RUSS SHELTON: FATHER OF THE CMM

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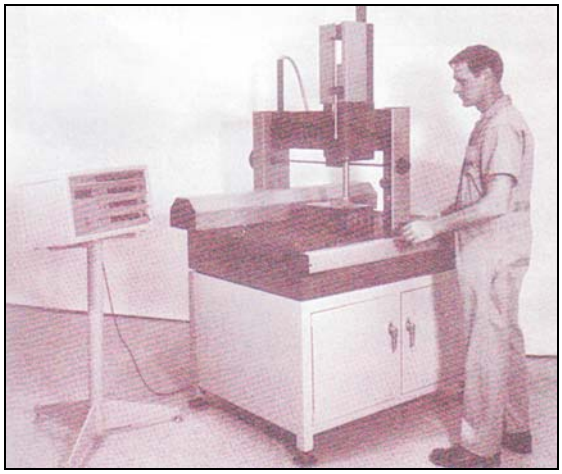
Russ Shelton is considered by many to be the father of the coordinate measuring machine. Certainly his work heavily influenced the structural materials, the design architecture, the types of bearings, and the probes used in the coordinate measuring machines. These notes hope to document just some of the contributions that Russ Shelton made in the measuring machine industry.



Russ Shelton with an early Check-Mate 1965

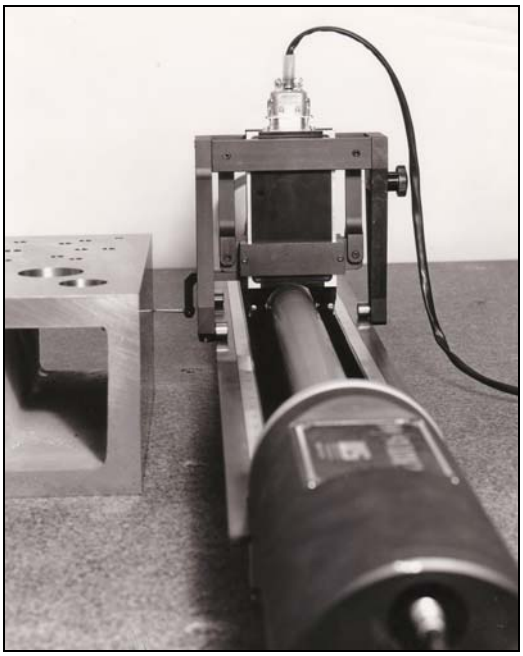
By 1965 Russ Shelton had already manufactured several coordinate measuring machines employing granite for structural components and air bearings for guidance. Prior to this almost all measuring machines had been based on machine tool design. Made from cast iron components with scraped or lapped oil lubricated ways, they were very expensive and required craftsmanship in their construction and care in their use. Russ used the stability and economics of granite and the technical advantages of air bearings combined with his own innovative ideas and machine architecture to found a new company called Shelton Metrology in 1965. In the promotion of his new metrology tools he needed to sell the idea of granite as a structural element. Everyone had granite surface plates but machine structures from granite were new.

At the same time Russ was developing and promoting the idea of porous air bearings. This was a complete departure from conventional air bearings. The first porous bearings were made from sintered bronze. He learned the hard way that because the bronze was malleable, it was difficult to machine the same way each time and that contact with the guide way would change its flow characteristics. Many other porous materials were tried; stainless steel, nickel, and ceramic. After years of experimentation porous graphite was chosen as the best material for such use.

Russ's early CMMs employed many fine precision machine design principles; notice the widely space guide bearings and also the early use of friction drives. The double bridge design has been lost on most contemporary builders, this feature eliminates any roll force about the bridge and is an important consideration because cross bridge roll especially on long and or tall bridges is a large error source and difficult to compensate for.

First extremely large air bearing CMMs. Electro Motive (foreground) and Y12 (background)

Many Shelton Metrology machines are still in operation after 30 years and I have heard more than one service technician say these machines are superior with regard to reversal errors and uncorrected accuracy.



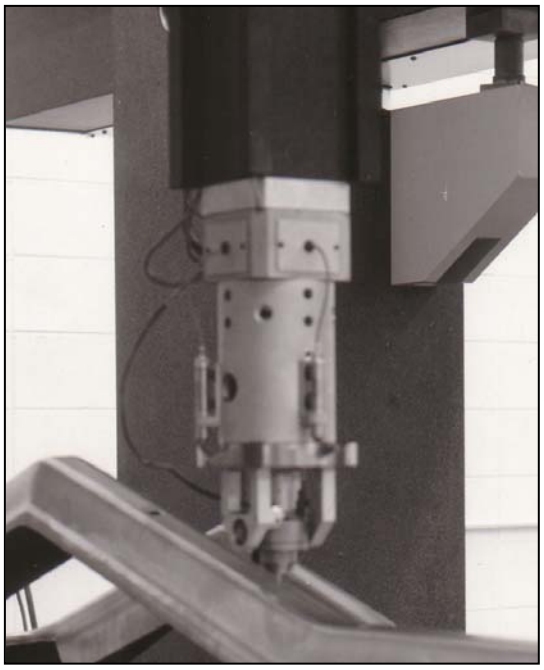
Veritas: uses Axis of Rotation
for straightness reference

Russ received a Design News award for Veritas, deemed to be one of the 100 most significant inventions of 1971. The Veritas was a device for measuring straightness by spinning a shaft between two opposed spherical air bearings and then measuring both sides of the spinning shaft with differential probes. In this way he could divine out the axis of rotation and use it as a straightness reference. He would joke you could measure millionths of an inch by spinning a wooden 2 x 4. In all seriousness, by integrating the Veritas into his CMMs he could provide straightness-measuring resolution of one millionth of an inch, and accuracy of ten millionths over 56 inches. Thirty years later commercial CMMs are still not capable of matching these specifications.

Russ would resort to natural physical references when ever possible. For instance, to define a plane he would use pools of mercury connected by tubes and reference them with capacitive probes. By backing out the calculated curvature of the earth he could establish a very accurate, inexpensive and flexible flat reference.

The first probes for CMMs were simply hard amounts of artifacts. Russ designed the first electronically triggered probe and it had a magnetic breakaway feature. His design allowed the operator to replace the probe without any need to recalibrate the machine probe relationship.

Russ then designed the first indexing touch trigger probe which was installed on one of his check-mate machines. That probe remained in use from 1971 until 1995 when it was replaced by an EMD scanning probe.



Early indexing trigger probe 1971

Russ was one of the first to build scanning probes for CMMs. He offered manual scanning probes in the mid 70s and CNC versions by the mid 80s. He was an early proponent of large amounts of data to more fully describe a part.

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