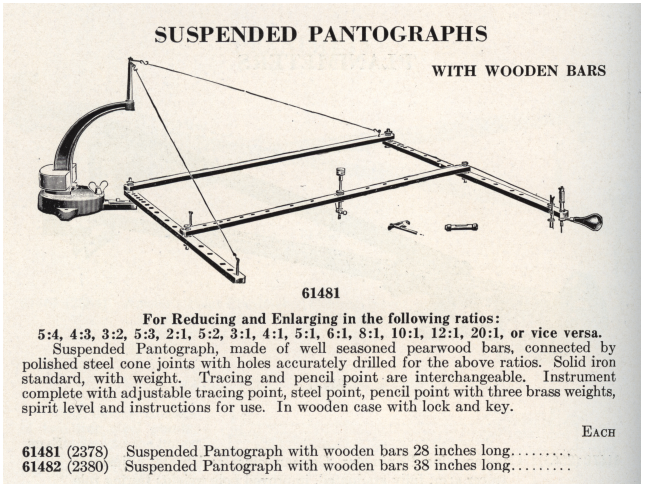


# So, What Is a Pantograph? (1/2)



**SUSPENDED PANTOGRAPHS**

**WITH WOODEN BARS**

**61481**

**For Reducing and Enlarging in the following ratios:**
**5:4, 4:3, 3:2, 5:3, 2:1, 5:2, 3:1, 4:1, 5:1, 6:1, 8:1, 10:1, 12:1, 20:1, or vice versa.**
Suspended Pantograph, made of well seasoned pearwood bars, connected by polished steel cone joints with holes accurately drilled for the above ratios. Solid iron standard, with weight. Tracing and pencil point are interchangeable. Instrument complete with adjustable tracing point, steel point, pencil point with three brass weights, spirit level and instructions for use. In wooden case with lock and key.

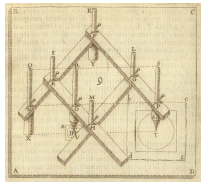
EACH

**61481** (2378) Suspended Pantograph with wooden bars 28 inches long.....
**61482** (2380) Suspended Pantograph with wooden bars 38 inches long.....

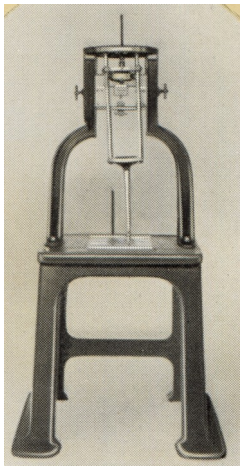
This is a pantograph
Type 1: Four-Bar Machines

- Performs scaling and, optionally, transformation
- Pivot, tool, and tracer all line up for simple scaling
- Invented by Christoph Scheiner, early 17th century

B.K.Elliott Co. drafting supplies catalog, circa 1943

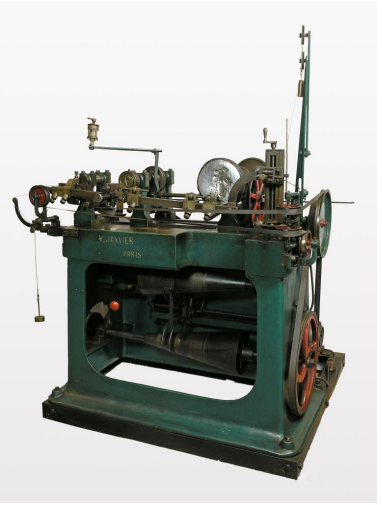


Both of these types operate using a principle of similar triangles.



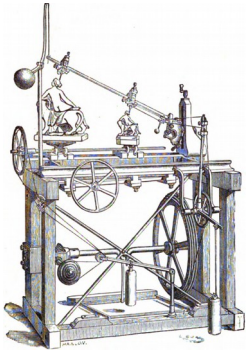
Benton Vertical Pantograph, Style 2 (Matrix Engraving)

ATF 1912 specimen book



Janvier "Reducing Machine" for making coining dies

Birmingham Museums Trust



Kennan, for Sculpture

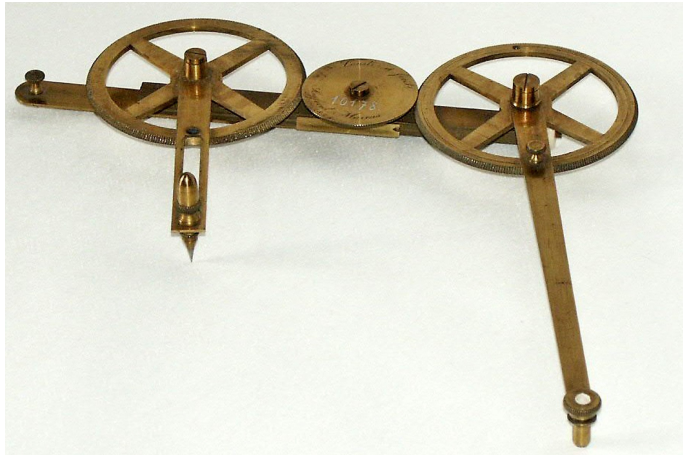
1862 Exhibition catalogue

Hollerith Hand Card Punch

United States Census Bureau

Some of these were called pantographs
Type 2: Single-Arm Machines

# What Is a Pantograph? (2/2)



By Siegfried Marcus (Austria), 1855.

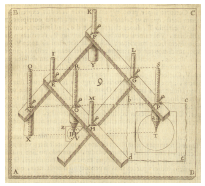
Photograph by Wikimedia Commons user "newfoundlanddog"

Other Mechanisms of many kinds do pantograph-like things.
Some were called "Pantographs."
Type 3: Other


On the Schynige Platte railway, Switzerland

Photograph by Audrius Meskauska

This is called a pantograph, but it is not.



The German word for "pantograph" (when it isn't just "pantograph") is "storchschnabel" / "storchenschnabel" (literally "crane's / cranes' bill"). This is also a kind of geranium.

Geranium pratense /
Meadow Cranesbill /
Wiesen-Storchschnabels

Photograph by
Julie Anne Workman

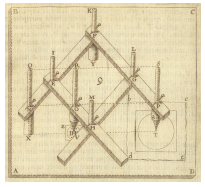
# The 4-Bar Pantograph, 1631 to 1840

Pretty much just a drawing device.


A display of drawing pantographs at the Science Museum, London

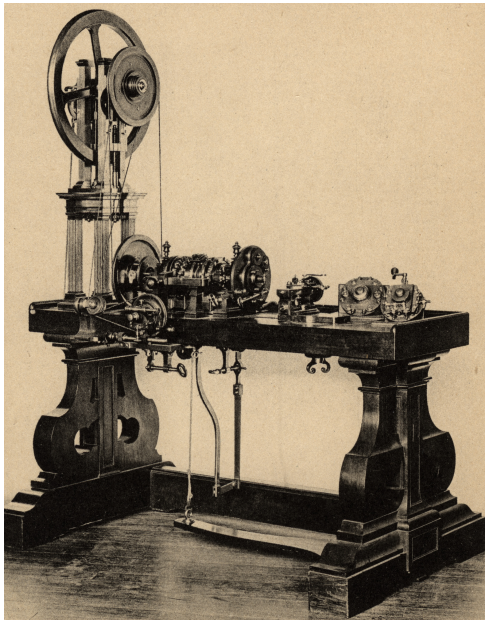
Photograph by Stefan Kühn

It is curiously difficult to find freely re-usable images of 18th century pantographs. I'm not actually sure of the dates of the ones shown here, but they resemble those common enough in the 18th century.



# The Single-Arm Pantograph, to 1884 (1/6)

The path to Benton starts a long way from Milwaukee



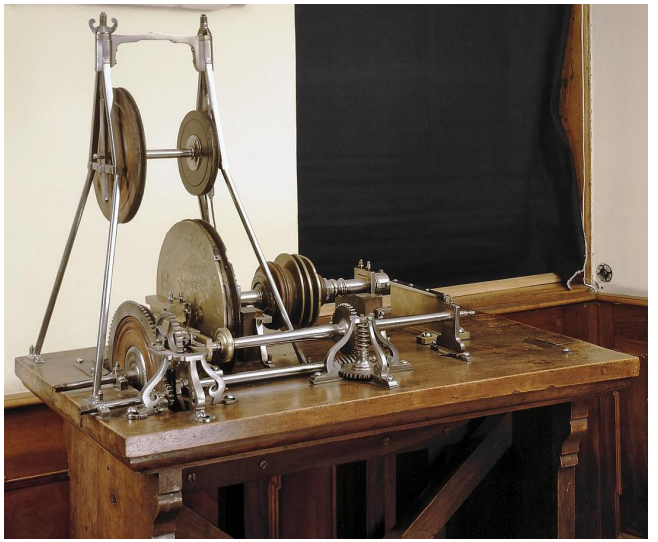
Origins in the Rose Engine and "Ornamental Turning" in the 16th century. This was cam-controlled geometric machining, primarily for ornamental items.

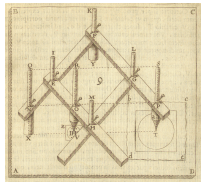
A relatively late example, constructed by Mercklein for Louis XVI prior to 1780.

From an early postcard by the CNAM

A. K. Nartov

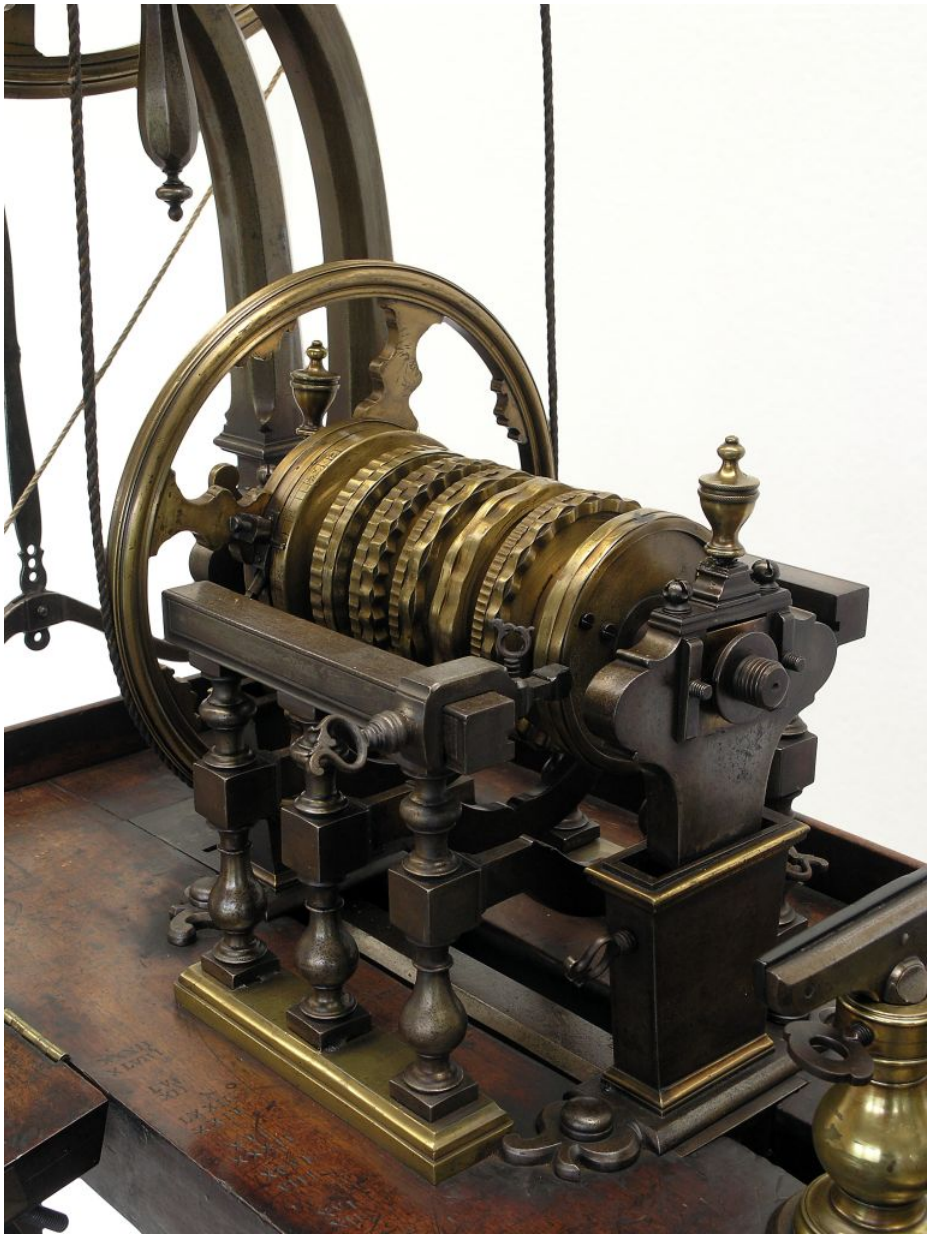
The portrait or medallion lathe of the 18th century. Nartov (Russia, 1710s–1730s). Teubers (German, 1740). Pantograph capabilities implemented with chain and shaft mechanisms. Used to cut commemorative medals from larger patterns cut in soft materials.





Nartov's Portrait Cutter Type 2, 1721

# Aside:  Rose Engines and O.T.

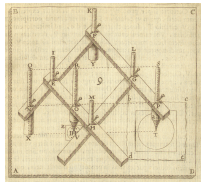


La Croix Rose Engine

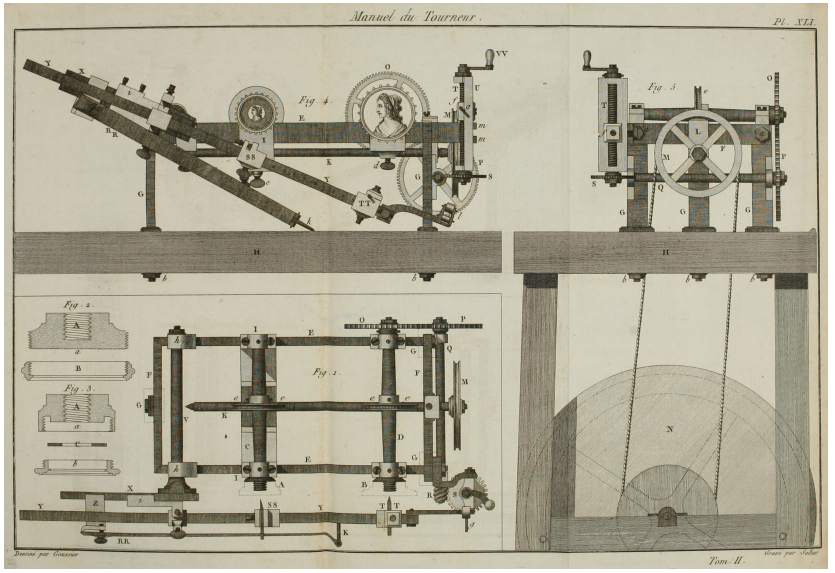
Birmingham Museums Trust

The tools of this field
are astonishingly beautiful.

They are extremely precise,
but accuracy hadn't been
invented yet.



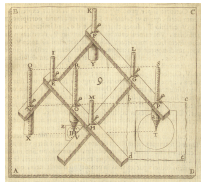
# The Single-Arm Pantograph, to 1884 (2/6)



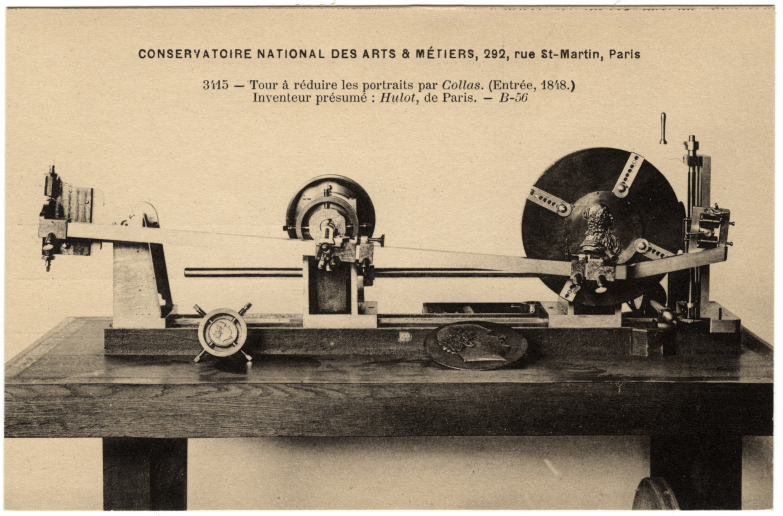

Hulot, fils, develops the single-arm version of the "portrait lathe" by 1796 (probably earlier). It accomplishes the same results as the earlier portrait lathes but employs a completely different mechanism: a single-arm pantograph.

From Bergeron [psued. for Salivet], Manuel du Tourneur, v. 2, 1796

Starting in the 1790s, Hulot's pantograph was adopted as the "Reducing Machine" to make the dies for Coinmaking. In the 19th century it was adopted at all major mints worldwide. It remained in use until the early 21st century. Janvier is the maker most associated with it.



Rotating cutters added by 1850
(see Cooper, 1988, p. 167)




From an early postcard by the CNAM

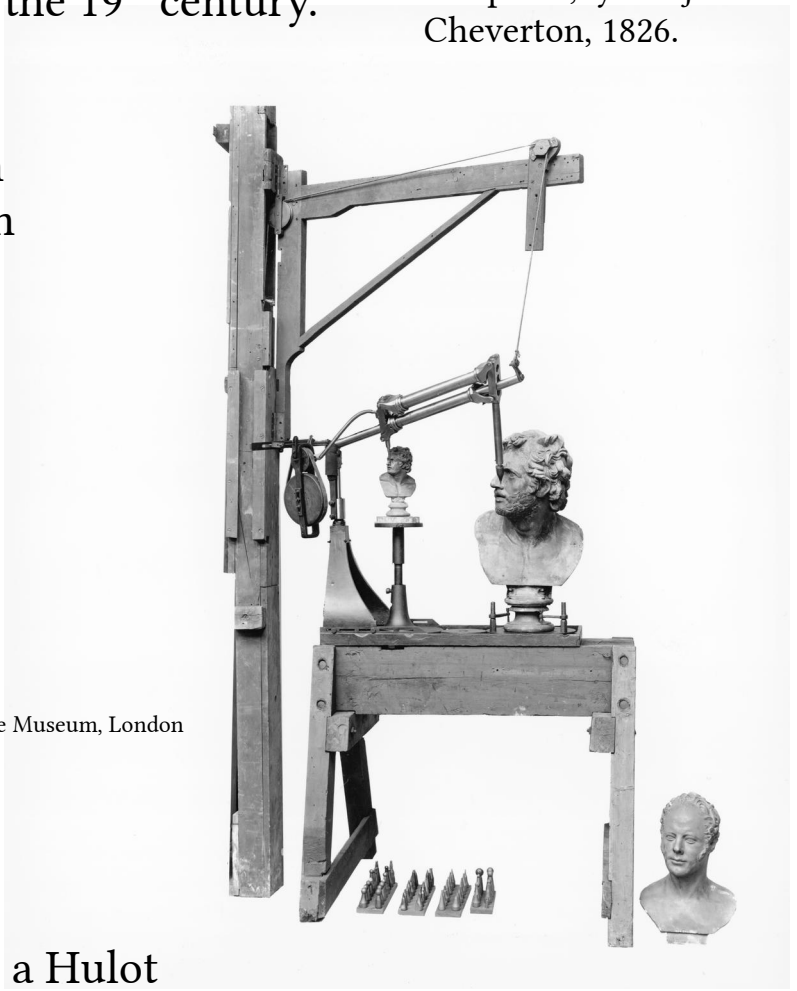
# The Single-Arm Pantograph, to 1884 (3/6)

One of Watt's two sculpture pantographs from the 1790s.

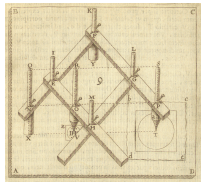
Widespread application of 3-D single-arm pantographs to sculpture reproduction from the 1790s through the 19th century.

- Watt
- Collas
- Contamin
- Cheverton
- Dalloz

Machine for Reproducing Sculpture,by Benjamin Cheverton, 1826.



Both photographs from The Science Museum, London



These do not work in the same way that a Hulot portrait lathe or Janvier reducing engine does.

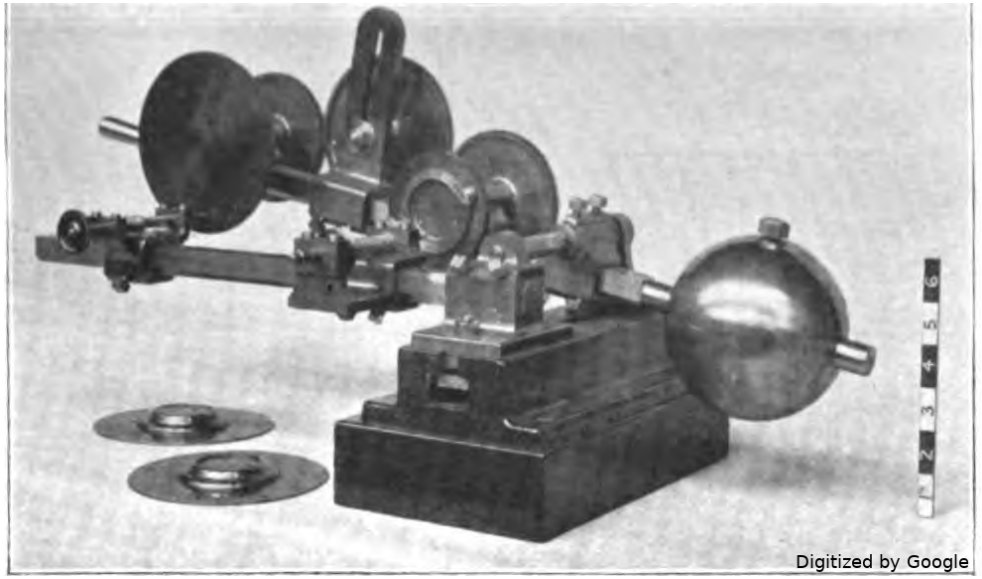
# The Single-Arm Pantograph, to 1884 (4/6)

(Minor Examples)

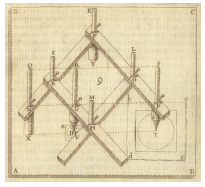
Andrew Smith. "Apograph," 1821. First vertical-format single-arm pantograph. Similar to the 3-D machines of Watt, Cheverton, etc.; not like a Hulot portrait lathe. For drawing; was produced for sale.

No freely reproducible images exist.

Applied to a drilling machine for horological plates in 1848 by Richard Roberts (1789–1864). Not widely used.



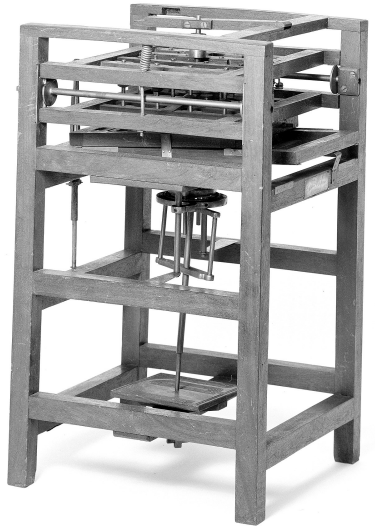

Science Museum photograph, from Roland (1899)

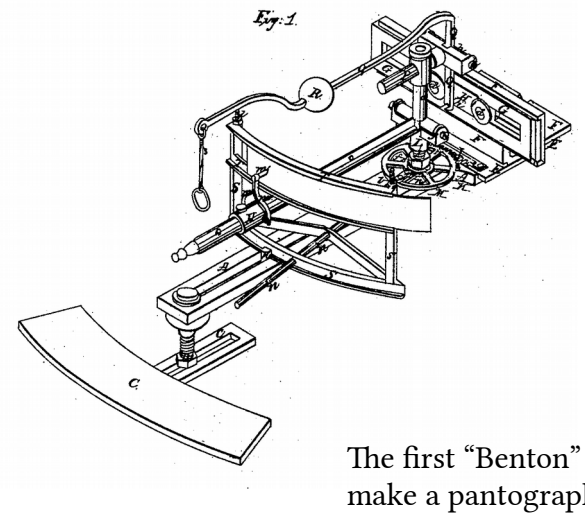


# The Single-Arm Pantograph, to 1884 (5/6)

(Minor examples which prefigure Benton)

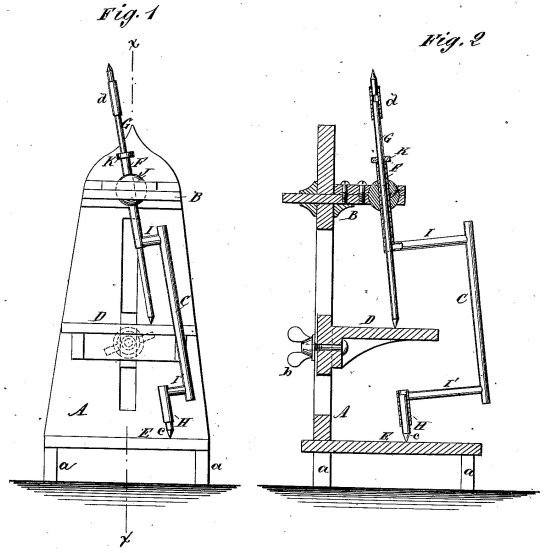
Luman Carpenter. 1842.
Ellipsograph. US Patent 2,894.
Not a pantograph, but had an extensible vertical arm.



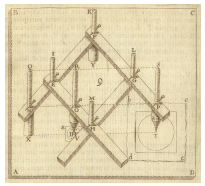



The first "Benton" to make a pantograph.

Elijah Ware. 1877. US Patent 190,797. Vertical format. Variable-length arm. For drawing.




John C. Guerrant and Benton J. Field. At least three single arm pantographs in 1866 (US Patent 60,506), 1867 (70,553) and 1868 (83,708). First two have layout like Hollerith's; third is vertical format.

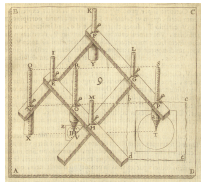


# The Single-Arm Pantograph, to 1884 (6/6)

**Summary / Points**

- Transformed two industries (minting, sculpture reproduction)
- The Hulot/etc./Janvier machines operated with great precision
- The dies which made the coins in Benton's pocket in 1884 were made using a pantograph "reducing machine" (Hill's)
- Many predecessors, but nothing quite like what Benton made

To Do: Chart the adoption of Reducing Machines by various mints worldwide. US: Hill in 1867, Janvier in 1908; Janvier used until 2008. Further research into sculpture reproducing machines.

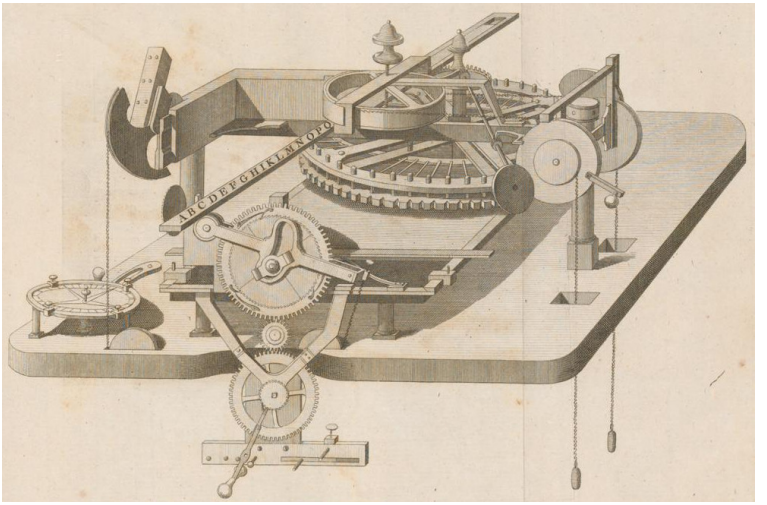


The "art of copying works in relief" is "anaglyptography." (Webster's, 1913)

# Late 18th Century Non-Developments

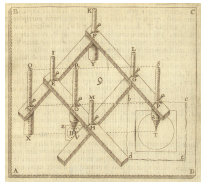
l'Abbé Rochon (Alexis-Marie de Rochon, 1741–1817).
Machine for engraving metallic plates, by 1783.
Not a pantograph at all, but a machine for positioning punches to engrave intaglio plates.

(Rochon also mentions Ged's early stereotyping in a later (1799) "Memoir.")



Rochon (1783), ETH/e-rara

Breguet's "Secret Signature" (so called) pantograph. 1795.
(famous but conventional; just an adapted drafting pantograph).
By Jean-Pierre Droz, for Breguet, Geneva.
Sold at Sotheby's in 2012 from the George Daniels collection for £13,750



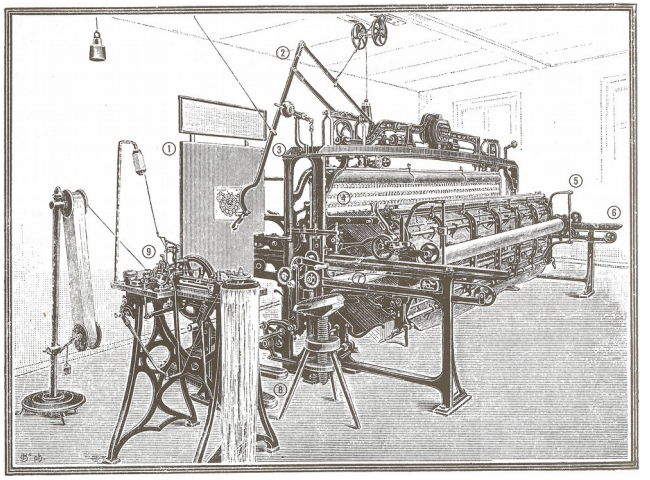
No freely reproducible images exist.

# Industrial & Engraving, 1840–1880 (1/8)

Type 1 (4-Bar) & Type 2 ("Other"); Excluding Machines for Wood Type

**There were a lot of them. That's the point.**

Joshua Heilmann. 1829. Handstickmaschine [Hand Embroidery Machine]. Multi-needle, 4-bar pantograph-controlled. Widespread adoption from ca. 1850; claim that 20,000 machines were in use in Switzerland in 1910.
Replaced by paper-tape controlled machines starting ca. 1890.

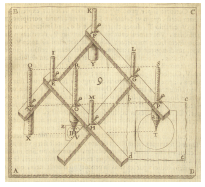


From Tanner via Wikimedia Commons

Georges Leschot (1800–1884). Watchmaking (plate drilling).
Important and well-known (awarded a medal in 1845):

> "En 1840 … George Leschot modifia profondément les bases mêmes [the basic foundation] de la fabrication horologère à Genève"
> - *Journal Suisse d'Horlogerie*, 1884.

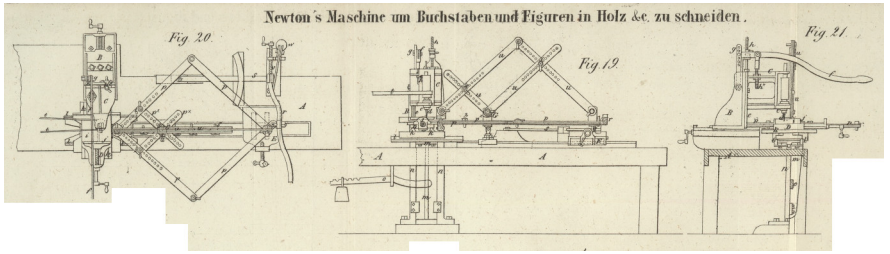
No freely reproducible images exist.



Technical notes: 4-bar, horizontal format.
Spindle is supported on its own swinging frame. This is a characteristic of later Taylor-Hobson (and thence Gorton & Deckel) machines).

# Industrial & Engraving, 1840–1880 (2/8)

Alfred Vincent Newton. 1850. GB Patent 13,2139 of 29 Aug. 1850.
Double-4-bar (3-D). For wood and "slab" engraving
Wilkes cites this as a "matrizenbohrmaschine," but it was not.
It does, however, have the same general form as the most common later German matrix pantographs.

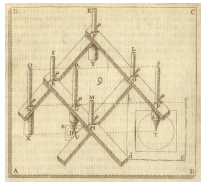


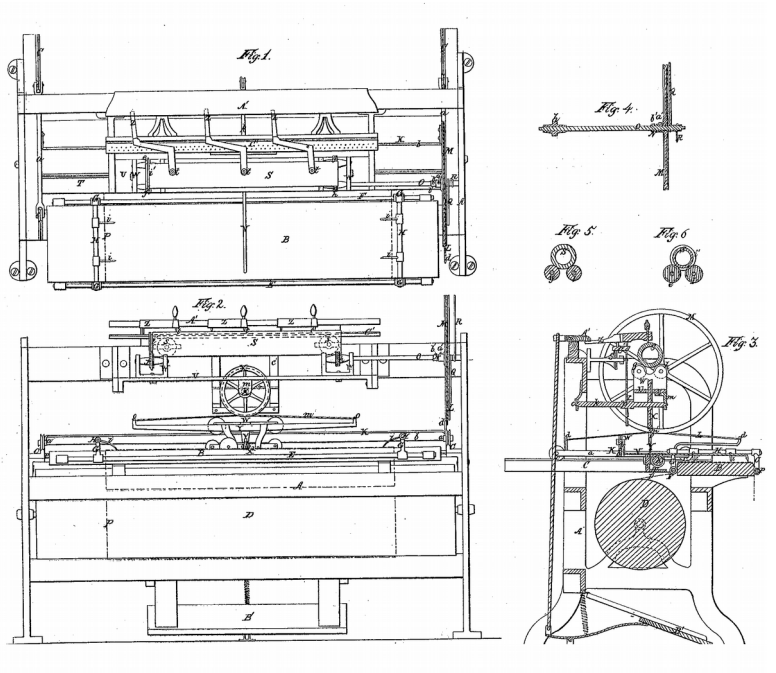
From Dingler's *Polytechnischen Journal* (1851)

Rigby. UK. 1854. First (?) pantograph for engraving rolls for calico printing.

(Can't find a picture)

John Hope. Providence, R.I. From 1850. Became an important business through the early 20th century.
Pantographs in engraving of rolls for calico printing.
Many variations, many patents. 1855 patent (US 13,462) says it is "similar in many respects to other engraving or pantographic machines in use."
Also known later for ruling engines for wood engraving.

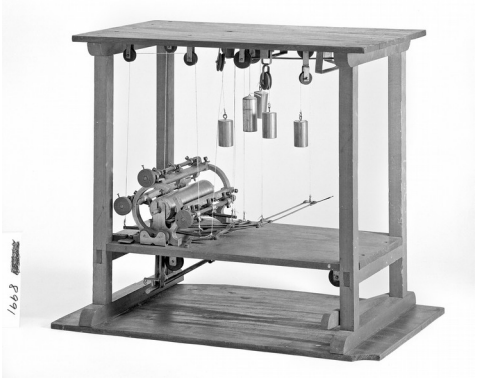




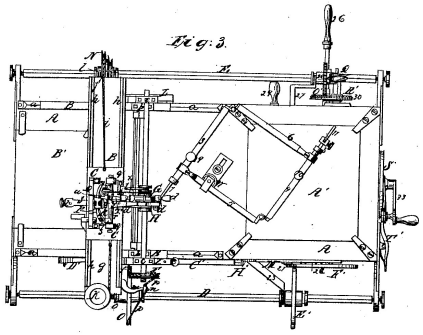
US Patent 13,462 (1855)

# Industrial & Engraving, 1840–1880 (3/8)

Isaac Taylor (1852), US Patent 8,991. 4-bar.
For engraving cylinders for printing calico and wallpaper.



Patent model. Smithsonian NMAH-MAH-69481

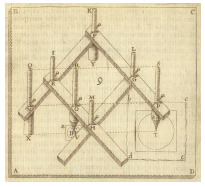


John B. Blair (1853) US Patent 9,743. 4-bar. For mezzotints

Note: The patent model shown by the Smithsonian for this machine, NMAH-MAH-69595, is the wrong machine.

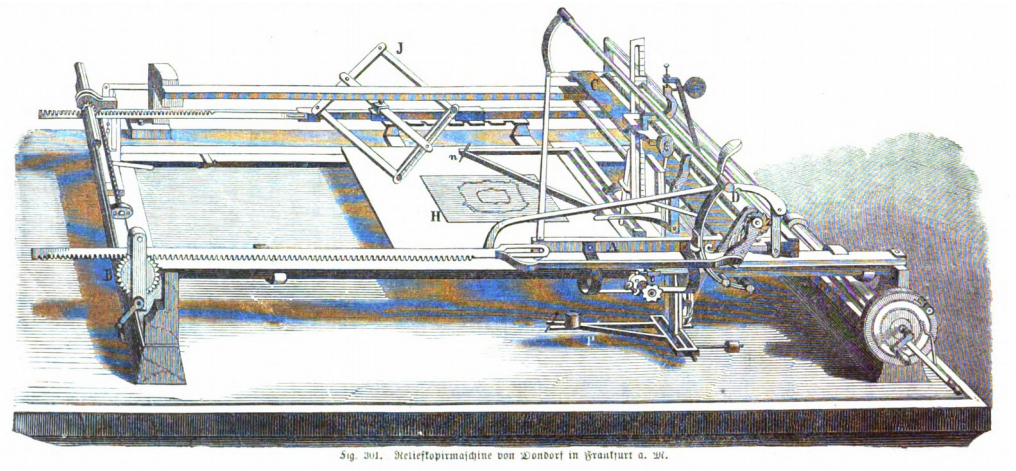
W. H. Pease. 1860. US Patent 27,827.
4-bar, rotary spindle.
For engraving "Wood, Metal, or Stone.

Patent model. Smithsonian NMAH-RWS2010-00215

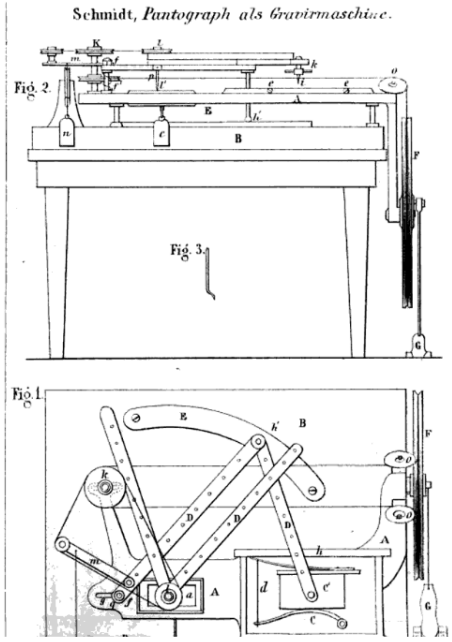


# Industrial & Engraving, 1840–1880 (4/8)

A machine incorporating a 4-bar pantograph, used for engraving complex designs for printed securities. Germany, by 1864.

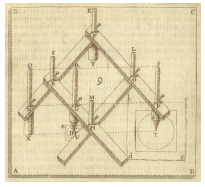


Bobrick, E., et al., Das eue buch der erfindungen, gewerbe und industrien. [The New Book of Inventions, Trade, and Industry] 5th ed. Band 1. Leipzig: Verlagsbuchhandlung von Otto Spamer, 1864. Article: "Die graphischen künste in tombinirter unwendung auf die herstellung von werthpapieren." [The graphic arts in combined use on the manufacture of securites] Digitized by Google from the NYPL copy, via The Hathi Trust.




("Security" printing links back to Rose Engines and "ornamental turning.)

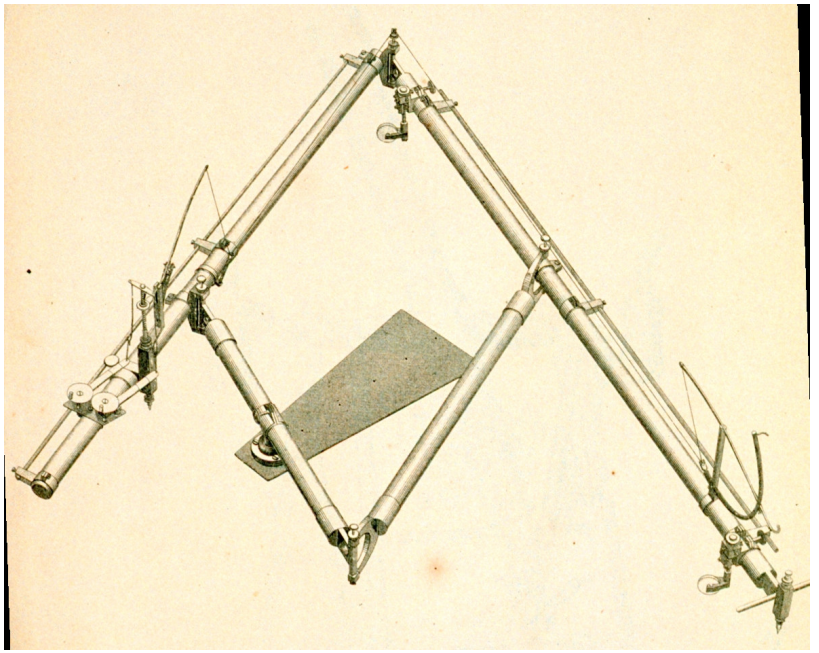
Schmidt. 1866. Germany. "Gravirmaschine." 4-bar. Not sure of its intended use.



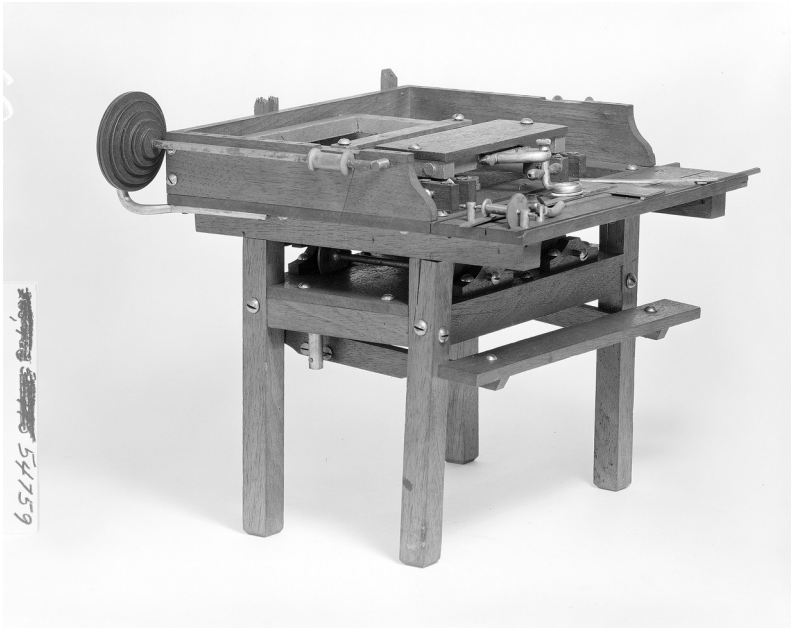
From the *Polytechnisches Centralblatt* (1866)

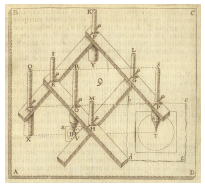
# Industrial & Engraving, 1840–1880 (5/8)

Sorensen's Engraving Pantograph. 1867.
"In use by the U. S. Coast Survey."



NOAA Central Library

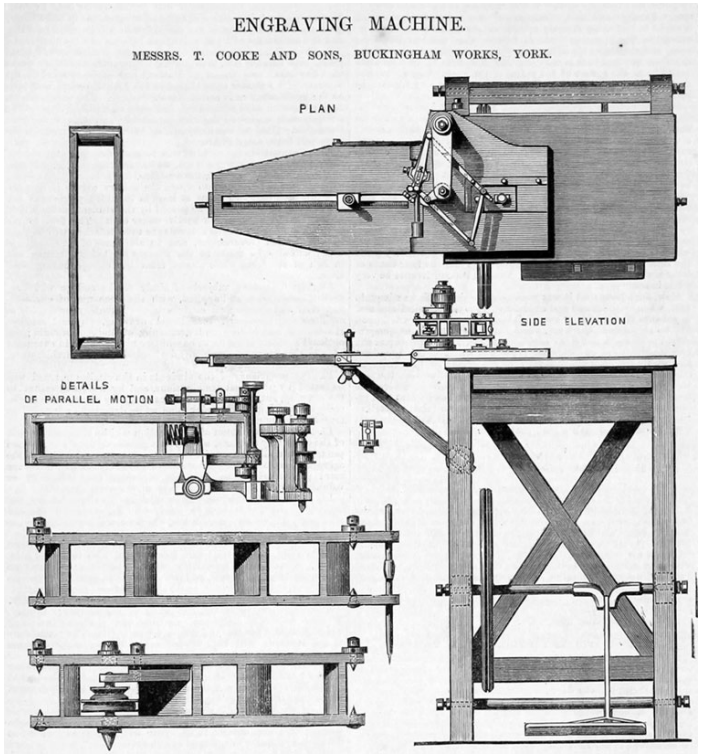




Patent model. Smithsonian NMAH-MAH-69471

Edmund Oldham. 1866 US Patent 54,759.
4-bar, with optical tracer.
For lettering and general engraving.

# Industrial & Engraving, 1840–1880 (6/8)




The Engineer (1870)

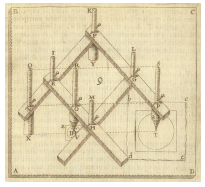
Francis Galton. 1870, GB. Used to engraved zinc plates for the Meteorological Office.


The Science Museum, London

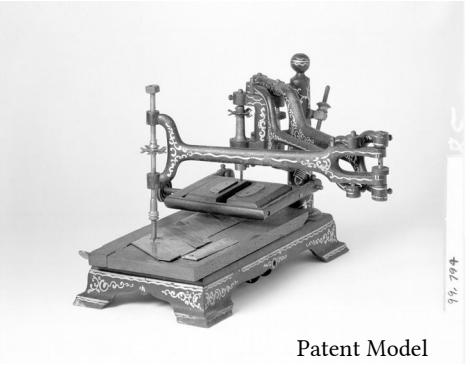
Cooke. 1870, GB. For engraving on lenses. 4-bar.

Later: Taylor, Taylor & Hobson (UK, lenses, in 1894)
Friedrich Deckel (Germany, Compur Shutter, 1920s)

J. Civilian Spencer. 1870. US Patent 99,794. 4-bar. For lettering and general engraving.

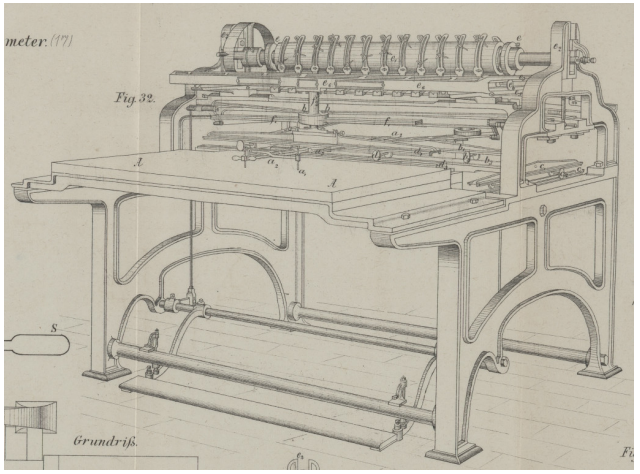


Patent specifies an orientable single-point cutter (which seems to be missing from the model).



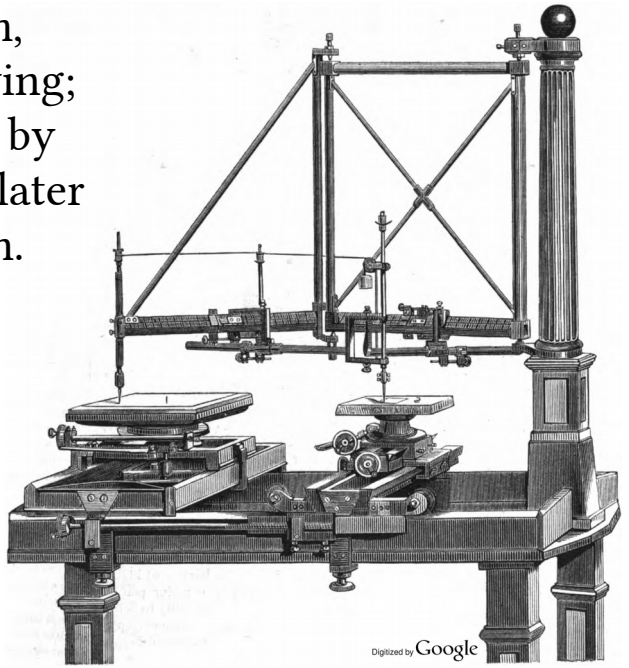

Patent Model

# Industrial & Engraving, 1840–1880 (7/8)

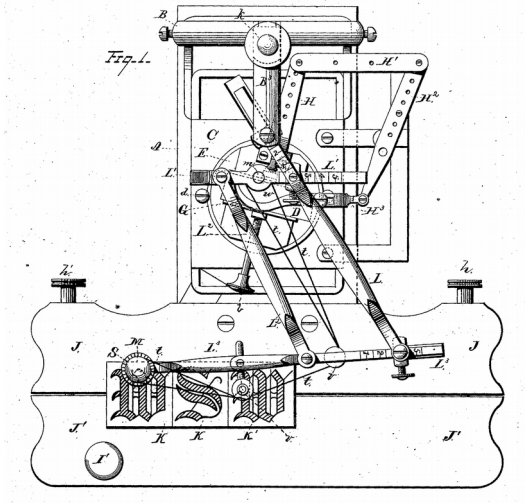


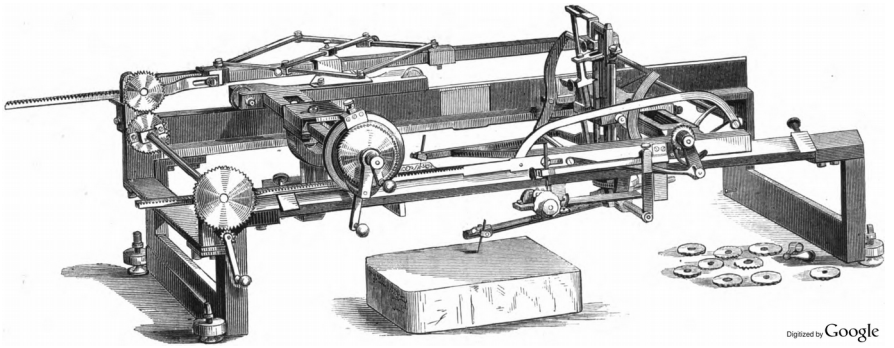

From Dingler's *Polytechnischen Journal.* (1875)

Shield. 1875. Birmingham, UK. For calico roll engraving; based on earlier machines by Taylor and by Rigby. See later machines by Keller-Dorian.

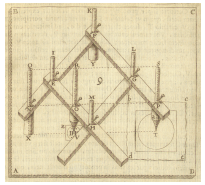



Ferdinand Lotz, Offenbach, DE. 1875. Several machines, for line engraving, etc.



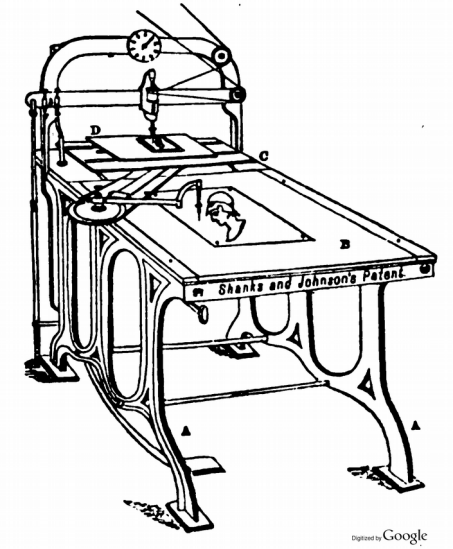

From Scientific American, 1875



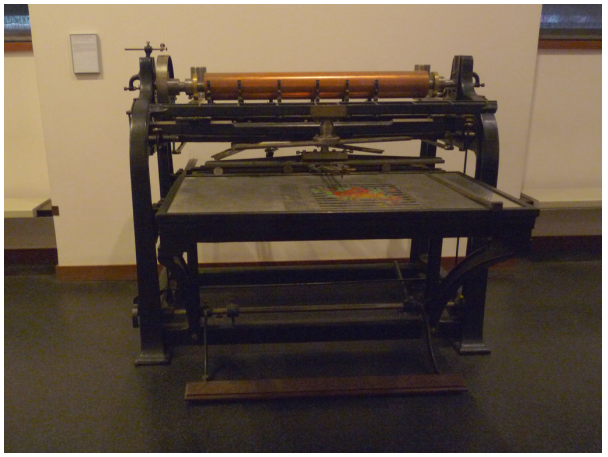
William S. Wight. 1875 (US Patent 159,488), with improvements in 1876 (US Patent 197,507).
Four-bar pantograph engraving machine for lettering.

# Industrial & Engraving, 1840–1880 (8/8)

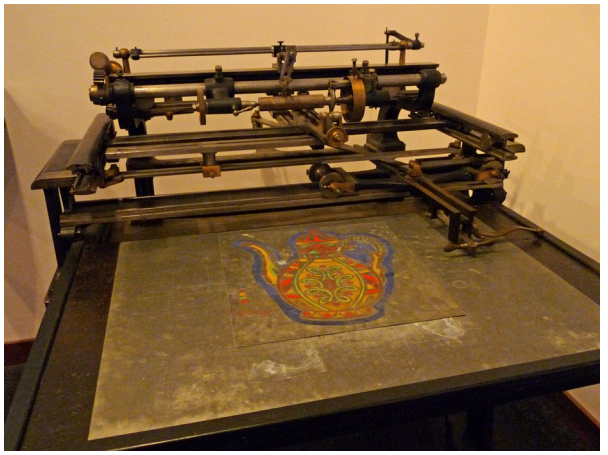
Peter Martin Shanks. 1874
4-bar.
For wood printing plates




From *Ure's Dictionary* (Hunt, 1878), Vol. IV Supplement



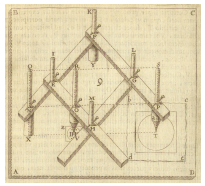
Circa 1879 English.
Very similar to Keller-Dorian (1883)



Unidentified

Two pantographs for engraving rolls for printing calico, Musée de l'impression sur étoffes de Mulhouse, France. By Ji-Elle, 2012

Note: Brocade Engines (developments of the portrait lathe, really) continued in use throughout and into 20th century



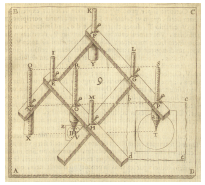
# Aside: Pantographs and Wood Type

Darius Wells, US, ca. 1827 - *router only.*
First application of rotary spindle tools?

William Leavenworth, US, circa 1834 -
*adds pantograph.*

Re-invention by Edwin Allen, 1836.

Intended to cut an end product individually (a piece of wood type), not to make a tool (punch, patrix, or matrix) for multiplying end products.



DARIUS WELLS, 1800-1875.

The Inland Printer (1907)

At the Hamilton Wood Type Museum

I am unaware of any technological influence of the wood type machines on pantographs for cutting punches, patrices, or matrices. This lack of connection is very strange.

Also: DeLittle, UK, 1888

# Summary, Circa 1880

**Well-established Victorian High-Tech**

Precision pantographs dominate these industries:

- Minting/Coinmaking
- Calico printing rolls
- Wood Type

Precision pantographs are significant in these industries:

- Watchmaking
- Banknote/Securities engraving
- Optics (lens engraving)

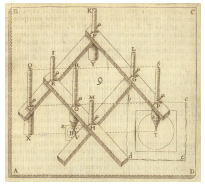
Perhaps lesser-precision pantographs dominate these industries:

- Sculpture Reproduction
- Hand embroidery (in Switzerland)

Pantographic Engraving for lettering is common

Pantographs also used for:

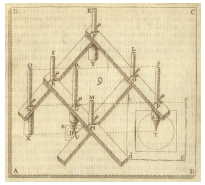
- Wood (relief) and copper (intaglio) printing plate making
  (especially in map making and scientific work)



# The Pantograph in Hand Punchcutting

In 1838 the Rev. Dr. Eli Smith and Homan Hallock began cutting punches for Arabic type. Hallock employed a drawing pantograph to transfer Smith's designs to the punch face:

> "After rough shaping about one hundred punches, with tolerable prospect of success, though not without long and painful effort, a wakeful hour of the night suggested to me that by reversing a certain part of a *pantograph* in my possession, I could trace my models direct upon the polished face of pieces of steel, reduced to any desired scale, and only have to follow my lines to make a perfect imitationof my patterns."
>
> - H. Hallock, *Bible Society Record*, 1866.



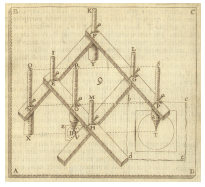
# Pantographic Matrices before 1882

There was interest. There may (or may not) have been success.
But so far I can find no indication of influence.

Herman Wiebking (father of Robert Wiebking). Germany, 1870s.
Failed, but brought his pantograph with him to the US, where he
"... engraved a matrix, in 1882, from which type was cast by Marder,
Luse & Company of Chicago." (Werner, 1927, p. 71)

H. Hofer. Report in 1881 of direct matrix engraving.
Hofer was an established maker of engraving machines for the
printing industry in Berlin in the 1870s.

> "H. Hofer lärer hafva uppfunnit en *mastrisboringmaskin* efta samma princep som pantografen, hvilken skall göra stålstämplarne obehöfliga och hvarmed en matris kan göras på 15 minuter men vi kånna icke huruvida den motsvarat sitt ändamål."
>
> "H. Hofer's teachings have invented a *matrix drilling machine* after the same principle as the pantograph, which will make the steel stamps unnecessary and with which a matrix can be made in 15 minutes, but we do not know whether it corresponds to its purpose."
>
> - Nordin. *Handbok i Boktryckarekonsten* (1881), p. 57.



I am indebted to Victor Thibout for discovering Hofer,
and for this translation.

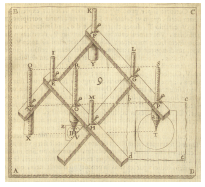
# The First Pantograph in Metal Type Making

**Not Benton. Central Type Foundry, St. Louis, 1882.**

Machine made in Germany.
Imported by the Cincinnati Type Foundry in 1880.
Acquired/used by the Central Type Foundry, 1882.
Operated by William A. Schraubstadter.
Patterns made by Gustave Schroeder (how?).
First faces: Geometric (1880, but to Pica only),
Geometric Italic (1883), Scribner (1883),
Morning Glory (1884).
Horizontal machine; presumably four-bar.
Direct matrix engraving in brass.

WILLIAM SCHRAUBSTADTER.
Who originated the lining system.

The Inland Printer (1907)



15a 10A c 24-Point Geometric. $5.00
HANDSOMER
Combination 18

24a 10A c 18-Point Geometric. $4.50
ANGULAR SHAPES
Squares Designed 36

From an 1892 Central Type Foundry specimen book

# Evaluating the Evidence

**How do we know this?**

Loy (1898). Schroeder "made for Central the patterns for Geometric Italic, Morning Glory, and Scribner, of which matrices were cut in brass by machine."

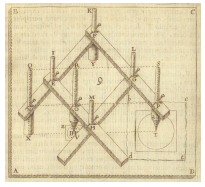
Nicholas Werner, writing many years later:

1925. *American Printer*. [I have not seen this yet]
   Data: Schraubstadter. Matrix engraving.
   Geometric, Geometric Italic, Morning Glory.
1927. *The Inland Printer*. ("St. Louis' Place…")
   Data: Schraubstadter & Schroeder.
   Direct Matrix Engraving
   Geometric, Geom. Italic, Morning Glory
1931. "St. Louis in Type Founding History"
   Data: Pantographs were horizontal
1932. Weibking obituary in *The Inland Printer*.
   Data: Machine imported 1880
   To Central T.F. in 1882
   Typewriter .


From Loy in The Inland Printer (1899)

**Why should we believe him?**

He was there.
He later acquired this machine and used it (with Schroeder and on his own).
What he says fits with Loy's biographies him (and of Schroeder).
Unlike Bullen, he did not tend to make things up.



Geometric. Boston T.F. showing 1880 (4 sizes, Nonpareil to Pica). US Design Patent 12,123 (1880-12-14).
Geometric Italic. *Printers Circular*, March 1883. US Design Patent 14011 1883-06-26 (drawings missing).
Morning Glory. 1882 (Werner) or 1884 (Robert Mullen). Named after Morning Glory Johnston.
Typewriter (Central). First typewriter face (Annenberg, TFOA).
Scribner. 1883 (Robert Mullen).

# Benton's First Vertical Pantograph

**Actually, we know very little.**

Bullen's stories don't hold water:

- No evidence that Benton was ever working on a composing machine
- Not true that there were no punch/patrix engravers available
- Story of P. T. Dodge and the first punch is demonstrably false

What do we know?

1882. Patent record shows Benton working on a mold for casting leads (US 254,792)

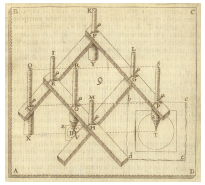
1883. No information

1884. Feb. 29, 1884. Pantograph patent filed (issued Dec. 22, 1885 as US 332,990) Patent specifies only punch cutting.

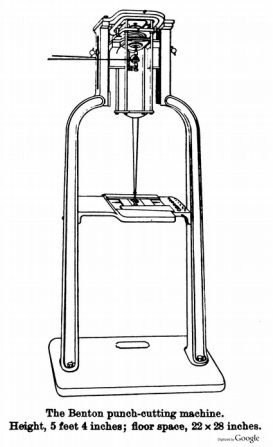
1884. July. Trade Note in *The Inland Printer* claiming **the ability to cut punches in steel.**

1888. Contract punchcutting for Merg.

1889. First machines leased.



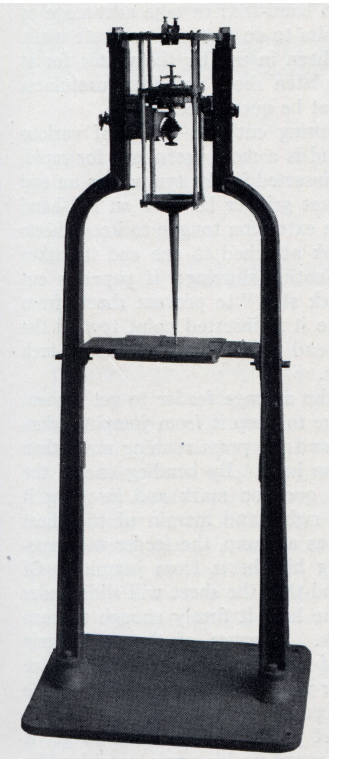
Although the two images at right are later, they look almost exactly like the one shown in the 1891 Benton-Waldo Type Foundry brochure (Cost 2011, p. 68)

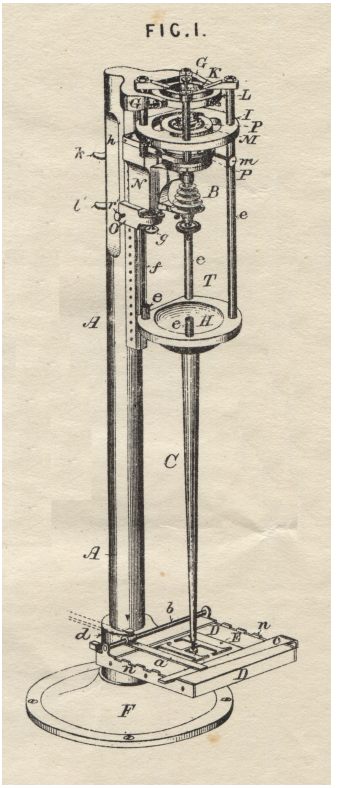


The Benton punch-cutting machine.
Height, 5 feet 4 inches; floor space, 22 × 28 inches.

From DeVinne (1900)

Identifying feature: WW lathe headstock as spindle






From the English version of the 1884/5 patent
My thanks to Mark Knudsen

Question: Do any survive?

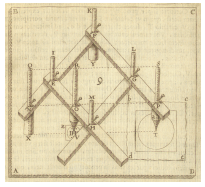
From *The Inland Printer* (1924). Rehak (1993) has a higher-quality version of this photo.

# Benton Cutting Punches in Steel

From the "Items of Interest" column in
*The Inland Printer,* Vol. 1, No. 10 (July 1884): 21.

BENTON, WALDO & CO., of Milwaukee, claim to have perfected a machine for cutting punches for original characters for type foundries in steel,—an invention which will much cheapen the ordinary process of cutting by hand. It will cut from the largest to the smallest punch—even to half-diamond; while as a time-saver, we may state that a piece of work now requiring four hours to perfect by the hand process can, under its operation, be turned out in *half an hour*.

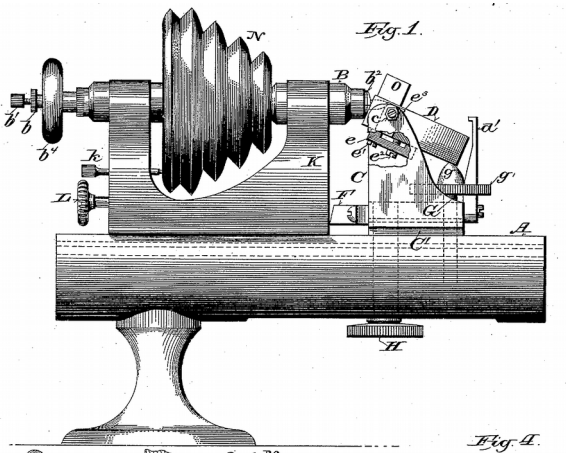
This, by the way, is how we know that Bullen's 1923 story that P. T. Dodge of Mergenthaler Linotype is false. The Mergenthaler company only became aware of Benton *after* the Blower Linotype (1886), which used (first) electroformed matrices and (later) mats from hand-cut punches. But Benton could cut punches in steel at least two years earlier.



# Benton's Two Cutter-Grinders

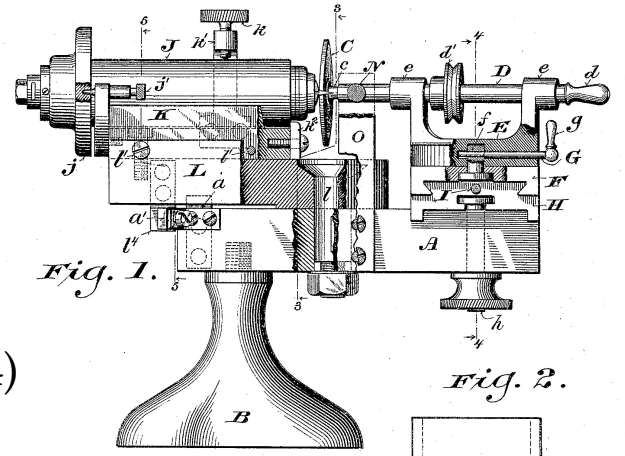
First version 1888 (US Patent 422,874 issued Mar. 4, 1890)

- Entire spindle assembly removed from pantograph
- Based around standard WW (Webster-Whitcomb) watchmaker's lathe technology



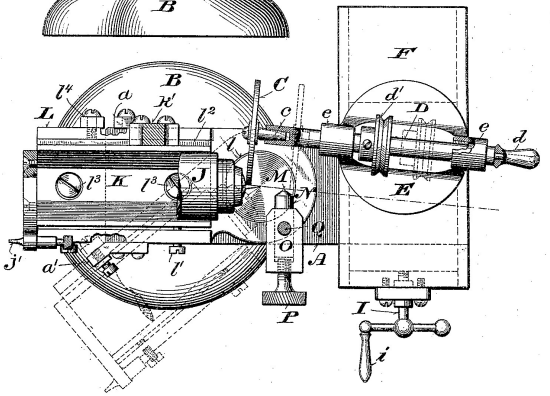

Solved the problem of cutter depthing after resharpening or replacement.

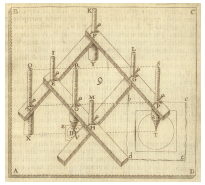
- Gorton later used an equivalent technology (removable spindle body) (but for their matrix engraving machines only)
- English Linotype (Barr) made their own [to do: check details; in L&G]
- Goudy used something like this [to do: check details]
- Wiebking (or Ludlow) may have relied on an "acoustic device"
- Rimmer was just good :-)




Second version 1900 (US Patent 774,030 issued Nov. 1, 1904)

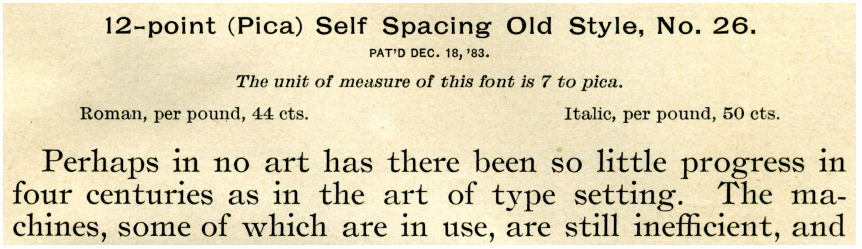
- Removable quill
- Diamond dresser to ensure wheel diameter





# Benton's Accomplishments

▸ Werner (1931) attributes to Benton the first *Roman* faces cut by machine.



12-point (Pica) Self Spacing Old Style, No. 26.

PAT'D DEC. 18, '83.

*The unit of measure of this font is 7 to pica.*

Roman, per pound, 44 cts. Italic, per pound, 50 cts.

Perhaps in no art has there been so little progress in four centuries as in the art of type setting. The machines, some of which are in use, are still inefficient, and

Benton, Waldo & Co. Typographic Specimens. (1886). Stephen O. Saxe.


We do not know which face Werner meant, but Benton was busy cutting his "Self-Spacing" (unit-set) types during this period.

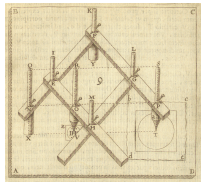
▸ The first *successful* pantograph of this style:

- Single-arm in vertical format
- Horizontal pattern and workpiece
- Rotary spindle
- Variable-length arm to solve problem of distortion

cf. Hulot/Janvier (circular) and Hollerith (distorted)▸

▸ **He kept going.**

- ◆ Second vertical pantograph, for matrix engraving, circa 1899
- ◆ Decades of hard work at ATF, with M. F. Benton
- ◆ At least three other pantographs:
  - 1899 "Opto-Mechanical" machine for reverse-engineering
  - Modified machines (the "Ad-Cut")
  - Wax plate machines
- ◆ He was a modest man who aligned himself with a very good P.R. machine



# But an Unanswered Question

When did Benton start engraving matrices?

Certainly not in 1884, when he claimed punch cutting in T*he Inland Printer* and when his patent made no reference to matrix engraving.

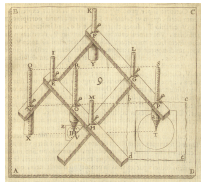
Almost certainly not in 1890, when the Benton-Waldo “Day Book” specifically names the machines leased as “Punch Engraving Machines.”

But certainly around 1899, when he filed the patent for his second vertical engraving machine - which specifically mentions matrices.

So probably in the 1890s - but when, exactly?

The answer is not in the published literature.

- It may be in surviving Benton-Waldo / ATF documents
- It may be in the physical evidence of ATF matrices of the 1890s



# And a Puzzle: Licensees, 1892–1902

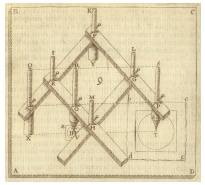
The Mergenthaler Printing Co. leased Benton machine No. 3 (Feb. 13, 1889).
The Linotype Co. Ltd. leased machines Nos. 8 and 9 (Feb. 15, 1890).
The Lanston Type Machine Co. leased a machine in August 1890.
All of these companies continued to use Benton-derived technologies.

Benton's 1885 patent didn't expire until 1902.

Rehak tells us that when ATF formed in 1892, Benton agreed "to recover all B&W devices leased to competitor firms, mainly Linotype and Monotype." (*Practical Typecasting*, p. 105).

Barr's machine (English Linotype) dates to 1902. Pierpont machines (English Monotype) dates to 1906. No US Linotype or Monotype machines from the period are known.

So if Benton did recover his machines, what machines were Linotype and Monotype using in the 1890s?



# Schroeder & Werner, 1889–?

## The First Matrix Engraving Service

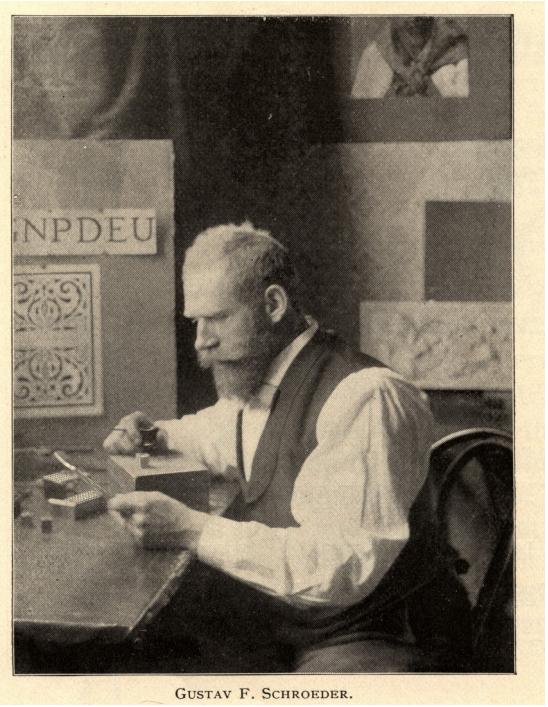
Gustave F. Schroeder and Nicholas J. Werner.
Left the Central Type Foundry in 1899 and formed a partnership
Schroeder had another pantograph made by the Boyer Machine Company
(the same company built the prototype Burroughs adding machines)
Together they cut:

For the Central: DeVinne (first eight sizes),
Victoria Italic (first eight sizes)
Hermes, Jefferson, Novelty Script,
Multiform, Johnston Gothic (l.c.)

For the Boston: Façade Condensed

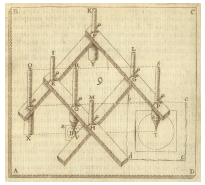
For BB&S: Era series

Schroeder left for California in 1891
Werner continued, cutting: DeVinne & Victoria Italic (finished), Quentell,
Flemish Extended (for Stephenson, Blake),
Caxton Bold (four larger sizes, for BB&S)
Werner designed and cut: DeVinne Condensed, DeVinne Italic,
Midgothic, Antique No. 6
Werner joined the Inland (1895) and for them cut at least part of:
Skinner, Gothic No. 8, Extended Woodward,
Condensed Woodward, [+2 more ca. 1898]
Schroeder continued, cutting: Aldus Italic (four sizes), Sierra (eight sizes),
French Old Style No. 2 (18 point),
Victoria Italic l.c. (6 to 24 pt)
Werner must have continued cutting by machine; it isn't clear if Schroeder did.



GUSTAV F. SCHROEDER.

From Loy in *The Inland Printer* (1898)



Sources: Loy's biographical sketches of Schroeder and Werner.
Werner's 1927 1931, and 1932 articles.

# Wiebking/Hardinge Pantograph

*The Inland Printer* (1932)

ROBERT WIEBKING

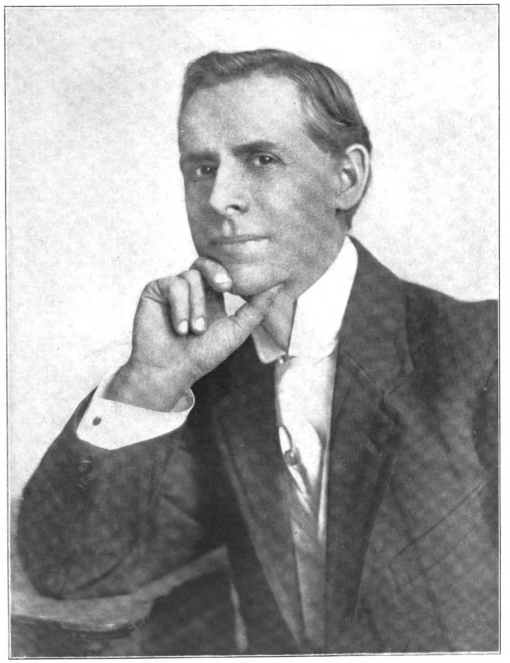
**The most important independent matrix engraving service of the 20th century**

Used for all Ludlow types

Henry Hutchins Hardinge
(1863–1946)

Robert Wiebking
(1870–1927)

*The Public* (1909)

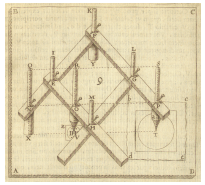


Yours faithfully
Henry H. Hardinge

Wiebking born in Westphalia (Kingdom of Prussia). Family emigrated to USA in 1881. Apprenticed to a commercial engraver in 1884. Started in business in 1893.

Hardinge born in Ontario. Co-founded Hardinge Brothers machine tool company in 1890; left in 1895.

Wiebking and Hardinge build their first pantograph matrix engraver in 1894.



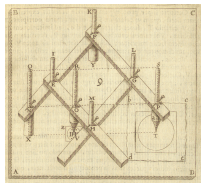
Wiebking designed several faces and cut many more, including Goudy's early work. Wiebking & Hardinge also have a history as typefounders (Hardinge type casting machine and the Advance Type Foundry), but that's a story for another time.

# Wiebking and Ludlow

When the startup-mode Ludlow Typograph Company moved from Cleveland to Chicago in 1909, they leased a floor in the building that Wiebking & Hardinge owned! (1131–1133 Newport Avenue, three blocks south of Wrigley Field; no longer standing)

Wiebking initially cut matrices for the first (matrix-bar) version of the Ludlow, then punches for the Ludlow as we know it. Circa 1917, the Ludlow Typograph Company convinced him to set them up with their own pantographs.

Wiebking was secretive. Paul Hayden Duensing said that the engraving room at Ludlow was kept locked, and that only the head engraver had the key.



Aside: Both Harold Bratter and Fritz Klinke have documented the existence of matrices engraved *in steel* by Wiebking for BB&S.

# Wiebking/Hardinge Pantographs

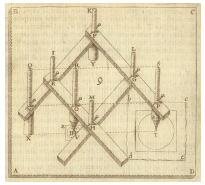
Three Wiebking/Hardinge pantographs are known to survive, all of them ex-Ludlow:

- At the Smithsonian, in storage
- At Letter-kunde Press, Antwerp (Patrick Goossens)
- At CircuitousRoot, Mineral Point, WI (me)

They are four-bar pantographs of conventional geometrical design but exceptionally fine construction.

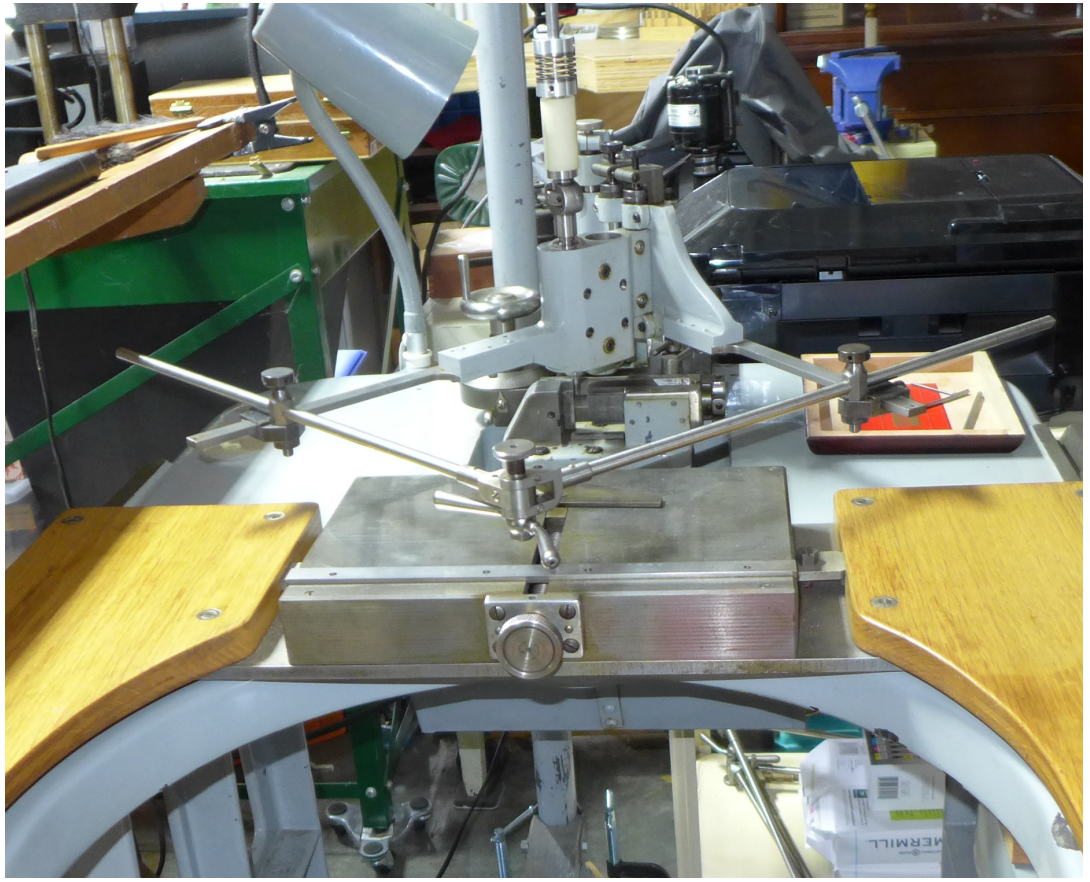
They are fitted with workholders for cutting punches, but it would probably not be difficult to cut matrices with them.

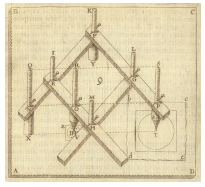
They employ an “acoustic device” to tell you when the tool touches the workpiece.



# One of the Survivors

The ex-Ludlow Wiebking/Hardinge Pantograph
at CircuitousRoot, August 2018





The light bulb on top glows brighter
as the motor turns faster.

# Geeky Details

(of use to nobody outside of Mineral Point and Antwerp)

Motor:  Variable-speed DC.  Nameplate max. RPM 3300, but I've measured it to 5740.

Tracer is a 4mm steel rod in a 6.5mm series WW collet.

Tooling is taper-shank.  Taper is 1:40.  This is not attested on any other machine tool I'm aware of.  It is 1/2 of a Jarno taper, though, and the Jarno is perhaps the most logical of tapers.

I cannot discover the logic of the spindle taper, though.  The spindle collet is *solid*, not split, and it has an external taper which is close to 1:13.5.  That is truly strange.  Its drawbar thread is 48 tpi, but at a diameter that makes it nonstandard.

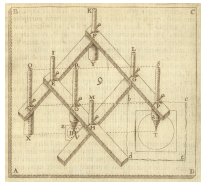
The machine came with two boxes full of taper-shank tools, but all of them have *conical* bodies - no cutting edges.  Are they blanks?  I'm not yet sure.

There isn't a calibration marking anywhere on the pantograph arms.

The vise elevation controls depth of cut.  It is calibrated in units of 0.000,24".  I'm assuming that it is "really" 0.000,25 and that there has been some wear.  (0.000,25" is, in American machinist's jargon, a "quarter thou").

The vise is equipped with an accessory for cutting slant-bodied punches (not only were Ludlow italic mats on slanted bodies - so were the punches!)

Some components have been updated - e.g., socket-head cap screws instead of cheese-head screws.  The flexible coupling to the spindle is a modern component installed by John Johnson as the original coupling (presumably flexible rubber) was missing.  It is very nicely done.

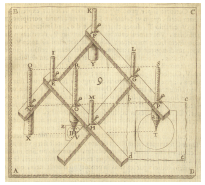


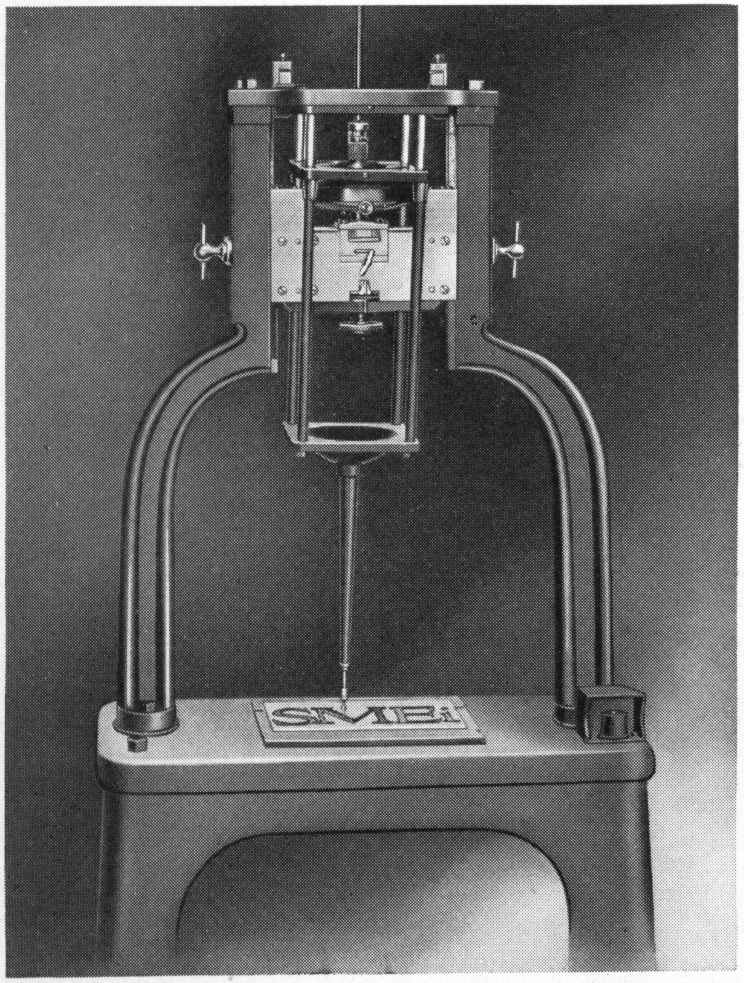
# Benton's Second Vertical Pantograph

US Patent filed Jan. 17, 1899 (issued 1906).

Patent specifies both matrix and punch cutting. Several of its claims refer to matrix cutting specifically.

Removable quill (patent for its cutter grinder not filed until 1900).





*The celebrated Benton Matrix Engraving Machine, invented by L. B. Benton, director of the General Manufacturing Department of the American Type Founders Company, which manufactures the machine. It has completely revolutionized the art of matrix making.*

ATF 1923 Specimen Book

# Clarity of Language

This is not a “Frigidaire”

(1927 General Electric “Monitor Top” Refrigerator, photographed by “Magi Media”)

This is not a “Ford”

(1931 Chevrolet Series AE Independence Phaeton, photographed by “Qflieger” in Germany)

This is not a “Benton”

(Pierpont / English Monotype punch engraving pantograph, shown in Legros & Grant (1916))

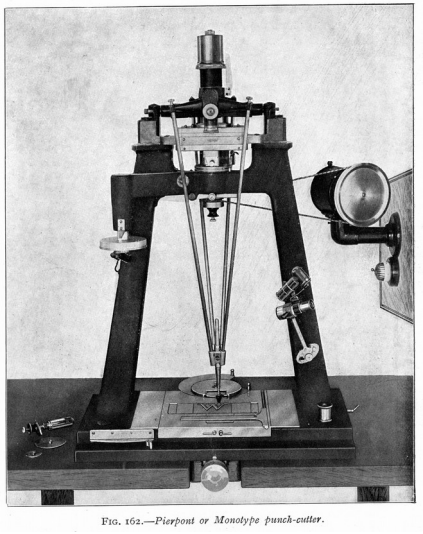
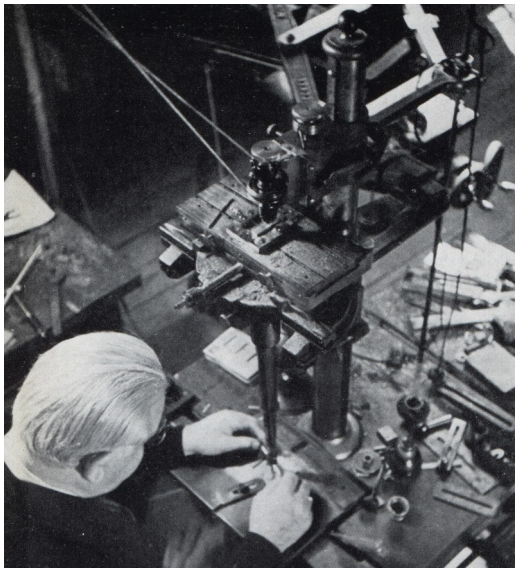
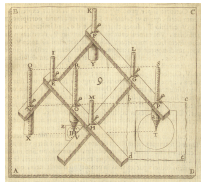


Fig. 162.—*Pierpont or Monotype punch-cutter.*



Neither is this

(Goudy at work on his Engravers’ & Printers’ Machinery Co. Model D rotary spindle pantograph engraving machine, just before the 1939 fire.)



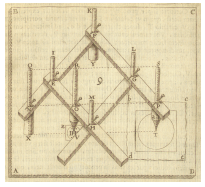
Benton, Wiebking and Pierpont worked to tolerances in the hundred-thousandths of an inch. We do them a disservice if we cannot even name their machines properly.

# Exact Copies of the Benton

The second version of the Benton vertical engraving machine was exported to Japan (Rehak, p. 107). These were copied there by Tsugami.

It is probably reasonable to call the Tsugami a "Benton," since it is an exact copy.

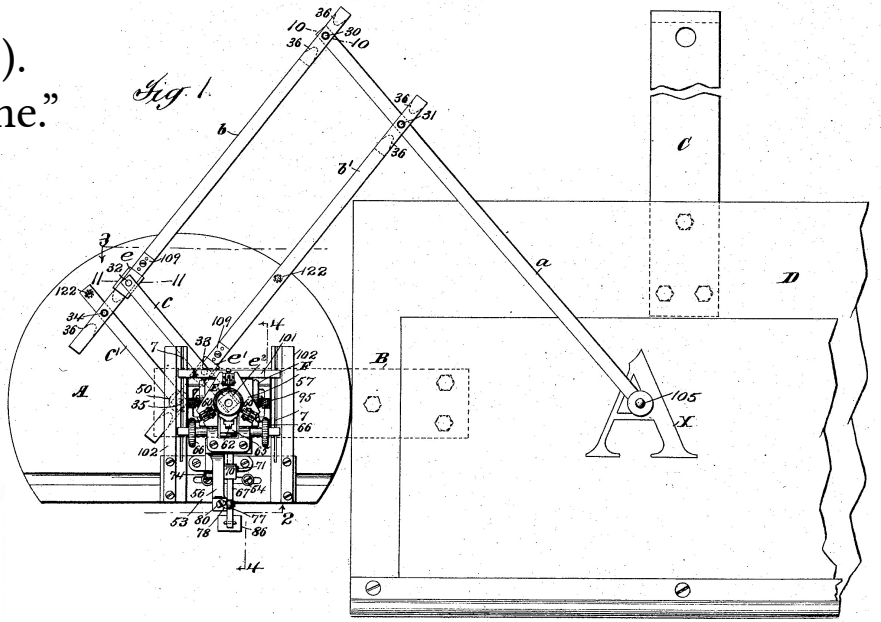
Photo here - check permissions w/V.T. first. Or link to photos on robundo site.



# Benton's "Opto-Mechanical" Pantograph

US patent 790,172, filed July 21, 1899 (issued 1905).
In 1906 Benton called this his "delineating machine."

Reverses a regular pantograph. Microscope is the optical tracer; can trace an existing type. Pen draws at an enlarged scale.
Can tilt the type to condense and expand design.
Microscope automatically adjusts its height to keep in focus over a tilted type!



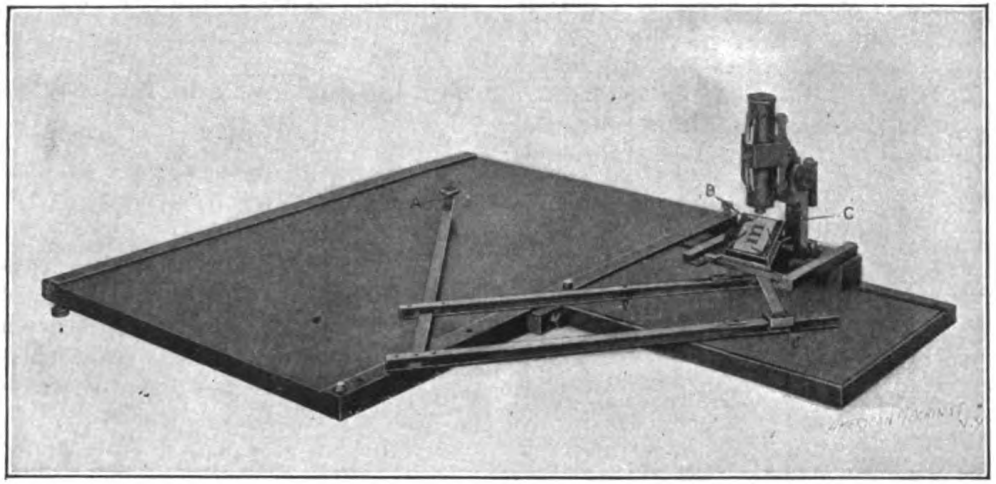
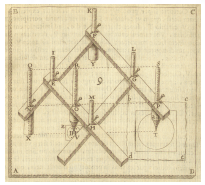
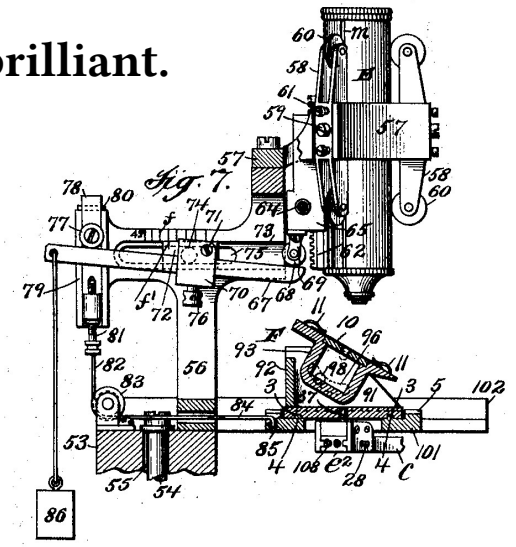



FIG. I. DELINEATING THE CHARACTERS
*A*, tracing point; *B*, fingers for clamping character; *C*, bed plate showing angle possibilities.



From Kaup in *American Machinist* (1909)

**This is just brilliant.**



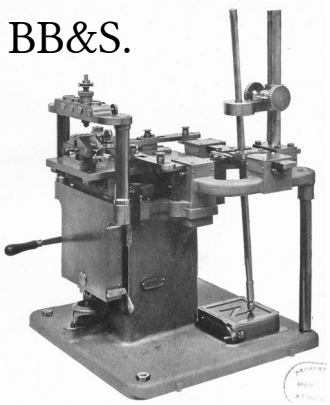

(I'm avoiding the term "Benton Delineator,"
as it has been used ambiguously in the past.)

# Other 19th Century Pantographs for Type (1/2)

It's been staring at us for 122 years, and we haven't noticed.
A pantograph at ATF Philadelphia (ex-MSJ), probably cutting patrices, shown in *One Hundred Years* (1896). This may be a machine by Charles Henry Beeler, who (Loy tells us) built a pantograph at MSJ/ATF. Beeler ended his career at the "Special Matrix Department" of Lanston Monotype.

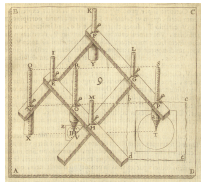

From Loy in *The Inland Printer* (1899)

By George F. Ballou in 1895 for BB&S.



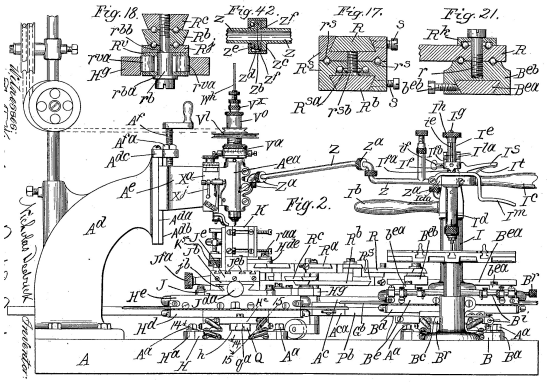
From Legros & Grant (1916)

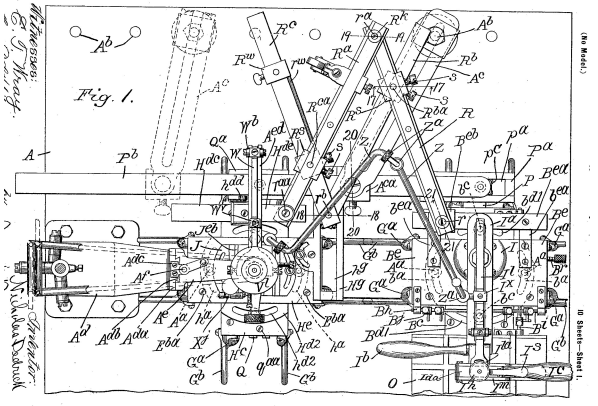
Inland Type Foundry (1895 – 1912) must have had something; they developed their own in-house "automatic" typecasting machines. Werner may have brought the Central Type Foundry pantograph to the Inland.
Werner (1931) also mentions that Inland sold an "engraving machine" to Genzsch & Heyse (Germany) and that it was still in operation in 1928.

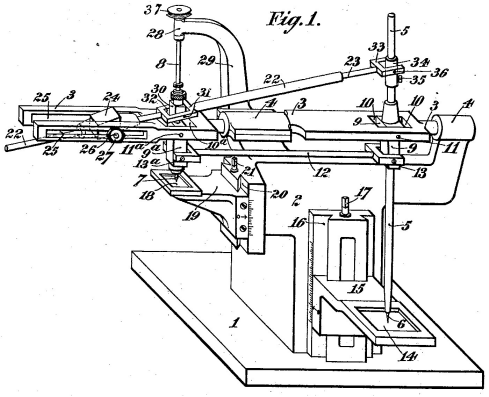


# Other 19th Century Pantographs for Type (2/2)

Nicholas Dedrick, 1896 or 1897, at BB&S. US Patent 614,845. It seems rather complicated, but in general form is not unlike 20th century German horizontal machines.

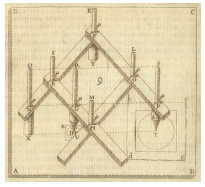






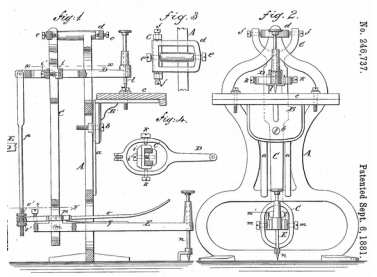

Mark Barr (UK, employed by Linotype & Machinery), but filed in the US in 1900 and issued as US Patent 655,750. It resembles the Ballou machine. It does not appear to have been used.

Barr also developed the machines that Linotype & Machinery did use, as well as a pantograph for coining (US 759,955) and a portrait engine! (US 759,956)



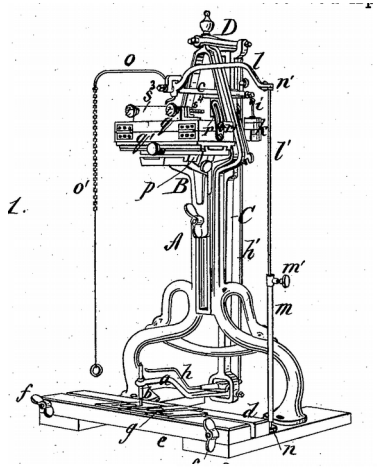
# A Few Nontypographical Pantographs (1/9)

Engle/Eaton/Glover/EP&M/Cronite: 137 Year Thread of Development



Stephen D. Engle. US Patent 246,737 (1881). Vertical-format single-arm with guided cutter. Not influential. (A lot like the 1821 Apograph)

(See also J. Civilian Spencer (1870) and Francis (1880s) for other machines with guided cutters.)



Stephen D. Engle. US Patent 275,618 (filed 1882). Vertical format single-arm, plain drag engraving. Produced commercially. Shown at right engraving on glass in a scientific instrument application in 1891.

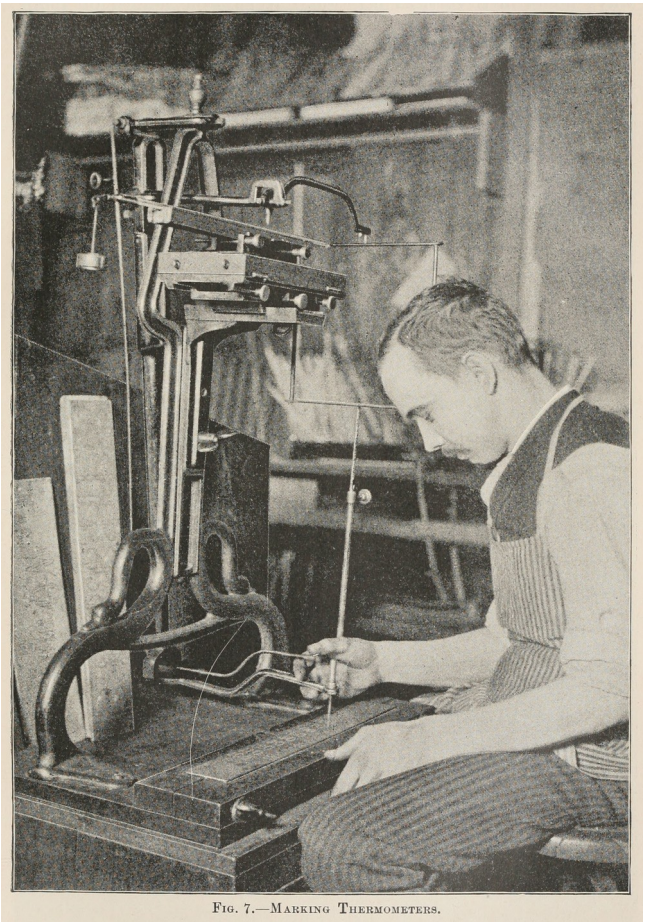
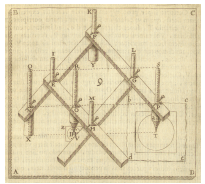
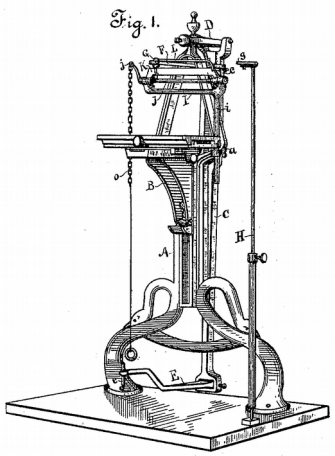


Fig. 7.—Marking Thermometers.

From *Popular Science* (1891)

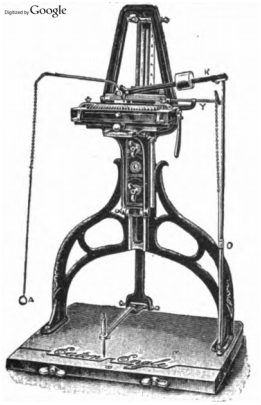





William S. Eaton, of Sag Harbor, NY, and William T. Goodnow improve on Engle's machine in a patent filed in 1896 (US 585,261).

# A Few Nontypographical Pantographs (2/9)

Engle/Eaton/Glover/EP&M/Cronite (continued)

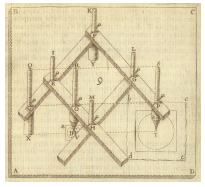


The Eaton-Engle machine is sold commercially through about 1902 (by the Eaton & Glover Co.)

From *Aluminum World* (1902)

From a *New Century* booklet

Then circa 1900, Eaton develops what was marketed as the "New Century" machine. (US Patents 663,563, filed 1900, and 729,758, filed 1901). This machine was successful. Used for general commercial engraving.



In 1902, Eaton files US patent 728,556. The machine it describes was not produced, but it employed a workpiece table on bearings (prefiguring later E&PM machines).

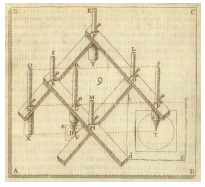
# A Few Nontypographical Pantographs (3/9)

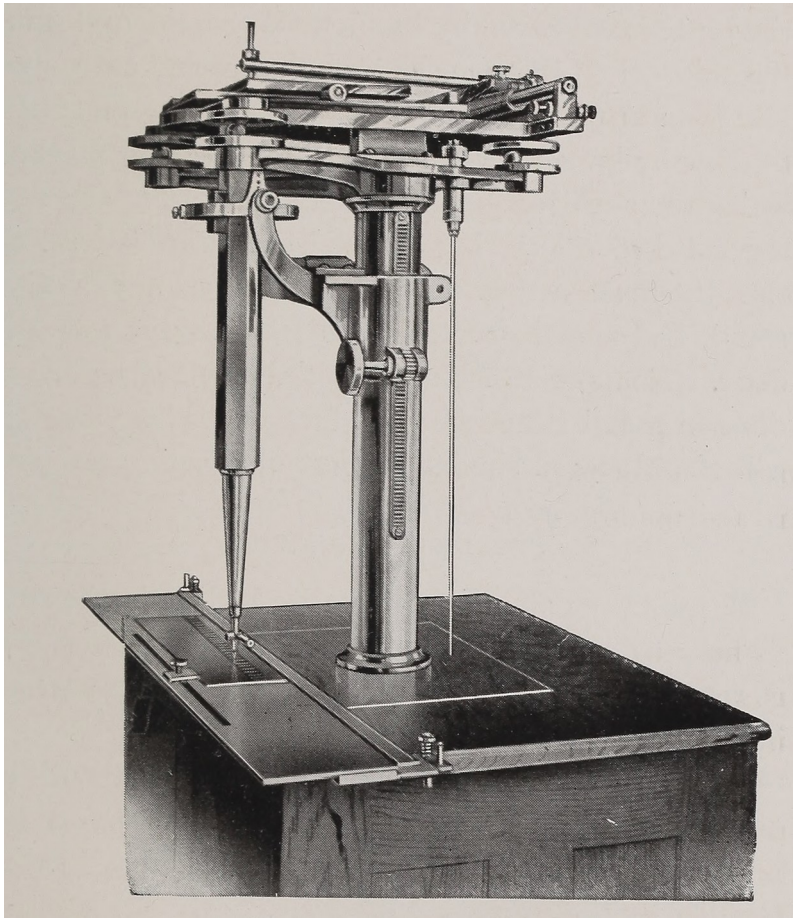
Engle/Eaton/Glover/EP&M/Cronite (continued)

Eaton became “Engraving Company of America” (ca. 1902–3) then “Interboro Engraving Co.” (ca. 1908–19120). It seems then to have been absorbed by the Engravers’ & Printers’ Machinery Co. (1911– ?) This company moved to Sag Harbor, NY (where Eaton lived).

Around 1912 they introduced their “Model C,” a vertical-format single-arm drag engraving machine with the worktable rolling on large balls.

(Goudy used the Model D rotary spindle version of this machine.)





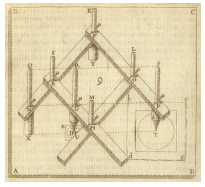
From Salade (1922)

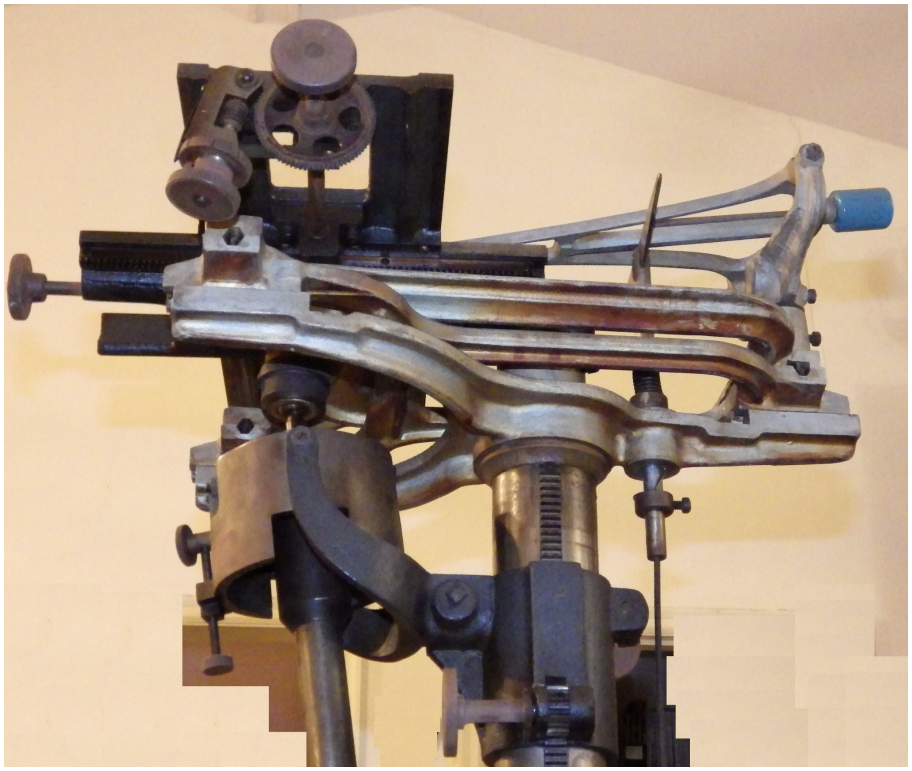
# A Few Nontypographical Pantographs (4/9)

Engle/Eaton/Glover/EP&M/Cronite (finished)

Over a period between 1934 and 1974 (details unclear) the assets of the E&PM Co. of Sag Harbor were acquired by the Cronite Company. It is still in business, serving the engraved stationary trade with drag engraving equipment. They kept the basic ball-supported design, but implemented a number of improvements. They did not continue with production of rotary spindle machines.

This is a photograph of my Cronite, looking upward. You can see the gimbal supporting the vertical arm. The Y-shaped horizontal support houses the balls on which the worktable moves.





# A Few Nontypographical Pantographs (5/9)

In Optical Manufacturing there is a common need for engraving on lens housings, shutters, and other camera parts. Three optics/camera firms created their own pantograph engraving machines:

Cooke (began by 1870)
Taylor, Taylor & Hobson (1894)
Friedrich Deckel (1903; 1920s, "Compur" shutters)

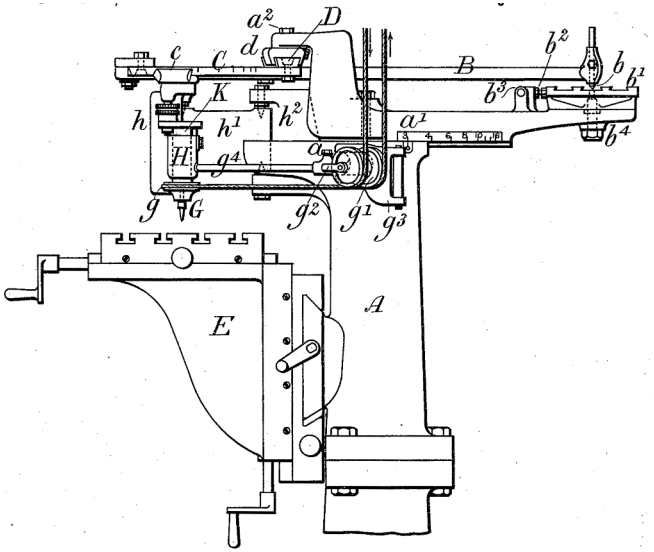
Taylor-Hobson and (especially) Deckel went on to become important machine tool makers in their own right. Machines by these firms frequently were used for engraving patterns.

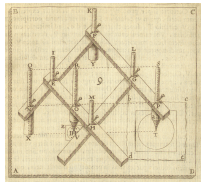
## Taylor-Hobson, UK

(The firm was "Taylor, Taylor and Hobson." The machine was a "Taylor-Hobson.")

Initial patent 1894 (GB 6420 of 1894, US 542,902).
Distinctive feature: Support of the spindle on a heavier articulated arm separate from the pantograph arms.

Stephen Austin & Sons / SASMATS, which became Ludlow UK, used T-H machines for matrix engraving.



## Jim Rimmer's Taylor Hobson in 2010

Courtesy Jason Dewinetz

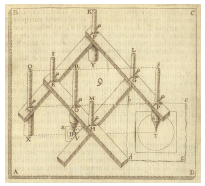
# A Few Nontypographical Pantographs (6/9)

## Friedrich Deckel, Germany

Founded 1903. Began making machine tools in the 1920s. Now the 'D' in DMG MORI AG. Distinct from Feinmechanik Michael Deckel, which continues to make Deckel cutter grinders.

It is very difficult to find a reproducible photograph of a Deckel.
In the smaller sizes (e.g. G1U) they were built on Taylor-Hobson principles and were very similar to equivalent Gortons.
However, their 3-D machines (e.g., GK-21) used a simple pivot where Gorton used a proportional mechanism ("Ratiobar").

In Boone's 1942 *Popular Science* article on Goudy, he is shown using an E&PM pantograph for patterns. This was a stopgap. His Deckel burned in the 1939 fire and he had difficulty in replacing it under wartime conditions.



Rehak, p. 135, noted that the Dale Guild used a Deckel for pattern work. I have not been able to find the model he cites (2G1) in the literature.

Goudy cutting a pattern on his Deckel, circa 1939.
From Advertising and Selling (1939)

# A Few Nontypographical Pantographs (7/9)

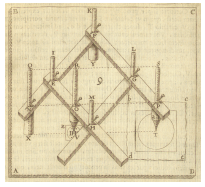
## George Gorton, US

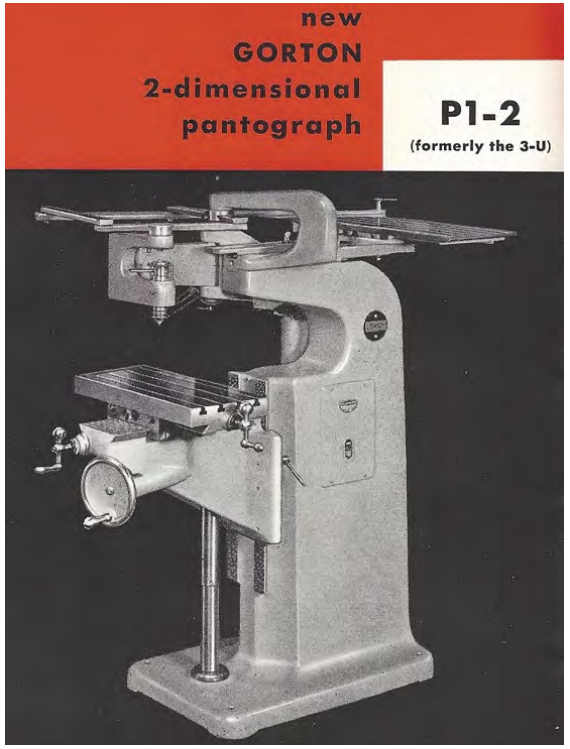
The preeminant American maker of industrial-scale pantograph engraving machines.

Gorton initially licensed Taylor-Hobson, and then went on to decades of their own designs. The Model 3-U, devloped later into the Model P1-2, was probably their most popular.

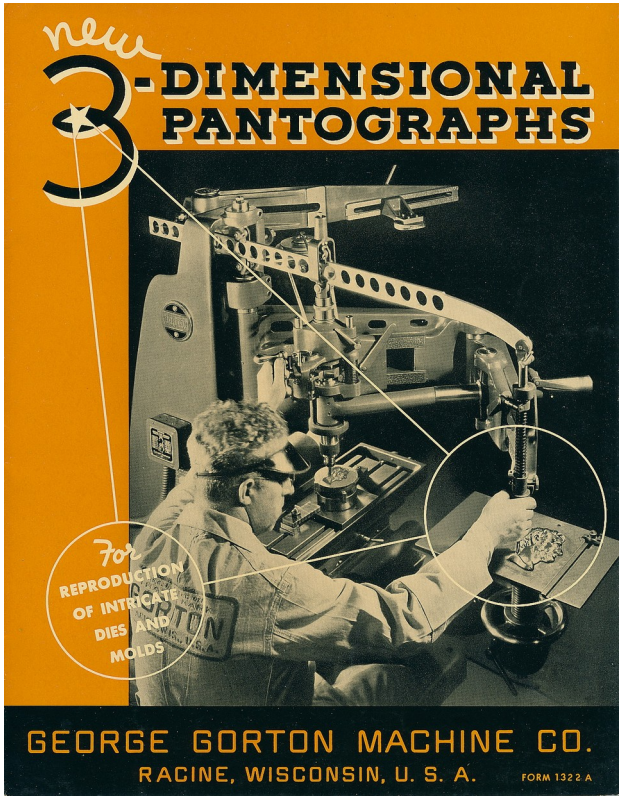
In the 1940s, ATF used a Gorton 3-B (not 3-U), slightly smaller than the 3-L shown below, for pattern engraving. It was stripped of its 3-D mechanism for this service. It is the machine shown in *Type Speaks!*

Gorton 3-L with "Ratiobar" system in 1937. Later became the model P3-2. Three-dimensional work.





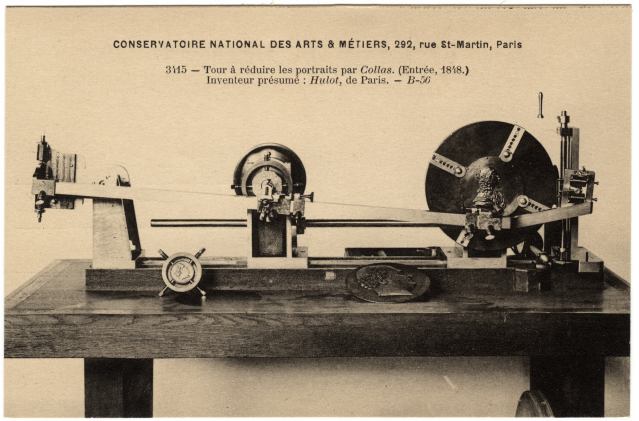

Gorton *Tools of Tomorrow* (1957)

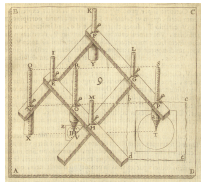



Gorton Form 1322A (1937)

# A Few Nontypographical Pantographs (8/9)

Herman Hollerith, in developing the punched card equipment for the 1890 census, used a single-arm pantograph mechanism for a hand card punch. It shows clearly a distortion issue that Benton may not have known he solved. Note the distorted pattern plate, necessary when a fixed-length single-arm is used for a workpiece or pattern which isn't a circular arc. This problemdoesn't happen with Hulot/Janvier sytle pantographs. Benton solved it by using a variable-length arm (shown below left on a Mergenthaler Linotype pantograph).



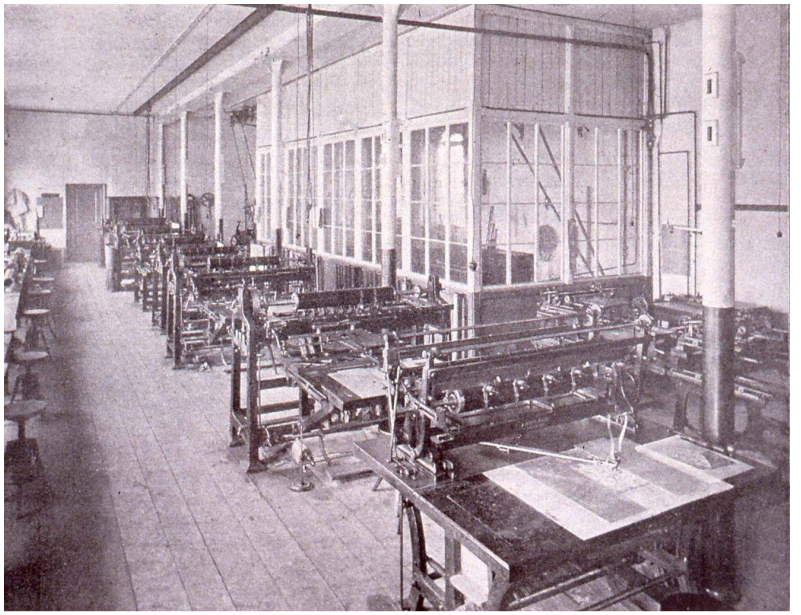
From *The Linotype Bulletin* (1923)

Herman Hollerith. US Patent 487,737, filed 1891, "Keyboard-Punch."
US Bureau of the Census, circa 1940

# A Few Nontypographical Pantographs (9/9)

## Multi-spindle/cutter machines

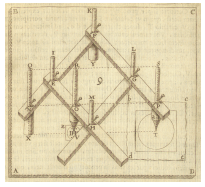
All of the pantographs for engraving rolls for calico printing, starting with Rigby, appear to have been multi-cutter devices. This 1902 photograph the Keller-Dorian factory in Mulhouse, France, gives a sense of the scale of this application. These aren't printing calico - they're just making the rolls for printing.

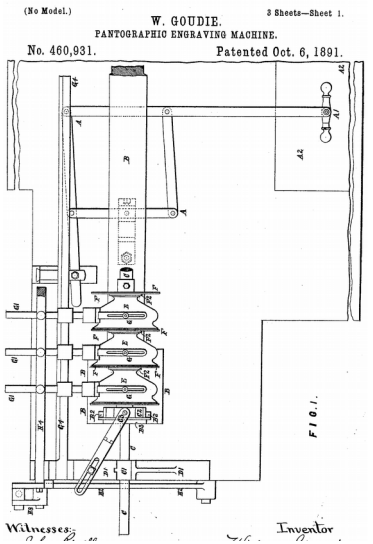



Gallica/BnF Archive

Photo by Doug Coldwell

Andrew Hallberg, for the Star watch case company (1905-1982), Ludington, MI. 32 spindles or drag engravers (I'm not sure which).




William Goudie, Scotland. US patent 460,931, filed and issued in 1891. Multispindle machine for glass.

# 20th Century Benton-Vertical Derivatives (1/5)

Linotype & Machinery Ltd. (UK)

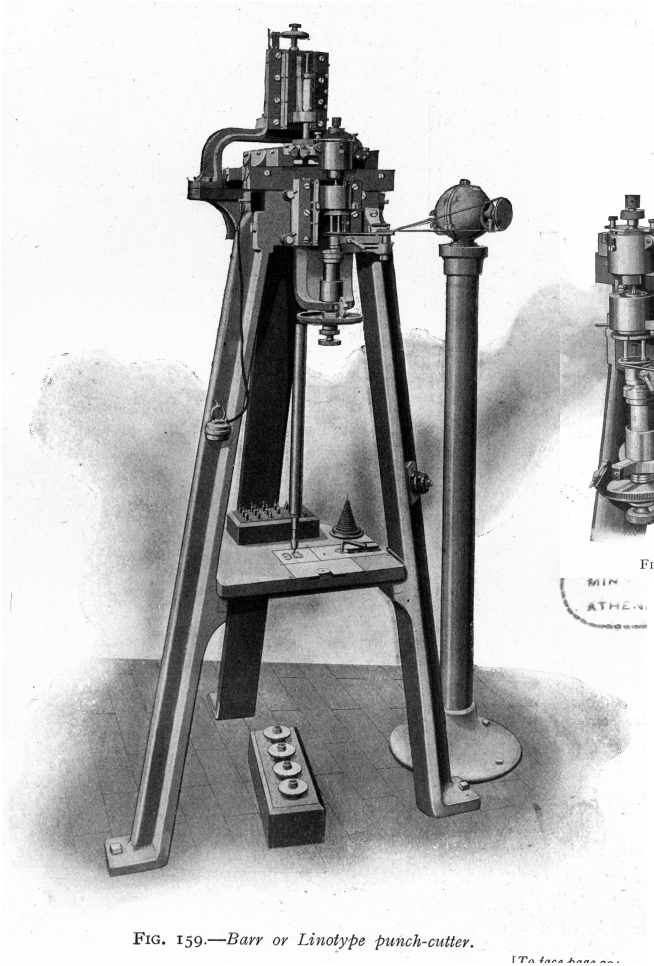


Fig. 159.—*Barr or Linotype punch-cutter.*

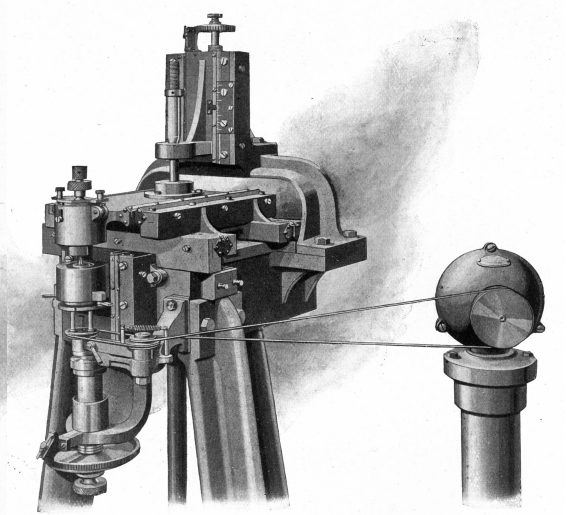
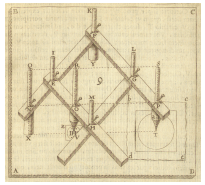


Fig. 160.—*Barr or Linotype punch-cutter; details.*

Legros & Grant (1916)

Science Museum, London

Later, make unknown



Barr, 1902

Mark Barr, for The Linotype Co. / Linotype & Machinery Ltd.

Patented ca. 1902 (GB ?, US 759,957, filed 1902)

Note: Barr patented a wide variety of pantographs and related devices. Note to self: See also GB 22,106 of 1900, pantograph with microphone annunciator.

# 20th Century Benton-Vertical Derivatives (2/5)

English Monotype

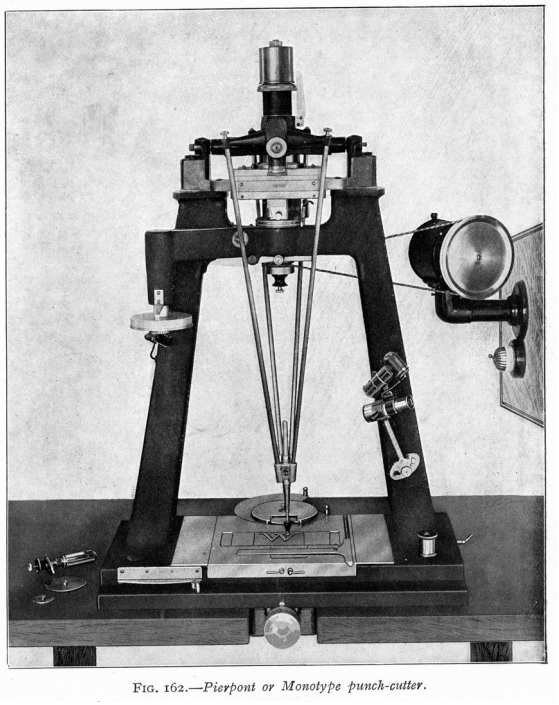
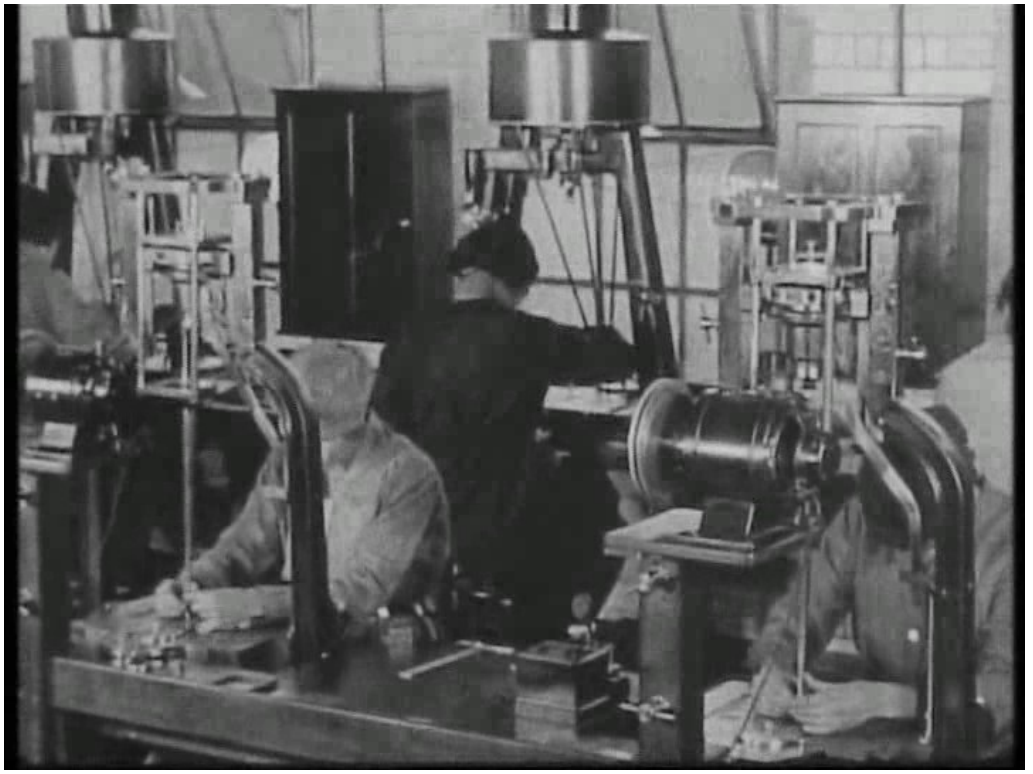


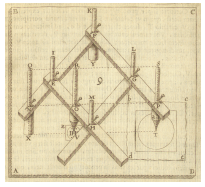
Fig. 162.—*Pierpont or Monotype punch-cutter.*

From Legros & Grant (1916)



From film *A Monotype Composing Machine* (1925)

Frank Hinman Pierpont.
Patents filed 1906 (GB 7206 of 1906, US 938,074).
But *two* styles shown in 1925 and 1956 films - one much more like Benton's.



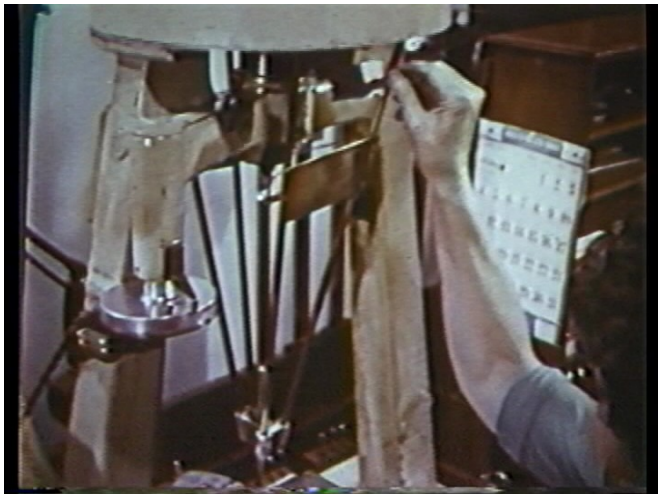
The ex-Lanston (US) machine which went to Hartzell, then M&H, then Giampa was a Pierpont machine (Fritz Klinke has a photograph of it online).

# 20th Century Benton-Vertical Derivatives (3/5)

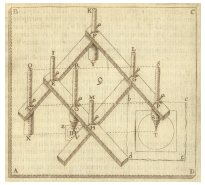
## Mergenthaler Linotype (US)

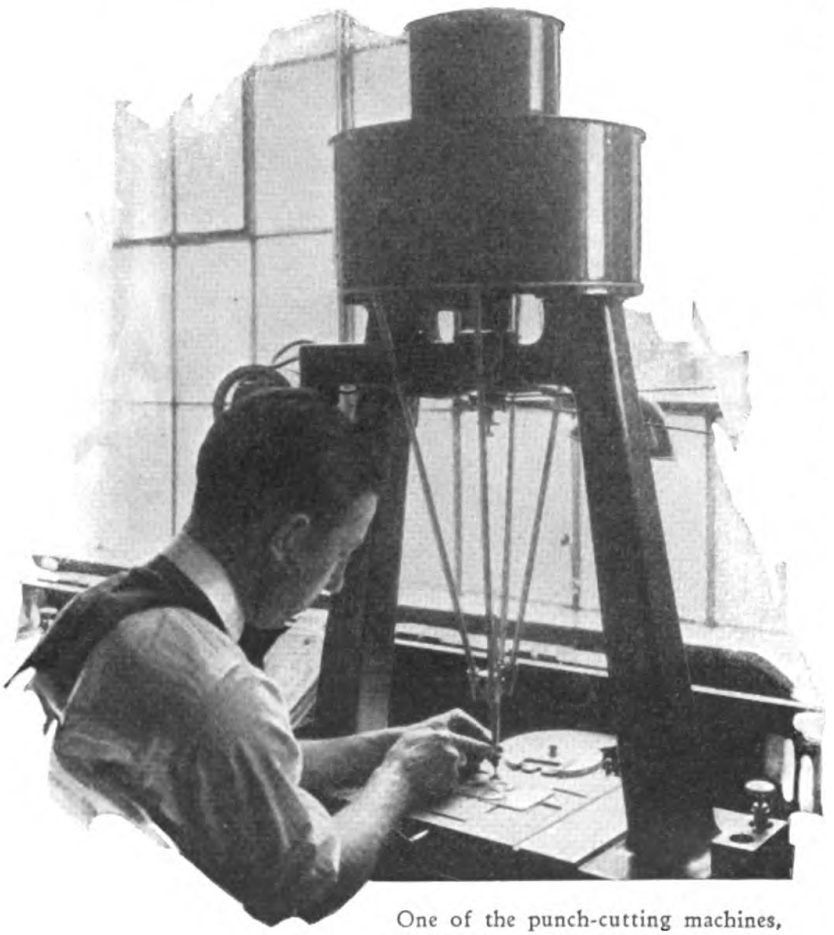
An illustration in Wilkes (1990), p. 57, shows Barr vertical punchcutting pantographs in an "amerikanischer Gießerei vor 1900" (but Barr's machine does not date to before 1900).
It is possible that this is the Mergenthaler Linotype Company

By 1923, MLC was using a machine which looks a great deal more like a Pierpont. The same machine appears in their 1961 film *The Eighth Wonder*.



*The Eighth Wonder* (1961)





One of the punch-cutting machines, a triumph of accuracy and precision.

*Linotype Bulletin* (1923)

# 20th Century Benton-Vertical Derivatives (4/5)

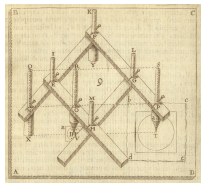
## Intertype.

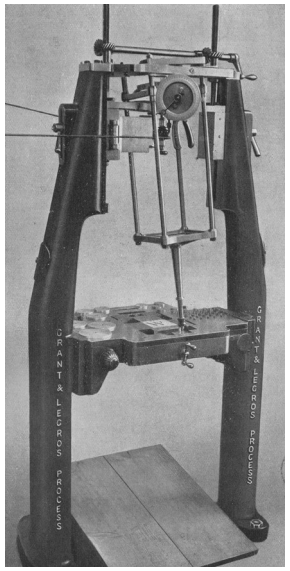
Photographs by Stan O. Coutant of the Intertype factory in Brooklyn in 1966 show machines very similar to the late machine from Linotype & Machinery Ltd.

A machine which looks exactly like a Pierpont machine is now owned by an ATF member. It is said to be ex-Intertype.

Intertype Factory Tour 1966

Formerly online on S. O. Coutant's website.
Now reposted to Dave Hughes' metaltype.co.uk site.






Naturally, John Cameron ["Poet of Empire"] Grant and Lucien Alphonse Legros made their own.

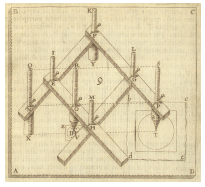
# 20th Century Benton-Vertical Derivatives (4/5)

## Lewis/Keystone

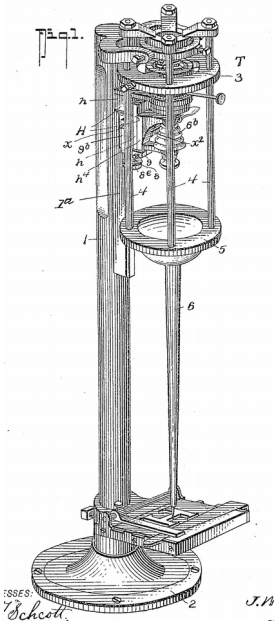
James William Lewis filed three patents for vertical typographical pantographs in the 1903–1905 timeframe.

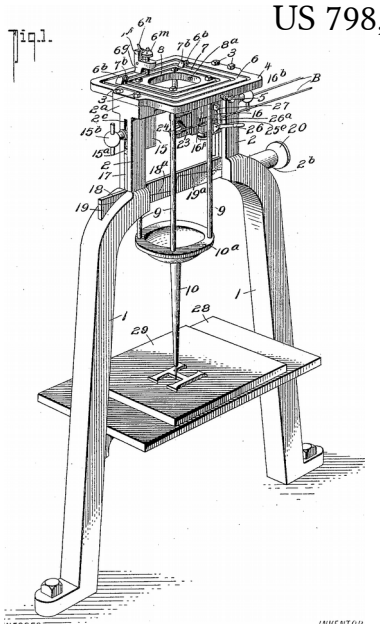
US Patent 787,197, filed in 1903, describes improvements to Benton's first vertical pantograph. It is interesting in that he refers to "personal experience" with this style of machine.

US Patent 798,354, filed in 1904, also describes improvements to the first style of Benton vertical pantograph (note its use of a WW lathe headstock for a spindle). It is shown with a later physical arrangement of the machine frame.

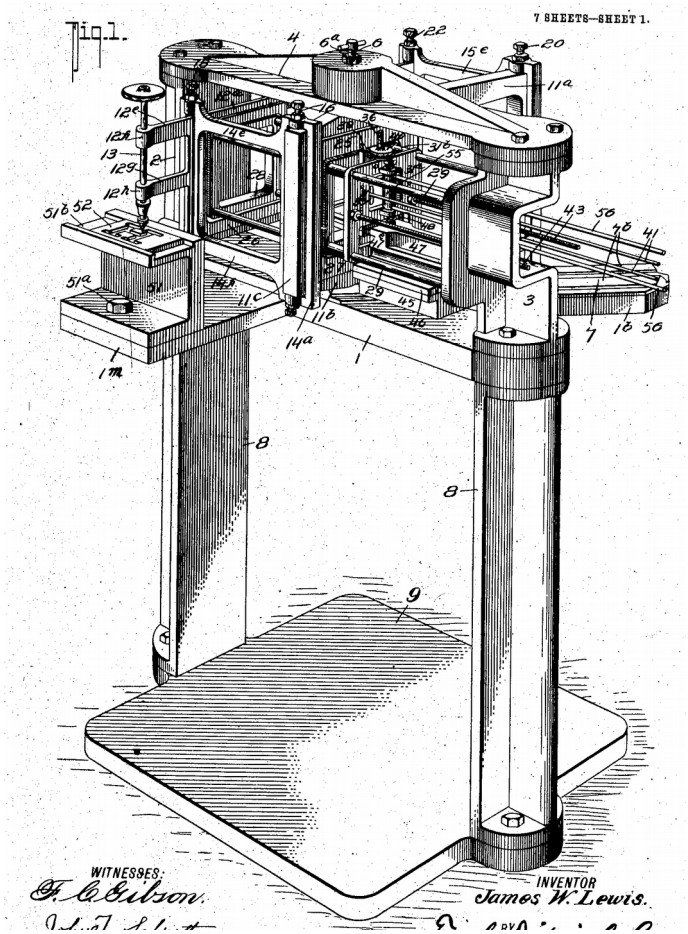


US 787,197





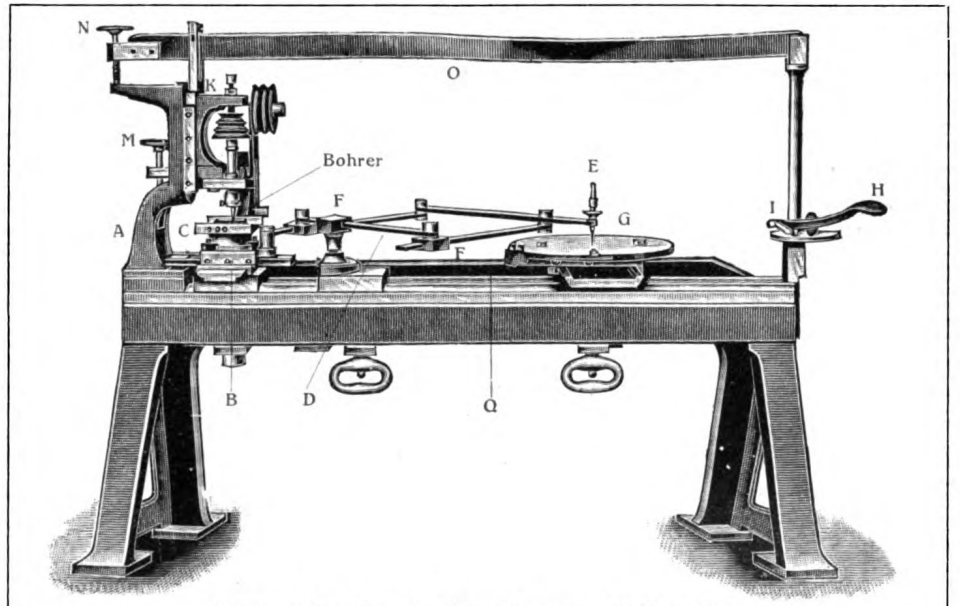
US 798,354




US Patent 839,011, filed in 1905 (see above) is for a machine of entirely novel construction (and doesn't really belong in this section of Benton-derivatives. This patent was assigned to the Keystone Type Foundry of Philadelphia.

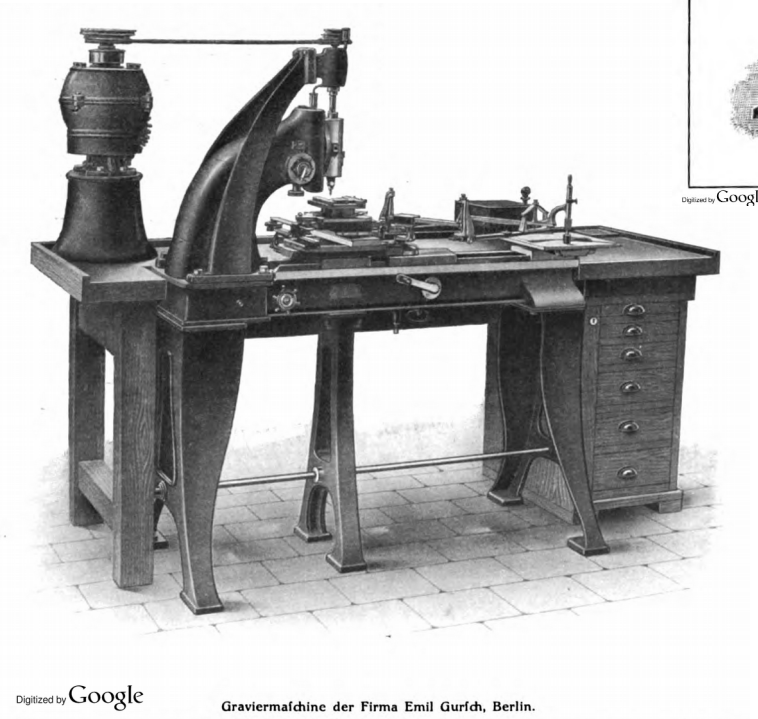
# 20th Century Other Typographical (1/7)

Some European foundries such as Stempel seemed to use Benton-derived machines. In those which did not, this general style of horizontal four-bar pantograph (storchschnabel) seemed common



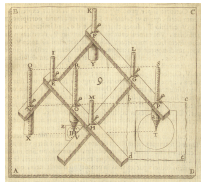
Matrizenbohrmaſchine der Firma H. Bernert, Charlottenburg.




Graviermaſchine der Firma Emil Gurſch, Berlin.



Two German matrizenbohrmaschinen, by Emil Gursch and H. Bernert, from an article by Julius Wernicke in *Klimsch's Jarhbuch*, 1909.



My thanks to Patrick Goossens for discovering this article.

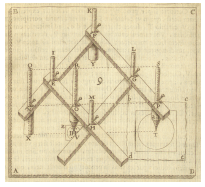
# 20th Century Other Typographical (2/7)

Photograph by Patrick Goossens

A horizontal-format four-bar pantograph for matrix engraving, at the Museum für Druckkunst, Leipzig

From *The Human Touch* (1937)

Mahr (1928), Der matrizenbohrer [the matrix engraver]

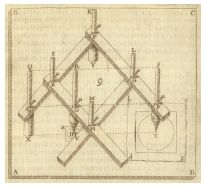


# 20th Century Other Typographical (3/7)

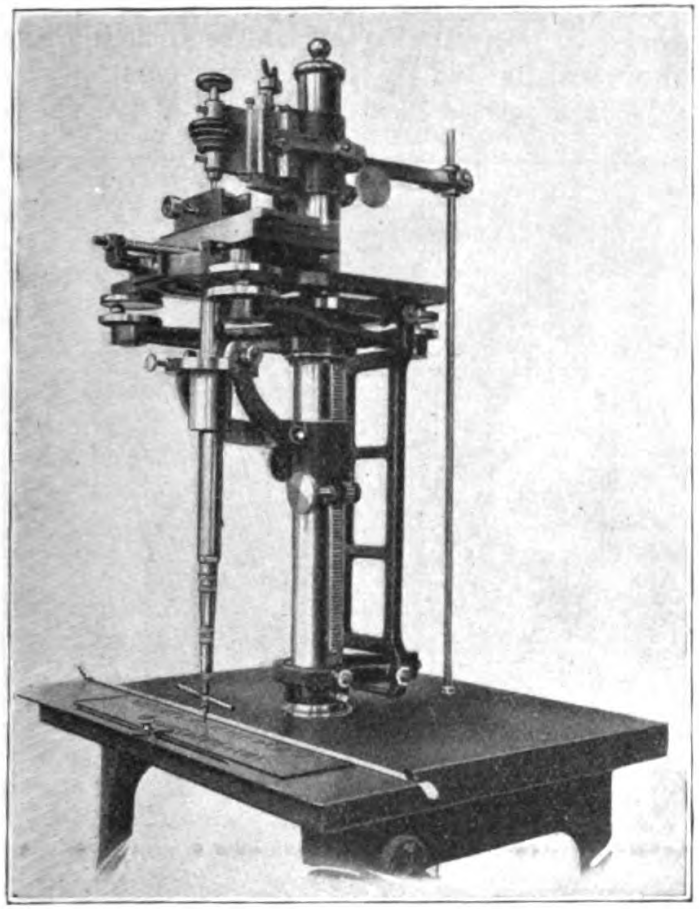
An unidentified pantograph in the Musée Renaudot, Loudun, France. According to its placard, it came from the Deberny & Peignot foundry.


Photograph by Patrick Goossens

Lane & Lommen (*Dutch Typefounders' Specimens*, 1998) show a photograph of the engraving room at Typefoundry Amsterdam in 1948 which has two (unidentified) horizontal-format 4-bar pantographs. Each is built into a kind of desk.



# 20th Century Other Typographical (4/7)



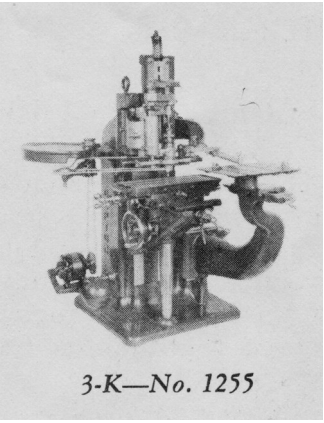
American Machinist (1919)

Goudy used Model D rotary spindle machines made by the Engravers' & Printers' Machinery Co. of Sag Harbor, NY. Shown here from *The American Machinist* at its introduction in 1919.

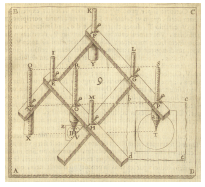
History back through Eaton (ca. 1900) to Engle (1880s)

History forward to Cronite

Gorton adopted the removable quill concept on several of its machines, making them suitable for matrix engraving. But this is their 3-K Matrix Machine, (shown in a 1935 catalog). Weight: 1,800 pounds.




Gorton Form/Catalog 1385 (1935)



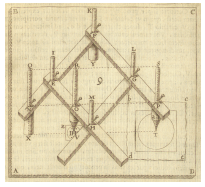
In a 1999 LETPRESS posting, Bill Simon (editor of The Ludlow Quarterly) said that matrix engraver "Henry Sheer (sp)??" in NY used a "Godzilla sized" Gorton engraver weighing 2,500 pounds to make Ludlow and Linotype mats. Allowing for some exaggeration, that suggests a 3-K.

# 20th Century Other Typographical (5/7)

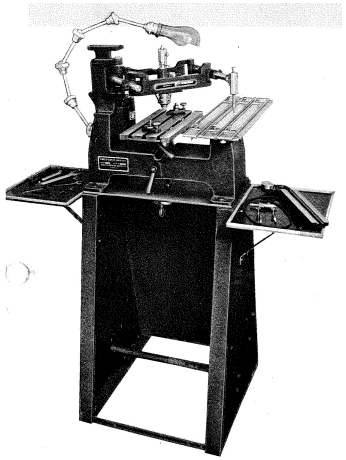
Charles H. Schokmiller. Werner (1931) says that Schokmiller built a pantograph engraving machine for Stephenson, Blake and that in 1906 he (Werner) travelled to England to deliver it and instruct them in its use. He elsewhere implies in the article that it was of horizontal, not vertical, construction.

Legros (1908), p. 1068, says that with a Mr. Colebrook he constructed "a pantograph which has given very satisfactory results" out of bicycle tubing.

Benton Ad-Cut (1918). I know little about this machine. Rehak (1993), p. 107, describes it as the only surviving example of a number of pantographs that Benton "enhanced."

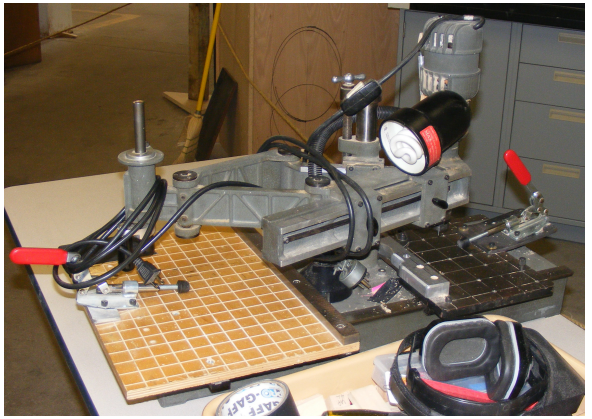


# 20th Century Other Typographical (6/7)



Paul Hayden Duensing used a Preis (not sure which model). At left is a floor-standing model (from a 1967 manual). At right is a tabletop model used by Scott Moore to demonstrate wood type cutting.

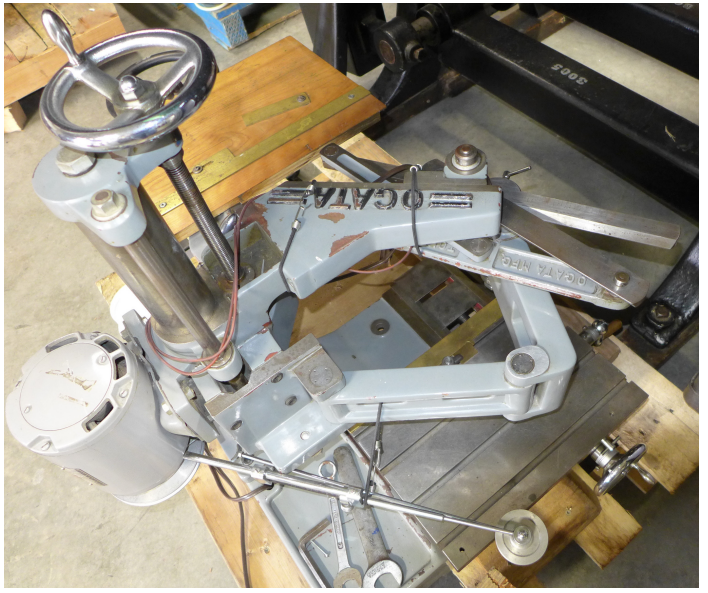
My thanks to Scott Moore for sharing and demonstrating this technology



At the 2014 APA Wayzgoose at the Hamilton (machine partly packed up after the demonstration)

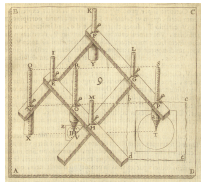
My thanks to Jason Dewinetz for preserving Rimmer's equipment and allowing me to photograph it.

Jim Rimmer used a 1973 Ogata RS-260 (*Pie Tree Press* (2008), p. 67). It is shown at right in storage at GreenBoatHouse Press in 2017.



**OGATA** Bench Engraving Machine, Model RS-260. Surface of pattern table, 13in. x 16in.; surface of working table, 10in. x 14in.; longitudinal feed of work table, 10½in.; cross feed of work table, 7in.; measurement of pantograph, 10½in. x 10½in.; smallest ratio, 1.1; largest ratio, 1.20; spindle speeds, 8500-12,000 r.p.m.; max. distance between table and spindle, 7in.; motor ¼ h.p., 240 volt. **Scruttons, Stand 3, Hall 1.**

From the *Official Catalogue of the Third Machine Tool Exhibition*, Sydney, Australia (1965).

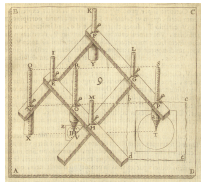


# 20th Century Other Typographical (7/7)

When late Ludlow Typograph production moved to England, the matrix department of Stephen Austin & Sons (SASMATS) took over matrix production. They employed first Taylor-Hobson and later Alexander pantograph engraving machines.
These were standard industrial pantographs; we associate them more with pattern making (Rimmer used a Taylor-Hobson for this. Alexander started out as the UK agent for Deckel).

I'm not sure if Ludlow UK was directly engraving mats or if they were still cutting punches.

The Offizin Parnassia Vättis owns a horizontal pantograph by Maschinenfabrik Michael Kampf KG. Kampf pantographs were made for the minting/coining trade. They have used it to cut matrices for their revival of Morris' Troy Types.



# Summary of Technologies - 20th Century

*Type-makers will use every technology that works.*

**Hand punchcutting** did continue into the 20th Century. See Lane (1991).
- Industrially: E. P. Prince, Louis Hoell, Charles Malin, Paul Rädisch, August Rosenberger, Henk Drost, . . .
- Revivalists: Rudolf and Paul Koch, Victor Hammer, Dard Hunter.
- Later 20th C.: Nelly Gable, Christian Paput, Dan Carr, Stan Nelson, . . .
- It continues today, though at a very much reduced scale.

**Hand patrix cutting** continued into the 20th Century in Europe.
- Bauer, Stempel, Typfoundry Amsterdam, Enschedé, ...

**Machine patrix engraving** continued into the 20th Century
- Compositype, [probably Lanston], ...
- [need to find more evidence and more closely examine what we know]

**Machine punchcutting** remained important, esp. for matrix *manufacturers*.

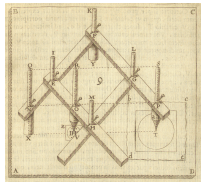
**Machine matrix engraving** became important (esp. at ATF)

Pantographs from two major, and some minor, traditions:
- Single-arm machines derived from Benton
- 4-bar machines — Wiebking, "Gursch/Mahr" style, [Gorton?], ...
- Goudy's E&PM, Duensing's Preis, Rimmer's Ogata, ...

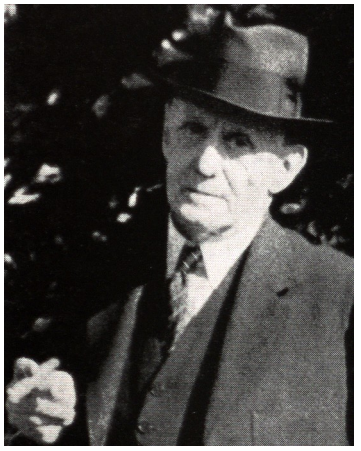
Despite hand methods, 20th century was the age of the pantograph.

Linotype Ad, Mar. 1942

*Inland Printer*, v. 108, n. 6



Updike Obit., Mar. 1942

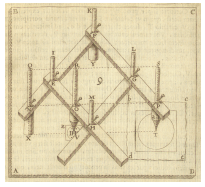


*Inland Printer*, v. 108, n. 6

Not everybody was happy about this.
It is worthwhile to understand why.

# Part 2:

# … and Its Discontents

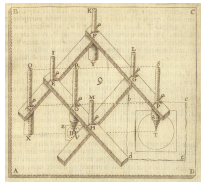


# (caution)

I'll be tangling two threads here:

- The mechanization of type-making at any size.
- The mechanical (or algorithmic) scaling of type.

It is difficult to untangle them,
as they're aspects of the same technological history.

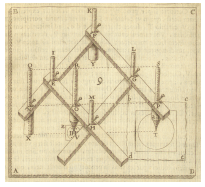


# (more caution)

Although I have a long history in programming, I'm pretty "old school" (1970s to early 1980s).

I've mostly avoided digital lettering since the mid-1980s.

It is likely that I will oversimplify the views and knowledge of the more sophisticated participants in the world of digital lettering.  There is a lot of good work being done today.



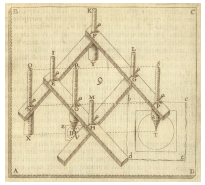
# Contemporary Opposition

(It just seemed wrong to transcribe Updike with modern digital lettering. So here is what he said as he set it, in *Printing Types* (1922), p. 11.)

But a design for a type alphabet that may be entirely successful *for the size for which it is drawn*, cannot be successfully applied to all other sizes of the same series. Each size is a law unto itself, and is often bettered by modifications in the original design made by the feeling and taste of the designer.

Parallels with other fields - there were common objections to the Reducing Machine in coining/minting. Here's a relatively late example:

> The greatest and indeed the most devastating innovation was the introduction in the late eighteenth century of the reducing machine. … Ultimately, coins and medals depend … upon working directly in the dies to produce toreutic qualities at a size and scale appropriate to them."
>
> - Ayres, *The Artist's Craft* (1985): 175-6.



("toreutic" just means "metalworking")

# Contemporary Support

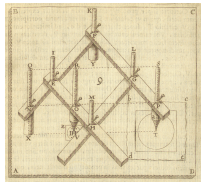
"The machine has not killed good craftsmanship; the machine in the hands of the craftsman is merely a more intricate tool than any that was available to the earlier worker, and *enables him to carry out his own creative ideas more exactly* than can be done when the work is passed into the hands of artisans ... *[who] obviously cannot realize fully* just what was in the type creator's mind, and therefore cannot carry out the work absolutely in the spirit in which he worked."

- Goudy. *Typologia*. (1940) [italics mine]

Modern comment in support of Reducing Machines:

"The reducing machine has been much blamed for the decline in standards of design and execution in modern coinage. This criticism is based on a confusion of ends and means, for the reducing machine in the hands of artists like Pistrucci and William Wyon was the mere servant of their skills, and did not diminsh the quality of their work."

- Pollard (1971): 317

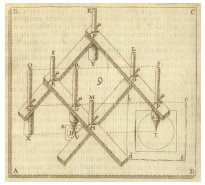


# Modern Views

All modern digital lettering (“type”)
is created by machine.

Obviously all type can be scaled;
we do it constantly.

You just have to do “optical scaling”
to get quality results.



Aside: The phrase “optical scaling” seems to be passing from fashion. It was perhaps too closely associated with late photographic and early digital type in the 1980s and 1990s. What I’m thinking of here is algorithmic scaling to achieve visual (optical) effects.

# Plan of Analysis

What is a “Typeface”?

I haven’t found the first use of the term yet. It is not attested in the OED 1st ed.

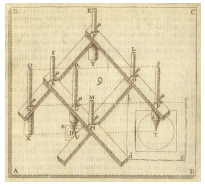
Not a “natural” category.
The concept arose in the late 19th century.
You cannot understand type before ca. 1850-1870
by thinking in terms of typefaces.

This concept was a part of a general move to
regularize type in the late 19th century.
It predated the pantograph,
but the pantograph enabled its full expression.

Can you always scale type algorithmically?

Yes, you can, and
No, you can’t.

These are issues which arose out of the pantograph
and its successor, the computer.



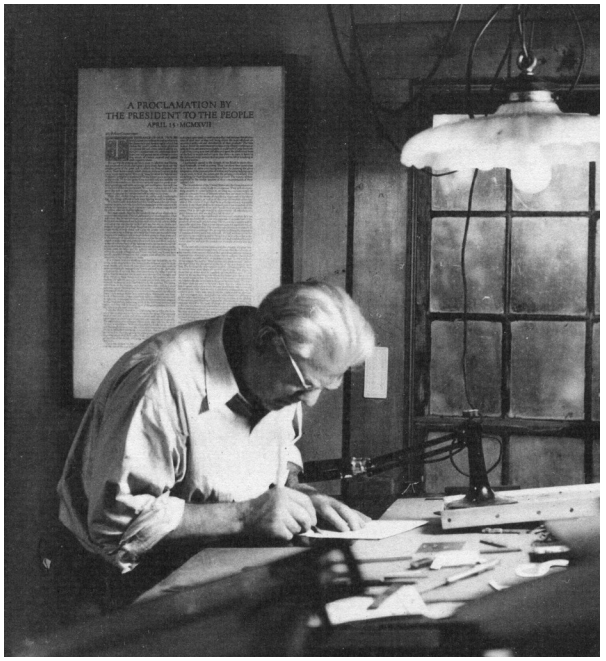
# The Evolution of the Concept of a “Typeface”

Today: A “typeface” is a design.

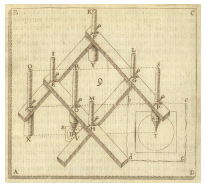
Covers many variations
(size, weight, roman/italic,
condensed/expanded, etc.)

But is essentially unified.

An expression of a designer’s intent.




Lewis (1941)



Goudy. The first Type Designer as Rock Star

(Meridian is roughly 44 point)

(Double Columbian is roughly 32 point)

# Bruce's 1828 Specimen Book (1/2)

*There are no typefaces in this specimen book.*

MERIDIAN.

**Quousque tandem abu-
tere, Catilina, patientia
nostra? quamdiu nos e-
tiam furor iste tuus elud**

**ABCDEFGHIJKLM**

**$ 1234567890 £**

GEORGE BRUCE, NEW-YORK.

DOUBLE COLUMBIAN.

**Quousque tandem abutere, Catili-
na, patientia nostra? quamdiu nos
etiam furor iste tuus eludet? quem
ad finem sese effrenata jactabit au-
dacia? nihilne te nocturnum præsi-
dium palatii, nihil urbis vigiliæ, ni-**

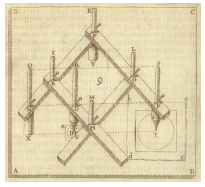
**ABCDEFGHIJKLMNOPQRST**

**$ 1234567890 £**

GEORGE BRUCE, NEW-YORK.

Types not named.
Identified only by size.
In only a few styles.

In a few instances
also numbered.



PICA, No. 1.

Quousque tandem abutere, Catilina, patientia nostra? quamdiu nos etiam furor iste tuus eludet? quem ad finem sese effrenata jactabit audacia? nihilne te nocturnum præsidium palatii, nihil urbis vigiliæ, nihil timor populi, nihil consensus bonorum omnium, nihil hic munitissimus habendi senatus locus, nihil horum ora vultusque moverunt? patere tua consilia non sentis? constrictam jam omnium horum conscientia teneri conjurationem tuam non vides? quid proxima, quid superiore nocte egeris, ubi fueris, quos convocaveris, quid consilii ceperis, quem nostrum ignorare arbitraris? O tempora, o mores! Senatus hoc intelligit consul videt: hic tamen vivit. Vivit! imo vero in senatum venit: fit publici consilii particeps: notat et designat oc-

**ABCDEFGHIJKLMNOPQRSTUVWXYZ**

ABCDEFGHIJKLMNOPQRSTUVWXYZÆŒ

$ 1234567890 $\frac{111123357}{2348348888}$

PICA, No. 2.

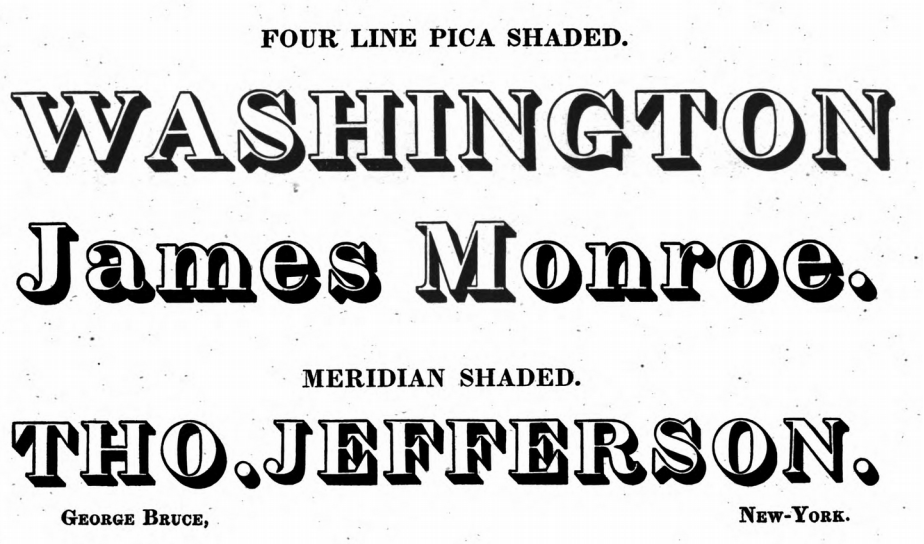
Quousque tandem abutere, Catilina patientia nostra? quamdiu nos etiam furor iste tuus eludet? quem ad finem sese effrenata jactabit audacia? nihilne te nocturnum præsidium palatii, nihil urbis vigiliæ, nihil timor populi, nihil consensus bonorum omnium, nihil hic munitissimus habendi senatus locus, nihil horum ora vultusque moverunt? patere tua consilia non sentis? constrictam jam omnium horum conscientia teneri conjurationem tuam non vides? quid proxima, quid superiore nocte egeris, ubi fueris, quos convocaveris, quid consilii ceperis, quem nostrum ignorare arbitraris? O tempora, o mores! Senatus hoc intelligit, consul videt: hic tamen vivit. Vivit! imo vero etiam in senatum venit fit publici consilii particeps: notat et designat oculis ad cædem unumquemque nostrum. Nos

**ABCDEFGHIJKLMNOPQRSTUVWXYZ**

ABCDEFGHIJKLMNOPQRSTUVWXYZÆŒ

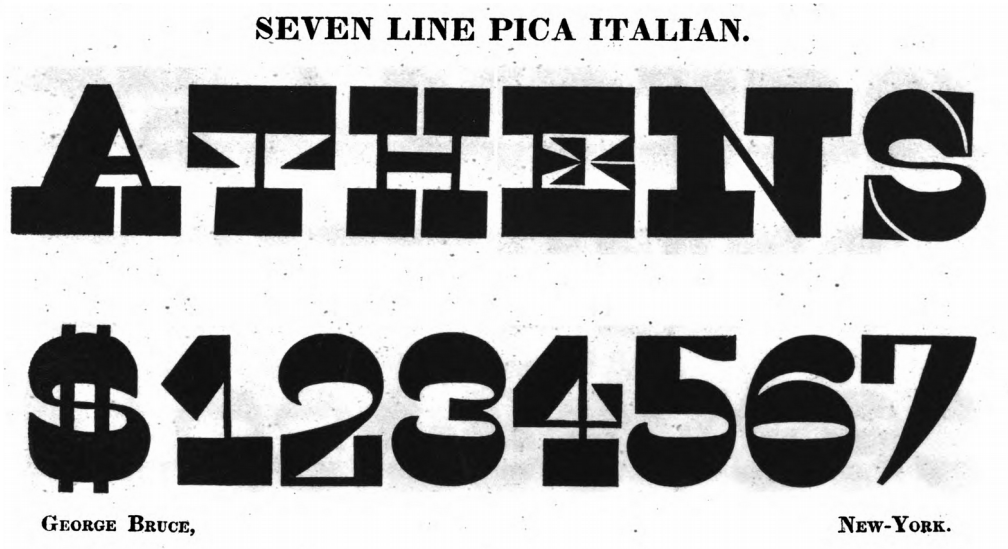
$ 1234567890 £ $\frac{111123357}{2348348888}$

# Bruce's 1828 Specimen Book (2/2)

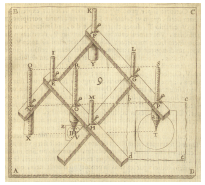



Unusual/new/display types still distingished only by name of style (Italian, Antique, Black)

Sometimes effects called out (Shaded, Open)

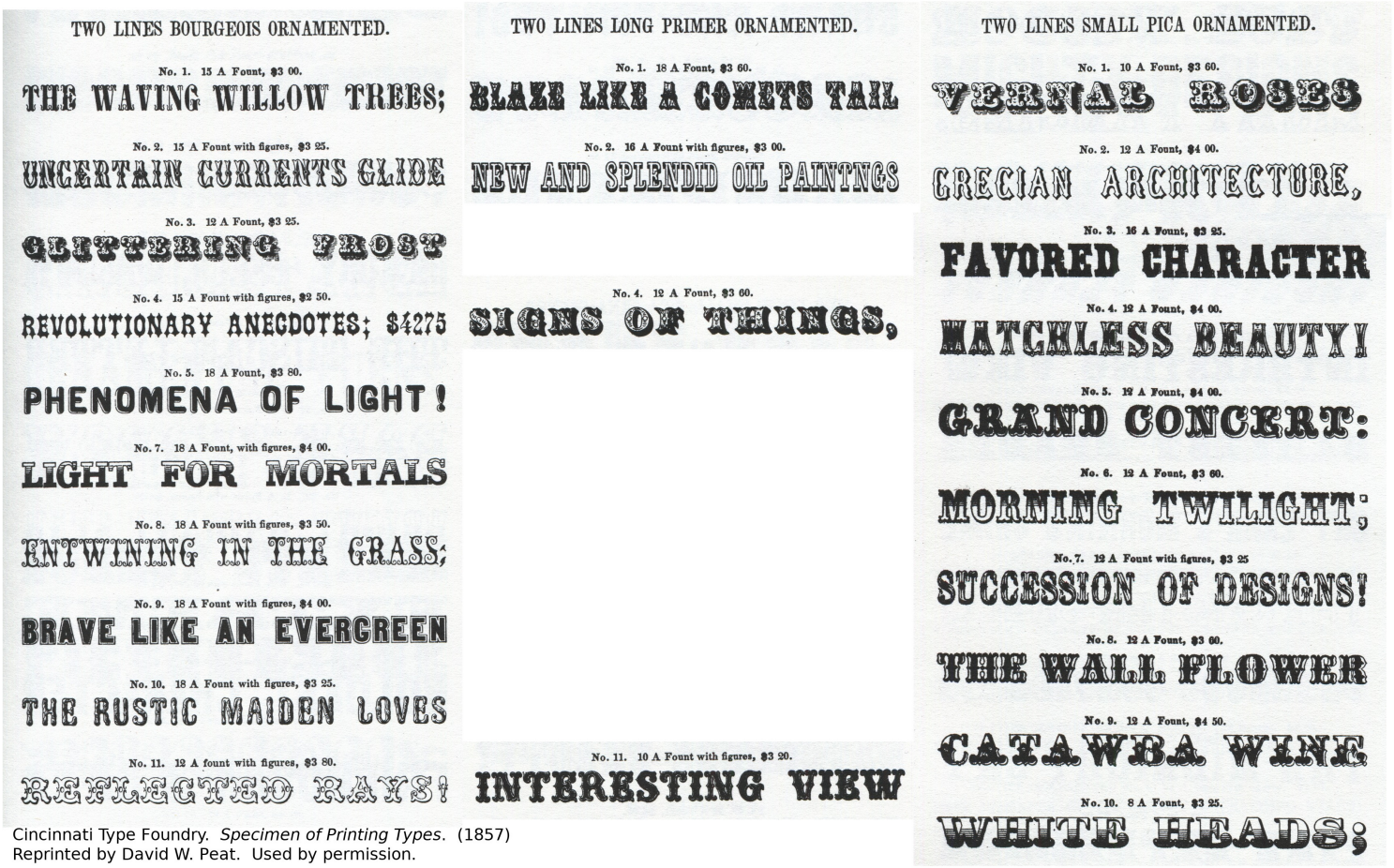



**There are type styles,**
**but every size was cut separately.**
**There are no typefaces.**



Two Line Bourgeois would be about 18 point, Two Line Long Primer 20 point (= Paragon), and Two Line Small Pica maybe 22 point.

# Cincinnati 1857 Specimen Book



TWO LINES BOURGEOIS ORNAMENTED.

No. 1. 15 A Fount, $3 00.
THE WAVING WILLOW TREES;

No. 2. 15 A Fount with figures, $3 25.
UNCERTAIN CURRENTS GLIDE

No. 3. 12 A Fount, $3 25.
GLITTERING FROST

No. 4. 15 A Fount with figures, $2 50.
REVOLUTIONARY ANECDOTES; $4275

No. 5. 18 A Fount, $3 80.
PHENOMENA OF LIGHT!

No. 7. 18 A Fount, with figures, $4 00.
LIGHT FOR MORTALS

No. 8. 18 A Fount with figures, $3 50.
ENTWINING IN THE GRASS;

No. 9. 18 A Fount with figures, $4 00.
BRAVE LIKE AN EVERGREEN

No. 10. 18 A Fount with figures, $3 25.
THE RUSTIC MAIDEN LOVES

No. 11. 12 A fount with figures, $3 80.
REFLECTED RAYS!

TWO LINES LONG PRIMER ORNAMENTED.

No. 1. 18 A Fount, $3 60.
BLAZE LIKE A COMETS TAIL

No. 2. 16 A Fount with figures, $3 00.
NEW AND SPLENDID OIL PAINTNGS

No. 4. 12 A Fount, $3 60.
SIGNS OF THINGS,

No. 11. 10 A Fount with figures, $3 20.
INTERESTING VIEW

TWO LINES SMALL PICA ORNAMENTED.

No. 1. 10 A Fount, $3 60.
VERNAL ROSES

No. 2. 12 A Fount, $4 00.
GRECIAN ARCHITECTURE,

No. 3. 16 A Fount, $3 25.
FAVORED CHARACTER

No. 4. 12 A Fount, $4 00.
MATCHLESS BEAUTY!

No. 5. 12 A Fount, $4 00.
GRAND CONCERT:

No. 6. 12 A Fount, $3 60.
MORNING TWILIGHT;

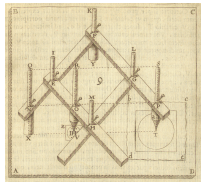
No. 7. 12 A Fount with figures, $3 25
SUCCESSION OF DESIGNS!

No. 8. 12 A Fount, $3 60.
THE WALL FLOWER

No. 9. 12 A Fount, $4 50.
CATAWBA WINE

No. 10. 8 A Fount, $3 25.
WHITE HEADS;

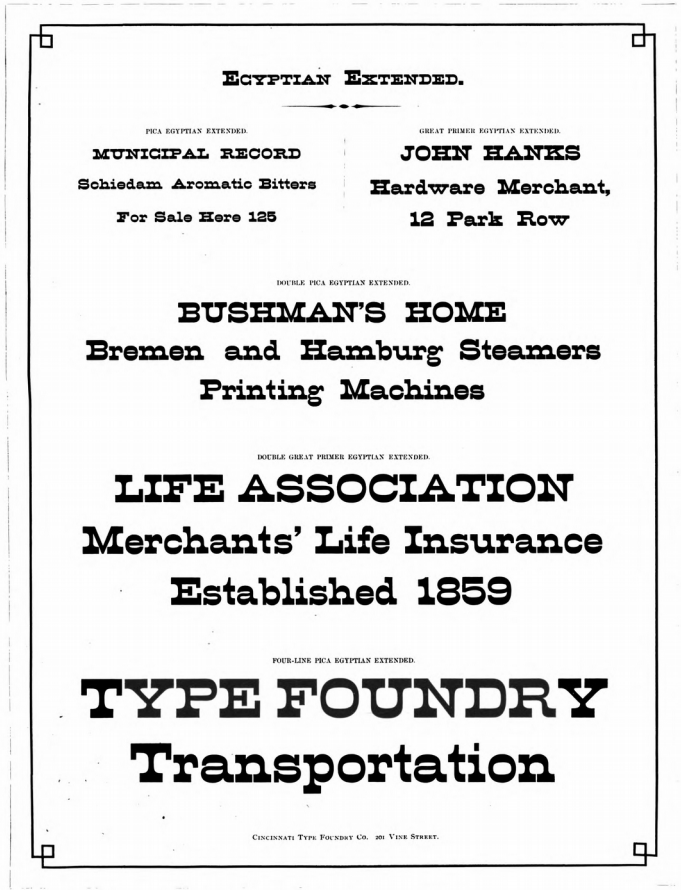
Cincinnati Type Foundry. *Specimen of Printing Types*. (1857)
Reprinted by David W. Peat. Used by permission.



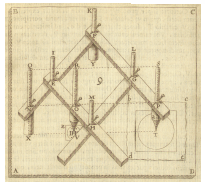
The faces are just numbered in the order in which they were cut within each size. Size is still the basic feature, not design.
We have since made typefaces out of some of these, but in 1857 the are still not being presented as typefaces.

# Transition to “Typefaces” (1870s)

By the 1870 Cincinnati specimen book, they were organizing types into groups.





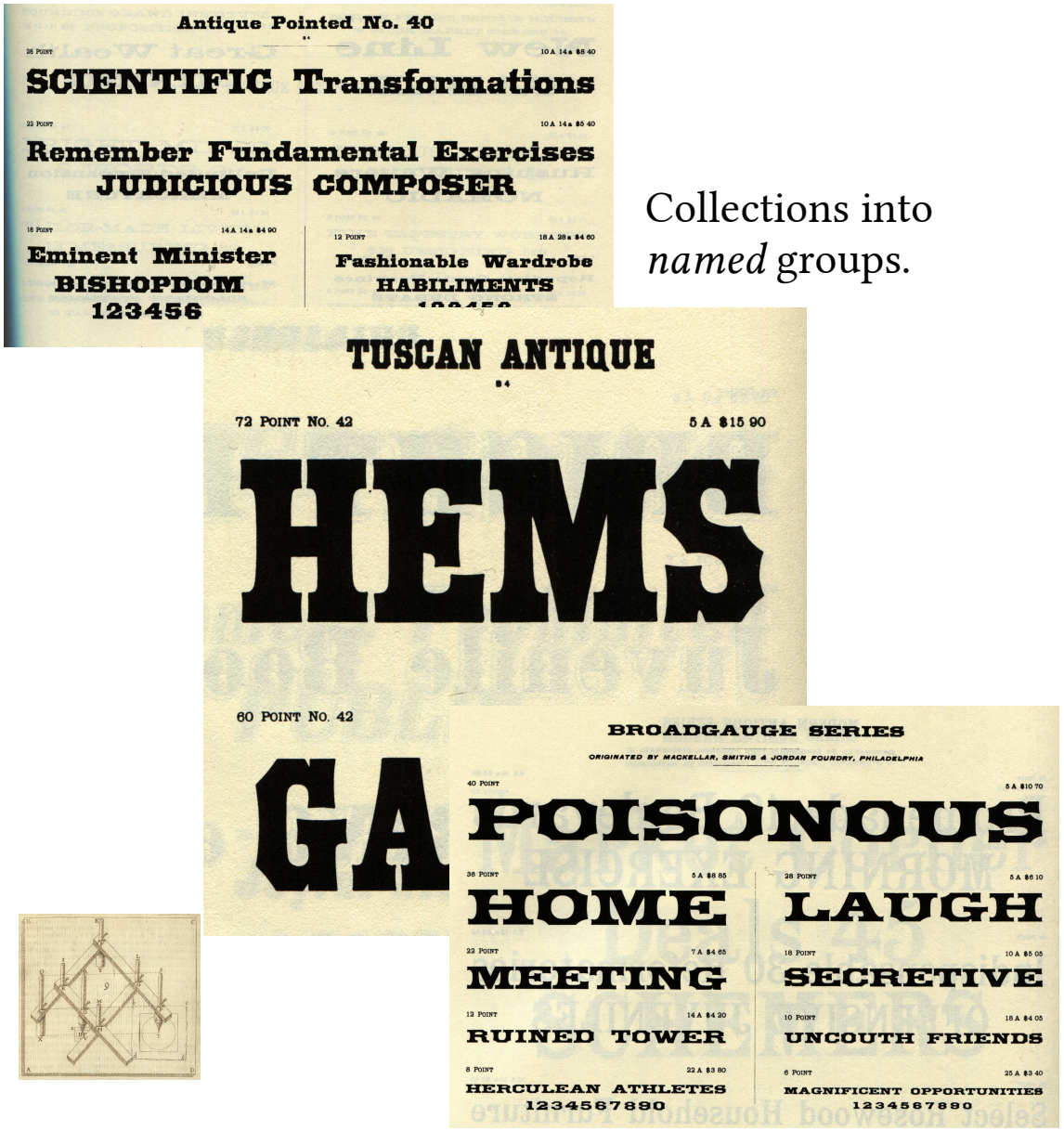


Sometimes these seem like typefaces.

Sometimes they’re just loosely related groups.

# Typefaces as We Know Them (By 1895)

By (certainly before) the 1895/6 ATF “Collective” Specimen book:

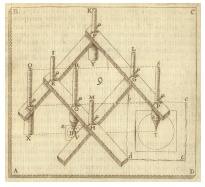



Collections into *named* groups.


Cohesively developed series. Typefaces as we understand the term.

# “Typeface” as a Concept Predates the Pantograph

It is a part of what appears to have been a general tendency to regularize type in the late 19th century.



# Other Regularizations

Point Bodies. From 1886. See Rich Hopkins' book.

Standard Type Height (introduced with the point system).

Standard Line (associated with two of the primary advocates of pantographs):

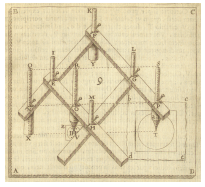
- Claimed by Nicholas Werner as his invention.
- The Bentons and ATF "American Line" (by 1906).

Point Line (in ATF's American Line; others?)

Unit Set:

- Precursors 1854 (Wiberg); 1880s (Thorp/Cleveland).
- Benton's "Self-Spacing" Type (by 1884).
- Lanston Monotype (1890s).

Point Set (Inland 1899; ATF spacing material).



**THIS IS NOT PI**

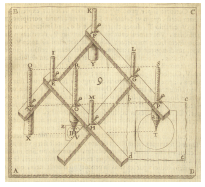
Nor is it an *attempt* at being **odd** or funny. It is simply a specimen *of* **STANDARD LINE TYPE.** Notice that **all faces line at the bottom.** Of course you **would not** use your type **in** *this* **manner,** but you **can** readily **see** *the* **advantage** of having it all **line.** All **different** *faces* on **one body** if **STANDARD LINE will** line with each other and **with leaders,** *and* they **will** line with **all** other **sizes** or **6-to-pica** brass *rule* by **means of** regular leads and slugs. **These** are but a few **of** *the* **advantages** which enable the printer **to** make and **save money** by using our type. . . . . If **you** wish **to** keep abreast of the times **send** for a copy of the **PRINTERS' QUARTERLY**. . . . . .

INLAND TYPE FOUNDRY

217-219 OLIVE ST. ITF ST. LOUIS

From *The Inland Printer* (1894)

# Can You Always Scale Type Algorithmically?

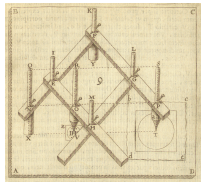


# Type Body Size and Hand Cutting

I can't say it better than Harry Carter...

> "A hand-punchcutter would have had to be extremely skilful to reproduce precisely the same letters on a dozen different scales. It is clear to anyone who can examine enlargements of hand-cut types that the good punchcutters varied the design, or at any rate the functional features of it, to suite the scale on which they worked. They did so instinctively because they corrected their work by eye, and they had the wisdom not to let mathematical rules override their judgment."
>
> - Harry Carter. "Optical Scale in Typefounding." (1937)

Carter's "Optical Scale" is not the same as later "optical scaling."



# Caslon's 1734 Specimen Close-Up


Wikimedia Commons

GREAT PRIMER ROMAN.

Quouſque tandem abutêre, Catilina, patientia noſtra? quamdiu nos etiam furor iſte tuus eludet? quem ad finem ſeſe effrenata jactabit audacia? nihilne te nocturnum præſidium palatii, nihil urbis vigiliæ, nihil timor populi, nihil con-

ABCDEFGHIJKLMNOPQRS

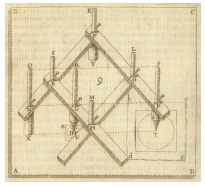
ENGLISH ROMAN.

Quouſque tandem abutêre, Catilina, patientia noſtra? quamdiu nos etiam furor iſte tuus eludet? quem ad finem ſeſe effrenata jactabit audacia? nihilne te nocturnum præſidium palatii, nihil urbis vigiliæ, nihil timor populi, nihil conſenſus bonorum omnium, nihil hic munitiſſimus

ABCDEFGHIJKLMNOPQRSTVUW

Great Primer English

Caslon cut his types each specific to its size and style.
He cut no typefaces.

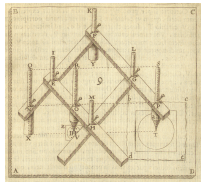


"Caslon went so far as to buy an existing type, cut 50 years before his time, for his Canon size; moreover, by modern standards we should hardly judge his 14-point [English] and 18-point [Great Primer] to be members of one family"

- Harry Carter, "Optical Scale in Typefounding." (1937): 2-3.

# Type Body Size and Machine Cutting

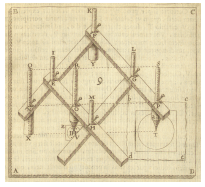
[Cop-out: Logically there should be a slide here, but I'm not yet sure where to go with it. Sub-topics include the linearity of simple pantographic scaling, more subtle pantographic scaling (e.g., with variable-width tracers), the use of pantographs to produce variations in faces (condense, expand, slant, etc.), and the use of multiple patterns each of which covered only part of the whole range of sizes.]



# First (?) Algorithmic Analysis (1987)

Bridget Johnson. *A Model for Automatic Optical Scaling of Type Designs for Conventional and Digital Technology.* RIT, 1987.

Asserts that at least for simple cases you could do with algorithms not only what you could do with a pantograph (Johnson thinks of it as doing only “linear” scaling) but go beyond the pantograph to match hand-cut type using a mathematical model of “nonlinear” behavior.



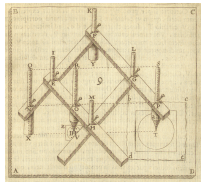
# Opposition to Scaling: Harry Carter

His 1937 article “Optical Scale in Typefounding” has often been cited.

He does not argue that “optical scaling” can be done.

Instead, he argues that the “optical scale” in typefounding means that at times types **should not be scaled at all**.

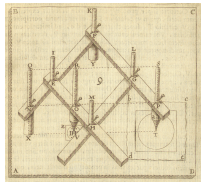
> “The design [of a type] must have beauty enough for large sizes and legibility enough for small ones; and these qualities must be stressed in appropriate degree for each size. Types which lack either good quality *should only be cut in the sizes for which they are suitable*.”
>
> - Carter (1937): 6. [italics mine]



I'll stop here in my ATF 2018 presentation.

What remains involves a bit more "hand waving."

I try to go beyond arguments about type scaling to recover, for future development, Knuth's idea from the early 1980s that the mechanization of type *should* be a way to allow us to better describe type, and thus better understand it…

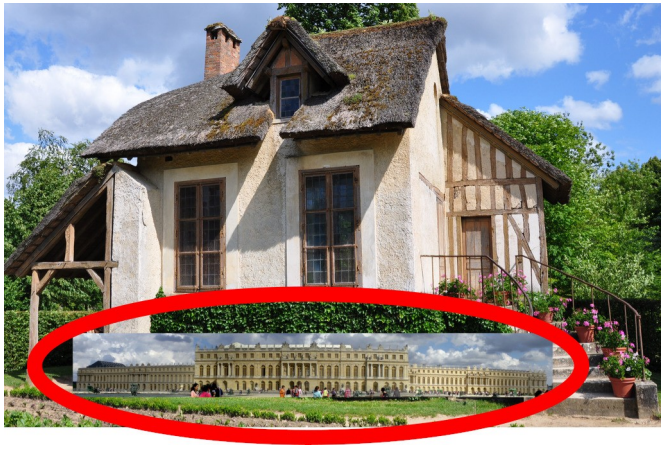


# Do Other Arts Scale?

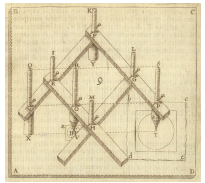
An example from architecture

A romantic cottage and the Palace of Versailles, each designed specifically for a particular size.

The cottage's scale compared to the palace's (it's inside the red circle).



The cottage if it were built to the scale of the palace. The front door would be over 500 feet tall.



Most of the arts do not scale. Why should we assume type does?

# Knuth vs. Hofstadter

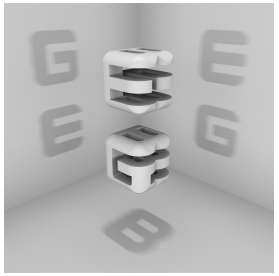
Donald E Knuth.
1938–



TEX
METAFONT

Douglas R. Hofstadter.
1945–





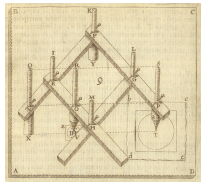
What this should lead to is a more deeply considered understanding of what it is to mechanize the construction of type. That in turn might lead to a better understanding of type at a structural level. This started to happen once in the early stages of digital lettering, but the attempt was quashed and has been forgotten.

Knuth's Metafont described type by letting you express your understanding of it (not just data points and curves). It is highly parametric, and in that sense is a successor to the pantograph. In "The Concept of a Meta-Font" (1982), he proposed (humorously) that technology could help you describe

> "... a 6 1/7-point font that is one fourth of the way between Baskerville and Helvetica ..."

Hofstadter's response stopped this line of research dead in the water.

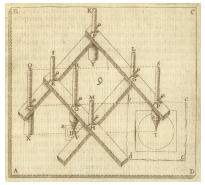
Yes, Hofstadter was right, but that doesn't mean it isn't worth trying. Attempting the impossible can be good for you.



# Old Good Intentions

"The art of letter design will not be fully understood until it can be explained to a computer; and the process of seeking such explanations will surely be instructive for all concerned ... In order to explain a font design to a machine, we need some sort of language or notation that describes the process of letter construction."

- Knuth, "The Concept of a Meta-Font." (1982)



# Progress, but…

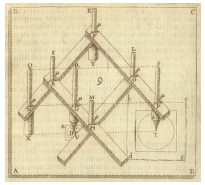
Sophisticated work *is* being done today.

E.g., Tim Ahrens & Shoko Mugikura

*Size-Specific Adjustments to Type Design* (2014)

But this kind of work seems to be research into desired optical/visual effects (which are then just left to programmers to implement) not an examination from an algorithmic perspective.

I would love to be wrong about this!



# Does It Matter?

Does it matter that we have so thoroughly misunderstood the history and the implications of the typographical pantograph? It's just an obsolete machine.

It matters to us, because everyone in this room is deeply interested in the history of the technology of type. It's what we do.

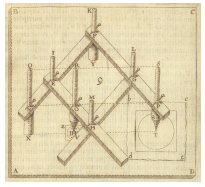
But it also matters in the brave new digital world. In both real type (through CNC matrix engraving) and digital lettering, the direct successor to the pantograph is the computer. If we fail to understand the first, we haven't got much chance with the second.

"The best way to understand something is to know it so well that you can teach it to a computer."

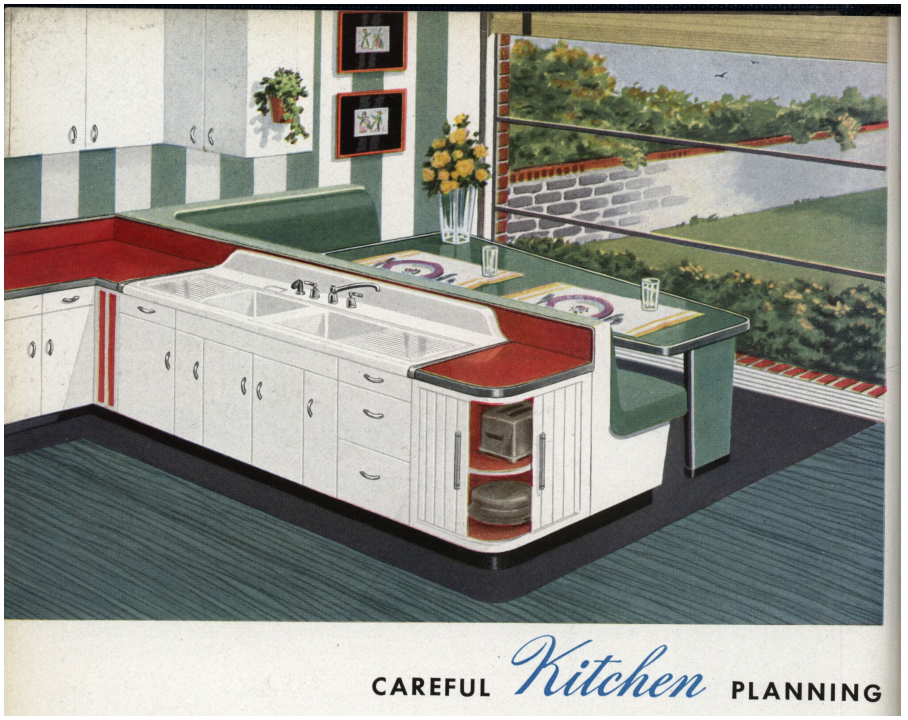
- Don Knuth

"A computer lets you make more mistakes faster than any other invention, with the possible exceptions of handguns and tequila."

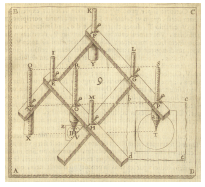
- Mitch Ratcliffe



# That's (almost) everything, plus…

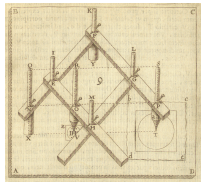



# Questions?



www.CircuitousRoot.com/artifice/letters/pantocut/index.html

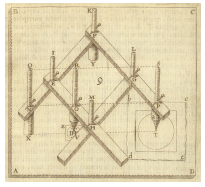
# Appendices



# List of Typographical Pantographs (0/7)

(For punch, patrix, or matrix engraving, unless noted otherwise.)

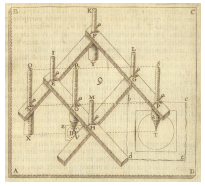
- 19th Century Machines other than Benton's
- Benton's Pantographs and their Derivatives
- 20th Century Machines Not Derived from Benton's
- Unknown Machines (many)
- Unidentified Machines
- Non-Existent (?) Machines
- Machines Not Suitable



# List of Typographical Pantographs (1/7)

19th Century Machines other than Benton's

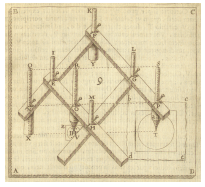
Wiebking's father's machine (1870s, not successful)
Machine by H. Hofer, Berlin (1881, success unknown)
The Central Type Foundry machine (made in Germany)
The Schroeder-Boyer machine (probably a copy of the Central T. F. Machine)
MacKellar, Smiths & Jordan patrix machine (1890s, maybe by Beeler)
Wiebking/Hardinge machines (from 1894)
Ballou (1895)
Dedrick (1896/7)
Presumed but unknown machines at the Inland Type Foundry (1895-1912)
    Werner (1931) mentions that Inland sold an "engraving machine" to Genzsch & Heyse, and that it was still in operation in 1928.
Barr (1900)



# List of Typographical Pantographs (2/7)

Benton's Pantographs and their Derivatives

- Benton's Machines
  - First vertical pantograph, punch/patrix (1884)
  - Second vertical pantograph, punch/patrix/matrix (1899)
  - "Opto-Mechanical" pantograph (1899)
  - Wax-plate pantographs
  - Modified third-party pantographs (e.g., the Ad-Cut Machine of 1918)
- Machines derived from Benton's vertical pantographs
  - Barr. English Linotype (1902)
  - Lewis/Keystone (1903–1906)
  - Pierpont. English Monotype (1906)
  - Mergenthaler Linotype (Brooklyn) machines
  - Grant & Legros (by 1916)
  - Late machines at Linotype & Machinery (arched)
  - Intertype (arched)



# List of Typographical Pantographs (3/7)

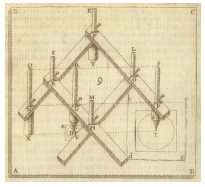
20th Century Machines Not Derived from Benton's

Schokmiller (in St. Louis, but for Stephenson, Blake in England)
Emil Gursch (Germany, by 1909)
H. Bernert (Germany, by 1909)
Ludlow versions of Wiebking's pantograph(s)
E&PM Co. Model D (rotary spindle; used by Goudy)

Preis (used by Paul Hayden Duensing)
Ogata RS-260 (used by Jim Rimmer)

Gorton machines with matrix equipment, smaller.
Gorton matrix machines, 3-K Precision Matrix Machine (very large)

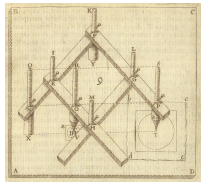
Used by SASMATS/Ludlow UK: Taylor-Hobson, Alexander



# List of Typographical Pantographs (4/7)

Unknown Machines (these firms were using something, but we don't know what)

Adler Traldi (Italy)
Baltimore Matrix (US)
Bauer (Germany)
Dougall Linotype / Canadian Linotype [briefly]
National Compositype Company (US)
Linograph (US)
Matrotype (UK)
Mergenthaler Setzmaschinen-Fabrik (Germany)
Monoline (US)
Neurnberger-Rettig (US)
Simicini (Italy)
Stempel (Germany)
Stephenson, Blake (England)
Stringertype
Thompson Type Machine Co. (US)
Rogers Typograph (Germany)
[1890s Rogers US firm took delivery of Benton s/n 10]
Victorline
Wicks Rotary Typecaster (UK)



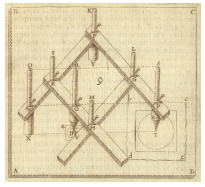
# List of Typographical Pantographs (5/7)

Unidentified Machines

Museum für Druckkunst, Leipzig. Conventional 4-bar horizontal.

Ex-Deberny & Peignot machine at the Musée Renaudot, Loudon, France.

Rainer Gersternberg's "Linotype Matrizen-Herstellung," which seems to be a pattern, not matrix, machine.



# List of Typographical Pantographs (6/7)

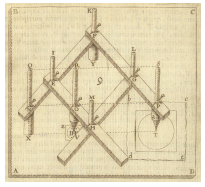
Non-Existent (?) Machines

Dietrich. Mentioned in Legros & Grant. Probably a typo for “Dedrick.”

Little Pioneer. Rehak (1993), p. 100, says Goudy used one. I can find no other reference to any such machine (anywhere).

Gem. Rehak (1993), p. 100, mentions this machine. I have been unable to discover any other reference to it in the literature.

Deckel-Kampf. Rehak (1993), p. 100, mentions this machine. No such machine exists. There have been Friedrich Deckel pantographs and Maschinenfabrik Michael Kampf KG pantographs, but the two firms are distinct.



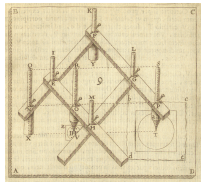
# List of Typographical Pantographs (7/7)

Machines Not Suitable

New Hermes, made with two kinds of spindle depth controls
- In the nosepiece style (more common), not suitable
- In the other style, maybe ok but really not the right tool for the job

Pantographs which Can Be Ignored Here

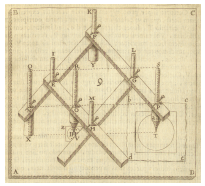
- Wallace's Eidograph (1821). Geared, for drawing.
- Ames/Wythes Cyclo-Ellipto Pantograph was not really a pantograph at all.
- Schnoor (US Patent 22,798, 1879), lightweight 4-bar, for dressmakers.
- "Trauringe" engraving machines (they're for jeweler's ring-engraving).



# A Census of Surviving Machines

(Suitable for punch, patrix, or matrix engraving)

| | |
|---|---|
| Benton, Vertical Type 2. | (#?) Swamp Press |
| | (#?) Letter-kunde Press |
| | (2?) Gregory Jackson Walters |
| | (?) Atelier Tipografico Tallone |
| | Other? |
| Benton Ad-Cut. | ? |
| Tsugami | (1 or 2) In Japan; direct copy of Benton Vertical Type 2 |
| Wiebking/Ludlow. | (1) Smithsonian |
| | (1) Letter-kunde Press |
| | (1) CircuitousRoot |
| Pierpont, Types 1 or 2 | (#?) The Type Archive |
| | (1) [private collection; might be ex-Intertype] |
| | (1) [NJ machinery dealer; probably in parts-machine condition] |
| Michael Kampf | (1) Offizin Parnassia Vättis |
| Ogata RS-260. | (1) GreenBoatHouse Press |
| 4-bar, ex-Linotype | (1) Schriftgießerei Rainer Gerstenberg |
| 4-bar, unkown | (1) Museum für Druckkunst, Leipzig |
| 4-bar, unknown | (1) Ex-Deberny & Peignot, Musée Renaudot, Loudon, France |
| Other? | Jim Walczak? |
| | ex-Stephenson, Blake at The Type Archive? |
| | Schriftgießerei Rainer Gerstenberg (other than above)? |



Industrial machines by Taylor-Hobson, Gorton, Deckel, Alexander, Preis, etc. are still relatively common. Maschinenfabrik Michael Kampf machines were sold primarily to mints; undoubtedly more exist. Rimmer's Ogata was just an industrial machine, but it is very rare. Cronite (E&PM) drag-engraving models are not uncommon (I have one), but I do not know of any surviving Model D rotary-spindle machines.

# Wiebking/Hardinge Survival

(Details and Speculations)

After Wiebking died in 1927, his business was carried on for a while with his sons. Werner said he had 14 pantographs. None are known to survive.

Paul Hayden Duensing said that when Ludlow shut down US production some pantographs were transferred to Scotland to continue production. But Ludlow production in the UK was by Stephen Austin & Sons, and they used Taylor-Hobson and Alexander pantographs. They were in Hertford, not Scotland. The article on this in ATFNL 33 by the former president of Ludlow UK does not suggest a transfer of machines to the UK. I am unaware of any surviving Wiebking/Hardinge Ludlow pantographs in the UK.

In 1977 the Smithsonian acquired from Ludlow ("through John M. Calhoun") "1 pantograph engraving machine". I presume they still have it, in storage. I'm not sure if this donation was associated with Middleton's efforts to save machines. This is survivor no. 1.

When Ludlow shut down US production, R. Hunter Middleton saved several machines:
1. (He may or may not have been involved with the Smithsonian donation.)
2. One to R. Stanley Nelson. Then to Henry Weiland (Milwaukee). Then Paul Aken. Currently owned by the Letter-kunde Press in Antwerp. This is survivor no. 2.
3. One to Paul Hayden Duensing. Then to Jim Rimmer, who attempted to use it in cutting patrices for Cartier (he found its spindle too worn). Then to George Kallas (Metropolitan Printers, Vancouver), for his printing museum. Presumed (but not verified) destroyed in the fire which burned his building earlier this year.
4. One via path unknown to Edward Leibhardt, a scientist and polymath who made his fortune in engraving diffraction gratings. Then to John Johnson. Currently owned by me. This is survivor no. 3
5. Paul Hayden Duensing said that R. Hunter Middleton had one in his basement. His iron hand press when to "a college in the mid-west" (Univ. of Iowa?) It may still exist. Or not.