Machine Dossier for BEM2a-53
(Benton Pantograph)

Part IV: Re-Engineering

Chapter 1: Physical Survey

Section B: Detailed Parts Survey

The current distribution of this machine dossier is at:
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Contents

Part IV: Re-Engineering

IV.1• Physical Survey

IV.1.B• Detailed Parts Survey

IV.1.B.i• Group 00. Frame

IV.1.B.ii• Group 10. Table Mechanism, BEM 55

IV.1.B.iii• Group 11. Table Mechanism, BEM2a-53

IV.1.B.iv• Group 20. Head

IV.1.B.v• Group 30. Gimbals and Pantograph

IV.1.B.vi• Group 40. Leverage Gauges, BEM 55

IV.1.B.vii• Group 41. Exp./Cond. Gauges, BEM 55

IV.1.B.viii• Group 42. Leverage Gauges, CR

IV.1.B.ix• Group 43. Exp./Cond. Gauges, CR

IV.1.B.x• Group 50. One-piece Followers, BEM 55

IV.1.B.xi• Group 51. Disk Followers, BEM 55

IV.1.B.xii• Group 55. One-piece Followers, CR

IV.1.B.xiii• Group 56. Disk Followers, CR

IV.1.B.xiv• Group 60. ATF Matrix Jig No. 55, for BEM 55

IV.1.B.xv• Group 61. ATF Patrix Jig, for BEM 55

IV.1.B.xvi• Group 62. BECO Ludlow Jig, for BEM 55

IV.1.B.xvii• Group 70. Matrix Jig, CR, Trad. Mats to 60pt

IV.1.B.xviii• Group 80. Quill, ATF #53

This is the quill marked “53” which, probably by coincidence, came with BEM2a-53.[1]

[1]At the 1993 ATF auction the Bentons were to be sold without quills. Greg Walters noted that at the auction “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, but that he did not put the quills into the machine by number and that fact that a quill numbered 53 was put into machine 53 was just a coincidence (email to the author, 2023-02-21).

IV.1.B.xviii.1 • Part 80.20 Collets (Moseley No. 1)

The original ATF quills use Moseley No. 1 series collets. This was determined primarily by measurement.

Partial confirmation also comes from Ed Rayher, who has observed that some of the original collets for the ATF quills on his Benton are marked "Moseley".[2]

The body diameter of these collets is 0.239,5″ (6.08mm), but they are not common 6mm WW style collets. Their cone angle is 25° (later and more common WW style collets have a cone angle of 20°). Their diameter over the threads is 0.2065″ and their thread pitch is 48tpi.

These figures match very closely those of the Moseley No. 1 style of collet, which has a diameter of 0.240″ a diameter over the threads of 0.208″ and a thread pitch of 48tpi.[3] I cannot discover any other historical collet with dimensions which even come close.

Unfortunately, the Moseley No. 1 series of collets is a very early style which was obsolete by the end of the 19th century. Benton's use of it at the time was reasonable. It suggests that the watchmaker's lathe headstocks that he employed on his Type 1 pantographs were early Moseley headstocks. If that was the case, he simply continued with what he had. For the modern user the situation is more difficult because Moseley No. 1 collets are rare. Moreover, they employ different cone angle (25°, vs. the more common 20°). This means that it is unlikely that some other, more common, collet could be adapted by making a new drawtube.

Also, all illustrations that I have found of the Moseley No. 1 show a collet with a crowned face. The single collet in the ATF quill of Benton No. 53 has a flat face. If you did manage to find some Moseley No. 1 collets with crowned faces you could, of course, easily grind them flat. Collectors of rare early industrial watchmaking equipment might take issue with this, though.

The collet installed in the original ATF quill No. 53 acquired with this machine is holding a 0.093″ shank diameter cutter. This is close to 3/32″ (0.093,7″).

[2] Ed Rayher, email to the author, 2023-02-21.

[3] See the "Table Showing Dimensions of Chucks [collets] of Various Manuacturers" in Ward Goodrich's *The Watchmakers' Lathe* (Goodrich 1903, 65).

IV.1.B.xix• Group 81. Quills, HEBCO

IV.1.B.xix.1• Group 81 Background

When I purchased BEM2a-53 from Greg Walters, he supplied three quills with it. One was the original ATF quill described in section IV.1.B.xvii, Group 70. Matrix Jig, CR, Trad. Mats to 60pt. Two were quills of modern manufacture. These were commissioned by Ed Rayher from a Northampton, MA based machinist, Lou Hebert.[4]

These quills are "plug compatible" substitutes for the ATF quills, but they differ in construction and in the collets they use.

IV.1.B.xix.2• Part 81.20 Collets (Sherline WW)

Measurements

These quills take a nominal 8mm WW style collet with a maximum body diameter of 7.938mm (which, by calculation, is 0.312,52″) and a minimum keyway width of 0.084″. The quill bore was measured using a Brown and Sharpe Tapered Hole Checker together with a Mitutoyo Cat. 293-240-30 0-1″ digital micrometer (accuracy: ±0.000,05"). The keyway width was measured using a shop-grade gage pin set. The end of a 0.084 pin fit but the end of a 0.085 pin did not. See (Worknotes 2023-02-23).

This is an unusually small receiver for a WW style collet. Most WW collets will not fit.

Intended Collets

Ed Rayher has confirmed that these quills were intended for use with Sherline Products, Inc. collets supplied by him to Hebert.[6] Here is the face of the collet which came in one of the two quills with BEM2a-53. The "S.P." maker's mark is that of Sherline Products.

However, as will be seen below, Sherline "WW" collets manufactured today (2023) do not fit.

Figure IV.1.1: S.P. Collet[5]

WW Lathe and Collet History

Understanding these collets is made more difficult for someone without some background in watchmaking by Sherline's own literature. To clear this up requires a digression into the history of WW collets.

[4]Ed Rayher, email to the author, 2023-02-21.

[5]Photo by the DMM.

[6]Ed Rayher, email to the author, 2023-02-21.

The early development of the American watchmaker's lathe (where the entire concept of the collet originated) by Moseley and others is covered well in Goodrich's *The Watchmakers Lathe* (Goodrich 1903). Especially in the beginning, there was naturally considerable variation from one manufacturer to another (the table on page 65 of Goodrich, which contains the Moseley No. 1 collet used by Benton, lists many variations now rarely seen). By the first part of the 20th century, though, things settled down and most WW collets were more or less interchangeable. There were differences that you had to be aware of,[7] but generally an 8mm nominal body size WW style collet became a standard item.

It is important to realize, though, that despite this there were no standards. This "standardization" occurred because manufacturers copied each other. The closest thing to a standard definition of a "WW style" watchmaker's lathe was a passage in a 1949 article by Samuel Levin, whose firm was one of the highest quality makers of these lathes in the mid-20th century. He wrote:

> Today, almost all leading makers of watchmaker's lathes make them according to the so-called WW standards. What, actually, are these WW standards? when one speaks of a WW type lathe he means one which has a 50 mm (1.394″) center height, 60° angular bed ways, 1.456″ width on the top of the bed, and 8 mm chuck body and a 40° included ancle on the chuck. (Levin 1949, 18).

Unsurprisingly, Levin specifies an 8mm body for a WW collet.[8]

Unnecessary Confusion

Sherline Products is a well established maker of small lathes. They have made watchmaker's lathe collets and collet adapters for their lathes for many years. Their products are excellent, but their product literature for their watchmaker's lathe collets introduces an unnecessary confusion.

They are quite clear about the specifications of their collets and in particular they call out a body diameter of 0.312–0.313″ for them (Sherline 2022). This works out to 7.924,8 – 7.950,2mm. Such clarity is laudable.[9]

The problem is that they say that these collets are "built to standard WW specifications" and that their are other "collets that are called 'WW' but will not fit our adapter." They call these "8mm" collets and imply that they are not true WW collets (Sherline 2023).

[7] For example: Moseley's later collets were conoidal in form, modern Chinese WW collets employ a metric thread, etc.

[8] He is clearly excluding here 6mm and 6.5mm collets. As a test, I took a Levin 8mm WW collet (7/64 capacity) and measured it using a Mitutoyo Cat. 293-240-30 0-1″ digital micrometer (accuracy: ±0.000,05"). Its body was 7.975 – 7.980mm in diameter (Worknotes 2023-02-20).

[9] However, actual measurement of a set of five Sherline "WW" collets purchased directly from Sherline indicated that, at least at present, they tend to undershoot these tolerances. Four of the five measured under 0.312″ (Worknotes 2023-02-24). This is not really a problem, though.

This is backwards. There are no "standard WW specifications," but insofar as there is any standardization in WW collets, all other[10] (and older) manufacturers' 8mm collets tend to a diameter much closer to 8mm. The Sherline collets are almost unique in being undersized. This presents no problem when using their collets in standard WW lathes. But when a device is built closely to Sherline collet dimensions, as the Hebert spindles are, it means that virtually every WW collet made for the watchmaking trade in the 20th century will not fit.

Current Production Sherline WW Collets

However, a test of five Sherline "WW" collets, newly purchased directly from Sherline, revealed a different problem. The collets fit the bore of the quill, but the keyway slot in them was to narrow to pass the key in the quill. The keyway on the Sherline "WW" collet which came with the Hebert quill measures 0.084″. the keyways on these new Sherline "WW" collets measure 0.078–0.081″. This difference of 0.003–0.006″ is enough to keep the collets from fully entering the quill.

Sherline does not publish a specification for the width of their collet keyways (and they make a point that they do not provide keys on their own WW collet fixtures). These collets aren't out-of-spec, they're just not the same as they once were.

Sherline "WW" collets are not hardened, so it should be possible to modify the keyway so that they will fit.

Potential Future Difficulties

The tolerance specification for Sherline "WW" collets is 0.312–0.313″ (which, by calculation, would be 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.

J.W.Starrett Collets

As a last note here, Sherline product literature claims that Starrett collets[11] are dimensionally the same as theirs (Sherline 2022). This is not necessarily so. In a test of nine J.W.Starrett WW collets, all of them were larger than Sherline's maximum specified body diameter. The largest of them measured 7.973mm (0.313,89″). None of them would fit a Hebert Benton quill (Worknotes 2023-02-23).

[10] Except J.W.Starrett.

[11] These are made by the J.W.Starrett company, not the better known L.S.Starrett company.

IV.1.B.xix.3 • Group 81 External Dimensions

IV.1.B.xix.4 • Part 81.01, Body

IV.1.B.xix.5 • Part 81.02, Spindle

This has an internal diameter at the collet-holding end of 7.938mm (Worknotes 2023-02-23).

IV.1.B.xx • Group 88. Cutter Wires

IV.1.B.xx.1 • ATF Cutter in Quill #53

IV.1.B.xx.2 • Rayher Style Cutters