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A Complicated Watch from the English Firm of John Barwise

by Craig O. Risch (CA)

Editor's Note: The author restores early American and English watches, ca. 1700–1800's, and has a special interest in pocket chronometers. Mr. Risch has a Master's degree from Washington University, St. Louis, MO, and has previously published an article, "The Evolution of the Safety Pinion," in the October 1987 BULLETIN.

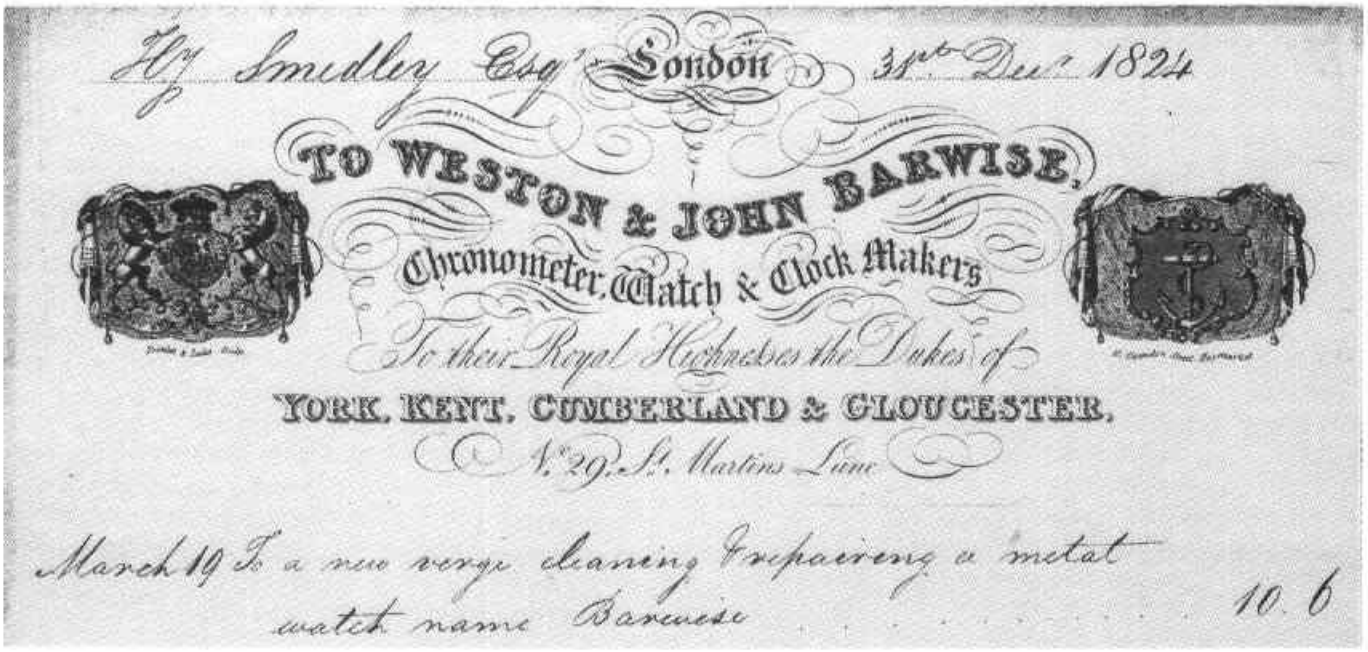
INTRODUCTION

During their period of supremacy in the field of horology, the English produced many fine watches. Among the best were the pocket chronometers. These timepieces were typically manufactured for the sole purpose of providing an extremely accurate and highly reliable portable timebase. Because of the requirements placed on their performance, they were considerably more expensive than average watches. As a result of their high cost, they were usually purchased only by individuals who absolutely needed one, the most important group of buyers being ships' captains who used them for navigational purposes and whose lives depended on their proper operation. Another important group of people included scientists and astronomers who used them in experiments and observations. Hence, most chronometer makers usually implemented the simplest possible mechanism to provide the desired performance and avoided any unnecessary complications that might add to the expense of production and possibly compromise the quality of the timekeeping.

Although the maritime industry and the scientific community represented the largest market for pocket chronometers, members of the wealthy upper classes were also customers. The well-to-do buyer certainly felt a measure of prestige in being able to own and carry a watch that was above the ordinary in both price and performance. In an effort to attract more of this type of business, pocket chronometers were sometimes fitted with a repeating mechanism. For those who could afford them, repeating watches had always been popular. Aside from the novelty, there was the more practical consideration of being able to tell time in the dark, a major concern before the advent of electric lighting.

The addition of a repeating mechanism to a pocket chronometer resulted in a very expensive watch which was probably not affordable by very many people. Hence, not many were produced, resulting in their relative scarcity today. Nevertheless, they are interesting from a horological standpoint. Since not many people have the advantage of closely examining such a timepiece, the purpose of this article will be to describe an example of such a watch: a pocket chronometer with a half-quarter repeater signed "John Barwise, London." This description will be mainly of a technical nature with attention being focused on providing an understanding of the various features pertaining to the construction and

Figure 1. Billhead from the firm of Weston and John Barwise.



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operation of this watch. Both the chronometer portion and the repeater portion will be examined. However, particular attention will be paid to the repeating mechanism since it is a type not normally encountered. Before describing this watch, it will be useful to briefly examine the life of John Barwise.

JOHN BARWISE

Unfortunately, there is not much published information about John Barwise. We know from Britten[1] that he worked between 1790 and 1843, at 29 St. Martins in London. A copy of a billhead in Figure 1 shows that for at least part of that time, he was in business with Weston Barwise who was probably his brother. A watchpaper from the firm shown in Figure 2 contains only the name of John Barwise.

Although items produced by his firm were signed with his name, it is certain that after 1820 John Barwise was acting as a retailer rather than a watchmaker. Hence, he operated as a businessman who employed watch and clockmakers to produce timepieces to his specifications. Barwise, along with Paul Phillip Barraud and B. L. Vulliamy, was among the first of the great entrepreneurs in the field of horology. Although he had very little, if anything, to do with the actual making of any watch or clock, he was still responsible for using some of the best makers to produce timepieces of exceptional quality. Some of the most notable makers included Lawson Huddleston (Mudge's apprentice) and Robert Pennington.[2]

Barwise was apparently a farsighted individual. He was the first to take note of the importance of the application of electricity to horology and in 1841 became associated with Alexander Bain to produce the Bain patent electric clocks. Also, in 1842 he got together with Pierre Ingold to start the British Watch and Clockmaking Company. This company was set up to manufacture watches by machinery. The ultimate goal was the production of watches with standard interchangeable parts. This venture was bitterly opposed by the trade and ultimately failed.[3]

After his death, the firm of John Barwise continued in business until the early part of this century.

THE TIMEKEEPING MECHANISM

It should be pointed out that this watch has unfortunately lost its original case which would most likely have been gold. But the movement survives completely intact and is in excellent running condition. A dial side view is shown in Figure 3. Since English watches are usually dated by the Hallmarks in the case, determining the exact date of manufacture is difficult. However, existing records indicate a date of circa 1827.

It is difficult to say who in the trade was employed to make and finish this particular watch. There are no indications or "scratchings" on any of the plates or on the mainspring barrel. Also, the layout and design does not appear to possess characteristics peculiar to any of the better known makers. However, judging from the quality of the watch, whoever actually made it was a first class craftsman.

The basic layout and construction of the movement is typical of most English watches produced during the latter part of the eighteenth and early part of the nineteenth century. A

Left, Figure 2. Watchpaper from the firm of John Barwise. Right, Figure 3. Dial side view of the movement.

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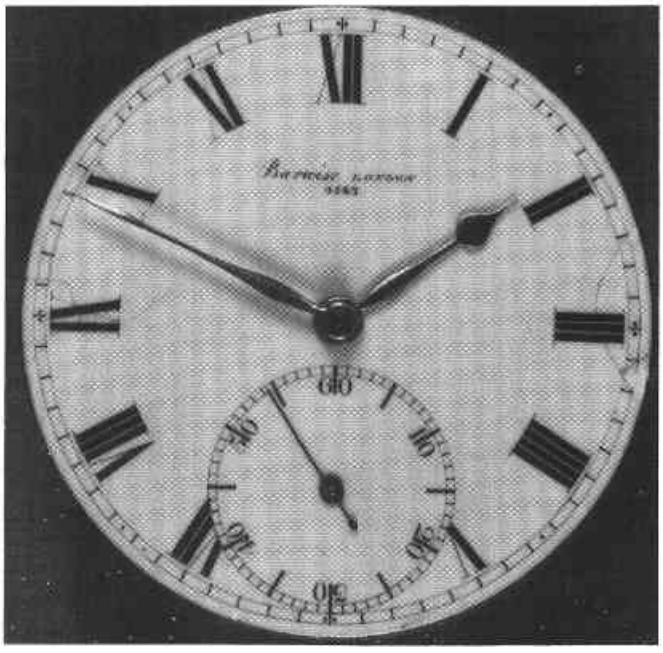

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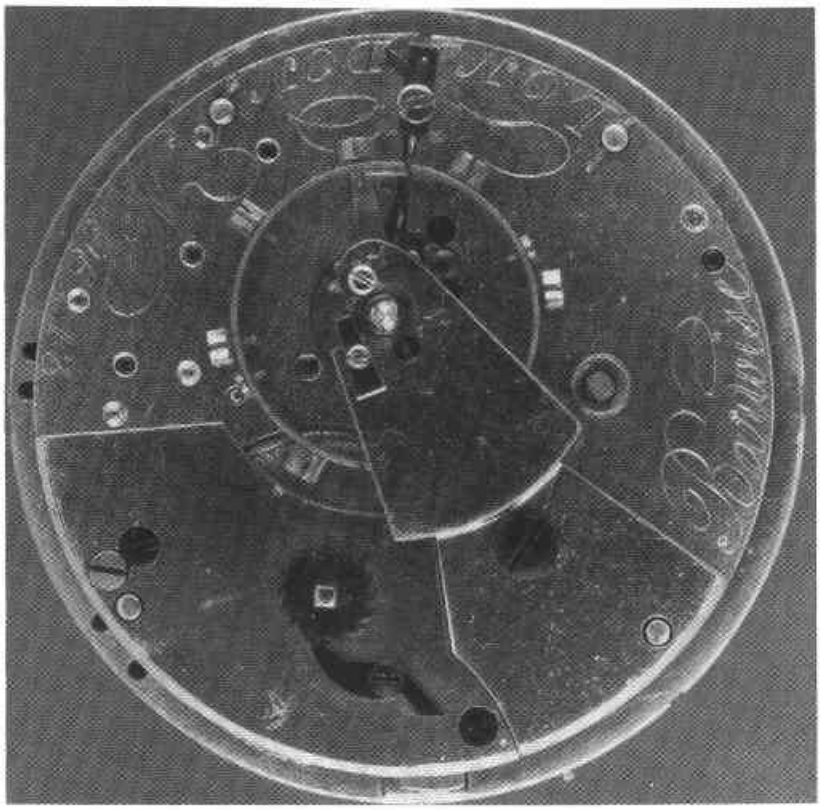
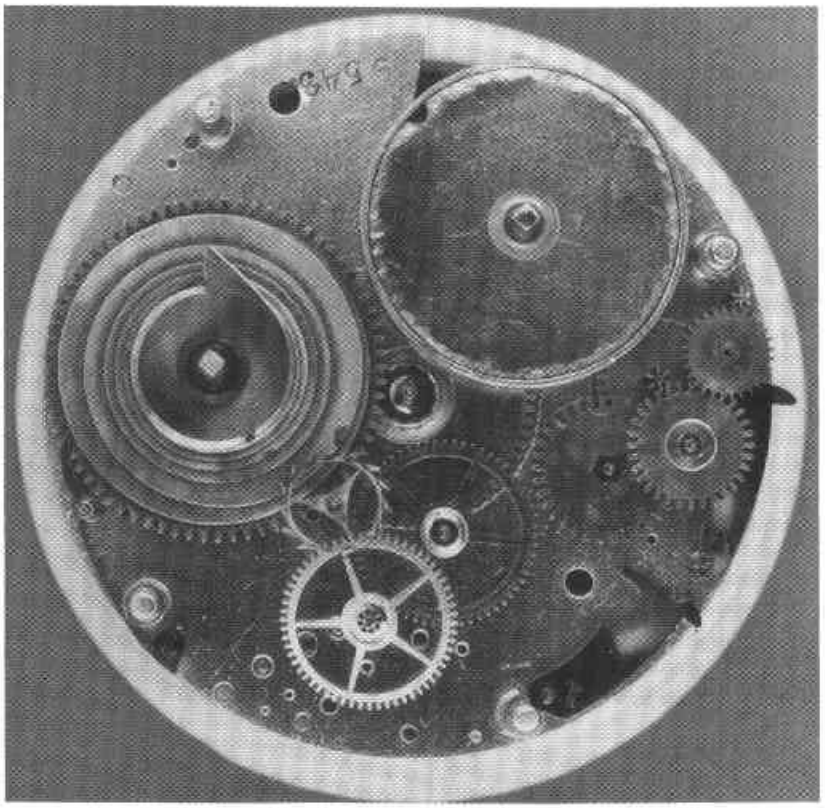


Figure 4. View of the top plate. Note that the gongs have been removed.

Figure 5. Top view of the pillar plate showing the time train and repeat train.



photograph of the top plate is shown in Figure 4. As can be seen, it has a rather plain appearance, with no extraneous engravings other than the name of the maker, the city where it was produced, and the serial number (No. 9543). The jeweling for the pivots is at an absolute minimum with only the escape wheel and balance having the requisite hole and cap jewels along with a single jewel for the lower pivot hole for the fourth wheel. The balance is a standard bimetallic (brass and steel) construction with brass weight screws and two pairs of meantime screws. Attached to the balance is a 4-turn helical hairspring with inner and outer terminal curves. If the top plate is removed, the view shown in Figure 5 is revealed. As can be seen, this watch uses a standard 4-wheel time train which provides for a beat of 18,000 per second to the balance, typical for pocket chronometers of this period. Motive force is provided by way of the fusee and chain connected to the mainspring barrel. The smaller 4-wheel train directly across from the fusee is part of the repeating mechanism. One feature of this layout is its compact construction. Both the time train and the repeat train are contained on a pillar plate measuring 1.69 inches in diameter. The thickness between the dial and top plate is about 0.45 inches. (Between the dial and top of the balance cock the thickness is about 0.60 inches.) This is very near to the minimum size of a plain English pocket chronometer of this period.

The heart of the timekeeping function of this chronometer as well as all other chronometers is the detent escapement. At first glance, one might assume that this watch would contain an Arnold-style spring detent. The design of an Arnold escapement is such that the foot of the detent is planted on top of the plate with a slot through the plate for the detent to interact with the escape wheel and balance which is exactly the case here. However, upon closer examination, one finds that the operation is functionally identical to an

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Earnshaw-style escapement which usually has the detent planted underneath the plate. A detailed comparison of these two escapements is shown in Figure 6.

The drawings in the top portion of Figure 6 show an example of Arnold's escapement as implemented in one of his watches (No. 89/390) circa 1785. View #1 is from above showing the escape wheel (W) with epicycloidal teeth (T). The detent consists of the spring (DS) to which is riveted the passing spring (PS). The detent spring emanates from the foot (F) and holds the locking jewel (in dotted lines) (J) which projects below the plane of the detent and locks the escape wheel. Here, as in all of Arnold's escapements, the force of the escape wheel is such that the detent spring is in tension. Presently, the balance staff is turning clockwise such that the discharging pallet (P) is about to push the passing spring toward the center of the escape wheel and cause the detent to carry the locking jewel off the tooth of the escape wheel. The escape wheel, now unlocked, moves forward. As soon as the discharging pallet clears the passing spring, the detent snaps back in time to lock the next tooth on the escape wheel. As the balance swings back, the discharging pallet bends the passing spring out of the way without disturbing the detent. As this cycle is repeated, impulse to the balance is given by the moving teeth of the escape wheel impacting the notch (N) on the impulse roller (R). View #2 is from the side and shows how the teeth rise above the plane of the escape wheel to meet the locking jewel.

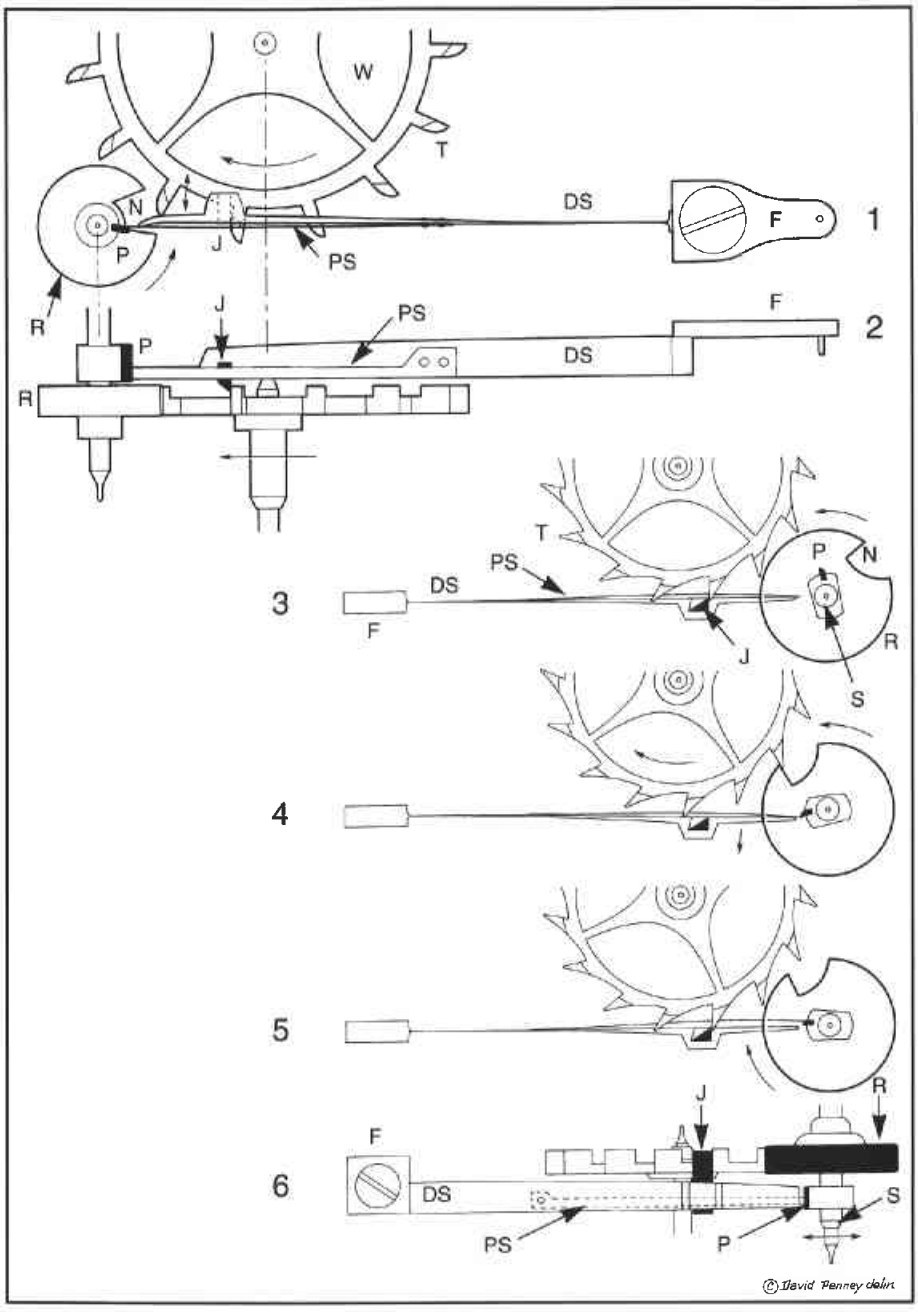

Figure 6. Arnold's and Earnshaw's detent escapements.

The illustration in the lower portion of Figure 6 shows Thomas Earnshaw's escapement as implemented in a chronometer by Howells of Kennington, London, circa 1805. View #3 is from the top showing the triangular escape wheel tooth (T) being held by the locking jewel (J). The detent spring (DS) emanates from the foot (F). The passing spring (PS) is attached to the detent spring and appears above it in the illustration. Here, the detent spring is in compression (i.e., the force of the locking jewel is pushing toward the foot of the detent). View #4 shows the balance staff (S) rotating to bring the discharge pallet (P) around to catch the end of the passing spring which forces the detent spring and locking jewel away from the center of the escape wheel. At this point, the second wheel tooth to the right of the tooth just released impacts the notch (N) in the impulse roller (R) giving an impulse to the balance. View #5 shows how the detent has just sprung back in time to lock the next escape wheel tooth. The discharge pallet then returns past the passing spring and pushes it out of the way without disturbing the detent spring. The side view in view #6 shows how the locking jewel rises above the plane of the detent to meet the teeth of the escape wheel. The impulse roller in most chronometers is usually made of hardened steel. However, in this particular watch by Howells it is fabricated from solid sapphire.

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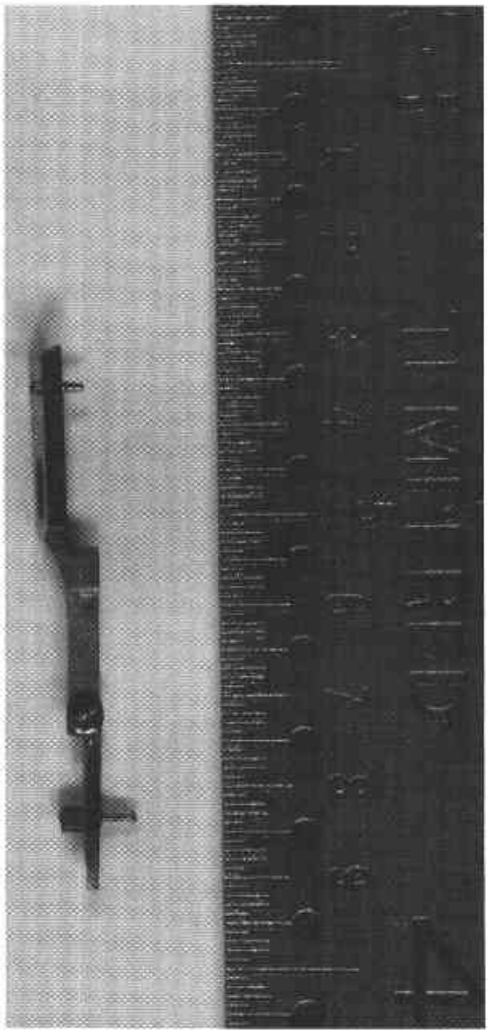

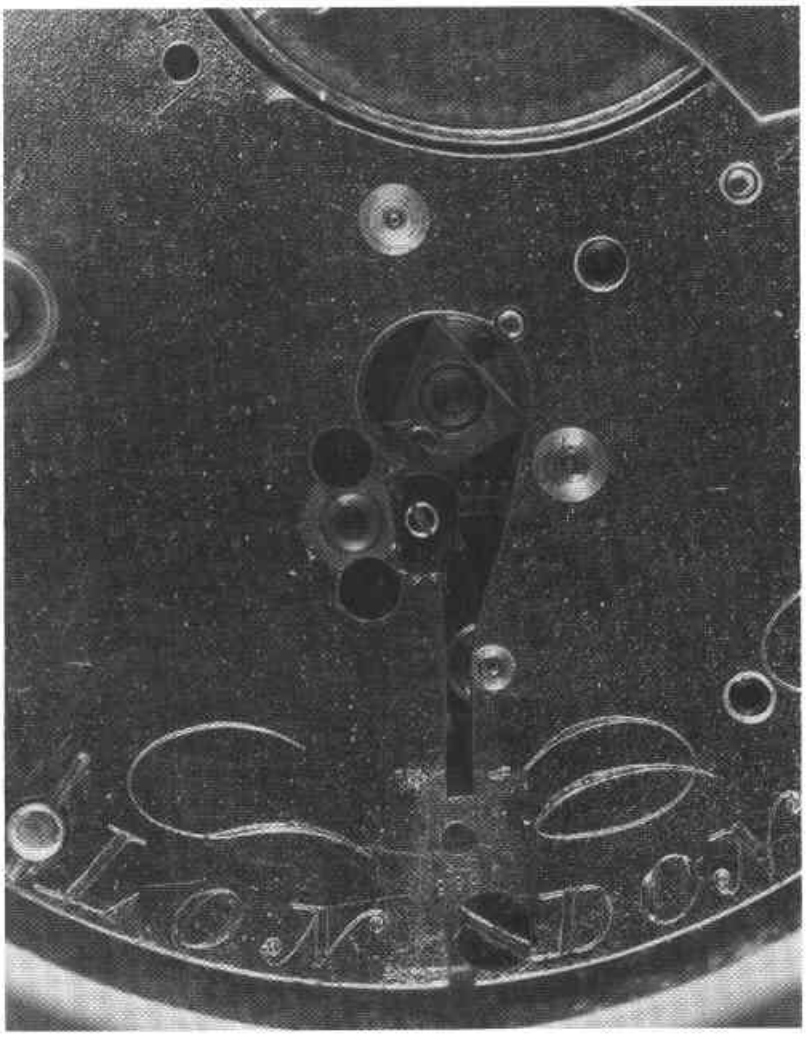

Left, Figure 7. Side view of the detent. The scale is graduated .01 inch per division. Right, Figure 8. Expanded view of top plate around the detent slot.

The detent from the Barwise watch is shown in Figure 7. The main body is made of steel which has been hardened, tempered, and carefully polished. The gold passing spring is attached by a small screw threaded into a boss on the detent's spring. The locking jewel is a triangular piece of sapphire held in place by a small brass wedge. Near the end of the foot is a brass locating pin which helps to fix the position of the detent.

The portion of the top plate where the detent is installed is shown in Figure 8. Note how the slot extends into an irregularly-shaped hole through which the lower pivot hole for the balance can be seen along with part of the escape wheel. At the edge of the plate, where the foot of the detent sets, is a screw with a small notch cut into its head. The steady pin on the foot of the detent fits into this notch such that the screw can be turned to adjust the distance between the depth of interaction between the passing spring and unlocking jewel. The D-shaped piece on the edge of the slot and next to the jewel for the upper pivot of the escape wheel is used to adjust the depth of the locking stone on the escape wheel teeth.

The construction of this escapement along with the high quality finish work show that this watch was intended to be a first-rate timekeeper.

THE REPEATING MECHANISM

Probably the most interesting portion of this watch is the half-quarter repeating mechanism. It is of the type invented by Matthew Stogden during the earlier part of the eighteenth century while he was employed by George Graham.[4] Stogden's mechanism has a unique compact arrangement of its parts. The advantage of this arrangement is that it allows room for other complications (e.g., calendar mechanism) in addition to the repeating works.[5] In spite of its rather unusual construction, Stogden's design seems to have found favor with many of the English makers. Examples of its use can be found in watches by such notable makers as Ellicott, Vulliamy, Mudge, and Arnold. Stogden's mechanism bears little resemblance to the layout found in more modern Swiss repeaters such as those described by LeCoultre.[6] It seems to have disappeared from use by the middle 1840's.

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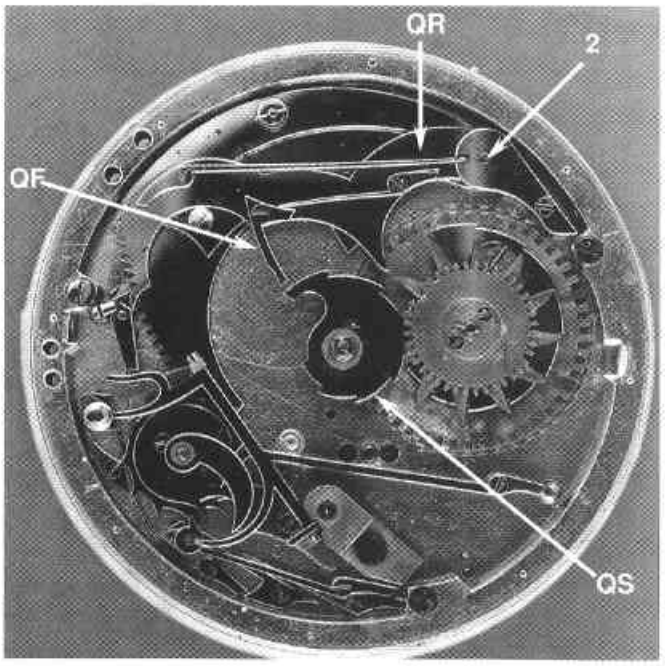

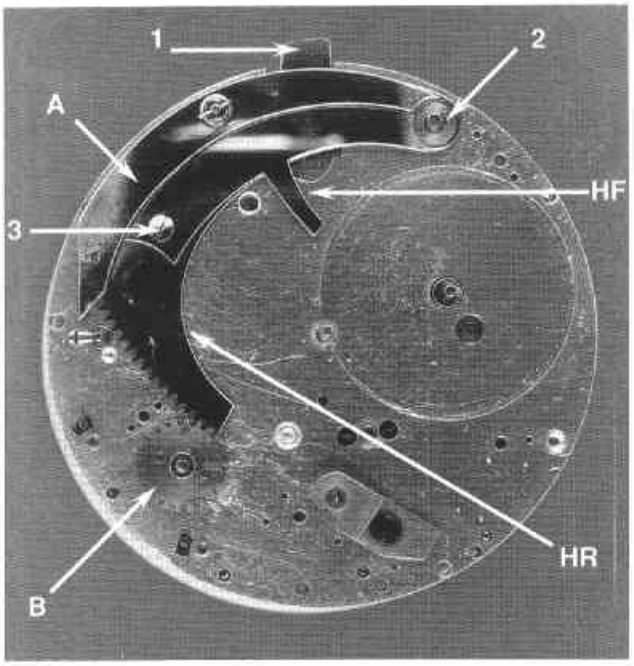

Left, Figure 9. Complete repeating mechanism as seen from the underside of the pillar plate with the dial removed. Right, Figure 10. View of partially disassembled repeating works showing orientation of hour rack with the all-or-nothing piece and winding wheel.

The main portion of the repeating works for this watch is located under the dial as shown in Figure 9. The dial is supported by a removable brass edge-ring which encircles the repeating works and is attached to the pillar plate with three screws.

There are basically three major differences between Stogden's mechanism and most later mechanisms. First of all, Stogden's repeating works does not have the usual hammer and trip arrangement commonly found in later repeating mechanisms. Instead, both the hour hammer trip teeth and quarter hammer trip teeth are contained on a pair of steel discs mounted one on top of the other and carried by the arbor of the repeating works' mainspring. When this mainspring is wound, all of the quarter teeth will pass the hammer trip levers. These trip levers are designed to move up and down on their arbors such that they will contact the trip teeth only for the purpose of striking and then be moved out of the way. Secondly, the design of the quarter snail differs in that its shape is such that the highest step determines the three-quarters plus one-half strike while the lowest step is for no quarters (i.e., time exactly on the hour). This arrangement is exactly the opposite of what is usually found in more modern Swiss mechanisms. Finally, the hour snail does not employ the star-wheel and detent configuration commonly found in other repeaters. Instead, a variation of the basic mechanism developed by Thomas Tompion is used. In this arrangement, the hour snail is attached to and turns with the minute wheel. Hence, the surprise piece is part of this hour snail and minute wheel assembly as opposed to being part of the quarter snail.

In order to understand how this type of repeating mechanism operates, it will be necessary to examine the series of events that take place when it is activated. During the course of this discussion, it will be useful to consult Figures 9 through 13 which show the repeating works in various states of disassembly.

The repeating function is activated by pressing downward on a plunger passing through the pendant of the case. Referring to Figure 10, this plunger makes direct contact with an appendage of the hour rack (labeled HR) at point 1. The hour rack in turn engages the wheel B connected to the arbor of the repeater mainspring. Hence, as the plunger is pushed downward, the hour rack pivots about point 2 causing the repeater mainspring to be wound.

The large flat curved piece of steel sitting on top of the hour rack and next to the all-or-nothing piece (A) is the hour finger piece (HF). This piece performs two basic functions. First, it limits the travel of the hour rack by making contact with the hour snail (HS) as shown in Figure 11. (In doing so, it provides the correct hour count by limiting the number of hour trip teeth that pass by the hammer trip lever.) Secondly, as it contacts the hour snail, the hour finger piece pivots about the screw at point 3 causing its other end to push against the end of the all-or-nothing piece near point 2. This results in the all-or-nothing piece pivoting about point 4 and making contact with the release lever (RL) as shown in Figure 11. The release lever works in conjunction with the trip lever elevation piece (EP) to control the position of the hammer trip levers (T1) and (T2). As was stated previously, these trip levers move up and down on shafts

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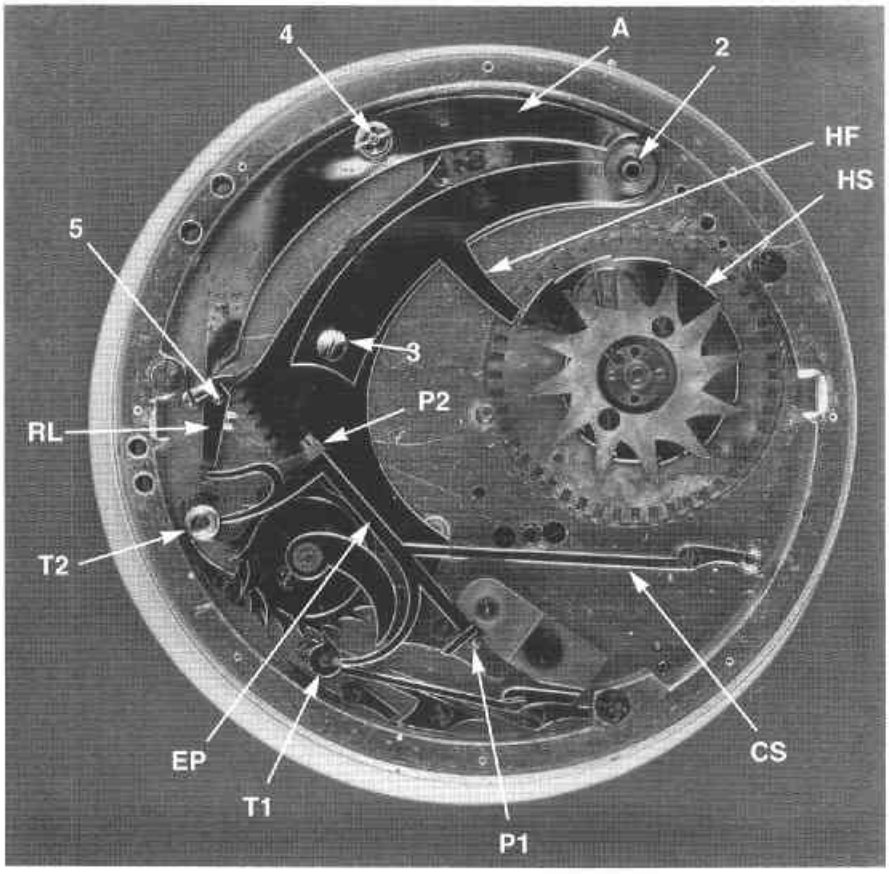
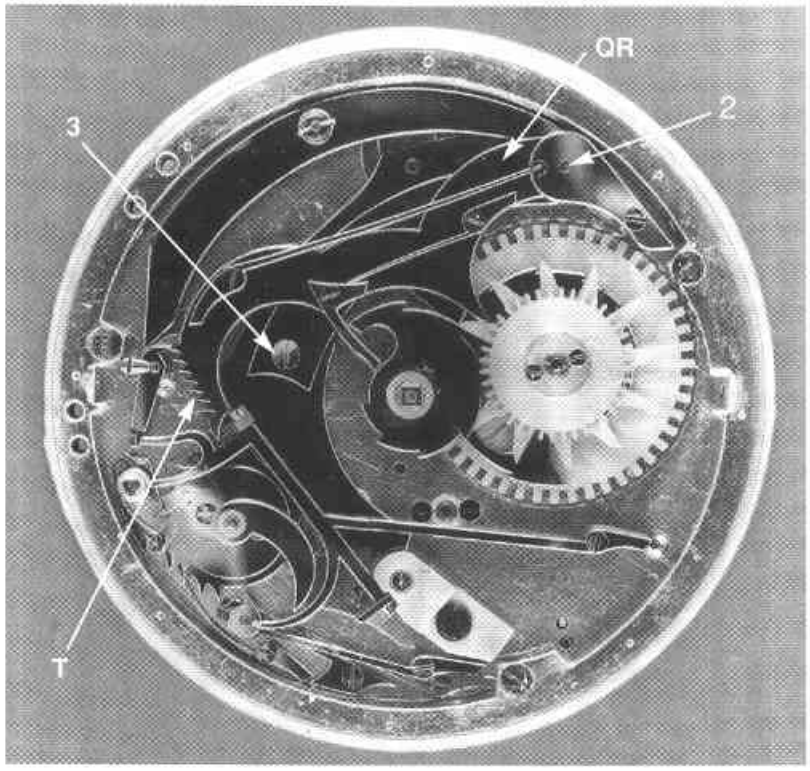


Figure 11. View of partially disassembled repeating works as it is activated but before beginning to strike. Note the function of the hour rack, all-or-nothing piece, and the release mechanism.

Figure 12. Orientation of the repeating works for striking exactly on the hour.



which are connected directly to the hammers.

The trip lever elevation piece pivots about P1 and P2 and has four fingers that protrude outward from its main body. Two of them intersect the hammer trip levers. Another protrudes directly outward from the straight section and sits on top of a cantilevered spring (CS). The fourth finger sits on top of the release lever. In its normal position, the wedge-shaped end of the release lever is pushed back underneath this finger as shown in Figure 9. This results in the hammer trip levers being elevated above the trip teeth. When the repeating mechanism is fully wound and ready to begin striking, the all-or-nothing piece forces the release lever to pivot about point 5 and move out from under the finger on the trip lever elevation piece as shown in Figure 11. The spring (CS) which is pushing upward from underneath causes the elevation piece to pivot about P1 and P2 and push the hammer trip levers down into position for striking.

The hammer trip teeth are contained on a pair of discs sitting on top of each other and attached directly to the winding wheel (B). The lower disc contains the trip teeth for the hours along with those for the first note (the lower pitched chime) of the quarters. The upper disc contains only those trip teeth for the higher pitched second note of the quarters and the single note of the half-quarter. The curved piece of steel above these discs is part of the bridge that supports the lower pivot of the arbor for the repeating works' mainspring.

The quarter rack (QR) sits directly on top of the hour rack and pivots at the same point as the hour rack (point 2) as shown in Figure 9. Its main purpose is to work with the release lever and the quarter snail (QS) to determine the correct count of the quarter striking. Attached to the quarter rack is a separate piece called the quarter finger (QF) which interacts with the quarter snail. The quarter snail is attached to the can-

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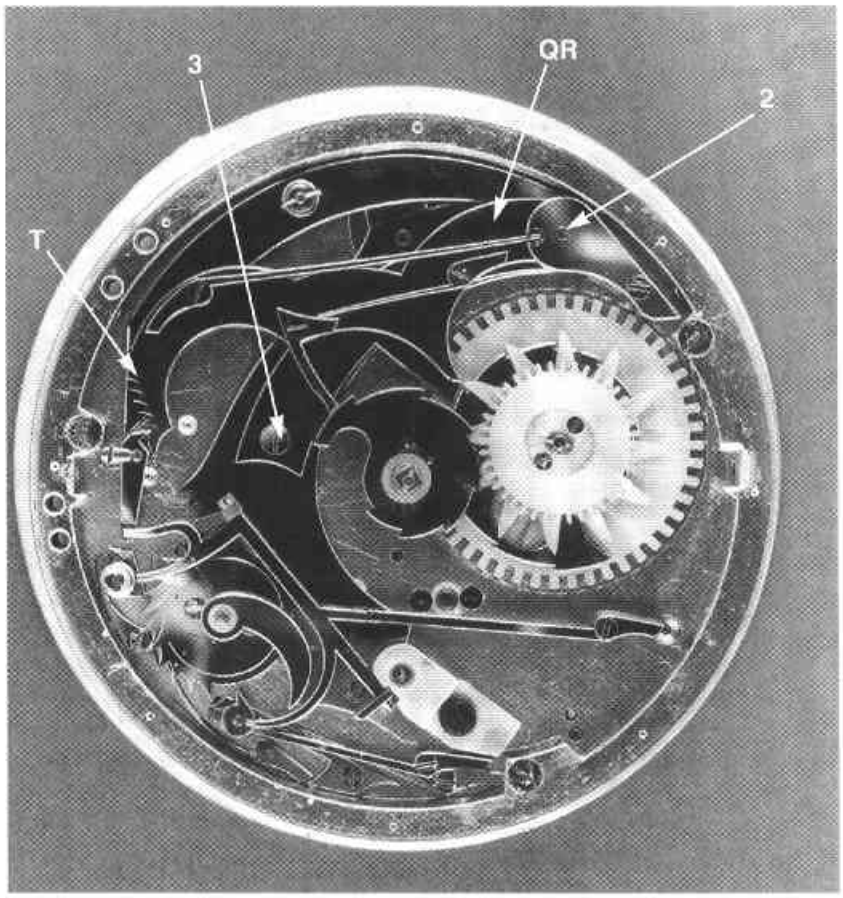

Figure 13. Orientation of the repeating works for striking three-quarters plus one-half past the hour.

non pinion and has a total of eight steps on it; each corresponding to a 7½ minute section out of the hour. As the plunger in the pendant of the case is being pushed downward to activate the repeating mechanism, the quarter rack moves in concert with the hour rack until the quarter finger comes into contact with the quarter snail. At this point, the quarter rack stops moving. However, the hour rack continues to move until the hour finger (HF in Figure 11) comes into contact with the hour snail and the all-or-nothing piece is activated causing the hammer lever trips to fall into position. The repeating mechanism now appears as shown in Figure 12. At this point, take note of the row of seven triangular teeth (T) located on the quarter rack opposite pivot point 2. The purpose of these teeth is to interact with the release lever so as to pull it back underneath the elevation piece and cause the hammer trip levers to be raised up out of striking position. The timing for this event is controlled by the manner in which the quarter finger and quarter snail interact. In order to understand how this arrangement works, it will be useful to examine and compare the situations shown in Figures 12 and 13. Figure 12 shows the orientation of the works for striking exactly on the hours. Note that the quarter finger is on the lowest step of the quarter snail and the row of triangular teeth is such that the last tooth is just past the end of the release lever. If the movement had been set up to strike all of the quarters plus the half, it would appear as shown in Figure 13. Here the quarter finger rests on the highest step of the quarter snail with the end of the release lever next to the notch just before the first tooth at T.

When the plunger is released, the hour rack starts to retract as the striking begins. During this time, the quarter finger remains in contact

Figure 14. Underside of the quarter snail and cannon pinion assembly showing the lantern pinion.

with the quarter snail until the screw head at point 3 on the hour rack comes into contact with the quarter rack causing it to begin retracting, also. At this instant, one of the teeth at T, as shown in Figure 12 (this is the last tooth), pulls the release lever back under the elevation piece causing the hammer trips to be raised and the striking terminated. The hour and quarter racks continue to move back to their rest positions to terminate the sequence. By comparing the situations shown in Figures 12 and 13, one can see that the strike count for the quarters is basically a function of the distance between the screw head at point 3 and the quarter rack at the time the mechanism is activated. In Figure 12, observe that this distance is at its minimum value. Hence, as soon as the hours are struck, the screw head comes into contact with the quarter rack and the striking stops. However, in Figure 13, this distance is at its maximum value which allows all of the quarters plus the half to be struck in addition to the hours.

In order to understand how the surprise piece functions, it will be necessary to examine the construction of the minute wheel and hour snail assembly. As was stated earlier, the hour snail is connected to and turns with the minute wheel. The minute wheel is coupled to the cannon pinion by way of a 4-prong lantern pinion located under the quarter snail as shown in Figure 14. Since the hour snail turns continuously instead of being jumped along, there is always a possibility that it may not have turned far enough when the next

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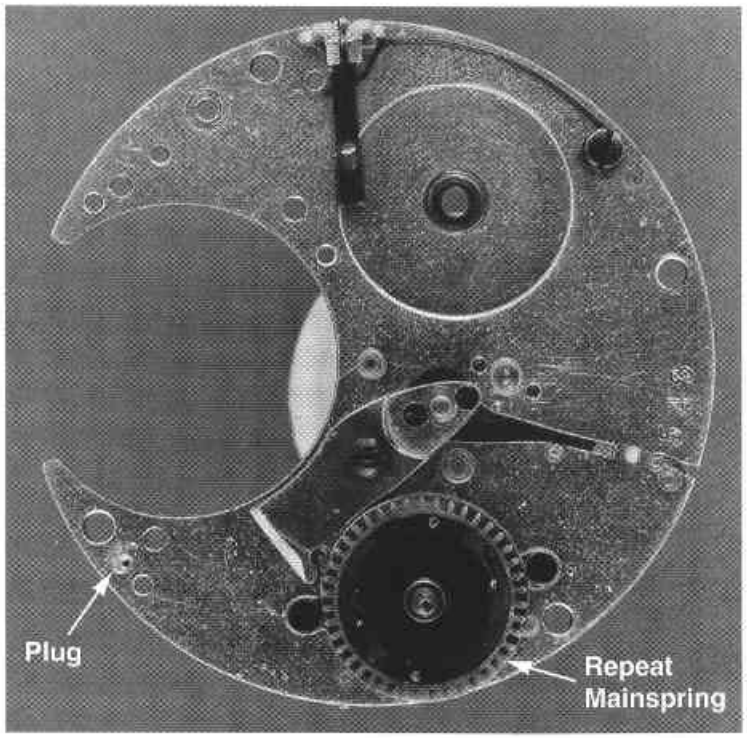

Figure 15. Underside of the top plate showing the locations of the repeater mainspring and the plug containing the upper pivot hole for the speed regulation pinion of the repeater train.

hour comes around, which would result in an incorrect hour strike. To make sure this does not happen, the hour snail and minute wheel assembly are constructed such that the hour snail is not rigidly attached to the minute wheel. Instead, it pivots on a raised boss on the minute wheel and is held in place by a straight piece of spring wire. This spring wire is rigidly attached to the hour snail and loosely fits into a notch in the boss on the minute wheel. It can be seen through the circular hole in the hour snail as shown in Figure 9. Attached directly on top of the hour snail is a brass piece with 12 rays protruding outward. When the repeating mechanism is activated, one of these rays will be engaged by a similarly shaped finger that protrudes from the quarter rack. This action has the effect of pushing the hour snail forward slightly to make certain that the hour finger comes to rest on the correct step. Hence, in this way the surprise piece action is obtained and the correct count for the hour strike is assured. As can be seen from Figure 10, the engagement between this finger on the quarter rack and one of the rays on the hour wheel assembly is comparatively deep since the time is exactly on the hour. However, as time progresses through the hour, this engagement becomes less and less such that near the end of the hour it is very shallow as shown in Figure 13.

As was shown in Figure 5, the repeater train is located between the pillar plate and top plate along with the time train. It consists of four wheels and five pinions. The pinion on the first wheel engages the main wheel on the repeater mainspring barrel assembly which is mounted to the underside of the top plate as shown in Figure 15. The speed at which the striking occurs depends on the speed of rotation of this wheel train. The speed of rotation in turn is controlled by the depth between the last pinion and its driving wheel. The upper pivot hole for this final pinion is in a brass plug inserted into the top plate. The hole is purposely drilled off-center so that by rotating the plug the depth is varied. A screw driver slot in the top of the plug facilitates this adjustment. It should be pointed out that this type of speed regulation is not peculiar to Stogden's mechanism. It found widespread use in other repeating mechanisms as well.

The overall quality of this particular repeating mechanism is excellent. All of the steelwork such as the racks and snails is beautifully polished to a mirror-like finish. The operation is smooth and flawless which is perhaps the best testimonial to its quality of construction.

CONCLUSION

The main purpose of this article has been to provide an in-depth technical description of a pocket chronometer with a half-quarter repeating works made by John Barwise of London. Detailed descriptions were provided for both the repeater and timekeeping portions of this watch. By studying this technical description, it is hoped that the reader will not only gain a better understanding of how the various mechanisms work, but also develop an appreciation for the high degree of workmanship and skill required to build a timepiece like this one.

Acknowledgements

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