Condition Report Sauter Calculator
Examination: 13. bis 17. May 2013 Stadtmuseum Göteborg

Fig. 1

The Sauter calculator is a calculating machine for the four basic arithmetic operations: Addition, Subtraction, Multiplication and Division. It has been build by “Sauter in Esslingen”. He describes it at the central plate:

Maschine
ohne nachzudenken
geschwind und sicher
damit rechnen zu könen [sic.]

The machine has been built in the succession of the famous calculating machine made by Pfarrer Hahn. Technically it is very similar but in some points there are remarkable differences. This will be explained in the detailed presentation.

On the top of the machine you find three rows of centrally arranged enamel discs. The external row is the input. The middle row is the output. And the inner row is to count the rotations of the central crank. The smaller cranks are added for deletion of the result device and for the rotation counter. The bell close to the holder of the crank is to give the user a warning if there is a overflow at the last place.

It is a so called “richtläufige Maschine” which means that the mechanism inside can be moved only in one direction. So the central driving crank can only be turned in clockwise direction. As a consequence of this you find red colored complementary digits at the enamel discs of the result plant.

The Sauter Calculator is mounted on a wooden pedestal. The pedestal has five paws of Lions as bases. All five are in good condition. The wooden pedestal is decorated with brass elements which are fire-gilded. The floral ornaments at the corners are complete but one of the side elements with a vertical stripe structure is missing. (Fig. 1)

While building the replica, this part can be done once more, so that it will be possible to complete it later on. The same applies for the upper Ornament with the small little balls too.

The machine itself is mounted on a big gearwheel which allows rotating it while using. This gearwheel is halted with a small hook which is hold in the correct position with a spring. (Fig. 2)

Fig. 2

In the pedestal there is a drawer which contains the instruction book of Sauter. It has a green book cover from leather with some floral gold embossing and it is in a very well condition. (Fig. 3)

Fig. 3

The Machine itself is allover in very good condition. It is not working at the moment but the inspections proved that it might be moved in working order with low effort. There are only minor parts missing like screws, or splints but nothing essential. All missing parts which are required for a perfect function can be replicated easily. The condition of the metall surface is mostly very well too.

Most of the inner parts of the machine are polluted and dirty. This might be easily removed with dry cotton buds. Several crystalline metall blooming might be removed with special watchmaker oil, cotton buds and special wooden toothpick under microscope. This procedure does not hurt the surface of the metall at all but it will remove most of the rust at the steel parts and the blooming at the brass surface. Tenacious rust might be partially treated under microscope with a kind of "Bimsmehl" or Arkansas oilstone powder – which is a special extremely fine polishing powder. It is usually used by the conservators of the Deutsches Museum Munich for the restoration of comparable objects. All this procedures are not only for beautification but for protecting the machine from future corrosion as much as possible. For this reason the clean parts might be covered with a very thin layer of special wax. This helps to protect the surface from further weathering and it protects the surface if it is touched directly with fingers without gloves.

All this mentioned procedures will approximately take one week. In the course of cleaning the machine it might be brought in working order too.

Detailed Presentation of the Sauter calculator and its function:

The Sauter calculator has been built in two assembly and function groups:

The external part (Fig. 4) contains the mechanism for the input and for the adoption of the movement of the actuator. In addition it contains the storage for the Input digits. This is needed for the multiplication and division where the same digit has to be used several times. Every multiplication is executed as an iterative addition.

The mechanism for clicking the inner part into place is included in the outer part too. It can be unlocked by pressing a nub on the top because it is possible to do an arithmetic shift. This is useful for multiplication. If it is a multi-digit multiplier the crank has to be turned at every place 9 times at most. You can find this mechanism between 7 and 8 o'clock in Figure 4. The nub on top has been removed to take the inner part out.

Fig. 4

The inner part (Fig. 5) contains the upright shaft with the central driving crank, the cranks for deletion, the mechanism for the adoption of the Input, the carry of tens, the rotation counter and the result device. It has been built very complex, small and highly optimized.

Fig. 5

The external part of the Sauter calculator has three layers (Fig. 6). The top level contains the input device. Between the top level and the middle level is the storage of the digits. Between the middle and the first level is the activator for the transfer of the digit from the store to the output device. This element is a gear segment, of which one cog of a wheel is strengthens by a steel application (Fig. 7). This reinforcement is needed because this cog of the wheel must be absolute exact to put the wheel after using in the right position again.

Fig. 6

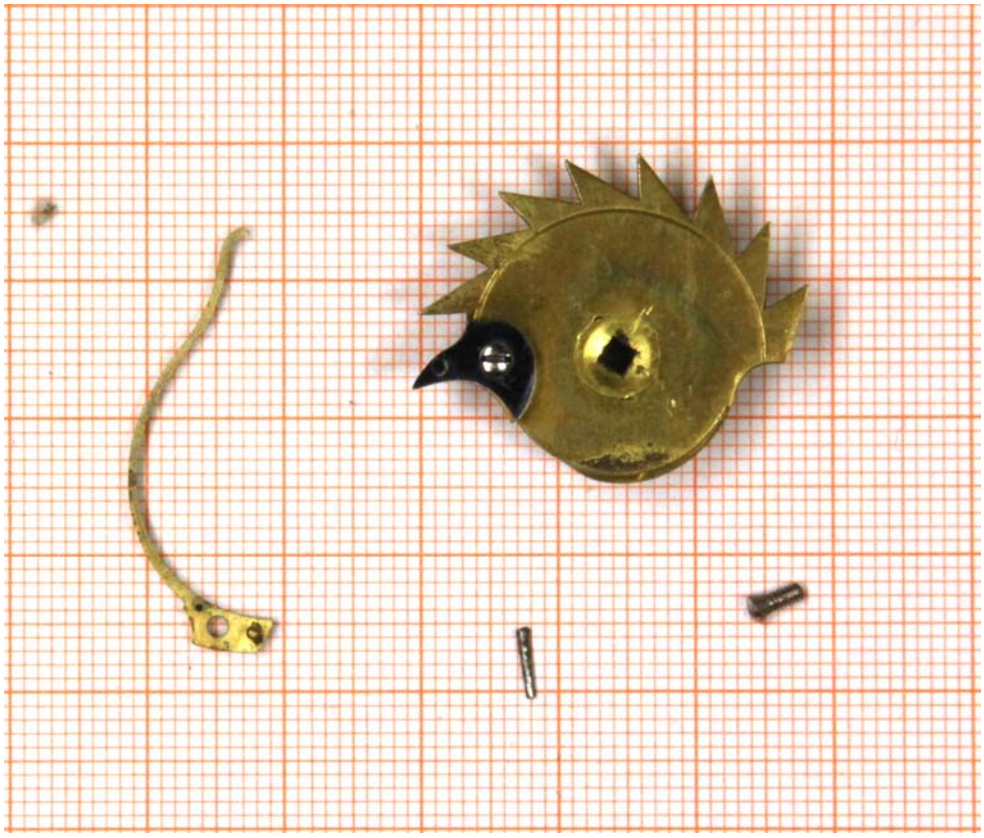

Fig. 7

Fig. 8

In Figure 8 you can see this function group. The big single steel gear on 11 o'clock is the starter for the movement of every input wheel. It touches an angle lever which is mounted at every place. The angle lever does unblock the repeat device of the input axis. A spring (Fig. 9) on top of the middle level becomes free and it moves the axis in clockwise direction immediately.

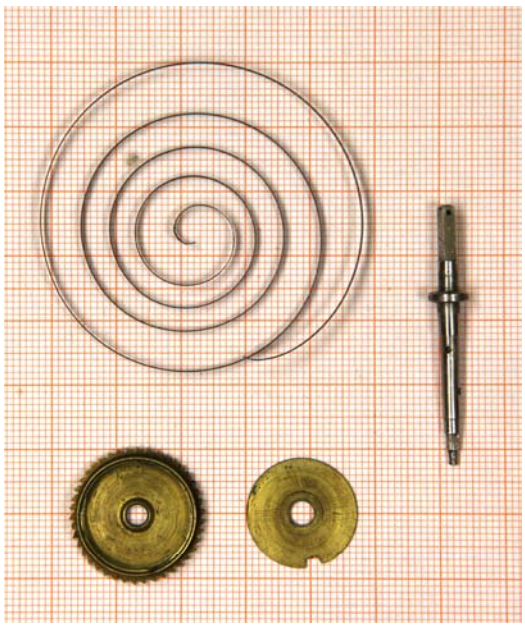

Fig. 9

In that moment the disc over the spring capsule takes it position which correspond to the digit which is plugged with the pin on the top level. This means that every input lever moves until it is stopped by the stop pin (Fig. 10 and Fig. 4 at 10 o' clock: the lever touches the pin) moves that disc to a distinct position.

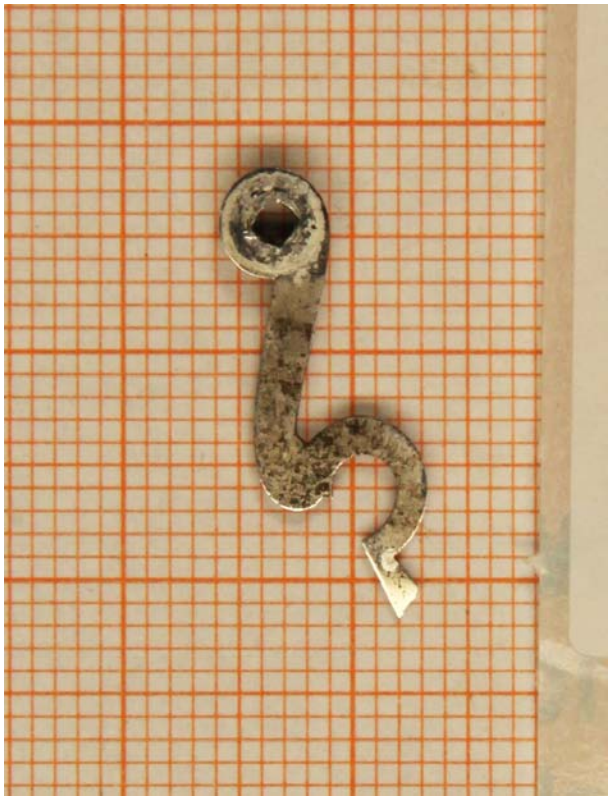

Fig. 10

During that movement the folding gears at this disc fold away (Fig.11). This means that the movement in that direction does not affect the output axis.

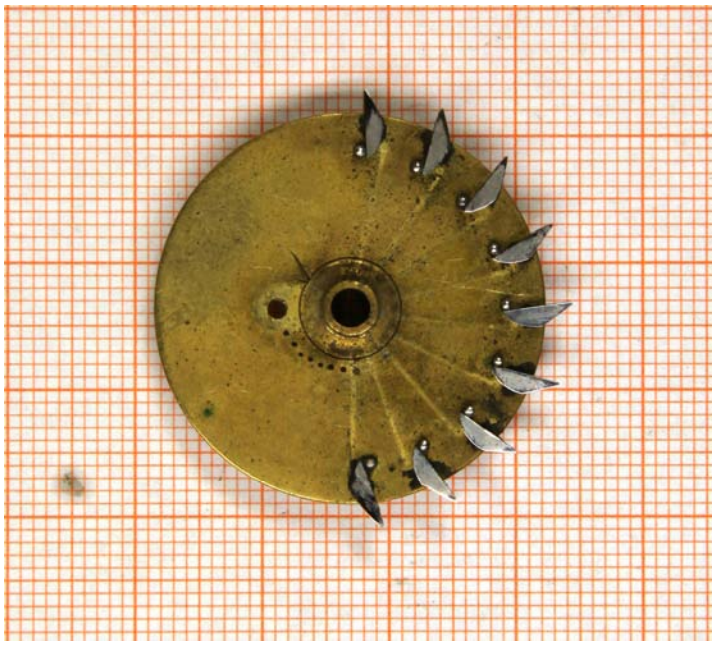

Fig. 11

A very special spring at that gear keeps the gears after that movement in the correct position again (Fig. 12).

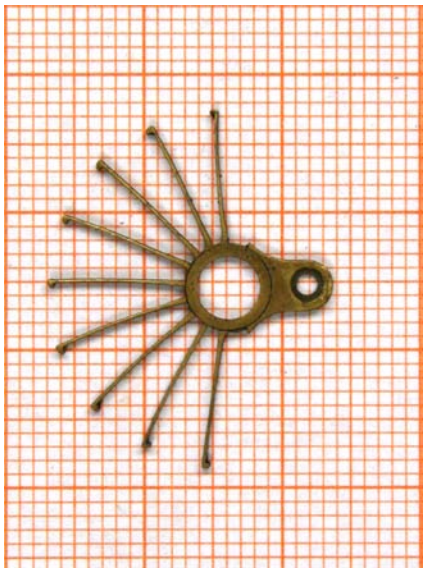

Fig. 12

The next movement is started by passing of the central segment gear wheel (Fig. 13 and Fig. 8: 5 o'clock).

Fig. 13

This big segment gear wheel (Fig. 13) moves the gears of the small segment gear wheel in Figure 7. This movement turns the disc with the folding gears in the opposite direction so that the gears are not folded away. The small positioning pin at the side of every gear keeps the gears now in an upright position. During the movement every gear which is engaged turns the output gearwheel respectively so far that one is added into the output. After that movement the gearwheel is clicked into place by the angel lever. The home position is reached again.

Now there are only two steps missing: the carry of tens and the counting of the crank rotation.

If during an addition or multiplication the result device moves at one place from 9 to 0 the carry of tens mechanism starts to work. There is a small pin at the rear side of the driven gear (Fig. 14 – red arrow).

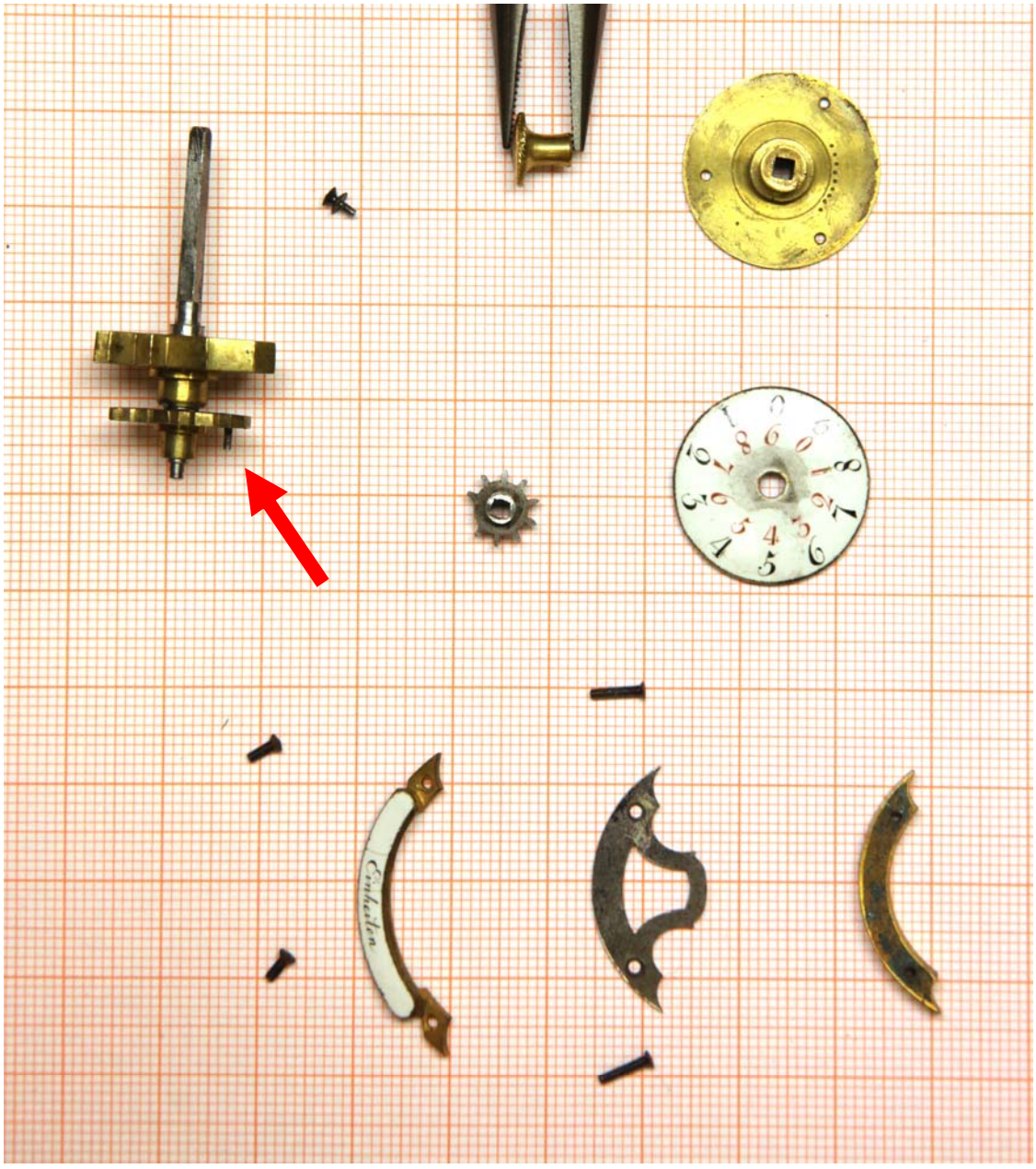

Fig. 14

This pin touches the three armed angel lever at the mechanism of the carry of tens (Fig. 15).

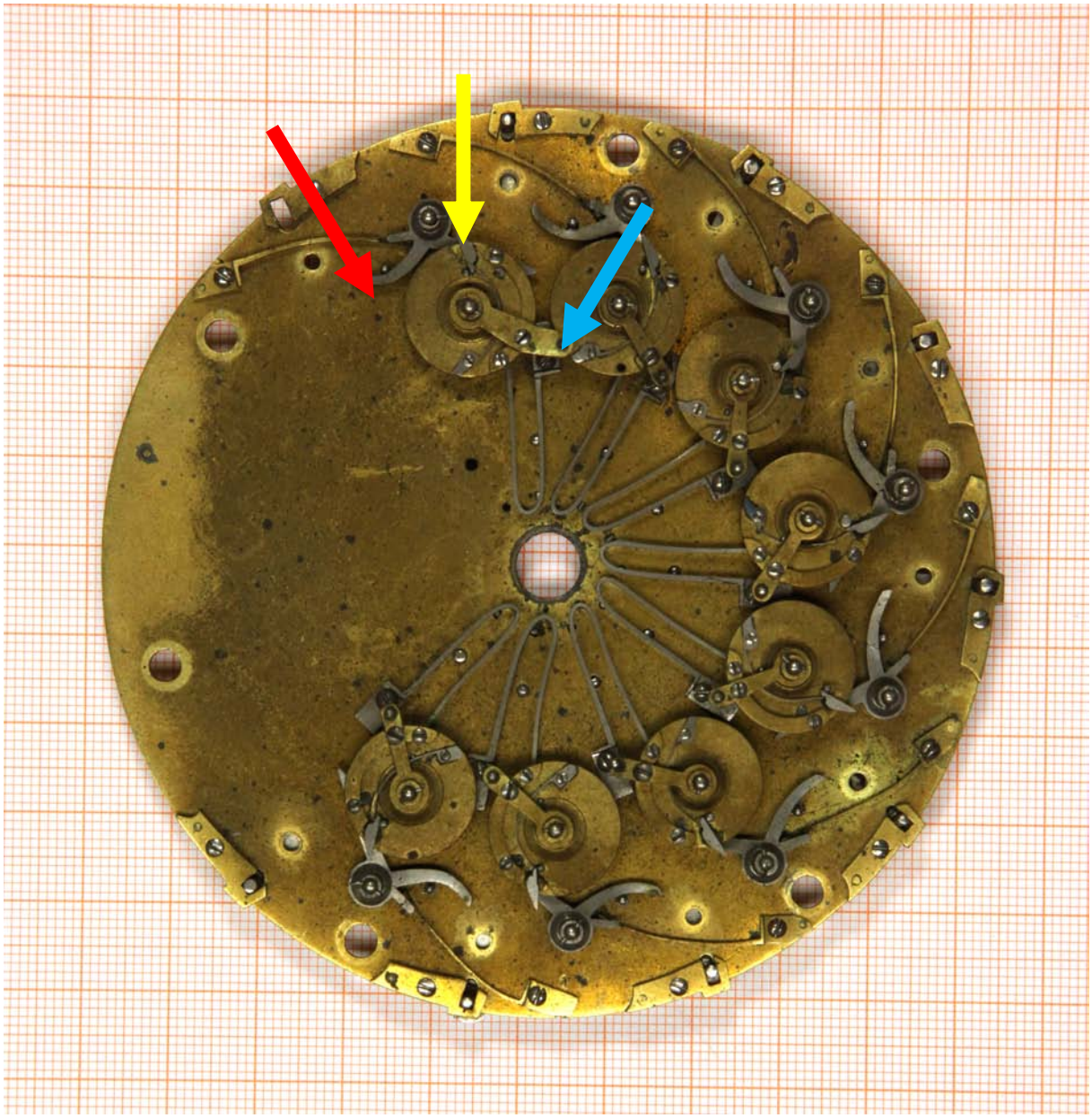

Fig. 15

The lever lets unlatch the disc with one single pin (Fig. 15 – blue arrow) and one single folding cog of a wheel (Fig. 15 – yellow arrow). The V-shaped spring moves the wheel 35 degree in clockwise direction until it is stopped with a pin underneath the disc. During this movement the folding cog of a wheel is folded away, so that it does not manipulate the gear wheel of the result axis of the next higher place. After this the carry of tens is prepared and stored.

In the next step the central rotary cam (Fig. 16 – red arrow) is moving with one release lever around. This release lever touches the single pin of the carry of tens disc and moves it back to the original starting position. During that movement the single folding cog of a wheel (Fig. 15 – yellow arrow) is not folded away and it turns the gear wheel of the next higher result place one digit further.

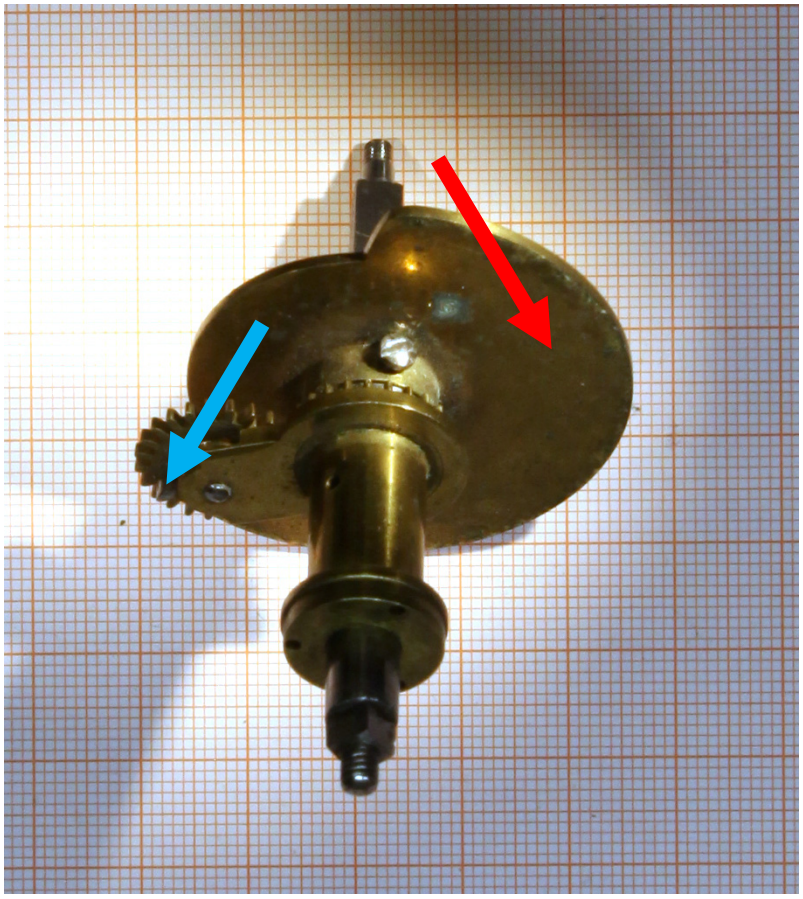

Fig. 16

After replacing the carry of tens mechanism the calculation is done. The single cog of a wheel under the gear wheel (Fig. 16 – blue arrow) moves now the counter of the central crank rotation at the place, where the input of the machine has its first place at this moment. If this is done the crank has turned one time and gets back to it starting position. A new calculation may occur.

So far the machine has been put into parts at this moment, the following parts can be declared as missing:

Top level

place of “Millionen” – the pin in the input device which is used for plug in the digit for calculating

Stand

Some decoration elements

Inside the machine

Several screws and splints but hopefully nothing which is relevant for making it operable again – they will be listed in detail during the next inspection. It seems to be that the machine has been opened for repairing or adjustment several times – and some of the extremely small screws have been lost at this occasion.

But since Sauter often used several alternative mounting parts parallel the important operating parts are almost all correct at their places, but sometimes fixed only with screws and not with screws and splints or sometimes only with five screws instead of six – one hole is free. It should be decided next time, if you would like to replace this small missing pieces, or not. All together we are speaking about at most fifteen pieces. The exact number will be found out next time.

Inside the spring capsules

two places are not moving so that it is supposed that these springs are not correctly at the right places or in the worst case are broken. This should be found out by opening the appropriate capsules during the next inspection.

Summary of this first inspection

The Sauter calculator is not only optically but also functionally in very good shape. Based on our experience with several original calculating machines of that time we will recommend cleaning the dirty parts very carefully without any abrasive blasting. A second step might be to treat the little heavy rust places with “Bimsmehl” or Arkansas oilstone powder and special watchmaker oil. According to experience this treatments will have the result that rust appearance will be considerably retarded. The “side effect” is that the machine looks again clean and it will bring the fire gilded surface to bear. Inside the machine the cleaning will making sense because the function will be much better if all parts are free from dust.

The minor “repairings” to get the machine operating again are as well reasonable because Sauter built a fantastic artwork of computing and his ideas can preserved perfectly in keeping his machine “alive”.

Bonn, 19.5.2013

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