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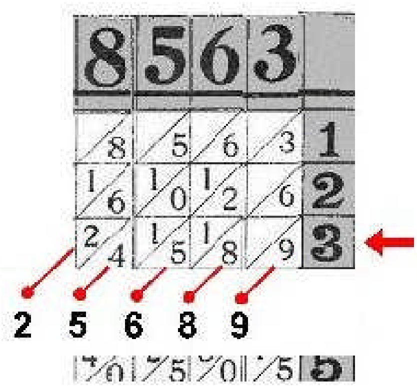
Remarks on Didier Roth's *Multiplicateur et diviseur à réglettes*

One of the problems while constructing a mechanical multiplying machine or instrument in the past had to do with the tens carry. Here we only discuss the tens carry mechanism in a multiplying instrument, which means there are no gears to perform this task.

During multiplication we first have to find the partial products out of every figure of the multiplicand and the – let's assume – only figure of the multiplier. Next we write down the unit figure of the partial product of lowest order, add its tens figure to the partial product of next higher order, write down its unit figure and so on.

We all know John Napier and his rods, invented to ease multiplication[1]. All partial products of a number on top are written down in eight or nine equal parts on one side of a rod or stripe. Their figures are arranged diagonally so that the user is guided with his eyes from one necessary addition to the next.

Other inventors[2] added small windows for a better reading or rearranged the figures of the partial products side by side.



Napier's rods to perform 8563 x 3 = 25689

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1 Jo. Neper, Rabdologia, Edinburgh 1617

2 For example *Automultiplicateur Eggis*, France 1892 (see La Nature 1892 No. 966 - 991, S.381).

In his *Multiplicateur et diviseur à réglettes*[3] Didier Roth used another system to display the figures of a product.

Roth's *Multiplicateur et diviseur à réglettes*
Replica and photo by Valéry Monnier, with his kind permission

Each of six vertical slots is numbered from bottom to top[4] with the figures 0 to 9. With small knobs in these slots the figures of the multiplicand are entered. The multiplicand itself can be read in a horizontal slot above the vertical ones. Within eight horizontal slots, marked from bottom to top with 2, 3,..., up to 9, the number of the multiplicand multiplied by 2, 3,... is displayed.

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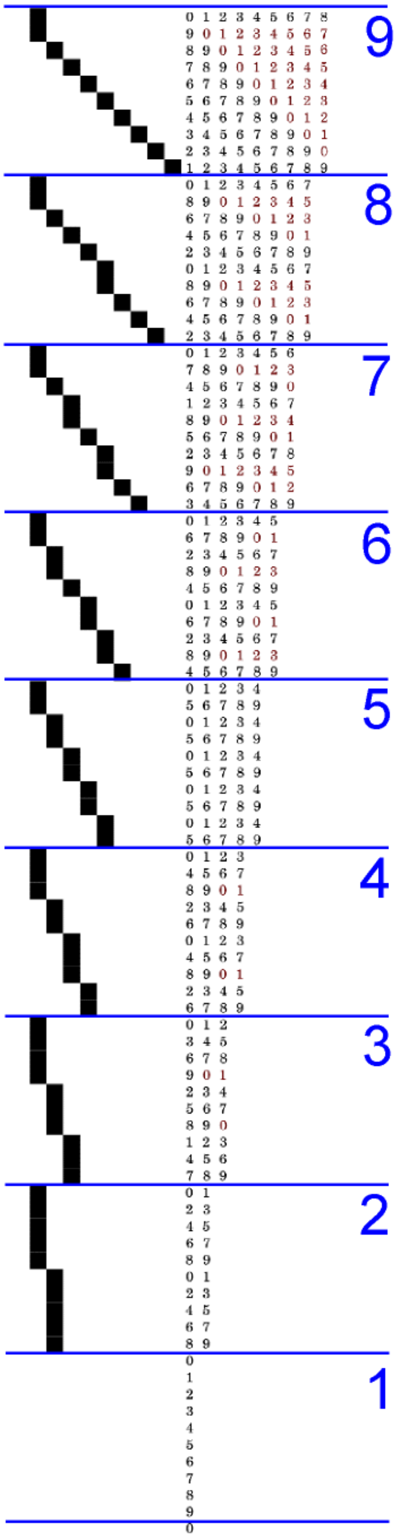
3 French patent (*Brevet d'invention*) 16536 dated March 18^{th} 1844.
Items in Musée des Arts et Metiers, Paris, Inv.N°
10479-0001-: *Multiplicateur et diviseur à réglettes dit "prompt multiplicateur et diviseur";*
10478-0001- *Multiplicateur et diviseur à réglettes*
10479-0002- *Tableau imprimé montrant l'intérieur du "prompt multiplicateur et diviseur"*
URL: http://cugnot.cnam.fr:8000/SEARCH/BASIS/collec/internet/objet/SDF (last visit Nov. 20^{th} 2008).
See also Valéry Monnier, URL: http://www.ami19.org/ROTH/IndexRoth.html (last visit see above).

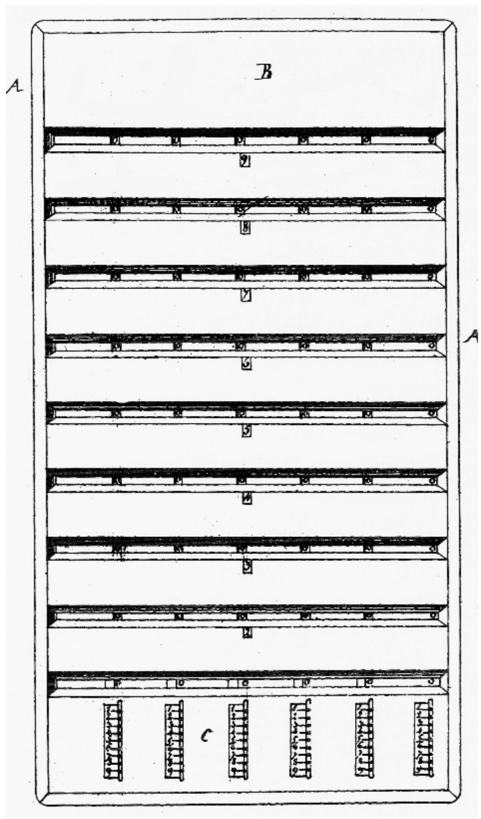
4 In patent 16536 the slots are erroneously numbered in reverse order.

Inside the *Multiplicateur* every knob moves a stripe (*réglette*) up and down. Each stripe is divided into nine sections. It bears columns of figures on the right and small windows on the left. Every section belongs to a different multiplier. The stripes overlap in a way that the windows of a stripe on the right side lay over the figures on the next stripe to the left. And of course only figures under a window are displayed.

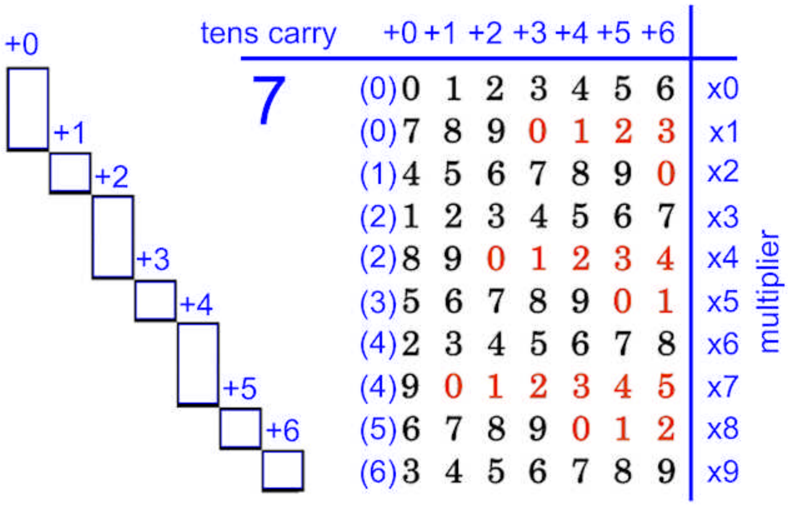
Next we discuss structure and rules included in a single section by use of section 7. Except for different figures, the positions of the small windows and their arrangement, these rules apply to every section.



One of the stripes used in *Multiplicateur*
Original drawing by Valéry Monnier



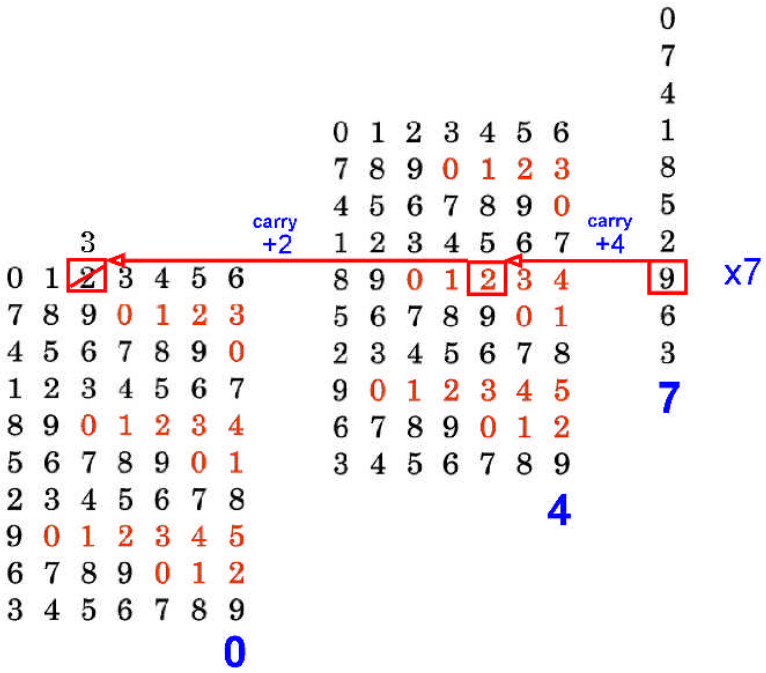
View of *Multiplicateur* in patent 16536



The figures are arranged as a field of two dimensions. In the vertical column on the left from top downwards we find the unit figures of the products 0*7=0, 1*7=7, 2*7=(1)4.... In the next column to the right we find these figures increased by 1, in the next column to the right increased by 2 and so on until we reach the last column on the right side that holds the unit figures increased by 6. All these increments, 0 included, represent the tens carry coming from the right stripe. Because of 9*7=63 the tens carry in this section cannot exceed 6.
The tens of all partial products 0*7 to 9*7 are carried to the left onto the next section by the positions of these small windows. They are positioned above those columns, in which the special tens figure belonging to this window is added.

Such a mechanism displaying the sum of unit figure plus a tens carry doesn't work properly in case the tens figure changes while a carry is added. Therefore if that happens the displayed figure becomes red which means that the user has to increase the next figure left in display by 1. In row multiplier x4 above we see black figures 8 and 9 with tens carry of 2 and red figures 0, 1, 2, 3, 4, because the latter belong to a tens carry of 3. For a better understanding an example multiplying 47 * 7 = 329 over three stripes is shown on next page.

Inside the instrument on the right side a smaller stripe is mounted. It only holds the unit figures of all partial products without carries added because no carry from the right occurs.



Multiplying example 47 * 7 = 329

Didier Roth wasn't the only inventor who constructed a mechanism for displaying the sum of unit figure plus a tens carry. In the following decades such a system has been renewed and altered in several patents. We only mention two of them:
DE223669: Gino Soncini in Lodi, Ital.: Multiplikationsvorrichtung (30. Aug. 1908),
DE270632: Optische Anstalt C.P. Goerz AG in Berlin-Friedenau: Multiplikationsvorrichtung (26. Nov. 1912)

Drawings by the author unless otherwise mentioned.

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