Machine Dossier for BEM2a-53
(Benton Pantograph)

Part IV: Re-Engineering

Chapter 1: Physical Survey

Section A: Parts List

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 IV: Re-Engineering

IV.1• Physical Survey

IV.1.A• Parts List

To the best of my knowledge, no parts list for any ATF manufactured Benton pantograph survives. We must construct one from whole cloth.

IV.1.A.i• Part Symboling System

IV.1.A.i.1• Inspiration

Usually this is called a parts "numbering" system, but the part numbers are not really numbers. They're comprised of multiple numbers plus modifiers. So the Monotype/Bancroft terminology of "symbol" makes more sense.

The system used here is inspired by that TO DO: FINISH WITH BIBLIO

TO DO: also differences. not infix

IV.1.A.i.2• Basic Scheme

Group Numbers

The basis of this parts symboling system is the division of the machine into groups of related parts. This division should seem as natural as possible, but it is still somewhat arbitrary and there will be contentious cases. For example, the part attached to the frame on which the leverage gauges rest is naturally called a "leverage gauge stop," but it could logically be a part of the frame group (to which it is attached) or the bridge group (which is what the leverage gauges locate). My decision to put it in the frame group here is arbitrary.

The group number is the first component of the overall part symbol.

Part Numbers

Within each group, the parts are numbered in some arbitrary (but, when possible, systematic) order.

So for example group 1 is the frame of the machine, group 2 the mechanisms on the table, group three the pattern guides attached behind the table, and so forth. Within group 1 (the frame), part 1 is the base casting, etc. Group number and part number can be combined easily as, for example: 1.1 (base casting).

There is a complication here which is particular to this machine. I need a parts list now, but I am not yet prepared to disassemble the machine fully. (It is more important for me to get the machine running so that I can produce operating instructions for it than it is to disassemble it for full examination.) This means that there will be parts that I don't presently know about which later will have to be fit into the systematic numbering within a group. The crude but effective solution is one which will be familiar to anyone old enough to remember line-numbered programming languages: add an extra digit. So

for example in group 4 (the bridge), the front plate would normally be part 1 but here it will be part 10, the back plate will be part 20, etc.

Numbers in a Series

Sometimes parts will come in regular series. Examples include the lateral spacing material for use in matrix holders, the "leverage" bars used in setting the bridge/cutter height, followers, etc.

When these exist, they should be indicated by a third dot-separated integer field. The numbering of the series is arbitrary as suites the situation. For example, lateral spacing material for a certain matrix thickness might simply be numbered by the matrix thickness in ten-thousandths of an inch (which might be different from their actual thickness).

IV.1.A.i.3 • Part Naming Conventions

TO DO: Add biblio ref to Rogers 1926

There are three options for the capitalization of part names

- Capitalize Each Word
- Capitalize the first word only
- capitalize nothing

The first of these is attested in TO DO: Biblio for Hunslett. The second was used by Mergenthaler Linotype and by Intertype. The third was used by Lanston Monotype for part names (but they used the first for group names).

It doesn't matter which system we use so long as we're consistent. I'll opt for the second convention, capitalizing only the first word (but proper names, such as Barth or Lanston Monotype, are always capitalized.)

It can be difficult at times to distinguish the actual part name from surrounding text when this convention is adopted. So in use the `\crPartCallout{}` construct can be used which will supply some form of different style for the part name (I haven't settled on what looks best yet).

IV.1.A.i.4 • Additions

There are several modifiers to be added to this basic system. These indicate:

- Notes
- Revisions
- Variations
- Quantities
- Identical parts serving different functions
- Commercial items (screws, pins, etc.)
- Other information for convenience

Notes

Sometimes it is either necessary or at least useful to specify some further detail in a part number in an ad hoc way. For example, cutter wires are specified logically and dimensionally by their group, part number, and number in a

series. So for instance 80.2.093 Cutter wire, high-speed steel defines a cutter wire 0.093″ in diamter which is made of high-speed steel (HSS). But there are many different alloys of HSS. If we were to assign a separate part number not only to each diamter of cutting wire but also to each possible HSS alloy the result would be a combinatorial explosion of part numbers.

Instead, the first optional additional field is a note number. This references a note in the part description which specifies something such as the HSS alloy used.

Two part symbols with different note numbers (but which are otherwise identical) are two different parts.

The note field can be used to call out anything which distinguishes a part: alloy, required supplier's part number, etc.

Revisions

We'll never know the revision history of the parts of this machine, so we will not be able to assign revision codes to original parts. But we will be maintaining this machine into the future. This will involve machining new parts for it and, inevitably, there will be engineering changes to them. (For example, it might be easier to replace a part which was originally machined from a casting with one which was originally machined from bar stock. Soon it will be economical to 3-D print some parts in metal.)

Monotype used a prefixed letter to indicate revisions, starting with a null letter. Here I will append a code consisting of the letter 'r' followed by an integer starting at 1. The initial revision level has no code and can be thought of as "revision 0." Example:

EXAMPLE

Variations

Revision numbers apply only to situations where we are making engineering changes and we know the order in which they were made. This is not always the case with an old machine such as the Benton. It is likely that we will discover different variations of parts on different surviving machine. To ATF these would have been revision levels, but to us they are variations. We will never know which of them came first.

Variations of this kind will be indicated with an appended code starting with the letter 'v' followed by an integer starting at 1. Parts with no identified variation have no such code and may be considered "variation 0."

When a part occurs in variations and also we remake it so that we have multiple versions, the variation code comes first.

EXAMPLE

Note: In situations where variations have different numbers of parts, it may be useful to skip numbers to allow other parts to line up. For example, the 30.50 Quill gimbal outer frame is a single part on BEM2a-53 but is has several

additional components on BEM 55. For the next part, skip a few numbers to 30.60 Quill gimbal Y frame.

Note: In the situation where two parts have real functional differences, they should be assigned different part numbers.

Note: Designs from scratch which replace groups or parts,[1] or entirely new components, are not variations and should be given their own group or part numbers.

Quantities

Quantities seem simple enough: truly identical parts serving the same function should have a single part symbol with the quantity used in parentheses after. Thus there are four of part 00.3 table screw, so this would be written:

00.3 table screw (4)

Identical Parts (Classification Numbers)

But what happens when identical parts are used in entirely different parts of the machine. This happens often enough, especially with screws. Monotype handled this with what they called a "classification number." This appeared in boldface in the leader dots after the part name. All parts having the same classification number were the same, regardless of their part number.

We'll do the same here. But where Monotype had an elaborate system of organizing these classifying numbers[2] here they'll just be assigned on an ad hoc basis.

Clarification: Classification numbers are only assigned when two separate part symbols are identical. They are not assigned when one part number has a quantity greater than one.

Commercial Parts

Finally, it may be that a part might be an off-the-shelf commercial unit or something specified by some standard. (This is something that didn't really happen at Monotype — they tended to make everything down to their own screws, as befits a company whose roots could be traced back to Sellers and the origins of American screw threads.)

If such a situation occurs here, it should be handled in a note with a reference to the appropriate vendor (e.g., a McMaster-Carr part number) or standard.

The situation can also arise where the ideal part is fully custom but there exists a reasonable commercial alterntive. For example, the traditional screw used on a Benton might be a cheese-head or fillister head screw. These are less common today and, further, an exact match for an existing screw might involve a nonstandard variation. If true visual fidelity is required, you would have to

[1] Such as the Group 71 new matrix jigs, which are based on photographs of ATF holders but no more.

[2] Numbers beginning with 1 were for bolts, 2 for screws, etc.

make this screw yourself — it won't look right otherwise. But if all it has to do is work, then replacing this screw with a commercial socket head cap screw is a valid alternative from the engineering point of view (it is the screw you might use if you were designing the machine from scratch today). Modern alternatives should be indicated in the part description.

Supplemental Information

The information here is handy but non-normative. For example, if a thread value here differs from that in the engineering parts drawing, the value in the drawing should be considered correct (but check it and fix it as necessary).

It is extremely useful to call out threads in part descriptions.

It is useful (though by no means required) to call out any tools necessary (e.g., hex keys, brass hammer, etc.) This should be done on a per-group basis and assists in assembling a kit of tools for the machine.

IV.1.A.i.5 • Things Not Used

There are also some aspects of the Thompson parts list that aren't relevant here.

- prices (nothing here is for sale)
- obsolete parts (they are *all* obsolete parts
- assemblies of parts not sold individually

The last of these items requires some explanation. The Thompson Type Caster was a mass-produced machine which generally had fully interchangeable parts. If you broke a 30TC2T Matrix Carrier Cam Lever Extension (upper lever), you just ordered a new one. But like many other machines, it was never economical to achieve full interchangeability for the Thompson. Some assemblies had to be hand fitted at the factory. An example of this would be the X42TC59 Center Jet Mold group.

It is likely, but not yet cetain, that many components of the Benton were interchangeable. However, it is clear that some were not. The fitter's match-marking on the actual pantograph assembly is proof of this. (This is shown quite clearly on this machine, No.53, where the punches used to stamp these numbers differ. This indicates that this assembly was repaired at some point in the past and that at the time of repair the new components were stamped with matching numbers — using the number stamps which happened to be at hand.)

But since we do not know for certain the manufacturing methods of these pantographs and since we are not contemplating restarting their serial production, none of this is relevant here.

As one final note[3] on differences with Monotype Thompson parts lists, Monotype sometimes used the name of the group as the name of the first part (even

[3]And a final final note: Monotype used various special characters to represent specific circumstances. So for example a star (not an asterisk) represented a part which was in an assembly where

when this was not an assembly - example: 81TC - Type Stick, which was both the entire group comprising a type stick and the wooden stick itself sold separately) I won't do this here

the assembly was available only hand-fitted at the factory but the part was available for separate purchase. These various situations do not apply here, but they bear thinking about when designing a part symboling system.

IV.1.A.ii• The Illustrated Parts List

The parts of the machine are divided into these overall groups.

- 00. Frame
- 10. Table mechanism, BEM2a-53 (revolving)
- 11. Set-up Square, BEM2a-53
- 12. Table mechanism, BEM 55 (standard)
- 13. Set-up Square, BEM 55
- 14. Table mechanism, BEM 99 (large)
- 15. Set-up Square, BEM 99
- 20. Head
- 30. Gimbals and pantograph mechanism
- 4n. Geometric adjustment gauges
  - 40. Leverage gauges, BEM 55
  - 41. Expansion/condensation gauges, BEM 55
  - 42. Leverage gauges, CircuitousRoot
  - 43. Expansion/condensation gauges, CircuitousRoot
- 5n. Followers
  - 50. One-piece followers, BEM 55
  - 51. Disk followers, BEM 55
  - 55. One-piece followers, CircuitousRoot
  - 56. Disk followers, CircuitousRoot
- 6n. Workpiece jigs, ATF & Dale Guild
  (incl. auxiliary pieces for each)
  - 60. ATF Matrix Jig No. 55, for BEM 55
  - 61. ATF Patrix Jig, for BEM 55
  - 62. BECO Ludlow Matrix Jig, for BEM 55
- 7n. Workpiece jigs, non-ATF
  (incl. auxiliary pieces for each)
  - 70. CircuitousRoot, traditional mats to 60pt
    (with backing piece for American Monotype display mats)
- 8n. Quills, collets, and cutters
  - 80. Quills, ATF #53, with Moseley No. 1 Collets
  - 81. Quills (HEBCO), with Sherline “WW” Collets
  - 88. Cutter wires
- 9n. Special tools

The drive is external to the machine itself and is not contained in this parts list.

I have included part numbering for certain ATF parts associated with BEM No. 55 (ex-Dale Guild, now at the Letter-kunde Press in Antwerp) because these parts are not present on BEM2a-53 and because I expect to have access to BEM No. 55 and will be able to examine these parts in some detail.

IV.1.A.ii.1 • Group 00. Frame

PARTS

00.0: Base casting

00.1: Table frame casting

00.3: Table screw (qty. 4)

> Note: The front operator-right screw on BEM2a-53 as received is a cheese head screw (which was loose when received). It almost certainly isn't original.

00.4: Leg, left

I would have called this component a "standard" (following 19th century practice), but Rehak has indicated that the term used at ATF was "leg."[4]

00.5: Leg, right

00.6: Leg screw (qty. 4)

00.7: Leverage gauge stop

00.8: Leverage gauge stop pin (qty. 2)

00.9: Leverage gauge stop screw (qty. 2)

[4]Theo Rehak, email to DMM dated 2023-03-04 00:29:59 -0500. See also (Rehak 1993, 112).

IV.1.A.ii.2 • Group 10. Table Mechanism, BEM2a-53 (Revolving)

10.0: Base plate

The table mechanism's base plate screws into the 00.01 Table frame casting from below.

Figure IV.1.1: Table Base Plate from Above, set into 00.01 Table Frame Casting

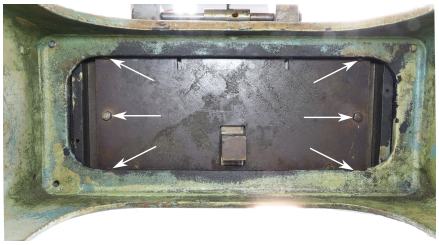

Figure IV.1.2: Table Base Casting from Underneath, with (Six) 10.1 Base Casting Screws Identified

10.1: Base plate screw (qty. 6)

[TO DO: measure]

10.10: Medial[5] motion plate

This plate moves the entire table assembly above it, and thus the pattern, in a "medial" direction[6] (fore-and-aft, toward and away from the operator).

At present I do not believe that motion in this direction played any part in normal ATF matrix making protocols. It may be a vestige of the failed adaptation of this particular machine for curved-face matrix making. To the best of my knowledge, this motion is not present on any other Benton Engraving Machine.

Figure IV.1.3: 10.10, Top

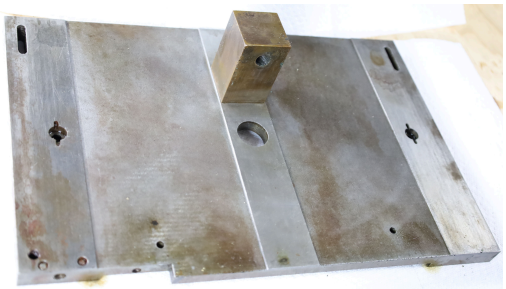

Figure IV.1.4: 10.10, Bottom

Note: This plate has two permanently plugged holes from prior work. These plugs are not cataloged as parts.

10.11: Medial motion plate locking stud (qty. 2)

[5] "Medial" = Y-axis, toward and away from the operator; vs. lateral / side-to-side / X-axis motion.

[6] This term has been introduced here; the ATF term for motion in this direction is not known.

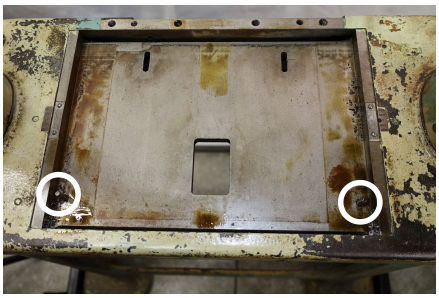

Figure IV.1.5: Base Casting, showing 10.11 Medial motion plate locking studs (circled)

10.12: Medial motion locking stud pin (qty. 2)

10.13: Medial motion locking stud nut (qty. 2)

10.14: Medial motion locking stud washer (qty. 2)

10.15: Medial motion scale (qty. 2)

Each side of the table has three scales. The inner pair of scales indicate rotation of the 10.40 Rotating motion plate. These will be discussed later. The outer pair of scales, scribed into the 00.1 Table Frame Casting have no function in the current configuration of this machine. Between these are the 10.16 Medial motion scales, screwed to the 10.0 Table mechanism base plate.

[TO DO: Measure units]

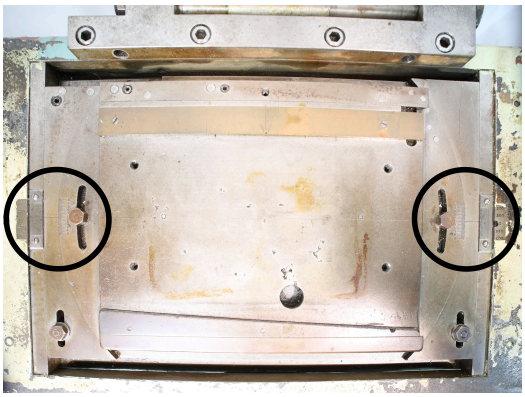

Figure IV.1.6: Table Scales (circled)

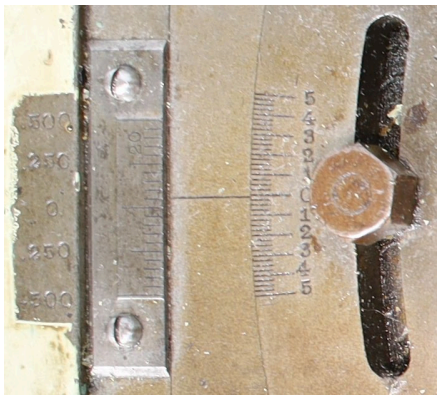

Figure IV.1.7: Left Scales Closeup

10.16: Medial motion scale screw (qty. 4)

[TO DO: measure]

10.17: Medial motion plate set screw

Figure IV.1.8: Set Screw

Note: This set screw has no purpose in the present configuration of the table mechanism. This is a potentially useful already tapped hole.

Specification: 5/16″- 18 UNC x 5/16″(0.326″ as measured) socket head set screw.

10.20: Medial motion actuator nut block

The original screw-based mechanism for moving the table medially has been lost without any surviving record. Only the 10.20 nut block and 10.21 screw survive. This is a new design by CircuitousRoot to accomplish a similar goal. It may not correspond to the lost original in its calibration and may be missing functionality present in the original.

Figure IV.1.9: Existing Medial Motion Actuator Nut BlockSet Screw

Specification: Hole is tapped 1/2-20 UNF (not Acme). Material is probably a bronze alloy.

[TO DO: Design and build an actuator mechanism.]

10.21: Medial motion actuator nut block screw (qty. 4)

Specification: #10-32 UNF cheese head screw, partially threaded. Steel.
Screw length: 0.757
Threaded length: 0.53
Head depth: 0.134
Length overall: 0.8915
Head diameter: 0.3125
Measured with: Harbor Freight 6″ digital caliper.

10.40: Rotating motion plate

Figure IV.1.10: Rotating Plate, Bottom

Figure IV.1.11: Rotating Plate, Bottom (Angled View)

Note: The top back hole in this plate is tapped #12-24 UNC and is not filled with any screw. It could be available for a pattern finger (hold-down clamp).

Note: The boss in the center of the bottom, around which the plate rotates, is blind-drilled and tapped 5/16″18 UNC. But in the current configuration of this machine it rests directly on the 10.0 Table mechanism base plate and this screw hole cannot be used for anything.

Note: This plate has several permanently plugged holes from prior work. These plugs are not cataloged as parts.

10.41: Rotating motion plate stud (qty. 2)

10.42: Rotating motion plate stud pin (qty. 2)

10.43: Rotating motion plate stud nut (qty. 2)

Note: There is no 10.44 Rotating motion plate stud washer.

10.45: Rotating motion plate set screw (left back) (qty. 2)

These two set screws fill holes which have no apparent function. They could be available for pattern fingers (hold-down clamps).

Specification: 1/4″- 24 UNS (note: special).

Hex key: 1/8″

10.46: Rotating motion plate set screw (center back)

This screw was not present on BEM2a-53 as received. It could be added to plug the single centered threaded hole at the back of the 10.40 Rotating motion plate. This hole does not need to be plugged, but keeping swarf out of it will make it easier to use if it should ever be needed for some future addition to this machine. Note that #12 hardware is relatively uncommon.

Specification: #12 - 24 UNC x 1/4″ to 1/2″ socket head cap screw

Wrench: 3/32″ hex key

10.50: Lateral motion plate

This plate is dovetailed in to 10.40 Rotating motion plate, but it is fixed in place by eight screws. The reason for this construction is unknown.

Figure IV.1.12: Lateral Motion Plate with Pattern Upper Guide Bar

Note: This plate has four through-holes tapped 1/4″ - 20 UNC. The function of these is unknown; they do not participate in retaining the pattern.

Note: The function of the large hole which extends through this plate and also through the 10.40 Rotating motion plate below (but no further than this) is unknown.

10.51: Lateral motion plate retaining screw (long) (qty. 2)

Specification: #10-32 UNF cheese head, partially threaded.
Length: 0.487″
Thread Length: 0.41
Head Diameters: 0.280
Head Thickness: 0.138
Note that these screws have a “waist” section turned down just below their heads which is 0.135″in diameter and 0.05″ long.

Note: These screws are strangely and poorly made, with off-center slots.

10.52: Lateral motion plate retaining screw (short) (qty. 6)

Specification: #10-32 UNF cheese head, partially threaded.
Length: 0.405″
Thread Length: 0.32
Head Diameters: 0.280
Head Thickness: 0.138
Note that these screws have a “waist” section turned down just below their heads which is 0.135″in diameter and 0.05″ long.

Note: These screws are strangely and poorly made, with off-center slots.

10.53: Lateral motion plate gib screw (qty. 3)

These are fitted as if they were gib screws on a dovetail slideway. However, there is no gib (and the lateral motion plate is fixed in place by eight other screws). They serve no purpose in the present arrangement; their original purpose is unknown.

Specification: #10-32 UNF x 1/2″cup head set screw.

10.54: Lateral motion plate face screw (qty. 4)

These screws were not present on BEM2a-53 as received. They could be added to plug the four threaded holes in the face of the 10.50 Lateral motion plate. These holes do not need to be plugged, but keeping swarf out of them will make them easier to use if they should ever be needed for some future addition to this machine.
Specification: 1/4″ - 20 UNC x 1/4″ socket head cap screw
Wrench: 1/8″ hex key

10.60: Pattern upper guide bar

Figure IV.1.13: Pattern Upper Guide Bar (above pattern)

In the figure above, the 10.60 Pattern upper guide bar is the horizontal brass strip above the pattern.[7] The space where the 10.62 Pattern wedge, missing as received, would have fit can be discerned below the pattern.

10.61: Pattern upper guide bar screw (qty. 2)

Specification: #5-48 UNS x 0.335″ (note: special) cheese head screw
Head diameter: 0.197
Head depth: 0.055

10.62: Pattern wedge

This part is missing as received.

10.70: Pattern finger

This part and its screw are missing as received.

10.71: Pattern finger screw

This part and its screw are missing as received.

[7]The pattern shown in this illustration is the original ATF pattern for the “SUg” characters for Century Schoolbook Italic, ATF series 465 6-48pt, Morris Fuller Benton, 1917–1919.

IV.1.A.ii.3 • Group 11. Set-up Square, BEM2a-53

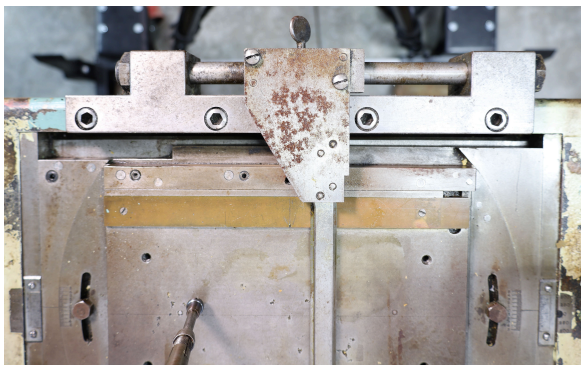

Figure IV.1.14: Set-up Square

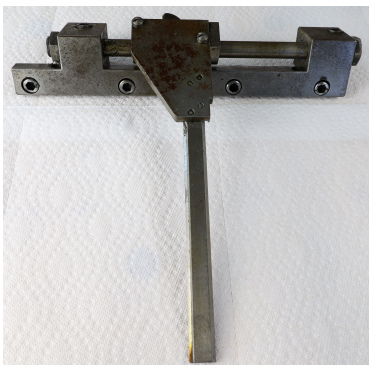

Figure IV.1.15: Removed

11.0: Set-up square main frame

[TO DO: Measure the two available tapped holes in the front of this part.]

11.1: Set-up square main frame screw (qty. 4)

Specification: 3/8″ - 16 UNC x 3/4″socket head cap screw
Head diameter: 0.559″ (to clear 0.632″)
Head depth: 0.378″(to not quite clear 0.3765″)
Wrench: 3/16 hex key.

11.2: Set-up square back lug spacer (qty. 2)

Figure IV.1.16: Back Lug Spacer, left

Figure IV.1.17: and Right, removed

11.3: Set-up square back lug spacer screw (qty. 4)

Specification: #10-32 UNF x 1/2″ (0.468″) cheese head screw
Head diameter: 0.314″
Head depth: 0.188″
Slot thickness: 0.050″
Screwdriver: 1/4″Craftsman 41584 works
Note: Head is a very close fit in the hole.

11.4: Set-up square back lug screw (qty. 2)

Specification: 3/8″- 16 UNC x 1.5″socket head cap screw
Head diameter: 0.553″(to clear 0.63″)
Head depth: 0.373″
Wrench: 5/16″hex key

11.5: Set-up square pivot rod

11.6: Set-up square pivot rod plug (qty. 2)

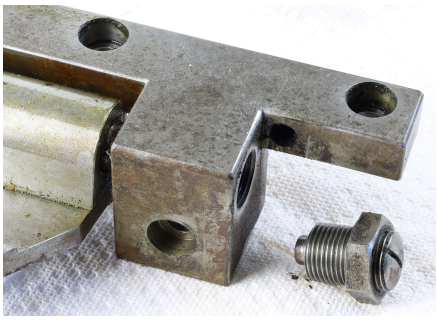

Figure IV.1.18: Pivot Rod Plug and Jam Nut

Note: Thread is 3/4″ - 16 UNC. Flat screw slot is 0.065″thick.

11.7: Set-up square pivot rod plug jam nut (qty. 2)

Specification: 3/4″ - 16 UNC
Thickness: 0.322″
Wrench: 1” box or open end

11.8: Set-up square pivot block

11.9: Set-up square pivot block thumbscrew

Specification: 1/4″ - 28 UNF x 1/2″ flat tip thumbscrew

11.10: Set-up square square

11.11: Set-up square square taper pins (qty. 2)

These are the pins locating the 11.10 square relative to the 11.8 pivot block

Not measured

11.12: Set-up square square screw (qty. 2)

Specification: 1/4″ - 24 UNS x 0.534″fillister head (note: special)
Slot width: 0.050″
1/4″ Craftsman 41584 screwdriver works (3/16″ bottoms out, 5/16″ too thick)

11.13: Set-up square rule

11.14: Set-up square square taper pins (qty. 2)

These are the pins locating the 11.13 rule relative to the 11.10 square.

Figure IV.1.19: Rule Attachment

In the Figure above, the two 11.14 taper pins are just visible as round circles next to each of the two screw heads. The left screw head (flush) is 11.16 Set-up square square screw, outer and the right screw head (proud) is 11.15 Set-up square square screw, inner.

Not measured

11.15: Set-up square square screw, inner

Specification: #10-32″UNF x 0.514″ cheese head
Head diameter: 0.313″
Head depth: 0.126″
Does not sit flush

11.16: Set-up square square screw, outer

Specification: #10-32″UNF x 0.514″ cheese head
Head diameter: 0.315″
Head depth: 0.108″(to fit nearly flush in 0.105″ counterbore)
Slot width: 0.050″
1/4″ Craftsman 41584 flat screwdriver works

11.20: Set-up square main frame plug screw (qty. 2)

These two screws were not present on BEM2a-53 as received. They have been added to plug the two threaded holes in the front of the 11.0 Set-up square main frame. These holes do not need to be plugged, but keeping swarf out of them will make them easier to use if they should ever be needed for some future addition to this machine.
Specification: #3/8″ - 24 UNF x 3/8″ socket head cap screw
Wrench: 3/16″ hex key

IV.1.A.ii.4 • Group 12. Table Mechanism, BEM 55 (Standard)

IV.1.A.ii.5 • Group 13. Set-up Square, BEM 55

IV.1.A.ii.6 • Group 14. Table Mechanism, BEM 99 (Large)

IV.1.A.ii.7 • Group 13. Set-up Square, BEM 99

IV.1.A.ii.8 • Group 20. Head

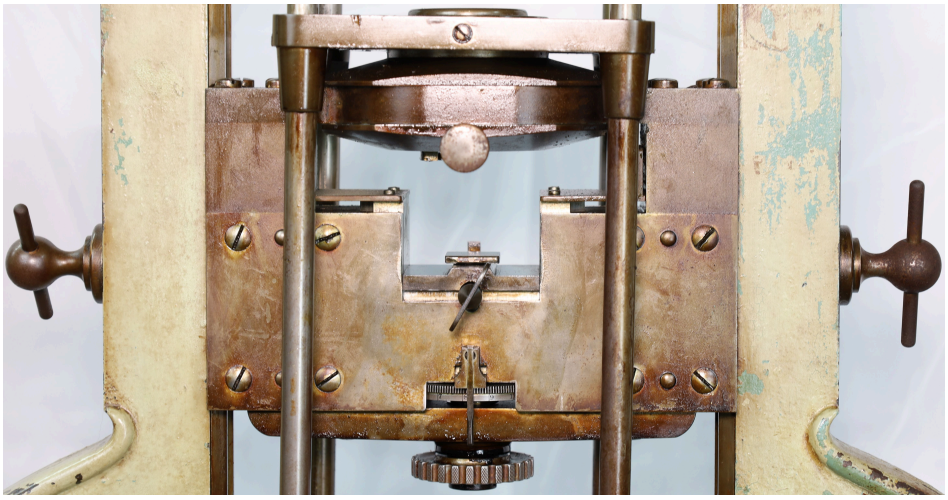

Figure IV.1.20: Head, Front View

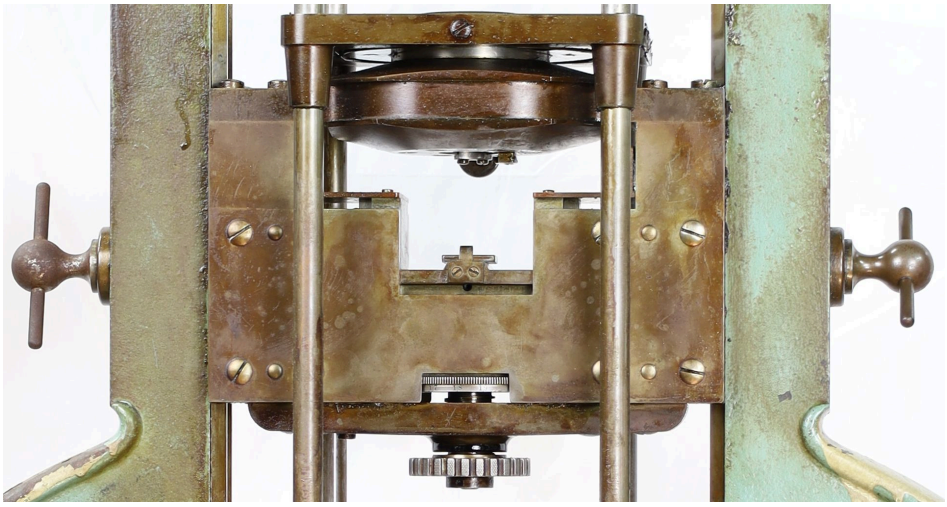

Figure IV.1.21: Head, Back View

The name “head” is that used by Ed Rayher in “Swamp Press Turns Virtual Xenotype Cherokee Into Hot Lead Monotype” (Rayher 2014, 9). Rehak has said

> Yes, it could very well be termed the “head” ’tho I cannot remember it being called as such, but rather the “assembly.”[8]

[8]Theo Rehak, email to DMM on 2023-03-04 00:29:59 -0500.

IV.1.A.ii.9 • Group 30. Gimbals and Pantograph Mechanism

30.0: Top gimbal fixed frame

This frame is marked with the machine number (53) on its top front.

30.1: Top gimbal fixed frame pins (qty. 4)

30.2: Top gimbal fixed frame screw (qty. 4)

30.10: Top gimbal X frame [body-wise]

This is the "intermediate" frame, which is the outermost of the two moving frames. It provides motion "fore and aft" (towards the operator and away from the operator). This is the X axis of the gimbal. It is the motion which is in the body-wise (vs. set-wise) direction of the face of the type.

As far as I can determine, the two tabs or lugs on each side of this frame are integral to the frame. It appears to have been machined out of a single casting. However, in case I am wrong about this and/or to accomodate a replacement version where these lugs are fabricated and attached, I am skipping eight part numbers here (on each side: two different lugs, four identical taper pins, and two identical screws)

30.20: Top gimbal X frame pivot (qty. 2)

I have not yet disassembled this. If the machine follows the patent drawing, then these pivots are screws which comes in through 00.4 Leg, left and 00.5 Leg, right and are is secured on their nonthreaded portions by two of 30.12 Top gimbal X frame pivot set screw.

30.21: Top gimbal X frame pivot set screw (qty. 2)

30.22: Top gimbal X frame elevating bracket (qty. 2)

Note: For the gauges to set the elevation for expanding and condensing, see Group 42 Expansion/condensation gauges, CircuitousRoot

30.23: Top gimbal X frame elevating screw (qty. 2)

30.24: Top gimbal X frame elevating knob (qty. 2)

30.25: Top gimbal X frame elevating knob taper pin (qty. 2)

30.30: Top gimbal Y frame [body-wise]

Note: I have not yet disassembled the upper gimbal. The pivot and screw parts identified below are provisional, based on an external inspection.

30.31: Top gimbal Y frame outer pivot (qty. 2)

This is the pivot screw which goes through the 30.10 Top gimbal X frame.

30.32: Top gimbal Y frame outer pivot set screw (qty. 2)

30.33: Top gimbal Y frame outer pivot adjusting sleeve (qty. 2)

30.34: Top gimbal Y frame outer pivot adjusting sleeve screw (qty. 2)

30.35: Top gimbal Y frame inner pivot (qty. 2)

30.36: Top gimbal Y frame inner pivot set screw (qty. 2)

30.40: Pantograph rod (qty. 4)

30.41: Pantograph rod top nut (qty. 4)

30.42: Pantograph rod bottom nut (qty. 4)

30.50: Quill gimbal outer frame

This frame is square and slides in the four 30.40 Pantograph rods. It therefore has both translational and rotational motion in both the X and Y directions.

On BEM2a-53, this part is unitary, apparently machined from a single casting.

TO DO: Disassemble and check for internal bushings and the potential of press-fit sleeves over the rods.

On BEM 55, this part has additional small handles on it. Rehak says that screws attached to these pressed on a split bushing (Rehak calls it a "cylindrical slide") to "compensate for wear on the gimbal rods."[9]

30.60: Quill gimbal Y frame

30.61: Quill gimbal Y frame outer pivot (qty. 2)

30.62: Quill gimbal Y frame outer pivot set screw (qty. 2)

30.63: Quill gimbal Y frame outer pivot adjusting sleeve (qty. 2)

30.64: Quill gimbal Y frame outer pivot adjusting sleeve set screw (qty. 2)

30.65: Quill gimbal Y frame inner pivot (qty. 2)

30.66: Quill gimbal Y frame inner pivot set screw (qty. 2)

30.71: Quill gimbal aperture outer pivot (qty. 2)

Note: The inner ring of the quill gimbal could be thought of as part 30.70 Quill gimbal inner ring , but it is really a part of the quill aperture and therefore in the group 20 Head. Its gimbal pivots, however, are a part of the quill gimbal and thus are placed here.

30.72: Quill gimbal aperture outer pivot set screw (qty. 2)

30.73: Quill gimbal aperture outer pivot adjusting sleeve (qty. 2)

30.74: Quill gimbal aperture outer pivot adjusting sleeve set screw (qty. 2)

30.75: Quill gimbal aperture inner pivot (qty. 2)

30.76: Quill gimbal aperture inner pivot set screw (qty. 2)

[9]Theo Rehak, email to DMM on 2023-03-17 20:17:08 -0400.

30.80: Wand plate

This is the square plate at the bottom of the four 30.40 Pantograph rods. The 30.61 Wand screws into it. In an email, Rehak referred to this as the "gimbal plate directly above the pattern."[10] I find it potentially confusing to refer to this as a "gimbal" plate, since it is not itself a gimbal (as are the mechanism at the quill level and the top level). So I've taken the term "plate" from Rehak's note and have associated it with the Wand (because the Wand screws into this plate).

30.81: Wand body

30.82: Wand spring

30.83: Wand chuck shaft

This part and the 30.74 Wand chuck body are assembled as a single unit. I'm not yet certain whether they are two pieces fitted (silver brazed?) together or whether they were turned as a single unit.

30.84: Wand chuck body

30.90.v1: Wand chuck, CircuitousRoot

This is a commercial ER8 collet chuck, style A (vs. style M) on an extension rod, turned down to fit the Wand. Unlike Benton's wand chucks, this style requires a 30.81 Wand chuck nut to close the ER collets. It also requires, of course, 30.82 Wand chuck, CircuitousRoot, ER8 collets.

30.91.v1: Wand chuck nut, CircuitousRoot

30.91.v1: Wand chuck, CircuitousRoot, ER8 collets

[10] Theo Rehak, email to DMM 2023-03-04 00:29:59 -0500.

IV.1.A.ii.10 • Group 40. Leverage Gauges, BEM 55

Figure IV.1.22: Leverage & Expansion/Condensation Gauges, Benton 55

IV.1.A.ii.11 • Group 41. Expansion/Condensation Gauges, BEM 55

IV.1.A.ii.12 • Group 42. Leverage Gauges, CR

Rehak uses spelling “gauge” (not “gage”), so I will accept it as the preferred spelling here.[11]

IV.1.A.ii.13 • Group 43. Expansion/Condensation Gauges, CR

[11]Theo Rehak, email to DMM dated 2023-03-04 00:29:59 -0500.

IV.1.A.ii.14 • Group 50. One-piece Followers, BEM 55

IV.1.A.ii.15 • Group 51. Disk Followers, BEM 55

- IV.1.A.ii.16 Group 52. One-piece Followers, CircuitousRoot
- IV.1.A.ii.17 Group 53. Disk Followers, CircuitousRoot

IV.1.A.ii.18 • Group 60. ATF Matrix Jig No. 55, for BEM 55

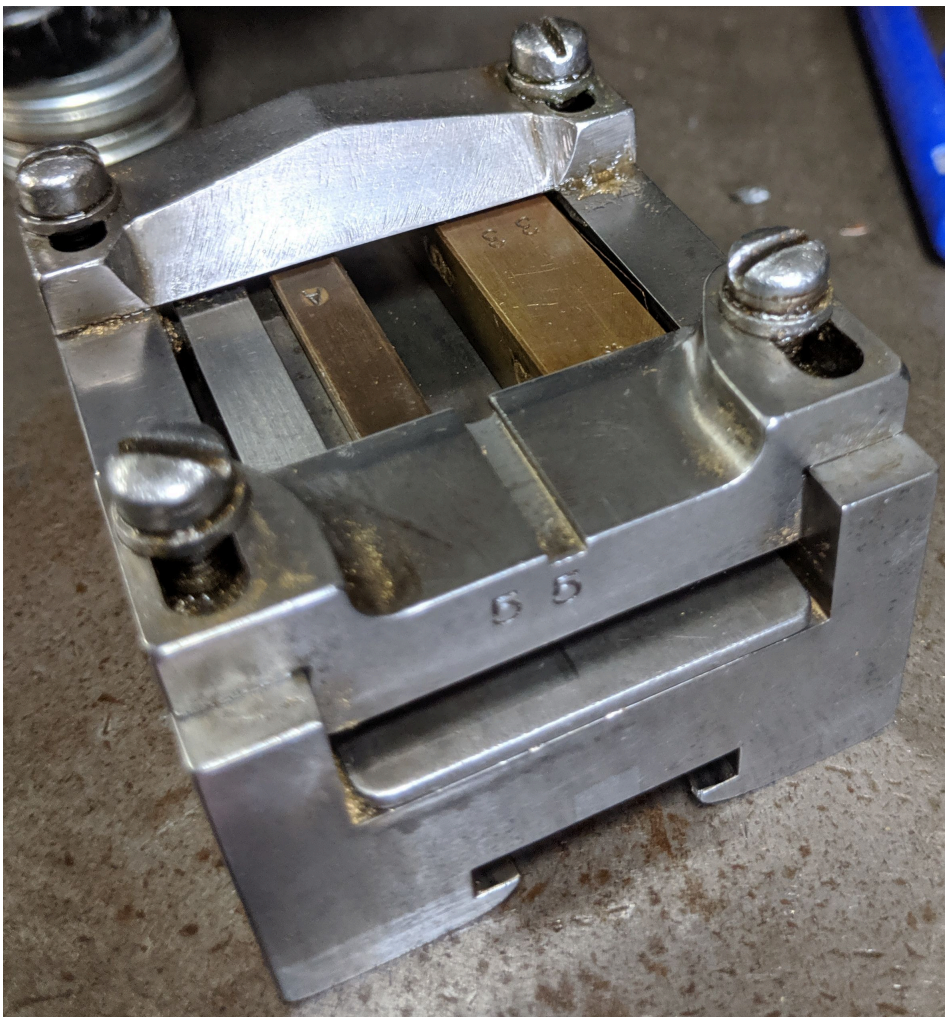

Figure IV.1.23: ATF Matrix Jig #55, for BEM 55

IV.1.A.ii.19 • Group 61. ATF Patrix Jig, for BEM 55

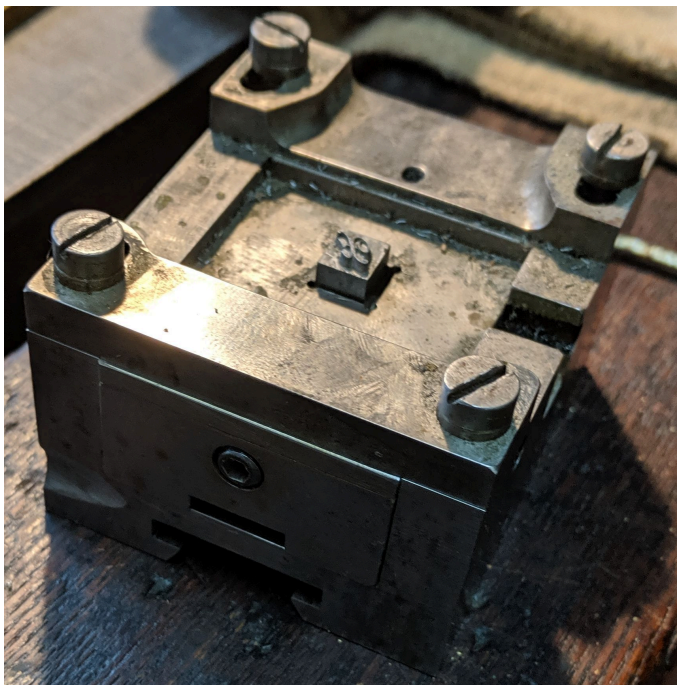

Figure IV.1.24: ATF Patrix or Punch Jig, for BEM #55

Figure IV.1.25: With Patrix Removed

IV.1.A.ii.20 • Group 62. BECO Ludlow Matrix Jig, for BEM 55

This jig was used by the Dale Guild under their Benton Engraving Company (BECO) name. It is associated with BEM 55 and is now at the Letter-kunde Press in Antwerp. My thanks to Patrick Goossens for permission to photograph it. Referring to this jig, Rehak wrote:

> I used that third jig to cut accents in lino-style shims or Ludlow matrices. There is no reason it cannot be converted to other uses.[12]

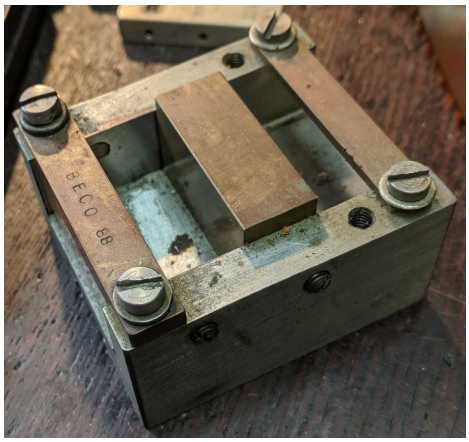

Figure IV.1.26: BECO 88 Jig, Top

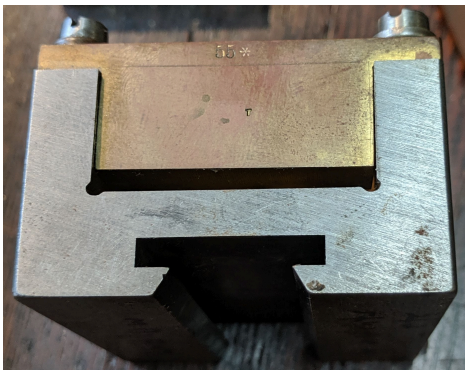

Figure IV.1.27: Side

Figure IV.1.28: Side, ID

Figure IV.1.29: Bottom

[12] Email to DMM, 2023-03-13 15:49:40 -0400.

IV.1.A.ii.21 • Group 70. Matrix Jig, CR, Traditional Mats to 60pt

This is obviously just a copy of the basic ATF matrix jig. I am distinguishing it here only because I don't have an ATF jig to copy exactly. The CircuitousRoot version will not be parts-compatible with the ATF original.

This matrix jig is intended for matrices of "traditional" form: thick rectangular blocks of the style employed in hand molds, on pivotal type casters, and on Foucher, Barth, and similar machines. These may be distinguished from matrices of more specialized forms, such as those intended for the Linotype. However, with the appropriate parts it can also be used for several kinds of relatively thin "flat" display matrices. particularly those for the Lanston Monotype Machine Company's Type-&-Rule Caster and for the Thompson and Monotype-Thompson Type Caster.[13]

When used for traditional matrices, it will accomodate planchets for a matrix thickness of 0.3944[14] with an allowance of an additional 0.XXXX for facing.

GET SIDE BEARINGS

CALCULATE MAX SET GIVEN SIDE BEARING

Tools Required

- Small brass or nylon hammer
- 3/32″hex key
- Flat screwdriver [TO DO: GET SIZE]

Additional Parts Required

- Lateral spacer and shim set for matrix depth required.

Parts

70.0: Base block

70.1: Head crossbeam and stop

70.2: Foot crossbeam

70.3: Crossbeam screw (qty. 4)

Specification:

Commercial Alternative:

70.4: Crossbeam screw washers (qty. 4)

Specification:

Commercial Alternative:

[13] Similar matrices for the Automatic Type Machine of the National Compositype Company (commonly but incorrectly called the "Compositype") may also be accomodated, but this machine is extinct.

[14] This thickness is that used by matrices for ATF's B-4 (New York) molds from 30 to 72 points and for ATF's STL-3 (St. Louis) molds from 30 to 72 pt.

70.5: Lateral adjustment set screw **c#100** (qty. 4)

Specification: Brass or nylon tipped set screw.
Thread: #10-32 UNF.
Length: 3/8″ threaded plus < 1/8″ tip.

Commercial Alternative: McMaster-Carr 91381A340 (pack of 10)
"Black-Oxide Alloy Steel Brass-Tip Set Screw."
10-32 UNF thread, nominally: 3/8" Long.
Actual length: 3/8″ threaded + 3/64″ tip.

70.10.3944: Wedge for mats for B-4 48–72pt molds, incl. Barth 60pt

70.20.NNNN: Wedge for flat mats

70.30.NNNN: Planchet backing piece for flat mats to 36pt

This piece is used below a planchet for a Lanston Monotype display matrix (to 36pt) to bring it to engraving height when using the 70.10.3944 Wedge and 201.1.3944 Lateral spacer and shim set for B-4 48-72pt molds (e.g., the 60pt Barth). It is not necessary when using 70.2.NNNN Wedge for Lanston Monotype display mats to 36pt. A different Planchet backing piece should be used when using other wedges.

70.31.NNNN: Planchet backing piece for flat mats, 42 to 48pt

IV.1.A.ii.22 • Group 80. Quill, ATF #53, with Moseley No. 1 Collets

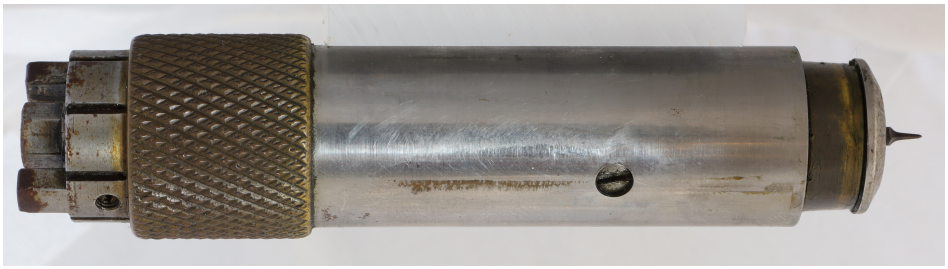

Figure IV.1.30: ATF Quill #53, General View (with cutter)

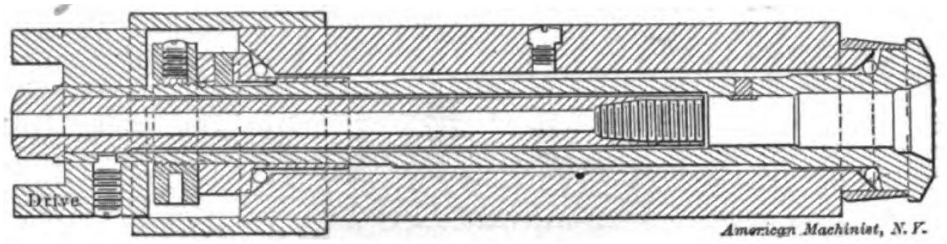

Figure IV.1.31: ATF Quill, Longitudinal Section[15]

Tools Required

- Quill wrench (see part 80.20, below)
- Long flat screwdriver [TO DO: get size]
- Small screwdriver [TO DO: get size]
- Syringe for lubricant[TO DO: specify]

Collets Used

These quills take Moseley No. 1 watchmaker's lathe collets.[16] Despite a superficial similarity, they do not take ordinary 6mm WW-style watchmaker's lathe collets.[17] The photograph at right shows the Moseley No. 1 series collet which came with BEM2a-53 above and, for comparison, a relatively standard Lorch (brand) 6mm series collet below. Note in particular the steeper cone angle of the Moseley and the difference in threads between the two.

Figure IV.1.32: Moseley No. 1 vs. Lorch 6mm

[15]From (Kaup 1909). Note that the 80.14 Collet stop as shown in this drawing differs from that on the quills examined. The depiction of the spindle bore for the collet end doesn't seem quite right, either.

[16]These were very early collets which were obsolete before the end of the 19th century. They are rare today.

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

Moseley No. 1 collets have a cone angle of 25°, a body diameter of 0.240″, and a 48 tpi thread (Goodrich 1903, 65).

PARTS

80.1: Body

80.2: Body oil hole cover screw

Remove to inject lubricant into the quill.

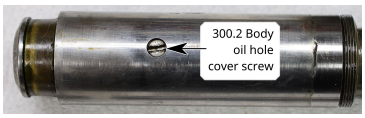

Figure IV.1.33: Oil screw

80.3: Spindle

80.4: Spindle key

This is a press fit into the spindle.

80.5: Front dust cover ring

80.6: Spindle rear end cap

80.7: Spindle rear end cap key

This part is a press fit into the 80.6 Spindle rear end cap. It slides into a keyway on the 80.3 Spindle. I have not yet fully disassembled the ATF quill with BEM2a-53 (because such a disassembly isn't in the critical path to the goal of getting the machine running) and so cannot illustrate it directly. At right is a photograph of the end of this key as it is visible externally. It appears as a circle of differently colored metal (encircled in red in the figure).

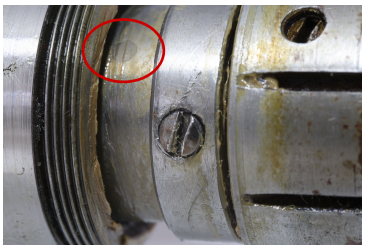

Figure IV.1.34: Rear cap key

80.8: Ball bearings **c#1** (qty. unknown)

The ATF collets employ two rings of loose ball bearings held between the body and the spindle. I haven't disassembled one to measure or count them.

80.9: Spindle nut

80.10: Spindle nut set screw

80.11: Drive and indexing ring

80.12: Drive and indexing ring set screw

80.13: Drawtube

80.14: Quill stop

80.15: Knurled rear dust cover ring

80.20.NNN: Collets, Moseley No. 1

NNN is collet capacity in thousandths of an inch.

80.30: Quill wrench

TO DO: Ed uses what is presumably an original ATF wrench in his cutter grinder video - identify it. Alternatively, a 5/16 socket or nut driver works.

IV.1.A.ii.23 • Group 81. Quills, HEBCO

These quills were manufactured for Ed Rayher by the Northampton, MA based machinist Lou Hebert (1935–2014), proprietor of HEBCO Tool and Manufacturing Company.[18]

These quills 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.[19]

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[20] 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.

81.1: Body

81.2: Spindle

81.3: Bearings (qty. 2)

> These are "SSRI 1038" bearings. That part nomenclature specifies a stainless steel, [single row], radial, inch system bearing. I do not know the other specifications of the bearings as installed (e.g., load rating, speed rating, seals/shields — these all vary significantly between various bearing manufacturers' part numbers), but in general it might be observed that a Benton quill is a very light-duty application for a modern ball bearing. The orginal bearings were obtained from Future Bearings, Inc.,[a] but this seems to be a standard bearing available from various suppliers. Here are the basic dimensional specifications, taken from the Product Data Sheet for this bearing as manufactured by National Precision Bearing, Inc. (NPB SSRI1038 n.d.) All dimensions in inches.

[a] Ed Rayher, email to the author, 2023-02-22 (A).

[18] Ed Rayher, email to the author, 2023-02-21. See (HEBCO 2014).

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

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

Parameter	Specified Value
Bore diameter	0.375
Outside diameter	0.625
Width	0.1562

81.20.NNN.n1: Collets, Sherline WW

Note 1. TO DO: On the fit of Sherline WW collets and the modification of current production collets.

IV.1.A.ii.24 • Group 88. Cutter Wires

88.0.NNN: Cutter wires, non-high-speed steel

88.1.NNN.n1: Cutter wires, high-speed steel

Note 1. TO DO: Indicate the first HSS alloy I try.

88.2.NNN: Cutter wires, carbide

IV.1.A.ii.25 • Group 90. Special Tools

IV.1.A.iii• Classification Number List

These are numbers which identify identical parts used in different areas of the machine (and which therefore have different part numbers for each use).

This list is sequential in an effectively random order (the order in which I encounter them while studying the machine).

[NOTHING YET]