REPAIRING A FUS

Not a straigh

It is always a satisfying to repair a clock that is owned by someone who is interested in mechanical timepieces, even though he (or she) might not be an expert. So when an early eighteenth-century bracket clock in an ebonised case, **figure 1**, was brought to me the problem had been correctly diagnosed by its owner before it arrived in the workshop. The click spring on the fusee of the going train was reported to be broken or at least misbehaving in some way. The owner was also understanding when it was explained that this could not be rectified without a complete strip down of the movement. It was agreed that when it was disassembled this would be a good opportunity to give the clock a full service, which it had not been done for a while.

This clock has had a chequered career and a couple of decades or so ago it underwent extensive restoration. Not only was it restored back to verge pendulum from a later anchor escapement, **figure 2**, but all the strikework was rebuilt. There had originally been a quarter pull-repeat mechanism which had subsequently been removed, along with much of the striking mechanism. In this sort of situation, since pull-repeating work can

Top row, left to right.

Figure 1. Early eighteenth-century ebonised bracket clock.

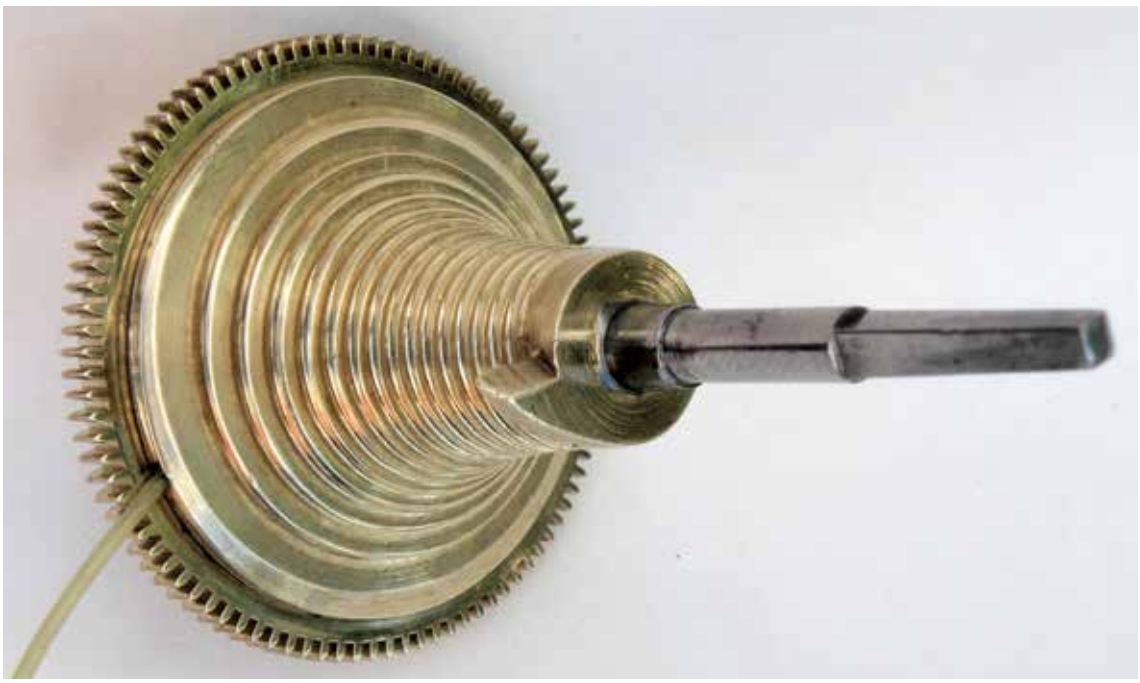

Figure 2. The engraved back plate with a restored verge pendulum and replacement verge apron or end plate.

Figure 3. The movement with rebuilt strikework.

EE CLICK SPRING
tforward job

by John Robey, UK

be very varied and individualistic, it is often virtually impossible to determine what had been there to start with, so rebuilding it with hour striking using a conventional rack and snail system had been the most pragmatic solution, **figure 3**. The owner was quite aware of all this and accepted it as a good-looking clock that fitted well into his period home.

The diagnosis proved to be correct —a faulty click spring was the problem. But this was not going to be a straightforward repair. Early fusees are constructed in a different manner to those on later clocks. There are two types of fusees: the later type with enclosed ratchet teeth and clicks and earlier ones where they are exposed. Bracket clocks and English dial clocks from the nineteenth century have a separate ratchet that sits inside a recess in the body of the fusee and is held in place with two or more screws, **figures 4** to **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

Figure 4 (far left). The enclosed type of fusee used in the nineteenth century.

Figure 5 (left). A separate ratchet 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 Deacon longcase clock.

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

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. If the 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 fusee of this bracket clock is of the early open type where the ratchet teeth are cut round the edge of the fusee itself 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 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 where making a new part is preferable to trying to repair it. 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 a perfect replacement can be achieved.

Unfortunately, though photographs were taken before and after the repair 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 purple 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 0.6mm to 3mm diameter and each size comes in three lengths, **figures 9** to **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 snap.

The other route to disaster is to use them freehand—instead hold them vertical in a in a staking tool to ensure a straight blow. One of the larger sizes of watchmaker's staking tool is suitable for small items like this, but for larger work the very versatile staking set made by JMW Clocks in Sheffield is well worth the investment, **figure**

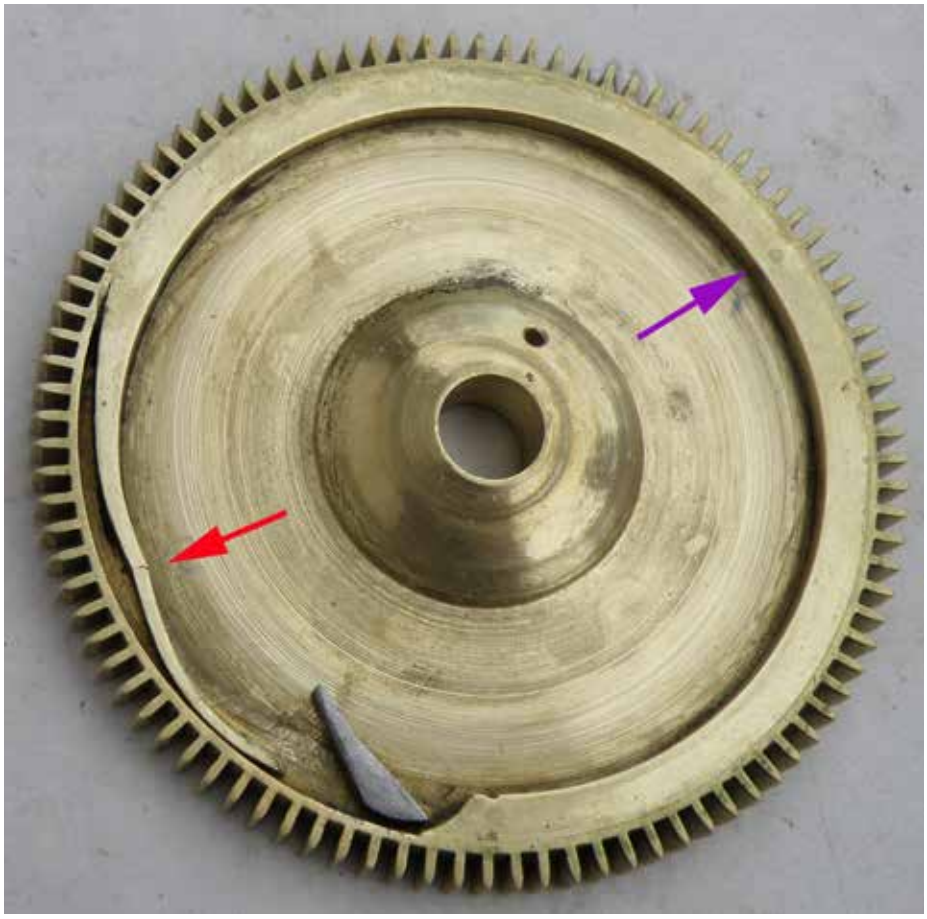

Figure 8. Fusee wheel. The red arrow shows the crack in the spring, while the purple arrow indicates the position of a rivet.

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

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

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

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

Figure 14. W12 step collet and closer.

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 on the JMW tool can be swung to the side allowing removal of the punch.

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** to **13**, as if you were making a clock wheel. This type of mandrel has been described many times before, and 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

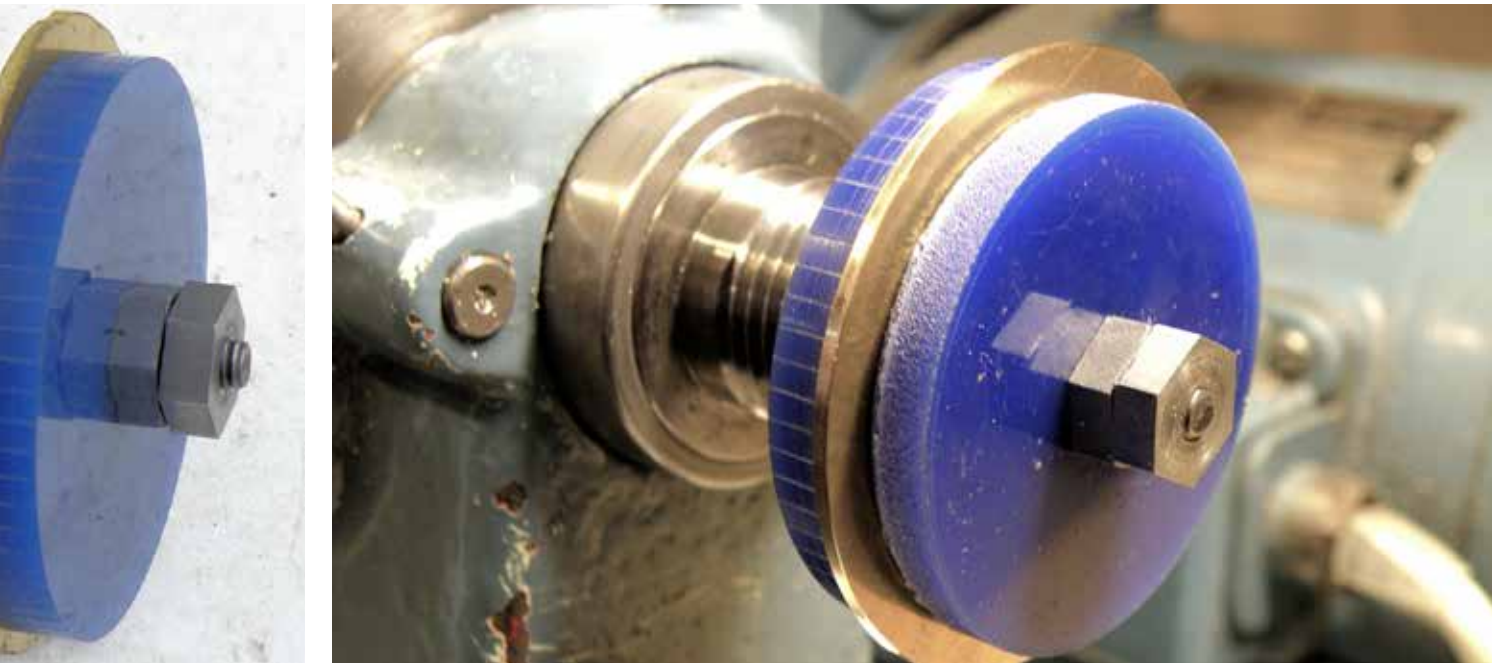

Figure 13. The mandrel held in the headstock spindle of a Schaublin SV70 lathe.

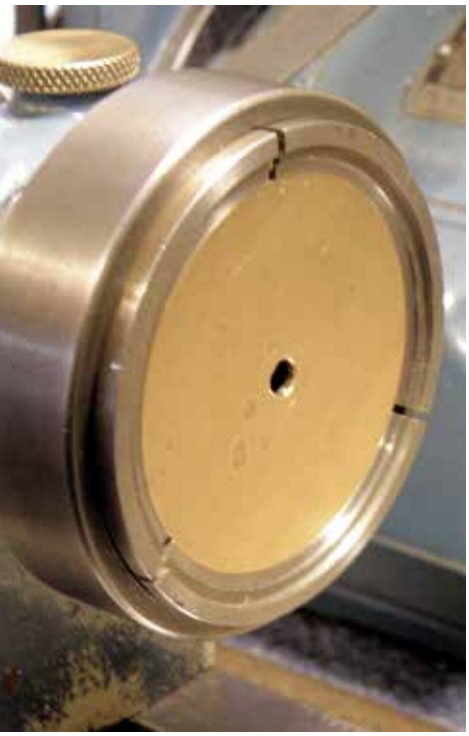

Figure 15. Brass disc held in a step collet.

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

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** to **15**, or a six-jaw bezel chuck. Since it has no moving parts a step chuck is the most accurate, but each one can only accommodate a limited range of diameters. A bezel chuck can grip a much wider range of sizes, though with slightly less accuracy, and would be a more useful alternative. 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 carefully 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 all the rivets—of brass, of course—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.

The other (striking) fusee of this clock had had a similar spring replacement by the previous restorer and the join was obvious while on the replacement described here it is only just discernible, **figure 17** to **18**. This makes no difference to the spring's operation, but it is satisfying to make a good neat job.

It is always a pleasure to work on a quality clock such as this one, and though this repair is not one that comes along very often it proved to be an interesting exercise in accurate turning and filing.

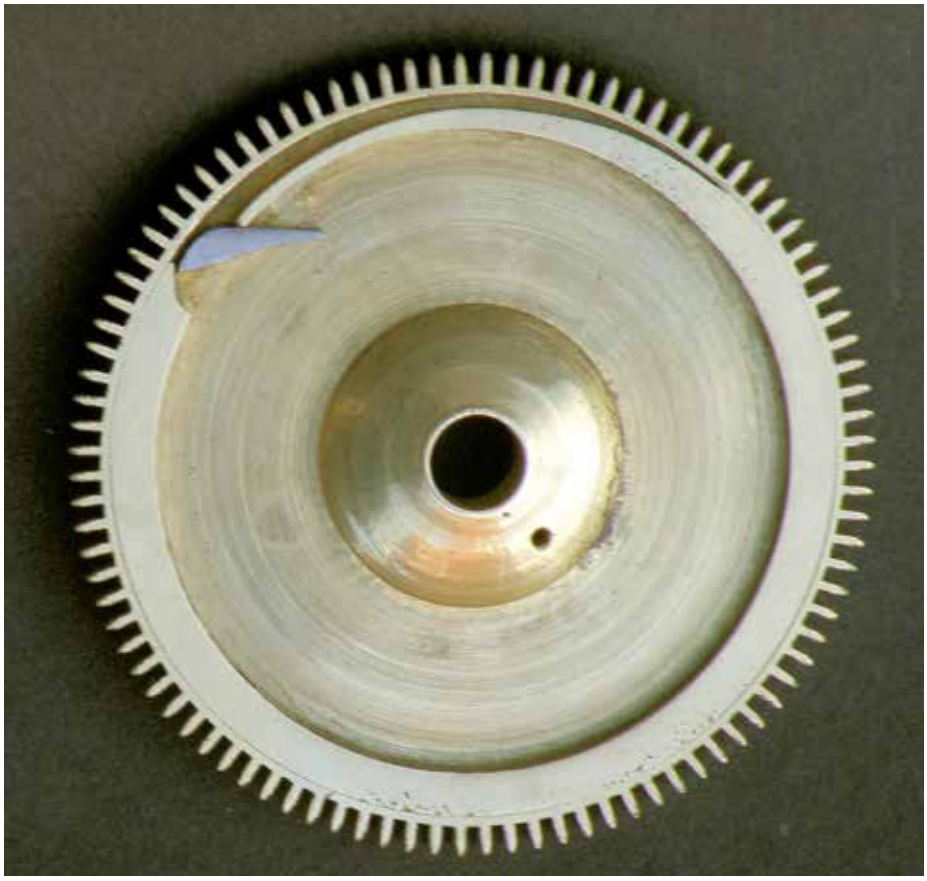

Figure 17 (right). The new spring in place.

Figure 18 (below). Job done and fusee reassembled