British Horology Times

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The Congreve Clock
Its History and Operation

By Bob Pritzker (Canada)

If one travels to any major clock museum one will note that a crowd may be gathered at a particular clock. The clock usually has three dials on the front plate and a movement supported on pillars above a table upon which a small ball rolls down a zig-zag path on a table which rocks back and forth as the ball reaches the end of each run in either direction. This is a Congreve Rolling Ball Clock and an example is shown in Figure 1.

Figure 1 – Clock by French in British Museum

The design of this type of clock is generally attributed to the Sir William Congreve (1772 -1828), the son of the Comptroller of the Royal Arsenal at Woolwich. He was a close associate of the Prince of Wales who would later become King George IV. Congreve was able to obtain a patent for his clock design in 1808 but he was not a clockmaker. Rather, Congreve fancied himself as an inventor and his designs included counterfeit-proof paper, pneumatic canal locks, and even a perpetual motion machine.

He is probably most famous for his development of the Congreve rocket, a weapon which was successfully used at the battle of Leipzig in the Napoleonic wars and less successfully at the siege of Baltimore during the war of 1812. These were the rockets alluded to in the American National Anthem.

Congreve's patent states that "the new principle or system of measuring time…is founded on…detaching the time-measurer from the first mover for an extent of duration fare beyond anything yet effected." Plainly, Congreve expected that his clock would be a more accurate timekeeper than a pendulum clock because the

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Opinions expressed in articles in this newsletter are those of the writers and are not necessarily endorsed by the Chapter and/or by the National Association of Watch and Clock Collectors, Inc.

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In This Issue…

Interesting watch paper from upstate NY by an unlisted retailer, Deloss Gould of Fonda. Depictions of city landscapes are very uncommon. Note Father Time sitting in the foreground (courtesy Al Bresee)

Next Meeting

Florida Mid-Winter Regional (February 9-10, 2018)

"Analysis & Restoration of a 17th Century Travel Clock"

Presentation by David Cooper

Further details can be found on our website

President's Message:

The British Horology Chapter can be especially proud of our Past President and current Vice-President Richard Newman. Rich was elected to the Chair of the Board of Directors of the NAWCC at their meeting in Arlington this summer. In addition, Rich was named a Fellow of the NAWCC at the Arlington Convention. I am certain I speak for all members of our chapter in congratulating Rich on his achievements.

The Arlington meeting was a great success and thanks are due to Ken Rockwell for his excellent presentation. Our next meeting will be at the Florida Mid Winter Regional in Lakeland where David Cooper will give a presentation on the analysis and restoration of a 17th Century travel clock. Dave is a fine presenter and consumate craftsman. I am certain you will enjoy his presentation. The Florida Regional is always excellent so please plan to join us there.

Our hard working secretary, Marion Krajewski, has undertaken yet another job. She, along with Lu Sadowski is in charge of the upcoming celebratory 75th anniversary National Convention of the NAWCC in York, Pennsylvania. This promises to be the best Convention yet and Chapter 159 along with other special interest chapters has committed to participating in the Convention's display. To do this we need your assistance. The display will be in the center of the Mart Room and will highlight items that reflect well the nature of the special interest chapter. Therefore, if you have a British timepiece that you would be willing to put on display at the Convention please let us know by responding to BritishHorology@gmail.com. They have promised a secure setting and can provide insurance coverage.

Included in this issue of the British Horological Times is an article that summarizes a presentation I made at the Southern Ohio Regional a couple of years ago. I hope you find it interesting. In addition, we have received a couple of rquests for assistance from fellow members. Please have a look at these. Your response would be most welcome. The strength of our Chapter lies in you, our individual member. We are always in need of articles for the newsletter and presentations for our meetings.

On a personal note, I, too, am deeply honoured to have received the Association's Fellow Award this summer. It is a distinction that I truly cherish.

Hopefully, I will see you at the meeting in Lakeland in February. Until then I hope the upcoming holidays are full of joy and happiness for you and yours.

Cheerio,
Bob

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oscillator would only be activated every 30 seconds. The patent drawing (Figure 2) shows the three dials and tilting table common to most of these clocks.

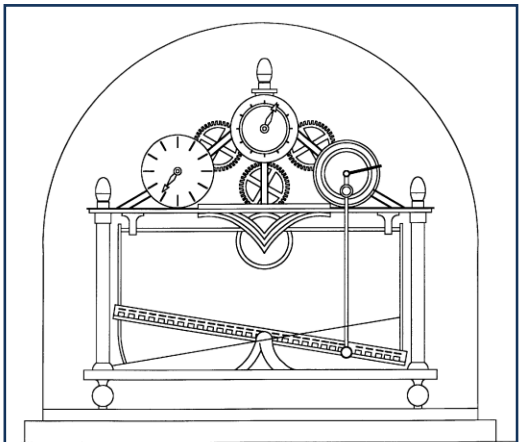


Figure 2- Congreve's Patent Drawing

Since Congreve was not a clockmaker, he had three clocks made to his specifications. The first was weight driven made by Gravel and Tolkien which he then presented to the Prince of Wales in 1808. The second clock, which appears to have been constructed by John Moxon, was spring-driven. The second model is in the collection of Buckingham Palace. A third clock was presented to the arsenal at Woolwich.

The clocks were, in fact, terrible timekeepers. Prince George returned the clock to Congreve to have it regulated in August, 1808. It was delivered to Benjamin Vulliamy in 1837 to be fixed. Vulliamy's records state: " … Repaired and made to perform properly, a spring clock made by Moxon, with extreme detached eschapement upon Sir William Congreve's principle, that goes mounted in a large skeleton frame, a most complicated and troublesome machine, and new silvered, the work that had been silvered before, and lacquered the skeleton plates and all the large parts and lacquering spirit level." All for four pounds Sterling.

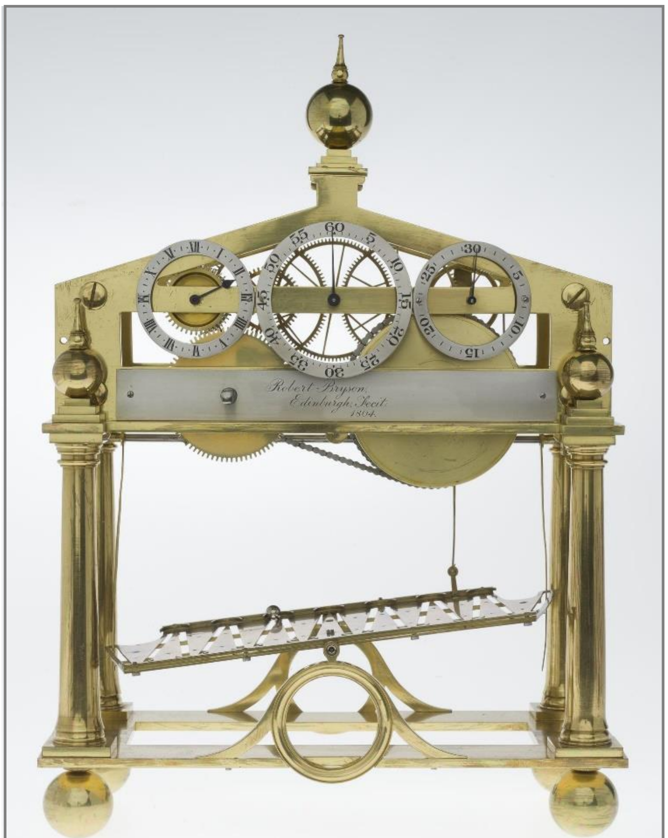


Figure 3 – Rolling Ball Clock by Bryson, 1804

The clock still proved a poor timekeeper. When the palace's clockmaker Charles Frodsham was given the task of setting it right, he trashed the movement and replaced it with a chronometer movement by Earnshaw. As a result the original Congreve clock was lost for all time.

Although Congreve received a patent for the clock, there exists in the National Museum of Scotland a rolling ball clock made by Robert Bryson (Figure 3). The plaque on this clock dates it to 1804, four years prior to the patent that Congreve received. The reader should note the similarity between the clock in Figure 3 and the clock in Figure 1. The British Museum clock was purportedly made around 1830.

The author has received a photograph from a member of the NAWCC of another early rolling ball clock made by Scottish maker James Nimmo. Nimmo was, according to Baillie, active in 1806. This leads one to speculate that Congreve had seen at least one of these clocks before preparing his patent application. Certainly, some of his other inventions were modifications of prior art. Regardless of who invented this style of timepiece, they are called Congreve clocks.

Many have asked why these clocks are such poor timekeepers. The answer lies partly in the way they operate. The clocks are intriguing to watch as a small ball rolls down a zig-zag path on the pivoted table. When the ball reaches the end of the path, the table tilts and the ball rolls back the other way. The tilting of the table is the oscillation that the clock depends on.

As one can see in Figure 4, much of the movement is typical to pendulum or balance wheel clocks. There is a spring barrel (F) which is connected to a fusee (C). Attached to the fusee is the great wheel (B). The fusee/great wheel assembly drives the hour wheel (A) and the center pinion. The center wheel (D) connects to the third wheel (E) which ultimately drives the detent wheel (G). The detent wheel has two pins 180° apart. One pin rests on the detent lever (J).

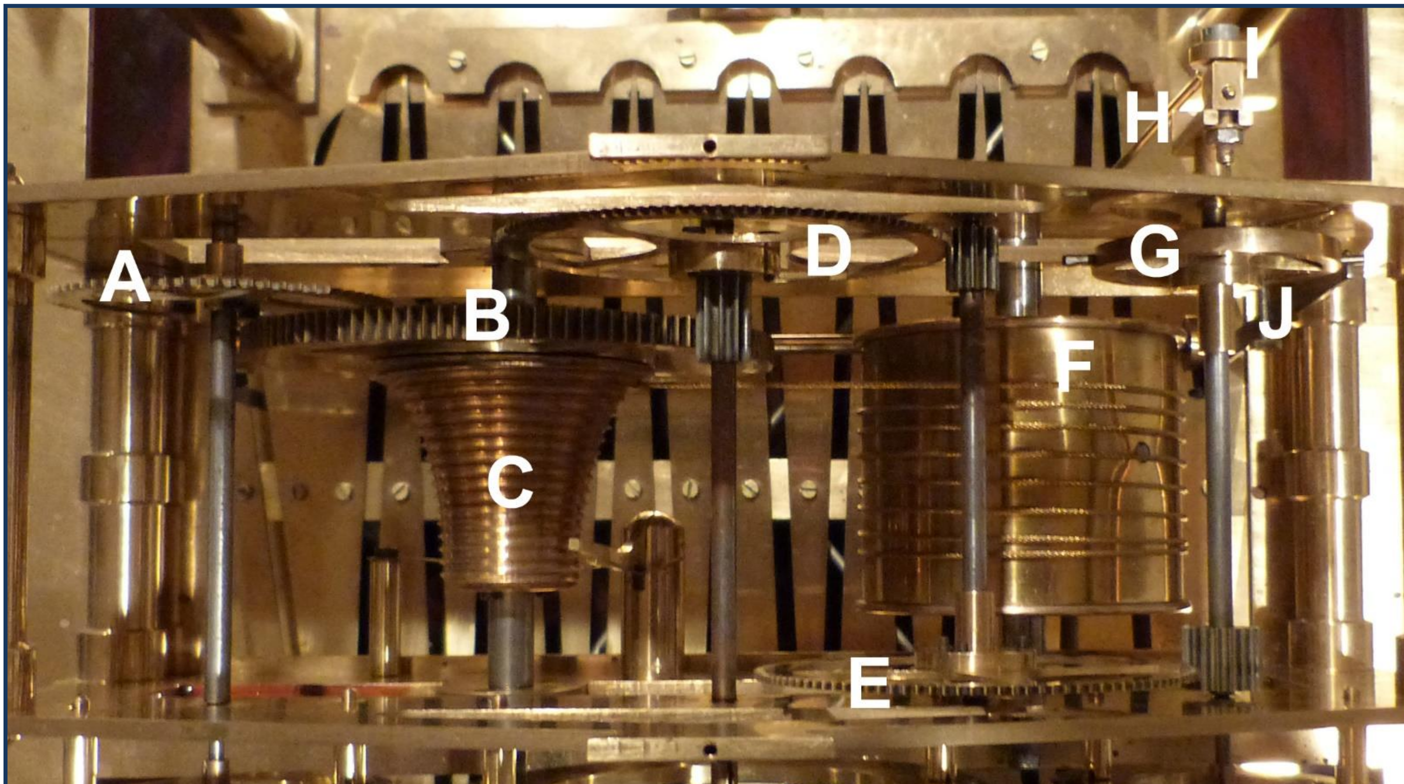


Figure 4 – Top view of Congreve Movement

The detent lever is attached to an arbor that runs parallel to the plates. Also attached to this arbor are two trigger levers which pierce the oscillating table at either end. In the side view of the movement, Figure 5, one of these trigger levers is labelled (K).

At the end of the ball's traverse along the zig-zag path of the table it will strike a trigger lever which then rotates partially the arbor. This causes the detent lever to rotate in the opposite direction towards the front plate and frees the detent wheel.

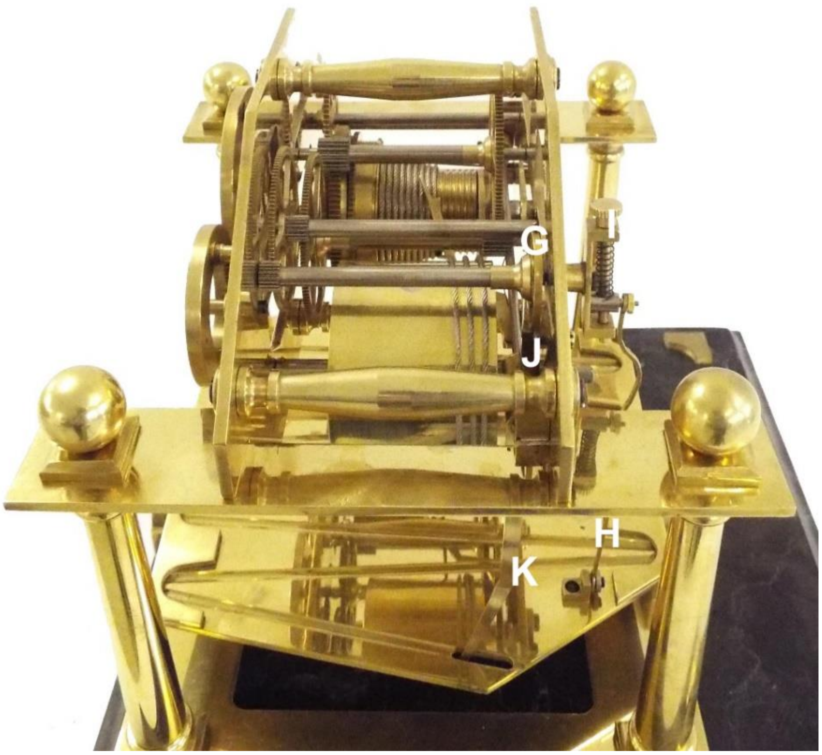


Figure 5 – Side view of Congreve Movement

The detent wheel rotates 180° turning the eccentric (G). Fastened to the eccentric is the lifting arm (I) which is also attached to the table. As the eccentric rotates it will cause the lifting arm to either lift or lower the end of the table to which it is attached. The ball will always be at the lower end of the table at this point. As the table rises, the ball begins its descent down the zig-zag path to the other end of the table.

The arbor on which the trigger and detent arms are mounted is counter-balanced so that the detent arm will have rotated back to its rest position in time to arrest the rotation of the detent wheel.

The single largest timekeeping problem of these clocks is that the oscillator has no natural period of vibration. The clock is completely dependent on the time taken between the two trigger levers being moved by the ball. This is, of course, dependent on the time taken for the ball to move down the zig-zag slope. Any perturbation of the movement of the ball will result in an inaccuracy in timekeeping.

It is necessary that the surface of the ball and the groove in the table be kept free of dirt, particularly oil or grease which would increase the friction between the surfaces and slow the ball's descent. This is not the only cause of error.

To be truly accurate, the ball must take an equal time to complete its movement in both directions on each and every cycle. Reproducibility is paramount. A major problem exists in that as the table is lifted the ball begins its descent. If there is a lack of uniform motion in the gear train of the movement through friction or other means, then the acceleration given to the ball will not be uniform and its rate of travel will be different on each pass. Congreve was unaware of the importance of this dependency of his clock as opposed to a clock with a pendulum or balance wheel that is oscillating with a natural frequency.

Congreve was also unaware that when the detent wheel is abruptly stopped by the pin hitting the end of the detent lever there is kinetic energy which must be converted. In John Wilding's clock design, he places a fly on the detent wheel arbor in an attempt to absorb some of this energy. Nonetheless, on close examination of the table's movement in slow motion, the energy in the table as it comes to rest in its new position causes the table to "flutter." This fluttering will significantly affect the movement of the ball as it starts its downward journey.

It is very unlikely that Congreve or any maker of these clocks was aware of this behavior of the table. In the patent specification, Congreve states:

> "...in the very short and rare action of the maintaining power, during the almost instantaneous shifting of the plane once a minute only, any inequality that can possibly arise with ordinary good workmanship must be next to nothing, and can hardly produce a sensible effect in the longest period of going. It shows, however, that ... inasmuch as neither the motion of the ball in its progress along the plane, nor at the moment of its departure on its return, is in the least influenced by the prime mover."

He was very wrong on both counts. Good workmanship cannot change the errors in design introduced by a lack of knowledge of the basic physics. The ball's motion may not be influenced by the forces applied through the clock's springwork as much as they are through friction and energy transformations.

Setting these clocks to run can be a challenging experience. Some suggestions to set up include:

- The pivots of the table and trigger levers must be as friction free as possible yet not allow anything other than rotational motion.
- It has already been mentioned that all contact surfaces between the ball and the table must be clean and as friction free as possible.
- The clock must be set so that when the table is horizontal it is absolutely level in two dimensions.
- The table must be balanced so that the force exerted by the eccentric will be able to lift the table while the ball is at either end.
- The lift arm must be set up so that it is vertical when the table is at rest, otherwise the clockworks may not exert adequate force to move the table.
- The length of the lift arm must be adjusted so that the table is lifted the same height in each direction.
- The size of the ball is important and dependent on the groove width.

In summary, the Congreve clock is an interesting timepiece. No one would ever confuse it with a chronometer. These are stylish clocks that are very entertaining to watch. In fact, they are almost mesmerizing.

People that own them and take the time to get them running find that these clocks are well worth having in their collection.

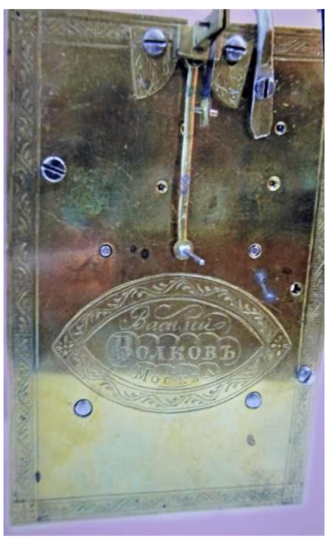
Assistance Requested ..

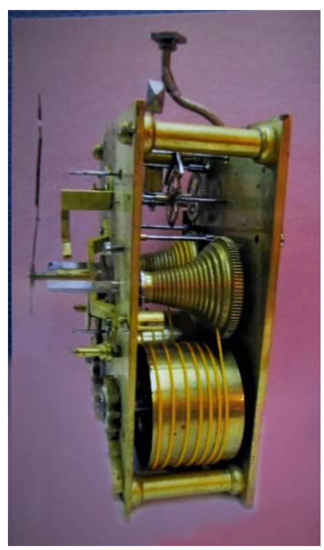
BH is always happy to receive pictures of member's clocks and watches, and provide guidance and research assistance when requested.

This interesting, heavily decorated mahogany shelf clock is owned by member Jack Wallace. It has every appearance of a Georgian English bracket clock, circa 1775 – 1800, having a heavy four-pillar, eight-day movement that strikes on a bell. The brass dial is unusually unsigned and features a calendar and silent/strike dial in the arch. However, this isn't a typical example - - the signature on the back plate of the movement is in Cyrillic! Apparently, the clock was retailed by Volkov Vasilli Alekseevich, Moscow, born 1776 and died 1846.

We often read about the English export trade to Turkey and China but seldom see examples destined for Russia. Do any other members have information on the Anglo - Russian trade or retailers in Moscow?

(right & below) Moscow-signed mahogany bracket clock and movement





Member George Hudson sent in a picture of this interesting weight and relayed that it came to him many years ago with a mid-18th century one-handed tall case clock by Thomas Sillito, Utoxeter, England. He's always wondered whether it truly is a clock weight and, if so, whether appropriate for an English 30-hour movement.

It's just under 9" high, the bottom sides measure 2", and total weight is 7 pounds which is sufficient to run the clock. Notice the interesting tapered shape and hook.

Please email us at BritishHorology@gmail.com if you have information to share.