

DIVIDING ENGINES



Figure 1 Dividing Engine at Burra antique shop, note vertical scribing tool and holey baseboard for holding down work piece.

In the article on Otto Boettger (Tappet Chatter, August 2011), I wondered whether I had acquired a Dividing Engine at a Burra antique shop. (see Figure1) Further research confirmed that I had! More than that, I found that these devices can be linear (straight line) or circular and that the latter caused such an improvement in sextants and other nautical instruments that it paved the way for the British Empire to dominate the Oceans of the World in Elizabethan times.

Linear Dividing Engines

Another example of a Linear Dividing Engine was found on the internet and is illustrated in Figure 2.

Note the baseboard with holes drilled to take pegs which hold the work piece in place. The screw on my Dividing Engine has a pitch of (exactly) 1 millimetre and could therefore score lines $1/100$ of a millimetre (10 microns) apart, but of course it would need a very fine scriber. At the next Power of the Past I plan to use it to make a rule and also a vernier scale to read fractions of the rule units. It seems appropriate to call the units “nerds” and I look forward to explaining verniers (and nerds) to interested parties.



Figure 2 Linear Dividing Engine (as seen on internet)

Automated Dividing Engines

Were built to scribe complex logarithmic and other scales on slide rules, particularly in making patterns for later mass production (see Figure 3).



Figure 3 Automated linear dividing engines for making slide rule patterns

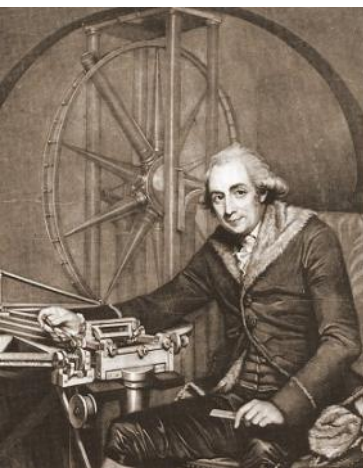


Figure 4 Jesse Ramsden and his Circular Dividing Engine

Circular Dividing Engines

Circular Dividing engines were around in the early 1700's but were vastly improved by Jesse Ramsden in the 1770's. He was awarded £615 by the Board of Longitude on the condition that he “share his skills” and engrave scales for other instrument-makers at the rate of “three shillings for each Octant and six shilling for each brafs Sextant”. Jesse's book is an absolute gem, as is an NZ engineer's commentary written in 2010 (see references below).

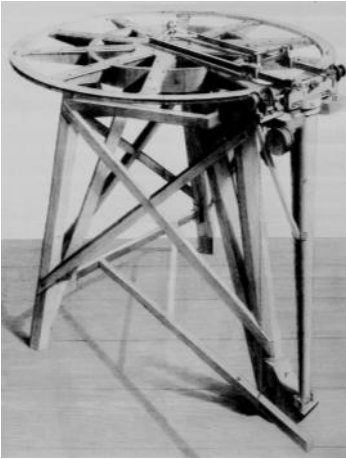


Figure 5 Ramsden's Circular Dividing Engine, note treadle and string. The scriber is similar to those on Fig 1 & 2. There are holes in the spokes to hold down work pieces.

Jesse's engine comprised a cast gun-metal wheel 1 metre in diameter with 2160 gear teeth accurately cut around the outer edge. Each tooth represents 10 arcminutes ($1/6$ of a degree). The wheel is turned by a nut with 60 graduations so each mark advances the wheel by 10 arcseconds. A clever treadle can be set up to rotate the nut through a specified number of arcseconds which semi-automates the process. It still required skill to accurately scribe the lines on the target instrument (surely a job assigned to apprentices!). Graduations on navigational instruments of the time were generally at 20 arcminute intervals which were subdivided further by using verniers.

Jesse also published a description of his thread cutting lathe used to make components of the Dividing Engine. This raises the "chicken and egg" question of what do you use as a lead-screw on a screw cutting lathe? It is thought that perhaps the earliest versions had hand-filed screws which then made better



Figure 7 Another "modern" circular dividing engine, now in a museum

threads to put in lathes to make better threads etc.

We know that Otto Boettger had a Circular Dividing Engine to complete the work previously described in Tappet Chatter on the telescope at the Semaphore Observatory.

This is confirmed by the following extract from the SA Register of April 1880:

...the first theodolites made in Australia have just been turned out by Mr. Otto Boettger, of Flinders-street, to the order of the Government... Amongst other instruments worthy of an inspection at this place of business is a dividing machine, furnished with very powerful glasses for the purpose of enabling the manufacturer to fix the degrees, &c, upon discs. It was made at Berlin.

Now wouldn't that be a great find in a bric-a-brac shop!

Mark Randell

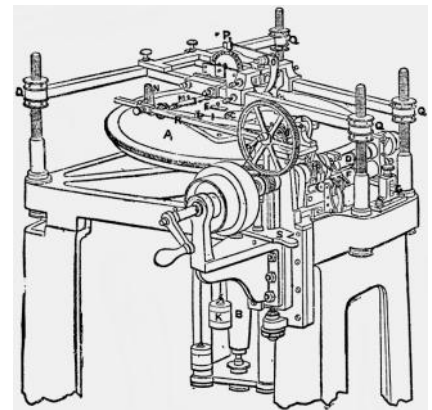


Figure 6 A "modern" Circular Dividing Engine (c 1850), note threaded pillars to adjust height of scriber.

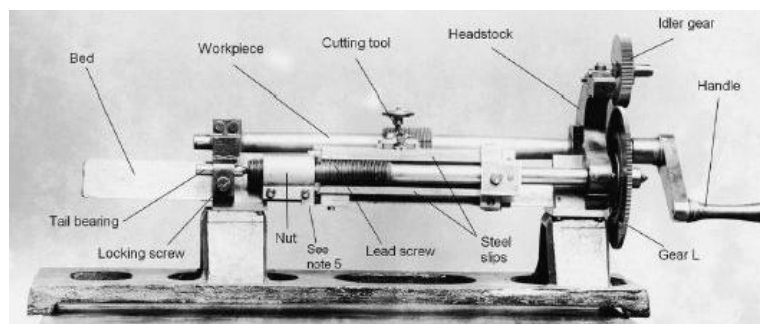


Figure 8 Jesse Ramsden's screw cutting lathe, on display at the Smithsonian Institute

Internet References

www.fer3.com/arc/imgx/Text.pdf www.fer3.com/arc/imgx/Commentary-on-Jesse-Ramsdens.pdf