Reprint of

"Punch Cutting Machines."
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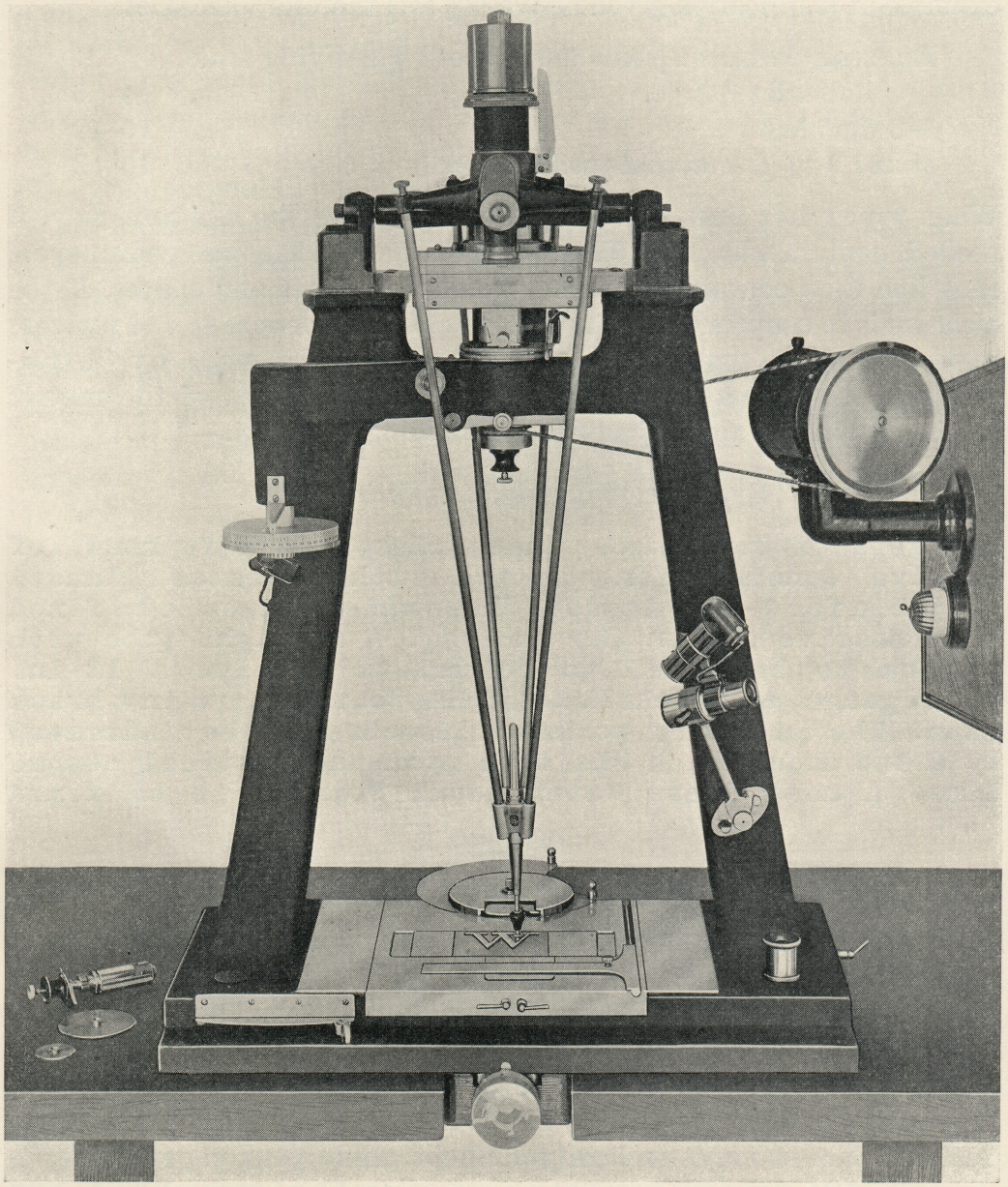
Note 1: The article ends so abruptly on p. 19 that it might be thought to be truncated. It is presented here just as it was printed in 1925.

Note 2: Most of the history of pantograph type-making methods recounted in this article is wrong. It should not be used as a reference for any future work. See the "Discussions and Corrections" appended after the article.



PIERPONT PUNCH-CUTTING MACHINE

PUNCH-CUTTING MACHINES

In British politics within recent years much argument has raged around what are known as "key" industries. These are industries upon which depend the success, and in many cases the actual existence, of greater industries. Punch-cutting is the "key" of the type-composing machinery business, without which neither "Monotypes" nor any other form of type-composing machine which makes a casting from matrices would be commercially possible. Punch-cutting is the forming of the punches required for stamping, usually in copper or gun-metal, the matrices from which the types are cast.

Before the advent of punch-cutting machines the punches used in type making were produced entirely by hand. The work was slow and tedious, and only a few expert punch-cutters were to be found.

When type-composing machines were first invented the question of the equipment of matrices at once became obvious, and it was quickly ascertained that if these machines were to become commercially successful some mechanical method of manufacturing the punches would have to be devised. Matrices could or had to be manufactured in great quantities at a high rate of production, and provision made to replace broken or worn punches with exact duplicates. It was imperative that there should be no difference in the appearance of the same letter cast from matrices impressed by different punches. These demands and necessities resulted in the evolution of the modern punch-cutting machine.

Punch-cutting by mechanical means may be said to have had its genesis a century ago. In 1827 a New York printer named Wells started the manufacture of wood type, which were cut mechanically in a machine with a flat-faced cutter revolving at high speed. The superfluous material from the end of the wood type was cut away on the same principle as that embodied in the modern routing machine, which is used for removing the unwanted surface of line blocks or stereotype plates.

In the early seventies Mr. Linn Boyd Benton, of Milwaukee, conceived the idea of mechanically cutting types which would serve as models (and from which electro-deposited matrices could be produced) to be used in connection with existing type-casting machines. Benton, like many other inventors who have revolutionised industries, was not an engineer, and his connection with the printing industry developed more or less by chance. Born on May 13th, 1844, he received his early education at the hands of a parson, who permitted him to play in the afternoons if his lessons were satisfactory in the mornings! Young Benton used to spend his afternoons in the company of a local tombstone

carver, and thus he learned the elements of letter-design. From tombstone work he passed on to repairing watches, and at this work must have learned to appreciate the value of accuracy in mechanical movements. His father was a lawyer who became interested in various newspapers, and it was as a result of this newspaper interest that the son acquired a knowledge of printing. He evidently did not like printing, and took up a book-keeper's post at a type-foundry in Milwaukee owned by an associate of his father. The proprietor of the typefoundry became bankrupt, and young Benton and a partner purchased the business. After several changes in the business a grocer named Waldo became his partner, and the business later on became a flourishing concern for the manufacture of "self-spacing" type, a term applied to type cut upon definite unit widths, similar to "Monotype" type of to-day.

Briefly described, a punch-cutting machine carries a pantograph, the lower end of which follows the outline of an enlarged pattern of the character which is to be reproduced much smaller in relief. The upper end of the pantograph carries the steel to be engraved, which is worked around a small cutting tool revolving at very high speed. The lower end of the pantograph is fitted with a roller, called the follower; this is traced around the edges of the large pattern of the character. This follower is then replaced by another of a smaller diameter, and so on until the engraved type on the steel punch body is correctly formed. The process is one of gradually cutting away the end of the steel punch body until the character is complete.

Mr. Benton worked upon this machine for twenty years, and eventually produced the first successful type-cutter. These machines must be most accurately made, and so fine is their construction that even a variation of the temperature of the room in which they are positioned may affect the nicety of their adjustments. The cutter revolves at about 10,000 revolutions per minute, and is ground under a microscope.

When the Mergenthaler Linotype Company started their business in New York they found that the process of producing their matrices, in the large quantities required, by electro-deposition was slow, cumbersome and expensive, and they conceived the idea of driving their matrices from steel punches. Mr. Benton was very doubtful as to the practicability of producing them on his machine, as it was designed to operate upon soft metal only; the Linotype Company, however, experimented with it, and certain minor modifications were made which solved the problem successfully. Little did Mr. Benton dream that his

invention was to make type-composing machines commercially practicable, but such was really the case, as the great demand for composing machine matrices made it necessary faithfully to reproduce the punches in quantities commensurate with the rate at which they were liable to become damaged or worn out.

Although a number of punch-cutting machines followed the introduction of the Benton machine none proved as satisfactory as his until the machine invented by Mr. F. H. Pierpont and manufactured by the Lanston Monotype Corporation was brought out in 1907. A little later Mr. L. A. Legros introduced a modification of the Benton machine, which added very considerably to its ease of operation, and at the same time increased the output; but in both this and the Benton machine, as well as in all other modifications of the Benton machine, there is a fundamental geometrical error, by which a punch cut from a square pattern will have two of its opposite sides concave, and the other two convex. This is not noticeable in punches for small sized letters, but it becomes apparent in those of larger sizes.

The Benton machine is capable of producing satisfactory punches when operated by experienced men, upon whose skill as much depends as upon the machine, and, naturally such men demand very high wages. As the output from the Benton machine is comparatively small, the Corporation found itself in much the same position as that occupied by the Mergenthaler Linotype Company in its early days, and it became necessary to look for a punch-cutting machine which could be accurately operated by unskilled attendants and, at the same time, give an output commensurate with the capital outlay. The machine adopted by the Corporation in 1907 is capable of producing with absolute precision eight times as many punches as the Benton. The machine is too complicated to describe in detail in the space available. There are, however, three features which should be mentioned: The pattern is automatically positioned in the machine so as to ensure the character being correctly located on the end of the punch blank; at one movement of a short lever a number of complicated and accurate movements are performed with a precision that would be impossible in a hand-operated machine; the machine is equipped with a microscope containing a vertical illuminator through which the final cutting tool is examined after the punch has been completed, for if its point is intact the punch must have been cut automatically correct. In some of the final cuts in the transit of the punch around the cutting tool only .00004″ of metal is removed.

Discussions and Corrections:

This article contains an excellent illustration of the pantograph engraving machine for punch production developed by Frank Hinman Pierpont for The Monotype Corporation (UK). Unfortunately, the text is marred by serious errors regarding the history of typographical engraving machines. Many of these seem to stem from a frequently cited, but wildly inaccurate, article by Henry Lewis Bullen in 1922 {Bullen 1922}. Here are discussions and corrections of some of the errors in this present article:

1. (p. 17, ¶4) While it is true that pantograph routing machines were used in the direct cutting of wood type from a relatively early point in the 19th century, the method of pantographic routing for wood type cutting is in no way the "genesis" of punch, patrix, or matrix cutting. It is merely another example of the common application of the pantograph in many industries throughout the 19th century. As this article notes, Darius Wells employed a "router" in 1827. (The article does not make it clear that Wells 1827 router was not pantographically controlled. The pantograph was not applied to this machine until 1834, by George Leavenworth. See {Kelly 1969}, p. 33). There is no evidence to suggest any *direct* link between these well-established methods and the introduction of pantograph engraving machinery in the 1880s.

2. (p. 17, ¶3) If one takes "type-composing machines" to mean composing typecasters and composing linecasters, then these machines did require for their commercial success the mass-production of matrices. (Actual typesetting machines which set previously cast type do not, but it is probably safe to say that these are not the machines intended here.) However, and quite remarkably, these composing linecasters (primarily the Linotype and its copies/derivatives) and composing typecasters (primarily the Monotype) were *not* developed as a consequence of machine methods in punch or matrix production. Development of both the Linotype and the Monotype began before their developers were aware of pantographic punch or matrix making technologies. We have Ottmar Mergenthaler's own evidence that he was aware of the problem of matrix production {Schlesinger 1989} (and can assume that Tolbert Lanston was aware as well), but development of these machines began with the assumption that this problem would be solved - not as a result of its having been solved. The Linotype was already in commercial production (1886) before any of its developers were aware of any punch-cutting machine (ca. 1887). Tolbert Lanston's first patent for a composing machine was filed in 1885, but the Lanston company did not acquire a punch engraving machine until 1890 ({Cost 2011}, p. 69).

The mistaken idea that these composing machines came about because of the pantograph engraving machine - a mistake which is still commonly repeated - stems from accounts such as Bullen's 1922 article on Benton {Bullen 1922}.

3. (p. 17, ¶5) There is no indication anywhere in the historical record of any involvement by Linn Boyd Benton with mechanical cutting of patrices, punches, or matrices "in the early [eighteen-]seventies." His first involvement probably dates to 1883. The first actual documentation of any of his work in this area dates to 1884 {IP 1884}.

4. (p. 17, ¶5) While it is tautologically the case that punches were cut by hand before the advent of punch-cutting machines, it is not true that punches were the only method of producing type in the 19th century. The method of (hand) engraving patrices in soft typemetal was introduced in the 1840s and became an important method of type production (especially for display types). Neither is it true that "only a few expert punch-cutters were to be found." Punch-cutting and patrix engraving were well-established trades. This misinformation may be traced to {Bullen 1922}.

5. (p. 17, ¶5) There is no indication anywhere in the historical record of any involvement by Linn Boyd Benton with mechanical cutting of patrices, punches, or matrices "in the early [eighteen-]seventies." His first involvement probably dates to 1883. The first actual documentation of any of his work in this area dates to 1884.

5. (p. 17, ¶5) While Benton may have been the first to conceive of the *mechanical* cutting of patrices for electroforming matrices, the method of cutting patrices by hand dates to the 1840s and was a widespread technology in typefounding by the 1880s.

6. (p. 17, ¶5) We do not know for certain any technical details at all of any Benton engraving machine prior to 1884, and know only a single fact concerning his machines prior to his 1885 patent. The only thing we know of his pantographs before the 1885 patent is that by July 1884 he could cut punches in steel by machine. It is *likely* that Benton first applied his pantograph engraving machine to cutting patrices in typemetal, as both this article and Bullen suggest {Bullen 1922}, but we do not actually have any evidence of this. It is likely for two reasons:

- First, it simply makes sense. Patrix cutting for electroforming was a common, efficient way of making matrices. Mechanizing this process would have been an obvious first step.
- Second, in the 1940s, William Charles Gregan, a master engraver at American Type Founders, spoke with Morris Fuller Benton (Linn Boyd Benton's son) about the elder Benton's early methods. Gregan "deduced" that Benton had first used his pantograph engraver for patrix engraving. Even though no actual evidence survives, given his professional training, Gregan's deductions carry great weight.

  See {Cost 2012}, p. 60.

7. (p. 18, ¶3) It is not true that Benton produced "the first successful type-cutter." The first types to be made from matrices created by machine were made in 1882 by William Schraubstadter (at the pantograph engraving machine) and Gustave Schroder (making the working patterns) at the Central Type Foundry in St. Louis. The matrices for these were cut directly by pantograph engraver (using a machine made earlier in German and imported in 1880 by the Cincinnati Type Foundry). {Werner 1927} {Werner 1931} While Benton was presumably cutting patrices in typemetal in 1883/1884, and certainly cutting punches in steel in 1884, he did not cut matrices directly until 1899.

8. (p. 18, ¶3) It is misleading to say that Benton "worked upon this machine for twenty years and eventually produced..." This mis-dates his machines and diminishes our appreciation of his great achievements. There is no indication that he was at work on any engraving machine before 1883, but by 1884 one was in commercial use. So he produced his first pantographic engraving machine within two years, not twenty. During the next 15 years, he produced at least five distinct pantograph machines for type-making (only two of which were vertical-format). Benton continued to work on the application of these machines until his death in 1932, 49 years after he began.

9. (p. 18, ¶4) The story of an involvement by the Mergenthaler Linotype Company in the adaptation of Benton's patrix-engraving pantograph to punch-engraving in steel is entirely false. Benton, Waldo and Co. announced machine engraving of punches in steel in July 1884 (in *The Inland Printer* {IP 1884}, p. 21). This was two years before the commercial introduction of the "Blower" Linotype. This first commercial form of Linotype was put into production in 1886, initially with electroformed matrices and later with matrices made from hand-cut punches (see {Schlesinger 1989} but also Mergenthaler's patents). The Linotype syndicate did not become aware of Benton's machine until late 1887. This demonstrably false story was first told by Bullen, but unfortunately has been repeated widely since then, sometimes by otherwise reliable authorities. {Bullen 1922}

10. (p. 19, ¶2) The assertion that no other pantograph was as "satisfactory" as Benton's until Pierpont's in 1907 must be seen both as an excess of corporate pride and as ignorance of other machines. "Satisfactory" is a subjective term, but a tremendous amount of work of the first quality was done on non-Benton pantographic engraving machines prior to (and subsequent to) the introduction of Pierpont's machine. To cite a few notable examples:

- Pantographic type-making machines were employed by Werner and Schroeder in their commercial matrix engraving services after they left the Central Type Foundry in the late 1880s (they cut DeVinne, for example). {Werner 1927} {Werner 1931}
- A pantographic engraving machine was developed by Robert Wiebking and Henry H. Hardinge and used by them for their well-known commercial matrix engraving service in the 1890s and later (engraving many of Goudy's early types, for example). {CR Wiebking} Wiebking was very secretive about his machines, but his services were well-known.
- The machines designed by Barr in England for Linotype & Machinery around 1900 appeared to serve Linotype well.

Notes and References:

{Bullen 1922} "Linn Boyd Benton: The Man and His Work."
The Inland Printer. Vol. 70, No. 1 (October, 1922): frontis, pp. 60-64.

{Cost 2011} Cost, Patricia A. *The Bentons*.
(Rochester, NY: RIT Cary Graphic Arts Press, 2011)

The information from Gregan was communicated first to Theo Rehak
and then to Patricia Cost, who finally published it.

{CR Wiebking} For an extensive discussion of the Wiebking/Hardinge engraving machines, see the CircuitousRoot Notebook at:

http://www.CircuitousRoot.com/artifice/letters/press/pantocut/wiebking/index.html

{IP 1884] The Inland Printer. Vol. 1, No. 10 (July 1884).

The trade note where Benton, Waldo and Co. offer the cutting of punches in steel by machine appears on p. 21.

{Kelly 1969} Kelly, Rob Roy. *American Wood Type: 1828-1900.* (NY: Van Nostrand Reinhold, 1969).

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

This is Mergenthaler's autobiography, written in the third person. Schlesinger deduced that the matrices used in the first six months of production of the "Blower" Linotype in 1886 were made using electroforming. We can also see this by an examination of Mergenthaler's patents (e.g., US 347,629 1996-08-07, sheet 10), which at this time clearly show electroformed matrices. (Old patent copies were harder to obtain in 1989, and presumably unavailable to Schlesinger.) We know from Mergenthaler's own account in this book that the "Blower" Linotype later employed matrices punched from hand-cut punches.

{Werner 1927} Werner, Nicholas J. "St. Louis' Place on the Type-Founders' Map." *The Inland Printer.* Vol. 79, No. 5 (August 1927): 764-766.

{Werner 1931} Werner, Nicholas J. "An Address by N. J. Werner of St. Louis." (St. Louis, MO: St. Louis Club of Printing House Craftsmen, 1931) Reprinted as "St. Louis in Type-Founding History" in *Share Your Knowledge Review*, Vol. 22, No. 3 (January 1941): 21-26.

Both of the Werner articles are reprinted at:
http://www.CircuitousRoot.com/artifice/letters/press/typemaking/history/punch-patrix-matrix-makers/werner/index.html

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