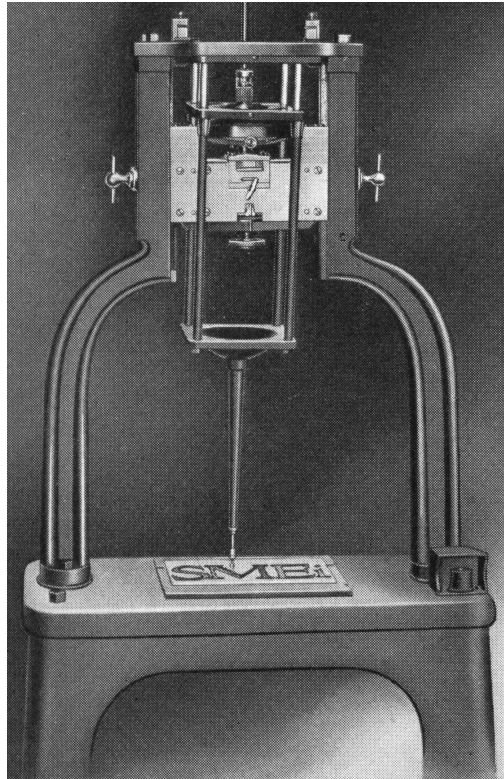


A Census of Benton and Related Pantographic Engraving Machines

Revision 12

Dr. David M. MacMillan



CircuitousRoot
2023

Dedication

To the memory of Gregory Jackson Walters (1953–2022), for his foresight in preserving *two* Benton pantogaphs and his kindness in allowing me to acquire one of them.

Acknowledgments

I would like to thank several people for their help and their generosity in providing information and materials for this census and for their care in reviewing it, including: Patrick Goossens, Richard L. Hopkins, HUANG Junfu (黃俊夫), Mark Knudsen, Laurie MacLeod, the late Dr. Ludwig Mohr, NAKANISHI Yasuhito, Ed Rayher, Theo Rehak, Schuyler R. (Sky) Shipley, Victor Thibout, the late Gregory Jackson Walters, and the owner of Benton No. 50.

Thanks also to the National Science and Technology Museum (Taiwan) and the Printing Museum (Tokyo, Japan).

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1• Introduction

1.1• Scope

This is a census of all known surviving Benton single-arm vertical pantographic typographical engraving machines and of closely related machines made by others (in Japan, China, and possibly Europe). It also contains information about the single surviving Benton horizontal pantograph (the “Adcut” machine), summaries of what little information we have about identifiable Benton and related machines which may no longer exist, and some information about surviving Benton and Benton-style cutter grinders.

It excludes single-arm vertical typographical pantographs which were influenced by Benton but differed to some substantial degree (such as the Pierpont machines used by Monotype and the later machines used by the American and English Linotype and Intertype companies).

1.2• Summary

Twenty Benton or Benton-style vertical pantographs,¹ one horizontal Benton pantograph, and seven Benton or Benton-style cutter grinders² survive.

Type	Maker	Made	Survive
1a	BW	1	0
1b	BW/ATF	$11 \leq x < ?$	0
1b (Gut. Mus., etc.)	unknown	unknown	1
1c (Sci. Mus.)	unknown	$5 \leq x < ?$	1
1d (Tallone)	unknown	unknown	1
2a	ATF	$\sim 25^3$	6
2a	Tsugami & Fuj.	$120 \leq x < ?$	8
2b	ATF	incl. in 2a	2
2c	China	unknown	1
Adcut & Friends	ATF/commercial?	“several”	1
1899 Tracing Apparatus	ATF	1	0
Wax Plate Pantographs	ATF?	unknown	0
Benton Cutter Grinders	ATF	unknown	4.5
Tsugami? Cutter Grinders	Tsugami	unknown	3

The rest of this census is basically one long footnote about why you should not trust any of these numbers.

¹The surviving Grant-Legros Punch-Cutter, which by some arguments could be considered a “Benton-style” machine, is not included in this count.

²Plus one in “parts machine” condition.

³Rehak estimates total production as about three dozen. We know that at least 11 were Type 1. This means that something on the order of 25 or fewer were Type 2.

1.3• A Call For More Information

This census can, of course, only contain what is known to me. There is certainly much more to be discovered. If you have any additional documented information I would be very interested in learning of it for possible inclusion, with credit given, in a revised edition of this census. If you are in a position to take photographs of any of the surviving machines, these too would be appreciated.⁴ In addition to general photographs of the machines and their mechanisms, photographs of the machine numbers on surviving Bentons would be of great use in confirming their identities. (See section 7.1, About Benton Machine Numbers, on page 41 for more information on how to find these numbers on the machine.) Photographs of cutter grinders and other related equipment would also be of use.

I am of course always interested in learning of mistakes in or problems with this document, from the simplest typo (there are probably many) to the most subtle error in logic or interpretation.

⁴Any photograph is better than no photograph, but the best would be freely shareable under a Creative Commons license.

2• Why and How

2.1• Why a Census?

Why compile a census at all? It is useful for at least three major reasons.

First, it gathers together a specific aspect of the history of the machine and allows us to understand it better.

Second, it is useful to owners and users of the machine, including private collectors, institutions, and businesses which are still operating it.⁵ When you are responsible for a rare machine it is always useful to know where the other ones are and who has them. Knowing about another machine and thus potentially being able to examine it can mean the difference between success and failure in your work.

Third, and perhaps most importantly in the long run, it is useful to conservators. Resources are always finite; you can't save everything. The knowledge of how common or rare a machine is plays a large part in determining how you will allocate your resources: How much attention will you give to a particular machine? What kind of attention? How urgently? Etc.

A census is a necessary preliminary step in preserving and using these machines now and in the future.

2.2• How Do We Know?

The single most common question asked of a census such as this, of a rare, important, but very poorly documented group of machines is “but how do you know?”

The answer is simple: mostly you don't. We will never know with complete certainty. But that doesn't make the effort any less important.

The scarcity of the evidence makes it more important than ever to be cautious with claims and to indicate clearly the distinction between what we have evidence for and what remains speculation (however likely that speculation might be). For example, while it is very likely that the pantograph sold by American Type Founders (ATF) to the National Printing Bureau of Japan in 1912 was a Type 2 machine, at present there is no evidence one way or the other. It is possible that ATF sold an older Type 1 machine. This should be stated clearly in the discussion of this machine.

Considered more deeply, a census brings an opportunity to do careful scientific research. The model of science first articulated by Karl Popper⁶ is useful here. This model is based upon the realization that outside of mathematics you

⁵At the time of writing, one Benton pantograph remains in commercial service.

⁶Popper's work is out of favor at the moment, but it is the only model which works. The competing school of thought, derived from the work of Thomas Kuhn, says a great deal about the sociology and psychology of scientists but has nothing at all to say about science itself.

can never prove the truth, but you can demonstrate falsity. Science consists of any body of statements that are possible, in some way, to show to be false (and of course once a statement is shown to be false it is excluded from science).

So for example if I say that there are eight surviving Benton vertical pantographs, this is a scientific statement. It can be shown to be false quite easily by discovering the ninth surviving machine. If that happens, then we would say that there are nine surviving machines and wait for this statement, in turn, to be shown to be false upon the discovery of the tenth. This discovery may or may not ever happen. Science is always provisional; so is this census.

3• Types of Benton Vertical Pantographs

There were two main types of Linn Boyd Benton's vertical pantographic engraving machines (with variations between instances and/or models of each).

3.1• Type 1 Machines (1884/5 Patent)

3.1.1• Type 1a, As Shown in the Patent

The first of these is the type described in his US patent of 1885, number 332,990 (filed February 29, 1884). It is distinguished by having a fixed cutting spindle (based clearly on the spindle of an American watchmaker's lathe⁷) with a workpiece mounted above the spindle and facing downward. All "Type 1" Bentons have this kinematic arrangement.

While these patent images have been widely reproduced, it is likely that Benton built only a single machine with this constructional style (that is, as a benchtop machine supported on a single column).

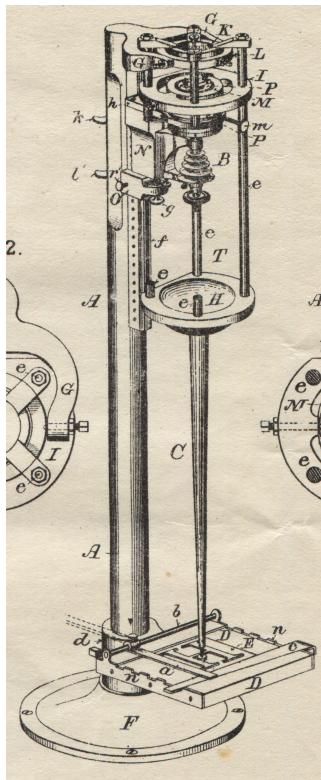


Fig. 1: 1885 Patent⁸

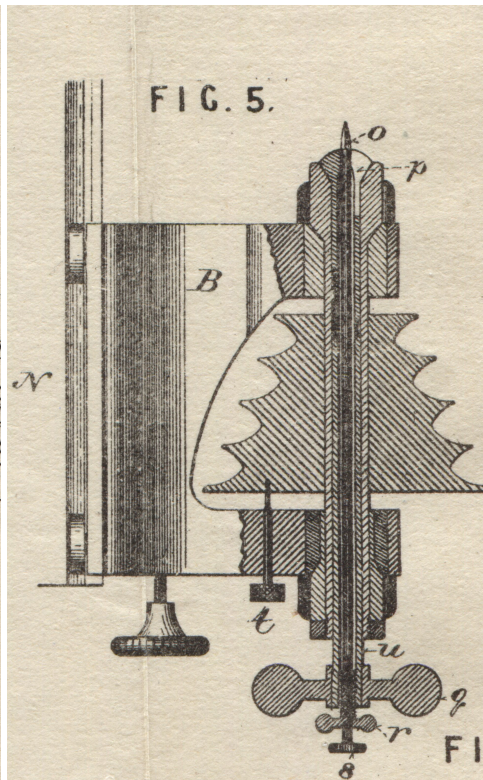


Fig. 2: 1885 Spindle

⁷Benton's patent actually calls it a "lathe-head."

⁸This image and the next are taken from the UK filing of Benton's patent, (Benton 1885b), UK No. 11,894 of 1885, because I was able to do a high-resolution scan of it from a copy supplied by Mark Knudsen, who in turn acquired it from Monroe Postman. Public domain.

At present I have discovered only one photographic image to prove that Benton ever constructed a machine of this style. This photograph appears in a 1936 catalogue in which the ATF Library offered duplicate volumes for sale.

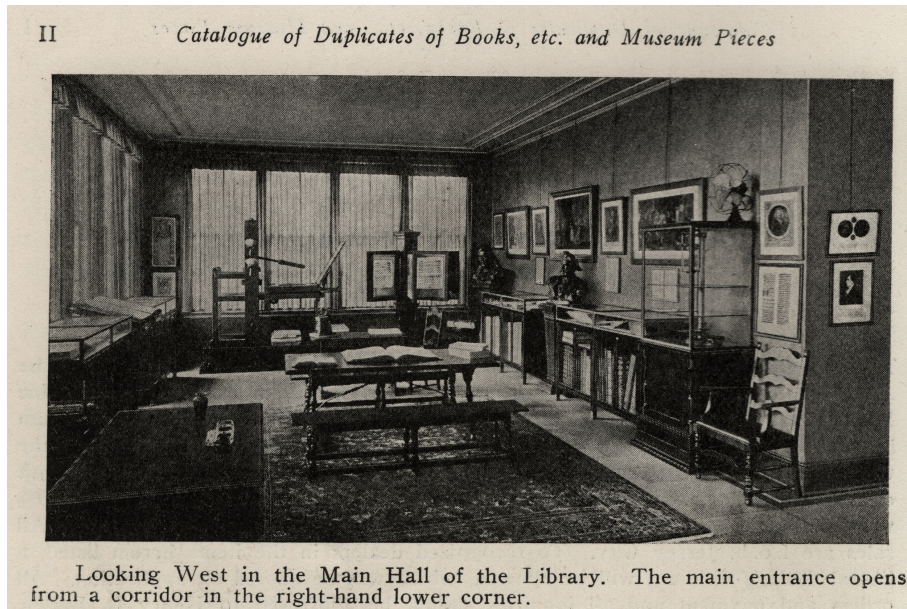


Fig. 3: ATF Library with Benton No. 1 in 1936⁹

If you look closely at the glass case on the right side of this photograph, and if you hold the Benton 1884 patent image in your mind, it is possible to make out Benton No. 1 (see the close-up illustration on the next page).

This machine does not appear in photographic views of the ATF Library in 1926 (ATF 1926). While that is not proof that it wasn't in the library then, it is not an unreasonable speculation to think that Benton retained this machine in his own workshop until his death in 1932 and that Bullen then moved it to the library.

Elsewhere, Bullen illustrated a Type 1b Benton pantograph and called the machine so illustrated the "second machine built by Benton" (saying as well that the third machine was acquired by the Mergenthaler Printing Company in 1889). While Bullen remains a highly unreliable source, the purchase of machine Serial No. 3 in 1889 is corroborated by independent evidence (see section 4.1, Type 1 Machine Dates, on page 18). It is possible that Bullen was telling the truth in this instance. If the second Benton pantograph was a Type 1b, then Benton must have constructed only this single example of a Type 1a machine.

The ATF Library was acquired by Columbia University in 1941 and subsequently dispersed into its various libraries. I have discovered no records of whether or not Benton pantographs Nos. 1 and 2 were a part of this acquisition

⁹From (ATF 1936, 2). Public domain.

or whether they have survived. Scrap drives during World War II were not kind to institutional collections of cast iron.

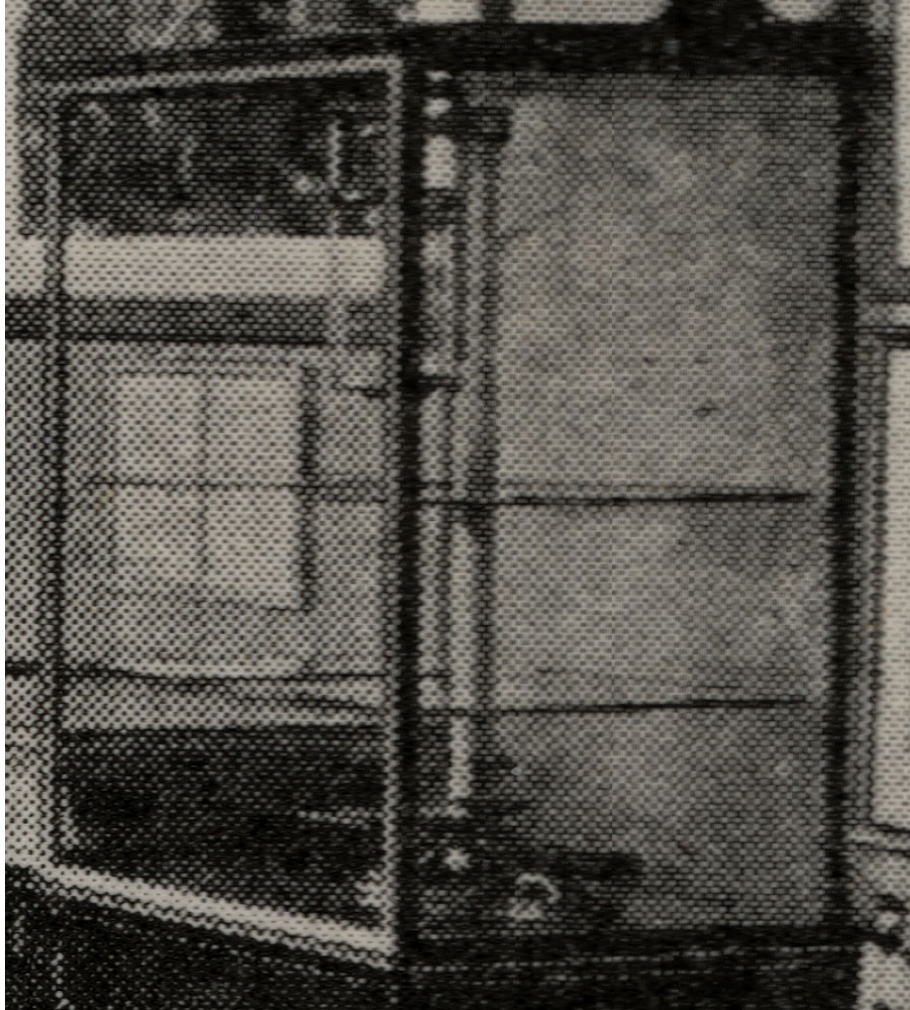


Fig. 4: Benton No. 1 in a Display Case, 1936

3.1.2 • Type 1b, As Sold

While Benton was clearly using his pantographic engraving machine by 1884,¹¹ the earliest visual or otherwise tangible evidence we have of it dates to circa 1891 in a pamphlet published by Benton, Waldo & Co. See (Cost 2011, 68). This same photograph was published in 1893 in an anonymous article in *The Inland Printer* about Benton ([Benton] L. B. Benton 1893, 237).¹² It is kinematically identical to the form of the machine shown in the 1884/5 patent, but it differs considerably in details of construction. Most notably, it is supported on two legs, not one.

We have evidence that the first machine to be sold by Benton, Waldo & Co. was serial no. 3, sold on 1889-02-13 (Rehak 1993, 109). While it is not absolutely certain, it is reasonable to assume that this 1889 sale was of a machine of this form advertised in 1891.

This first type of machine, from its beginnings, would be equally suited for engraving both patrices in soft metal¹³ and punches in steel.¹⁴ It should be noted that it is clear both from the evidence of William Gregan (via Theo Rehak) presented in (Cost 2011, 73) and from a general knowledge of the wide use of electroforming from patrices in the late 19th through the 20th centuries¹⁵ that Benton was also cutting patrices in soft metal on this

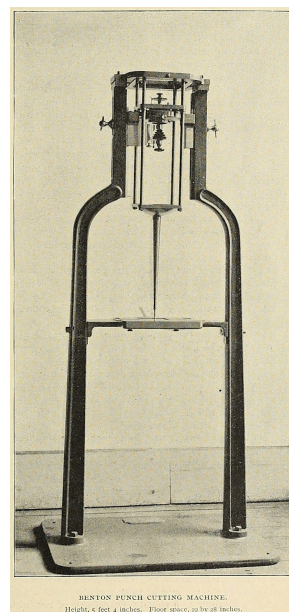


Fig. 5: 1891/1893¹⁰

¹⁰From ([Benton] “L. B. Benton” 1893, 237). Image from the Smithsonian Institution’s scan. Public domain. This is the earliest photograph of a Benton pantograph known.

¹¹In July of 1884 a trade note based on information supplied by Benton, Waldo & Co. appeared in *The Inland Printer* in which they claim “to have perfected a machine for cutting punches for original characters for type foundries in steel” (Benton 1884).

¹²Slightly later, the drawing of this machine in DeVinne’s *The Practice of Typography* is clearly based on this photograph (DeVinne 1900, 351).

¹³That is, original “pattern types” intended for the electroforming of matrices. The singular of this term is “patrix.” Think of it as something like punch, but cut by hand or by machine in a soft metal such as lead-tin-antimony alloy somewhat softer than most typemetals. This term may be unfamiliar to many. In the period from the mid-19th through the mid-20th centuries, when this technique was common, there was no generally accepted term; “patrix” is only one of several options. The great Canadian typemaker Jim Rimmer used this term, though, and if it was good enough for him it is good enough for me.

¹⁴As shown by (Benton 1884).

¹⁵The cutting of original designs as patrices in soft metal for matrix electroforming was, from the 1940s, erased from the narrative of typemaking in American sources. It was in fact not only an important method but at times and above certain sizes the dominant method. This invisibility, which does not exist in, for example, the German literature, has significantly distorted the American understanding of the history of typemaking. For a preliminary discussion of this issue and a

machine. Other than small details which do not change the overall machine¹⁶ there is no inherent difference between a pantograph used for cutting patrices in soft metal and one for punches in steel. In theory, with minor adaptations a pantograph of Benton's first type could even have been used for direct matrix engraving (but I am aware of no evidence that this was done).

I will refer to machines of this kinematic design and this constructional style as "Type 1b" Benton or Benton-style vertical pantographic engraving machines.

3.1.3 • Type 1c, At Monotype (UK)

The Lanston Monotype Corporation, Ltd. in England (always a separate firm from the Lanston Monotype Machine Company in Philadelphia) employed what appear to be Type 1 Benton pantographs. Several photographs show these and one actual machine survives. However, these machines differ in construction details from the Type 1b pantographs seen earlier. It is not yet clear whether these were actual Benton pantographs (that is, machines made either by Benton, Waldo & Company or by ATF) or whether they were copies made by or for Monotype. For now, I'll call these "Type 1c", though it must be emphasized that at our present state of knowledge it is not clear that these Monotype (UK) machines are genuine Benton, Waldo & Co. or ATF manufactured Bentons.



Fig. 6: Monotype¹⁷

The surviving machine will be discussed later in section 6.2 on page 37, The Science Museum's Object No. 1995-1516. Here are two of the details which differentiate it from Type 1b machines.

Most importantly, its spindle is mounted on a complete assembly¹⁸ between presentation of the evidence, see the CircuitousRoot Notebook "The Issue of Patrix Cutting in Soft Metal" at <https://circuitousroot.com/artifice/letters/press/typemaking/the-issue-of-patrix-cutting-in-soft-metal/index.html>. For a brief semi-technical overview of the literature for pre-pantographic hand methods, see the CircuitousRoot Notebook "Patrix Cutting in Soft Metal by Hand: A Survey of the Technical Literature" at <https://circuitousroot.com/artifice/letters/press/typemaking/literature/patrix-cutting/index.html>. I regret that I do not have a corresponding Notebook for pantographic methods. It has been very difficult to discover information about them.

¹⁶These could involve: changes for workholding, possibly minor changes in cutter geometry, and possible changes in cutter speed (although the cutter speeds on these machines were always vastly lower than speeds used in modern engraving).

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¹⁸The term used by Ed Rayher for this assembly is "head." Theo Rehak has indicated that during his time at ATF it had no particular name but was simply called an "assembly" when necessary (Theo Rehak, email to DMM on 2023-03-04 00:29:59 -0500).

the two legs (as opposed to being mounted from one side). See Fig. 7, below left. It also has a much larger and heavier working table and a cylindrical boss of unknown (to me) purpose on the left leg. See Fig. 8, below right.



Fig. 7: Type 1c, “Bridge”¹⁹



Fig. 8: Type 1c, Working Table

There is no information as to when the manufacture of this first style of pantograph ended. By 1909, an article on “Modern Automatic Type Making Methods” at ATF was illustrating a Type 2a Benton pantograph (Kaup 1909, 1043). Word traveled slowly, though, and in 1916 Legros & Grant were describing a Type 1 Benton pantograph in detail as “the” Benton pantograph (Legros & Grant 1916, 196–204).

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3.1.4• Type 1d, Now At Tallone

This pantograph is currently at the Atelier Tipografico (typographic studio) of Alberto Tallone Editore. Its main entry in this Census is in section 6.3, Tallone Editore, on page 39



Fig. 9: Type 1d, at Tallone, 2016²⁰

This is an interesting and slightly hybrid style of machine. Kinematically, it is a Type 1 machine with a “bridge” [head?] holding the cutting spindle as in the Type 1c machines at Monotype (UK). But rather than being supported on two legs going all the way to the floor, as in Types 1b and 1c, it has a distinct table and base unit which resembles the Benton Type 2 machines. At present I know nothing of its origins and have not yet discovered historical records of similar machines.

²⁰Photograph copyright © by Patrick Goossens, Letter-kunde Press, Antwerp. License: Creative Commons Attribution-NonCommercial (BY-NC) 4.0 International. My thanks to Patrick for supplying this image.

3.1.5 • Grant-Legros

Lucien Alphonse Legros was a French engineer working in England who was involved in a number of typesetting and typographical machinery projects. John Cameron Grant was a writer and poet. In 1910, their firm introduced a punch-cutting pantograph based on Benton's (Legros & Grant 1916, 206–208 & Plate IX). It is a matter of judgment and opinion as to whether this machine should be classified as a “Benton-style” pantograph or as a distinct machine in its own right. I have chosen to exclude it from the class of “Benton-style” machines (and hence from this census) and to consider it as a machine in its own right because Legros and Grant sold it under their own name and emphasized their own production process in its use. Reasonable opinion may differ.

The Grant-Legros machine was used commercially at least in their own works, as shown by this photograph of “The Punch-Cutting Room” of the Willesden (London) works of Grant, Legros & Co., Ltd. from 1913.



Fig. 10: Grant-Legros, 1913²¹

²¹From ([Legros & Grant] 1913, 5) Public domain.

One Grant-Legros machine survives, acquired by the Science Museum in 1937 (Object Number 1937-91). They identify it as having been constructed by Williams Engineering Co., Ltd (At their Nodis Works, Ealing. Williams was an important maker of typesetting machinery and tools).

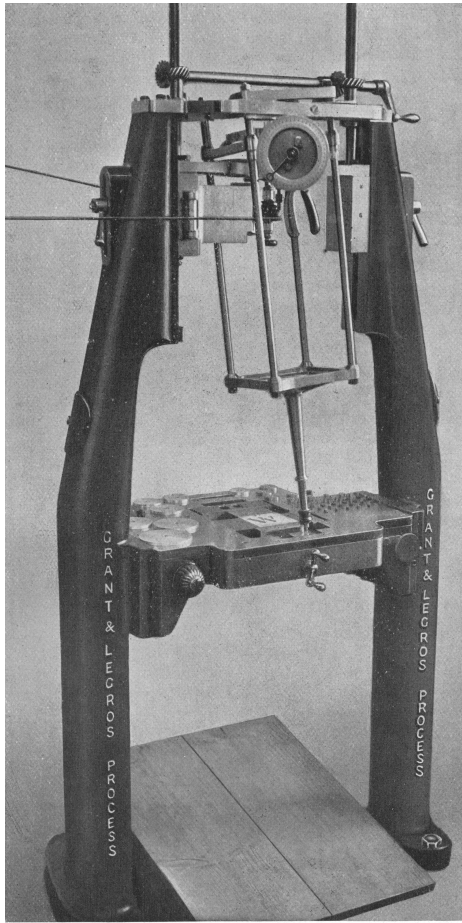


FIG. 163.—Grant-Legros punch-cutter.

Fig. 11: Grant-Legros, 1916²²

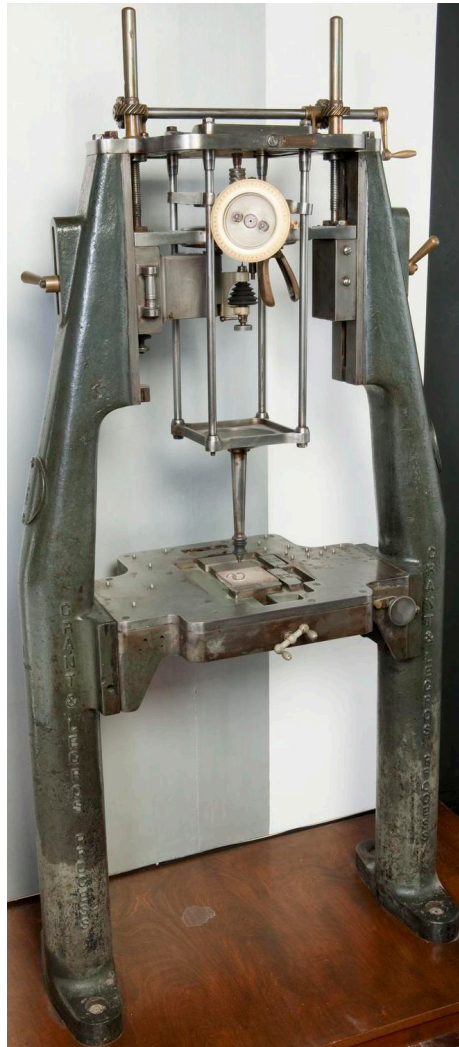


Fig. 12: Grant-Legros, 1910²³

²²From (Legros & Grant 1916, Plate IX facing p. 208.) Public domain.

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3.2• Type 2 Machines (1899/1906 Patent)

3.2.1• Type 2a, ATF, Tsugami, Fujikoshi; Type 2b, ATF

Benton's second type of vertical pantographic engraving machine dates to his 1906 US patent, number 809,548 (filed February 17, 1899). This version is kinematically inverted from the Type 1 design, with the workpiece held fixed underneath a moving cutting head.²⁴ The cutting head ("quill" in ATF terminology but not in the patent) is constrained to move in a two-dimensional plane just as the workpiece was in the 1884/5 design.

I will refer to machines of this kinematic design as "Type 2" Benton vertical pantographic engraving machines.

A machine of this type could be used for cutting patrices in soft metal and punches in steel, and for the direct engraving of matrices. The patent itself spends considerable time on the subject of workholding for direct matrix engraving and these machines were best known as matrix engraving machines. However, the Type 2 Machine No. 55, formerly of the Dale Guild and now at the Letter-kunde Press in Antwerp, has been used both for matrix and punch engraving.

Fig. 13, below, shows a matrix jig for machine No. 55.²⁵ Fig. 14 shows a jig for the same machine which is capable of holding either a punch or a patrix. Fig. 15 shows this same jig with the engraved patrix removed.²⁶

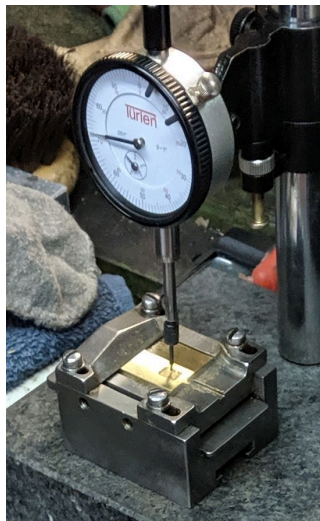


Fig. 13: Matrix Jig

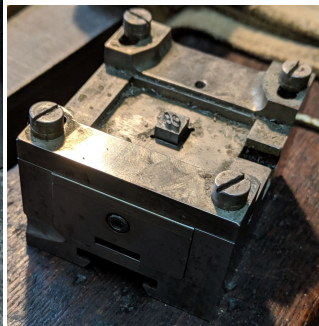


Fig. 14: P or P Jig

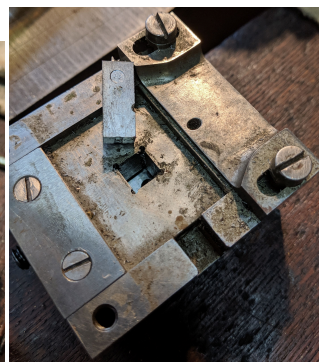


Fig. 15: Patrix

²⁴His 1884/5 patent did allow for the "change [of] the relative positions of the work and the tool, making the work stationary and the cutting-tool movable" (p. 4, lines 56–58), but that feels very much like the wording of a patent lawyer trying to expand the scope of the patent. Benton's 1899/1906 patent goes much further.

²⁵It has been removed from the machine and I was checking the current depth of cut of the matrix.

²⁶The pinmark suggests that this patrix began life as a pivotal-cast quad.

These Type 2 pantographs were made in at least two distinct models, a smaller one and a larger one. There are probably variations along the way; “smaller” and “larger” may be inadequate characterizations. Aside from their greater height, the larger machines are distinguished by a horizontal bar connecting the two vertical bars which are used to adjust one direction of the top gimbal to allow for expanding and condensing the design.²⁷ But this horizontal bar differs in design between Machine No. 60/63 (Swamp Press / Rayher) and Machine No. 99 (Printing Stewards, ex-Gregory Jackson Walters). Each of the surviving Bentons is in some sense unique. Pending further refinement as these machines are better documented, I’ll call the smaller style “Type 2a” and the larger style “Type 2b.”

²⁷This mechanism for adjusting the gimbal is also present on the smaller Type 2a machines, but the amount of its travel is much smaller.

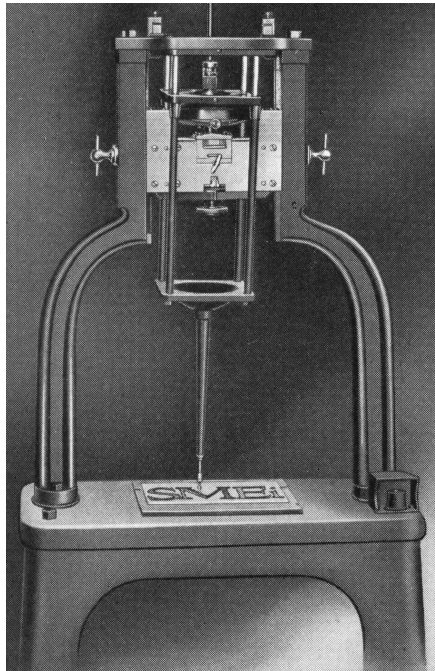


Fig. 16: Type 2a, ATF 1923²⁸



Fig. 17: Type 2, Small & Large²⁹

Figure 16 shows a Type 2a machine as illustrated in the 1923 ATF specimen book. Figure 17 shows Machine No. 53 (left, greenish, short, Type 2a) next to Machine No. 99 (right, black, tall, Type 2b) as they were in 2021 at the foundry of Gregory Jackson Walters.

²⁸(ATF 1923, 10). Public domain.

²⁹Photograph by DMM, August 6, 2021.

3.2.2• Type 2c, China

At present this is the only substantive variant of the Type 2a Benton of which I am aware (the Tsugami and Fujikoshi machines may differ from genuine Bentons, but to a smaller degree). It is still clearly a Type 2 Benton-style machine, but it is built upon a massive base.

For further discussion of these, see section 15, Chinese Benton-Style Pantographs, on page 91.



Fig. 18: In Beijing³⁰

³⁰Photograph copyright © by Patrick Goossens, Letter-kunde Press, Antwerp. License: Creative Commons Attribution-NonCommercial (BY-NC) 4.0 International. My thanks to Patrick for supplying this image.

4• Benton Production Dates and Quantities

4.1• Type 1 Machine Dates

As noted earlier, there is no evidence that a Type 1a machine with the same construction style as Benton's 1884/5 patent³¹ was ever built. The only evidence we have for it comes from the patent. Outside of the patent drawings, no source showing its construction in this form has ever been published. On the other hand, there is no evidence that one or more were not constructed in this form. It is likely that at least one was, as patent drawings of the period tended to be taken from actual machines — but we just don't know.

The earliest surviving visual evidence we have for a Benton vertical pantograph is an undated pamphlet from circa 1891³² by Benton, Waldo & Co.³³ entitled "Benton's Punch Engraving Machine." The cover of this pamphlet shows a photograph of a Type 1b machine. This cover is reproduced in (Cost 2011, 68), but I do not have permission to reprint that here. The same photograph was published in 1893 in *The Inland Printer* ([Benton] L. B. Benton 1893, 237). For this see Fig. 5 on page 8 previously or Fig. 20 on page 20 to follow.

The first machine offered for sale or lease was No. 3,³⁴ offered to the Mergenthaler Printing Company (predecessor to the Mergenthaler Linotype Company) on Feb. 13, 1889.

The latest Type 1 machine we know by chronological serial number is No. 10, sold on May 19, 1890 to the Rogers Typograph Company (Rehak 1993, 109). The latest machine we have evidence of is one sold in August 1890 to the Lanston Type-Machine Company (Cost 2011, 69.) Certainly more Type 1 machines must have been sold later, but we have no information about them.

So all of the sales information we have for Type 1 Benton pantographs dates from the period 1889-02-13 (serial no. 3)³⁵ through 1890-11-03 (serial number unknown, but greater than 10).³⁶ The earliest visual evidence postdates this. So at one extreme it is possible that all of the early sales through circa 1891 were Type 1a machines. At the other extreme, it is possible that zero through two machines were of Type 1a and that all of the machines sold were Type 1b. This is in my opinion much more likely, but this is only an opinion.

Thirty-one years after this first published photograph, Henry Lewis Bullen published a photograph of a Benton Type 1b pantograph which he said was in the Typographic Library and Museum of ATF.³⁷ He asserted, further, that

³¹That is, with a single column and a spindle based on a watchmaker's lathe headstock.

³²This date is presumed by Cost.

³³The cover of the pamphlet says "Benton, Waldo Type Foundry".

³⁴See section 10, Known Lost Benton Vertical Pantographs, on p. 64 for more information.

³⁵(Rehak 1993, 109).

³⁶(Cost 2011, 69),

³⁷This library was his creation.

this machine was serial number 2. The problem of course is that this account is by Bullen and his word cannot be trusted. It is probably not unreasonable to assume that this machine was in the ATF library, but the assertion that it was machine serial number 2 cannot be relied upon. His further claim about punchcutting in steel reflects his early and entirely fictitious story about the origins of Benton's cutting punches in steel.³⁸

On the other hand, Bullen's assertion that the Mergenthaler Printing Company purchased machine number 3 in 1889 is confirmed by the extract from the Benton, Waldo & Co. "day book" reprinted in (Rehak 1993, 109).

Reproduced on the next page are the two known photographs of Benton Type 1b pantographs.

³⁸Briefly: In Bullen's 1922 biographical article on Linn Boyd Benton (Bullen 1922) he presents a story which has P. T. Dodge of the Mergenthaler company convincing an unwilling Benton to try cutting punches in steel (vs matrices in soft metal). Bullen's story is elaborate, with dialog and specific dollar amounts, but it cannot be true. We know that the "Blower" Linotype went in to service in 1886 using electroformed matrices because punchcutting by hand in steel was too expensive and Ottmar Mergenthaler and the Mergenthaler Printing Company did not then know any way to cut punches by machine in steel. Carl Schlesinger's research finds electroformed matrices in use with the Linotype through at least August of 1886 (Mergenthaler 1989, 103–106). We also know from the Mergenthaler Printing Company annual report issued January 1888 that the Mergenthaler company had "recently completed [a contract] with Benton, Waldo & Co., of Milwaukee, for the mechanical cutting of these dies [punches]" (quoted in Goble 1984, 87). So Bullen's story, if it were true, would have had to have taken place in the late 1886 through 1887 timeframe. But in July 1884, two to three years earlier, a trade note from Benton, Waldo & Co. had appeared in *The Inland Printer* claiming the ability to cut punches in steel by machine (Benton 1884). Bullen's story is a complete fabrication.

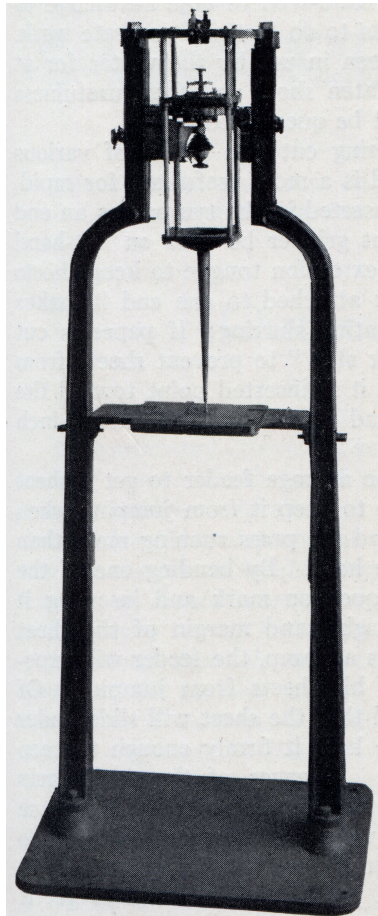
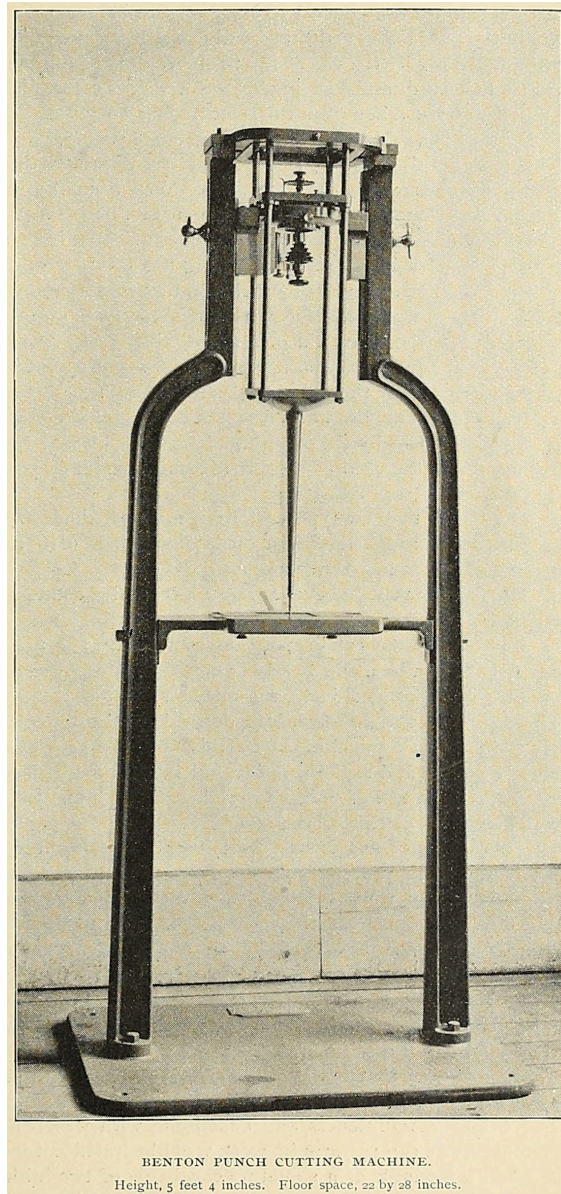


FIG. 6.—The Benton punch-cutting machine, on which the first steel punch was cut for the Mergenthaler linotype machine. The second machine built by Benton. The Mergenthaler Printing Company bought No. 3 in 1889 and several others shortly after. Without this invention Mergenthaler's invention was impracticable. This machine is in the Typographic Library and Museum of the American Type Founders Company, in Jersey City.



BENTON PUNCH CUTTING MACHINE.
Height, 5 feet 4 inches. Floor space, 22 by 28 inches.

Fig. 19: Maybe Benton No. 2³⁹

Fig. 20: 1891/1893⁴⁰

To the best of my knowledge, these two photographs are the only surviving evidence of the appearance of the Type 1b Benton pantograph.⁴¹ This is a tiny quantity of information both in absolute terms and in proportion to the extraordinary fame of this machine.

³⁹From (Bullen 1924, 937). Scanned by DMM from an original copy. Public domain.

⁴⁰From ([Benton] "L. B. Benton" 1893, 237). Smithsonian Institution's scan. Public domain.

⁴¹But see section 5.2, The Benton Vertical Pantograph In Germany, on page 31 for Type 1b style machines in Germany which may or may not be US manufactured Bentons. Both the drawings in (Legros & Grant 1916, 196–204) and the woodcut in (Mahr 1928) are interpretations. The "Type 1c" machines at the Lanston Monotype Corporation, Ltd. (UK) are slightly different in construction and may not be by Benton/ATF.

4.2• Type 1 Machine Quantities

Rehak indicates that the early Benton vertical pantograph machine numbers were “chronological” (Rehak 1993, 107). As noted earlier, the highest chronological machine number known is 10 (sold on May 19, 1890). To this we can probably add the one sold in August 1890 to Lanston. So at least 11 Type 1 Benton vertical pantographs were built. Of course, the real number is almost certainly higher than this.

Additional information on several machines could add to this number. These include:

- The surviving Type 1b machine once displayed at The Gutenberg Museum, Mainz.
- The 13 Type 1b machines which were probably at the Stempel foundry in Germany prior to 1914.
- The five (minimum number) Type 1c machines at the English Monotype firm from before 1910, including one survivor (Sci. Mus. Obj. 1995-1516).
- The single Type 1d machine surviving at Alberto Tallone Editore.

4.3• Type 2 Machine Dates

All of the surviving machines are of Type 2, so the filing date of Benton’s 1899/1906 patent gives an approximate *terminus post quem* for their dates of manufacture.

Rehak said in 1993 that all surviving machines were manufactured prior to 1912⁴² (Rehak 1993, 107). However, this probably does not include the two surviving machines in Japan, which were ordered in 1921 and 1922. In 1993 there was no information available in the west to indicate that they had survived.

4.4• Type 2 Machine Quantities

Rehak says that “other [ATF] records show that nearly three dozen were produced and eventually sold or leased” (Rehak 1993, 107). This figure presumably includes both types 1 and 2. It does not include machines retained by ATF for their own use.

Rehak also indicates that “those machines that still exist⁴³ are numbered in the forties upward but are not chronological, and all of them date prior to 1912” (Rehak 1993, 107, 109), Surviving machine numbers are: 48, 49, 50, 53, 55, 60 or 63, 62?, and 99. These are not chronological serial numbers and there may have been gaps in the numbering. But if machines were produced to 1924, as Rehak says, then higher machine numbers might (or might not) have existed

⁴²He also notes that no machines were produced after 1924, though there were “small refittings and upgrading ... into the late 1930s.”

⁴³All of which are Type 2.

for machines produced in the 1913–1924 timeframe.

Very few views of the engraving department at ATF exist. Here are two views of the same matrix engraving room at ATF from around 1912.

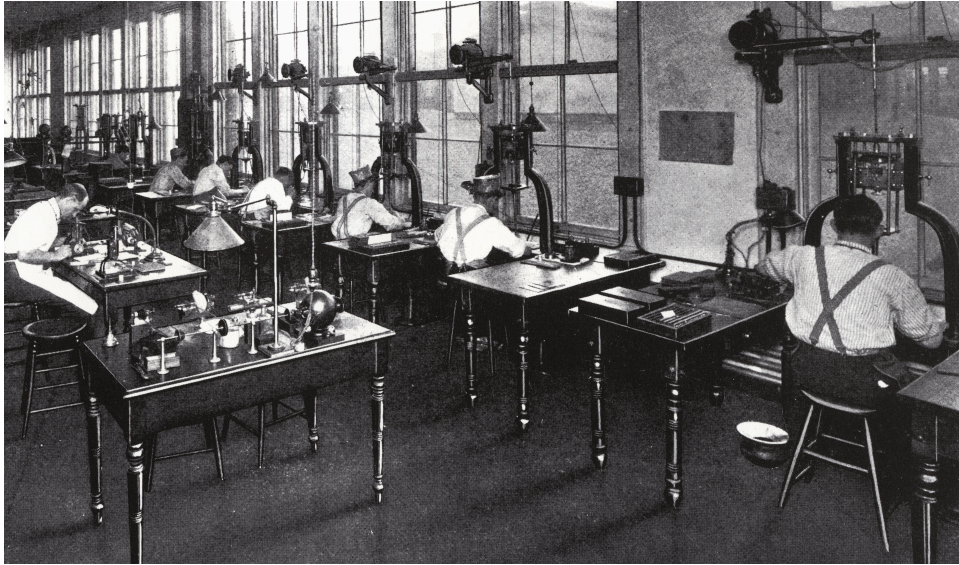


Fig. 21: ATF Engraving Department, circa 1912⁴⁴

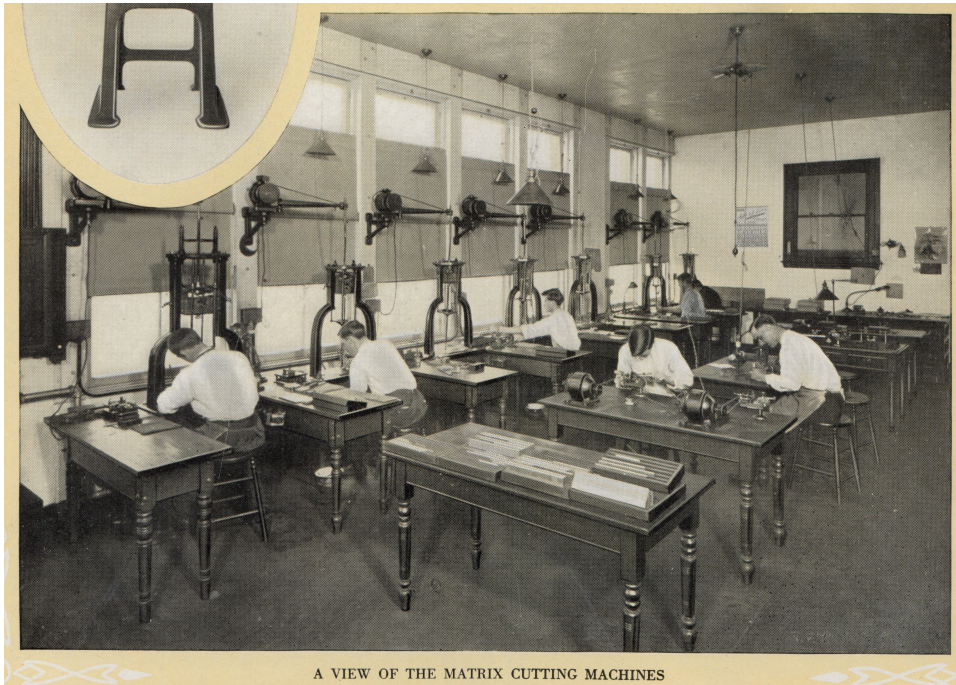


Fig. 22: ATF Matrix Cutting Machines, by 1912⁴⁵

⁴⁴(ATF 1912b/2002)

⁴⁵(ATF 1912a, ix)

Fig. 21, on the previous page, is the photograph which shows the greatest number of pantographs at once. It is from an undated (but probably circa 1912) booklet of views of the ATF Central Plant. Working from right to left, it shows five Type 2a machines clearly. The next machine (in front of the column) is a Type 2b. Then there are three machines which are very difficult to distinguish. The first and third of them might be Type 1b machines. It is impossible to make out what the second might be.

Fig. 22 shows the same room from a different angle. It appeared in the 1912 *ATF American Specimen Book of Type Styles*. By comparing it to the first it becomes apparent that there were six (not five) Type 2a pantographs installed. The one on the far right in Fig. 22 was just out of the shot in Fig. 21.

But as interesting as these photographs are, they don't provide any conclusive evidence of minimum production numbers. It is possible (unlikely, but certainly possible) that the six machines at ATF in 1912 include one or more of the Nos. 49, 61, and 62 which were sold to Japan.

So we have actual evidence only for a total of ten: two lost machines sold to Japan and the eight surviving machines.

The presence of a machine number of 99 on a machine manufactured before 1912 (according to Rehak), when Rehak says that production continued until 1924, does suggest the possibility that 100 or more were produced. But these machine numbers are not chronological serial numbers and so this argument is not conclusive.

All in all the information is very incomplete and it is not possible to give an estimate of the total production of Type 2 machines with any degree of certainty.

4.5• Total Vertical Machine Quantities

If you want a firm minimum number of machines constructed by Benton & Waldo or ATF, for which solid evidence exists, that number is 21 (11 Type 1 and 10 Type 2). This is obviously too low.

If we take Rehak's "nearly three dozen" to mean 35⁴⁶ machines *sold* and add to it the five which are known not to have been sold,⁴⁷ then the total would be 40.

In correspondence, Rehak has further clarified his thoughts on this matter:

I believe it is now impossible to accurately say how many BEMS ever existed. A conservative, rolling estimate of @3 dozen seems reasonable.⁴⁸

⁴⁶As close to three dozen as "nearly" gets you.

⁴⁷Because they were finally sold at auction in 1993.

⁴⁸Theo Rehak, email to DMM on 2023-03-11 08:00:02 -0500.

4.6• Horizontal Machine Quantities

Rehak says that Benton “built and enhanced a small number of pantograph engraving machines” to accept the same quill as the vertical machines. (Rehak 1993, 107). Of these, only one survives: the “Adcut” machine. It has a machine number of 5, but as discussed elsewhere this is not a serial number. There is also a single ephemeral reference to a “new” Adcut Machine No. 1 in 1930. (See section 12.2, Modified Machines and the Adcut Machine, on page 69 for a discussion of this.) So the best we can say is that “some” were made or modified from commercial sources and that one survives.

It would appear that only one Tracing Apparatus⁴⁹ was constructed, It does not survive.

No information exists as to how many wax-plate pantographs were made by Benton. It is possible that this was a commercial unit; we have no information about its design or manufacture. None survive.

⁴⁹For reasons discussed later, I am not calling this machine the “Benton Delineator” in this Census, although Rehak’s use of this term suggests that this is what it was called at ATF.

5• Benton Pantograph Exports

5.1• The Benton Vertical Pantograph In Japan

Note: “Benton,” phonetically in katakana characters, is: ベントン. In kanji, 活字 (katsuji) is “type.” This can be very useful in searching online.

Yuki Akari (雪朱里)⁵⁰ has done substantial and important research into the history of ATF-manufactured Bentons imported into Japan (as well as the Tsugami copies of the Benton manufactured in Japan). My account here is based primarily on her work.

If I understand Yuki’s research correctly,⁵¹ a total of four USA-manufactured Benton pantographs were exported to Japan by ATF. Two of these survive: at the company museum of the Sanseido publishing house and at the Printing Museum in Tokyo (associated with the Toppan printing firm).

The Tsugami and Fujikoshi copies of the Benton were not produced until after the Second World War. They will be discussed later, in section 14.

5.1.1• National Printing Bureau, 1912 (No. 59?)

Yuki says that the first of these pantographs was purchased from ATF in 1912⁵² by the Japanese government’s [National] Printing Bureau.⁵³ See (Yuki No. 12 2019); Yuki in turn cites a 1943 history of the Printing Bureau by the Printing Bureau itself.

Few details are known about this machine. It was probably a Type 2 machine (see below), but even this is not completely certain. It does not survive.⁵⁴

The National Printing Bureau has a museum, お札と切手の博物館 [Osatsu to kitte no hakubutsukan, Museum of Banknotes and Stamps; but “Banknote & Postage Stamp Museum,” in English, on their website].⁵⁵ In 2014 this museum held an exhibition on the National Printing Bureau’s creation of typefaces. The flyer for this exhibition discusses the Bureau’s acquisition of a Benton pantograph in 1912 and shows an old photo of a Type 2a Benton pantograph in

⁵⁰This is a Japanese name presented in the traditional order. The family name is Yuki (雪).

⁵¹I may not. I am relying upon Google’s machine translation to read her work, which is in Japanese. Any errors here are my own.

⁵²More specifically, Yuki says Meiji 48, which ended on July 30, 1912. So this machine must have been imported in the first half of 1912.

⁵³国立印刷局 [Kokuritsu Insatsu-kyoku, National Printing Bureau.] See the English-language Wikipedia page for this Bureau at https://en.wikipedia.org/wiki/National_Printing_Bureau. This is the current name of this institution. I do not know what its name was in 1912, as it has undergone several mergers and changes of name. See the English-language history page on its website at: <https://www.npb.go.jp/en/guide/enkaku.html>.

⁵⁴The typographical pantograph that the museum does have on display is a Tsugami from 1956. See section 14.4.1, Banknote and Postage Stamp Museum, on page 79.

⁵⁵See the museum’s history page at <https://www.npb.go.jp/ja/museum/about/history.html>

operation at the Bureau. The citation for the photograph is not explicit, but it is likely that this is the machine acquired in 1912 (NPB 2014, 7).

Benton wrote up instructions for the use of this machine, a copy of which was preserved in the Typographic Library of American Type Founders (Lohf 1980, Vol. 1, p. 140). These instructions may survive in the library system of Columbia University, which acquired the ATF Library in 1941. However, the ATF Library has been dispersed into the various libraries of Columbia University and much of it remains uncataloged in their systems.

The catalog entry⁵⁶ for these instructions as this volume existed in the ATF Library gives its title as “Instructions for Setting Up Benton Matrix Engraving Machine #59”. The catalog entry also contains a quotation from this work:

“The ... instructions were written by me and sent to the Imperial Printing Bureau of Japan at Tokio, on the occasion of shipping the first Benton Matrix Engraving Machine to that country.” L. B. Benton (sig.)

This very strongly suggests that this first machine was No. 59.

There is one note of uncertainty, however. Bullen (again, an unreliable source) dates these instructions to “1917–22”. A date of 1917 is well after the date of 1912 cited in Yuki’s research and a date of 1922 overlaps with the three later machines sent to private companies in Japan (see below).

5.1.2 • Bauer’s Diary

In *Practical Typecasting*, Theo Rehak mentions the journey of ATF foreman John Bauer to deliver pantographs to Japan. He also prints a photograph of the tattered and incomplete cover and a portion of the title page of a diary kept by Bauer.⁵⁷ Rehak says that two machines were sold to Japan in the early 1920s, but the cover of this diary may indicate three (Rehak 1993, 107, Fig. 32 on p. 109).

The fragments shown in Rehak’s photograph are brief but complex.

The incomplete cover has the title “MATRIX E ... MACHINE # ...” To this a later hand has added the number 62.

Continuing to the title page, it looks as if it was first titled “Eng. Machine #61 for Japan.” This has been amended twice. First, the word “Matrix” was added above the title. Second, the number 62 has been added in a later hand.

Together, these indicate that machines 61 and 62 were exported. The use of the word “matrix” is significant because it means that these machines were matrix engraving machines and thus Type 2.

⁵⁶Written by Henry Lewis Bullen.

⁵⁷It is subtitled “Records & Diary.” Rehak further indicates that it is incomplete.

But there is more information than this. If you look carefully at the bottom of the cover of this diary there are three lines of notes. Each seems to indicate a particular machine.

The first line is for machine 61, for which the delivery to Japan commenced June 16, 1922.

The second line, however, is for machine 49, commencing Jan 16 of what *might* be 1924 (the date is unclear in the photograph).

The third line is for another machine. Its number is mostly illegible, but what remains is not inconsistent with “62”. Its delivery began on April 7 of some year (the year is illegible) (Rehak 1993, 109).

5.1.3• Tsukiji (Their First Machine, 1921–1923, No. 61?)

After considerable investigative work, Yuki has concluded that the second Benton pantograph exported to Japan was purchased in May 1921 by Tokyo Tsukiji Letterpress Factory Co., Ltd. (東京築地活版製造所, Tōkyō Tsukiji kappan seizōjo).⁵⁸

This machine was put into use in 1922–1923. (Yuki No. 12 2019); These dates are consistent with Bauer’s (see above). It is therefore likely that this was Machine No. 61, the first machine noted in Bauer’s diary.

Yuki says that this machine was destroyed in the Great Kanto Earthquake (which was September 1, 1923).

See: (Yuki No. 31 2019).

5.1.4• Tsukiji (Their Second Machine, 1922–1924. No. 49)

Yuki says that in 1922 Tsukiji purchased a second pantograph from ATF, but that it was not delivered until 1924 (after the Great Kanto Earthquake, fortunately). The dates for this correspond with Machine No. 49 on the cover of Bauer’s diary, which shows a delivery “commencing Jan 16, 1924”. (But caution is in order, as the writing for “1924” is not entirely clear.)

This documentary evidence suggests that this machine is No. 49. This has been confirmed with photographic evidence by the Printing Museum, Tokyo.⁵⁹

Yuki’s account indicates that the Tokyo Tsukiji Letterpress Factory, which

⁵⁸The Tokyo Tsukiji Letterpress Factory Co., Ltd. (株式会社東京築地活版製造所, Kabushiki-gaisha Tōkyō Tsukiji kappan seizōjo) was founded in 1885 by Hirano Tomiji [This is a Japanese name presented in the traditional order. Hirano is the family name.] See: (Hirano 2017). It ceased business in 1938 (Yuki No. 31 2019).

The 築地活字 (Tsukiji Katsuji, Tsukiji Type / Tsukiji Printing Co. Ltd.) company which exists today began in 1919 (Taisho 8) as a separate company with an entirely different name. At a later point it inherited some of the materials of, and adopted a name based on, the then defunct Tokyo Tsukiji Letterpress Factory. See the Tsukiji Katsuji “築地活字の概略史” [“Tsukiji katsuji no gairyaku-shi” “Brief History of Tsukiji Type”] web page at <http://tsukiji-katsuji.com/profile.html> (Tsukiji Katsuji N.D.)

⁵⁹NAKANISHI Yasuhito, curator of the Printing Museum, Tokyo, email to DMM on 2023-03-14.

ceased business in 1938, sold its Benton in 1936 to 凸版印刷株式会社 (Toppan'insatsu kabushikigaisha, Toppan Printing Co., Ltd.) From its use with them, it has passed now to its current location. It is preserved in The Printing Museum, Tokyo (which is the successor to the Printing Archives of the Toppan company and which is located in Toppan's corporate headquarters building).

See: (Yuki No. 31 2019).

5.1.5 • Sanseido (1922–1924, No. 62?)

The fourth Benton pantograph to go to Japan has taken a simpler path.

Yuki said that it was ordered in 1921 (Taisho 11) by the Sanseido publishing firm⁶⁰ during a trip to the USA.

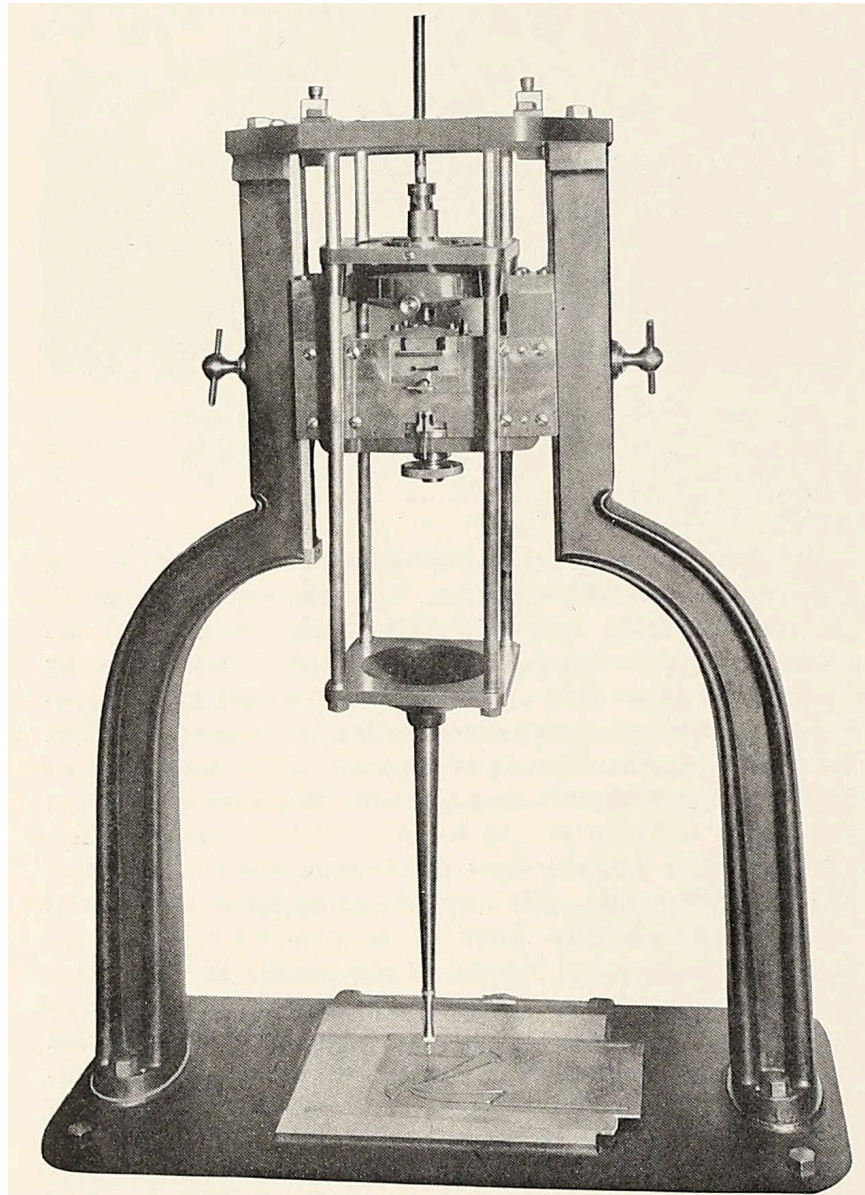
But fortunately it was not unpacked and set up until after the Great Kanto Earthquake. It was put into service in 1925. Correlating Yuki's research with Bauer's diary, it would seem likely that this is Machine No. 62. (This is not completely certain, however. An examination of the machine number stamped on the pantograph mechanism of this machine would resolve this uncertainty.)

This machine survives in the corporate museum of Sanseido Co., Ltd., Publishers. See: (Yuki No. 31 2019).

5.1.6 • One of the Machines Before Export

By chance, one photograph of a Benton pantograph probably destined for export to Japan was published. Some care must be taken in its interpretation, though.

⁶⁰This is the same firm which has published Yuki's columns and her book on the Benton pantographs.



The Benton Matrix-Cutting Machine. The follower is engaged in a pattern of a Japanese word character. Photograph is from one of two machines sold to the Imperial Printing House of Japan for use in its typefoundry. This is one of the most perfect mechanisms made in America.

Fig. 23: A Benton for Japan, 1922⁶¹

This photograph was published in Henry Lewis Bullen's biographical article on Linn Boyd Benton in *The Inland Printer*.⁶²

The first caution, therefore, is that this is a work by Bullen and without independent corroboration nothing in it can be relied upon to be true. It is,

⁶¹(Bullen 1922, 64). From the Smithsonian's digitization.

⁶²(Bullen 1922).

in fact, the article in which he published his entirely fictional account of the origins of cutting punches in steel on the Benton — an account which has for a century been repeated as if it were true and which has completely distorted all subsequent understanding of Benton’s work and achievements. This is an article packed full of false statements.

At the same time, while Bullen’s body of work is flawed by innumerable fictions presented as fact, not every word he wrote can be a lie. This is a Type 2a Benton matrix engraving pantograph. He does say that it was sold for export to Japan. It is likely that it was.

He says that it was one of two, which is not correct. (Yuki’s research has established that there were four sold: one in 1912, one in 1921, and two in 1922.) He says that this one was for “the Imperial Printing House of Japan.” This name is a reasonable mistake for the National Printing Bureau, but that machine was sold in 1912. This machine was sold in the early 1920s and all of those sales were to private companies.

Given the date of this publication (October 1922) and the fact that three machines were ordered by Japanese companies in 1921 and 1922, it seems more likely that this is one of those three machines.

Bullen is correct that the character on the engraving pattern shown on the pantograph in the photograph is a Japanese character. It is 之 (romanized as “kore.”)⁶³

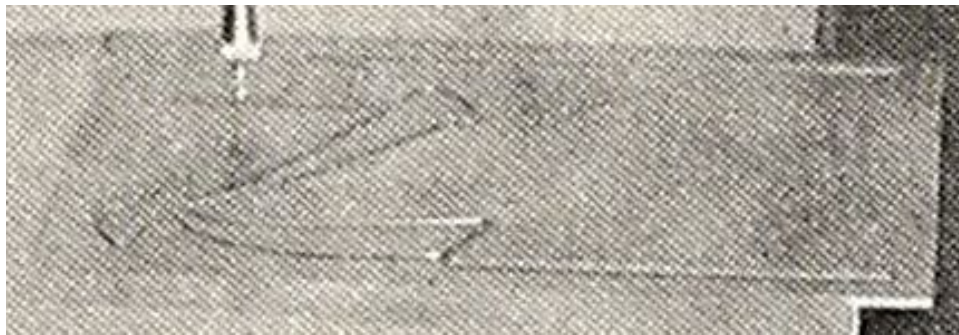


Fig. 24: Pattern in the 1922 Photograph

Interestingly, the “Matrix Machine Setting Record” reproduced in *Practical Typesetting* is for cutting this character (Rehak 1993, 209).

⁶³My thanks to Victor Thibout for identifying this character. When reading it, note that in a Type 2 Benton matrix engraving machine the pattern is right-reading and right-side up relative to the operator’s position.

5.2• The Benton Vertical Pantograph In Germany

One Benton or Benton-style pantograph survives in Germany, in the Gutenberg Museum in Mainz. See section 6.1 on page 36.

Wilkes, in *Das Schriftgießen*, reproduces a photograph of the engraving room of a German typefoundry which has 13 machines which are either Benton Type 1b pantographs or locally manufactured copies. Since there is presently no information on the export of Benton machines to Germany, I'm placing these in section 9.2, Copies In Germany, on p. 63. However, it is entirely possible that these are actual US-manufactured Benton pantographs.

It is also suggestive, though of course not conclusive in any way, that in Germany in 1928, in a series of woodcuts illustrating various stages of typemaking, Karl Mahr showed two kinds of pantographs. For “Der Matrizenbohrer” (literally “matrix driller,” but more idiomatically matrix engraver) he shows a horizontal four-bar pantograph. But for “Der Maschinen-stempelschneider” (The Machine Punch-Cutter) he shows a single-arm vertical pantograph very similar to a Type 1b Benton (rather than a Pierpont or one of the vertical machines in use by the US and UK Linotype and Intertype firms by that time). See (Mahr 1928).

This engraving enters into the public domain in the USA in 2024. Include it here then.

5.3• The Benton Vertical Pantograph In England

Summary:

At a bare documented minimum: two US-manufactured Type 1b Benton pantographs were imported into England (to Linotype) and five Type 1c Benton-style machines of unknown origin are attested (at Monotype). One of the latter, Science Museum Object 1995-1516, survives. No Type 2 machines are attested.

The actual total of US-made Benton pantographs imported into England must certainly have been higher.

5.3.1• Linotype (UK)

The English company which licensed production of the Linotype began in 1889 as The Linotype Company Ltd. In 1903 it merged with The Machinery Trust Ltd. to become Linotype & Machinery, Ltd.⁶⁴

From the page in the Benton, Waldo & Co. “Day Book” reprinted in (Rehak 1993, 109), we know that at least two Type 1b pantographs, Nos. 8 and 9, were sold to the Linotype Company Ltd. in Manchester. (See section 10, Known Lost Benton Vertical Pantographs, on page 64 for this information.)

From around 1900, the Linotype Company Ltd. began developing its own pantographs in-house. See GB patent 22,106 of 1900 (Lock & Barr 1900).

At present I know nothing of any other Benton pantographs which might have been imported by the Linotype Company Ltd. in the 1890s. It is possible that documentation now owned by The Science Museum Group (UK) might have more information.

5.3.2• Lanston Monotype Corp. Ltd.

NOTE: It is likely that much more information is contained in surviving documents in the Monotype Archives and in The Science Museum Group (UK) collections. At the present moment (2023) the knowledge of several former employees of the old Monotype Corporation is still available to us. Much that appears provisional and complicated here probably has an easy answer somewhere.

The highly incomplete Benton, Waldo and ATF records reprinted in (Rehak 1993) and (Cost 2011) do not record sales of any Benton pantographs to the Lanston Monotype Corp. Ltd. (UK),⁶⁵ but this absence of evidence is not evidence of absence.

Richard Southall reports that in 1898 the Lanston Monotype (UK) directors authorized “the purchase of five punchcutting machines of Benton’s design”

⁶⁴For the history of this firm see Basil Kahan’s biography of Ottmar Mergenthaler (Kahan 2000). The date of its name change to L&M is documented in (MOSI 2001). Unfortunately, neither source mentions punch engraving machines.

⁶⁵This corporation did not change its name to the now more familiar “Monotype Corporation Ltd.” until 1931 (Slinn *et al.* 2014, 77).

(Slinn *et al.* 2014, 359). Unfortunately, this wording is ambiguous because it could mean either the import of ATF-manufactured Bentons or the purchase of copies made elsewhere. The Benton pantograph is an engineering marvel, to be sure, but it is not magical. Copies could easily have been built by many precision machine shops worldwide at this time. Authorizing a purchase is also not the same as actually purchasing, but Southall goes on to record that these machines were transferred to the new Monotype works at Salfords when it was established in 1900, so presumably these five machines were acquired.

What is interesting about the Benton-style machines in the published photographs of the Monotype matrix works and also the single surviving Benton-style machine is that all of these machines are “Type 1c” machines. In particular, they all carry their cutting spindle on a bridge between the two legs and the spindle itself is not obviously based on a watchmaker’s lathe headstock (where the Type 1b machines attested in the *Inland Printer* photographs carry what is basically a watchmaker’s lathe headstock on the left leg only). It is further interesting that none of the machines visible in the published photographs is the machine which survives.

Four relevant photographs were published in (Slinn *et al.* 2014, 361–364, 368). (Unfortunately, I cannot reprint them here.)

The first of these (p. 361) shows the original matrix department of the Salfords work, built in 1900. In it, three Benton-style pantographs are shown at a bench.

In a later view (pp. 362–363) taken after the extension of the works in 1910, three machines are shown again. These may well be the same three machines with a slightly different bench.

The third relevant view (p. 364) is dated by Southall to 1953 and shows the same room with four Benton-style pantographs. Three of them are probably the same three machines of the earlier photographs (or at least identical machines). The room has been rearranged so that their bench is now nearer to the windows and the Pierpont machines (and it has been rotated 180 degrees to face away from the windows). In this photograph, the top of a fourth machine is just visible. It differs from the first three (it is taller) and yet it is not the surviving machine.

(The fourth photograph (p. 368) shows the new matrix factory built in the 1950s. It is relevant because it does *not* show any Benton-style machines.)

This department was also shown in a 1925 Monotype silent film entitled *A Monotype Composing Machine*.⁶⁶ It appears for only a few seconds, with a title card at 20:44 and footage of the pantographs from 20:53 to 21:06. Three pantographs are shown in a panning shot. Here they are, in two screenshots from the film edited to show the three machines:

⁶⁶In the film it is called the “punch cutting department,” not the “matrix department.”

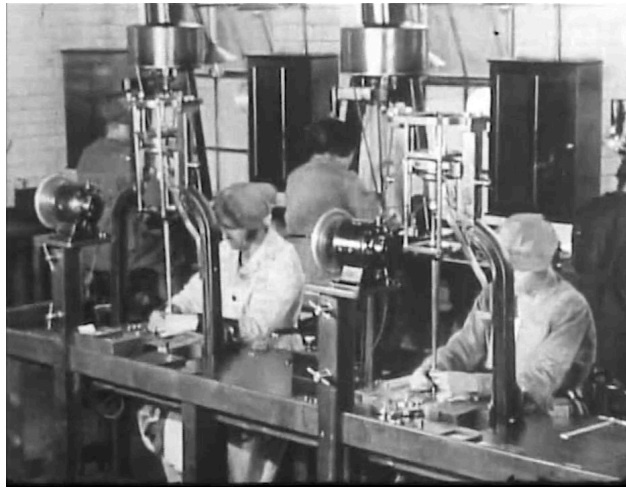


Fig. 25: Monotype 1925, 2 of 3⁶⁷

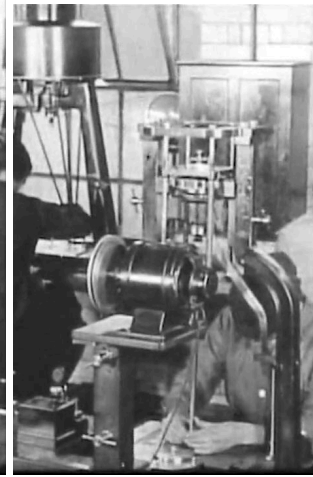


Fig. 26: 3rd

This 1925 film must have been taken between the time the second photograph in Slinn (post 1910) but before the third (1953). The bench for the three pantographs is more or less the same as that of the post 1910 photograph (note the square stands for the motors), but it is in the position that it occupies in the 1953 photograph. In that later photo, however, the motors have cylindrical mounts. The fourth machine shown in the 1953 photo isn't present in this photo.

One machine which is either an actual Type 1b Benton pantograph⁶⁸ or an English-made copy of one survives in The Monotype Corporation collection of the Science Museum Group (UK)⁶⁹ This is their Object No. 1995-1516⁷⁰ See section 6.2, [The Science Museum's Object No. 1995-1516](#), on p. 37 for more on this machine.

All that can be concluded on the basis of this evidence is that the Benton-style pantographs owned by the English Monotype firm over the years were all variations on Type 1c machines. Five are attested through photographic or physical evidence. Three of these were of the same style and seemed to constitute the basic battery of machines. One was taller. The surviving machine is none of the above.

At present I have no other information concerning either the direct import of Benton machines by the English Monotype firm or the possibility of the transfer of machines to England from the Lanston Monotype Machine Company.⁷¹

⁶⁷(Monotype 1925). Public domain.

⁶⁸But slightly different in construction details than the one shown in the circa 1891 Benton, Waldo sales brochure.

⁶⁹This has been on loan to what is the Type Archive, but the situation there is presently in flux.

⁷⁰That is, the 1,516th item inventoried in acquisitions in 1995.

⁷¹The LMMC was never the parent company of the independent English firm, but they maintained a strong relationship with it in the early 20th century.

5.3.3• Other and Red Herrings

Roy Millington, in his history of the Stephenson, Blake type foundry, reports that a “Benton-Waldo” pantograph was imported by them (Millington 2002, 81–82). There is good reason, however, to believe that this machine was not actually a Benton pantograph but rather an entirely unrelated, horizontal-format, Schokmiller pantograph. See section 11, Lost Probable Non-Bentons, on p. 11 for more on this.

6• Surviving Type 1 Benton-Style Pantographs

At this time all of the surviving machines which are known with certainty to be ATF-manufactured genuine Benton pantographs are Type 2 machines. These are discussed in later, in the section 7, Surviving Benton Pantographs, on page section 41. All of the Tsugami pantographs (several of which survive) were Type 2 machines. The pantograph in the China Printing Museum is also a Type 2 machine. These are discussed in their own sections as well.

However, there are three surviving Type 1 pantographs presently known to me. It is not yet clear whether they were manufactured by either Benton, Waldo & Co. or ATF (and would thus be genuine Bentons) or if they were made by someone else. One of them appears to be quite similar to a Type 1b as shown in the 1891/1893 photographs (though it is hard to make out sufficient detail in existing images). The other two differ somewhat. All three are in Europe.

6.1• In the Gutenberg Museum, Mainz

Until relatively recently (at least 2015) a Type 1 Benton or Benton-style pantograph was on display at the Gutenberg Museum in Mainz, Germany. It was part of a larger display of important historical typesetting machines. This display has been removed and the machine is reported to be in storage.

Of the three unidentified Type 1 Benton-style machines, this machine most closely resembles an actual Type 1b Benton as sold in the 18902. However, nothing has ever been published about its provenance.

It seems to be shown only twice online (in one image and in a few seconds of a video). I do not have permission to reprint either of these here.

It appears in a flickr.com posting by Roberta Soriano (username: Roberta SDREA) from 2013. This photo shows it in the context of its display. (Soriano 2013) See: <https://www.flickr.com/photos/robertasoriano/8578507952/in/album-72157633=051931915/>

It also appears in a few seconds of a travel video on youtube by user “AFN Wiesbaden”. The brief pan across the display containing this machine starts at time 2:16 in the video. (AFN Wiesbaden 2015) See: https://www.youtube.com/watch?v=Gwp_y1d131s

I would be very interested in learning more of the origins and provenance of this machine. Also, if anyone has any photographs of it that they own and would be willing to share here, please let me know.

6.2• The Science Museum’s Object No. 1995-1516

The Science Museum (London) owns this machine. It is their Object Number 1995-1516 and has been on loan to the Type Archive. It has been in service with The Monotype Corporation Limited (formerly The Lanston Monotype Corporation Limited) prior to this. It is what I am calling here a “Type 1c” pantograph, but it is not yet clear if it was manufactured by Benton⁷³ or by someone else.

This machine is illustrated by two photographs and is described on a web page in the Science Museum’s online collections site. It is likely that these photographs were taken at some point after the start, in 2019, of a large-scale project to photograph the Museum’s collections, including their Monotype holdings. See (Brignell 2020).



Fig. 27: Science Mus. #1995–1516⁷²

However, the description of this machine by the Science Museum is confused. It gives two conflicting dates for the manufacture of this machine, for example: 1900 and 1907. It also calls the working punch-cutting pantograph at The Type Archive a “Benton-Waldo” (it is not; it is a Pierpont) and says that there is only one other such machine in the world (there are at least two: one at the Letterkunde Press in Antwerp and one with a private typefounder in Canada). See: (Science Museum Group 1995-1516), or visit this page directly at <https://collection.sciencemuseumgroup.org.uk/objects/co8693027/benton-waldo-punch-cutter-machines>

The date of 1907 is less plausible. Pierpont’s patent for his punchcutting pantograph dates to 1906 and, as the Science Museum’s page itself says, 1907 would have been when the Lanston Monotype Corp., Ltd. (UK) started to install Pierpont pantographs — not Bentons.

The date of 1900 is more plausible. This was the date at which the corpora-

⁷²From (Science Museum Group 1995-1516). These images are *not* licensed under the same terms as the rest of this document. It is copyright © by The Science Museum Group (UK) and is licensed by them under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License. This license is more restrictive than that of the rest of this document.

⁷³That is, either Benton, Waldo & Co. or ATF.

tion established their manufacturing plant at Salfords. But it is not yet clear whether this machine was manufactured by ATF and imported or manufactured in England or elsewhere and acquired by Monotype.

As a Type 1c machine, it differs in constructional details from the Type 1b Bentons shown in the photographs in *The Inland Printer*. See section 4.1, Type 1 Machine Dates, on page 18 for these. But, interestingly, it also differs from all published photographs of other Type 1c machines at Monotype. It is not one of the Type 1 machines shown in the three photographs in Slinn, Carter, and Southall's *History of the Monotype Corporation* (Slinn *et al.* 2014, 361–364, 368). Neither is it one of the three Type 1c machines shown in the 1925 film *A Monotype Composing Machine* (Monotype 1925). For a discussion of the history of the Type 1c machines at Monotype (UK) see section 5.3.2, [Exports → England] Lanston Monotype Corp. Ltd, on page 32.

Obviously a further investigation of this machine is in order — not only the physical machine itself but also any surviving documentation and potential oral history.

6.3• Tallone Editore

The Atelier Tipografico (typographic studio) of Alberto Tallone Editore⁷⁴ in Alignano, Italy has a Type 1d Benton-style pantograph.



Fig. 28: Type 1d, at Tallone, 2016⁷⁵

Like other Type 1 machines, it has its cutting spindle below the workpiece.⁷⁶ But unlike all of the photographs of Type 1b machines and the surviving Type 1c machine in England, the supporting frame of this machine is constructed

⁷⁴<https://www.talloneeditore.com/tallone/index.php/component/sppagebuilder/75-how-we-work>

⁷⁵Photograph copyright © by Patrick Goossens, Letter-kunde Press, Antwerp. License: Creative Commons Attribution-NonCommercial (BY-NC) 4.0 International. My thanks to Patrick for supplying this image.

⁷⁶You can see clearly the swing-away protective guard attached to the pantograph arm which would keep the operator from being sprayed with oil from the spindle.

like that of a Type 2 machine, with a table and base. All other Type 1 machines known to me have legs which go directly down to the floor.

This machine is shown in operation in a triptych of photographs posted to flickr.com by MEAT collettivo grafico. Its caption says “ Esecuzione in diretta di una matrice in ottone al pantografo da parte del sig. Saviolo, ex dipendente della Fonderia Nebiolo — Torino.” (“Live execution of a brass matrix on the pantograph by Mr. Saviolo, former employee of the Nebiolo Foundry - Turin.”) However, the workpiece which he is cutting is not a matrix. It is either a punch or a patrix. (MEAT 2012). These operational photos show clearly the spindle drive from behind and the relationship of the spindle below to the workpiece above. They also show the cylindrical workholding device with a newly cut punch or patrix in place.

Further information on this machine and its provenance would be greatly appreciated.

7• Surviving Benton Pantographs

The section here will cover just the vertical machines. For the other Benton pantographs, see section 12, [Benton Horizontal Pantographs](#), on page 67.

Eight ATF-manufactured Benton vertical pantographs are known to have survived. All are of “Type 2” (1899/1906 patent style): six Type 2a and two Type 2b.

A very few Type 1 pantographs of as-yet unknown manufacture have survived. Since it isn’t certain that they are genuine Bentons, they are discussed earlier, in section 6, [Surviving Type 1 Benton-Style Pantographs](#), on page 36.

7.1• About Benton Machine Numbers

Each surviving machine which has been checked for this has a unique number stamped on the major components of its pantograph mechanism and at least sometimes on its matrix holders.⁷⁷ At a technical level this is what might be called “match numbering,”⁷⁸ whereby parts which have been hand fitted together are given identical numbers so that they may be kept together.⁷⁹

This number has been taken to be the “machine number” of the machine in question. It was so used in the auction report for the 1993 auction of ATF’s machinery. Also, the records of the transportation of machines 61, 49, and 62 to Japan, fragments of which are reprinted in Rehak’s *Practical Typesetting* (Rehak 1993, 109), explicitly use the term “Machine #”. This usage is reasonable as this number is unique to each surviving machine and it is unlikely that any pantograph mechanism ever will be exchanged from one surviving machine to another.

However, this “Machine Number” is not a serial number. In *Practical Typesetting*, Rehak notes specifically that the early machine numbers from the Benton, Waldo & co. “day book” that he reproduces *are* “chronological” but that “those machines that still exist are numbered in the forties upward but are not chronological” (Rehak 1993, 107, 109).

⁷⁷This information is itself interesting because it means that the Benton vertical pantographs were not made with fully interchangeable parts. Parts for critical assemblies were hand fitted to each other and might not fit correctly in other instances of the machine (hence the need for match marking). This was not uncommon in industry in the period, despite the advanced degree of interchangeable manufacture then present. For example, both American and English Monotype molds were hand fitted at the factory and delivered as units which were not serviceable in the field.

⁷⁸Surprisingly, there does not seem to be a generally accepted term for this practice. It was most commonly done using a manufacturing serial number. For example, Hounshell, in his study of the development of interchangeable manufacture, discusses the move away from hand fitting at the Singer sewing machine company from the 1860s through the 1880s. He says only that the earlier hand fitting methods involved “marking all critical parts with the same serial number, hardening, and refitting parts with matching numbers” (Hounshell 1984, 91).

⁷⁹The numbers on machine 53 have been stamped by two different styles of punches. This suggests that it was repaired at some point and that number was stamped into the newly fitted part.

Neither can it be asserted that these machine numbers form a set of unique numbers across both Type 2 and Type 1 machines.

The photographs on the next page show Machine No. 53 at CircuitousRoot with the three locations in which machine numbers may appear indicated by red arrows. These are: the lower frame (where the four rods are joined into one), the quill frame, and the top frame (from which the pantograph mechanism is suspended). The lower frame has the machine number once. The quill frame has it twice.⁸⁰ The upper frame has the machine number three times. The Type 1b machine No. 99 has a slightly different pattern (see section 7.9 on page 58).

The author would very much like to receive photographic evidence of the machine numbers of Benton pantographs not yet identified in this way.⁸¹

⁸⁰Since writing this I have discovered that the number “53” is also stamped on the aperture for the quill.

⁸¹If possible, it would be good to have photographs which can be shared under a compatible Creative Commons license and included in future revisions of this census.

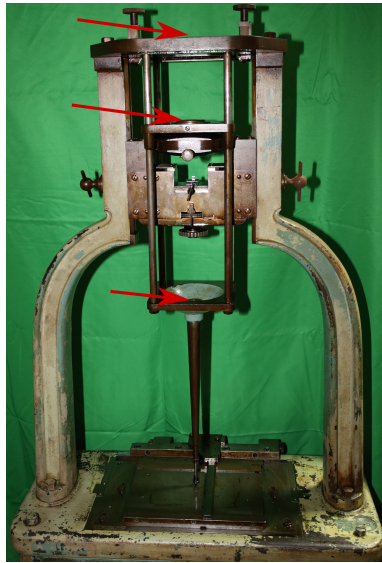


Fig. 29: #53, Machine Numbers

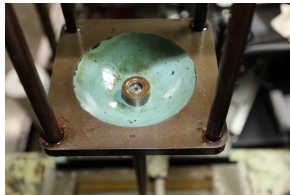


Fig. 30: Lower Frame

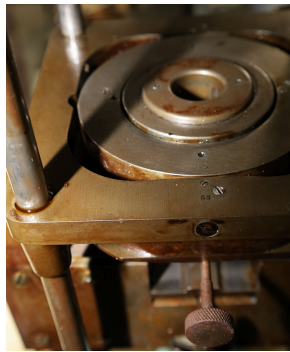


Fig. 31: Quill Frame

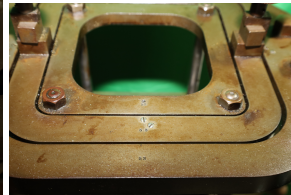


Fig. 32: Upper Frame



Fig. 33: One Time



Fig. 34: Two Times



Fig. 35: Three Times

7.2• Machine No. 48, Golgonooza

This is a Type 2a machine (the smaller model). It is presently (2023) at the Golgonooza Letter Foundry & Press⁸³ of Julia Ferrari and the late Dan Carr. It is likely that it is in operating condition.

It was purchased at the 1993 ATF auction by Dan Carr. Both (Walters 1994, 105) and (Willner 1993) note this as Machine No. 48, which was auction lot #34 and which sold for \$650.

There is one photograph of this machine which positively identifies it: the one taken by Rich Hopkins at the 1993 ATF auction (Hopkins 1994, 15). It is identifiable by the auction tag number on it, 34.

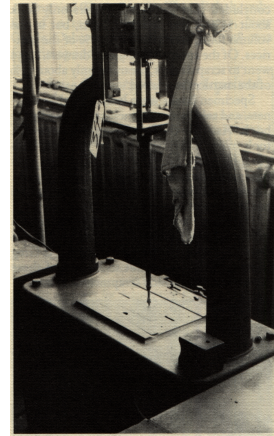


Fig. 36: #48 in 1993⁸²

Other photographs of this machine include:

- One taken by Hopkins a dozen years earlier (Hopkins 1981, 9). (The machine looks almost untouched between the two pictures.)
- One in the former Dale Guild's flickr photostream, showing the ATF Matrix Department just before the 1993 auction. <https://www.flickr.com/photos/47496314@N06/4579566999/>

⁸²Copyright © 1994 by Richard L. Hopkins. License: Creative Commons Attribution-NonCommercial 4.0 International.

⁸³ <http://golgonoozaletterfoundry.com/>

7.3 • Machine No. 49, Printing Museum, Tokyo

This is a Type 2a machine (the smaller model). It is presently (2023) preserved by and on display in The Printing Museum, Tokyo. Its inventory number⁸⁴ is 33364. It is illustrated on the museum's website at: <https://www.printing-museum.org/collection/looking/33364.php> (Printing Museum 2023).

As discussed earlier in section 5.1.4, page 27 on the second Tsukiji machine, Yuki has identified this as the second machine purchased by Tokyo Tsukiji Letterpress Factory from ATF. Their first machine had been purchased in 1921 (exported 1922) but was destroyed in the Great Kanto Earthquake in 1923. This second machine was purchased in 1922 but not delivered until 1924 (Yuki No. 31 2019).

Yuki's information on the history of these machines, when correlated with the information kept in a diary by ATF foreman John Bauer when delivering these machines,⁸⁵ indicates that this must be machine No. 49. This has been confirmed with photographic evidence by the Printing Museum, Tokyo. They have found the number "49" on the Matrix Jig of this machine.⁸⁶ While the matrix jig is a removable component, the machine numbers on other machines such as No. 55 (Antwerp) indicate that matrix jigs were numbered along with the rest of the machine. There is no doubt that this is Benton No. 49.

A matrix cutting slip for cutting "Medieval [/Celtic] Border" in 6pt on two machines, No. 55 and No. 49, survives in the ex-Dale Guild collection now at the Letter-kunde Press, Antwerp. It is dated 1918-05-16 and 1918-06-22. It would seem, therefore, that this machine was not made for the Tsukiji purchase in 1922 but was a machine which had been in service at ATF in at least 1918 (and of course probably earlier).

As noted previously, Yuki's account indicates that the Tokyo Tsukiji Letterpress Factory, which ceased business in 1938, sold this Benton in 1936 to 凸版印刷株式会社 (Toppan insatsu kabushiki gaisha, Toppan Printing Co., Ltd.) Toppan exists today as a Tokyo-based international printing technology firm. At some point this machine ceased to be used in production and it found its way to The Printing Museum.⁸⁷

This machine was included in 2012 in a survey of the "History of Japanese

⁸⁴More literally from their website, its "資料番号" (Shiryō bangō, document number).

⁸⁵See the discussion of *Bauer's Diary* in "Benton Pantograph Exports", section 5.1.2 on page 26 and (Rehak 1993, 107, Fig. 32 on p. 109).

⁸⁶NAKANISHI Yasuhito, curator of the Printing Museum, Tokyo, email to DMM on 2023-03-14.

⁸⁷The Museum's history page says that the Toppan Printing Archives were founded in 1987. Their website goes on to say that the Printing Museum itself was founded in 2000 and that the artefacts of the Toppan Printing Archives were transferred to it. See (Printing Museum 2020). The Printing Museum is located in Toppan's corporate headquarters building in Tokyo.

Industrial Technology” by the National Museum of Nature and Science, Tokyo. It is Document Number 108911001019 in that survey: “ベントン母型彫刻機.” [“Benton bokei chōkoku-ki,” “Benton matrix engraving machine”] (HJIT 2012). This survey confirms that this machine was manufactured by the American Type Founders Co.

7.4• Machine No. 50, Australia

This is a Type 2a machine, It is presently (2023) in the foundry of an Australian printer. The owner has confirmed that it is in perfect working order.⁸⁹

It was purchased in the 1993 ATF auction by Theo Rehak on behalf of this Australian printer. Both (Walters 1994, 105) and (Willner 1993) note it as Machine No. 50, which was lot #39 and which sold for \$700.

The machine has an ATF brass property tag number of 09017 and bears a stencilled number 30.



Fig. 37: #50, 2011⁸⁸



Fig. 38: BEM 50, Brass Tag



Fig. 39: BEM 50, Stencil

⁸⁸All photographs of BEM 50 are copyright by the owner of this machine and are licensed under the Creative Commons Attribution-NonCommercial 4.0 license. My thanks to the owner of this machine for a great deal of help in identifying and understanding it.

⁸⁹In correspondence with the author on 2023-02-04.

The machine numbers stamped on the machine in three locations confirm its identity. Note that at the “quill gimbal” level shown below the number is stamped at three locations, not just the two visible in the photograph. (The third location, on the aperture around where the quill goes, is not visible in the photograph. These locations on the machine are very difficult to photograph.)



Fig. 40: Upper Gimbal Fig. 41: Quill Gimbal Fig. 42: Wand Plate

(Walters 1994, 105) also notes that a “Benton Power Stand,” lot #35, was purchased with this machine for \$50. This power stand is shown in a photograph of the 1993 auction on the former Dale Guild Type Foundry flickr.com photostream at: <https://www.flickr.com/photos/47496314@N06/4579566999/>

The owner further said that about 15 years after the ATF auction he was able to acquire two Benton cutter grinders, one complete and one in “parts machine” condition.



Fig. 43: Cutter Grinder, Top



Fig. 44: Cutter Grinder, Side

The owner of this machine has very kindly supplied additional photographs of some of its details:

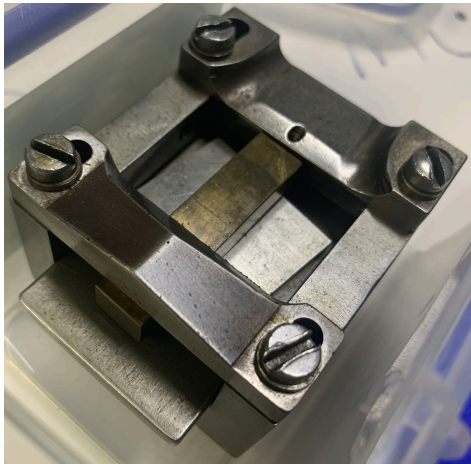


Fig. 45: Matrix Jig



Fig. 46: Power Input Connector



Fig. 47: Block of Quills



Fig. 48: A Single Quill

(Lest there be any confusion: the power input connector is the end of a rotary flexible shaft which supplies mechanical rotational power to the top of the quill. This isn't an electrical plug.)

7.5• Machine No. 53, CircuitousRoot

This is a Type 2a machine. It is presently (2023) at CircuitousRoot (the collection and workshop of the author of this census, Dr. David M. MacMillan). It is not now operational, but while it is missing parts, what remains is in good shape. Restorative conservation is underway.⁹¹

It was purchased by Gregory Jackson Walters at the 1993 ATF auction. Both (Walters 1994, 105) and (Willner 1993) note that it was lot #30 and that it sold for \$100. Walters further indicates that it was “missing a lot of parts.”

It was not used by Walters but was sold in the condition he received it⁹² to Dr. David M. MacMillan in 2021⁹³ for \$1,000.

No machine number was given in the ATF auction results for this machine, but examination of it shows that it is Machine No. 53.

It has a brass ATF property tag which reads “09015”. It is missing all other identification.

This machine has been assigned the identification code “BEM2a-53”⁹⁵ in the CircuitousRoot inventory.

It does not appear that this machine came to Walters with a Power Stand, but when he sold it to me he chose to include the Power Stand which originally came with Machine No. 99 (see below).

The machine came to me with one original ATF quill, with an ATF-ground cutter installed in it. Note that while all Benton quills should be interchangeable, there was a great mixing-up of quills at the 1993 auction. It is not clear that the ATF quill I received was one actually used in this machine or if cutter in this quill was ground for use with this machine. Walters also supplied with it two additional quills which were made for Theo Rehak by a machinist at a later date.



Fig. 49: #53, 2023⁹⁰



Fig. 50: #53, Property Tag⁹⁴

⁹⁰Photograph by DMM, taken 2023-01-16 in my Machine Shop (CircuitousRoot).

⁹¹You can follow my progress (or lack of progress) on this at:

<https://www.CircuitousRoot.com/artifice/letters/pantocut/benton/index.html>

⁹²On its 1993 pallet with its original Willner auction tag.

⁹³I posted the check to him on May 19, 2021. I collected the machine over the weekend from Friday, August 6 through Sunday August 8, 2021.

⁹⁴Photograph by DMM, taken 2023-01-25 in my Machine Shop (CircuitousRoot).

⁹⁵Benton Engraving Machine, Type 2a, No. 53.

The machine is missing its matrix holder, has no followers,⁹⁶ has only the standard 40pt expansion/condensation blocks, has no leverage bars, and has been stripped of some other parts and assemblies. Some of the large screws are not correct for the machine. It has been repainted at least once (probably twice). The last repainting, at ATF prior to the 1993 auction, was very badly done.⁹⁷ It will be an interesting challenge.

⁹⁶Further, the final follower which had been installed on it has been sheared off violently in the wand.

⁹⁷By the end in 1993, ATF standards had declined considerably since Benton's day.

7.6• Machine No. 55, Letter-kunde, Antwerp

This is a Type 2a machine. It is presently (2023) at the Letter-kunde Press of Patrick Goossens,⁹⁹ in Antwerp. It is fully operational.

This machine is the only surviving Benton vertical pantograph which did not come out of the 1993 ATF auction. (Walters 1994, 105) indicates that Theo Rehak [the Dale Guild] had “the only Benton in operating order” before the auction.¹⁰⁰ This is the machine which was at The Dale Guild and which was acquired by the Letter-kunde Press at the demise of that foundry.

Photographs taken by me in 2019¹⁰¹ show that it is Machine No. 55.

This machine also has a brass ATF property tag on it reading “09018”. It has the number “28” stencilled on it. A plate reading “BE CO.” (for Benton Engraving Company) was added when this machine was owned by The Dale Guild.

At least one of the matrix holders with this machine is also stamped “55”.

This machine is complete with its original Power Stand.



Fig. 51: #55, 2019⁹⁸

Since this is the ex-Dale Guild machine, it has been illustrated a number of times in the literature. Examples include:

- Patricia Cost’s blog for 2008-02-22, <https://morrisbenton.com/2008/02/22/the-no-55-benton-matrix-engraver/>
- Micah Currier’s short film *Disciplines & Protocols* (Currier N.D. [by 2016])
- At the Dale Guild, on that former foundry’s flickr.com photostream (still online as of 2023). Close up: <https://www.flickr.com/photos/47496314@N06/4552258250/>
This is the same photograph used in (Currier 2011).
- In context in the Dale Guild’s matrix engraving room: <https://www.flickr.com/photos/47496314@N06/4551617695/>
- A blog posting by Russell Maret on the cutting of Iohann Titling by Currier (Maret 2011). <http://russellmaret.blogspot.com/2011/02/>

⁹⁸Photographs by DMM, taken 2019-05-17 at the Letter-kunde Press, Antwerp. My thanks to Patrick Goossens both for preserving this machine and for so generously allowing access to it.

⁹⁹<https://www.letter-kunde.be/>

¹⁰⁰This does raise the interesting question of whether or not there were Benton vertical pantographs in *non*-operating order outside of ATF before the auction.

¹⁰¹When I had the great good fortune to be able to cut a mat on it under the direction of Ed Rayher.



Fig. 52: #55, 2019

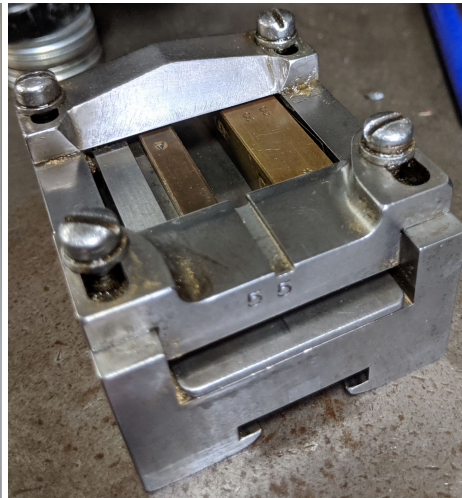


Fig. 53: #55, 2019

Here are further views of this machine.¹⁰² Note in particular the machine number, 55, stamped into the matrix holder in the photo above right. These views also show the “power stand” clearly.



Fig. 54: #55, 2019

¹⁰²All photos on this page taken by DMM at the Letter-kunde Press in 2019.

Here is a series of photos zooming in on the machine number (55) as it is stamped on the top gimbal (middle frame). It is probably stamped elsewhere on the machine, but when I was taking these photos with my phone I wasn't looking for it.



Fig. 55: #55, 2019, Top Gimbal



Fig. 56: Closer



Fig. 57: Machine No. 55

7.7• Machine No. 60 (or 63?), Swamp Press

This is a Type 2b machine (the larger model). It is presently (2023) at Swamp Press (prop. Ed Rayher) in Massachusetts. It is in commercial production and has been used to cut several notable contemporary faces, including Xenotype Cherokee. For the Swamp Press matrix engraving services, see:

<https://swamppress.com/benton-matrix-engraving.html>

It was purchased by Gregory Jackson Walters at the 1993 ATF auction on behalf of Ed Rayher. Both (Walters 1994, 105) and (Willner 1993) say that it is Machine No. 60 and that it was purchased for \$300. However, (Rayher 2014, back cover) says that it is No. 63 (with ATF property tag number 09020). Rayher says that Theo Rehak said that it was No. 63. He has examined the machine and can find no machine numbers stamped on it (but they may exist and be obscured by paint).

(Walters 1994, 105) say that this was lot #32 at the 1993 auction, but (Willner 1993) says it was lot #33. Ed has confirmed that 33 is the correct number (see his photograph of the auction tag, Fig. 59 below).

It has the number 23 stencilled on it (see Fig. 59, below, where it appears, faintly, just above the auction tag).

A photograph of this machine by Ed Rayher appears on the next page.

A black and white photograph of this machine at ATF in 1984, taken by Patricia Cost, was published in her book on the Bentons. The machine is identifiable by its unusual cruciform part joining the four upper pantograph arms with the wand. See (Cost 2011, 125).



Fig. 58: Brass Property Tag¹⁰³

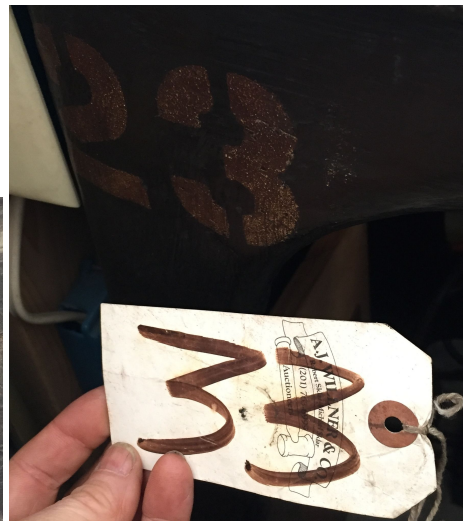


Fig. 59: Auction Tag & Stencil 23

¹⁰³Photographs by Ed Rayher (Swamp Press), used with his kind permission.

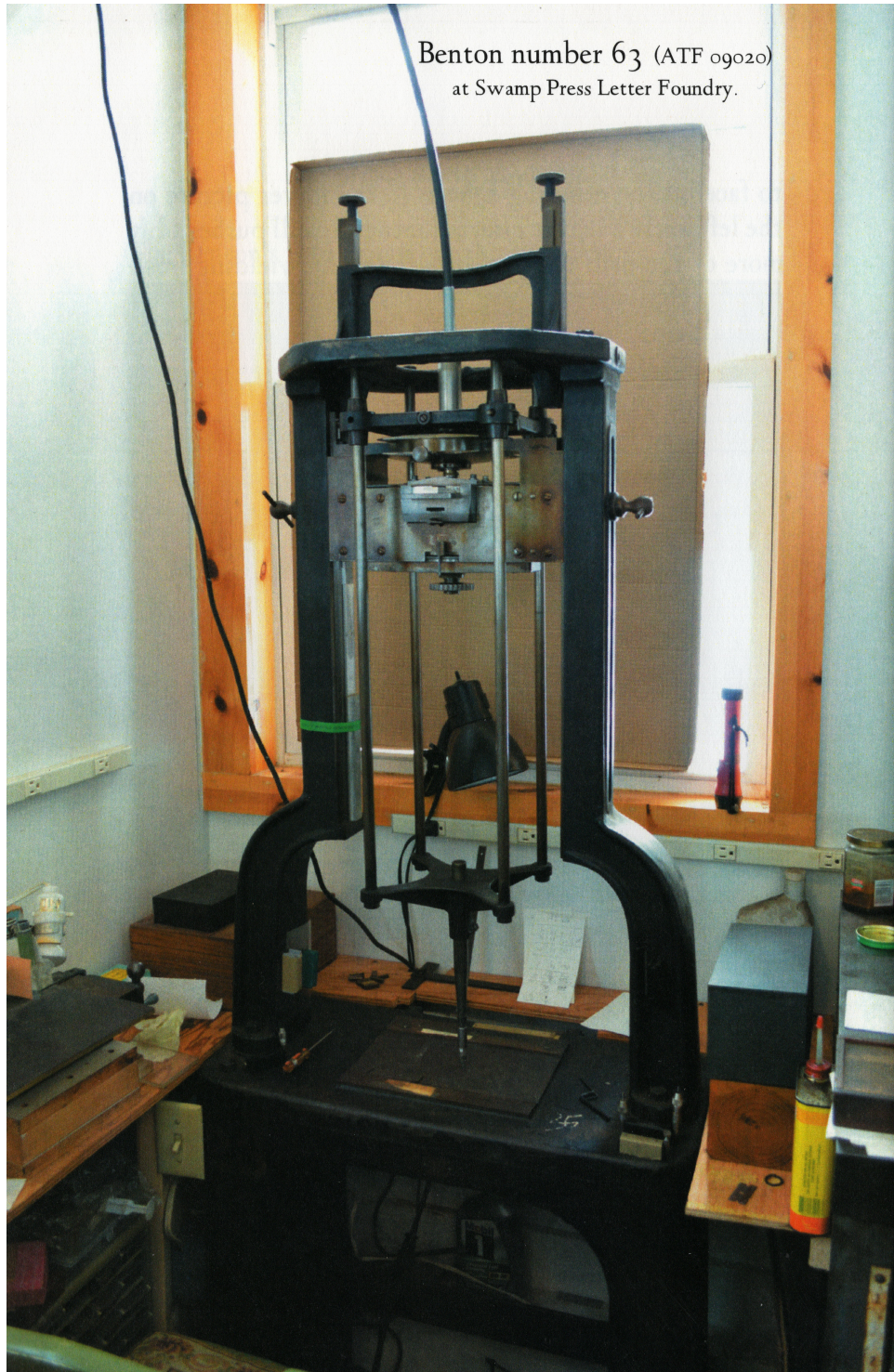


Fig. 60: The Type 2b Benton At Swamp Press¹⁰⁴

¹⁰⁴Photograph by Ed Rayher from "Swamp Press Turns Virtual Xenotype Cherokee Into Hot Lead Monotype" (Rayher 2014, back cover). Used with his kind permission.

7.8• Machine No. 62 (?), Sanseido

This machine may have taken the simplest path of all surviving Bentons. Relying again on the extraordinary research of Yuki Akari, (Yuki No. 31 2019), it appears that this machine was sold by ATF in 1922 to the Sanseido (三省堂) publishing company (which is now Sanseido Co., Ltd., Publishers).¹⁰⁵

It isn't entirely clear to me if it arrived before or after the Great Kanto Earthquake (September 1, 1923), but it was not destroyed and was set up for use in 1925. It is still owned by Sanseido, although it has been retired from service and is in their corporate museum.

This is a Type 2a machine (the smaller model).

Yuki also presents two particularly useful photographs of this machine. The first of these is an overall view of the machine. The second shows a close-up of the nameplate, which reads: AMERICAN TYPE FOUNDERS CO. You can't ask for better evidence than that. The machine as shown in this photo also bears a brass tag which appears to be a Sanseido property tag. (Yuki No. 31 2019).

Yuki's posting No. 31, with photographs of this machine confirming its manufacture by American Type Founders Co., is at: <https://dictionary.sanseido-publ.co.jp/column/benton31>

¹⁰⁵The Sanseido corporate website's history page says that they were founded as a bookstore and then began publishing. The publishing branch became a separate entity as Sanseido Co. Ltd. in 1915. They continue today as publishers under this name. See (Sanseido 2021). From the point of view of the present census, they are particularly important as the publishers of Yuki's columns on the Benton and her book derived from these columns. See (Yuki 2021a).

7.9• Machine No. 99, Walters / Printing Stewards

This is a Type 2b machine. It is presently (2023) in the Gregory Jackson Walters Typographic Archive of The Printing Stewards.¹⁰⁷ It is complete (except for its power stand) but has not been operated since before the 1993 auction. It has the highest known ATF Benton machine number.

It was purchased by Gregory Jackson Walters at the 1993 ATF auction. Both (Walters 1994, 105) and (Willner 1993) say that it is Machine No. 99. I have confirmed this by visual inspection and photographic documentation.¹⁰⁸

(Walters 1994, 105) says that this was lot #21 at the auction, but the auction results in (Willner 1993) say that it was lot #32. The machine itself still bears its original Willner auction tag with the number 32.

(Walters 1994, 105) says he purchased it for \$300. The number in (Willner 1993) is illegible.

The machine has a brass ATF property tag numbered 09021. It has “22” stencilled on its base.

This machine is now Accession/Inventory No. 91 of The Printing Stewards.

As acquired by Walters in 1993 this machine came with a power stand. When he sold Machine No. 53 to MacMillan in 2021, he chose to include this power stand with No. 53. Machine No. 99 is otherwise complete, with a single matrix holder and at least one quill.



Fig. 61: #99, 2021¹⁰⁶



Fig. 62: #99, Stencil & Brass Tag¹⁰⁹

¹⁰⁶Photograph by DMM, taken 2021-08-06 at the foundry of Gregory Jackson Walters. The machine behind No. 99 is No. 53.

¹⁰⁷<https://printingstewards.org/>

¹⁰⁸One careful reviewer has asked how we can be certain that this is machine 99 rather than 66. While absolute certainty is not possible, several things make any identification other than 99 exceedingly unlikely. The most important piece of evidence is the auction record. The auctioneers were not reading these tiny numbers on the machine. They were simply told by ATF that it was No. 99. So ATF believed that the machine marked 99/66 was 99. Further, there were never many Type 2b (large) Bentons. Only two are attested photographically. Matrix cutting slips for machine 99 survive in the ex-Dale Guild archive at the Letter-kunde Press in Antwerp. At least one of these is for a size (96pt) not possible on Type 1a machines. The orientation of the stamped numbers in this machine, interpreted as 99, also corresponds to that of every other known machine. There is no reason to believe that this is not machine 99.

¹⁰⁹Photograph by DMM, taken 2021-09-06 at the foundry of Gregory Jackson Walters.

Here is a photograph of the upper frame of this machine, showing clearly how it differs from a Type 2a. At right below is a close-up of the machine number (99) as it appears on the upper frame. Unlike the Type 2a Machine No. 53, the numbers here appear only on the inner two frames, not on the outer frame.

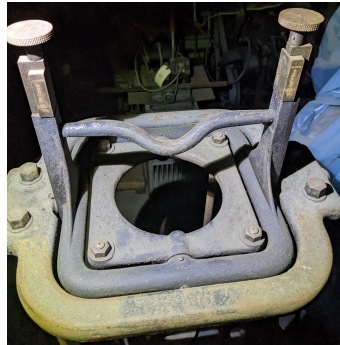


Fig. 63: No. 99, Upper Frame



Fig. 64: Upper Frame Machine Numbers

Here is a general view of the upper part of the machine, showing the quill frame.¹¹⁰ The machine number appears only once in this location on this machine (as shown below right).



Fig. 65: No. 99, General View, Upper Part



Fig. 66: Quill Frame Machine Numbers

¹¹⁰The machine does have a matrix holder. I had removed it temporarily when I took this photo.

I was unable to find a machine number on the “lower” frame (where the four rods are joined into one). It may be there.

7.10• Table of ATF Identification Information

Here is a table of the identification information on each of the surviving Benton vertical pantographs, presented in case any patterns should emerge. Unknown or nonexistent information has been omitted.

No.	Type	Tag	Stencil	1993 Lot #	Now At
48	2a			34	Golgonooza
49	2a				Printing Museum (Tokyo)
50	2a	09017	30	39	Australia
53	2a	09015		30	CircuitousRoot
55	2a	09018	28		Letter-kunde (Antwerp)
60/63	2b	09020	23	33	Swamp Press
62?	2a				Sanseido (Tokyo)
99	2b	09021	22	32	Printing Stewards/GJW

8• Rumored Surviving Benton Pantographs

Caution: There has been a tendency in type history to call any pantograph used for typemaking a “Benton” pantograph even when it is a machine of some other make. This greatly complicates the research process.

Walters’ Comment

(Walters 1994, 105) said that Theo Rehak (the Dale Guild) had “the only Benton in operating order” before the 1993 ATF auction. This begs the question: were there any other Benton pantographs outside of ATF in non-operating order? I am not aware of any, but the possibility of what the antique automobile collectors call a “barn find” remains.

Dan X. Solo

In the American Typecasting Fellowship *Newsletter*, No. 5 (May 1980) there appears a brief note about an “impromptu West-Coast gathering of typecasting enthusiasts.” It reports that Dan X. Solo (Solotype and many Dover publications on type) “managed to acquire a Benton pantograph from England” (p. 4). While this is not impossible, it is likely that this is an instance of every typographical pantograph being called a “Benton.”¹¹¹

¹¹¹Also, the son of the late Dan X. Solo has been attempting to put his father’s materials in good hands. A friend of mine with a very deep knowledge of matrices and typecasting has acquired some of these materials. In response to a query, my friend indicated that no sign of any pantograph has come to his attention.

9• Other Copies of Benton’s Pantographs

The most numerous surviving copies of the Benton vertical pantograph, the Tsugami and Fujikoshi machines, are discussed in section 14 on page 76 and in section 5.1 on page 25.

The derivative of the Benton in China is discussed in section 15 on page 91.

It is not clear at this time whether the “Type 1c” machines of the English Monotype firm were actual Bentons or derivatives. These are discussed in section 5.3.2 on page 32 and the surviving machine is discussed in section 6.2 on page 37.

9.1• Copies In the USA

To the best of my knowledge, the Benton vertical pantographs were never copied directly in the United States. However, more research needs to be done in this area. There is a poorly documented period between the merging of Benton, Waldo & Co. into ATF in 1892¹¹² and the development of in-house pantographs at Mergenthaler Linotype and the English Monotype firm (which maintained strong ties to the Lanston Monotype Machine Company). Benton’s 1885 patent did not expire until 1902.

9.2• Copies In Germany

Wilkes, in *Das Schriftgießen* reproduces a photograph of the engraving room of a German typefoundry before 1914.¹¹³ It shows about a dozen pantographs which look very much like Type 1b Bentons. But Wilkes also says that the Stempel foundry “hat die Benton-Waldo-Maschinen im Laufe vieler Jahre modifiziert und weiterentwickelt” (has modified and further developed the Benton-Waldo machines over the course of many years¹¹⁴) and then in 1920 went on to completely re-engineer the machine. This suggests that the machines at Stempel prior to 1920 were either actual US-manufactured Benton Type 1b pantographs or German-manufactured direct copies of Type 1b machines (in both cases modified by Stempel). (Wilkes 1990, 56, fig. 60 on p. 58) At present there isn’t sufficient information to know which is the case.

¹¹²Rehak says that ATF required Benton “to recover all B&W devices leased to competitor firms, mainly Linotype and Monotype” and that this was “eventually accomplished” (Rehak 1993, 105).

¹¹³The photograph is from the Archive D. Stempel at the Technische Hochschule Darmstadt and so is likely that of the Stempel foundry, but this is not completely certain from the caption and attribution.

¹¹⁴Translation by Google Translate

10• Known Lost Benton Vertical Pantographs

We have at least some information on several Benton vertical pantographs which have been lost.

10.1• Known Lost Type 1 Machines

In *Practical Typesetting*, Theo Rehak reprints a single page from a Benton, Waldo & Co. “Day Book”¹¹⁵ (lost by 1993) which reports on early pantograph sales and/or rentals.¹¹⁶ The machines are given machine numbers and these start at 3. Rehak says of these numbers that they are still “chronological” (by which I presume he means serial numbers) in contrast to the numbering of the surviving machines which are not chronological. (Rehak 1993, 107, 109)

This is interesting because it suggests that very few machines were in use internally at Benton, Waldo & Co. in the period from 1884 through the first recorded sale in 1889.

Here is the information from this day book page:

Date.	No.	Called	Purchaser	Price
Feb. 13, 1889	3	Benton Punch Engraving Machine	Mergenthaler Printing Co., Brooklyn, NY	\$4,500.00
May 1, 1889	4	Punch Engraving Machine	Minneapolis Electro Matrix Co.	\$4,900.00
Jun. 29, 1889	6	Punch Engraving Machine	Minneapolis Electro Matrix Co. ¹¹⁷	\$2,000.00
Feb. 15, 1890	8	Punch Engraving Machine	Linotype Company, Ltd., Manchester, England	\$5,000.00
Feb. 15, 1890	9	Punch Engraving Machine	Linotype Company, Ltd., Manchester, England	\$3,500.00
May 19, 1890	10	Benton Engraving Machine	Rogers Typographic Co., Cleveland, Ohio	\$5,000.00

Patricia Cost transcribes the text of a letter from the Lanston Type-Machine Co. (predecessor of the Lanston Monotype Machine Company) to Benton, Waldo & Co. praising the Benton pantograph for use in punch cutting. This letter is dated November 3, 1890 and refers to a machine delivered “last August” (Cost 2011, 69). Presumably this is August of 1890 because no delivery to Lanston appears in the Benton, Waldo daybook information (see above) for August 1889.

10.2• Known Lost Type 2 Machines

Two of the four machines shipped to Japan have been lost. These are the machine at the National Bureau of Printing (1912) and the first machine at Tsukiji (1921, probably No. 61).

See section 5.1, [The Benton Vertical Pantograph In Japan](#), on page 25 for more information.

A matrix cutting slips for machine No. 30¹¹⁸ survives in the ex-Dale Guild

¹¹⁵But note that the page reproduced is a typescript, not a handwritten entry page from a day book.

¹¹⁶The price of Machine No. 4 is noted specifically as a “rental price.” No indication is given with the other machines as to whether they were sold or rented.

¹¹⁷Machine sent to Ames Manufacturing co., Chicopee, Mass.

¹¹⁸For cutting Bradley Designs at 30pt, finished 1905-04-26.

materials now at the Letter-kunde Press in Antwerp. This machine has been lost.

11• Lost Probable Non-Bentons

As noted earlier, there has been a tendency even among the otherwise very well informed to call any typographical pantograph by any maker, whether vertical or horizontal, a “Benton.” This has been the case not only in the understandable situations where the machine in question was a close copy (such as the Tsugami), but also when the machine in question had nothing at all to do with Benton’s design. This has naturally led to false sightings.

At Stephenson, Blake

Roy Millington reported that at some point probably in the 1890s the English typefounding firm Stephenson, Blake installed a “Benton-Waldo” pantograph. (Millington 2002, 81–82). But he gives no further details and does not cite any sources for this information.¹¹⁹ Against this we do have evidence that in 1906 Stephenson, Blake purchased a pantograph constructed by Charles H. Schokmiller, of St. Louis. It is likely that this S-B pantograph was a Schokmiller, not a Benton.

For a discussion of this pantograph see (CircuitousRoot “Schokmiller” 2022). The underlying source material comes from an address by Nicholas J. Werner (Werner 1931) / (Werner 1941).

¹¹⁹There are also errors in description of Benton’s pantograph. He says that it was similar to Leavenworth’s horizontal pantograph for wood type and that by 1885 Benton had modified it to cut matrices directly. Neither of these things is true. On the other hand, the Schokmiller pantograph which was sold to Stephenson, Blake *was* a horizontal machine.

12• Benton Horizontal Pantographs

12.1• The 1899 Tracing Apparatus (Delineator)

This machine probably existed in only a single instance, which does not survive. It was patented by Benton in US patent 790,172, “Tracing Apparatus”, filed in 1899 and issued in 1905 (Benton 1905). It is known reliably from only one other contemporary source, a 1909 article in *American Machinist* describing “Modern Automatic Type Making Methods” (Kaup 1909). It is also mentioned in a less reliable source, Bullen’s 1922 article on Benton (Bullen 1922, 63–64).

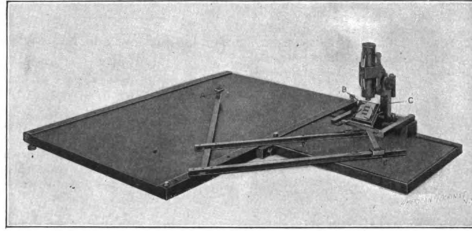


Fig. 67: Tracing Apparatus¹²⁰

It was a horizontal four-bar¹²¹ pantograph intended for enlarging to produce large working drawings. It was ingeniously adapted to allow the optical tracing of existing types.

Cost records an important piece of ATF oral history, via a personal communication with Theo Rehak, to the effect that after the death of Morris Fuller Benton the use of this pantograph at ATF ceased (Cost 2011, 121).

This is the machine that Theo Rehak calls the “Benton Delineator.” As Theo is the primary repository of knowledge of ATF internal practices, perhaps this is the best name for it. I have found it difficult, however, to discover this name in the admittedly scanty published literature.

Patricia Cost calls it the “delineating machine” (Cost 2011, 97), but in this she must be relying upon Rehak and Bullen.

Bullen did call this machine the “Benton Delineator” and “Benton’s Delineating Apparatus” in his 1922 article on Benton (Bullen 1922, 63). But Bullen is a highly unreliable source who simply made things up. This same 1922 article contains his entirely fictitious story of the origin of punch cutting in steel on Benton’s first vertical pantograph. Sadly, this highly influential article is useless for scholarship. Nothing in it can be taken to be true without independent confirmation.

Other than in Bullen, this machine was not called a “delineator” in the contemporary literature. In (Kaup 1909), for example, the term “delineating” is applied both to this machine and to the ATF wax plate pantographs. That is to say, when Kaup visited ATF in 1909 and the process of typesetting was

¹²⁰From (Kaup 1909, 1042). Public domain. This is the only known photographic image of the 1899/1904 patent Tracing Apparatus.

¹²¹Implemented with five bars.

described to him by someone at ATF, “delineating” was just a term for the operation of two kinds of tracing pantographs. It was not a part of the name of this machine specifically.

So at least for the purposes of this Census, it seems best to avoid this term and stick to the somewhat less elegant term known in the published literature (its patent) to have been employed by Benton: “Tracing Apparatus.”

As noted, all traces of this machine except the patent, Kaup’s 1909 article, Bullen’s unreliable 1922 account, and Cost’s recording of ATF oral history, are lost.

12.2• Modified Machines and the Adcut Machine

Rehak says that:

Benton also built and enhanced a small number of pantograph engraving machines, fitting them with his quill and cutting tool assemblies, which enabled them to produce engravings with the same precision as the other machines. All have been scrapped, save one, the “Ad-cut” machine. (Rehak 1993, 107)

I had always interpreted this as meaning that Benton took various commercial pantographs and modified them to accept his quills. I’m no longer certain of that, because I cannot determine what commercial machine might have served as the base for the Adcut machine.

The adcut machine was lot 41 at the 1993 ATF auction. It was described as “BENTON HORIZONTAL ADCUT ENGRAVING MACHINE #5” and sold to Theo Rehak for \$300 (Willner 1993). It is not clear if the machine number, #5, is in the same set as the machine numbers of the vertical pantographs. It may be, as these machine numbers are not chronological serial numbers.



Fig. 68: The Adcut Machine¹²²

This machine was at The Dale Guild and is now at the Letter-kunde Press of Patrick Goossens, in Belgium. It is of massive construction. It has the number “20” stencilled onto it. On the left side of the table a number, “109” has been cast into the table but painted over.

Until 2021 it had not seemed that any documentation concerning the Adcut machine had survived. However, in that year while the Printing Stewards, Inc. were consolidating the materials of the late Gregory Jackson Walters into a safe location I noticed and identified a letter-sized envelope from ATF labeled “Records of Adcut Machine / March 1921”.¹²³ This envelope contained handwritten notes dated to 1921 concerning the setup of the Adcut machine. However, it also contained a single sheet of notes, dated March 28, 1930, entitled “New Adcut Machine #1 Tests”. Linn Boyd Benton was alive and working at ATF at this time (he died in 1932). This would seem to indicate that there had once been at least two “Adcut” machines.

A matrix cutting slip for the Adcut machine¹²⁴ survives in the ex-Dale Guild materials now at the Letter-kunde Press in Antwerp. This has not yet been published.

¹²²Photograph by DMM, taken May 17, 2021 at the Letter-kunde Press of Patrick Goossens in Antwerp, Belgium. My thanks to Patrick. The matrix holder sitting on the machine is not for the Adcut pantograph; it is for Benton No. 55, which is just to the left. A Benton cutter grinder (with a green base pedestal) is visible just beyond the Adcut machine. It is for both the Adcut and No. 55.

¹²³These records are now a part of the Gregory Jackson Walters Typographic Archive of The Printing Stewards, Inc. I have scanned them, but they have not yet been published (ATF 1921).

¹²⁴For cutting the Red Cross Outline, character C79 of ATF Handy Pack #6, at 60 pt.

12.3• Wax Plate Pantographs

These were conventional horizontal four-bar pantographs which were adapted to scratch through a wax coating on a plate which could then be electroformed to create a working pattern. Similar methods were used at the English Monotype plant and in other type foundries and punch and matrix production companies. They are described and illustrated in Kaup's article on

"Modern Automatic Type Making Methods" (Kaup 1909, 1042). They are shown in the introductory matter in the 1912 and 1923 ATF specimen books.

It is only an assumption that these machines were created by Benton. We have no actual evidence, and they are similar to other suspended drafting pantographs of the period. But Benton was the master of pantographs at ATF and these were a part of the entire process of typemaking that he refined for ATF, so it is not unreasonable to associate them with him.

None are known to have survived.

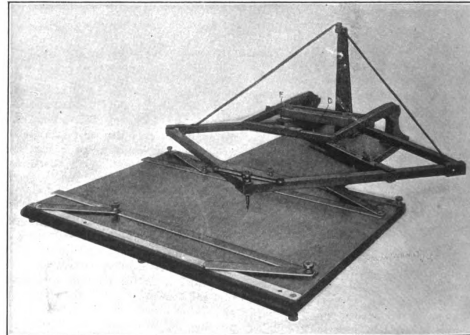


Fig. 69: Wax Plate Pantograph¹²⁵

¹²⁵From (Kaup 1909, 1042). Public domain.

13• Benton Cutter Grinders

13.1• About Benton's Cutter Grinders

The most important auxiliary machine for a pantographic engraving machine is its cutter grinder. The cutter grinder developed by Benton was unique.

Benton actually developed two cutter grinders, each quite different from the other. The first was that of his US patent 422,874, filed in 1888 and issued in 1890 (Benton 1890). No further information about it exists and none are known to have survived.

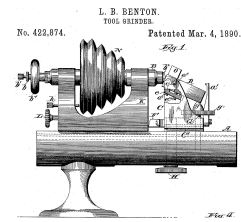


Fig. 70: 1888¹²⁶

The second was that of his US patent 774,030, filed in 1900 and issued in 1904 (Benton 1904). It is a much more sophisticated design. This is the cutter grinder now associated with the use of both the Benton vertical engraving machines and the horizontal Adcut machine. I'll refer to it here as “the” Benton cutter grinder.

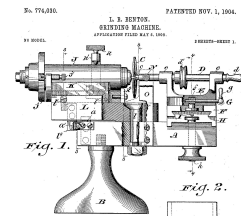


Fig. 71: 1900¹²⁷

Here are two views of the ex-Dale Guild machine now at the Letter-kunde Press of Patrick Goossens in Antwerp.¹²⁸

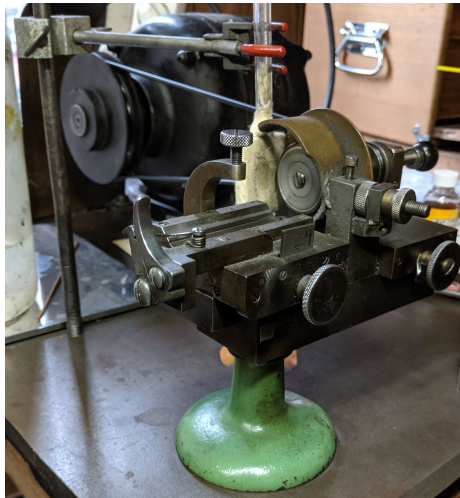


Fig. 72: Benton Grinder, No Quill

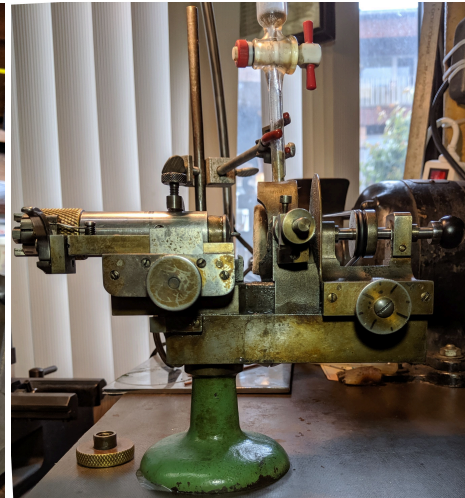


Fig. 73: Benton Grinder, with Quill

¹²⁶From (US Patent 422,874 (1890)). Public domain.

¹²⁷From (US Patent 774,030 (1904)). Public domain.

¹²⁸Photographs by DMM, taken 2019-05-17 and 2019-05-25.

13.2• Cutter Grinders at the 1993 ATF Auction

Four Benton cutter grinders were sold at the 1993 ATF auction. Here are the auction results, from (Willner 1993, 1):

Lot	Called	Purchaser	Price
31	BENCH-CUTTER/GRINDER	127 [unidentified]	\$50
36	CUTTER GRINDER	9 [Theo Rehak]	\$0 ¹²⁹
38	CUTTER GRINDER	9 [Theo Rehak]	\$0
40	CUTTER GRINDER	8 [Dan Carr]	\$100.00

I am unaware of what became of lot 31 of the 1993 auction or who buyer 127 was. This buyer number does not appear elsewhere in (Willner 1993)¹³⁰

13.3• Known Benton Cutter Grinders

This list includes not only ATF-manufactured Benton cutter grinders but also Japanese-manufactured copies (presumably, but not yet certainly, made by Tsugami).

13.3.1• Swamp Press

One surviving Benton cutter grinder is at Swamp Press (Ed Rayher). He has an excellent video on its use on [his youtube channel](#) at:

<https://www.youtube.com/watch?v=lp8W4LR1Bus>

I do not know the provenance of this machine.

13.3.2• Letter-kunde Press

Another is at the Letter-kunde Press of Patrick Goossens in Antwerp, Belgium. This is an ex-Dale Guild machine which might be one of the two purchased by Theo Rehak at the 1993 auction.

It is shown briefly in Micah Currier's short film *Disciplines & Protocols* (Currier N.D. [by 2016])

13.3.3• Golgonooza Letter Foundry & Press

It is likely that the one purchased by Dan Carr remains with Benton No. 48 at Golgonooza Letter Foundry & Press.

¹²⁹The auction results show \$0.00 for lots 36 and 38. This cannot be correct. (Walters 1994, 106) says that Theo Rehak purchased both of these lots for a total of \$150.00.

¹³⁰But this copy of the 1993 auction results is missing one page.

13.3.4• Australia

Two Benton cutter-grinders survive with Machine No. 50 in Australia. One is fully operable, the other is in “parts machine” condition. Both were acquired about 15 years after the owner acquired this Benton.¹³¹

(See section 7.4, Machine No. 50, Australia, on page 47 for photographs of this device.)

13.4• Known Copies of Benton Cutter Grinders

Some number of Benton or Benton-style cutter grinders survive in Japan. I have no information on whether they are actual ATF-manufactured Benton cutter grinders or (more likely) Japanese-made copies (probably by Tsugami).

13.4.1• Chiba University Engineering Department Museum

Possibly as many as two Benton-style cutter grinders are preserved in the “Old Collections Room” of the Faculty of Engineering at Chiba University. The uncertainty over the number of cutter grinders is due to the fact that the illustration of the second of them on the web page describing this collection is not of a cutter grinder but is a repetition of an earlier photograph of a cutter inspection microscope. The uncertainty over the status of this collection is due to the fact that their website was last updated in 2007 and as of 2023 I can find no other information about it online. It is not clear if these are actual ATF Benton cutter grinders (unlikely) or Japanese-manufactured copies (presumably by Tsugami, which is likely).

The first of these cutter grinders is illustrated in the “Chiba University Engineering Digital Museum” website at https://www.f-eng.chiba-u.jp/dm/ocr/index_pr.htm (Chiba 2007).

This collection also houses a Tsugami pantograph. See section 14.4.3, Chiba University Engineering Department Museum, page 81 for further discussion.

13.4.2• Motoya Print Museum

A Benton-style cutter grinder (probably by Tsugami) is on display at the Motoya [モトヤ] Co., Ltd. Print Museum [活字資料館, Katsuji shiryōkan] in Osaka.

A photograph of it, with quill installed, appears on the blog posting “モトヤ活字資料館見学会(第3回文字る会).” [“Motoya katsuji shiryōkan kengaku-kai (dai 3-kai mojiru-kai),” “Tour of the Motoya Type Museum (3rd Letter Meeting).” (Nishio 2012).

¹³¹Personal communication via email on 2023-02-04.

13.4.3 • Sasaki Printing and Publishing Museum

There is a Benton-style cutter grinder on the table next to the Tsugami pantograph at this museum.

See section 14.4.7, Sasaki Printing and Publishing Museum, on page 87 for more information.

In particular, it is shown on a photograph on the museum's Facebook account, dated 2011-10-03 (Sasaki 2011). It is also shown in the Google maps Street View "Virtual Tour" of the museum as linked on the museum's website:

<https://www.katsujikan.jp/index.html>

14• Tsugami and Fujikoshi Pantographs

Some later typographical pantographs were based on Benton's vertical machines. An example of such a machine would be the one developed by Frank Hinman Pierpont for the English Monotype firm.

But these were inspired by Benton's work; they were not close copies. The primary example of which I am aware of a machine which was very closely based on a Benton vertical pantograph is the one manufactured by the Tsugami company¹³² in Japan from 1949 through at least the 1970s. This was directly reverse-engineered from a Type 2a Benton vertical pantograph. The Fujikoshi firm¹³³ also made some number of machines as a result of the same reverse engineering project.

CAUTION:

These machines were made in Japan and survive in Japan, Taiwan, and South Korea. I can read none of the languages of these countries and am here relying upon Google Translate. To the native speakers of these languages, I apologize for the errors that I must certainly be making. All readers are cautioned that the information here should be treated with care and independently confirmed before relying upon it. I would greatly appreciate corrections of any errors from native or expert speakers of these languages.

14.1• Origins of the Tsugami Pantograph

The origins of the Tsugami pantograph are discussed in some detail in several of Yuki's columns, including (Yuki No. 54 2020), (Yuki No. 55 2020), and (Yuki No. 52 2020).

I will not attempt to summarize them in detail here because I do not want to introduce mistakes into this history. The original columns are available online

¹³²The Tsugami Corporation still exists as an important precision engineering and instrument firm in Japan. Their corporate website's history page indicates that they were founded in 1928 as Tsugami Mfg., Co., Ltd. While they did offer stock on Japanese exchanges in 1949 (the same year as they introduced their pantograph), they did not change their corporate name to the Tsugami Corporation until 1970 (at which point they were still offering pantographs for sale. I'll refer to them here by their earlier name or simply as Tsugami. See: (Tsugami 2015).

¹³³This company also still exists, as a Japan-based multinational machinery manufacturer, the Nachi-Fujikoshi Corporation. The history pages on its corporate website (English language version) say that it was founded in 1928 as Fujikoshi Steel Industry Co., Ltd. It adopted "Nachi" as a trademark in 1929, but did not formally rename itself the Nachi-Fujikoshi Corporation until 1963. Since the pantographs discussed here were introduced in 1949, I'll use the name this company had then, "Fujikoshi." Note, though, that it is possible that their pantographs might bear the "Nachi" brand (I have yet to see a photograph of one). See (Nachi-Fujikoshi 2021a), (Nachi-Fujikoshi 2021b), (Nachi-Fujikoshi 2021c), and (Nachi-Fujikoshi 2021d).

and may be read with the help of machine translation if, like me, you do not read Japanese.

Very briefly, the engineering process began in 1948 and was conducted by the Tsugami company. They based their design specifically on the Type 2b Benton pantograph at Sanseido Publishing, but they took into account the needs of Japanese character development. The first machines were delivered for production in 1949. Yuki's column 55 reproduces a photograph from September 20, 1949 showing the first two machines along with some of the executive team and others involved in the project.

A blog posting on the Robundo publishing site, (Robundo 2013), has additional information about the origins of the Tsugami. It transcribes the results of a meeting in which Katashio Jiro¹³⁴, president of Robundo, had this to say about the origins of the Tsugami:

大日本印刷機械部と津上製作所の技術者たちは、解体することなく採寸・スケッチして、そこから模倣国産機をつくったわけですから、日本の工業技術力は、敗戦直後とはいえ高かったわけです

Dainippon'insatsu kikai-bu to Tsu-jō seisakusho no
gijutsu-sha-tachi wa, kaitai suru koto naku saisun suketchi shite,
soko kara mohō kokusan-ki o tsukutta wakedesukara, Nihon no kō-
gyō gijutsu-ryoku wa, haisen chokugo to wa ie takakatta
wakedesu¹³⁵

Engineers from the Dai Nippon Printing Machinery Department and Tsugami Seisakusho took measurements and sketched the machines without dismantling them, and then used them to create domestically produced machines that imitated them.

If this is the case, it is very interesting that they did not dismantle the original Benton pantograph.

The Tsugami was offered for sale until at least the 1970s. Yuki's column 52 reprints the cover of a 1971 sales brochure. (Yuki No. 52 2020).

It is possible that there was more than one variation of the Tsugami machine. The sales brochure from 1971 refers to a matrix engraving machine "T-TME". The Tsugami instruction manual shown in (Yuki No. 57 2020) is for a machine "T-PTP". Until someone who knows Japanese can review this material, though, this must remain a hypothesis.

14.2 • Origins of the Fujikoshi Pantograph

Much less information is available about the Fujikoshi pantograph.

¹³⁴This Japanese name is presented in the traditional order. Katashio is the family name.

¹³⁵Translation by Google Translate.

Yuki documents its introduction in 1949 and reprints an un-illustrated sales brochure (Yuki No. 56 2020). In another column, she says that it was cheaper than the Tsugami, but that its accuracy was inferior (Yuki No. 58 2020).

I have not been able to discover a published photograph of a Fujikoshi machine.

14.3 • Tsugami and Fujikoshi Production Quantities

Several Japanese firms involved in printing, matrix manufacturing (as a business in its own right), and type composing machinery manufacturing employed substantial numbers of machines. We have figures for a few:

The Motoya Print Museum website says that at that company's peak of matrix production in 1955 (Showa 30) they had installed "more than 20" Tsugami engraving machines. See (Motoya 2009) or view it directly at <https://www.motoya.co.jp/business/katsuji.html>

(Yuki No. 58 2020). reports that at its peak Iwata had about 20 Tsugami machines installed in-house and that it had at its disposal the outsourced capabilities of 30 more.

Yuki reports that Nippon Typewriter (日本タイプライタ, Nihon taipuraita) at one time had 50 Benton-style engraving machines (Yuki No. 58 2020).

Yuki reports that Tokyo Kikei Seisakusho (東京機械製作所, Tōkyōkikai-seisakusho; Tokyo Machine Works) at one time had 50 Benton-style engraving machines (Yuki No. 58 2020).

At a minimum this gives 90 machines (assuming that Iwata's outsourced machines were at these other firms), but (assuming they were elsewhere) this gives a figure of 120. This figure does not include smaller firms such as Yokohama Seikoshō (「横浜精工所」; see section 14.6.1 on Agata Seisakusho).

Even with these highly incomplete figures, it is clear that there were many more Tsugami and/or Fujikoshi pantographs made than US-manufactured Bentons.

14.4• Surviving Tsugami Pantographs

This section identifies those surviving Tsugami pantographic engraving machines for which there is recent evidence of their survival.

Please note, once again, that I do not read Japanese, Chinese, or Korean. I'm relying heavily on Google Translate. There are probably errors here in my handling of languages other than English

I apologize that I do not have permission to post any photographs of these machines. If you wish to see them, follow the various links to these images online (or, if possible, visit the machines themselves — several are on public display.)

14.4.1• Banknote and Postage Stamp Museum

As discussed earlier, the Japanese government's [National] Printing Bureau [国立印刷局, Kokuritsu Insatsu-kyoku] acquired an ATF-manufactured Benton pantograph in 1912. This machine does not survive. However, the NPB has a museum, お札と切手の博物館 [Osatsu to kitte no hakubutsukan, Museum of banknotes and stamps; but “Banknote & Postage Stamp Museum,” in English, on their website].¹³⁶ which has on display a Tsugami pangtograph manufactured in 1956. It is displayed complete with its Power Stand. See the museum's web page for this pantograph at: <https://www.npb.go.jp/ja/museum/tenji/gallery/benton.html> See (NPB Tsugami N.D.)

¹³⁶See the museum's history page at <https://www.npb.go.jp/ja/museum/about/history.html>

14.4.2• Cheongju Early Printing Museum, Cheongju, South Korea

The Cheongju Early Printing Museum in Cheongju, South Korea exhibits a Tsugami pantograph in their Modern and Contemporary Printing Exhibition Hall (근현대인쇄전시관). The museum's website shows this hall online at: <http://jikjiworld.cheongju.go.kr/jikjiworld/contents.do?key=17480>. Image 5 of this presentation, reproduced below, shows the Tsugami. (I have confirmation from a friend who has visited the museum that the pantograph on display is a Tsugami. He also noted that in a display case next to this they also have two quills for this machine.)



Fig. 74: Modern and Contemporary Printing Exhibition Hall, Image 5¹³⁷

¹³⁷This image is *not* licensed under the same terms as the rest of this document. It is copyright © by the Cheongju Early Printing Museum and it is licensed under the Korean Open Government License, with the terms “Indication of Source” (BY), “Prohibition of Commercial Use” (NC), and “Prohibition of Alteration” (ND). See <https://www.kog1.or.kr/index.do> This license is more restrictive than the license used for most of the material in this census. If you re-use the work of this census and choose to include this image, you must abide by its license terms.

14.4.3 • Chiba University Engineering Department Museum

The Faculty of Engineering, Chiba University [千葉大学工学部, Chibadaigaku kōgakubu] has (or had as of 2007, the last update date of its website) a “Collection Reference Room” [収蔵品資料室, Shūzō-hin shiryō-shitsu], aka “Old Collections Room.”¹³⁸ This departmental collection was documented in a website entitled “Chiba University Engineering Digital Museum / Old Collections Room” at https://www.f-eng.chiba-u.jp/dm/ocr/index_pr.htm (Chiba 2007).

This departmental museum preserved several items of interest here, including a Tsugami pantograph (with power stand), said to be from the first production year of 1948. The website calls this a ベントンの彫刻機 [Benton chōkoku-ki, Benton Matrix Cutting Machine]¹³⁹

The collection also includes either one or two Benton-style cutter grinders¹⁴⁰ (called a ベントンの附属作業台, Benton fuzoku sagyō-dai, Benton Attached Workbench), a cutter inspection microscope (ベントンの附属顕微鏡, Benton fuzoku kenbikyō, Benton Attached Microscope), and an item that I cannot identify but which, I suspect, is probably misidentified as a “植字台と引戸式スチール製ケース馬 (5段2列5枚)” (Shokuji-dai to hikido-shiki suchīru-sei kēsu-ba (5-dan 2-retsu 5-mai), Typesetting table and sliding door type steel case horse (5 columns, 2 columns, 5 pieces)).

Two commercially made devices associated with the Tsugami pantograph complete the illustrations of the collection: a stereo inspection microscope (ベントンの附属双眼鏡, Benton fuzoku sōganky) and an optical comparator (ベントンの附属拡大投影装置, Benton fuzoku kakudai tōei sōchi / Goko LP-6 Profile Projector). There are several other items in the collection related to letterpress printing but not specifically to matrix engraving.

The web page for this “Digital Museum” was last updated in 2007. I do not know the current status of this collection.

¹³⁸Name in English on their site.

¹³⁹Google Translate says “Benton Engraving Machine.”

¹⁴⁰The entries call out two machines, but the photograph for the second seems to be a repetition of an earlier photograph of the cutter inspection microscope.

14.4.4 • Ichigaya Letterpress Factory

The Ichigaya Letterpress Factory (as it calls itself in English), or 市谷の杜本と活字館 [Ichinotani no mori hon to katsuji-kan, Ichigaya no Mori Book and Type Museum], is located in a former building of the Dai Nippon Printing Co., Ltd. in Tokyo. <https://ichigaya-letterpress.jp/>. It opened in November of 2020. They have a Tsugami pantograph on display.

This is a new museum and the provenance of this machine is unknown to me. It is of course most likely that it came from Dai Nippon Printing, but I have not found confirmation of this.

The museum has a photograph of this machine, as it is displayed, on its “Architectural Restoration” web page (Ichigaya, “Architectural Restoration,” N.D.). It is displayed with its Power Stand and it is clear that during its long years of service it was equipped with a much more modern electrical control box.

Another good view of the machine is in the video recording of a discussion with author Yuki Akari (雪朱里) on the occasion of the publication of her book “「書体」が生まれる: ベントんと三省堂がひらいた文字デザイン。” [“Shotai’ ga umareru: Benton to Sanseidō ga hiraita moji dezain.”, “The Birth of Typefaces: Letter Designs Created by Benton and Sanseido”] (Yuki 2021a). Most of this discussion was held in front of this machine. See (Yuki 2021b).

The museum has also posted photographs of their Tsugami to their Instagram page. See (Ichigaya 2020-03-03) and (Ichigaya 2021-01-23).

14.4.5• Motoya Letterpress Museum, Osaka

A Tsugami pantograph is on display at the corporate museum of the Motoya [モトヤ] Co., Ltd. printing company in Osaka, along with its original power stand, patterns, matrices, and a Benton-style cutter grinder.

What was probably the initial version of the museum’s website dates to 1997 and was online until 2017. An archived view of it is still viewable via The Internet Archive’s “Wayback Machine.” See (Motoya 1997).

A more recent website, dating to 2009 but still online, incorporates and adds to the material of the first. They both indicate that the museum dates from 1996 (when the firm moved away from metal type) and they both illustrate the machine. They call it a “ベントン彫刻機” (Benton Engraving Machine) even though it has the name “TSUGAMI” cast into the front of its base. This 2009 website also notes that they installed “more than 20” Tsugami engraving machines. See (Motoya 2009) or view it directly at <https://www.motoya.co.jp/business/katsuji.html>

The typefounding division of Motoya has evolved from the metal to the digital and now employs the trade name “モトヤフォント” (Motoyafonto, Motoya Font). As of 2023 they present two web pages relevant here. One is a history of type (metal to digital) at Motoya Font. It refers to the founding of the museum in 1997. Its last entry is 2014 and it is still online in 2023. See (Motoya Font 2014). Their other page is devoted to the Motoya Print Museum, but its content seems identical to the main corporate page, (Motoya 2009). It is at <https://www.motoyafont.jp/about/motoya-typo-museum.html>

On January 24, 2022, the Japanese digital webfont service FONTPLUS (フォントプラス, Fontopurasu; <https://fontplus.jp/>) published an online article on Motoya (as one in a series of articles on digital lettering suppliers whose products work with FONTPLUS’ products). This article traced some of the history of Motoya in metal type and specifically mentioned the museum (and illustrated its Tsugami pantograph). At present this is the most recent reference that I can find to the Motoya Print Museum and its Tsugami machine. See (FONTPLUS 2022).

There are also online descriptions of visits to this museum:

- “ベントン彫刻機の謎.” [“Benton chōkoku-ki no nazo,” “The Mystery of the Benton Engraving Machine.”] This 2016 account is the most recent actual visit to the museum that I have been able to discover online (Nakanishi 2016).
- “モトヤ活字資料館をお訪ねして,” [“Motoya katsuji shiryōkan o o tazune shite.” “Visit the Motoya Type Museum.”] This contains close-up photographs of the top of the matrix holder and the follower of the tracer (Sekiguchi N.D.).
- “モトヤ活字資料館見学会 (第3回文字る会).” [“Motoya katsuji shiryōkan

kengaku-kai (dai 3-kai mojiru-kai),” “Tour of the Motoya Type Museum (3rd Letter Meeting).” This blog posting has the best pictures of not only the Tsugami pantograph but also the Man-Nen type caster. It also shows a Benton-style cutter grinder and an inspection microscope. (Nishio 2012).

- “特別編 金属活字のできるまで (株式会社モトヤ「活字資料館」見学 > 会レポート) .” [“Tokubetsu-hen kinzoku katsuji no dekiru made (kabushiki-gaisha Motoya ‘katsuji shiryōkan’ kengaku-kai repōto),” “Special edition: How metal type is made (Motoya Co., Ltd. ‘Type Museum’ tour report).”] (Imada 2015).
- “モトヤ活字資料館.” [“Motoya katsuji shiryōkan,” “Motoya Type Museum.”] (“swing” 2014). This is a collection of photographs on a Japanese online photo sharing site. It has some particularly good detail shots of the Tsugami.

14.4.6 • NSTM, Kaohsiung, Taiwan

There are two Tsugami pantographs preserved at the National Science and Technology Museum in Kaohsiung City, Taiwan.¹⁴¹ Photographs of these machines have been made available through the kind assistance of Mr. HUANG Junfu (黃俊夫) of the NSTM.¹⁴²

The machine which appears to be the older of the two is NSTM Collection Number P0200001002. Its manufacturer's plate identifies it as a model T-TME, serial number 3513, manufactured in 1969.



Fig. 75: Tsugami T-TME 3513¹⁴³



Fig. 76: No. 3513



Fig. 77: Tsugami No. 3513

¹⁴¹The English-language version of the museum's website is at: <https://www.nstm.gov.tw/English/>

¹⁴²My thanks also to Victor Thibout for making this possible.

¹⁴³The photographs from the NSTM in Taiwan have been provided here by the Museum and are Copyright © by the National Science and Technology Museum, Kaohsiung, Taiwan. These are licensed under the following terms: "The National Science and Technology Museum allows the publication of photos of cultural relics of the museum in academic papers, as long as it is indicated that it is in the collections of the NSTM."

The machine which appears to be the newer of the two is NSTM Collection Number P0200001001. Its manufacturer's plate identifies it as a model T-TME, serial number "1981 10". Its date of manufacture is not specified, unless it is encoded in the machine number (1981).



Fig. 78: Tsugami T-TME 1981 10



Fig. 79: No. 1981 10



Fig. 80: Tsugami No. 1981 10

14.4.7• Sasaki Printing and Publishing Museum

The Sasaki Printing and Publishion Co., Ltd. (笹氣出版印刷株式会社, Sasaki shuppan insatsu kabushikigaisha)¹⁴⁴ maintains a small corporate museum. The best views online of this museum are in the Google Maps “Street View” presentation linked from the museum’s home page at:

<https://www.katsujikan.jp/index.html>

Here is a direct link to the “Street View”:

https://www.google.com/maps/@38.2537853,140.9342686,3a,82.2y,289.71h,76.24t/data=!3m7!1e1!3m5!1sAF1QipMjFMROT1zWr4ose6OXV-g0J6s_CxnILRs6_C5E!2e10!3e12!7i10000!8i5000.

This museum preserves a Tsugami pantograph and its Benton-style cutter grinder. Turn to your right as you enter the “Street View” presentation; the pantograph and grinder are displayed in the right hand back corner of the museum.

The Collections page for this museum is at: <https://www.katsujikan.jp/collection.html>¹⁴⁵ and the page for their Tsugami, specifically, is <https://www.katsujikan.jp/collection/chuzo/collection01.html> (Sasaki 2020).

The installation of this Tsugami at the museum is shown in a photograph on the museum’s Facebook account, dated 2011-10-03 (Sasaki 2011). This photograph also shows the Benton-style cutter grinder displayed near the pantograph.

14.5• Surviving Fujikoshi Pantographs

No Fujikoshi machines are known (to me) to have survived.

¹⁴⁴<https://sasappa.co.jp/>

¹⁴⁵In addition to the Tsugami, it shows a number of other important machines. These include: A Rineisha “Man-Nen” automatic type casting machine (which is an original Japanese design), an Ikegai Japanese-made derivative of the Thompson Type Caster, a Japanese implementation of the principle of the Elrod stripcasting machine (arranged with the pot on the right), a Monotype Composition Caster (for European languages), a Nippon Typewriter Co. composition casting machine for Japanese (the display says that this is a derivative of the Monotype, but in fact it is a wholly original Japanese design on different principles, using a cylinder of matrices and a 6-level paper tape (but not a Teletypesetter-compatible tape; the sprocket hole positions are centered rather than aligned with the leading edge of the data holes as in a TTS 6-level tape)), and a PAVO-KY phototypesetter.

14.6• Possibly Surviving Japanese Pantographs

14.6.1• Agata Manufacturing, Yamanashi City, to 2012?

At least seven Tsugami (or possibly Fujikohi) pantographs were in operation through at least 2012 at Agata Seisakusho (Agata Works/Factory). I do not know what has become of these machines.

Here are the references that I know of at present:

A posting by the Robundo publishing company for the Salama Press Club¹⁴⁶ outlines the work of Agata Fumio.¹⁴⁷ He spent his regular career as a matrix engraver for 横浜精工所 [Yokohama seikōsho, Yokohama Precision Works]. Upon retirement, he set up on his own as 安形製作所 [Agata (安形) Seisakusho (製作所), Agata Factory/Works/Manufacturing] in 山梨市三ヶ所 [Yamanashi-shi sangasho, Sankasho, Yamanashi City]. He installed “several” engraving machines (the Robundo posting shows photographs of two). One of these (the grey one) is clearly identified as a Tsugami. The identity of the the other (in a bright green coat of paint) is not clear. The Adana (now Salama) Press Club visited his works in 2008. Agata died on January 1, 2012. See (Robundo 2012).

A video or short film, “オの旅” (O no Tabi, O’s Journey)¹⁴⁸ describes the path taken by katakana character オ (U+30AA) from a new design through matrix cutting at Agata Seisakusho (and on through casting and printing). This film shows seven Tsugami (or possibly Fujikoshi?) pantographs, six in a single row along a wall and another freestanding behind them.

Two short videos made by or with Dai Nippon Printing (DNP) with the cooperation of Agata Seisakusho show the Agata Seisakusho pantographs at work. These videos were posted to Youtube recently, but it is not clear when the material at Agata Seisakusho was filmed.

The more recent of these two videos is by the Ichigaya Letterpress Factory (and also DNP) and is on the Ichigaya Letterpress Factory’s Youtube channel: <https://www.youtube.com/watch?v=jsxtOmKBJNQ> See (Ichigaya 2021). It has good detail views of work at the Tsugami pantograph but fewer overall views of the machines and working area.

The older of these two videos is by DNP directly and is the first of a series¹⁴⁹ on the creation of their Shueitai family of types. But it was made after the end of metal type at DNP in 2003. So while it does show archival photographs of the use of a Tsugami at DNP¹⁵⁰ the live sequences showing pantographs at

¹⁴⁶At the time this was the Adana Press Club.

¹⁴⁷This Japanese name is in the traditional order. Agata is the family name. 安形 文夫 / あがた ーふみお, Agata Fumio.

¹⁴⁸Through at least 2015 this video was viewable on youtube, but now it is a private video. See ([O’s Journey] “オの旅”. By 2015).

¹⁴⁹The series is a part of their playlist at <https://www.youtube.com/playlist?list=PLee djxjGR5uvlZTrAKHQiZdISkCkvFyf5>

¹⁵⁰And also electroforming baths, something that is shown less often.

work are at Agata Seisakusho. Three Pantographs are shown, though none of these are identified (they are just called “Benton” machines). But the middle of these three is one which has been identified as a Tsugami in the Robundo material (Robundo 2012). The one to its right seems to be identical. A third pantograph, unidentified and painted bright green, is to the left. Note also at time 3:23 two things: a quill for the machine on a stand in the window sill (in front of a blue-covered book) and the arrays of followers behind the machine by the wall. These videos well repay attention to their details. For example, they show a method of moving the straight arm of the Tsugami by means of attached wires for convenience (giving “handles” much more like those found on the Adcut machine or on Wiebking’s pantographs). See (DNP 2018).

14.6.2 • Benton Engraving Studio in Itabashi, Tokyo. ?

This may be a red herring due to my misinterpretation of a machine translation of a Japanese-language web posting.

The Robundo Publishing blog post at <http://www.robundo.com/robundo/column/?p=3362>, (Robundo 2012). says that the owner of the 東京・板橋にあったベントン彫刻所 (Tōkyō Itabashi ni atta benton chōkoku-sho, Benton Engraving Studio in Itabashi, Tokyo) had just died (in 2012). I have not been able to discover any further information about this studio.

14.6.3 • Other?

Several Japanese companies not mentioned earlier had substantial numbers of Tsugami and/or Fujikoshi pantographs in operation. I do not know if any of their machines have survived and would greatly appreciate hearing from anyone who knows.

Iwata

Iwata Matrix Manufacturing (岩田母型製造所, Iwata bokei seizōjo), founded in 1920, still exists as Iwata Corporation.¹⁵¹ Yuki charts their history through the letterpress era in two columns, (Yuki No. 57 2020) and (Yuki No. 58 2020). In the second of these columns, Yuki reports that at its peak Iwata had about 20 Tsugami machines installed in-house and that it had at its disposal the out-sourced capabilities of 30 more.

大熊肇 (Ōkuma Hajime)¹⁵² visited the Iwata factory in 2001, while it was still producing physical matrices. His account of this tour starts at: <http://www.tonan.jp/okazawa-ken/010217iwatabokei/index.html> (Tonan’s Web 2001).

Nippon Typewriter

¹⁵¹They are now a digital lettering manufacturer with websites at <https://www.iwatafont.co.jp> (in Japanese) and <https://www.iwatafont.com/en/> (in English).

¹⁵²This Japanese name is presented here in the traditional order. Ōkuma is the family name.

Yuki reports that Nippon Typewriter (日本タイプライタ, Nihon taipuraita) at one time had 50 Benton-style engraving machines (Yuki No. 58 2020).

Tokyo Kikei Seisakusho

Yuki reports that Tokyo Kikei Seisakusho (東京機械製作所, Tōkyōkikai-seisakusho; Tokyo Machine Works) at one time had 50 Benton-style engraving machines (Yuki No. 58 2020).

15• Chinese Benton-Style Pantographs

Note: Victor Thibout has done important research into the history of Benton-style pantographs in China. An expanded section based upon his work will appear in the next revision of this Census.

The China Printing Museum (中国印刷博物馆, zhōngguó yìnshuā bówùguǎn) in Beijing, preserves and displays a typographical pantograph with a mechanism based on the Benton Type 2a. It is in other respects clearly an original Chinese design. I know very little about it and would appreciate learning more.



Fig. 81: Chinese Benton-Style Pantograph, Beijing¹⁵³



Fig. 82: Its Manufacturer¹⁵⁴

¹⁵³This photograph and the detail from it in the next figure are copyright © by Patrick Goossens, Letter-kunde Press, Antwerp. License: Creative Commons Attribution-NonCommercial (BY-NC) 4.0 International. My thanks to Patrick for supplying this image.

¹⁵⁴My thanks to Victor Thibout (in an email on 2023-02-16) for noting that this is the name of the factory where this pantograph was manufactured.

16• Bibliography

TO DO: Add more links to online versions where possible.

Bibliographic Style Issues

I am aware of issues/difficulties in the citation style. The style guides for bibliography and citation in the humanities have entered into a dark period where citations are expected to flow into the text so smoothly that it is difficult to follow the citation at all. This may suit aesthetics, but it is a discourtesy to the reader and an impediment to the researcher. The best remaining style guide, and the one used here, is the *Chicago Manual of Style*, 17th edition (2017), with its (author date) style of citation.

But at the same time, the inherent complexity of bibliography has increased with the rise of online content. While *Chicago* has tried valiently to accomodate this, difficult situations remain. Examples of these, encountered here, include undated, untitled, anonymous online content in Japanese cited for an English-speaking audience, where the name of the institution (as author), correctly translated, does not fall into the alphabetical sequence appropriate for it. To this you must add the fact that corporate author's names do not always alphabetize in the same way that personal names would. This can produce unexpected results.¹⁵⁵ Surprise does not suit a bibliography, so occasionally I will have recourse to adding a sensible first indexing term [in brackets].

Character Code Issues

Unicode U+2015, Horizontal Bar, does not exist in the T_EX Gyre Schola digital lettering font. It has been replaced here by a T_EX em dash: —

Unicode U+2460, U+2461, and U+2464, Circled Digit 1, 2, and 5, do not exist in the T_EX Gyre Schola digital lettering font. They have been replaced here by the explanatory text: [U+2460 circled digit 1], etc.

Translations

All translations are by Google Translate.

AFN Wiesbaden [youtube username]. 2015. "Gutenberg Museum: Wiesbaden Out 'n About." Youtube video, posted 2015-01-29. Accessed 2023-02-02. https://www.youtube.com/watch?v=Gwp_y1d131s

ATF. 1912a. *American Specimen Book of Type Styles [and] Catalogue of Printing Machinery and Printing Supplies*. Jersey City, NJ: American Type Founders Company.

ATF. 1912b/2002. *Photographic Views of Central Plant, American Type Founders Company*. Jersey City, NJ: American Type Founders Company. Reprinted with additional editorial material by Theo Rehak, David W. Peat, and Richard L. Hopkins, 2002.

¹⁵⁵So for example something written by Hirano Tomiji would alphabetize as "Hirano, Tomiji" but the "Tomiji Hirano Association," correctly expressed as the association would style itself in English, would alphabetize under "Tomiji" rather than the more sensible "Hirano." In such a case I will write: "[Hirano] Tomiji Hirano Association."

ATF. 1921. "Records of Adcut Machine / March 1921." Manuscript notes. Jersey City, NJ: American Type Founders Company.

This is an envelope containing several sheets of manuscript notes concerning the operation of the Adcut pantograph (presumably Machine No. 5). It also contains a single page dated March 28, 1930, referring to a "New Adcut Machine No. 1". It was noticed by DMM in 2021 in the materials of the late Gregory Jackson Walters. It is now a part of the Gregory Jackson Walters Typographic Archive of The Printing Stewards, Inc. At this time it remains unpublished.

ATF. 1923. *Specimen Book & Catalogue*. Jersey City, NJ: American Type Founders Company.

ATF. 1926. *A Catalogue of an Exhibition of Recent European Fine Book and Commercial Printing - Loaned by the Typographic Library of the American Type Founders Company*. Jersey City, NJ: American Type Founders Company.

By Henry Lewis Bullen. This booklet is notable here only for having photographs of the ATF Library in 1926 which do *not* show the first Benton pantograph.

ATF. 1936. *Catalogue and List Prices of Duplicates of Books, Prints, Museum Pieces and Broadsides Offered for Sale by the Typographic Library and Museum of the American Type Founders Co.* Jersey City, NJ: American Type Founders Company.

By Henry Lewis Bullen. This volume contains two photographs of the ATF Library, one of which shows the first Benton pantograph on display in a case.

Benton, Waldo & Co. 1884. "Benton, Waldo & Co., of Milwaukee, claim..." [Untitled trade note.] *The Inland Printer*. Vol. 1, No. 10 (July 1884): 21.

This may be the single most important trade note in the history of type, for it disproves Bullen's completely fictitious account (so often repeated) of the origins of the cutting of punches in steel on Benton's pantograph.

This volume of *The Inland Printer* has been scanned by the Smithsonian Institution from its copy. It is online at the Smithsonian's website at <https://library.si.edu/digital-library/book/inlandprinte118831884chic> and at The Internet Archive at <https://archive.org/details/inlandprinte118831884chic>.

Benton, Linn Boyd. 1885a. "Punch-Cutting Machine." US Patent No. 332,990. Filed February 29, 1884 as application serial no. 122,534 and issued December 22, 1885. Assigned to Benton, Waldo & Co., Milwaukee, WI.

This is the first patent by Benton for a pantograph.

Benton, Linn Boyd. 1885b. "Improvement in Machines for Cutting Punches and the like." UK Patent No. 11,894 of A.D. 1885. Filed by Alfred Julius Boulton for Linn Boyd Benton. Specification dated October 6, 1885.

This is the GB patent filing equivalent to Benton's US patent 332,990.

Benton, Linn Boyd. 1890. "Tool-Grinder." US Patent No. 422,874. Filed January 17, 1888 as application serial no. 261,053 (with model) and issued March 4, 1890. Assigned to Benton, Waldo & Co., Milwaukee, WI.

This is the first form of Benton cutter grinder. It is entirely different from the second form of 1900/1904.

[Benton] "L. B. Benton." 1893. *The Inland Printer* 11, no. 3 (June): 237-238.

This volume of *The Inland Printer* has been digitized at least twice. The Google Books digitization of a University of Michigan copy is available at The Hathi Trust. ID: mdp.39015086781211. <https://babel.hathitrust.org/cgi/pt?id=mdp.39015086781211>. The digitization by the Smithsonian Institution of their copy (formerly owned by the US Patent Office) is online at the Smithsonian's website at <https://library.si.edu/digital-library/book/inlandpri111218931894chic> and at The Internet Archive at <https://archive.org/details/inlandpri111218931894chic>.

Benton, Linn Boyd. 1904. "Grinding-Machine." US Patent No. 774,030. Filed May 5, 1900 as application serial no. 15,593 and issued November 1, 1904. Assigned to American Type Founders Company.

This is the second form of Benton cutter grinder. It is entirely different from the first form of 1888/1890.

Benton, Linn Boyd. 1905. "Tracing Apparatus." US Patent No. 790,172. Filed July 21, 1899 as application serial no. 724,584 and issued May 16, 1905. Assigned to American Type Founders Company.

This is for a horizontal four-bar pantograph for producing design drawings from small drawings or types to be copied.

Benton, Linn Boyd. 1906. "Matrix and Punch Cutting Machine." US Patent No. 809,548. Filed February 17, 1899 as application serial no. 705,785 and issued January 9, 1906. Assigned to American Type Founders Company.

This is the patent for Benton's second type of vertical pantographic engraving machine.

Brignell, Hannah. 2020-10-07. "Studying the Monotype Collection." Blog posting for The Science Museum (London). <https://www.sciencemuseumgroup.org.uk/blog/studying-the-monotype-collection/>

Bullen, Henry Lewis. 1922. "Linn Boyd Benton — The Man and His Work." *The Inland Printer* 70, no. 1 (October): frontis, pp. 60-64.

Readers are cautioned that Bullen is an extremely unreliable source and that his outright fictions concerning the Benton pantograph have misled historians for a century. Nothing that he says can be taken as true unless it is independently corroborated.

This volume of *The Inland Printer* has been digitized at least twice. The Google Books digitization of the University of Michigan copy is available via The Hathi Trust, ID: mdp-39015086783449 <https://babel.hathitrust.org/cgi/pt?id=mdp.39015086783449>. The much better scan by the Smithsonian Institution of their copy (formerly owned by the US Patent Office) is available on the Smithsonian Library's website at: <https://library.si.edu/digital-library/book/inlandprint7019221923chic> and on The Internet Archive at <https://archive.org/details/inlandprint7019221923chic/>

Bullen, Henry Lewis. 1924. "Origin and Development of the Linotype Machine, Part II." *The Inland Printer* 72, no. 6 (March): 936-938.

This volume of *The Inland Printer* has been digitized by Google from a University of Michigan copy. It is available via The Hathi Trust, ID: mdp.39015011442962 <https://babel.hathitrust.org/cgi/pt?id=mdp.39015011442962>. However, the digitizations from it used here were done by me from my own copy.

Cheongju Early Printing Museum. “근현대인쇄전시관.” [“geunhyeondaeswaejeon-sigwan,” “Modern and Contemporary Printing Exhibition Hall.” N.D. Cheongju, South Korea: Cheongju Early Printing Museum. Accessed 2023-01-25. In Korean. <http://jikjiworld.cheongju.go.kr/jikjiworld/contents.do?key=17480>

Chiba University, Faculty of Engineering. 2007. “Chiba University Engineering Digital Museum / Old Collections Room / 収蔵品資料室, Shūzō-hin shiryō-shitsu, Collection Reference Room.” Chiba, Japan: Faculty of Engineering, Chiba University [千葉大学工学部, Chibadaigaku kōgakubu]. Website dated 2007, accessed 2023-01-22. https://www.f-eng.chiba-u.jp/dm/ocr/index_pr.htm In Japanese, except for a few titles.

CircuitousRoot. “Schokmiller Typographical Pantograph Engraving Machine.” 2022. Web page, last updated 2022. <https://www.circuitousroot.com/artifice/letters/pantocut/schokmiller/index.html>

The last update date of 2022 reflects the reconstruction of this page after its loss in a security breach. As of January 2023, the actual content of this page hasn't been updated since I wrote it in 2012.

Cost, Patricia A. 2011. *The Bentons: How an American Father and Son Changed the Printing Industry*. Rochester, NY: RIT Cary Graphic Arts Press. ISBN: 978-1-933360-4-3.

Currier, Micah Slawinski. April 2011. *Disciplines & Protocols*. Article distributed in a blog posting, dated 2011-07-10, on cutting “Iohann Titling” (see note below). Howell, NJ: The Dale Guild Type Foundry.

This was distributed originally on an older version of the Dale Guild's website, at <http://thedaleguild.com/news/1124/>. This site has been namesquatted since late 2013. The last crawl of that website by The Internet Archive's Wayback Machine was on 2013-10-12, <https://web.archive.org/web/20131012034308/http://thedaleguild.com/>, but it did not include this page. One Wayback Machine crawl from 2013 which did include this page and the article was: <https://web.archive.org/web/20120930061451/http://thedaleguild.com/news/1124/>

This article is particularly useful as it contains a short glossary of Benton-specific names for parts of the pantograph and the processes of its use.

Currier, Micah Slawinski. N.D. [by 2016]. *Disciplines & Protocols*. Film. Howell, NJ: The Dale Guild Type Foundry.

Dale Guild Type Foundry. Flickr.com photostream. 2010. Begun 2010, last content posted 2010, accessed 2023-01-30. <https://www.flickr.com/photos/47496314@N06/with/6350024461/>

DeVinne, Theodore Low. 1900. *The Practice of Typography: A Treatise on the Processes of Type-Making, the Point System, the Names, Sizes, Styles and Pricing of Plain Printing Types*. NY: The Century Company.

This has been digitized several times. The image used here is from the digitization by Google of a Harvard University copy.

DNP. 2018. “< DNP の秀英体 > その手が文字をつくるまで～活版印刷の職人たち～ (1) 作字.” [“< DNP no shūeitai > sono-te ga moji o tsukuru made katsuban'insatsu no shokunin-tachi (1)-saku ji,”] “<DNP's Shueitai> Until the hand creates the

letters Letterpress printing craftsmen (1) Writing.”] Online video, posted 2018-07-23. Tokyo: 大日本印刷株式会社 (Dainippon’insatsu kabushikigaisha, Dai Nippon Printing Co., Ltd.) In Japanese. <https://www.youtube.com/watch?v=sGkFRfRLTRE>

This video contains archival photographs from DNP of electroforming (time 1:15) and a Tsugami pantograph at DNP (time 1:19). At time 3:30 in the video, the sequence showing pantographic matrix engraving is identified as “協力 [cooperation]: 安形製作所 (Agata seisakusho, Agata Factory).

FONTPLUS. 2022. “「活字は印刷の元や（関西弁）！」モトヤの社名ルーツです。” [“Katsuji wa insatsu no gen ya (Kansai-ben)! Motoya no shamei rūsudesu,” “Type is the source of printing (Kansai dialect)!” The roots of the company name Motoya.”] Web page / online article dated 2022-01-24. Tokyo, Japan: SB Technology Co., Ltd. [SB テクノロジー株式会社, SB tekunoroji kabushikigaisha; formerly SoftBank Technology] dba FONTPLUS. <https://note.fontplus.jp/n/nd01cc9f09d25>

Goble, George Corban. 1984. “The Obituary of a Machine: The Rise and Fall of Ottmar Mergenthaler’s Linotype At U.S. Newspapers.” (Doctoral dissertation, Indiana University.)

@hamabee. 2022. “先日、印刷博物館の工房見学に行ってきました。” [“Senjitsu, insatsu hakubutsukan no kōbō kengaku ni ittekimashita.” “The other day, I went to visit the workshop of the Printing Museum.”] Tweet by Twitter user “はまあ @hamabee” (<https://twitter.com/hamabee>), 7:50 AM • Mar 20, 2022. <https://twitter.com/hamabee/status/1505527191756410885/photo/1> This tweet has a lovely photograph of the Benton pantograph at The Printing Museum, Tokyo.

[Hirano] Tomiji Hirano Association. 2017–. 平野富二: 明治産業近代化のパイオニア. [*Hirano tomiji Meiji sangyō kindai-ka no paionia, Hirano Tomiji*¹⁵⁶: *Pioneer of modernization of Meiji industry*. Ongoing website and blog posting series, begun in 2017. [No location]: 平野富二の会 [Hirano Tomiji no kai, Hirano Tomiji Association]. <http://hirano-tomiji.jp/> In Japanese.

This is a website by the Hirano Tomiji Association recording the history and achievements of this Meiji-era businessman. He founded, among other enterprises, the Tokyo Tsukiji Letterpress Factory (type foundry).

HJIT. 2012. “ベントン母型彫刻機.” [“Benton bokei chōkoku-ki,” “Benton matrix engraving machine.”] Document Number 108911001019. In the *History of Japanese Industrial Technology* database. Web page showing a database entry. Tokyo, Japan: National Museum of Nature and Science. In Japanese. <https://sts.kahaku.go.jp/sts/detail.php?no=108911001019>

This survey records the ATF Benton at the Toppan printing museum in 2012. It confirms that it was manufactured by American Type Founders Co.

Hopkins, Richard L. 1981. “The Living Legend: American Type Founders Company.” Photo essay with captions. *American Typesetting Fellowship Newsletter* [whole number] 6 (May). Pages 7–14.

The ATF Newsletters are online at CircuitousRoot: <https://www.circuitousroot.com/artifice/letters/press/typemaking/atf/newsletter/index.html>

¹⁵⁶This is a Japanese name presented in the traditional order. Hirano is the family name.

Hopkins, Richard L. [anonymously] 1994. “American Type Founders Company: A Troubled Report On Its Demise.” *American Typecasting Fellowship Newsletter* [whole number] 18 (June). Pages 2–17.

The ATF Newsletters are online at CircuitousRoot: <https://www.circuitousroot.com/artifice/letters/press/typemaking/atf/newsletter/index.html>

Hounshell, David A. 1984. *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States*. Baltimore, MD: The Johns Hopkins University Press. ISBN: 0-8018-3158-X.

Ichigaya Letterpress Factory. 2020-03-03. [Instagram posting showing their Tsugami pantograph.] Tokyo: Ichigaya Letterpress Factory (市谷の杜本と活字館, Ichinotani no mori hon to katsuji-kan, Ichigaya no Mori Book and Type Museum). <https://www.instagram.com/p/CaojudwOrVa/>

This Instagram posting has two photographs. The first shows a closeup of the cutter. It is rather dark, but this is a difficult photograph to take. The second shows the matrix holder level of the machine.

Ichigaya Letterpress Factory. 2021-01-23. [Instagram posting showing their Tsugami pantograph.] Tokyo: Ichigaya Letterpress Factory (市谷の杜本と活字館, Ichinotani no mori hon to katsuji-kan, Ichigaya no Mori Book and Type Museum). <https://www.instagram.com/p/CKYMATajZxa/>

This Instagram posting has two photographs. The first shows a good closeup of the matrix holder level of their Tsugami. The second shows a good overall view of the machine. I do like the fact that Dai Nippon installed a great big friendly red EPO button on it!

Ichigaya Letterpress Factory. 2021. “活版印刷の流れ／市谷の杜本と活字館活版印刷映像アーカイブその1.” [“Katsuban’insatsu no nagare/ Ichinotani no mori hon to katsuji-kan katsuban’insatsu eizō ākaibu sono 1,” “The Flow of Letterpress Printing / Ichigaya no Mori Book and Type Museum Letterpress Video Archive Part 1.”] Online video, posted 2021-08-21. Tokyo: Ichigaya Letterpress Factory (市谷の杜本と活字館, Ichinotani no mori hon to katsuji-kan, Ichigaya no Mori Book and Type Museum) / DNP (Dai Nippon Printing). In Japanese. <https://www.youtube.com/watch?v=jsxtOmKBJNQ>

The opening title card is for the Ichigaya Letterpress Factory. The closing title card (time: 6:15) is for DNP (Dai Nippon Printing).

This video surveys the whole type-making process (and composition, but not printing). It has a brief but good section on matrix engraving at a Tsugami pantograph. At time 1:29 in the video, the portions showing pantographic matrix engraving are identified as “協力 [cooperation]: 安形製作所 (Agata seisakusho, Agata Factory).”

Ichigaya Letterpress Factory. N.D. [after Summer 2020]. “建築の復元.” [“Kenchiku no fukugen,” “Architectural Restoration.” Tokyo: Ichigaya Letterpress Factory / 市谷の杜本と活字館 [Ichinotani no mori hon to katsuji-kan, Ichigaya no Mori Book and Type Museum], Web page. In Japanese. <https://ichigaya-letterpress.jp/about/architecture.html>

Imada, Kinichi [今田欣一]. 2015-03-17. “特別編 金属活字のできるまで (株式会社モトヤ「活字資料館」見学会レポート).” [“Tokubetsu-hen kinzoku katsuji no dekiru made (kabushikigaisha Motoya ‘katsuji shiryōkan’ kengaku-kai repōto),” “Special edition: How metal type is made (Motoya Co., Ltd. ‘Type Museum’ tour report).”]

Blog posting. In Japanese. <https://imadakin1.seesaa.net/article/416751169.html>

The photographs in this blog posting contain among other things a nice view of the front of the matrix holder. Thanks.

Kahan, Basil. *Ottmar Mergenthaler: The Man and His Machines*. New Castle, DE: Oak Knoll Press, 2000

Kaup, W. J. 1909. "Modern Automatic Type Making Methods." *American Machinist*. Vol. 32 (December 16, 1909): 1042-1046.

[Legros & Grant] "Typecasting for the Printer: Where the Davis Machines are Made." 1913. *The British and Colonial Printer and Stationer* 72, No. 14 (March 29): 3-6. This volume has been digitized by Google from the University of Michigan copy. Google Books ID: Q38jAQAAMAAJ

Legros, Lucien Alphonse and John Cameron Grant. 1916. *Typographical Printing Surfaces*. London: Longmans, Green, and Co.

Lock, William Henry and Mark Barr. 1900. "Improvements in Engraving Machines, such as are Specially Adapted to Engrave or Cut the Punches for Punching the Formative Cavities in the Matrices for Type, Linotype, and the like." GB Patent No. 22,106 of 1900. Date of application, 5th Dec. 1900. Complete specification left, 5th Sept., 1901. Accepted, 5th Dec., 1901.

The modern publication number for this patent is GB190022106A. It may be seen online via the European Patent Office's Espacenet service at <https://worldwide.espacenet.com/advancedSearch>

Lohf, Kenneth A., ed. 1980. *The History of Printing from Its Beginnings to 1930: The Subject Catalogue of the American Type Founders Company Library in the Columbia University Libraries*. Four Volumes. Millwood, NY: Kraus International Publications.

The main title of this book is misleading. It is not a history, but is simply a photographic reprint of the index cards comprising the catalog of the American Type Founders Library, 18 to a page, ordered within subject categories. These catalog cards were created by Henry Lewis Bullen, librarian of the ATF Library. Lohf, a rare book librarian at Columbia University, has added a useful Introduction.

Mahr, Karl. *Der Druckbuchstabe: Sein Werdegang in der Schriftgießerei dargestellt in Holzschnitten und Versen*. [no location, but Mahr in Frankfurt a. M.]: Verein Deutscher Schriftgießereien E.D.)

Maret, Russell. 2011. "Specimens: Making Iohann Titling." Blog posting dated 2011-02-22. <http://russellmaret.blogspot.com/2011/02/>

McGrew, Mac. 1993. *American Metal Typefaces of the Twentieth Century*. New Castle, DE: Oak Knoll Books. ISBN: 0-938768-39-5.

MEAT collettivo grafico. 2012. "Atelier tipografico TALLONE." Online photograph, taken 2012-06-24. Accessed 2023-02-02. <https://www.flickr.com/photos/meatcollettivografico/7442080102/in/photostream/>

Mergenthaler, Ottmar, ed. Carl Schlesinger. 1989. *The Biography of Ottmar Mergenthaler, Inventor of the Linotype*. New Castle, DE: Oak Knoll Books.

This volume contains a reprint of Mergenthaler’s anonymously published 1898 biography. It also contains substantial original research by Schlesinger confirming the use of electroformed matrices for the “Blower” Linotype.

Millington, Roy. 2002. *Stephenson Blake: The Last of the Old English Typefounders*. New Castle, DE: Oak Knoll Press, ISBN 1–58456–086–X / London: The British Library, ISBN 0–7123–4795–X.

[Monotype] Lanston Monotype Corporation Ltd. 1925. *A Monotype Composing Machine*. Silent film. London: Lanston Monotype Corporation.

This film was discovered by the Ferrymead Printing Society in New Zealand. It is presented online now by <https://printingfilms.com>. Note that their title card is slightly in error; the English Monotype firm had not yet changed its name to The Monotype Corporation Limited when this film was made.

Monotype Corporaton, Ltd. 1956. “Monotype’ Matrices and Moulds In the Making.” [complete number of] *The Monotype Recorder* 40, no. 3 (Autumn). London: The Monotype Corporation Limited.

MOSI. 2001. “The Linotype & Machinery Co. Ltd.” Two-page PDF format document. Manchester, UK: The Museum of Science and Industry in Manchester, 2001.

The Museum of Science and Industry in Manchester is now the “Science+Industry Museum” (Manchester, UK) and its online collections pages have been amalgamated into The Science Museum Group. This document is no longer online, but an archived copy may be seen via The Internet Archive’s Wayback Machine at, e.g.: <https://web.archive.org/web/20141002231831/http://www.mosi.org.uk/media/33870636/thelinotypeandmachineryco.pdf>

Motoya Co., Ltd. 1997. “活字資料館.” [“Katsuji shiryōkan.” “Print Museum.”] Osaka, Japan: Motoya Co., Ltd. Website dated February 1997, now offline. Last accessed by the Internet Archive’s Wayback Machine on 2017-07-21. In Japanese.

The last scan of this site by the Wayback Machine is at: <https://web.archive.org/web/20170722171751/http://www.motoya.co.jp/business/katuji/>

Motoya Co., Ltd. 2009. “活字資料館.” [“Katsuji shiryōkan.” “Print Museum.”] Osaka, Japan: Motoya Co., Ltd. Website dated 2009, accessed 2023-01-23. In Japanese. <https://www.motoya.co.jp/business/katsuji.html>

Motoya Font. 2014. “モトヤフォントの歴史.” [“Motoyafonto no rekishi,” “History of Motoya Font.”] Osaka, Japan: Motoya Co., Ltd. Website dated 2014, accessed 2023-01-23. In Japanese. <https://www.motoyafont.jp/about/history.html>

The Motoya Font division of Motoya also maintains a website on their Print Museum. Its content seems identical. <https://www.motoyafont.jp/about/motoya-typo-museum.html>

Nachi-Fujikoshi Corp. 2021a. “Corporate Info., History and Milestones.”

Tokyo, Japan: Nachi-Fujikoshi Corporation. Web page dated 2021, accessed 2023-01-19. In English. <https://www.nachi-fujikoshi.co.jp/eng/company/history.html>

This is the main English language corporate history page for this firm.

Nachi-Fujikoshi Corp. 2021b. “Corporate Info., History and Milestones:

1928–1940” Tokyo, Japan: Nachi-Fujikoshi Corporation. Web page dated 2021, accessed 2023-01-19. In English. https://www.nachi-fujikoshi.co.jp/eng/company/70s_1.html

This page highlights the early history of the firm, from 1928 through 1940. It dates the adoption of the trademark “Nachi.”

Nachi-Fujikoshi Corp. 2021c. “Corporate Info., History and Milestones: 1945–1963” Tokyo, Japan: Nachi-Fujikoshi Corporation. Web page dated 2021, accessed 2023-01-19. In English. https://www.nachi-fujikoshi.co.jp/eng/company/70s_2.html

This page highlights the history of the firm from 1928 through 1940. It dates the change in name to Nachi-Fujikoshi Corp. in 1963.

Nachi-Fujikoshi Corp. 2021d. “Corporate Info., Origin of the Corporate Name ‘Fujikoshi’ / About the trademark ‘Nachi.’” Tokyo, Japan: Nachi-Fujikoshi Corporation. Web page dated 2021, accessed 2023-01-19. In English. <https://www.nachi-fujikoshi.co.jp/eng/company/name.html>

This page explains the meaning of the firm’s name and trademark.

Nakanishi, Hidehiko. 2016. “ベントンの彫刻機の謎.” [“Benton chōkoku-ki no nazo,” “The Mystery of the Benton Engraving Machine.”] Blog posting. Undated in the text, but datable to July 2016 by its URL. In Japanese. <http://olj.cocolog-nifty.com/weblog/2016/07/post-78ae.html>

Nishio, Masaya¹⁵⁷ 2012. “モトヤ活字資料館見学会（第3回文字る会）.” [“Motoya katsuji shiryōkan kengaku-kai (dai 3-kai mojiru-kai),” “Tour of the Motoya Type Museum (3rd Letter Meeting).”] Blog posting dated 2012-12-09. Accessed 2023-01-23. In Japanese. <http://katagihara.org/report20101207.html>

NPB. N.D. “活字の文字を彫刻する機械 ベントンの彫刻機.” [“Katsuji no moji o chōkoku suru kikai benton chōkoku-ki,” “Machine for Engraving Type Letters Benton Engraving Machine.”] Web page. Tokyo, Japan: Banknote and Postage Stamp Museum of the National Printing Bureau. In Japanese. <https://www.npb.go.jp/ja/museum/tenji/gallery/benton.html>

This web page documents the Tsugami pantograph in the Banknote and Postage Stamp Museum’s permanent collection.

NPB. 2014. “平成26年度 第2回特別展: 紙幣と官報 2つの書体とその世界.” [“Heisei 26-nendo dai 2-kai tokubetsu-ten shihei to kanp: 2tsu no shotai to sono sekai,” [“2014 2nd Special Exhibition: Banknotes and Official Gazettes Two Typefaces and Their World.”] Documents for a temporary exhibition, 2014-12-16 – 2015-03-08 at the Banknote & Postage Stamp Museum of the National Bureau of Printing, Japan. Web page and PDF flyer. Tokyo, Japan: Banknote and Postage Stamp Museum of the National Printing Bureau. In Japanese. https://www.npb.go.jp/ja/museum/tenji/kako/261216shotai_tenji.html and https://www.npb.go.jp/ja/museum/tenji/kako/pdf/tenji_h26_shotai_leaflet.pdf

The flyer discusses the adoption of an imported Benton Engraving Machine in 1912 by the National Bureau of Printing and shows an old photograph of a Type 2a Benton pantograph. The citation is not explicit, but this is probably the machine imported in 1912 by the Bureau.

Okuma Hajime (大熊肇)¹⁵⁸ 2001. “岩田母型製造所を見学.” [“Iwata bokei seizōjo o kengaku,” “Tour of Iwata Mold Factory.”] Web page series on website *Tonan’s Web*

¹⁵⁷The author appears online as Masaya Nishio. I believe that this name is presented in western order and that the family name is Nishio. I apologize if I have this backwards.

¹⁵⁸This Japanese name is presented here in the traditional order. Okuma is the family name.

[in English on the site]. The pages are not dated. The date of the tour they record was 2001-02-17. Accessed 2023-01-26. Kasukabe City, Saitama Prefecture, Japan: Tonan Co., Ltd. In Japanese. <http://www.tonan.jp/okazawa-ken/010217iwa-tabokei/index.html>

[O's Journey] “オの旅 / O no Tabi.” By 2015. Video or short film, with title but no credits. In Japanese. Formerly viewable at <https://www.youtube.com/watch?v=ZAHScKibMmg>, but now a private video.

This short film documents the journey of a katakana character オ (U+30AA) from design through matrix engraving (at Agata Seisakusho), casting, and printing.

Printing Museum (Tokyo). 2020. “History of the Museum.” Tokyo, Japan: The Printing Museum. Ongoing museum history page, updated in 2020 and accessed on 2023-01-23. In English. <https://www.printing-museum.org/en/etc/history/>

Printing Museum (Tokyo). Accessed 2023-01-23. “ベントン彫刻機” [“Benton chōkoku-ki”, “Benton Engraving Machine”.] Document No. 33364. Web page. Tokyo, Japan: The Printing Museum. In Japanese. <https://www.printing-museum.org/collection/looking/33364.php>

This is the official web page of The Printing Museum, Tokyo, for their Benton Engraving Machine, probably Machine No. 49.

Rayher, Ed. 2014. “Swamp Press Turns Virtual Xenotype Cherokee Into Hot Lead Monotype.” Northfield, MA: Swamp Press.

Rehak, Theo. 1993. *Practical Typesetting*. New Castle, DE: Oak Knoll Books. ISBN: 0-938768-33-6.

Robundo. 2012-10-11. “タイポグラフィ家群像＊004 安形文夫ベントン活字母型彫刻士。” [“Group of typographers *004 Fumio Agata Benton type matrix sculptor.”] [Blog post by 朗文堂 [Robundo Publishing, Inc.] for the サラマ・プレス倶楽部 [Salama Press Club]. In Japanese. <http://www.robundo.com/robundo/column/?p=3362>

This posting contains information on the business of Agata Fumio¹⁵⁹, which had at least seven Tsugami pantographs.

Robundo. 2013-03-13. “タイポグラフィ家群像＊002 杉本幸治氏 — 本明朝・杉明朝原字製作者／ベントン彫刻法の普及者 — 三回忌にあたって再掲載。” [“Group of Typographers * 002 Mr. Koji Sugimoto — Creator of the original characters of Honmincho and Sugimincho / Popularizer of the Benton engraving method — Republished on the 3rd anniversary of his death.”] [Blog post by 朗文堂 [Robundo Publishing, Inc.] for the サラマ・プレス倶楽部 [Salama Press Club]. In Japanese. <http://www.robundo.com/robundo/column/?p=1194>

This posting contains important information on the origins of the Tsugami and Fujikoshi pantographs.

Sanseido Co., Ltd. 2021. “三省堂のあゆみ。” [“Sanseidō no Ayumi,” “History of Sanseido.”] Website updated in 2021, accessed 2023-01-23. In Japanese. <https://www.sanseido-publ.co.jp/annai/ayumi4.html>

Sasaki Printing and Publishing Museum. October 3, 2011. “文字・活字とのふれあい Day.” [“Moji katsuji to no fureai Day,” “Contact with letters and type Day.”] Face-

¹⁵⁹This is a Japanese name presented in the traditional order; Agata is the family name

book posting. Sendai, Miyagi Prefecture, Japan: Sasaki Printing and Publishing Co., Ltd. In Japanese. [hyperlink to posting on Facebook]

This Facebook posting from 2011-10-03 shows the installation of the Tsugami pantograph at the Sasaki museum. It also shows clearly the Benton-style cutter grinder which accompanies this pantograph.

Sasaki Printing and Publishing Museum. 2020. “ベントン彫刻機.” [“Benton chōkoku-ki,” “Benton Engraving Machine.”] Web page. Sendai, Miyagi Prefecture, Japan: Sasaki Printing and Publishing Co., Ltd. In Japanese. <https://www.katsujikan.jp/collection/chuzo/collection01.html>

This is the Sasaki Printing and Publishing Museum’s Collections page for their Tsugami (not Benton) pantograph.

Science Museum Group. 1937-91. “Science Museum Group. Punch and printing plate cutting machine. 1937-91” Accessed February 3, 2023. Web page with photograph and catalogue. <https://collection.sciencemuseumgroup.org.uk/objects/co37907/punch-and-printing-plate-cutting-machine-punch-cutter>
The catalog entry for this object says that it consists of the machine and “3 stone printing plates”. This is ambiguous. It could either mean three lithography stones (which would be entirely unrelated to this machine) or to 3 stone (42 pounds) of metal printing plates.

The original catalog entry for this object, transcribed as JSON data, says that it was made by the “WILLIAMS ENGINEERING CO LTD/ NODIS WORKS, EALING, LONDON, W.5.”

Science Museum Group. 1995-1516. “Benton-Waldo punch-cutter, 1995–1516.” London: Science Museum Group Collection Online. Accessed February 3, 2023. Web page with two photographs, catalogue data, and a confused and inaccurate description. <https://collection.sciencemuseumgroup.org.uk/objects/co8693027/benton-waldo-punch-cutter-machines>

Sekiguchi, Hiroyuki. N.D. “モトヤ活字資料館をお訪ねして,” [“Motoya katsuji shiryōkan o o tazune shite.” “Visit the Motoya Type Museum.”] Web page, undated. Accessed 2023-01-23. <http://fontplus.sakura.ne.jp/mojimojitalk/motoya/>

Slinn, Judy, Sebastian Carter, and Richard Southall. 2014. *History of the Monotype Corporation*. London: Printing Historical Society / Woodstock, UK: Vanbrugh Press. ISBN: 978-0-900003-15-8 (PHS) / 978-0-9930510-0-5 (Vanbrugh).

This is the definitive, but unauthorized, history of the English Monotype firm.

Soriano, Roberta (flickr.com username “Roberta SDREA”). 2013. “MAINZ — Gutenberg Museum_68.” Online photograph, taken 2013-01-19. Accessed 2023-02-02. <https://www.flickr.com/photos/robertasoriano/8578507952/in/album-72157633=051931915/>

“swing” [username]. 2014-03-25. “モトヤ活字資料館.” [“Motoya katsuji shiryōkan,” “Motoya Type Museum.”] Collection of photographs on an online photo hosting site; photos taken in 2013. In Japanese. <https://30d.jp/swing/5>

This collection of photos has some very good detail views of the Tsugami pantograph at the Motoya museum as well as a photograph of a wall chart showing the pump and choker valve operation of a Man-Nen type caster.

Tsugami Corp. 2015. “About Tsugami: History.” Web page dated 2015, accessed 2023-01-19. In English. <https://www.tsugami.co.jp/eng/company/history/>

Tsukiji Katsuji. N.D. “築地活字の概略史” [“Tsukiji katsuji no gairyaku-shi,” “Brief History of Tsukiji Type.”] Web page. Accessed 2023-01-23. Tokyo, Japan: Tsukiji Katsuji / Tsukiji Printing Co., Ltd. In Japanese. <http://tsukiji-katsuji.com/profile.html>

Walters, Gregory Jackson. 1994. *Auction of the Century: The Sale of the American Type Founders Company*. [A booklet published as an issue of the periodical] *Square Text* 9 (Autumn), pp. 99–134. Clinton, MI: Square Text / Philip Driscoll.

This has been digitized by Fritz Swanson of The Printing Stewards and is online on their website in the Gregory Jackson Walters Typographic Archive:

<https://printingstewards.org/ATAUCTION.html>

Werner, N.J. [Nicholas J.]. 1931. “N. J. An Address by N. J. Werner of St. Louis.” Booklet. St. Louis: [St. Louis Club of Printing House Craftsmen, 1931.]

This was reprinted a decade later as (Werner 1941.) Both versions have been reprinted in the CircuitousRoot Notebook on Nicholas J. Werner at <https://www.circuitousroot.com/artifice/letters/press/typemaking/history/punch-patrix-matrix-makers/werner/index.html>

Werner, N.J. [Nicholas J.]. 1941. “St. Louis in Type-Founding History.” *Share Your Knowledge Review* 22, no. 3 (January): 21-26.

This was a reprint of (Werner 1931.) Both versions have been reprinted in the CircuitousRoot Notebook on Nicholas J. Werner at <https://www.circuitousroot.com/artifice/letters/press/typemaking/history/punch-patrix-matrix-makers/werner/index.html>

Wilkes, Walter. 1990. *Das Schriftgießen: Von Stempelschnitt, Matrizenfertigung und Letterguss: eine Dokumentation von Walter Wilkes*. Darmstadt, Germany: Technische Hochschule Darmstadt / Stuttgart: Germany Hauswedell. In German. ISBN: 3-7762-0311-0 (the ISBN is the same for both the Darmstadt and the Stuttgart editions).

[Willner] A. J. Willner & Co. [auction company]. 1993. [Report of the results of the 1993 Kingsley-ATF auction.]

An almost complete copy of this provided by the late Dr. Ludwig Mohr is online on the CircuitousRoot Barth typecaster pages at:

<https://www.CircuitousRoot.com/artifice/letters/press/noncomptyp e/casters/barth/history/census/index.html>

Yuki, Akari (雪朱里¹⁶⁰) No. 12, January 9, 2019. “「書体」が生まれる—ベントンのひらいた文字デザイン第12回印刷局とベントンの彫刻機” [“Shotai’ ga umareru — benton ga hiraita moji dezain dai 12-kai insatsu-kyoku to benton chōkoku-ki,” “The Birth of Typefaces: Letter Designs Created by Benton Vol.12 Printing Bureau and Benton Engraving Machine.”] Blog posting on the Sanseido publishing firm’s “Word-Wise Web” site. In Japanese.

<https://dictionary.sanseido-publ.co.jp/column/benton12>.

This posting, No. 12, covers the importing of the first Benton pantograph into Japan in 1912.

¹⁶⁰This is a Japanese name presented in the text in the traditional order. Yuki (雪) is the family name.

Yuki, Akari (雪朱里). No. 31, October 2, 2019. “「書体」が生まれる—ベントンのひらいた文字デザイン第31回増補：築地活版とベントン彫刻機 [U+2464, circled digit 5] ベントンの移籍” [“Shotai’ ga umareru — benton ga hiraita moji dezain dai 31-kai zōho: Tsukiji kappan to benton chōkoku-ki [U+2464, circled digit 5] benton no iseki,” “The Birth of Typefaces: Letter Designs Created by Benton No. 31 Supplement: Tsukiji Letterpress and Benton Engraving Machine [U+2464, circled digit 5] Transfer of Benton.”] Blog posting on the Sanseido publishing firm’s “Word-Wise Web” site. In Japanese.

<https://dictionary.sanseido-publ.co.jp/column/benton31>.

This posting, No. 31, untangles the complete history of the Benton pantographs imported into Japan.

Yuki, Akari (雪朱里). No. 52, 2020-07-22. “「書体」が生まれる—ベントンのひらいた文字デザイン第52回ベントン彫刻機の国産化 [U+2461 circled digit 2] 大日本印刷の決意。” [“Shotai’ ga umareru — benton ga hiraita moji dezain dai 52-kai benton chōkoku-ki no kokusan-ka [U+2461 circled digit 2] Dainippon’insatsu no ketsui,” “The Birth of Typefaces: Letter Designs Created by Benton No. 52 Domestic production of Benton engraving machine 2 Dai Nippon Printing’s determination.”] Blog posting on the Sanseido publishing firm’s “Word-Wise Web” site. In Japanese.

<https://dictionary.sanseido-publ.co.jp/column/benton52>.

This posting, No. 52, contains a photograph of the cover of a 1971 brochure advertising the Tsugami pantograph.

Yuki, Akari (雪朱里). No. 54, 2020-08-19. “「書体」が生まれる—ベントンのひらいた文字デザイン第54回ベントン彫刻機の量産化 [U+2460 circled digit 1] 毎日新聞社と津上製作所。” [“Shotai’ ga umareru — benton ga hiraita moji dezain dai 54-kai benton chōkoku-ki no ryōsan-ka [U+2460 circled digit 1] Mainichishinbunsha to Tsujō seisakusho,” “The Birth of Typefaces: Letter Designs Created by Benton 54th Mass production of Benton engraving machine [U+2460 circled digit 1] Mainichi Shimbun and Tsugami Seisakusho.”] Blog posting on the Sanseido publishing firm’s “Word-Wise Web” site. In Japanese.

<https://dictionary.sanseido-publ.co.jp/column/benton54>.

This posting, No. 54, begins the discussion of the origins of the Tsugami pantograph.

Yuki, Akari (雪朱里). No. 55, 2020-09-02. “「書体」が生まれる—ベントンのひらいた文字デザイン第55回ベントン彫刻機の量産化 [U+2461 circled digit 2] 毎日新聞社の原字制作。” [“Shotai’ ga umareru — benton ga hiraita moji dezain dai 55-kai benton chōkoku-ki no ryōsan-ka [U+2461 circled digit 2] Mainichishinbunsha no gen ji seisaku,” “The Birth of Typefaces: Letter Designs Created by Benton 55th Mass production of Benton engraving machine [U+2461 circled ditit 2] Production of the original characters for the Mainichi Shimbun.”] Blog posting on the Sanseido publishing firm’s “Word-Wise Web” site. In Japanese.

<https://dictionary.sanseido-publ.co.jp/column/benton55>.

This posting, No. 55, continues the discussion of the origins of the Tsugami pantograph.

Yuki, Akari (雪朱里). No. 57, 2020-10-14. “「書体」が生まれる—ベントンのひらいた文字デザイン第57回ベントン彫刻機の普及—岩田母型とベントン [U+2460 circled digit 1].” [“Shotai’ ga umareru — benton ga hiraita moji dezain dai 57-kai benton chōkoku-ki no fukyū — Iwata bokei to benton [U+2460 circled digit 1],” “The Birth of Typefaces: Letter Designs Created by Benton The 57th Popularization of Benton Engraving Machines: Iwata Matrices and Benton [U+2460 circled digit 1].”] Blog posting on the Sanseido publishing firm’s “Word-Wise Web” site. In Japanese. <https://dictionary.sanseido-publ.co.jp/column/benton57>.

This posting, No. 57, outlines the origins (but not the ending) of 岩田母型製造所 (Iwata bokei seizōjo, Iwata Matrix Manufacturing). It also contains two photographs of the instruction manual for Tsugami pantograph engraving machine type T-PTP: the cover and the overall dimensions diagram.

Yuki, Akari (雪朱里). No. 58, 2020-10-28. “「書体」が生まれる—ベントンのひらいた文字デザイン第58回ベントン彫刻機の幅広い活用—岩田母型とベントン [U+2461 circled digit 2].” [“Shotai’ ga umareru — benton ga hiraita moji dezain dai 58-kai benton chōkoku-ki no habahiroi katsuyō — Iwata bokei to benton [U+2461 circled digit 2],” “The Birth of Typefaces: Letter Designs Created by Benton No.58 Wide Application of Benton Engraving Machine - Iwata Matrices and Benton [U+2461 circled digit 2].”] Blog posting on the Sanseido publishing firm’s “Word-Wise Web” site. In Japanese. <https://dictionary.sanseido-publ.co.jp/column/benton58>.

This posting, No. 58, continues the account of 岩田母型製造所 (Iwata bokei seizōjo, Iwata Matrix Manufacturing).

Yuki, Akari (雪朱里). 2021a. “「書体」が生まれる: ベントンと三省堂がひらいた文字デザイン.” [“Shotai’ ga umareru: Benton to Sanseidō ga hiraita moji dezain.”, “The Birth of Typefaces: Letter Designs Created by Benton and Sanseido.”] Tokyo: Sanseido [三省堂]. In Japanese. Worldcat: <https://worldcat.org/title/1272097268>. OCLC Number / Unique Identifier: 1272097268. ISBN-10: 4385349150, ISBN-13: 978-4385349152.

This book is based on a series of online columns starting in 2018 for the Sanseido publishing house. This series began with “「書体」が生まれる—ベントンのひらいた文字デザイン第1回はじめに”, [“Shotai’ ga umareru — benton ga hiraita moji dezain dai 1-kai hajimeni”, “The Birth of Typefaces: Letter Designs Created by Benton Part 1 Introduction”:] <https://dictionary.sanseido-publ.co.jp/column/benton01>

Yuki, Akari (雪朱里). 2021b. “もしベントン彫刻機がなかったら、秀英体は途絶えていたかも?” オンライントークイベント.” [“Moshi benton chōkoku-ki ga nakattara, shūeitai wa todaete ita kamo?” Onrain tōku ibento,” “If there was no Benton engraving machine, Shueitai might have died out?” Online talk event.”] Online video, uploaded 2021-12-10. Tokyo: Ichigaya Letterpres Factory / 市谷の杜本と活字館 [Ichinotani no mori hon to katsuji-kan, Ichigaya no Mori Book and Type Museum.] In Japanese. <https://www.youtube.com/watch?v=dF2PbzTCqU0>

17 • Appendix 1: 1993 ATF Results, p. 1

LOT	DESCRIPTION	MARS.	DEPOS.	SUVER	ENT.	EID	TOTAL	LOT
1	SOUTH BEND ENGINE LATHE 18" X 48"		500.00	31	1	150.000	150.00	1
2	BRACK & DECKER 10" DOUBLE END GRINDER		50.00	94	1	100.000	100.00	2
3	2-DOOR CABINET W/ELECTRICAL SUPPLIES		0.00	2	1	0.000	0.00	3
4	BENCH W/LEATHER BELT REPAIR EQUIP.		0.00	2	1	0.000	0.00	4
5	ROLLING CART W/ASST. TDOLS		200.00	2	1	40.000	40.00	5
6	LOCKERS		0.00	2	2	0.000	0.00	6
7	LOT-SPARE HOLDING FOR BART AUTO CASTER		0.00	2	1	0.000	0.00	7
8	TIME CLOCK		0.00	2	1	20.000	20.00	8
9	STRAIGHT-EDGE & SQUARE		0.00	96	1	0.000	0.00	9
10	LOT - V-BLOCKS & BRINDING JIG		0.00	36	1	0.000	0.00	10
11	ASST. CABINETS		0.00	96	2	0.000	0.00	11
12	TABLE W/ANVIL		20.00	96	1	35.000	35.00	12
13	ROLLING TABLE		0.00	96	1	0.000	0.00	13
14	CABINET W/PLUG GAUGES & JO-BLOCKS		1000.00	24	1	100.000	100.00	14
15	LOT - DRESSING KNIVES		100.00	129	1	40.000	40.00	15
16	ATF KNIFE GRINDER		100.00	13	1	25.000	25.00	16
17	ATF KNIFE GRINDER		0.00	5	1	40.000	40.00	17
18	CABINET W/ASST. NUTS-BOLTS-PARTS		2000.00	8	1	5.000	5.00	18
19	LOT - REST HAND TDOLS		0.00	1	1	50.000	50.00	19
20	LOT - HAND REAMERS		0.00	3	1	0.000	0.00	20
21	DIAM. DOUBLE END GRINDER		0.00	3	1	0.000	0.00	21
22	WORK BENCH W/LIGHT		0.00	3	1	0.000	0.00	22
23	REAMING JIG		0.00	3	1	0.000	0.00	23
24	WORK BENCH W/PARTS		0.00	3	1	0.000	0.00	24
25	HEAD-ON BENCH		0.00	3	1	0.000	0.00	25
26	WORK BENCH W/CUTTER		0.00	5	1	5.000	5.00	26
27	DUST COLLECTOR		0.00	5	1	0.000	0.00	27
28	WORK BENCH W/PARTS		0.00	113	1	5.000	5.00	28
29	BENTON VERTICAL ENGRAVING MACHINE		0.00	115	1	0.000	0.00	29
30	BENCH-CUTTER/SPINDER		0.00	2	1	100.000	100.00	30
31	BENTON VERTICAL ENGRAVING MACHINE #93		100.00	127	1	50.000	50.00	31
32	BENTON VERTICAL ENGRAVING MACHINE #60		0.00	1	1	100.000	100.00	32
33	BENTON VERTICAL ENGRAVING MACHINE #48		0.00	2	1	100.000	100.00	33
34	BENTON POWER STAND		0.00	8	1	550.000	550.00	34
35	CUTTER GRINDER		0.00	9	1	50.000	50.00	35
36	ROLLING CART		0.00	9	1	0.000	0.00	36
37	CUTTER GRINDER		0.00	1	1	150.000	150.00	37
38	BENTON VERTICAL ENGRAVING MACHINE #50		0.00	9	1	0.000	0.00	38
39	CUTTER GRINDER		0.00	8	1	700.000	700.00	39
40	BENTON HORIZONTAL ADCUT ENGRAVING MACHINE #5		0.00	8	1	100.000	100.00	40
41	FAIRBANKS PLATFORM SCALE		0.00	8	1	300.000	300.00	41
42	FILES W/ADCUT PHOTO & CUTTING SLIPS		50.00	89	1	30.000	30.00	42
43	STONING JIG FOR CUTTERS		0.00	-H0BD	3	0.000	0.00	43
44	BAUSCH & LOMB MICROSCOPE ATF 09005		0.00	2	1	10.000	10.00	44
45	CUTTING QUILLS FOR BENTON ENGRAVERS		0.00	3	1	30.000	30.00	45
46	BAUSCH & LOMB MEASURING MICROSCOPE		0.00	9	14	17.500	245.00	46
47	SETS- STEEL MATRIX PUNCHES		0.00	2	1	50.000	50.00	47
48	STORAGE CABINETS		40.00	137	8	10.000	80.00	48
49	HAND PROOF PRESS		20.00	36	2	10.000	20.00	49
50	SINGLE DOOR CABINETS W/CONTENTS		0.00	95	1	50.000	50.00	50
51	LOT-ENGRAVING PATTERNS (4-PLACES)		0.00	-H0BD	2	0.000	0.00	51
52	IMPOSING STONE W/TYPE CABINET		100.00	54	1	2100.000	2100.00	52
53	CHANDLER & PRICE 12X18 PLATEN PRESS		100.00	52	1	100.000	100.00	53
54	2 DOOR STORAGE CABINET W/CONTENTS		250.00	H 52	1	400.000	400.00	54
55			0.00	2	1	40.000	40.00	55

This page is from (Willner 1993).

The layout of this monograph was done
using the X_YL^AT_EX derivative of
Prof. Knuth's T_EX digital layout system.

Digital Lettering Faces

Latin text: T_EX Gyre Schola.

Based on URW Century Schoolbook,
which in turn is based on
ATF's Century Schoolbook by M. F. Benton.

It seems a fitting tribute.

Latin display: Gillius ADF No. 2
from Arkandis Digital Foundry.

Based on Gill Sans.

Computer text: T_EX Gyre Cursor.

Based on URW Nimbus Mono L,
which has roots in Kettler's Courier.

Japanese: TO DO: CHECK.

Traditional Chinese: TO DO: CHECK.

Simplified Chinese: TO DO: CHECK.

Hangul: TO DO: CHECK.