Machine Dossier for BEM2a-53
(Benton Pantograph)

Part I: Identification

The current distribution of this machine dossier is at:
https://www.CircuitousRoot.com/artifice/letters/pantocut/benton/machine-dossier-bem2a-53/index.html

Contents

Part I: Identification

I.1• Overview

I.1.A• Identification Code

Within the CircuitousRoot workshops and collection this machine may be identified by the character string `BEM2a-53` (for "Benton Engraving Machine, Type 2a, Machine Number 53"). Accession date: 2021-08-06.

No true serial number is known for this machine and it bears no identifying plates or serial number stamps. The number "53" is the match number stamped on the major components of the pantograph arm assembly.[1] All other Type 2 Benton Engraving Machines examined so far have equivalent, but different, numbers in these locations and in each case these numbers match the "machine numbers" called out in the 1993 American Type Founders auction list. It is therefore reasonably safe to assume that it is unique over all BEM2 pantograph arm assemblies. The maching number stamps on BEM2a-53 are done with at least two different styles of punches, which indicates that components were replaced and re-fitted over time.

The choice of name for this machine, Benton Engraving Machine, is deliberate but not without question.

Theo Rehak and the former Dale Guild Type Foundry preferred to call this a Benton Engraving Machine (which, of course, it is). But there were other Benton Engraving Machines which were unrelated to this one.[2] Moreover, it was at times referred to in surviving ATF literature by other names.[3] Still, it seems most respectful to keep Benton's name in the name of the machine, and the vertical engraving machines were certainly the most significant of his pantographs, so BEM it is.

There were two styles of Benton vertical pantographs produced, each with some variation in form. The history of both of these styles is covered in greater detail in *A Census of Benton and Related Pantographic Engraving Machines* (MacMillan 2023). In the taxonomy of that document, BEM2a-53 is a Type 2a machine.

[1] This in itself is interesting information. It means that the Benton vertical pantographs were not made with fully interchangeable parts. Parts for critical assemblies such as the pantograph arm were fitted to each other and might not fit correctly with other instances of this machine. This was not uncommon. 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.

[2] A surviving example is the "Ad-Cut" pantograph now at the Letter Kunde Press in Antwerp. It is a commercially made four-bar horizontal pantograph modified by Benton to accept his quills.

[3] For example, in the journal kept by John Bauer when delivering Benton pantographs to a customer in Japan he refers to it simply as a "Matrix Engraving Machine" (Rehak 1993, 109).

I.1.B• Brief Description and Summary of Importance

(Think of this as a museum placard.)

Linn Boyd Benton was the second person in the United States to use a pantographic engraving machine in the process of manufacturing typographical matrices. No examples of his first type of pantograph, based on his patent filed in 1884 are verified to have survived. This is one of eight surviving examples of his second type of pantographic engraving machine (based on his patent filed in 1899). It is suitable for cutting punches in steel for driven matrices, cutting patrices (pattern types[4]) in soft metal for electroformed matrices, and for engraving matrices directly. Benton's 1884 and 1899 patent machines are unusual because they are single-arm vertical-format machines rather than traditional four-bar pantographs.

The Benton pantographs were not the first typographical pantographs. They were, however, highly influential. In particular, both the American and English Linotype and Monotype companies adopted them and went on to develop vertical-format pantographs of their own. Their success was such that it has been common for many decades for even well-informed typographers to call any typographical pantograph, of any kind by any maker, a "Benton."

This particular example was in service by at least 1905. It was one of five preserved by typecasting enthusiasts at the 1993 auction which disposed of the assets of the American Type Founders Company.

[4]Linn Boyd Benton called these "originals" (Benton 1906).

I.1.C• Basic Identification Photos

Figure I.1.1: BEM2a-53, Benton Engraving Machine No. 53

Figure I.1.2: Power Stand for No. 99

Figure I.1.3: BEM2a-53, Front

Figure I.1.4: Motor Side

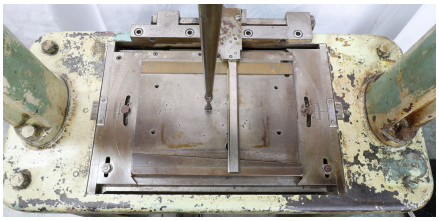


Figure I.1.5: BEM2a-53, Table

Not shown: Flexible drive cable from power stand to quill.

Figure I.1.6: Property Tag Location

Figure I.1.7: Brass ATF Property Tag

I.1.D• What Does It Do?

Cast metal letterpress printing type may be thought of as having three parts: the body, the shoulder, and the face.

[TO DO: Illustrate]

It is made in what a nonspecialist might think of as a two-part mold. The mold proper (as a typecaster might consider it) defines the body of the type. This mold is closed off at one end by a "matrix" which contains, in intaglio, the face and shoulder of the type.

The Benton Engraving Machines are used in the creation of this matrix. This may be done in any of three ways.[5] The engraving machine might:

- Cut a punch in steel, which is then driven into a blank to form the matrix.
- Cut a "patrix" or pattern type in soft metal, around which a matrix (or its casting cavity) is then electroformed.
- Engrave a matrix directly.

Any of the Benton Engraving Machines could in principle be used for any of these three methods. The early "Type 1" machines (of which little record exists) were constructed in such a way that workholding for patrix and punch cutting was straightforward. The later "Type 2" machines were constructed in such a way that blanks for patrices, punches, and matrices could all be held easily.

For all methods, the engraving machine was only one of a coordinated set of machines involved in matrix production. Other necessary machines include

- Other pantographs for pattern production
- Electroforming equipment if electroformed patterns are used
- Cutter grinders.
- Depth gauges and other small measuring tools.
- Presses for matrices produced by driving steel punches
- Electroforming equipment for matrices produced from soft metal patrices
- Matrix fitting and facing machines.
- Microscopes for inspection.
- Optical projectors for design and review.
- Justifier's force pump and hand molds for test casting
- Type dressing bench for test casting
- Printing equipment for proofing

In the industrial era of metal type, from the mid-19th to the late 20th centuries, type making required considerable equipment and the involvement of many skilled people. Lone designers such as Frederic Goudy, Rudolf Koch, and Victor Hammer who retained individual control over the entire process, while well publicized, were outliers.

[5] There were additional matrix creation methods, including early sandcasting methods, the "lead matrix" method reverse-engineered by Stan Nelson, and the built-up large matrices of the "sanspariel" types. These were all special cases used, typically, for large types.

I.1.E• What Was Its Historical Context?

(The material here is just a brief sketch without source citations. A full treatment of this subject will be forthcoming in the monograph *The Typographical Pantograph: Correcting the Received Narrative*.)

I.1.E.i• Myths

Three myths must be dispelled in order to understand the place of the Benton pantograph in history.

First, typemaking did *not* proceed directly from hand punchcutting to steel punch engraving. Since at least the 1940s, the method of matrix making by electroforming from patrices — first from hand-cut patrices and later from machine-cut patrices — has been written out of the history of typemaking as it is known in America and England. In fact it was not only an important method, but in many cases it was the dominant method. This omission is regrettable because it has led to false conclusions by well-intentioned authors.

Second, Linn Boyd Benton was not the first to apply a pantograph to the making of either punches in steel, patrices in soft metal, or matrices directly. This claim, still frequently repeated, was known to be false as early as the 1920s and can be refuted on firm evidence.

Third, Benton was rather late to the game in the direct cutting of matrices. Matrix engraving was offered as a regular commercial service by at least two independent firms in the late 1880s and mid 1890s. Issues of matrix workholding were not addressed by Benton until his second vertical pantograph patent (filed 1899). Patrix cutting by machine (which remains a viable technology even today) was in use at ATF alongside direct matrix engraving until well into the 20th century.

In considering this subject is is also useful to understand just how popular the pantograph was in this period. It is only a slight exaggeration to say that in the late 19th century every technical problem had a pantograph applied to it in much the same way that we apply a computer to everything today.

I.1.E.ii• Quick Chronology

Non-Cutting Precursors

The first application of pantographs to the making of type happened in relative isolation, but remains important. Between 1838 and 1841 Homan Hallock, an American missionary and printer in Smyrna, employed a pantograph to draw what were to him unfamiliar Arabic and “Nestorian” (Syriac) glyphs onto punch blanks for hand punchcutting. While his work received attention in the press in the USA, it does not seem to have been directly adopted.

It is also worth noting that, surprisingly, there seems to have been no technology transfer between the use of pantographs for the direct cutting of wood

types (by William Leavenworth circa 1834 and Edwin Allen in 1836) and the later use of pantographs for punch, patrix, and matrix making.

By 1872, MacKellar, Smiths and Jordan were using a pantograph in some way in their type production. The details of this are not known, but it is most likely that this was for drawing scaled letterforms for hand punch or (more likely) patrix cutting. One photograph of a vertical-format pantograph which *might* have been used at this date survives (from a later publication, in 1896).

The First Use in Cutting

Various attempts and claims for the use of a pantograph to *cut* (vs. to draw) in type making appear in the late 1870s and very early 1880s. The trail here leads to Germany, where Herman Wiebking attempted to cut matrices by 1879 and H. Hofer, a manufacturer of engraving machines, is reported to have engraved matrices by 1881.

The first verified use of a pantograph to cut in the matrix making process was in 1882 at the Central Type Foundry in St. Louis. This was done with a machine which they had purchased from the Cincinnati Type Foundry. The Cincinnati T.F. had in turn, imported it from Germany in 1880, but had been unable to use it successfully. At the Central, Carl Schraubstadter, Jr. used this pantograph for the direct engraving of the matrices for the face "Geometric" in sizes larger than pica. The patterns for the Central's effort were made by Gustav Schroeder. No image of this pantograph survives, but it was a horizontal four-bar machine.

In addition to Geometric, Schraubstadter also cut Geometric Italic, Scribner, Morning Glory, and their pioneering face, Typewriter, for the Central.

Benton's First Pantograph

There is no evidence that Benton had begun work on his pantograph in 1882, when the Central began direct matrix engraving. He must have started relatively soon after that. Nicholas Werner, in his account of the early matrix engraving at the Central, does credit Benton with the first cutting of a Roman (vs. gothic[6]) type.

Benton's first machine would have been well adapted for cutting both patrices in soft metal and punches in steel. It is almost certain that he was cutting patrices. It is completely certain that he was also cutting punches, because in July of 1884 a trade note originating from Benton, Waldo & Co. claims the ability to cut punches in steel by machine.[7]

Commercial Matrix Engraving in the 1880s and 1890s

[6] Sans serif, in modern terminology

[7] The story that Henry Lewis Bullen told in 1922 about P. T. Dodge visiting Benton and convincing a reluctant inventor to try his hand at steel punchcutting has no truth in it. That event, had it happened, would have to have occurred around 1887. We know that Benton was cutting punches in steel by 1884.

Schroeder and Werner purchased the Central's pantograph in the late 1880s, and also had another constructed. With these they embarked upon commercial matrix engraving services, producing (for example) eight sizes of DeVinne as well as various other faces.

In 1896, Robert Wiebking and Henry Hardinge (co-founder of the Hardinge machine tool firm) constructed a horizontal four-bar pantograph and began offering commercial matrix engraving services. They cut, among many other things, some of Goudy's first types.

Benton's Second Pantograph

By the mid-1890s, commercial typographical matrix engraving was well-established. We do not yet know when Benton began direct matrix engraving. In principle, nothing in the machines based on his 1884 patent would preclude this. However, both the patent drawings and the known photographs of machines as constructed show a form of construction which would have made holding a matrix blank difficult. The machine described in his 1899 patent (issued 1906) inverted the relationship of the workpiece and cutter. Machines of this form (such as BEM2a-53) could be used equally well for patrix cutting, punch cutting, and direct matrix engraving. We know also that patrix cutting continued after 1900 at ATF.

Where BEM2a-53 Fits In

Benton's pantographs occupy what can only be called an iconic place in the history of type. Every account of typemaking with aspirations to completeness now includes a paragraph about them, always claiming them to be the first. But while they were not the first, or even the most important in terms of overall production,[8] they were the best known. They were also highly influential. It is unlikely that the Mergenthaler, Intertype, and Monotype firms would have developed vertical-format pantographs but for Benton's example.[9]

The "Type 2" Benton engraving machines such as BEM2a-53 need to be seen in context as but one kind of machine in a dynamic period of the mechanization of type production from the 1870s through World War One, but this does not in any way diminish their importance.

[8]The machines produced by Wiebking for Ludlow, by Pierpont for the Monotype companies, by the Linotype company, and by many other matrix makers and type foundries produced far more of the type seen in the 20th century.

[9]Taking this further, the Benton-derived Tsugami pantographs and further derivatives in China were produced by the hundreds.

I.1.F• How Rare Is It?

This question is best answered by the monograph *A Census of Benton and Related Pantographic Engraving Machines*. This is online at `https://circuitousroot.com/artifice/letters/pantocut/benton/census/index.html` and may be considered to be incorporated into this machine dossier by reference.

At the time of writing, a total of eight "genuine" ATF-manufactured Benton vertical pantographs are known to survive. This may represent about 20 percent of the total production.[10]

Of these two are the larger "Type 2b" model (No. 60 (63?) and No. 99), while the rest are Type 2b (smaller) models.

One larger model (No. 60 (63?)) is presently engaged in commercial matrix cutting. One smaller model (No. 55) is engaged in experimental matrix cutting. One smaller model (No. 53, the subject of this machine dossier) is incomplete but undergoing active restorative conservation. One larger (No. 99) and two smaller (No. 48 and No. 50) machines are in private or institutional hands and may be returned to operational status. Two smaller machines (No. 49 and No. 62(?) are in museums and are unlikely to be returned to operation.

A larger number of copies of the Benton Type 2 pantograph were made in Japan and China. At least twelve survive, which is likely less than 5 percent of total production.

No Type 1 Benton pantographs are, at present, confirmed to have survived.[11] Copies of the Type 1 Benton were made in Europe; of these a very few survive.

This ATF-manufactured Type 2a Benton, BEM2a-53, should be considered rare.[12] As importantly, it is iconic in the history of American type making. Its conservation is important. As a machine at CircuitousRoot, it also presents a good opportunity for documentation of the machine and its protocols more extensively than has been done in the past.

[10] This is based on Theo Rehak's rough estimate of a total production of about three dozen machines.

[11] One incompletely identified Type 1 machine now in storage in the Gutenberg Museum in Mainz *might* be a genuine Benton rather than a copy.

[12] Using the IUCN Red List categories for classifying endangered species, ranging from "Extinct" to "Least Concern," the Benton Engraving Machines would be classified as "Endangered."

I.2• Provenance

I.2.A• Machine No. 53

This machine was built by American Type Founders Company. Except for pouring castings, ATF had the in-house capability to manufacture such a machine; there is no reason to believe that its construction was outsourced.

We do not know the date it was built. It is what I am calling a "Type 2a" Benton pantograph. These are based on Benton's 1906 US patent, number 809,548, which was filed February 17, 1899. It is unlikely, therefore, that this machine was made substantially before 1899. A cutting slip for this machine survives which indicates that 19 hours of work in cutting characters was completed on "July 14/05" (meaning 1905-07-14)[1] This means that it must have been built before the middle of 1905.

We do not know the location at which it was manufactured. During the range of dates given above (circa 1899 to mid-1905) ATF was in a process of transition from several manufacturing foundries to a single Central Plant in New Jersey. The building for this plant was complete by the 1903 ATF annual report (fiscal year ending Aug. 31, 1903), but the typefounders' strike from October 1903 to January 1904 delayed its occupancy. The ATF annual report for 1904 indicated that the Central Plant was in production. The 1906 report indicated that all production was by then consolidated into the Central Plant.[2]

It is therefore very likely (though of course not absolutely certain) that it is one of the six Type 2a machines shown at work in the two circa 1912 photographs of the ATF engraving department.

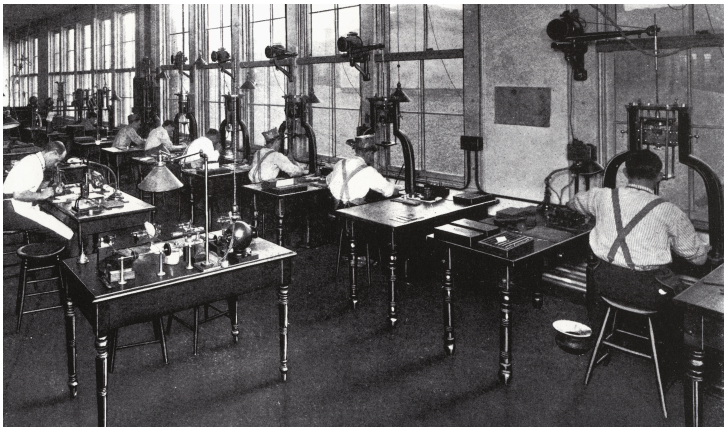


Figure I.2.1: ATF Engraving Department, circa 1912[3]

[1](ATF 1905).

[2]For a discussion of this see the CircuitousRoot Notebook "American Type Founders: Early History through 1906," https://www.circuitousroot.com/artifice/letters/press/noncomptype/typography/atf/history-early/index.html

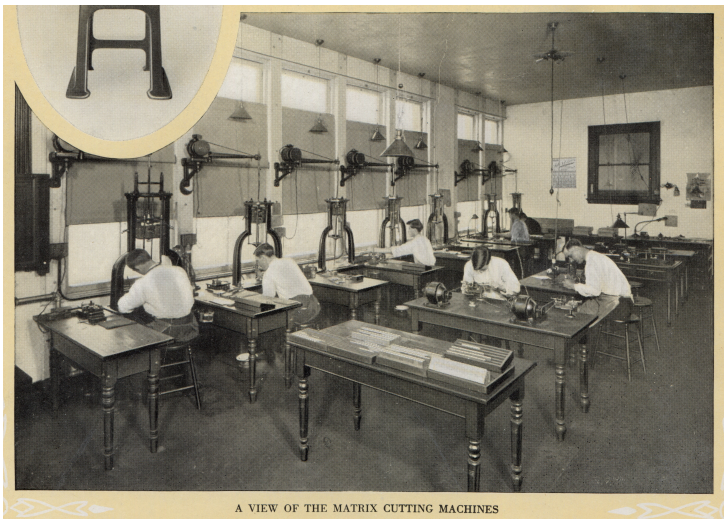


Figure I.2.2: ATF Matrix Cutting Machines, by 1912[4]

At some point this machine was modified as a part of an experimental program. Theo Rehak writes:

> During the period of my presence at ATF Elizabeth I learned it was sacrificed for an experiment to cut curved wire type matrices for Kingsley's lucrative government contract for "curved wire" of chrome plated zinc type for the stamp-marking of round wire. ATF wanted to eliminate the arduous and labor intensive electro matrices which wore out quickly. Hence, the revolving pattern base, which was finally considered a failure and so marked the device to be scrapped. That it was not scrapped merely shows that it was kept as a source of cannibalized parts (a common ATF practice toward the end) …[5]

My own estimation of the state of the machine as it is (ignoring obvious missing parts, such as the lack of a matrix jig) is that much of this additional apparatus was removed from the machine and it was returned to a state where it could be used for ordinary engraving. Some vestiges of the "curved wire" project may survive on the machine (such as the rotational and translational capabilities of the table, which are not present in other BEMs), but the relationship, if any, between these features and the "curved wire" project may never be known.

As Theo notes, this machine continued to be owned by ATF until the liquidation of its assets in the 1993 auction. Photographs of the ATF plant prior to the auction, however, show it as an unpowered machine which had been moved aside.[6]

[3](ATF 1912b/2002)

[4](ATF 1912a, ix)

[5]Theo Rehak, email to DMM 2023-03-03 11:22:25 -0500.

[6]See for example (Dale Guild 2010).

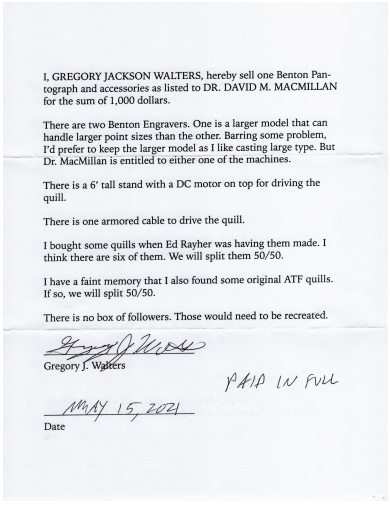
Figure I.2.3: Auction Tag

It was Lot No. 30 in the 1993 ATF auction and was purchased by Gregory Jackson Walters for $100.00 on Tuesday August 24, 1991. See (Walters 1994, 105) and (Willner 1993, 1). In his account of the auction, Walters said that it was "missing a lot of parts" as purchased by him. At the auction the auctioneers intended to sell the pantographs without quills, Walters noted that, surreptitiously, "one of our number was kind enough to put a quill in each machine" (Walters 1994, 106). Ed Rayher has confirmed that he was the one who did this. Entirely by coincidence, the quill Ed put into this machine, No. 53, was one marked 53[7] and may have been one once associated with this machine.[8]

[7]Ed Rayher, email to DMM, 2023-02-21.

[8]Other quills marked "53" survive with BEM No. 55.

It remained unused in Walters' collection in Piqua, Ohio until 2021, when it was purchased by Dr. David M. MacMillan (the author). I posted the check to Greg for this machine on May 19, 2021. I collected the machine over the weekend from Friday, August 6 through Sunday August 8, 2021.[9]



I, GREGORY JACKSON WALTERS, hereby sell one Benton Pantograph and accessories as listed to DR. DAVID M. MACMILLAN for the sum of 1,000 dollars.

There are two Benton Engravers. One is a larger model that can handle larger point sizes than the other. Barring some problem, I'd prefer to keep the larger model as I like casting large type. But Dr. MacMillan is entitled to either one of the machines.

There is a 6' tall stand with a DC motor on top for driving the quill.

There is one armored cable to drive the quill.

I bought some quills when Ed Rayher was having them made. I think there are six of them. We will split them 50/50.

I have a faint memory that I also found some original ATF quills. If so, we will split 50/50.

There is no box of followers. Those would need to be recreated.

Gregory J. Walters

PAID IN FULL

MAY 15, 2021

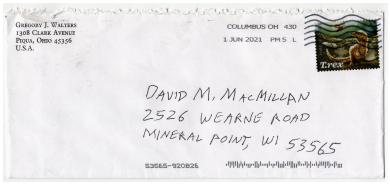
Date

Figure I.2.4: BEM2a-53 Bill of Sale, 2021-05-15

Here is the bill of sale for the machine. Greg signed and dated it on May 15, 2021, but by the time he sent it on June 1, 2021 he had already received my check for it. He therefore kindly marked it "paid in full." The original documents are kept with the machine.[10] Scans of them are in this dossier's archive of source material. My email correspondence with Greg about this machine also happens to reference other people and events not directly related to the machine. To respect their privacy, this correspondence has been filed in the private archive of source material.

Sadly, Gregory Jackson Walters passed away on January 17, 2022.

This machine remains in my collection at the time of writing.



GREGORY J. WALTERS
1308 CLARK AVENUE
PIQUA, OHIO 45356
U.S.A.

COLUMBUS OH 430
1 JUN 2021 PM 5 L

DAVID M. MACMILLAN
2526 WEARNE ROAD
MINERAL POINT, WI 53565

53565-920826

Figure I.2.5: BEM2a-53 Bill of Sale, Envelope, 2021-06-01

[9] I would like to acknowledge the help of Fritz Swanson and Jody Harnish (of The Printing Stewards, Inc.) and Rob and Kim Miller (Tribune Showprint, Muncie). They made everything so much easier.

[10] They're in the green metal letter-file box, along with the original auction tags.

I.2.B• Power Stand

The power for a Type 2 Benton pantograph is delivered via a rotating shaft from above.[11] Each machine has its own motor drive. Originally these were wall-mounted. This is shown in the circa 1912 views of the ATF matrix engraving department (see for example Fig. I.2.1).

At some point these wall mounted drives were placed onto tall stands (the ATF 1993 auction list calls these "Power Stands.") Some sense of this can be obtained from the view of the last ATF plant shortly before the 1993 auction which was published online by the Dale Guilde Type foundry at: `https://www.flickr.com/photos/47496314@N06/4579566999/` (Dale Guild 2010). That photograph shows BEM2a-53 by itself on the left (Lot 30) and machines 99 (lot 32), 60 or 62 (lot 33), and 48 (lot 34) along the windows (No. 50, lot 39, does not appear in this photograph).

Machine 53 did not come with any power stand. Machine 99 (lot 32) came with a power stand which also bore the lot number 32. Greg Walters acquired No. 99 with its power stand for $300.

When I purchased machine 53 from Greg in 2021, he decided to include with it the power stand that had originally been with machine 99 (auction lot 32). This power stand is now with machine 53 at CircuitousRoot.

Figure I.2.6: Auction Tag for the Power Stand

[11] This is one way easily to distinguish a Type 2 machine from a Type 1. The earlier machines had their power delivered by belt from the side.

I.3• General Photographic Survey

These views of BEM2a-53 were taken in early 2023 at CircuitousRoot.

Figure I.3.1: General View, Front

Figure I.3.2: General View, 3/4 Front, Operator-Right (Note that there is some perspective distortion in this and other views.)

Figure I.3.3: General View, Side, Operator-Right

Figure I.3.4: General View, 3/4 Back, Operator-Right

Figure I.3.5: General View, Back

Figure I.3.6: General View, 3/4 Back, Operator-Left

Figure I.3.7: General View, Side, Operator-Left

Figure I.3.8: General View, 3/4 Front, Operator-Left

Figure I.3.9: Underneath, Looking Up (Back is at Top)

Figure I.3.10: Table

Figure I.3.11: Table with Pattern[1]

[1]This pattern was acquired in 2011 from Stanton Peters, who in turn acquired it from his late business partner Henry Weiland.

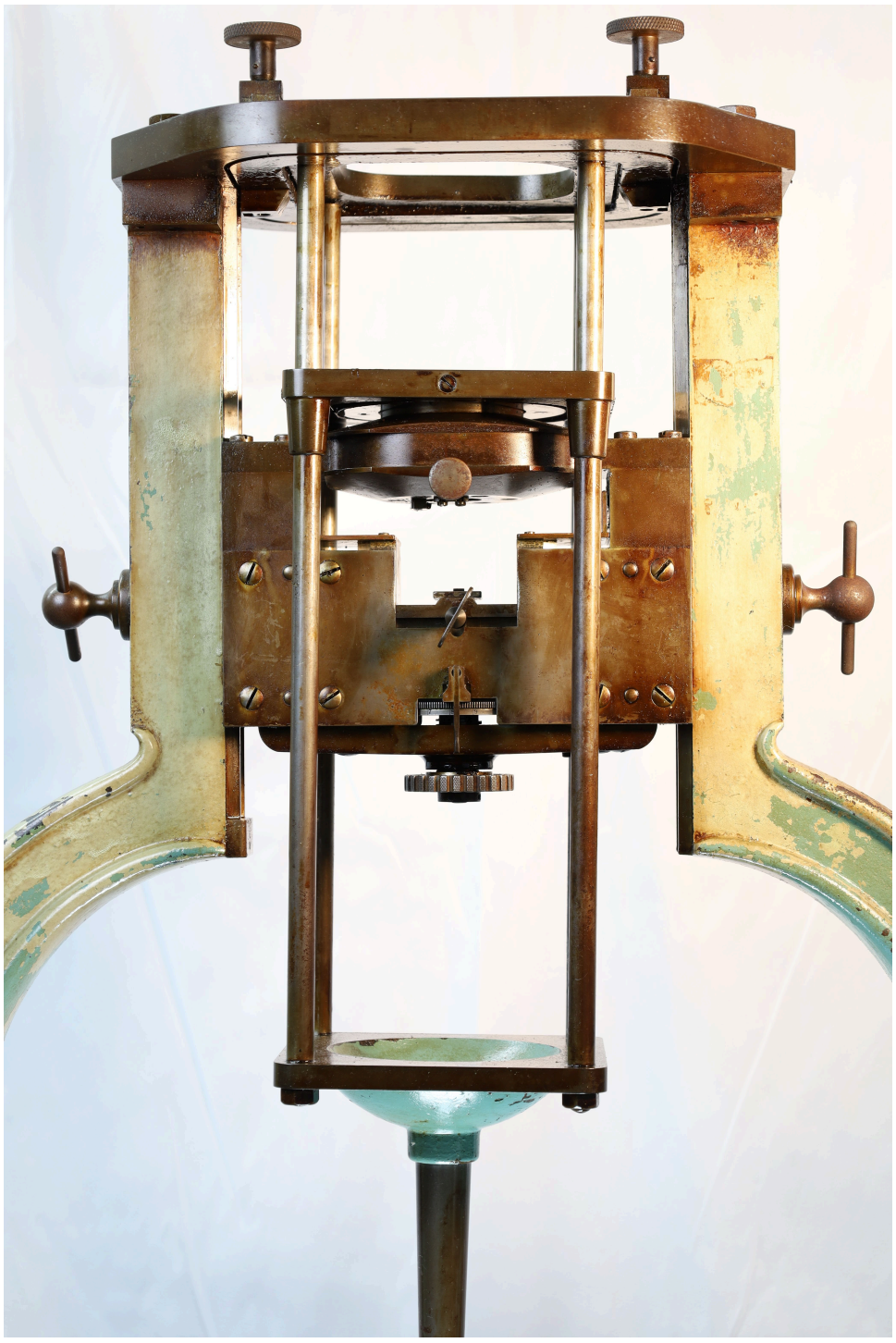


Figure I.3.12: Pantograph Mechanism and Head

As Greg acquired the machine at the ATF auction, there was one quill with it. Subsequently, Ed Rayher commissioned several new quills from a Massachusetts machine shop, HEBCO. Greg acquired several of these and included two with BEM2a-53.

This is the genuine ATF quill (facing right), with an ATF-sharpened cutter installed.

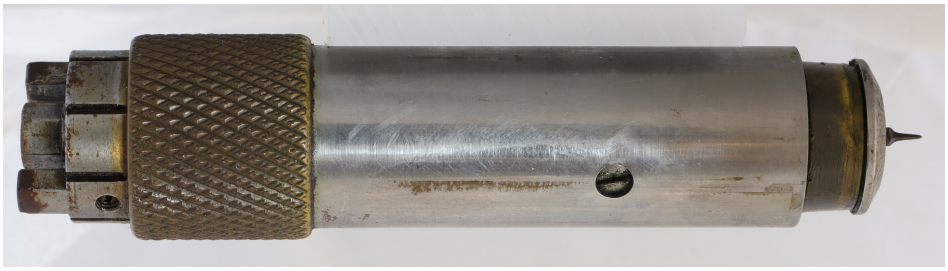


Figure I.3.13: ATF Quill #53, General View (with cutter)

This is one of the two HEBCO quills (facing left). The HEBCO quills originally had a knurled ring similar to that of the ATF quills, but neither of the two HEBCO quills acquired with BEM2a-53 had this ring installed.

Figure I.3.14: HEBCO Quill, General View

I.4• Record of All Markings, Tags, Etc.

This record includes only markings intended for identification. It does not include the scales on the table.

I.4.A• On the Engraving Machine Itself

A brass property or asset tag is screwed to the operator-right rear of the part 00.0 Base casting. Rehak has confirmed this, saying "Yes, the oval brasses riveted to the equipment are property tags. ATF was keenly aware of asset control."[1]

Figure I.4.1: Property Tag Location

Figure I.4.2: Brass ATF Property Tag

The auction tag for this machine from the 1993 auction survives and is preserved with the machine. It was still physically attached to the machine when acquired by DMM in 2021.

Figure I.4.3: 1993 Auction Tag (Lot 30)

[1]Theo Rehak, email to DMM on 2023-03-10 12:58:38 -0500.

On the operator-left side of the 00.0 Base casting something has been removed. It might have been an identifying tag, but it is also likely that it was a device of some kind.

Figure I.4.4: Operator-Left Side

Figure I.4.5: Removal Evidence

The primary evidence of the identity of this machine is its "machine number." This is stamped at several locations in the pantograph mechanism itself: three times on the frames of the upper gimbal, three times on the frames and quill aperture of the quill gimbal, and once on the 30.80 Wand plate. These levels are pointed to in Fig. I.4.6 at right.

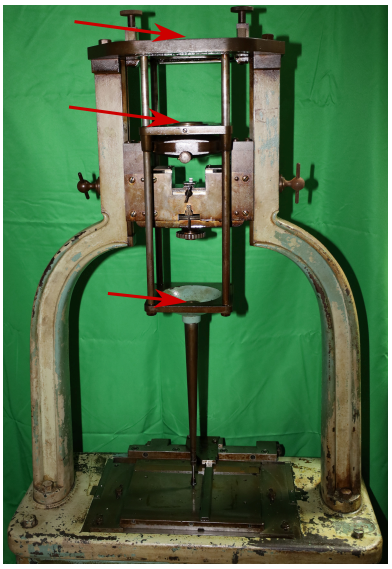


Figure I.4.6: Locations

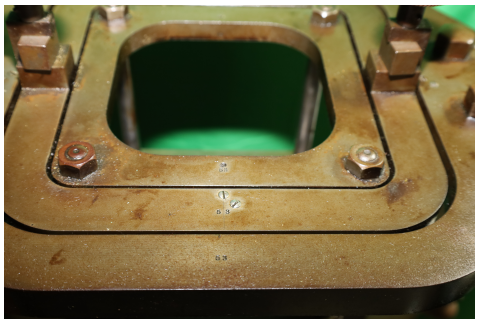


Figure I.4.7: Upper Gimbal Frames

Figure I.4.8: Three Times

Figure I.4.9: Quill Frame

Figure I.4.10: Two of Three Times

Figure I.4.11: On the Quill Aperture

Figure I.4.12: Quill Aperture

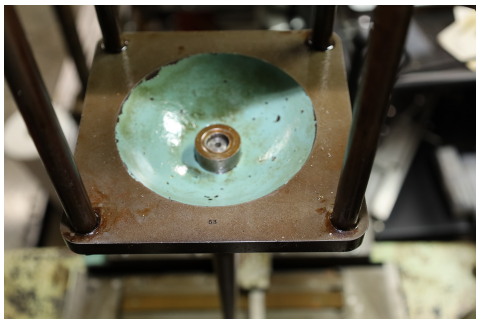


Figure I.4.13: Wand Plate

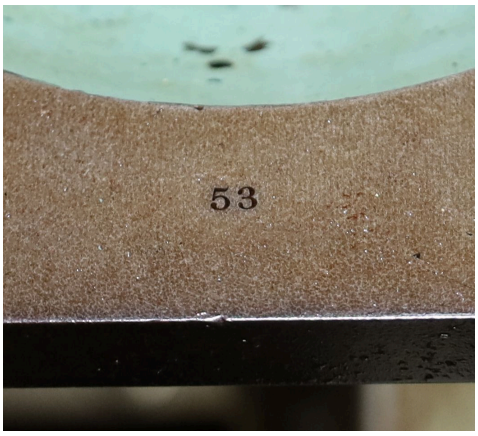


Figure I.4.14: One Time

The four 30.40 Pantograph rods are also stamped with fitter's numbers. These run from 1 to 4, starting with the front operator-right rod and continuing counterclockwise around the machine. The corners of the 30.50 Quill gimbal outer frame are numbered correspondingly. I have not yet found similar numbers on any of the other gimbal frames or on the 30.80 Wand plate.

Here for reference is the Wand plate (ignore the drops of oil below the rods):

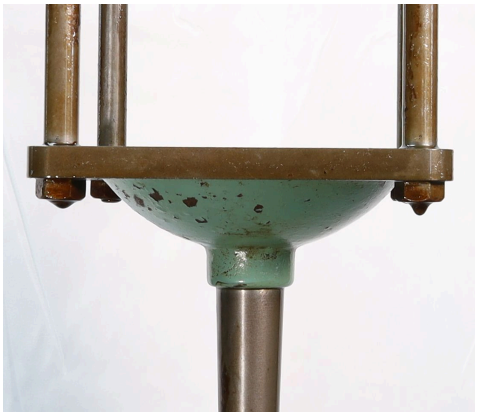


Figure I.4.15: Wand Plate, Front View

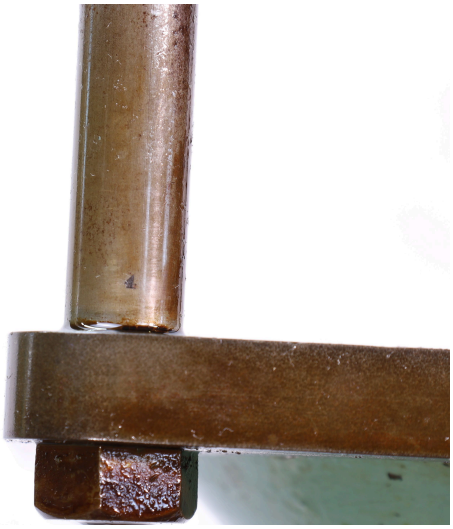


Figure I.4.16: Rod 4, Front Left

Figure I.4.17: Rod 1. Front Right

Figure I.4.18: 4

Figure I.4.19: 1

Here are the two rods on the back of the machine.

Figure I.4.20: Rod 2, Back Left

Figure I.4.21: Rod 3. Back Right

Figure I.4.22: 2

Figure I.4.23: 3

Figure I.4.24: Quill Gimbal Outer Frame, Front View

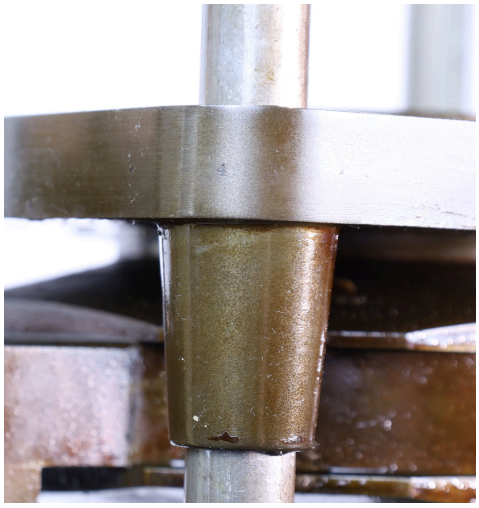


Figure I.4.25: Corner 4, Front Left

Figure I.4.26: Corner 1, Front Right

Figure I.4.27: 4

Figure I.4.28: 1

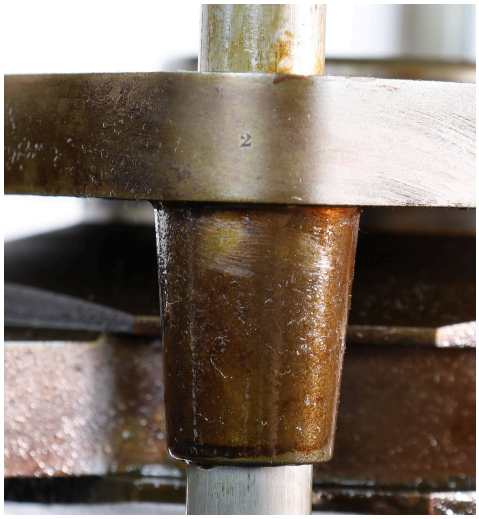


Figure I.4.29: Corner 2, Back Left

Figure I.4.30: Corner 3, Back Right

Figure I.4.31: 2

Figure I.4.32: 3

I.4.B• On Quills

The single ATF quill which came with this machine bears a number, which happens to be 53.

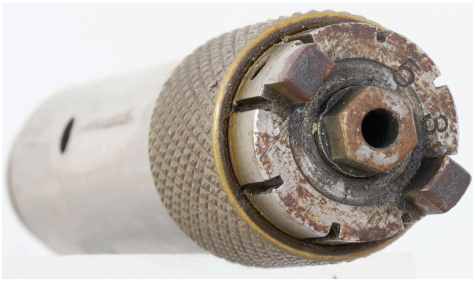


Figure I.4.33: ATF Quill Number

Figure I.4.34: 53

As noted earlier in Section I.2, Provenance, on page 11, at the 1993 ATF auction the engraving machines were to have been sold without quills. Ed Rayher placed a quill in each machine to make them all more nearly functional. I have confirmed with Ed that he did this without regard for numbering, so the fact that this quill 53 was put into Benton 53 is entirely coincidental.

Benton No. 55, now in Antwerp, has at least eight quills. Theo Rehak, the first non-ATF owner of No. 55, acquired quills both before and during the 1993 ATF auction. Of these, at least two bear the number "53". The conclusion would seem to be that the quills were fitted for each machine and marked to identify them, but that in the chaos of the decline of ATF and the 1993 auction quills were mixed up. This does not seem to have affected their utility either with the machine at Swamp Press or No. 55 in Antwerp.

Figure I.4.35: Benton 55, 6 Quill Block

Figure I.4.36: 53

In the photograph above, of a block for six quills now with Benton 55 at the Letter-kunde Press in Antwerp, "53" is legible on the quill in the slot with the paper tag reading "'7". The numbers on the other quills are not legible in this photograph.

Figure I.4.37: Benton 55, 4 Quill Block

Figure I.4.38: 53

In the photograph above, of a block for four quills now with Benton 55 at the Letter-kunde Press in Antwerp, “53” is legible on the quill in the slot with the paper tag reading “‘7”.[2] The numbers on the other quills are not legible in this photograph.

[TO DO: Examine and photograph all of the quills with Benton No. 55]

[2]The fact that both quill blocks have a quill numbered 53 which has in each case been tagged “7” is coincidental.

I.4.C• On the Power Stand and Motor

(The original power stand for this machine has been lost without record. These are the identification plates/markings for the power stand originally associated with BEM No. 99, which is presently with BEM2a-53.)

I have not yet discovered any identifying markings on the motor drive unit or stand itself. The motor drive unit (motor mounting and flexible shaft drive) is probably the wall-mount unit from the original installation of Benton 99 (although the materials and construction of the actual flexible shaft suggest that it is a later replacement). This has been rather crudely welded on to a tall commercially made stand.

Here is the motor nameplate.

Figure I.4.39: Motor Nameplate

I.4.D• Missing (Possibly Once Present)

The matrix jig for BEM2a-53 has been lost. Presumably it would have had a "53" stamped on it, as the matrix jigs were individually fitted to each machine.[3]

Here as an example is the matrix jig for Benton 55, now in Antwerp, showing the "55" stamped on it.

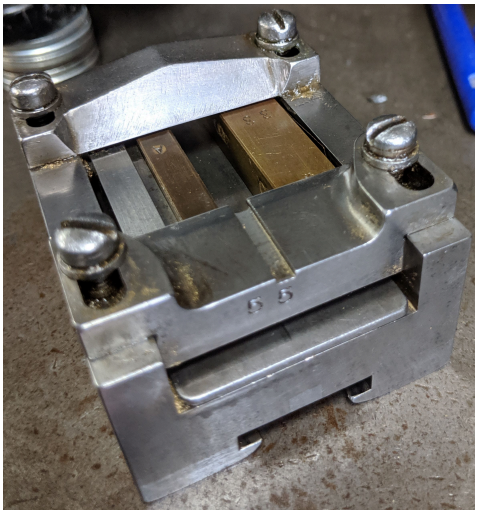


Figure I.4.40: Benton 55, Matrix Jig 55

Figure I.4.41: Jig 55

Several other Benton Engraving Machines have a two-digit number painted on them using a stencil. BEM2a-53 does not, though such a number may be present underneath the very bad final paint job it was given. Here, for reference, is the stencil number on Benton 99, in the Gregory Jackson Walters Typographical Archive.

Figure I.4.42: #99 Stencil

[3]Rehak has confirmed that "Only one jig was provided for each machine." Email to DMM on 2023-03-18 18:04:26 -0400.

I.4.E• Possibly Never Present

BEM2a-53 does not have an "American Type Founders Co." nameplate on it. There is no indication that it ever did, though of course this evidence might be concealed by paint.

Here, for reference, is the nameplate for Benton No. 55, now in Antwerp. It is possible that this machine, which bears only the 1885 patent date, was one originally intended for sale.[4]

Figure I.4.43: Benton 55 Nameplate

An American Type Founders Co. nameplate of a different style is affixed to the Benton now preserved at the Sanseido publishing company in Japan. A photograph of this is online at YUKI Akari's blog at:
`https://dictionary.sanseido-publ.co.jp/column/benton31`
(Yuki No. 31 2019).

[4]Rehak has said that it was an early machine originally intended for punch and patrix cutting which was converted to the later style. Email to DMM on 2023-03-13 11:36:51 -0400.

I.5• Critical Issues In Conservation and/or Use

I.5.A• General Survey of Condition

What remains of the machine is in remarkably good condition. The pantograph mechanism has no rust and everything moves smoothly. What little rust is present does not affect operation. The three quills acquired with the machine (one ATF, two HEBCO) rotate, but may have excessive runout. Each quill has one collet.

I.5.B• Missing Components

Several important components are missing entirely:

- There is no matrix jig (or patrix/punch jig).
- There are no shims for the missing matrix jig.
- The quills each have but one collet. Since the ATF quill uses very rare Moseley No. 1 collets, this limits its use to the size present (0.093″). The HEBCO collets take an older version of the nonstandard variation on the WW collet manufactured by Sherline (and sold by them as a “WW” collet). Current Sherline “WW” collets may be modified to fit.
- There are no followers.
- There are no leverage gauges.
- There are no expansion/condensation gauges.
- The 10.62 Pattern wedge for securing the pattern is missing.
- There is no 10.70 Pattern finger (but it isn’t clear if there ever was one in the last configuration by ATF of this machine).
- The drive is for another machine and at best will need adapting (but it is more likely that I will employ an alternative drive method). The drive motor itself is DC, which presents issues in a modern shop.
- The screw mechanism which moved the pattern table in the body-wise direction is missing almost entirely (only the nut on the bottom of the pattern table is present). This movement is not necessary for ATF engraving protocols, though.

I.5.C• Damaged and Badly Worn Components

I.5.C.i• Wand Chuck Body

The 30.84 Wand chuck body has a locking taper which fits the followers. The last follower which had been installed on the machine has been sheared off flush with the end of this rod. The markings on it suggest some violent impact.

It may be impossible to extract this fragment of a follower without damaging the chuck. Damage to this original chuck is unacceptable, so an alternative component will have to be fabricated.

I.5.C.ii• Excessive Quill Runout

The runout on the single ATF quill is high (0.000,9″ measured over a gage pin). The runout on the spindle cone is unreadable due to excessive pitting (approx. 0.002″ pits).

The runout on the first of the two HEBCO quills (the one with less rust) is high (0.001″ on the spindle cone). With the original Sherline collet this becomes 0.002″, which makes this combination unusable. A more accurate collet might help.

The runout on the second of the two HEBCO quills (less rust) is much better. TIR over the spindle cone is 0.000,4″, which should be acceptable. (With the original Sherline collet acquired with this quill the TIR over a gage pin was an unacceptable 0.002,9″. This exceeds Sherline's own specifications for their collets.)

Sherline specifies a maximum runout of 0.002″ for their collets. This is unacceptably large. By way of comparison, Levin WW collets[1] have a specified maximum runout of 0.000,2″(Levin 2023).

Additional testing with new Sherline collets[2] will be necessary to see if the combination of the second HEBCO spindle and new collets results in acceptable runout. This will require both luck and selective assembly.

If this does not work, then a new quill (spindle) will be required. Curiously, commercial spindles of the same diameter as the Benton quills (0.897″ or 22.8mm) are available (e.g., from NSK/Nakanishi and Finley Precision Spindles).

[1] Which are true WW collets and which therefore will not fit the HEBCO spindles made for the nonstandard Sherline "WW" collets.

[2] With keyways modified to fit the old Sherline dimension keyways on the HEBCO quills.

I.5.D• Endangered Information

I.5.D.i• Cutter Geometry

The ATF quill which came with this machine had a cutter installed in it. Since this quill was dropped into the machine during the 1993 ATF auction and had not been used since, it is certain that this cutter was sharpened by ATF. It is therefore a record of at least one cutter geometry used by ATF.

There is at most one other cutter which, if it exists, would be known by its provenance to be, with certainty, ground by ATF.[3]

The cutter from the ATF quill for BEM2a-53 has been removed and macro-photographed. It will be preserved un-used as potentially unique evidence of ATF practice.

I.5.D.ii• Lubricants

A sample of the lubricant present in the original ATF quill has been removed and preserved.

[3]That is the cutter on the ATF quill with machine No. 99, if that quill has a cutter. The four other machines outside of Japan have either been used or have cutters which came via the Dale Guild and which may have been sharpened there. The two machines in Japan left ATF in the 1920s.

I.5.E• Potential Health and Safety Issues

These are relatively modest and in no case greater than those in a small traditional machine shop. Areas of concern include

- Rotating drive components
- Pinch points when moving the Head
- A high speed cutter rotating at eye level
- Petroleum-based lubricants

I.6• Operating Context

TO DO - the ancillary machines involved in the process (planchet preparation, cutter grinding, matrix fitting, test casting, etc.)

I.7• Specifications

The specifications of a machine define anything which might be important to someone dealing with the complete machine as it is. So they would be of interest to someone planning for its use, someone moving (rigging) it, someone installing (millwrighting) it, someone operating it, and probably others.

Beyond the specifications there are definitions of the machine's interfaces. These are things of interest to an engineer in designing something to work with the machine (for example, a new matrix holder for a different style of matrix). The interfaces are discussed in Division IV (Re-Engineering), Section 2.

I.7.A• Capacities

This BEM is capable of cutting matrices up to a maximum body size of 60pt. Some faces at large body sizes may have set width requirements which exceed the capacity of this machine. Theo Rehak wrote: "Remember also that wide set 60pt matrices would be done on the AD-CUT No. 5 engraver."[1]

The patterns accepted are standard ATF "wax plate method" raised line patterns with a body-wise nominal pattern size of 5 inches and a set-wise nominal pattern width of 9 1/2 inches. The thickness of the 10.60 Upper pattern guide bar, and therefore the nominal thickness of the non-raised portions of a pattern, is 0.111″.[2]

Other styles of patterns within these dimensions could certainly be used as well.

I.7.B• Tool and Work Holding

I.7.B.i• Collets

The Benton quills employ watchmaker's lathe collets to hold the cutter. However, there are complications.

Original ATF Quills

The original ATF quills use Moseley No. 1 series collets.[3] These were already obsolete when this machine was built and are rare today.

Hebert (1990s) Non-ATF Quills

The quills manufactured by the late Lou Hebert for Ed Rayher, two of which were acquired with BEM2a-53, take a nominal 8mm WW style collet with a maximum body diameter of 7.938mm (0.312,52″) and a minimum keyway width of 0.084″. This is an unusually small body for a WW style collet. Most WW collets will not fit.[4]

[1]Email to DMM on 2023-03-18 18:04:26 -0400.

[2]This is just slightly over 8 points, but I do not know if this dimension was specified by ATF in points or in inches.

[3]See section IV.1.B.xviii.1, Part 80.20 Collets (Moseley No. 1), for a discussion.

[4]See section IV.1.B.xix.2, Part 81.20 Collets (Sherline WW), for a discussion.

They were intended to be used with Sherline brand “WW” collets (so called by Sherline) as supplied to Hebert by Rayher. However, Sherline “WW” collets as manufactured in 2023 will not fit because Sherline has slightly reduced the size of the keyway on their collets.

Sherline collets are not hardened and the keyways may be modified so that they will fit. Note, however, that the tolerance specification for Sherline “WW” collets is 0.312–0.313″ (7.924,8–7.950,2mm). The upper end of this exceeds the bore of the Hebert spindles. It is possible that Sherline brand collets at the upper end of their dimensional tolerances might not fit.

Also note that Sherline claims that Starret brand collets[5] are dimensionally the same as theirs. This is not necessarily true. In a test with nine J. W. Starrett collets, all of them were slightly larger than the Sherline specification. None of them fit a Hebert Benton quill.

Cutter Diameter

Original ATF quills: The largest diameter wire which may be passed through a Moseley No. 1 collet is 3.8mm (0.149″) (Goodrich 1903, 65).

Hebert quills: Sherline product documentation claims that the largest diameter wire which can be passed through their “WW” collets is “3/16″ or 4.5mm.” (Sherline 2023).

The geometry and methods of sharpening typographical engraving cutters is a complex and contentious subject not considered here.

I.7.B.ii• Pattern Holding

[TO DO]

I.7.B.iii• Matrix Holding

[TO DO]

[5]Made by the J. W. Starrett company, not the L. S. Starrett company.

I.7.C• Overall Dimensions and Weights

Integer overall dimensions, for rigging (in inches):

Dimension	Value
Maximum width (bottom of base)	33
Maximum depth (bottom of base)	18
Maximum height (at 40pt)	64
Weight (estimate)	600 pounds

Overall dimensions (in inches):[6]

Dimension	Value
Maximum width (bottom of base)	32.32 ± 0.05
Maximum depth (bottom of base)	17.19 ± 0.05
Maximum height (at 40pt)	63.84 ± 0.05
Table width	26.410
Table depth (less set-up square)	12.288
Table depth (with set-up square)	13.475
Table height	30.00 ± 0.06
Top gimbal width	12.530
Top gimbal depth	10.334
Table to top of top gimbal	31.50 ± 0.02
Top gimbal to top screws at 40pt	0.335

The maximum height value is for the machine configured with its standard 40pt expansion/condensation gauges. [TO DO: measure a 40pt gauge's height]

As a rough guess – and this is only a guess – I would estimate the machine at 600 pounds.

[TO DO - add a diagram]

[6]Measurements over 24″ were done with a generic 1000mm/40″ vernier caliper plus a Harbor Freight (brand) 6″ digital caliper and automotive feeler gauges. Measurements under 24″ were done with a Shars (brand) Cat. 303-1055 600mm/24″ vernier caliper and, as needed, the same digital caliper and feeler gauges. Feeler gauges were necessary because the machine bottom is sunk into a mobile machine base and is not directly accessible. They were used to subtract the distance from the machine feet to the inside of the mobile base. See bem2a-53-workshop-notes for 2023-04-02.

I.7.D• Inputs and Services

I.7.D.i• Electrical

The only input to the machine, other than the operator's control of the wand by hand, is the power to drive the quill. There are no lights, heaters, electrical/electronic controls, etc. There are no water or compressed air inputs.

The quill drive, as received, was the power stand originally associated with Benton pantograph No. 99. This power stand is equipped with a General Electric direct current motor, Type BC, Model 5BC44AB1708. This is a 1/3 Horsepower, 115 Volt, 3.25 Amp, 3450 RPM continuous-duty motor.[7] This is a shunt-wound motor and thus it would have good constant-speed characteristics. It was hardwired into the ATF building and has an armored power cable but no plug.

Figure I.7.1: Motor

Figure I.7.2: Motor Nameplate

[7] I have not yet found an original General Electric catalog showing this motor. The 1942 G.E. *Motors (Pacific Coast Edition)* catalog GEA-624E lists the 1750 RPM version of this motor (GE 1942, 44). It also indicates that the General Electric *Bulletin* covering Type BC motors was GEA-3513. I have not yet found a copy of this.

I.7.E• Lubricants and Lubrication Fittings

I.7.E.i• Quill, Original ATF

The original ATF quills are lubricated with petroleum jelly. There is a screw on the side of the quills. This is removed and petroleum jelly is pumped into the quill body using a syringe. Ed Rayher notes that the older protocol for this involved liquifying the petroleum jelly with heat before injecting it but that he finds it sufficient simply to inject it and to let it liquify under the heat of operation.[8]

I.7.E.ii• Quill, Hebert

These have non-sealed ball bearings and do require lubrication. Ed Rayher has tested many options and has settled on SAE 0W-20 automotive oil as a good choice. If the quill in question has a divot in the end cap (the side connected to power) then add it there. If it does not, then put oil on the gap between the quill body and the end cap and let it migrate into the quill.[9]

I.7.E.iii• Quill Gimbal Plates

Ed Rayher has found that lubricating these with SAE 0W-20 automotive oil works well. He also notes that Theo Rehak has said that originally ATF used whale oil.[10]

I prefer to use industrial oils with complete datasheets and would also note that the detergents in SAE 0W-20 might cause issues with the bearings in the gimbals. I plan to experiment with light spindle oils (SAE 0W is roughly equivalent to ISO Viscosity Grade 22).

I.7.E.iv• Other Locations

Ed Rayher has said that for the other lubrication points on his Benton he uses SAE 30 non-detergent automotive oil.[11] These locations include:

- The pivots of the gimbals.
- The sliding bearings on the four pantograph rods.
- The spring-loaded rod at the end of the wand.

As noted above, I plan to experiment with modern industrial lubricants. SAE 30 is somewhere between ISO VG 68 and ISO VG 100.

I.7.E.v• Static Locations

When reassembling static or rarely moved parts, such as the rotating table plate, I have lubricated them at reassembly with BreakFree (brand) CLP.

[8] Ed Rayher, email to DMM, 2023-02-22 (E).

[9] Ed Rayher, email to DMM, 2023-02-22 (E).

[10] Ed Rayher, email to DMM, 2023-02-22 (F).

[11] Ed Rayher, email to DMM, 2023-02-22 (G).

This is my favorite of many commercial products claiming to meet US military standard MIL-L-63460[12]

[12]"Military Specification, Lubricant, Cleaner and Preservative for Weapons and Weapons Systems."

I.7.F• Non-Attached Components

The matrix holder(s), quills. followers. leverage gauges, and expansion / condensation guages, all of which are missing, have yet to be reverse-engineered and specified.

The original documents for this machine (its 1993 auction tag and 2021 bill of sale) are stored in a metal file box with the machine.

I.7.G• Supporting Tools and Machinery

There is no Benton Cutter Grinder for this machine. I intend to attempt to achieve the same cutter forms using a Chinese copy of the Deckel S0 cutter grinder (which, in turn, was based on the Gorton 265 cutter grinder). If that fails, I have a Gorton 375 which can grind four-dimensional parts for alien spacecraft.

I.7.H• Replaceable Standard Components

The original ATF quills employ Moseley No. 1 collets. These are extremely rare and my expectation is that I will never find another.

The HEBCO quills employ Sherline “WW” (so called) collets as manufactured in the 1990s. Despite Sherline’s insistance, these are not really true WW collets. They are seriously undersized relative to true WW collets such as those manufactured by Levin. The HEBCO spindles are a very tight fit on these collets, though, and most true WWW collets will not fit.

Modern Sherline “WW” collets will fit, but Sherline has changed their collet keyway dimensions over the years. New Sherline collets will need to have their keyways widened to fit the HEBCO quills.

The Sherline collet specification for runout is 0.002″, which is not acceptable for typograhical engraving. Selective fitting will be required.

The diameter of the ATF quill which came with this machine is 0.899,0″. The diameter of the HEBCO quills is 0.897,0 – 0.897,5″. It is likely that a modern 22.8mm (0.897,6″) spindle will fit as a drop-in replacement.

I.7.I• Consumables (other than Lubricants)

[TO DO - Wire for cutters]

I.8• Differences from Other BEMs

I.8.A• No. 50 (In Australia)

[TO DO]

I.8.B• No. 55 (Letter-kunde Press, ex-Dale Guild)

No. 55 has “55” stamped on the tracing table (lower left), No. 53 does not. See antwerp-2019 IMG_20190520_170757.jpg

No. 55 has two levers on each of the bearings through which the four rods go. No. 53 does not See antwerp-2019 photos.

No. 55 lacks the fore-aft table movement present on No. 53 (though No. 53 is lacking the screw to actuate this table movement).

No. 55 lacks the rotational table movement present on No. 53.

No. 55 lacks the medial table movement present on No. 53.

No. 55 still has its original complement of ATF followers, leverage gauges, and expansion/condensation gauges.

I.8.C• No. 60 (63?) (Swamp Press)

No. 60 (or 63) is a Type 2b machine, so of course differs in many respects. One of note here is that as received by Ed Rayher it lacked followers. He has engineered a new tip for the wand of this machine and new followers to go with it.

I.8.D• No. 99 (Walters Archive)

No. 99 is also a Type 2b machine, and so some differences will not be relevant.

The set-up square on No. 99 is considerably lighter in construction than that on BEM2a-53.