Another unusual compact 8-day movement with rack & snail striking

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In the December 2012 journal, the author presented an unmarked 8-day spring driven movement with unusual rack and snail striking. This article presents another unconventional 8-day movement with unusual rack and snail striking. It was probably a 'one-off' movement made by an inventive English clock maker.

Introduction

This loose movement was probably made in England in the second half of the nineteenth century and incorporates a variety of different design influences, some of which came from contemporary American movements. The striking arrangements and possibly also the mainspring assembly both suggest a link to Charles Kirk's American Patent No. 3233 of 26 August 1843.[1]

The movement plates

The rear plate of this quite compact movement measures 5 11/16 x 3 11/16 inches overall and was constructed from five strips of cast brass that were fastened together with six pillars and additionally four rivets, one in each corner through both thicknesses, to give the framework structural stability (see Figs 1, 2 & 3). Acting as a front plate, five similarly positioned strips are all individual pieces of brass with the two thinner horizontal pieces placed top and bottom acting just as pillar spacers (see Figs 3, 4, 5 & 6). All five front pieces of brass are placed individually on the pillar ends when the movement is assembled. Additionally an extension piece, added to accommodate the fly's front pivot hole, was riveted into the top of the front left vertical strip with a dovetail joint (as seen in Fig. 5). The front pallet arbor's pivot hole is located in a rectangular shaped cock that is fixed to the front middle vertical strip by a screw and two steady pins with the cock itself appropriately shaped so that it fits over the pinned end of the top middle pillar (see Figs 3, 4 & 5). All this is a lot of work to create an open strip framework when compared with conventional plates, but this construction does make assembling the movement relatively easy. Perhaps the inspiration for the movement's plate structure came from contemporary Black Forest movements that also use vertical strips as movement plates, or from so-called 'strap plates' as produced in the USA under Joseph Ives's influence.[2]

The movement's main train wheels

All the wheels were finished from cast brass blanks with the two great wheels already having their front recess cast in (see Figs 4, 5 & 7) and all other wheels having their crossings cast in (see Figs 1–5). All wheels are thought to have possibly been standard English stock items available from a materials supplier with the great wheels probably originally intended for use as fusee great wheels (see Figs 7 & 8).[3] Notice from Figs 4, 5 & 7 how the great wheels have typical English click work with brass clicks. The mainsprings are also probably English made and are both approximately

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1. See Kenneth D. Roberts, *The Contribution Of Joseph Ives To Connecticut Clock Technology* (Ken Roberts Publishing Co., 1988) 2nd ed., p. 244, where Charles Kirk's 1843 patent is reprinted in full.

2. Roberts, *Contribution* – general reading.

3. This assumption has been arrived at through correspondence with John Robey. To date the author is unaware of any data that could confirm these wheels as being standard stock items from a materials supplier.

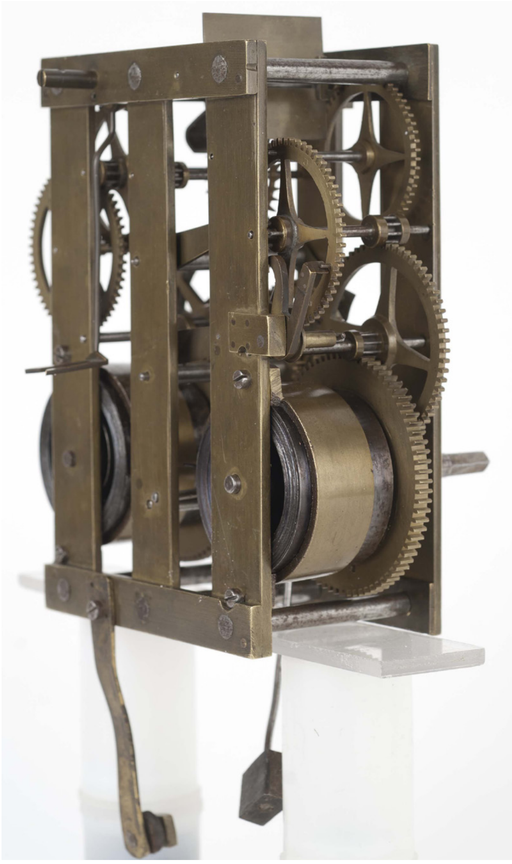

Fig. 1. A ¾ left rear movement view showing the rear strip plate construction and the striking train wheels. Note the two screws that secure the striking mainspring's cast brass containing ring in place, both being on the rear right vertical strip plate.

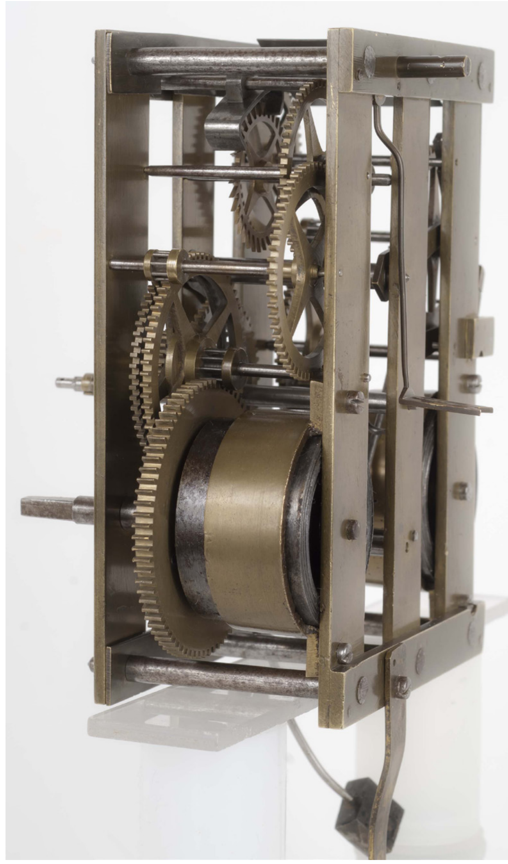

Fig. 2. A ¾ right rear movement view showing the rear strip plate construction and the going train wheels including the intermediate wheel adjacent and just to the right of the going 2nd wheel. Note the two screws that secure the going mainspring's cast brass containing ring in place, both being on the rear left vertical strip plate.

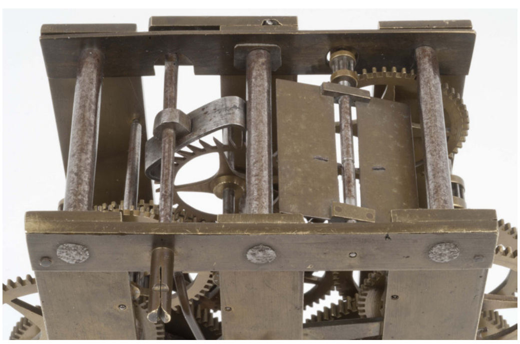

Fig. 3 (left). An angled view supplying a top rear detail of the movement and showing the three upper pillars that join the rear strip plates together as well as two corner pin rivets. Note the front strips assembled onto the three pillar ends as well as the small rectangular packing piece on the centre pillar (probably necessary because the pillar was made too short). There is also a good rear view of the pallet arbor cock..

27 mm wide x 0.35 mm force (Figs 6 & 9 show the striking train's mainspring). Each spring is housed in a cast brass-containing ring that has two lugs (see Fig. 9); these lugs were drilled and threaded so that the rings could be fixed to the appropriate vertical strip plate with screws (see Figs 1, 2, 4 & 6). (This system of lugged brass mainspring sleeves or rings screwed to movement plates or bars was used in sixteenth-seventeenth-century European clockwork.[4] The cast brass containing rings on this movement also have a passing resemblance to Charles Kirk's cast iron mainspring cups

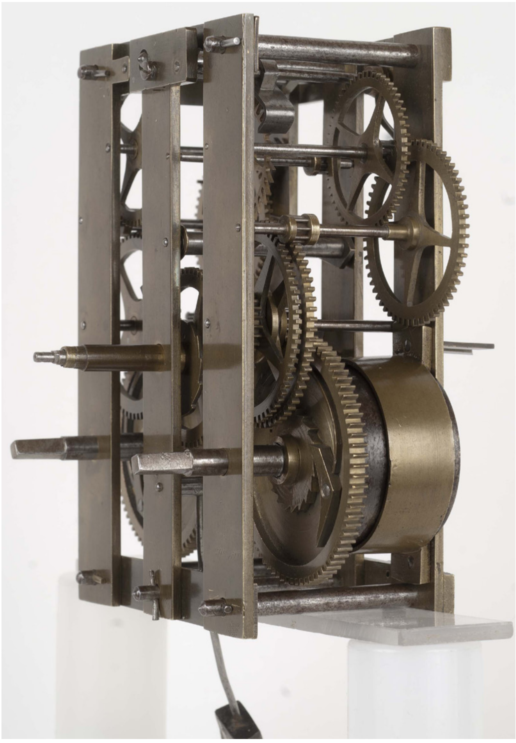

Fig. 4. A ¾ right front movement view showing the front strip plate assembly and most of the going train wheels including the intermediate wheel assembly just in front of the going 2nd wheel.

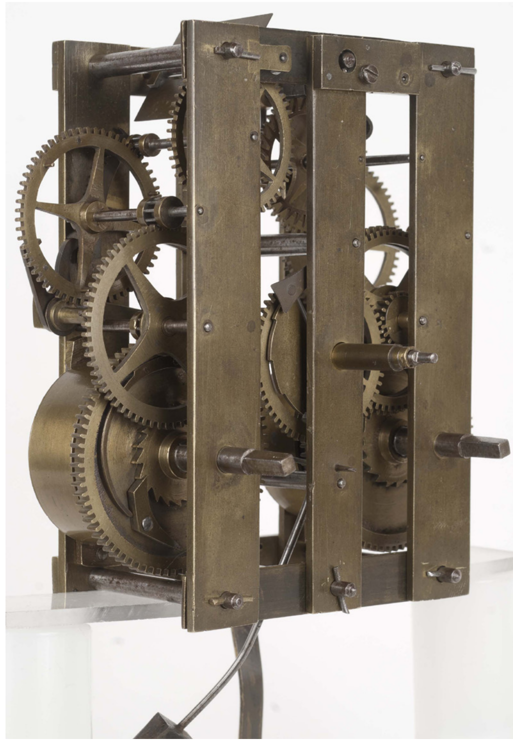

Fig. 5. A ¾ left front movement view showing the front strip plate assembly and a view of the striking train. Note a number of plugged holes, barely visible

used on the second version of his patent movements.[5] Both or either possibly could have influenced the design used on this particular movement.)

Both main trains employ lantern pinions throughout and all wheel teeth look typically American in shape being characteristically short with rounded tips (Figs 7, 10, 12, 13 & 14).[6] The striking 4th and 3rd wheels seen in Figs 1 & 5 respectively and the escape wheel seen partially in Fig. 3 all have typical American shaped wheel collets whereas the going 3rd wheel seen in Fig. 4 has an English shaped wheel collet.[7] All wheels, whether fixed to an independent wheel collet or onto the back of a lantern pinion, are riveted-on using an English riveting technique,[8] except for both the 2nd wheels that unusually have pin rivets fixing each wheel to the major lantern pinion shroud (see Fig. 10).[9]

Lastly the fly's fan was built up by each fly vane being let into blocks, one at each

4. Information supplied to the author by Michael Hurst.

5. Roberts, *Contribution*, pp. 250–251.

6. From a close inspection with a high magnification lens it became apparent that all teeth on all wheels were cut with the same cutter(s) producing distinctively shaped teeth that thin very slightly towards their root.

7. All wheel collets and pinion shrouds were found to have been soldered to their arbors.

8. See W.J. Gazeley, *Watch and Clock Making and Repairing* (Robert Hale, London) 4th ed., p. 157.

9. On American manufactured movements that use lantern pinions it is common practice for a number of small indentations to be created around the periphery of the mounting collet/shroud by punching. These indentations swell the surrounding metal and thus hold the wheel in place.

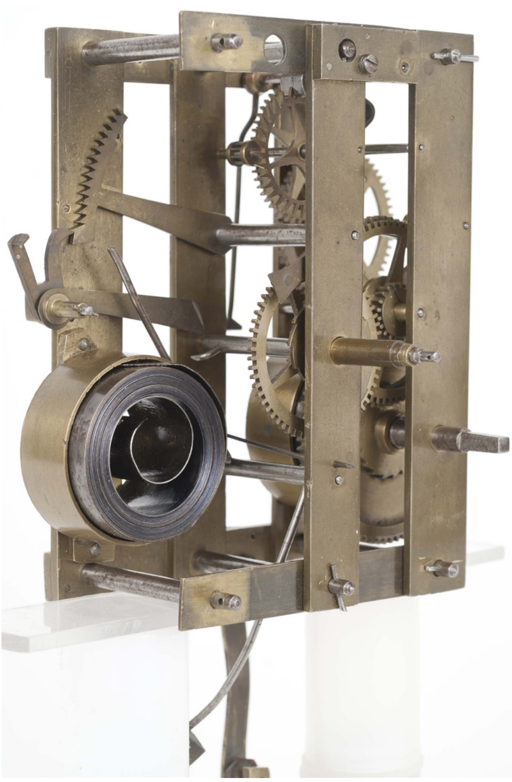

Fig. 6. A ¾ left front movement view with the front left vertical strip plate and all of the striking train wheels removed so that the striking detent components and striking mainspring's retaining ring can be clearly seen.

Fig. 7. A detailed view of the front face of the striking great wheel showing the use of typical English click work. (The click work on the going great wheel is exactly the same but reversed.)

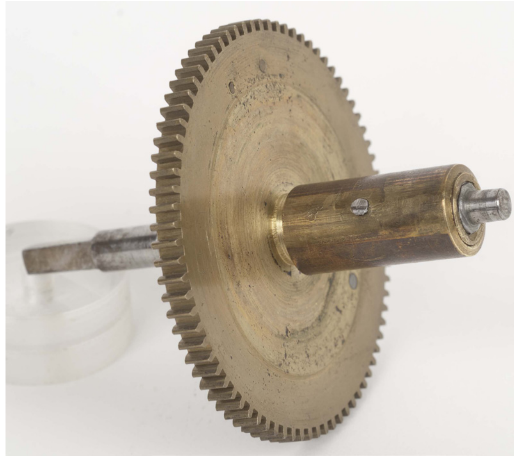

Fig. 8. A detail view of the rear face of the striking great wheel with the mainspring removed. Note how two brass tubes have been positioned over the steel arbor, one over the other, to increase the arbor's diameter (with the spring hooking piece secured through all the thicknesses of material). Exactly the same constructional technique was used on the going great wheel.

Fig. 9. A detailed view of the striking mainspring cast brass retaining ring removed from the movement but with the mainspring still installed within the retaining ring. (The cast brass retaining ring for the going mainspring is exactly the same as this one but with minor lug-shaping differences; the direction of the spring is also reversed.)

Fig. 10. A detail view of the striking 2nd wheel showing the pin-rivets that secure the wheel to the rear of the lantern pinion shroud.

Fig. 12. A detail view of the going 2nd wheel with the intermediate wheel assembly secured to the arbor. Note the witness marks on both intermediate wheel and pinion at an 8 o'clock position and how the tips of the intermediate wheel have been topped; these topped teeth provide clearance with the 3rd wheel's lantern pinion shroud when this wheel is assembled in the movement (see Figures 2 & 4).

Fig. 13. A detailed view of the going 2nd wheel with intermediate wheel assembly completely dismantled from the arbor.

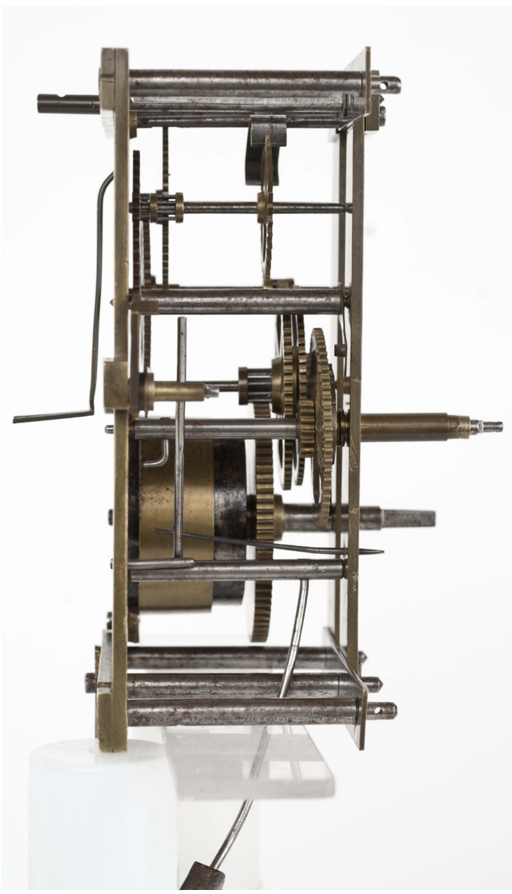

Fig. 11 (left). A left side movement view with the front left vertical strip plate and all the striking train wheels including the striking mainspring and its retaining ring removed to give a good view of the minute arbor, the going 2nd wheel arbor and the striking hammer arbor and components.

Fig. 14. A detail view of the rear side of the strking 3rd wheel showing the three sets of three pins.

Fig. 15. A detail view of the rack hook resting just under the rack's elevated high tooth. Note how centre punch marks locate possibly initially badly placed 2nd & 4th wheel positions.

end of the arbor, with the fly vanes then being held in place by rivets (see Fig. 3).

The movement's motion work

In Figs 5 & 6, at the far right centre in both photographs, viewed between the second and third of the vertical brass strips which are part of the front plate of the movement, one sees a 'smallish gear' (concentric with the going 2nd wheel arbor) on the far right in both figures, engaged with a larger gear, which when viewed in Fig. 6 (where all the striking train wheels have been removed) can be seen to be the hour cannon wheel mounted on the minute arbor. The 'smallish gear' engaged with the hour cannon wheel is in fact the pinion of the intermediate wheel assembly. Fig. 11 is a side view of the movement with all the striking train wheels including the striking mainspring and its retaining ring removed. Fig. 11 now provides a good view of the minute arbor assembly. Notice from this illustration how the minute arbor pinion is just to the left of the hour cannon wheel and meshes with the intermediate wheel that is just to the right of the going 2nd wheel proper. If Fig. 11 is once again viewed in conjunction with Figs 2 & 4 and if we follow the transmission of energy through the going train: the great wheel drives into the 2nd wheel's lantern pinion with the 2nd wheel then just driving into the 3rd wheel's lantern pinion. Thus it can now be realised that it is the intermediate wheel that drives the minute arbor pinion and the intermediate pinion that drives the hour cannon wheel. Fig. 12 shows the going 2nd wheel disassembled from the movement with the intermediate wheel and pinion in place on the 2nd wheel arbor and Fig. 13 shows the same going 2nd wheel arbor again but with the components of the intermediate wheel and pinion assembly fully dismantled from the arbor. In this assembly (as can be seen in Fig. 13) a dished brass washer was first threaded onto the front end of the going 2nd wheel arbor followed by a brass tube being driven along the same arbor, but not tight up against the dished washer so that the dished washer is now captive on the 2nd wheel arbor but can still rotate freely. The brass tube was then finished to accept the intermediate wheel and pinion assembly so that the intermediate wheel and pinion assembly could also rotate freely on the brass tube and then a friction tight slotted washer secured with a pin held all in place


Fig. 16. A right rear partial movement view showing the French pattern crutch piece. Note the going 3rd wheel riveted onto the English shaped collet. Also note two plugged pivot holes, barely visible, one on each the middle and right vertical strip plates.

(see Fig. 12 again). This constructional arrangement secures the intermediate wheel assembly to the 2nd wheel arbor under spring tension so that during the normal operation of this movement the intermediate wheel and pinion assembly rotates as one with the going 2nd wheel.[10] The motion work assembly only rotates faster, by slippage on the 2nd wheel arbor, when the clock hands are being manually moved forward. (In most applications, the intermediate wheel assembly — a gear with a centrally located 'small' pinion — is placed on a stud, free to rotate freely, so there is nothing wrong with placing it on a nearby arbor with axis parallel to that of a hypothetical stud. Of course, this is providing it can either freely rotate around the arbor if the train counts employed dictate it, or, as in our case here, the train counts are so arranged that it needs to rotate at exactly the same speed as the arbor it is placed onto, but with a provision to adjust the hands of the clock though slippage in some way.)

Striking arrangement

Fig. 14 is a detailed view of the rear face of the 3rd wheel removed from the movement. Notice how the wheel has three sets of three pins with each pin being 120 degrees from the two other pins in its particular set. (Notice from Fig. 14 how two of the pins that project from the rear face of the wheel cannot be seen completely, but just their ends flush with the wheel face.) This arrangement of nine pins on the 3rd wheel is exactly the same as that used by Charles Kirk on his patent movements (see note 1). However this movement, unlike Kirk's patent movements, has no 'run to warning' or repeating facility with the striking arrangement. The way the striking is first let-off and then locked again is very similar in action, but not lay-out, to another anonymous movement already detailed by John Robey.[11] On this particular movement the inner set of pins (see Fig. 14 again) are mounted onto a collet and advance the rack; the outer set of pins, seen on the same face of the wheel as the collet, are used to lock the striking train and the last set of pins on the rear face of this wheel are used to trip the striking hammer. (As these three sets of three pins are all on the same wheel and have been carefully positioned with each other, no further setting-up procedure is required to ensure the striking sequence on this movement operates correctly.)

Figs 1 & 5 show the 3rd wheel with the movement fully assembled and Fig. 6 (in which all wheels have been removed from the striking train) shows the rack, the pivoted striking detent assembly, the

10. From the train counts supplied at the end of this article it can be noted that, even though these train counts are unusual for motion work, they still bear a proportion to each other of twelve to one, ensuring the minute and hour hands will rotate correctly in relation to each other.

11. See the *Horological Journal* Vol.142, No.8 (Aug. 1999), 294 and/or *The Longcase Reference Book*, Volume 1, p. 266, or (with more examples) pp. 269-272 in the second, much enlarged and revised edition.

minute arbor's right-angled detent wire and finally the hammer tail wire (seen rising up at a 45 degree angle to the right of the striking mainspring's retaining ring). Also notice in Fig. 6 how the rack is riveted onto the rear of an arbor with this arbor being pivoted between the front and rear central vertical movement strips as in English inside rack movements. On the front end of this same arbor can be seen the rack tail incorporating a pin that will drop onto the snail when the rack is released (see Fig. 5 for another shot of the snail in a different position to that seen in Fig. 6). In Fig. 6 also notice how the striking detent assembly is pivoted on a post that is attached to a block that in turn is riveted to the left-hand rear movement strip in an appropriate middle vertical position (also look at Fig. 1 that shows the rear of this block well). The pivoted striking detent assembly consists of three radiating arms that are all firmly fixed together, thus all three arms move as one component. In Fig. 6 the lifting piece can be seen radiating-out in approximately a 3 o'clock direction from the post towards the rear of the minute arbor. The right-hand tip of this lifting piece is just too short to make contact with the minute arbor (not illustrated) so that it is only the rack follower tip resting just under the rack's elevated high tooth (as seen in Fig. 6 and in more detail in Fig. 15) that stops the striking detent assembly from rotating further in a clockwise direction. As the hour approaches the minute arbor's right-angled lifting detent (clearly seen in Figs 6 & 11) will start raising the right-hand tip of the lifting piece of the striking detent assembly. As the pivoted striking detent assembly moves in an anti-clockwise direction the rack is released, allowing the rack tail pin to drop onto the snail. The locking arm (seen radiating-out in approximately a 11 o'clock position from the striking detent post in Fig. 6) will have also moved the same amount in an anticlockwise direction, but as it has a broad right angled pallet riveted onto the end of its arm, the locking pin on the 3rd wheel will remain locked on this pallet even after the rack has fallen. It is only when the lifting piece of the striking detent assembly finally drops off the minute arbor's right-angled lifting detent, on the hour, that the striking detent assembly will now be able to rotate much further in a clockwise direction with the rack follower tip dropping between two of the normal rack teeth while simultaneously the locking pallet arm releases the 3rd wheel's locking pin from the right angled locking pallet. The train now starts to run with the 3rd wheel turning in an anti-clockwise direction (as seen in Fig. 5). The inner set of three pins mounted on the collet of the 3rd wheel start gathering-up the rack with the rack follower tip holding the rack in each new successive position, while the hammer tail wire is deflected to the right by the pins positioned on the front face of the 3rd wheel. Eventually at the end of the striking sequence the rack follower tip is once again lifted up onto the elevated section on the bottom end of the rack to lock under the high tooth while simultaneously the locking arm with broad right angled pallet once again returns to its original position (as seen in Fig. 6) so that one of the locking pins on the 3rd wheel locks once more on the pallet. When the striking train is locked none of the three pins mounted on the collet of the 3rd wheel are engaged with the rack so that in just under an hour, when the movement commences another striking sequence, the rack is free once more to drop.

Fig. 15 not only shows the rack teeth, rack follower arm with its tip, locking pallet and hammer tail wire in more detail but also the rear pivot holes for the 2nd, 3rd and 4th wheels. Note how well placed the 3rd wheel's rear pivot hole is for the three inner pins on the collet of the 3rd wheel to gather-up the rack, as well as how the uppermost back edge of the rack has been cut-away to accommodate the 4th wheel's arbor. Last, also note from Fig. 15 how the elevated section of the rack with its small locking high tooth has been re-fashioned with a new piece of brass soldered in. Could this be a repair to the high tooth which became worn and failed to work due to its small angle? Or is it perhaps evidence of a trial-and-error modification done while the movement was being made to achieve satisfactory locking?

Pendulum and related components

As can be seen from Figs 2, 3 & 4 this movement has American styled bent strip pallets that were mounted on a boss with this component then being driven along a hexagonal tapered section of the pallet arbor (Fig. 3 shows the hexagonal pallet arbor, but not in any great detail). This last assembly technique is commonly used on French movements, where the taper usually only has four sides. Figs 1, 11 & 16 also show this movement's crutch. It appears to be a standard component used on many nineteenth-century French movements. The crutch has been riveted onto a collet that is only a friction fit onto its arbor so that the crutch can still be adjusted without bending the crutch arm to bring the escapement into beat.

From the train counts (see below) it has been calculated that this movement had a 10½ inch long pendulum. As there are no holes in the front movement strips, it would appear that a dial was never attached to this movement. There is also no evidence to suggest how this movement was fixed to a case. However if this movement originally had a seat board, a fixing with conventional hooks over the pillars with cut-outs for the bell bracket and hammer would be practical (see Fig. 1). As the escape wheel pallets now have deeply worn sections and the lantern pinion trundle wires on the fly arbor also show signs of wear, it can at least be confirmed that this movement was in use for some time. Perhaps it never had a case or dial but, being an object the maker was proud of, was placed on a bracket or stand and used like a skeleton clock?

Conclusion

This movement could possibly have been made by an inventive English clockmaker who blended some of his own ideas with selected features he had seen from a variety of other movements. Five very well plugged holes found on the movement's strip plates (with only some barely visible in Figs 5 & 16), as well as a number of centre punch marks for train arbor positions that were subsequently abandoned (see Fig. 15 for some examples), probably confirm that a certain amount of trial and error must have taken place during the constructional process employed to produce this, probably unique, English made, compact 8-day time and striking movement.

Acknowledgments

A thank-you to Chris Bailey, Francis Brodie, Michael Hurst and Snowden Taylor for their help and comments.

Wheel counts

Going train

Great wheel	78 teeth	20 toothed ratchet wheel	
Second wheel	64 teeth	10 lantern pinion wires	
Third wheel	60 teeth	8 lantern pinion wires	
Fourth wheel	56 teeth	8 lantern pinion wires	
Escape wheel	33 teeth	8 lantern pinion wires	

Motion work

Minute arbor	16 teeth	
Intermediate wheel	64 teeth	20 pinion leaves
Hour Cannon wheel	60 teeth	

Calculated pendulum length 10.5 inches

Striking train

Great wheel	78 teeth	20 toothed ratchet wheel	
Second wheel	64 teeth	8 lantern pinion wires	
Third wheel	60 teeth	9 lantern pinion wires	3 sets of 3 pins
Fourth wheel	56 teeth	6 lantern pinion wires	
Fly arbor	6 lantern pinion wires		