Repairing a Damaged Fusee Chain in a Verge Watch

An Incorrect Replacement is Remedied

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Objective
To illustrate the methods employed in the repair of a broken fusee chain.

The Watch
The subject of this article is a silver-cased verge pocket watch. The maker as engraved on the movement is ‘Alexander Sutton London’, hallmarked London, 1825.

The Condition
Initial inspection showed the watch movement as presented had the following defects:

1. Broken top pivot on third wheel.
2. Fusee chain broken; hook at fusee end soldered.
3. Fusee damaged at the area of the hooking pin, Figure 1.
4. Bushing pitted and punched.
5. Balance spring distorted into conical form; collet badly pinned.
7. Potence raised from plate by overlong barrel bridge screw.

Only item 2, the damaged fusee chain, will be dealt with in detail, the other defects being referred to only in the context of their relevance to this or to illustrate those which may be expected in such a watch of this age. This was the fault of the present repairer and highlights the importance of a thorough initial inspection. Proper examination will usually reveal whether any of the components are not original. In movements of this vintage (this one being almost 200 years old), as they will have been through the hands of several repairers, it is not unusual to find that a part might have been replaced with an item salvaged from another watch.

This was precisely the case here. A warning was there in the damage to the area of the fusee around the hooking pin, as mentioned above.

The movement was presented with the broken fusee chain wrapped around the train between the plates. Unfortunately, it was only after completing the repair of the chain and rectifying all the other faults that it became obvious that the chain was too wide to sit in the grooves of the fusee. It was 0.4 mm wide; the grooves needed a chain of 0.3 mm. There was no reason to suspect that the fusee itself was a later addition, so the chain must have been salvaged from another watch. The damage to the pinning point referred to above...
had resulted from a previous repairer trying to fit a thicker hook which had additionally been the subject of an earlier clumsy repair. It came as a surprise that it was not only the hook that was incorrect.

The Solution
This could be resolved only by fitting a chain of the correct height. Fortunately, I had two lengths of such a chain and was therefore able to join these.

Repairing the Fusee Chain

Tools
Perhaps the most significant challenge encountered in this type of repair is handling and clamping the various components at different stages of the work. To address these difficulties, two devices were developed. The first of these was a modified tool that is normally used in the repair of escapement cylinders, Figures 2A and 2B. The modification consisted of drilling two holes of 0.4 mm, one to a depth of 0.4 mm, the other to about 0.2 mm. Note also the alignment marks scribed on the clamping plates.

The second device was a piece of dense animal bone, curved and with a groove of decreasing depth. This was mounted in a small vice which is not fixed to the bench. This will be illustrated below.

Method
Very often it is the middle (sandwiched) link in these chains that breaks, Figure 3. In order to remove the remains of this broken link, the pin or trundle has to be pushed through the links above and below it, without damaging either of those links. This means the riveted head of the trundle has to be carefully removed so that when it is pushed through, no damage is inflicted on those links.

A dead hard centre punch fitted into the staking tool, Figure 4, is used prior to drilling off the rivet head. The chain was clamped in the modified cylinder tool and this was placed on the plate of a Seitz jewelling press. A 0.6 mm spade drill, Figure 5, was used to remove the head of the rivet, Figure 6, rotating the drill by hand.

Next, the sharp centre punch is replaced with a flat, blunt punch, similar to that shown in Figure 7. Mounted in the staking tool and again with the chain held in the cylinder tool, it is used to push the pin through and thereby release the broken link for removal.

Figure 8 shows the pin partly removed. Note the rivet head on the underside. From this it can be seen that it is necessary to remove the rivet head from the upper end of the trundle, to avoid deforming or splitting the links.
This process is repeated on the length of chain to be joined. A new middle link, in this case salvaged from another chain, was cleaned and located in the prepared end. A short length of pivot steel is selected to be a good fit in a hollow staking punch. A pin is turned on this, to be a sliding fit in the bore diameter of the middle link which is to be sandwiched between the pair of links. This pin has to be slightly longer than the height of the chain. Figure 9 shows the preparation for assembly. Note
the slight neck on the pin to facilitate breaking it off later. The chain is fitted into the cylinder clamping tool with the pin aligned to the blind hole. Figure 10 shows the chain before it is aligned correctly. This set-up is mounted on the staking tool and the pin pushed through. The blind hole in the cylinder clamping tool ensures that it penetrates only sufficiently to permit enough of the pin to protrude to form the rivet. A piece of scalpel blade is firmly clamped horizontally in a small vice, with the sharp edge uppermost. The chain, together with the pin, is then taken and laid along the blade; using a sharp fine screwdriver with a vee slot, the pin is sheared off, Figure 11. The opposite end of the protruding pin is also visible.

The task now is to form the rivet heads on the ends of the pin. To prepare for this, any coarse excess material at the point where the pin was sheared off has to be filed to form a flat surface, proud of the link. This is where the second device is employed, Figure 12. The groove cut into the bone has to be the width of the chain. The chain is laid in the groove, as shown. The varying depth of the groove makes it easy to protect the links during filing of the excess. It is important that the ends of the pin are flat. A Fine diamond file (not a ‘Super Fine’) is ideal for this. The chain was then removed to the staking tool, clamped in the cylinder tool and riveting was started with a dead hard centre punch. The grainy finish left from the filing of the ends of the pin help to prevent the centre punch from slipping as it is aligned. A fine spherical punch was used to spread the ends of the pin further, thereby forming the rivets. For the forming of the first of the two rivet heads the chain is clamped with the protruding end of the pin sitting in the shallower of the two blind holes in the cylinder tool. For the second rivet head, the process is the same, but the chain is clamped so that the first sits on a flat area of the tool, i.e. not above any of the holes.

Any rough metal must then be removed using the slotted bone and Super Fine diamond file, finishing with a ceramic burnisher to ensure a smooth surface to both ends of the pin. The process of forming the rivet work-hardens the pin satisfactorily.

**Historical Note**

The fine fusee chains found in watches are remarkable feats of craftsmanship, even more so because they were most commonly made by children. One centre of production was the Christchurch Workhouse in Dorset, where manufacture is known to have been operating in 1800. There were reportedly three other manufacturers in the area, the last of which ceased in 1914. Details of some of the tooling and methods can be found in a book by Sue Newman. The employment conditions in the workhouse would have been harsh and the absence of good lighting would have been very detrimental to the eyesight of the pauper children. When handling these fine chains, one cannot help but reflect on those young workers.

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* Fine and Super Fine as used here refer to the grades of ‘Eze-Lap’ diamond laps/hand files as advertised, for example, by Eternal Tools. Fine is given as 600 grit, and Super Fine as 1200 grit; there is also a Medium (400 grit) available. —Tech. Ed.

**ENDNOTE**