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Fusee Click Spring Repair

Replacing the Click Spring in an Eighteenth-Century Clock

John Robey

Figure 1. Early eighteenth-century ebonised bracket clock.

Figure 2. The engraved backplate with a restored verge pendulum and replacement verge end plate.

Figure 3. Movement with rebuilt strike-work.

The click mechanism of a fusee sometimes needs attention due to wear or component failure, as exemplified by Mike Cardew's recent article ('Pocket Watch Fusee Repair', *HJ*, March 2019) describing making a new click wheel for a nineteenth-century pocket watch. The click spring might also fail, and this article describes its replacement on an early eighteenth-century bracket clock, **Figures 1–3**. This clock has had a chequered career and a couple of decades or so ago it underwent extensive restoration back to verge pendulum from a later anchor escapement and all the strike-work was rebuilt. There had originally been a quarter pull-repeat mechanism which had subsequently been removed, along with much of the striking mechanism. It had been rebuilt with hour striking using a conventional rack and snail system.

Winding problems had developed, which were soon diagnosed as a faulty click spring. Early fusees are constructed in a different manner to those on later clocks and there are two types of fusee: the later type with enclosed ratchet teeth and clicks and earlier ones where they are exposed.

Clocks and pocket watches from the nineteenth century have a separate click wheel that sits inside a recess in the body of the fusee and is held in place with two or more screws, **Figures 4 and 5**. The click and its spring are fixed to the fusee wheel so when assembled, all the click mechanism is enclosed and ingress of dirt is prevented. Often the click is a simple affair with no tail, but on quality clocks there may be a tail and a small radial hole drilled in the wheel rim between two teeth. This enables a thin wire to be used to depress the tail and disengage the click from the ratchet. The main use of this was to let down the mainspring in stages when using a set-up tool, instead of the more risky procedure of releasing the set-up click a tooth at a time.

Samuel Deacon, the well-known Leicestershire clockmaker, used a very similar enclosed click system on his eight-day longcase clocks, but without the ability to disengage the click from the outside, **Figure 6**. In theory this is a superior system that protects the ratchet and click, but there are practical disadvantages when it is used on a longcase clock. If the weight line becomes tangled or needs replacing, there is no hole between two teeth to disengage the click (it would probably be in an inaccessible position anyway). Feeding the free end of the line back off the barrel might solve the problem, but if it is wrapped tightly round the arbor, or if it is on the centre barrel of one of Deacon's three-train musical clocks, then dismantling the whole movement is the only solution. Since Deacon was very keen on parting his customers from their money, it is likely that this was a deliberate ploy so that they had to pay for a strip-down, which could be avoided with a conventional longcase movement having an open ratchet and click.

The fusees of this bracket clock are of the early open type where the ratchet teeth are cut round the edge of the fusee itself

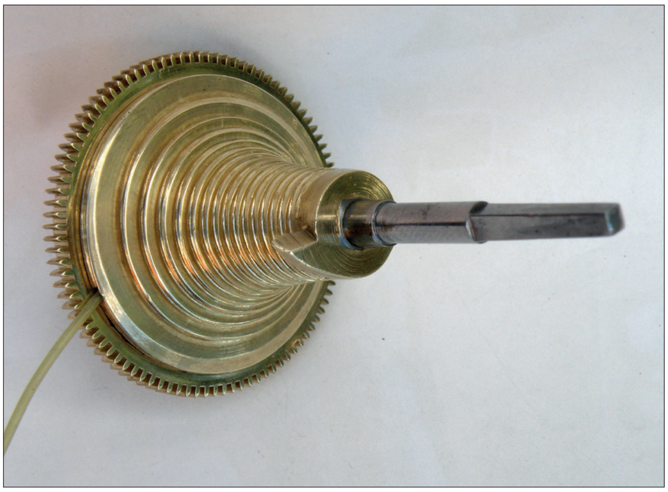

Figure 4. The enclosed type of fusee used in the nineteenth century.

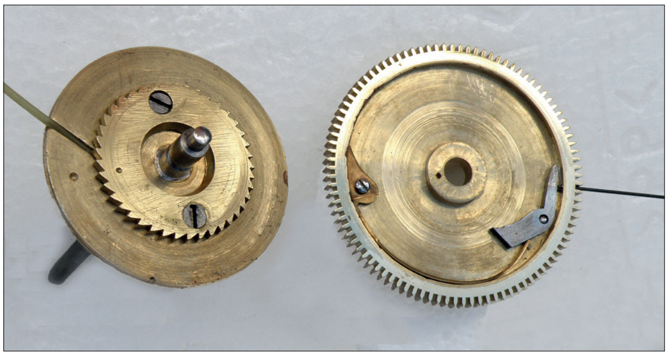

Figure 5. A separate click wheel is screwed to the fusee with the click and spring fitted on the fusee wheel. Note the wire on the right demonstrating how the click may be released from the outside.

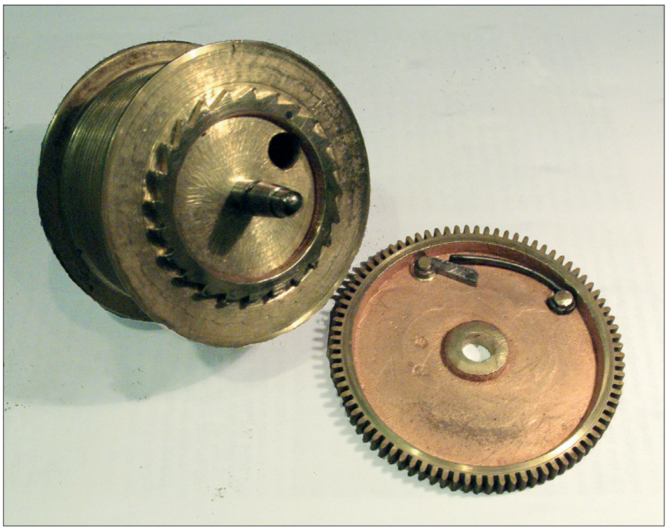

Figure 6. Internal click on the barrel of an eight-day Samuel Deacon longcase clock.

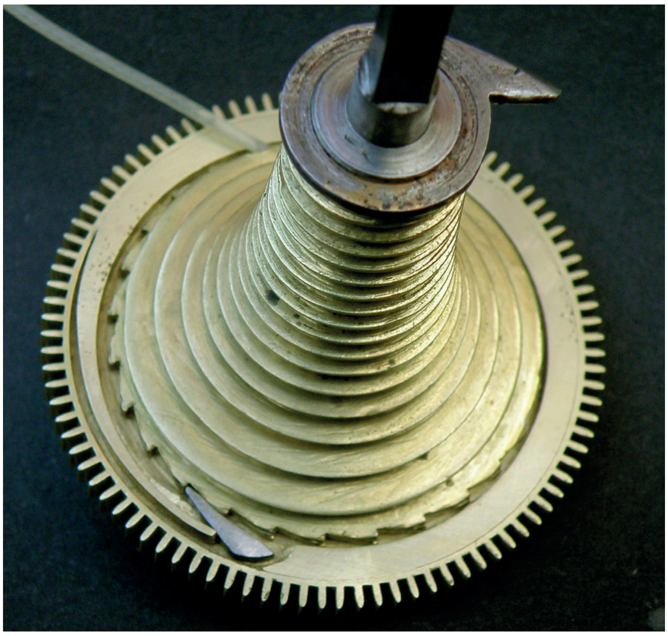

Figure 7. Early type of open fusee with the ratchet teeth cut into the edge of the fusee and the click spring part of the wheel (shown after repair).

with the click and its spring recessed into the wheel, **Figure 7**. The spring is of a particularly neat and elegant construction and at first glance it appears to be impossible to make it. In fact, the spring is a brass ring that fits so closely inside a recess in the wheel that no join is visible and it seems to be part of the wheel itself. A crack can be seen in the old spring, **Figure 8**, but it would be difficult, though not impossible, to repair it satisfactorily. This is an instance when making a new part is preferable to trying to repair a broken one, but making a new spring for this type of fusee is not as straightforward as for the later enclosed type. With careful planning and accurate machining, however, a perfect replacement can be achieved.

Though photographs were taken before and after the repair, unfortunately there are none of the intermediate stages, so descriptions and mock-ups will have to suffice. Needless to say, how the job is tackled will depend on the equipment that is available. The broken spring must first be removed and finding the three rivets that hold it in place can be a challenge. The blue arrow in **Figure 8** indicates the position of the only one whose location could be identified, so this was the first to be removed, using a punch just smaller in diameter than the rivet. For this type of job I have made a series of punches ranging from 0.6 mm to 3 mm diameter and each

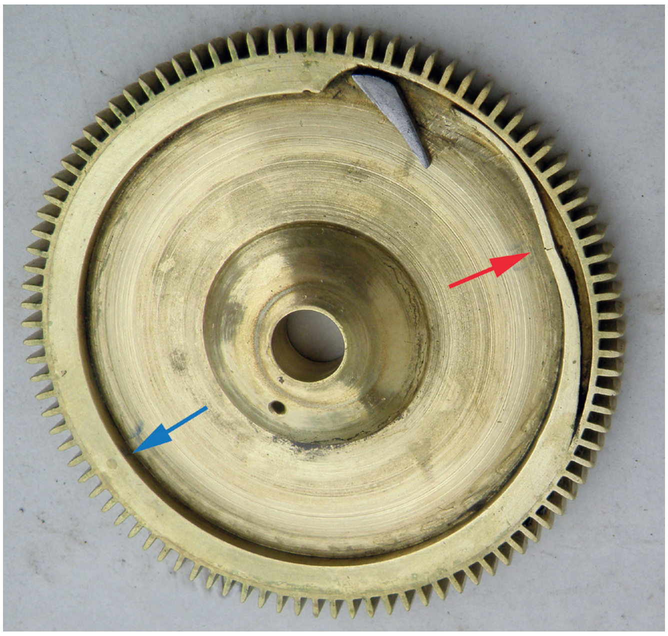

Figure 8. Fusee wheel. The red arrow shows the crack in the spring, the blue arrow indicates the position of a rivet.

Figure 9. Set of homemade punches with spaces left for additional sizes and a couple awaiting repair.

Figure 10. The smallest and largest diameter punches, each of three lengths.

size comes in three lengths, **Figures 9 and 10**. Knocking out a stubborn pin with a long punch is likely to result in a bent – and subsequently useless – punch. The shortest should be no longer than about one to two diameters. Once the pin has started to move progress to a longer punch and finally use the longest one to knock the rivet out. These punches were made from either blued pivot steel or spare Allen keys. The latter are of a high-quality tough steel which, after turning to size, is ideal for this purpose. They are then set in mild-steel holders with high strength Loctite. While punches can be made from solid silver steel, not only is it more expensive, but hardening and tempering the ends, especially for the smaller sizes, can be tricky. Also, due to its high carbon content it can be quite brittle and prone to snapping.

The other route to disaster is to use punches free-hand – instead hold them vertical in a staking tool to ensure a straight blow. One of the larger sizes of watchmakers' staking tools is suitable for items like this, but for larger work the very versatile staking set made by JMW Clocks in Sheffield is well worth the investment, **Figure 11**. If the punch jams in the hole it can be very difficult to remove it from a traditional watchmaker's tool, but the upper arm of the JMW tool can be swung to the side allowing removal of the punch.

Figure 11. A watchmaker's staking tool (right) and the larger versatile JMW staking tool (left).

Once the first rivet is out then the others should become more obvious, but if not use a thin scalpel blade underneath the spring to gently prise it up a little. With the broken spring removed and the recess cleaned, measure the inner and outer diameters and select a piece of brass of the correct colour. Modern brass is too red, so cast yellow brass is needed to give a perfect match. A piece cut from a scrap brass longcase dial will be about the correct thickness and will have been hammered so it will have the correct springiness. Centre punch and scribe the inner and outer diameters with dividers. The ring could then be cut out with a piercing saw and held in a three-jaw chuck, using first the outer jaws and then the inner jaws, but by doing it this way there is the probability that the ring will distort and it will not fit snugly in the recess in the wheel. A better approach is to drill a central hole to fit the blank on a mandrel, **Figures 12 and 13**, as if making a clock wheel. The one shown here was made by silver soldering a mild steel bar into an old redundant W12 collet and turning a spigot and clamping thread on the end. A similar arrangement made from round bar and held in a three-jaw lathe chuck will serve the purpose equally well.

Turn the outside of the brass blank until it almost fits in the recess, or is at least a tight fit – it must not be loose. Then cut out the centre and hold the ring by its outer edge. Ideal for this is a step collet of the correct size, **Figures 14 and 15**, or a six-jaw bezel chuck. Since it has no moving parts, a step collet is the most accurate, but each one can accommodate only a limited range of diameters. A bezel chuck can grip a much wide range of sizes, though with slightly less accuracy, and would be a more useful alternative.

Figure 12. Brass disc held between Perspex backing discs in a mandrel made from an old collet.

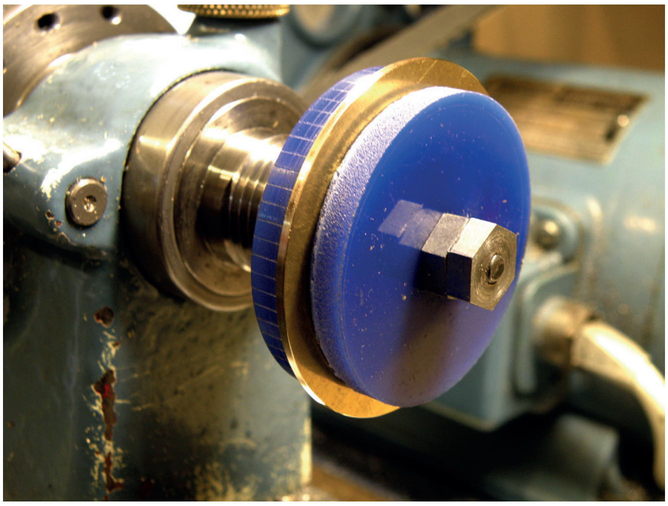

Figure 13. The mandrel held in the headstock spindle of a Schaublin SV70 lathe.

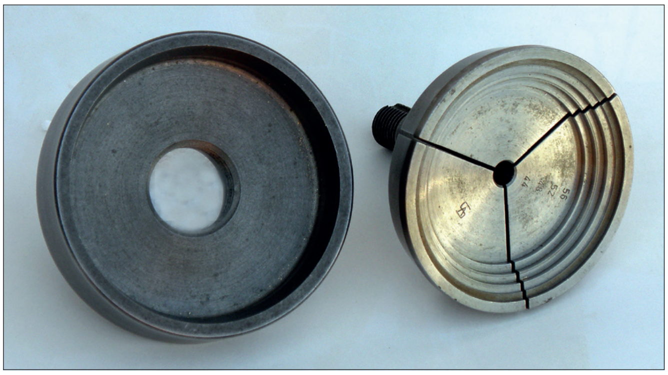

Figure 14. W12 step collet and closer.

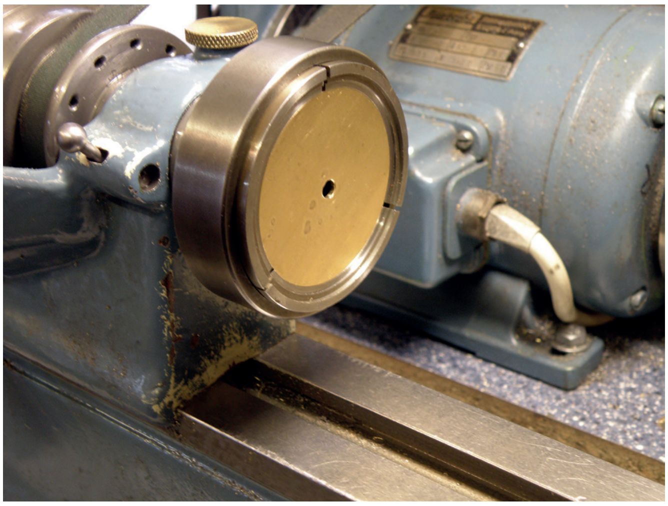

Figure 15. Brass disc held in a step collet.

Failing either of these, mount a block of aluminium alloy, brass or even hardwood, in a three- or four-jaw lathe chuck and turn a recess into which the ring fits firmly, if necessary holding it with shellac or a removable adhesive. Since the inner diameter of the spring is not critical, an alternative would be to carefully file to the inner scribed line.

After turning the inside diameter saw through the ring and file one end to form the spring. The inside diameter will be found to provide the correct amount of movement for the click without the need to bend it, so only file the outer edge, checking with callipers until the part that forms the actual spring is of the correct width. There is little metal to grip in the jaws of even a small vice, so it is best to hold it by hand, supported on a round piece of wood of a suitable diameter. **Figure 16** shows the broken spring and the new one ready for fitting.

Once the ends have been shaped to match the original it can be snapped into place and the operation of the click tested. The new spring must not move while the rivet holes are being drilled, but if in doubt hold it in place with adhesive tape, turn the wheel over and drill through one of the existing holes. Do not drill the other two until the first rivet is in position. Once

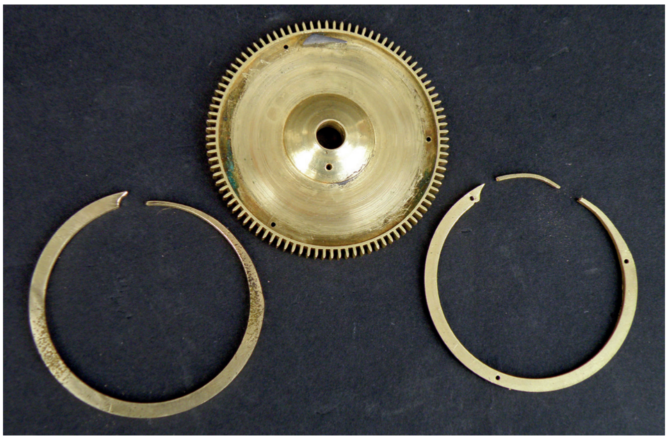

Figure 16. The fusee wheel after removal of the broken spring (right) and the new one (left) ready for fitting.

all the brass rivets are firm it just remains to smooth off the ends and reduce the spring's thickness until it is flush with the top of the recess. All being well, the join should be invisible.

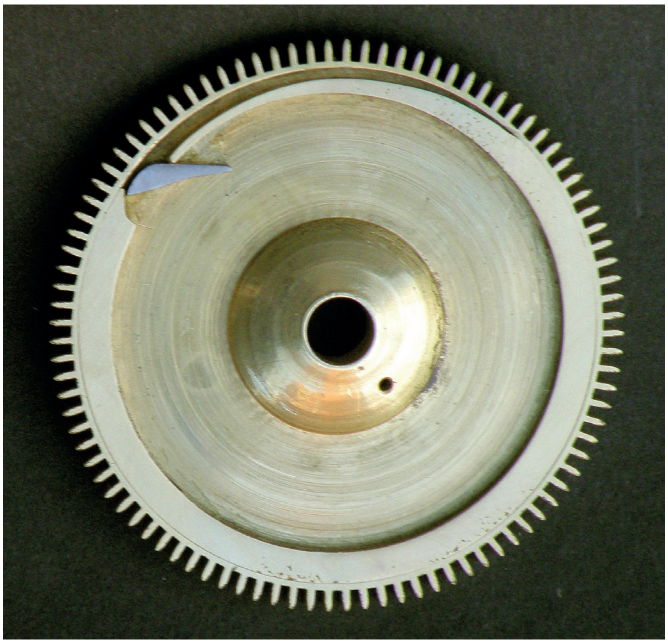

Figure 17. The new spring in place.

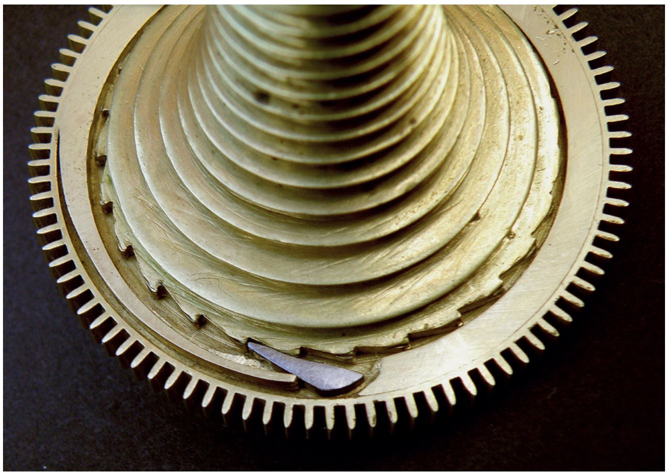

Figure 18. Job done and fusee reassembled.

The other (striking) fusee of this clock had had a similar spring replacement by a previous restorer and the join was obvious, while on the replacement described here it is only just discernible, **Figures 17 and 18**. This makes no difference to the spring's operation, but it is satisfying to make a good neat job. Though this repair is not one that comes along very often, it proved to be an interesting exercise in accurate turning and filing.