English Clock Systems

Contents

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2.1 History

R Bailey and T Johnstone formed a company in 1936 called Synchro Time Systems Ltd which dealt with commercial timekeeping equipment. They became associated with Smiths in 1938 but still used their own name.
In 1939 the name was changed to English Clock Systems Ltd, Industrial Branch of Smiths English Clocks Ltd.
They produced the ECS master clocks. There were three series and manufacture continued until 1963 or later.
In 1962 they collaborated with a competitor, Gents, to produce a clock called by them the ECS Memory Master. Gents marketed the same clock as the Chronopher.
The initial design for the ECS master clock probably came from Reginald Bailey and Thomas Johnstone who started a company called **Synchro Time Systems Limited** (STS) which was registered on 4th August 1936 with a nominal share capital of £1000. The original Directors of the company were:

Reginald Alfred Bailey (Electrical Engineer)
Thomas Johnstone (Electrical Engineer)
F.D.S. Jerrard (Gentleman)
W.E. Thorne (Gentleman)
J.T. Bett (Solicitor)
G.E. Bouskell-Wade (Solicitor)

All six were also shareholders. Reginald Bailey had been involved with industrial timekeeping since 1916 when he was fourteen years old, being particularly interested in the technical aspect of horology. The main business of STS was the installation and maintenance of Ericsson time recording equipment imported from Sweden, and the installation and maintenance of synchronous turret and advertising clocks.

The development of the 1- second master clock was carried out largely by the works manager, a Mr Powell. At an Extraordinary General Meeting of the shareholders on 5 November 1937, just over one year after the company was formed, the £1000 initial capital was increased to £2000 and the value and allocation of shares was changed to reflect the cash input from S. Smith & Son (1934) Ltd. This move gave S. Smith & Son (1934) Ltd. 3000 of the 4000 available shares in STS and a seat on the Board. STS thus became the Industrial Branch of Smiths, dealing with "Sectric" time recorders, turret and exterior clocks, advertising clocks and master clock systems. Initially it retained its own company name and the trade mark name of "Relyon", and traded from its address at Relyon House, 57/63 Wharfedale Road, Kings Cross, London. It had contracts with many well known names such as K.L.G. Spark Plugs, Gillette Industries, Littlewoods Ltd., Prudential Assurance Company and the Financial Times offices in London. Neon-lit turret clocks and advertising clocks using a Smiths "Sectric" synchronous motor and reduction gear formed a large part of the company's work in 1938.

On 28 March 1939, a Special Resolution was passed by the Board of STS to change the name of the company to **English Clock Systems Limited**, and in May 1939, two of the original shareholders, Messrs. Bett and Bouskell-Wade, transferred their shareholdings to S. Smith & Son (1934) Ltd., thus giving Smiths 3506 out of 4000 shares. In June 1939, an English Clock Systems Ltd. advertisement in the Horological Journal mentions "pendulum master clocks", so the design was probably complete and in a marketable form by then. This is the earliest published record found so far of the master clock. In December 1944, the shareholding of S. Smith & Son (1934) Limited was transferred to Smiths English Clocks Ltd. and by December 1947 share ownership had changed again, to leave Messrs. Bailey and Johnstone with 20 shares each, and Smiths English Clocks Ltd with the remaining 3960 shares. In February 1949, Reginald Bailey died at the age of 47, and in 1950 his shareholding was also transferred to Smiths English Clocks Ltd, giving them 3980 of the 4000 shares. The remaining 20 shares were still held by Thomas Johnstone, one of the founders of the original company. In February 1955, Thomas Johnstone transferred his twenty shares, giving nineteen to Smiths English Clocks Ltd. and a single share to Mr. D.W. Barrett, who had previously been a shareholder from 1944 to 1947. Smiths English Clocks Ltd. now had 3999 of the 4000 shares. In 1960, Smiths acquired the last remaining share.

ECS had depots in Birmingham, Manchester, Leeds, Glasgow and Belfast, each with a depot manager who was responsible for sales and two or three service staff. There were also foreign agents in Greece, Holland, South Africa, Sweden and Algeria, although none were very active. In September 1969, ECS moved its operating base to Park Royal in West London, and in October 1980, it had been taken over by Blick.

1.2 ECS Showrooms and Premises

The works operation for **Synchro Time Systems Ltd** was originally based at **Relyon House, 57-63 Wharfdale Road, Kings Cross, London N1** from the commencing of production until 1969. There are several advertisements and editorial paragraphs in leading horological publications over that period to confirm this. Unfortunately no photographs have emerged yet showing these premises. The only indication of the premises are a graphical representation in company advertisements. The example shown below is part of a full page advert from the Horological Journal in 1949.

Figure 1 - ECS advert

Around the end of 1948 or early 1949, the company (by then English Clock Systems) opened a Head Office and Showrooms at **Speedometer House, 179 Great Portland Street, London, W1**. During 1949, there are advertisements showing both the works address in Kings Cross, and the showroom address in Great Portland Street. Later publications only refer to the Head Office address in London's West End.

In September 1969, the works, Head Office and Showroom operations were moved to **Industime House, Chase Road, Park Royal, London, NW10**.

Figure 2 - The showroom at Speedometer House, 179 Great Portland Street, London W1, in the early 1950s.

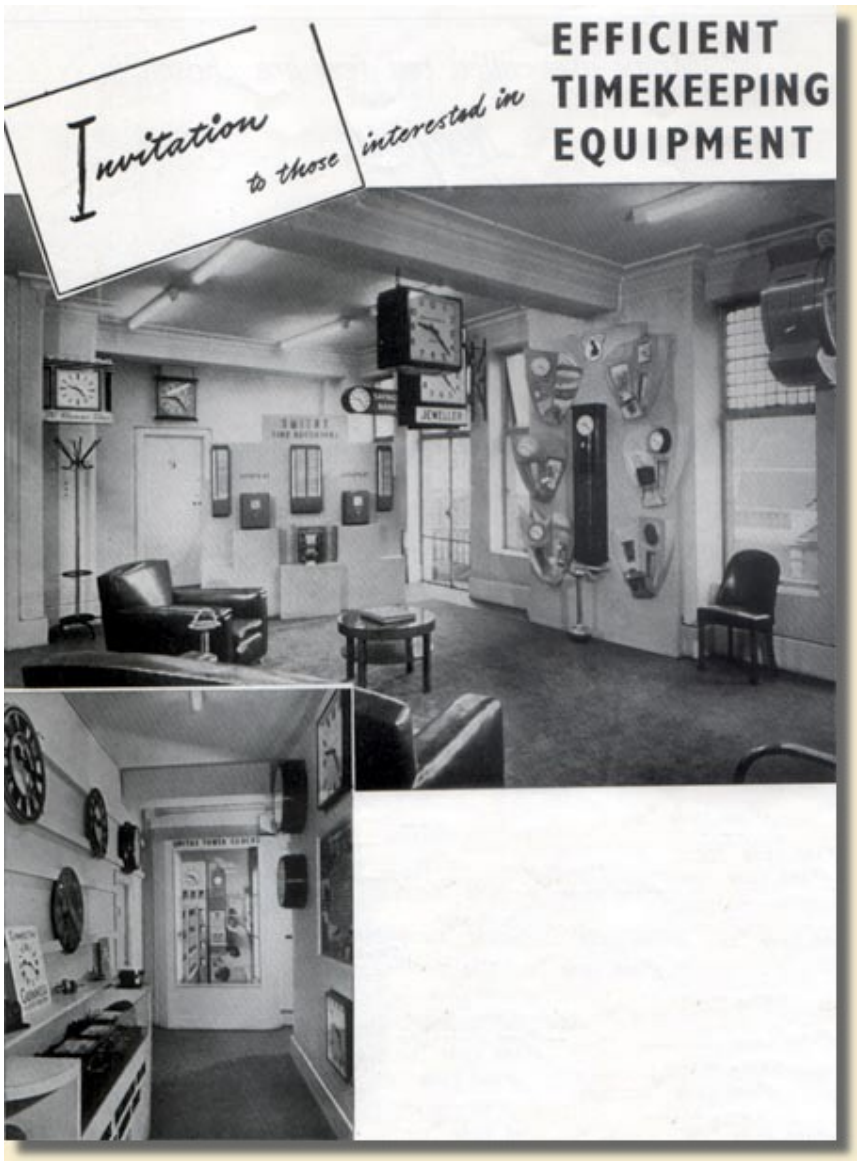


Figure 3 - Another two views of the showroom from an advertisement dated November 1951.

1.3 ECS Master

The clocks have a 1-second Invar pendulum with a 17 pound cylindrical bob, and are impulsed every 30 seconds by an electrically reset gravity arm. There are two case styles; flat-top (Figure 4) and round-top (Figure 5). The movement is built on a cast iron A frame (Figure 6). There is a 15-tooth count wheel, two resetting coils mounted vertically above the gravity arm, a capacitor (with a spark quench resistor behind the casting) and a current setting rheostat.

Figure 4 - Flat top case style

Figure 5 - Round top case style

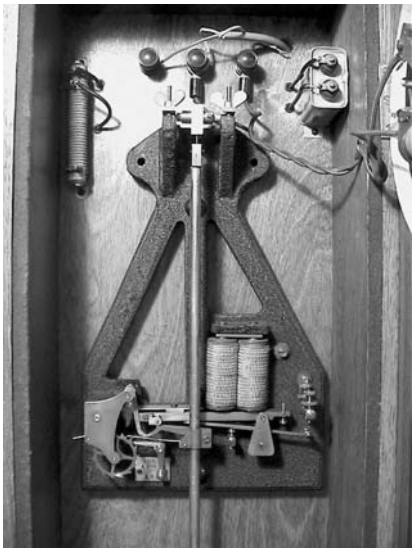


Figure 6 - Cast iron A frame movement

1.3.1 Clock Serial Numbers and Dating

All clocks are serial numbered on the A.R.N. plate mounted on the movement casting. There are 5 groups of serial numbers:

- sub-1000 series (Sample and dating too vague to give dates)
- 1000 series up to approximately mid 1950
- 10,000 series up to late 1954
- 20,000 series up to mid 1957
- 30,000 series last recorded clock mid 1966

As the earliest recorded mention of the master clock is in an advertisement in June 1939, production may well have started just before World War II broke out, but would almost certainly have been reduced or suspended during the war. Dating of the early clocks (sub-1000 and 1000 series) is almost impossible as they were not dated during manufacture. There is a published report regarding a clock with serial number 196 giving a purchase date of 1945/6 and a possible manufacture date of 1938, but the latter is not a verifiable date. The circuit diagram with that clock is dated 1948, the most likely delivery date. The clock was installed on the Isle of Wight

Two examples in the 1000 series have installation dates recorded in pencil on the inside surface of the pilot dial (1948 and 1950), and one clock's serial number is shown on a dated technical drawing (1949). Until evidence to the contrary is found, 1945 has been taken as the probable start of the main production and marketing. The serial numbers are not a true reflection of the actual number of clocks made as numbering recommenced each time a new series was started. Some obvious design changes happened at serial number boundaries, and some design changes were made during a series. The reasons for the numbering changes are not always obvious.

From the latter part of the 10,000 series onwards the movement of the pilot dial was given a date code that was stamped into the rectangular brass plate on which the movement is constructed. This becomes the prime source of dating information. Initially this code was in the form of two digits for the year, followed by one or two digits for the month, e.g. 547 gives July 1954 and 5512 gives December 1955. Around 1961 or 1962 this code changed to become one or two digits for the month and one digit for the year within the 1960 decade. e.g. 113 is November 1963 and 54 is May 1964.

Even this dating evidence is not too accurate as the slave movements were also produced for individual slave dials and for other clocks apart from the master clocks, and it is suspected that slave movements were dated at the time that a batch was manufactured, but were not taken from stock in strict rotation when assembling the master clocks. Thus, a clock with a higher serial number may have an earlier dated pilot movement than an adjacent lower serial number clock. This gives an uneven distribution to the production pattern.

1.3.2 Major Design Changes

There were two major design changes for which dates can be established.

1.3.2.1 Case and dial style.

The first change coincides with the start of the 20,000 series in late 1954 and is purely cosmetic. The case style is changed from flat-top to round-top; the dial is given Arabic numerals instead of Roman, with a painted background instead of silvered; and the hands are changed to a more 'modern', sleeker shape (Figure 7 and Figure 8). An intermediate form of hand is also used from this time onwards where a tail from the original design is retained, presumably as a counterbalance, along with the main part of the new design (Figure 9).

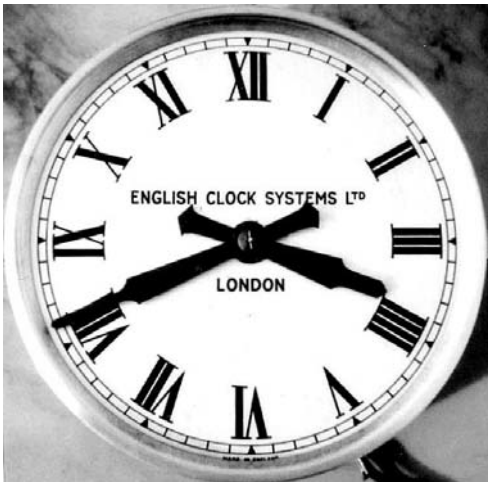


Figure 7 - Older style dial

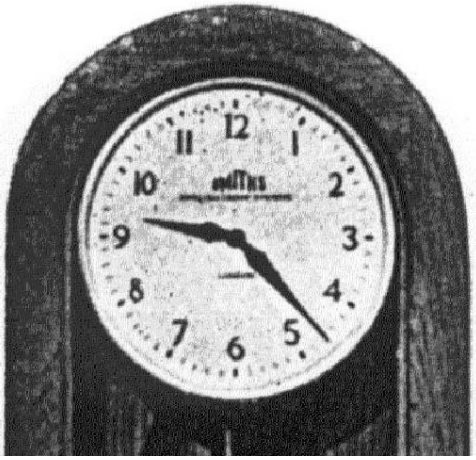


Figure 8 - New style dial and hands

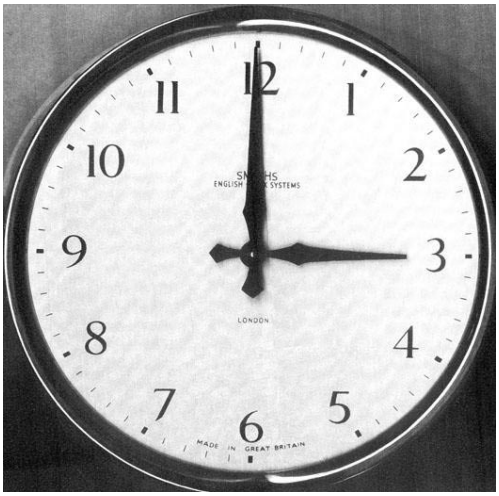


Figure 9 - Intermediate style dial and hands

1.3.2.2 Contacts.

The other major change was technical, occurring part-way through the 30,000 series towards the end of 1959, where the contacting arrangements were changed from double-contact to single-contact. In the double-contact design (Figure 10), the moving contact on the armature bridges two fixed contacts to complete the circuit. This obviated the need for a flexible wire connection from the armature to the frame of the clock. A flexible wire could fracture, or could stiffen over time and impede the action. The original double-contact arrangement had always been a source of unreliability as the two sets of contacts are both required to make a reliable connection to complete the resetting circuit, and therefore the contact pressure is shared between them. In the later single-contact design (Figure 11), the armature became part of the circuit and a flexible connection was then required back to the baseplate. Contact pressure was thus doubled, giving a more reliable contact.

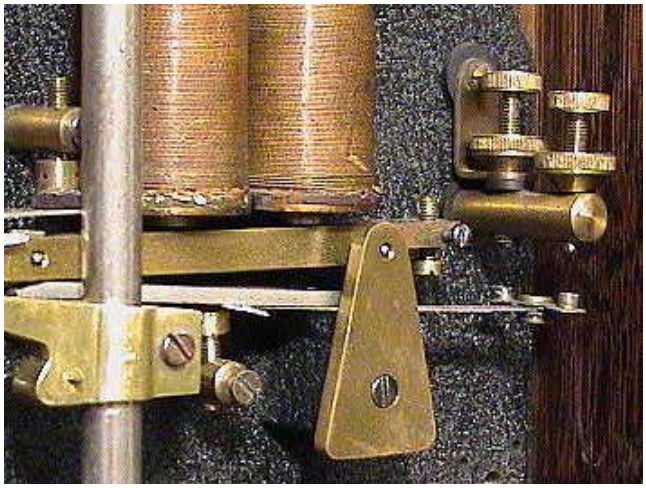


Figure 10 - Double contact and brass 'L' link

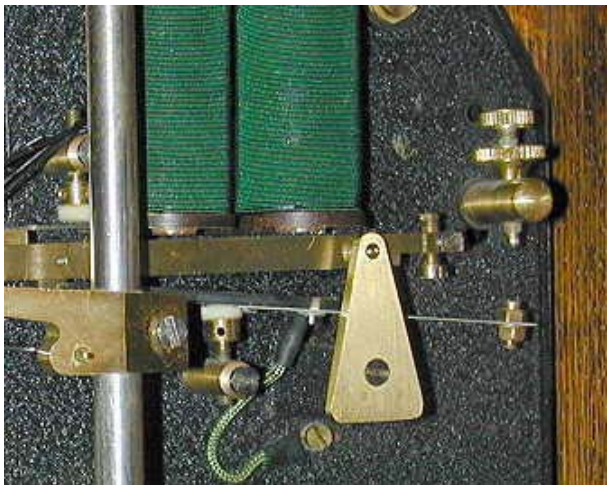


Figure 11 - Single contact

1.3.3 Minor changes

There were also a number of more minor changes, none of which have yet been definitely dated or related to changes in serial number series. These are:

1.3.3.1 Impulse pallet form.

Up to around the end of the 10,000 series, the impulse pallet was parallel sided with a curved form around the pendulum rod (Figure 12). Later pallets were of a diamond plan form with the widest part of the pallet around the rod (Figure 13). There does seem to be a slight difference in the profile of the impulse slope between examples, with some being steeper than others (Figure 14), but this has not been researched in detail as it would involve at least a closely matching photograph, if not personal examination, of every recorded clock.

Figure 12 - Impulse pallet up to end of 10,000 series

Figure 13 - Impulse pallet 20,000 & 30,000 series

Figure 14 - Impulse pallet 10092 - example of a steeper slope

1.3.3.2 Connection to double-contact pillar.

Where clocks have the double-contact arrangement, both contacts are mounted on a single pillar and are insulated from each other and from the baseplate. The rear contact is connected through the baseplate via an insulated bush and a brass 'L shaped link (See Figure 10). Towards the end of the 10,000 series, the brass 'L' link gives way to a wire link.

1.3.3.3 Pilot dial movements.

Early pilot dial movements have a solid composition index wheel (Figure 15). This style has only been recorded in two clocks, 1006/S & 1021/S, both dating to pre-1950. These early movements also have "SEC" printed on the bridge plate as the movement maker, and the type number is stamped into the square brass plate. Later movements from around the start of the 1950s have a crossed out brass wheel and are printed with ECS and the type number on the bridge plate (Figure 16). All slave movements were made and supplied by Smiths English Clocks Ltd.

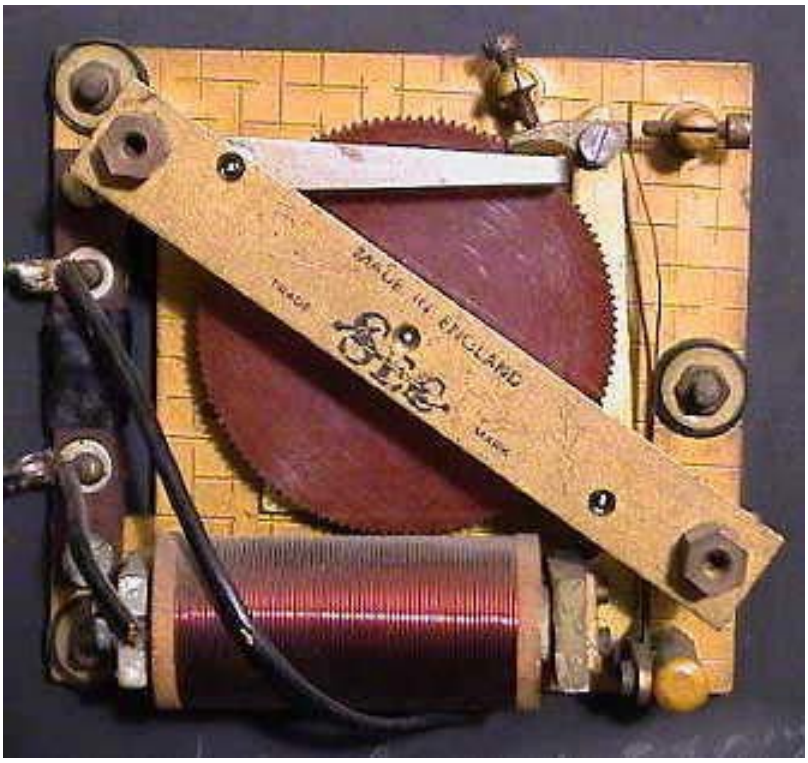


Figure 15 - Early slave - solid composition wheel (Type 205/19)

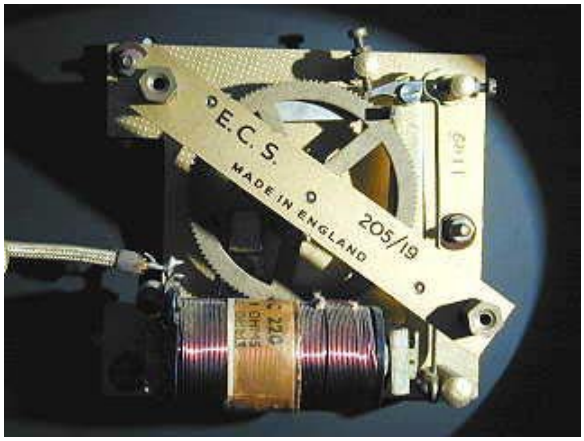


Figure 16 - Later slave - Brass crossed out wheel (also type 205/19)

Most clocks in the survey sample contain a pilot dial with a movement of type number 205/19. There is a period from January 1954 to September 1958 when dials were supplied with a type number 205/12 movement. ECS specifications for type 205/12 have been found, but not for the more common 205/19. From survey responses, both types appear similar and were suitable for a dial up to 12 inches diameter. Specifications of slave movements are given in the Appendix.

1.3.4 Engineering & Design - An Appraisal

Generally, the design followed many of the principles that had been established by existing designers in the master clock field, but there are some areas where the design appears to deviate from best practice.

1.3.4.1 Pendulum impulse action.

The installation instructions that accompanied the clock specified that with the gravity arm on its catch and the pendulum at rest the shoulder of the impulse pallet 'E' should be directly in line below the pivot of the impulse roller 'D' (see Figure 17). This means that impulse can only begin once the pendulum has swung to the right past its zero position whereas accepted practice is to divide impulse equally about the zero position.

1.3.4.2 Gathering jewel position.

The installation instructions specify that with the pendulum at rest the jewel 'S' be midway between two teeth as shown in the drawing (Figure 17). The jewel is not working directly over the top of the count wheel, and must slide up a significant

length of the back of the tooth it is about to gather. This must introduce unnecessary friction and reduce the freedom of the pendulum.

1.3.4.3 Contact arrangements.

As has been explained earlier, the double-contact arrangement could be unreliable.

1.3.4.4 Armature design & termination of impulse.

The armature 'J' (See Figure 17) is pivoted at its left-hand end in the gravity arm and is supported by the felt-buffered stop 'Q'. As the gravity arm (which is pivoted at 'K') falls, the armature rocks about stop 'Q' and the moving contact 'M' rises to meet the fixed contact(s). The right-hand half of the armature, which carries the moving contact, is made of spring steel and flexes under the weight of the gravity arm after the contacts have met. The gravity arm roller does not run off the end of the impulse curve, but impulse to the pendulum is gradually terminated as the gravity arm's downward motion is slowed by the springy element in the armature contact arm and by the growing electromagnetic resetting force. Impulse therefore continues at a reduced level after the contacts have made. However, the rate at which the electromagnetic resetting force builds is dependent on battery condition and these factors, it is believed, make the end of impulse variable, and the total impulse energy imparted to the pendulum dependent partly on battery condition. The effect is only very small, and only likely to be a problem under certain circumstances, e.g. where the clock is run from dry batteries that will age. Martin Ridout, to whom I am indebted for almost all of the information on ECS has written a paper on this from which the preceding sections, and history are drawn.

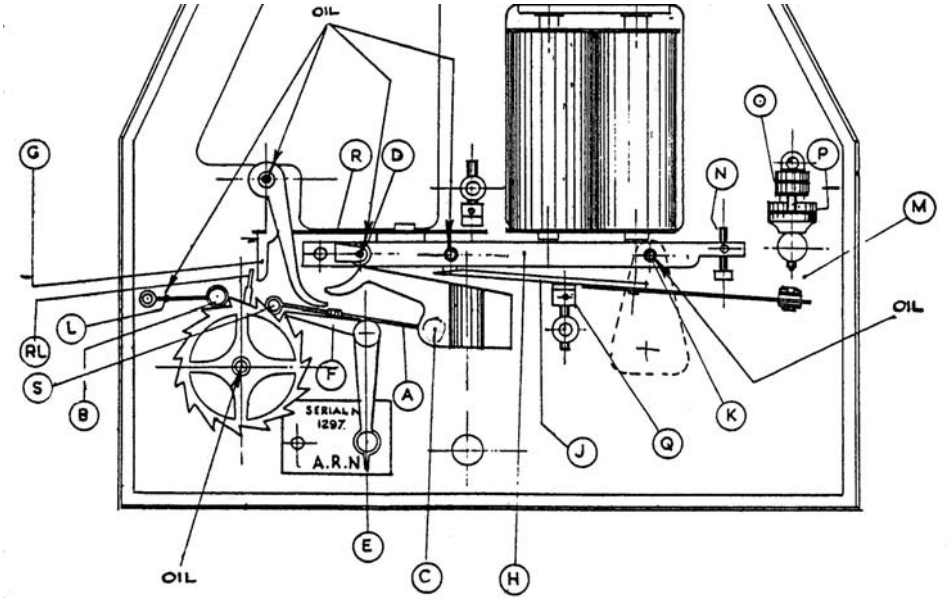


Figure 17 - General layout of master movement showing positions of roller 'D', pallet 'E' and jewel 'S' with the pendulum at rest

1.3.5 Special Examples

Two variations from the normal pattern of clock have emerged from the survey.

1.3.5.1 Mercury Switch.

There are three clocks recorded, all in South Africa, whose contacts have been replaced by a mercury filled glass tilt switch mounted on the right-hand end of the gravity arm.

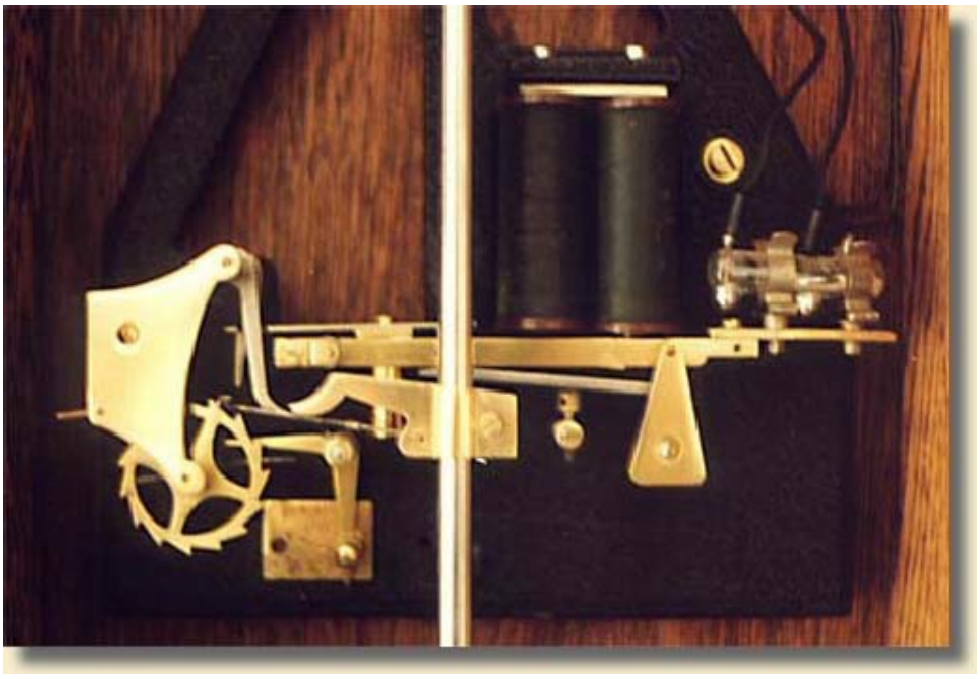


Figure 18 - Mercury switch modification

These modifications were carried out by the ECS agent in South Africa, United Clocks Sales (PTY) Ltd., from around 1960. Several master clocks in South Africa were modified, although only three have been recorded in the survey.

1.3.5.2 Master clock with seconds dial.

Two clocks have been recorded in the UK with a suffix to the serial number of '/S'. These are both early flat-top case clocks, with serial numbers 1006/S and 1021/S, probably dating to the second half of the 1940s. The suffix 'S' denotes a clock with a seconds pilot dial (Figure 19). Seconds pulses are derived by means of an additional short arm fixed to the pendulum rod projecting to the right and level with the bottom of the frame casting. This carries an almost circular horse-shoe magnet below which is a soft iron armature attached to a contact set which is mounted on the frame casting with a screw and two steady pins (Figure 20). The magnet passes over the armature and causes the contacts to close at the centre of the pendulum's swing, so giving true seconds pulses of short duration. There is an auxiliary relay mounted on the backboard of the case below the frame casting.

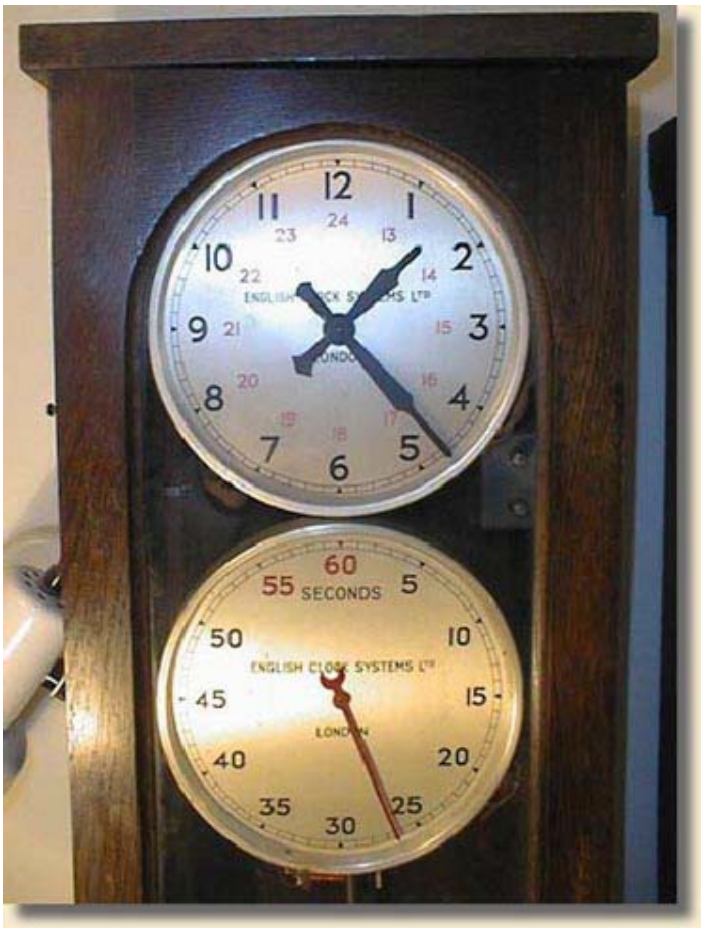


Figure 19 - Clock 1006/S with slave seconds

Figure 20 - Seconds movement

The arbor of the seconds pilot dial carries an insulating drum with a conducting sector (Figure 21 and Figure 22). As the drum rotates with the seconds arbor, a pair of fixed contacts wipe the drum and connect with the conducting sector for a 5 second period each minute. The numerals 55 and 60 on the seconds dial are painted red, with all other numerals in black, so the 5-second sector should logically relate to the last 5 seconds of the minute. However, the drum with the contact sector can be rotated on the seconds arbor and locked in any position.

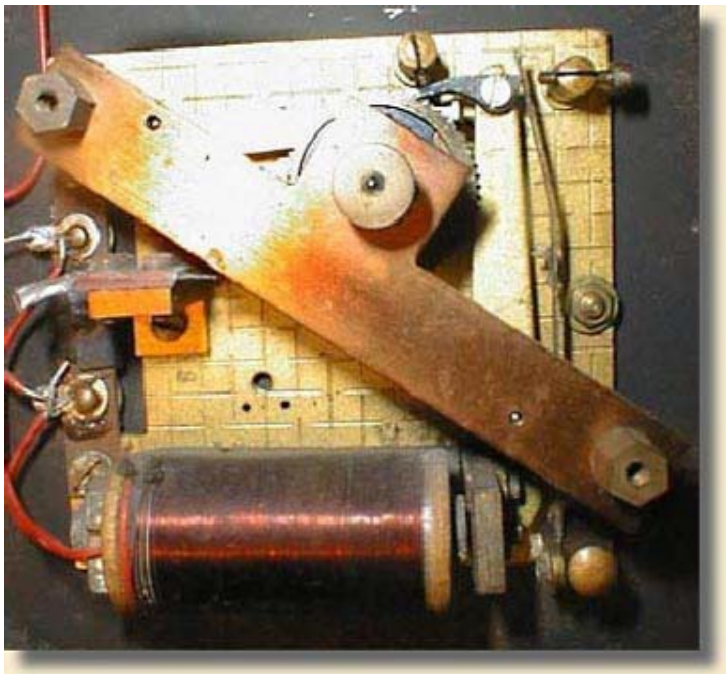


Figure 21 - Seconds pilot movement (type 205/18)

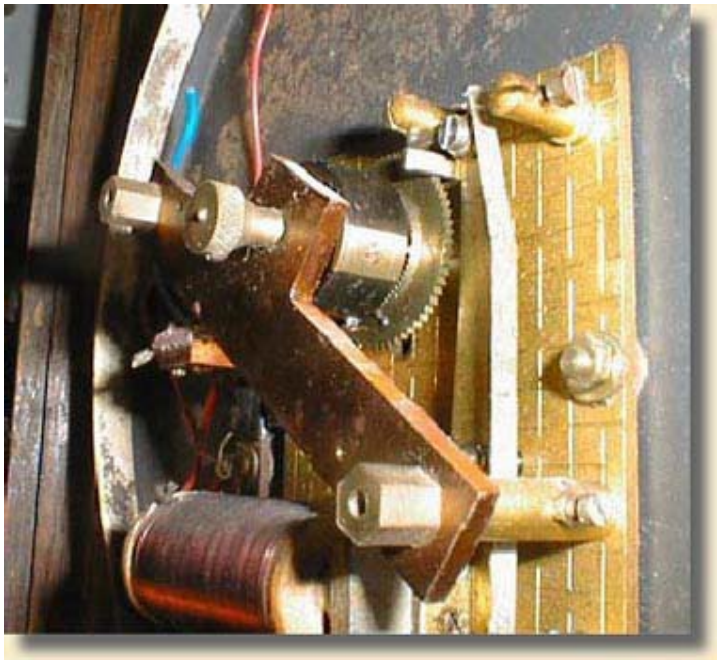


Figure 22 - Seconds pilot movement, showing insulating drum and conducting sector

The wiring in this clock is not original or complete, so the function of the auxiliary relay and 5-second contacts is conjecture. A possible scenario is that the wiping contact allowed the auxiliary relay to operate once per second for 5 seconds per minute. This would give 6 closures per minute. Only one of these two '/S' clocks is complete with the seconds contacts and dial, the other having been altered back to a standard form. Empty screw holes in the A-frame casting and in the case attest to its original form being similar to the complete example.

1.3.6 Serial Number Anomalies

There are three clocks which do not fit the pattern of the rest of the survey sample:

1.3.6.1 Serial number 1238

This is an early double contact movement, but is in a post-1955 style round-top case with its original Roman style pilot dial which carries a pencilled installation date of June 1950. Perhaps a style-conscious owner changed the case. Serial number 30408 is a single contact movement with an Arabic pilot dial marked with a date code for November 1963, but mounted in an early flat-top case. The date code on the pilot dial and the movement's serial number are contemporary. This is an isolated

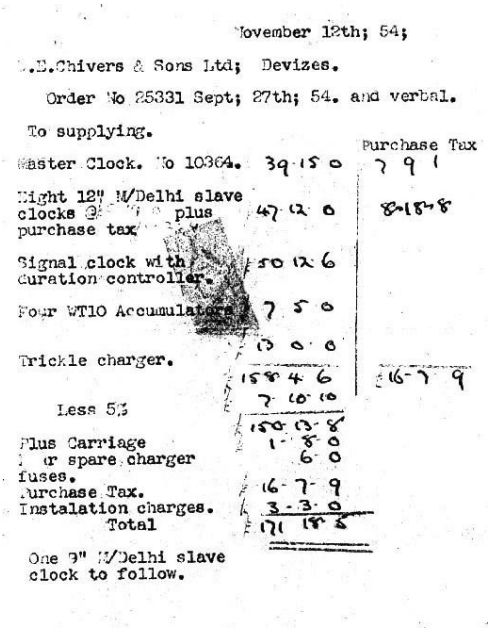
example of a flat-top case containing a later movement, and could be due to a replacement movement and pilot dial in an existing case.

1.3.6.2 Serial number 30129

This is a single contact movement in a round-top case with an Arabic pilot dial. The slave date code and the clock serial number are contemporary, and put the date of the clock at November 1958. This is the lowest serial number clock recorded with a single contact movement, and there are no more single contact clocks in the survey sample until serial number 30243 dated October 1959, yet there are six other surviving examples of double contact clocks in the interim. After clock 30243 no more double contact clocks have been recorded. Clock 30129 is, therefore, an isolated example of the single contact movement apparently produced a year earlier than the change appears to have been generally made.

1.3.7 Prices, and Reliability

One Bill of Sale for an ECS system has been found from 1954:-



November 12th; 54;

...E.Chivers & Sons Ltd; Devizes.

Order No 25331 Sept; 27th; 54. and verbal.

To supplying.

		Purchase Tax
Master Clock. No 10364.	39-15-0	7 9 1
Eight 12" M/Delhi slave clocks @ plus purchase tax	47 12 0	8-18-8
Signal clock with curation controller.	50 12 6	
Four WT10 Accumula...	7 5 0	
Trickle charger.	0 0 0	
	158 4 6	16-7-9
Less 5%	7 10 10	
	150 13 8	
Plus Carriage	1-8-0	
...r spare charger fuses.	6 0	
Purchase Tax.	16-7-9	
Instalation charges.	3-3-0	
Total	171 18 5	

One 9" M/Delhi slave clock to follow.

Figure 23 - Bill of sale 1954

Based on inflation since 1954, the system would be priced around £3000 in 2002. The following master clock price comparison is based on old price lists (excluding Purchase Tax) from the various companies:

- ECS £39-15-0
- Synchronome £36-10-0
- Gents £31-0-0

The ECS price is from the invoice above (1954). The Synchronome price is from a 1951 price list. (The Synchronome price in 1954 would have been very similar.). The Gents price is calculated, based upon a comparison of 1970 price lists, where the Gent price is about 15% cheaper than the Synchronome in that year.

The ECS master clock was one of the last of its type to reach the market and it needed to compete with the well established makes, primarily of Gents and Synchronome, both of whom had already been selling their master clocks for several decades. Gents produced an average of 360 clocks per year over the period from 1945 to 1960, and Synchronome produced around 160 to 200 clocks per year over the same period. English Clock Systems Ltd appear to have produced an average of 83 clocks per year of the double-contact version from 1945 to 1960, which dropped to an average of only 50 clocks per year from 1960 (after the introduction of the improved single-contact version) to 1966 which is the last recorded clock in the survey. In its early life, the ECS was also the most expensive of the three. Although the quality of manufacture of the ECS master clock was mainly sound, there were design flaws. It did not introduce any major new technical innovation, and it proved to be less reliable than its competitors, due largely to the double-contact arrangement. Service record cards that have survived with three clocks in the survey show that, on average, three or four service calls were made each year with some years requiring six calls. There is one example of eleven calls in a calendar year. The introduction of the improved single-contact version seems to have been too little too late to save the future of the clock.

1.3.8 Some individual clocks

The master clock shown in Figure 24 was made by English Clock Systems Ltd around 1949. English Clock Systems Ltd was part of Smiths English Clocks Ltd based in North London. The clock has a glazed wooden case and can drive a large number of half minute slave dials connected in a series loop, the dial in the case being the first of those. Impulse to the pendulum is given by a weighted arm falling onto a curved sloping impulse face attached to the pendulum. A battery or power supply is required to reset the gravity arm on to its latch, and to impulse the slave dials.

Figure 24 - ECS master

Figure 25 - ECS master, open

The pendulum is suspended from the top of a cast iron 'A' frame which also supports the gravity arm and resetting coils. The one second pendulum is made of Invar with a substantial cast iron bob. This is shown in Figure 26.

Figure 26 - ECS master - movement

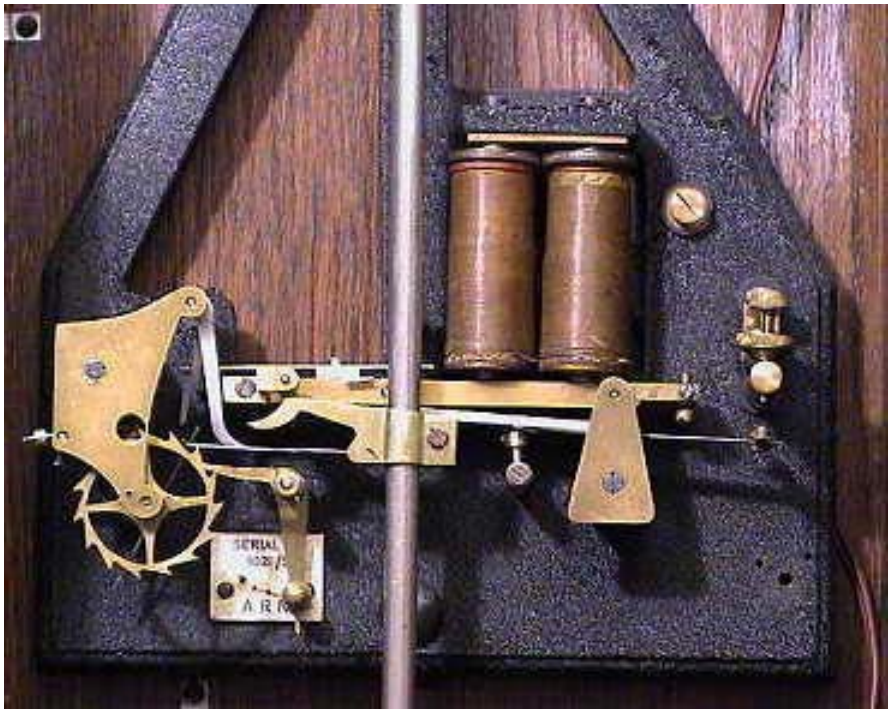


Figure 27 - ECS master, movement detail

The two coils shown in Figure 27 that reset the gravity arm can be seen on the right of the pendulum. As the gravity arm falls, an electrical contact is made that energizes the coils to reset the arm. Also in series with the resetting coils are all the slave dials, so the slaves only receive a pulse to advance them when the gravity arm is reset.

At the top of the case is a terminal block for the internal wiring of the clock, and at the top left is a metal-cased 2uF capacitor to help quench the spark across the contacts. At the top right is a variable resistor which is in series with the resetting coils and slave dials, and is used to set the current drawn by the whole system to 320mA, irrespective of the battery voltage or number of slaves.
The gravity arm is released every 30 seconds. A 15 tooth escape wheel is indexed round by one tooth each time the pendulum swings left to right, i.e. once every two seconds. Behind the escape wheel and fixed onto its arbor is a wire (visible diagonally from 1 o'clock to 7 o'clock), which releases the catch holding the gravity arm once each revolution of the wheel, and triggers the whole resetting and impulse action. The weighted gravity arm is caused to fall; the roller rides down the curved plane attached to the pendulum, and impulse is given to the pendulum; at the bottom of its fall, the electrical contacts (on the right of the coils) are made, the arm is reset, and the slaves are pulsed.

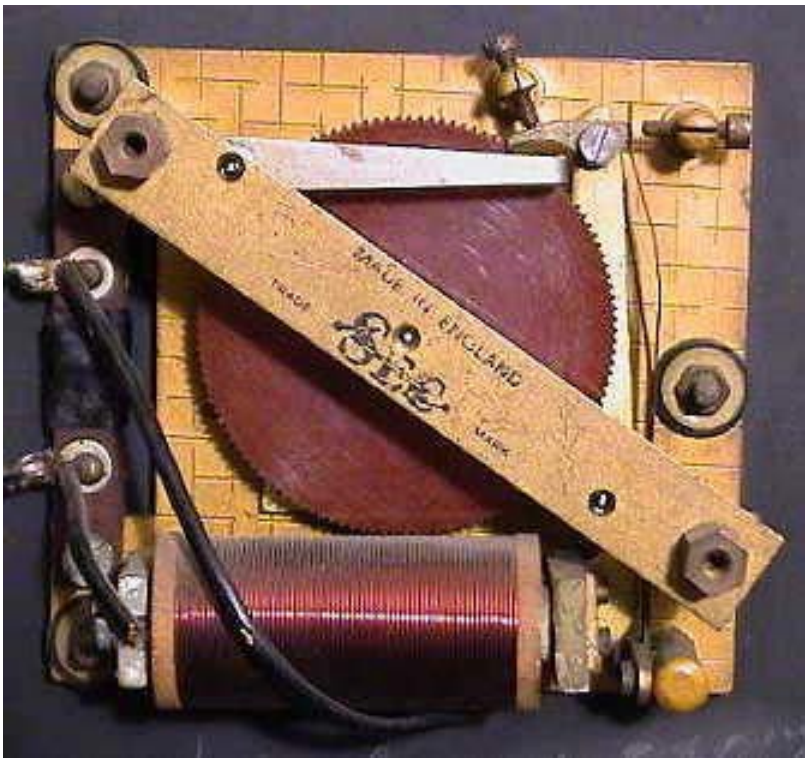


Figure 28 - ECS master, slave movement

The slave movement shown in Figure 28 is within the master clock. The electromagnet attracts its armature (on the right), which is pivoted at the lower end of the diagonal bar, and releases it after about 1/5 second (the duration of gravity arm resetting). As the armature is released, the indexing pawl at the top pushes the large 120 tooth wheel round by one tooth and thereby moves the minute hand by half a minute. The hour hand is driven by conventional motion work. The silver coloured lever across the top stops the minute hand being driven backwards.

Figure 29 - Another ECS master, s/n 10143

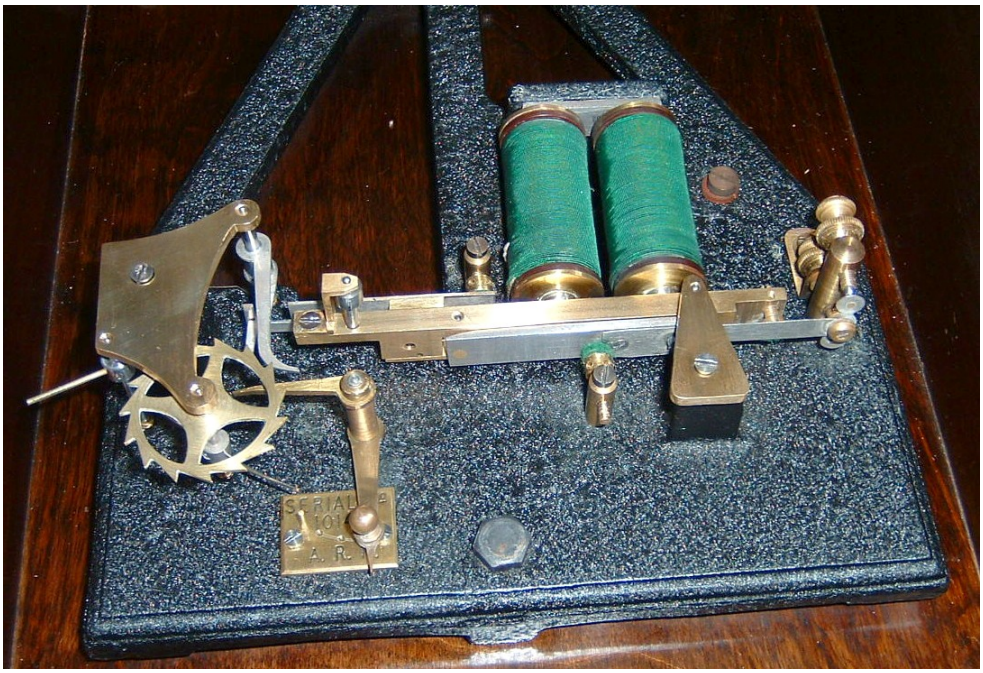


Figure 30 - S/n 10143 movement

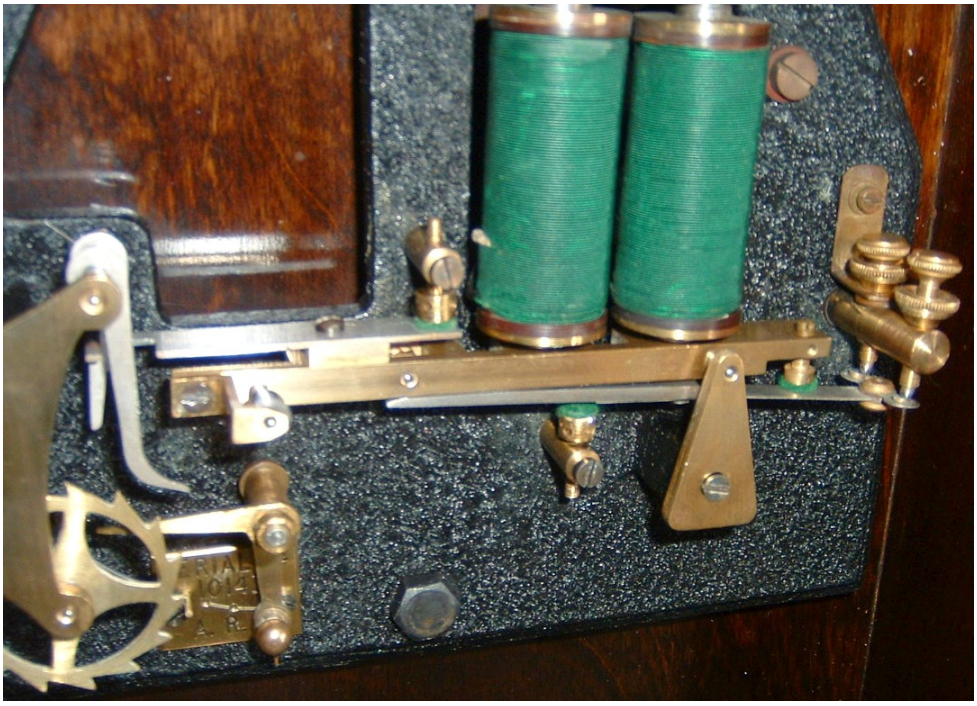


Figure 31 - S/n 10143 movement, contact details

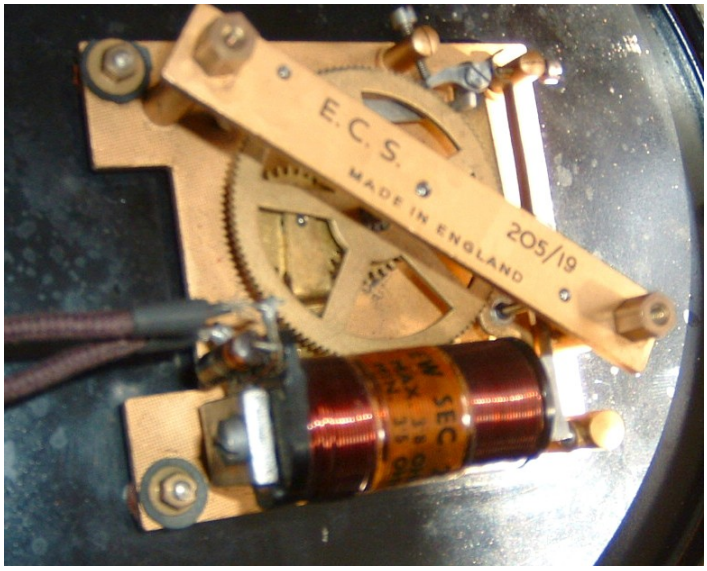


Figure 32 - S/n 10143, slave dial movement

Figure 33 - Round topped cased ECS

Figure 34 - Round topped cased ECS open

1.4 ECS Slaves

ECS slaves are comparatively scarce. The slave shown in Figure 35 to Figure 37 is quite modern (1960s?) and has ECS's own movement. It is badged STC, who I believe used to lease out systems.

Figure 35 - ECS slave badged STC

Figure 36 - ECS slave rear view

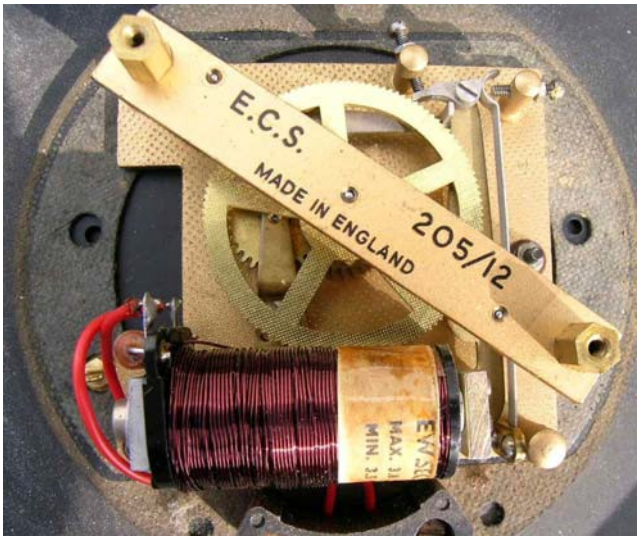


Figure 37 - ECS slave movement

Figure 38 – Modern ECS slave

Figure 39 – Modern ECS slave rear view

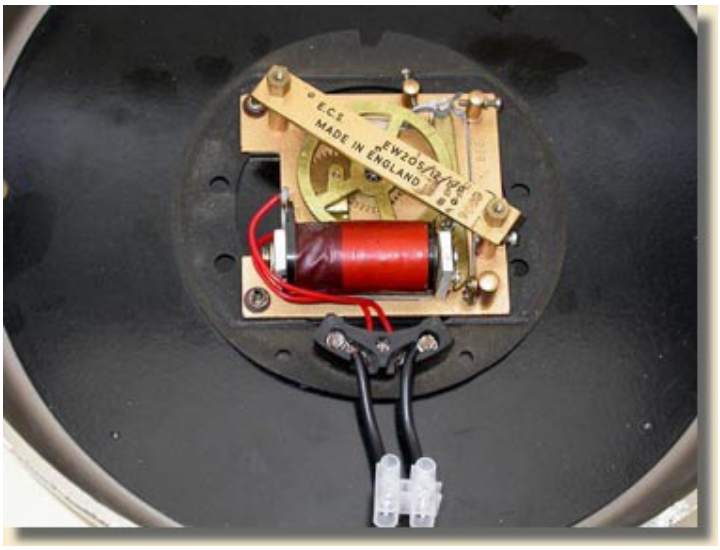


Figure 40 - Modern ECS slave rear view – cover removed

The master clocks with a 1 second pendulum provide a pulse every 30 seconds for the advancing of the slave dials. The pulse is always of the same electrical polarity, and actuates an armature and pecking pawl to advance an index wheel.

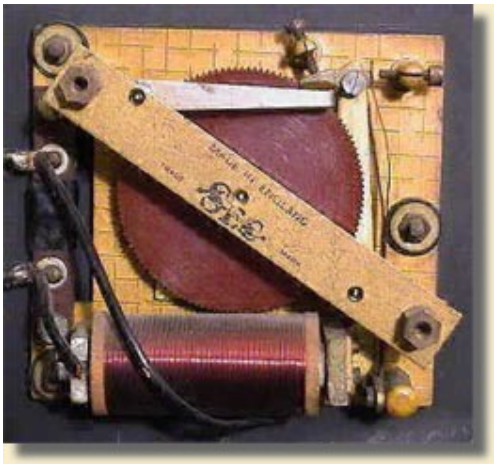


Figure 41 - Early design 205/19 type slave movement from about 1950

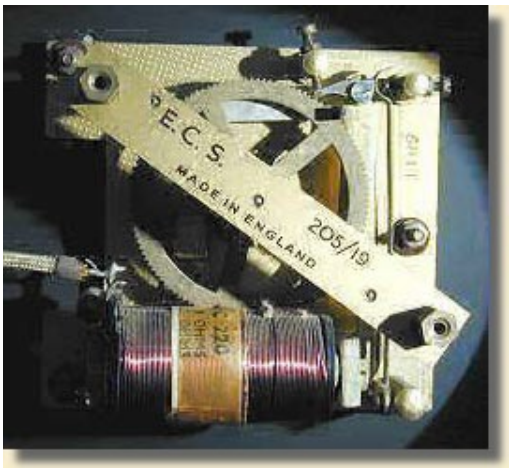


Figure 42 - Later design type 205/19 slave movement

The movements for ECS slave dials were made by Smiths English Clocks Ltd and were generally marked with the initials 'ECS' and the type number written on the bridge plate of the movement. Very early slave dial movements, such as the one illustrated on the left, were marked with the initials SEC (for Smiths English Clocks) and were designed with a paxolin index wheel. The later movements were made with a brass index wheel as shown in the right-hand example. For more details of the standard slave movements, see Design Progression further down this page.
Many styles of case and dial were produced over the years, and examples are to be found illustrated on the 'Catalogues' page. Most dials for interior use are around 9 or 10 inches in diameter and use the light duty movement, type 205/12 or type 205/19. These light duty movements have an index wheel 47mm in diameter.

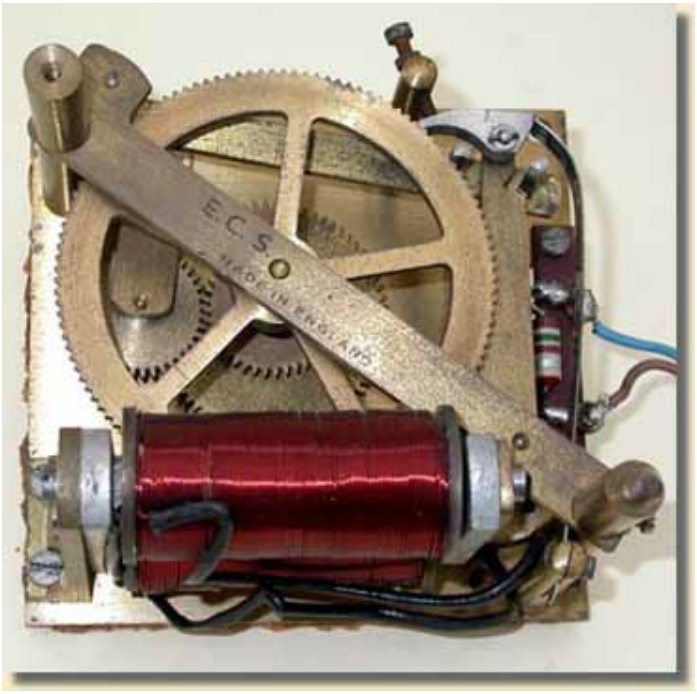


Figure 43 - Slave movement type EW/245 for larger dials up to 36 inches diameter

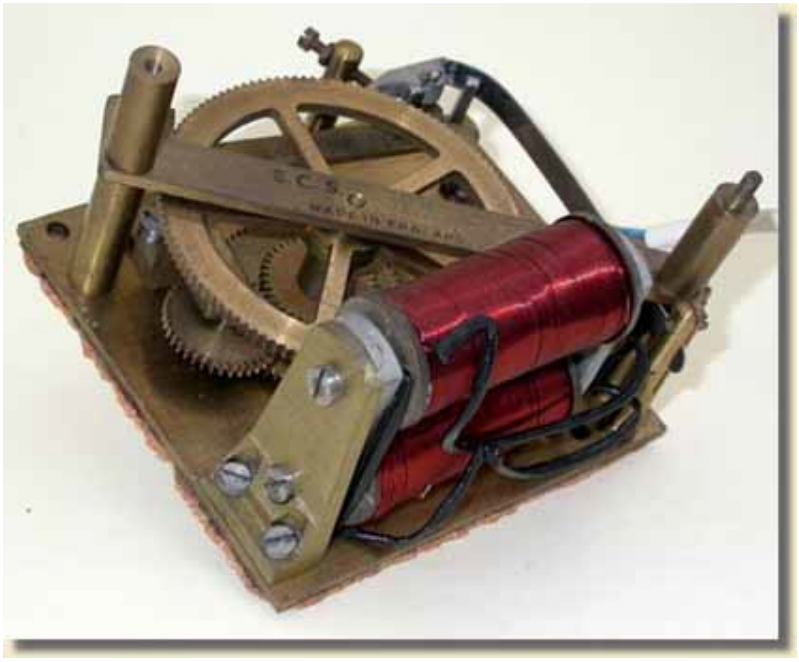


Figure 44 – Slave movement type EW/245 for larger dials up to 36 inches diameter

Larger dials for publicly visible clock dials were made, and used the heavier movement, type EW/245 which has twin coils (in series) acting on a single armature. The index wheel is 76mm in diameter.

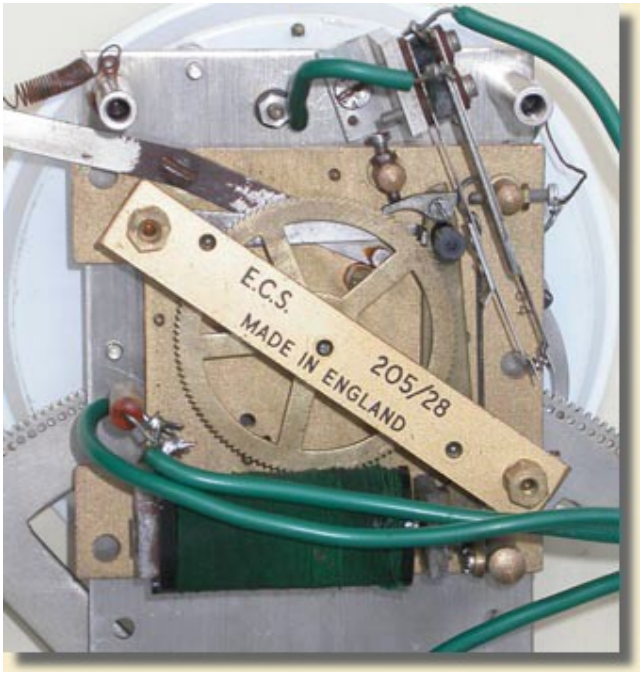


Figure 45 - Slave movement type 205/28 for medium sized dials

Only one example has been found of the movement Type 205/28 quoted in the ECS specifications below, (specified as suitable for mid-sized dials) and this was in the smaller programmer described in the Ancillaries section. Although in this case it was not driving a medium sized dial, the various contact sets presented a considerable load to the slave action. The index wheel diameter is 47mm, the same as the light duty movements.
Dials were also made for the British GPO, to their own specifications, and had the GPO logo on the dial and the name of ECS on the rear cover and on the movement.

The design of the impulse movement in the half-minute dials can help to date a clock or dial.
From approximately 1952 onwards, the dials were given a date code which was stamped into the square brass plate on which the movement is built. Initially this code was in the form of two digits for the year, followed by one or two digits for the month, e.g. 547 gives July 1954 and 5512 gives December 1955. Around 1961 or 1962 this code changed to become one or

two digits for the month followed by one digit for the year within the 1960 decade. e.g. 113 is November 1963 and 54 is May 1964.
Changes in the design of the 205/12 and 205/19 movements are shown by the following series of pictures.

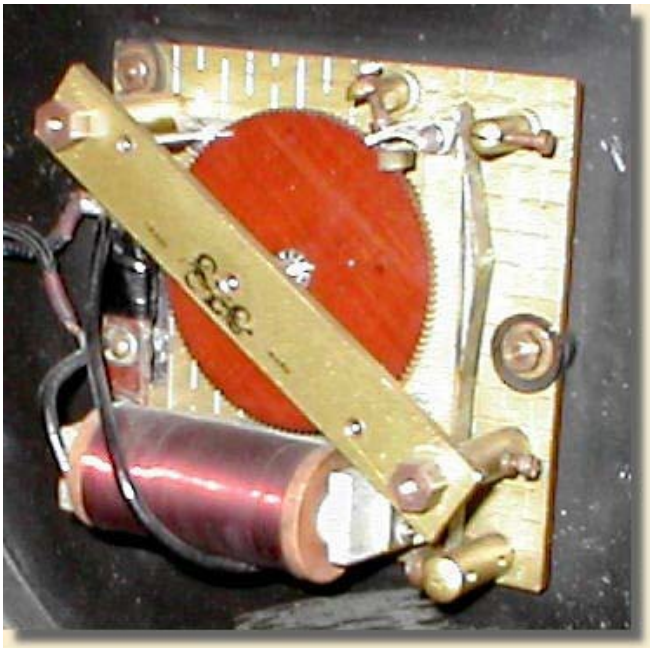


Figure 46 – Probably late 1930s or mid 1940s

ACTUATING SPRING: Twin springs, straight ended. One spring acts on the armature, and the other on the tail of the index pawl. BRASS PLATE: Squared pattern.
TYPE NUMBER: No information.
WHEEL: Resin bonded paper. Solid.
MAKER'S NAME: Smiths English Clocks.
COIL: Enamelled copper wire, not covered; no part number.
QUENCH RESISTOR: Resistance wire wrapped round paxolin strip.
DATE CODE: None.
From clock No. 162

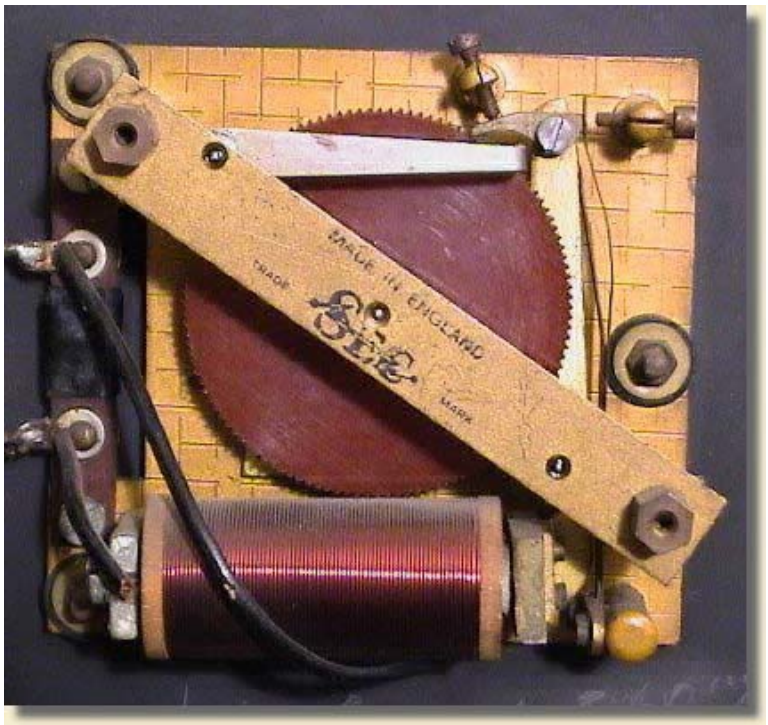


Figure 47 – Pre - August 1950

ACTUATING SPRING: Twin springs, straight ended. One spring acts on the armature, and the other on the tail of the index pawl.
BRASS PLATE: Squared pattern.
TYPE NUMBER: 205/19 stamped into base plate
WHEEL: Resin bonded paper. Solid.
MAKER'S NAME: Smiths English Clocks.
COIL: Enamelled copper wire, not covered; no part number.
QUENCH RESISTOR: Resistance wire wrapped round paxolin strip.
DATE CODE: None.
From clock No. 1021

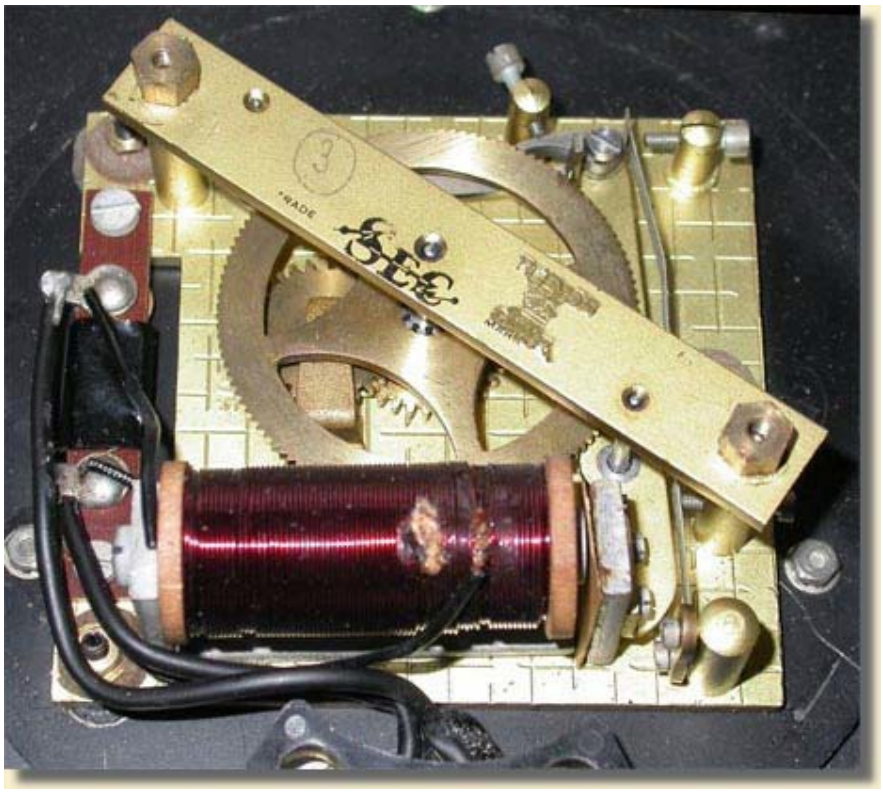


Figure 48 – Pre - 1952

ACTUATING SPRING: Single spring, straight ended, acting on the tail of the index pawl.
BRASS PLATE: Squared pattern.
TYPE NUMBER: 205 stamped into base plate
WHEEL: Brass. Crossed out.
MAKER'S NAME: Smiths English Clocks. Also has name 'RELYON' stamped into bridge bar.
COIL: Enamelled copper wire, not covered; no part number.
QUENCH RESISTOR: Resistance wire wrapped round paxolin strip.
DATE CODE: None.
From slave dial, movement marked GVIR (King George 6th, who died in 1952).

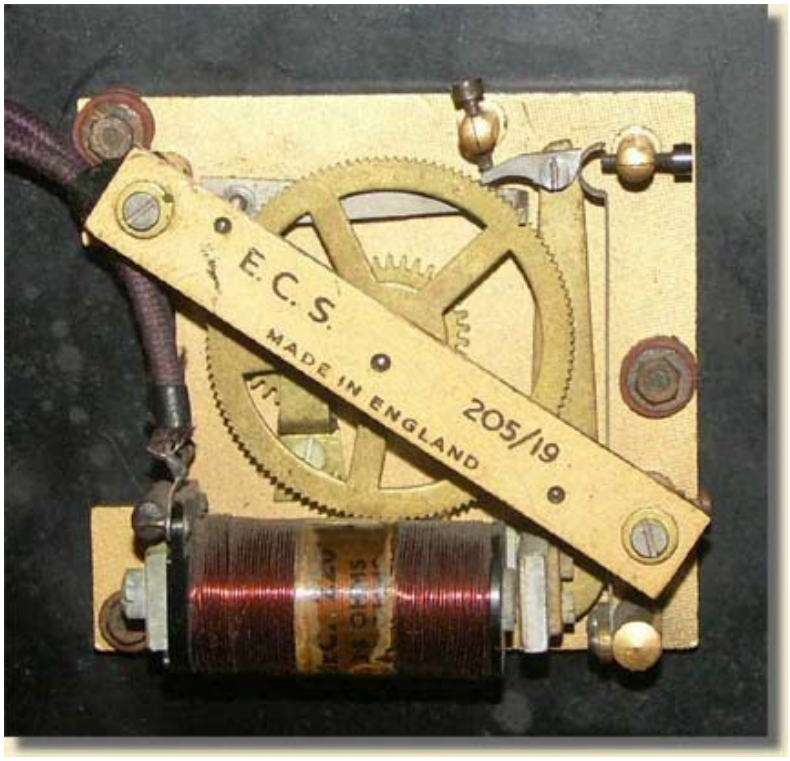


Figure 49 – Early 1950s

ACTUATING SPRING: Single spring, curved end, acting on the tail of the index pawl.
BRASS PLATE: Plain.
TYPE NUMBER: 205/19 printed on bridge bar.
WHEEL: Brass. Crossed out.
MAKER'S NAME: English Clock Systems.
COIL: Enamelled copper wire, not covered; part number label.
QUENCH RESISTOR: Carbon resistor soldered to coil tags.
DATE CODE: None.
From clock No. 1285.

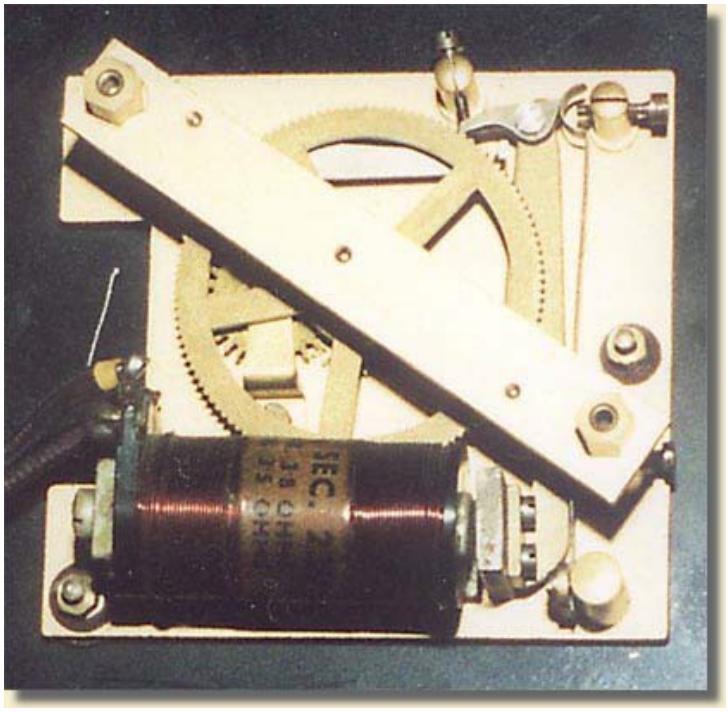


Figure 50 – Early 1950s

ACTUATING SPRING: Single spring, curved end, acting on the tail of the index pawl.
BRASS PLATE: Plain.
TYPE NUMBER: 205/19 printed on coil only.
WHEEL: Brass. Crossed out.
MAKER'S NAME: None on bridge. SEC on coil label only.
COIL: Enamelled copper wire, not covered; part number label.
QUENCH RESISTOR: Carbon resistor soldered to coil tags.
DATE CODE: None.
From clock No. 10092.

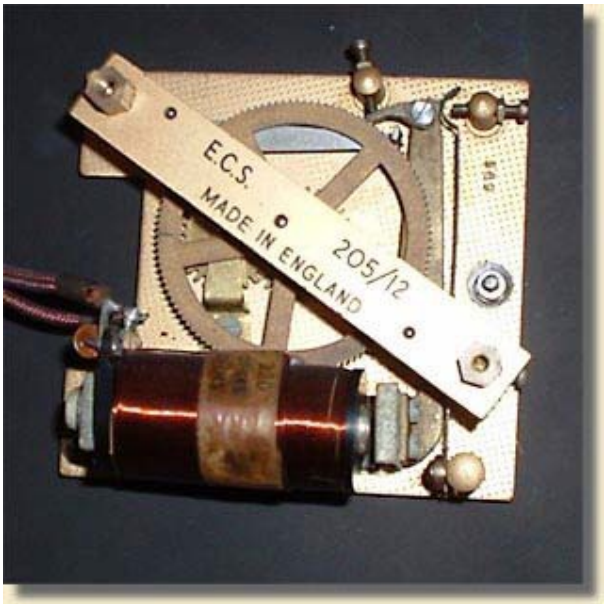


Figure 51 – September 1956

ACTUATING SPRING: Single spring, curved end, acting on the tail of the index pawl.
BRASS PLATE: Dotted pattern.
TYPE NUMBER: 205/12 printed on bridge bar.
WHEEL: Brass. Crossed out.
MAKER'S NAME: English Clock Systems.
COIL: Enamelled copper wire, not covered; part number label.
QUENCH RESISTOR: Carbon resistor soldered to coil tags.
DATE CODE: 569.
From clock No. 20110.

Figure 52 – September 1958

ACTUATING SPRING: Single spring, curved end, acting on the tail of the index pawl.
BRASS PLATE: Dotted pattern.
TYPE NUMBER: 205/12 printed on bridge bar.
WHEEL: Brass. Crossed out.
MAKER'S NAME: English Clock Systems.
COIL: Enamelled copper wire, not covered; part number label.
QUENCH RESISTOR: Carbon resistor soldered to coil tags.
DATE CODE: 589.
From clock No. 30136.

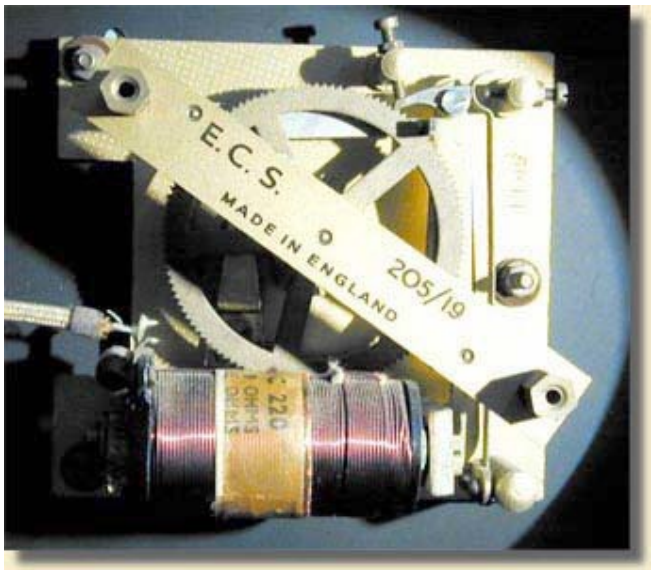


Figure 53 – November 1958

ACTUATING SPRING: Single spring, curved end, acting on the tail of the index pawl.
BRASS PLATE: Dotted pattern.
TYPE NUMBER: 205/19 printed on bridge bar.
WHEEL: Brass. Crossed out.
MAKER'S NAME: English Clock Systems.
COIL: Enamelled copper wire, not covered; part number label.
QUENCH RESISTOR: Carbon resistor soldered to coil tags.
DATE CODE: 5811.
From clock No. 30129.

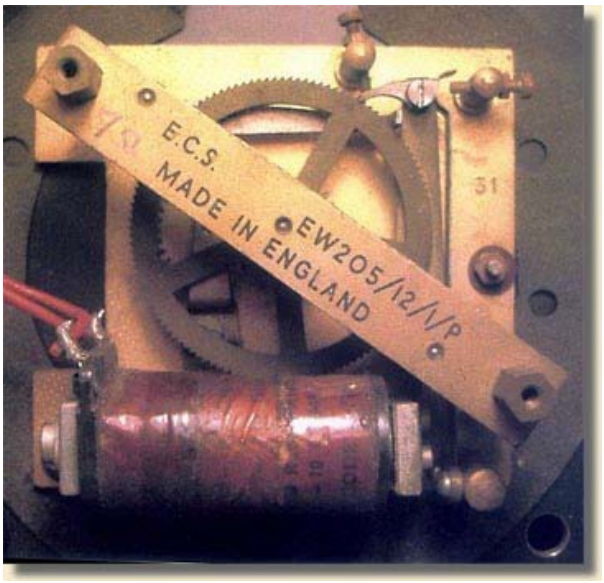


Figure 54 – March 1961

ACTUATING SPRING: Single spring, curved end, acting on the tail of the index pawl.
BRASS PLATE: Plain.
TYPE NUMBER: 205/12/1/P printed on bridge bar (GPO code).
WHEEL: Brass. Crossed out.
MAKER'S NAME: English Clock Systems.
COIL: Enamelled copper wire, covered; part number label.
QUENCH RESISTOR: Separate winding of resistance wire on coil former.
DATE CODE: 31.
From a GPO slave dial.

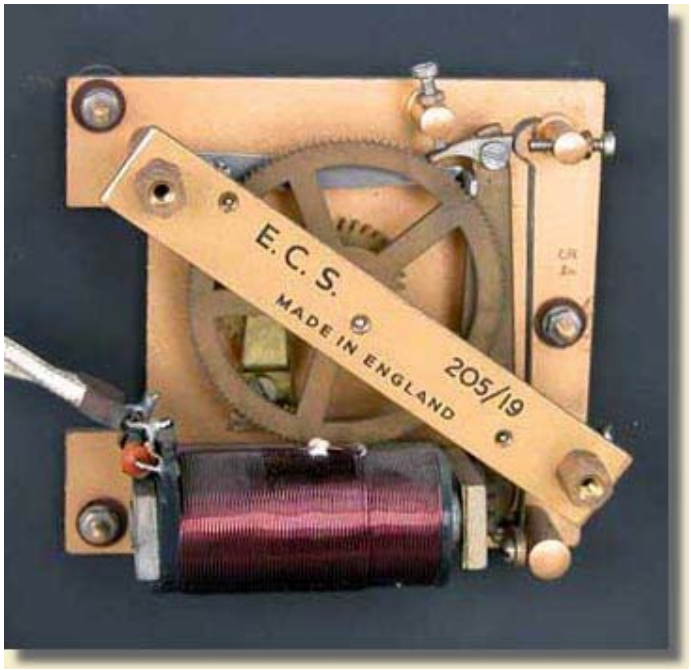


Figure 55 – May 1964

ACTUATING SPRING: Single spring, curved end, acting on the tail of the index pawl.
BRASS PLATE: Plain.
TYPE NUMBER: 205/19 printed on bridge bar.
WHEEL: Brass. Crossed out.
MAKER'S NAME: English Clock Systems.

COIL: Enamelled copper wire, not covered; no part number label.
QUENCH RESISTOR: Carbon resistor soldered to coil tags.
DATE CODE: 54.
From clock No 30437.

1.5 ECS Slug Relay

Where there are many slave dials run from a single master clock, they will usually be divided up into several smaller circuits or rings so that maintenance can be done on a small part of the system at a time. A relay box, controlling several rings switched at the same time, is placed in the main circuit from the master clock and each relay switch then carries the current for its own separate part of the ring circuit.
Some of the larger slave movements, for example those driving tower clock dials, will need a longer pulse than the master clock can supply to ensure that the hands are advanced reliably. This extra length pulse is supplied by a 'slug relay' where the relay stays engaged for longer than the initiating pulse length.

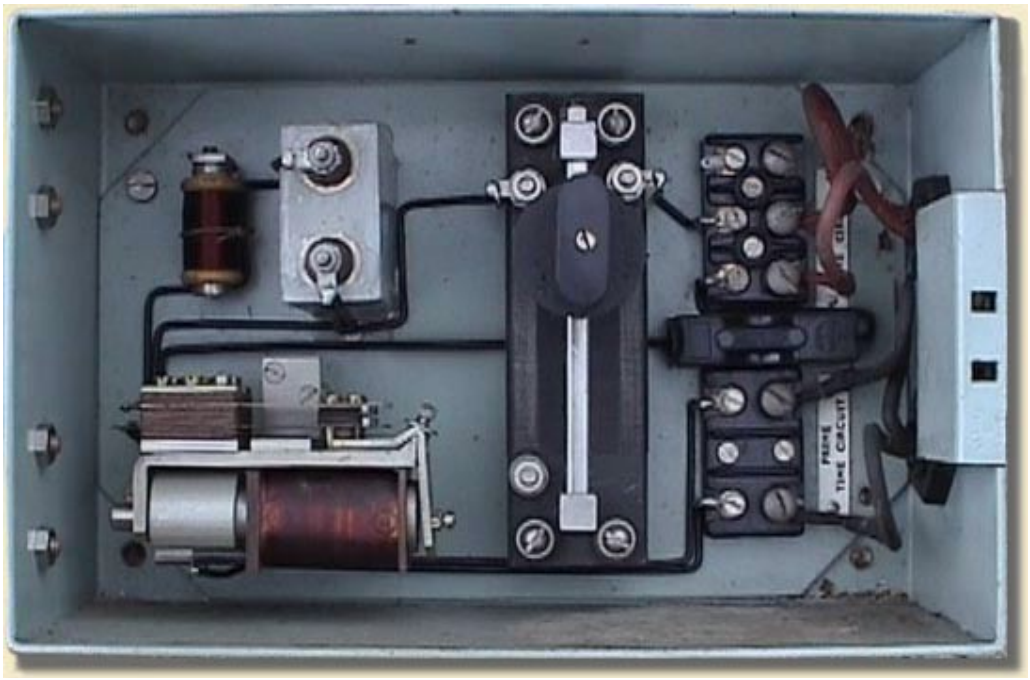


Figure 56 - Slug Relay box

The lower terminals (with black wires) are connected to the master clock circuit in the same way as a normal slave dial, and operate the relay once every 30 seconds. The slugged relay contacts then connect a separate external power supply, through the current control rheostat, to an independent circuit feeding the slaves (the red wires).

1.6 ECS Impulse Converter

The electrically impulsed clocking in clocks supplied by ECS had high resistance coils requiring a pulse of 36 volts once every minute. This is different from the standard slave dials which had low resistance coils, were impulsed every 30 seconds, and were set up by the current flowing in the circuit, not the voltage. Therefore, the clocking in clocks could not be simply added to the slave dial circuit.
There were two ways to generate the required 36 volt, one-minute pulse.

- Firstly, where a master clock system was not already in place, a device called a Synchronator was used.
- Secondly, where a master clock was in place, an **impulse converter** could be connected in the normal slave circuit of a master clock.

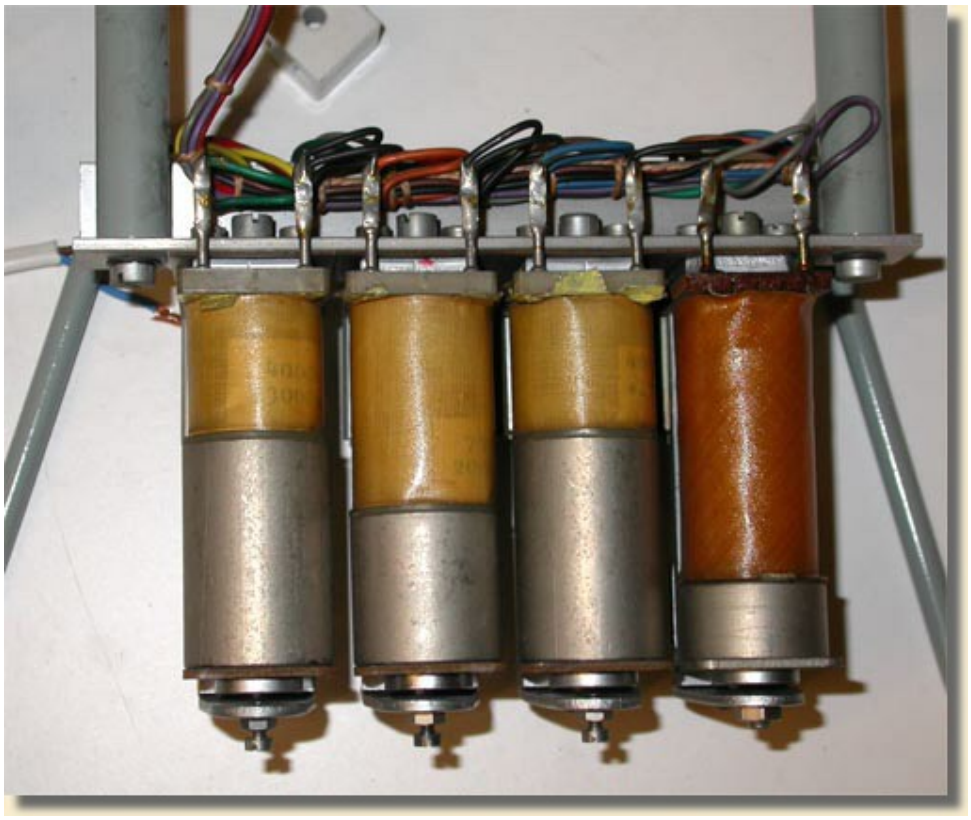


Figure 57 - Telephone Rentals impulse converter

An impulse converter consists of four relays. One has a low resistance coil and is connected in the series half-minute slave circuit running at 320mA.
The other three latch on, and release, each half minute, ultimately switching a separate 36 volt DC supply to give a pulse each minute.
An ECS impulse converter has not yet been found, but a company called Telephone Rentals used a similar device with an almost identical circuit design. The picture above is of a Telephone Rentals unit.

1.7 ECS Synchronator

The electrically impulsed clocking in clocks supplied by ECS had high resistance coils requiring a pulse of 36 volts once every minute. This is different from the standard slave dials which had low resistance coils, were impulsed every 30 seconds, and were set up by the current flowing in the circuit, not the voltage. Therefore, the clocking in clocks could not be simply added to the slave dial circuit.
There were two ways to generate the required 36 volt, one-minute pulse.

- One was by using an impulse converter connected in the normal slave circuit of a master clock.
- The alternative, where a master clock system was not already in place, was to use a device called a **Synchronator**.

Figure 58 – Synchronator

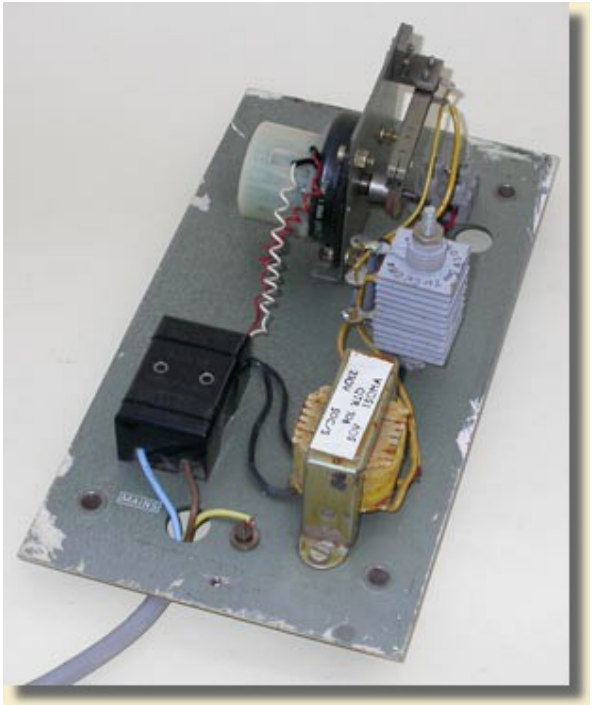


Figure 59 - Synchronator cover removed

A synchronous motor running from the AC mains supply drives a cam which closes a contact set for a few seconds once per minute and connects 36 volts from a mains transformer via a rectifier to the clocking in clock.

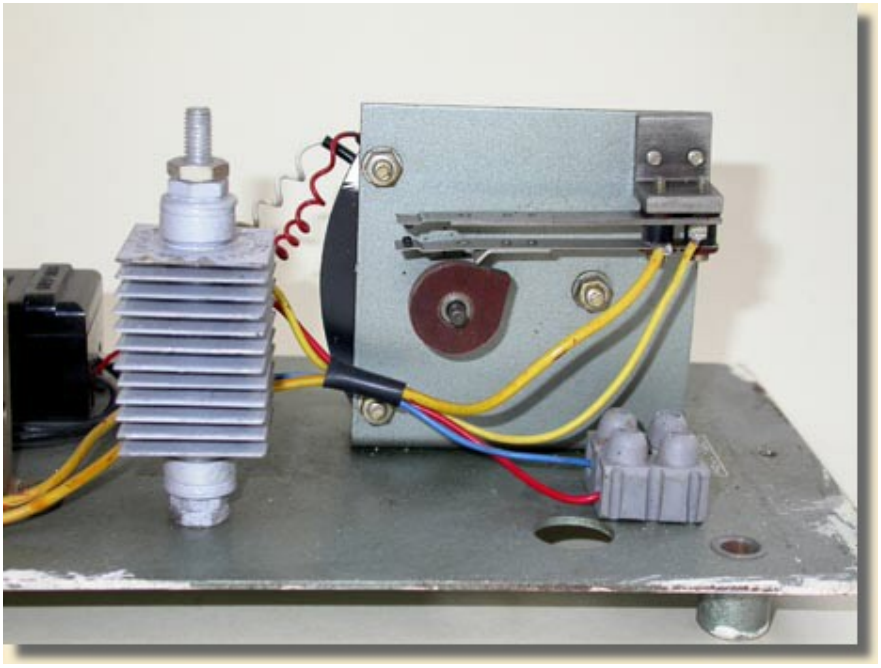


Figure 60 - Synchronator workings – cam and contact set

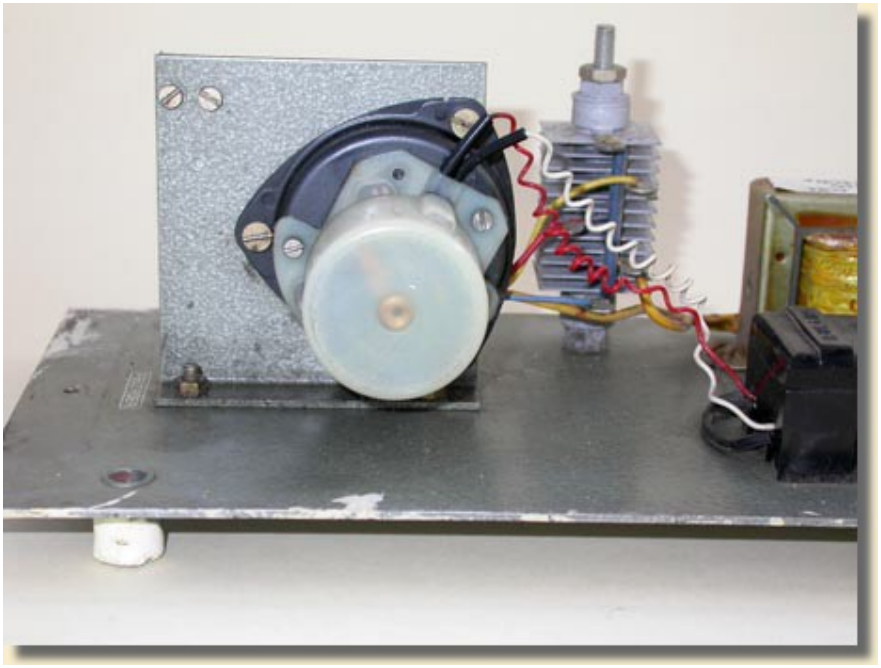


Figure 61 - Synchronator workings - Smiths synchronous motor

1.8 ECS Programmers

These devices were used to control the ringing of bells (for example in a school) or factory sirens to indicate shift changes.

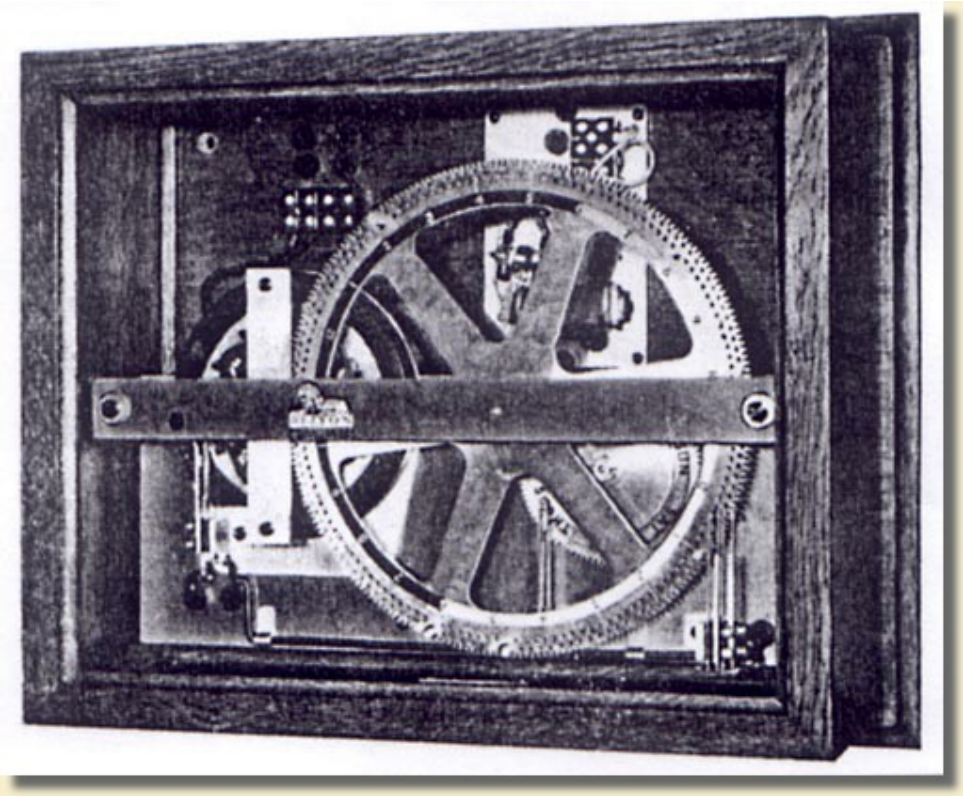


Figure 62 - "The Smith Automatic Bell Controller" - Advertisement, 1940

The earliest record of ECS marketing a bell ringer is in an advertisement in "The British Clock Manufacturer" in March 1940.

An example of this design has not yet been found.

1.8.1 Example 1

Later programmers appear to have been bought in from another maker.
The example illustrated below is badged as English Clock Systems, but is virtually identical to those supplied and badged by the Synchronome Company, the only visible difference being the metal framework supporting this movement is black, instead of grey as on many of the Synchronome examples.

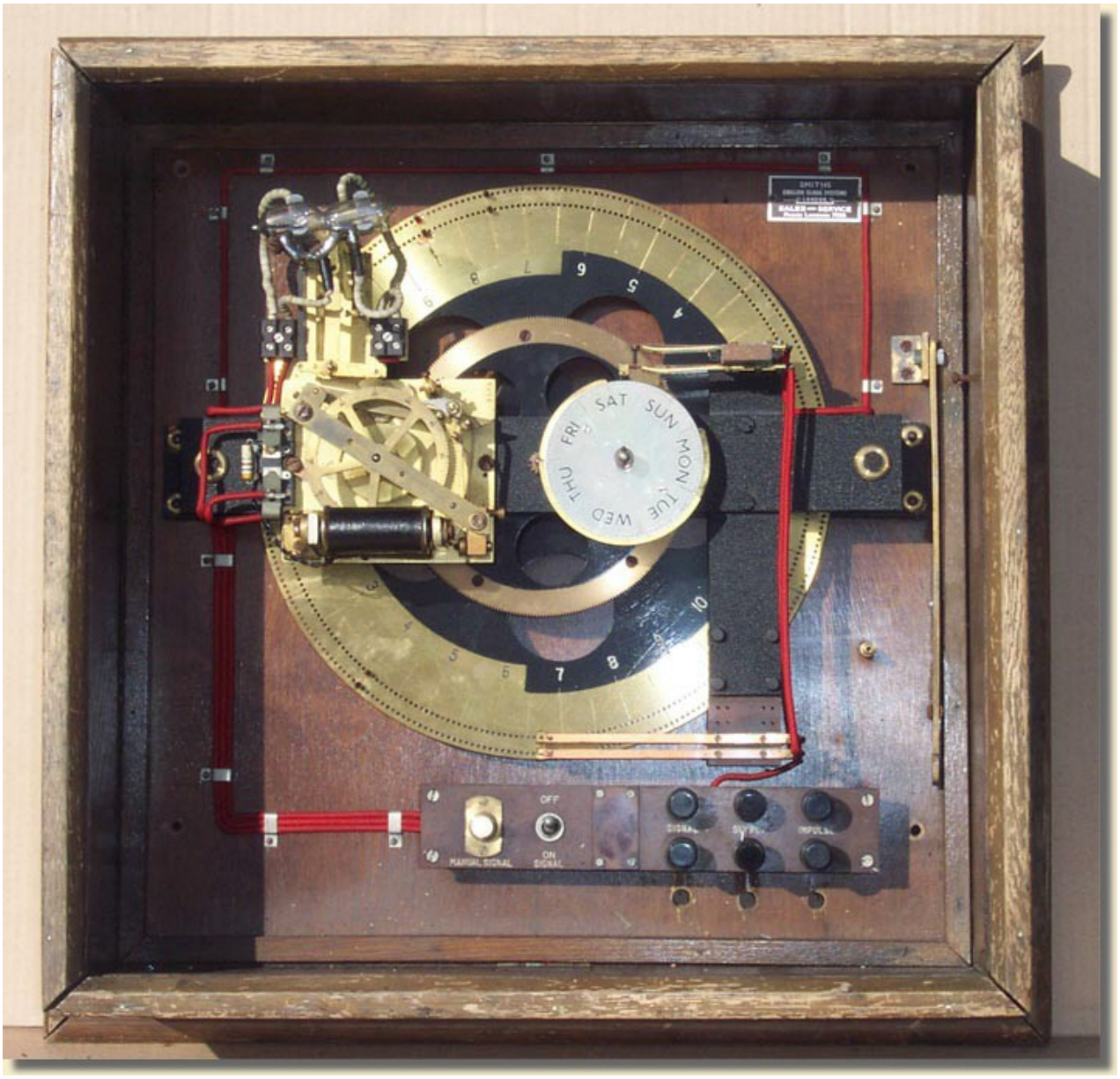


Figure 63 - Smiths programmer

The impulse movement, on the centre left of the picture, is similar to those in a slave dial, but is larger and more powerful, using two coils. It advances one tooth of its hour wheel every 30 seconds. This in turn advances the large wheel once in 24 hours and the day wheel once in 7 days. Holes drilled round the edge of the 24 hour wheel are at 5 minute intervals, and pins are screwed in to indicate the required times. The mercury switch above the impulse movement is triggered every 5 minutes regardless of where the pins are, and if a pin is under the lower bronze contact strips, **and** the day contacts are made, then the mercury switch completes the circuit and an external bell or hooter sounds.
Without the mercury switch arrangement, the bell would sound continuously for 30 seconds until the next impulse moved the 24 hour wheel on one step. This had been found to be too long, so the mercury switch was added as a duration controller, only holding the circuit made for 8 to 10 seconds.

Figure 64 – Impulse movement and duration controller

There are two mercury tilt switches wired in series.
During each 5 minute interval, the front mercury switch, with its curved duration control tube, is rotated clockwise from its rest position as shown, until it is horizontal and in its 'on' position. The rear mercury switch, which is a simple on/off device, is rotated clockwise to its 'off' position. The circuit is never completed during this move.
As the front switch rotates clockwise, the mercury flows rapidly through a large aperture between the two halves of the glass enclosure. The mercury connects the contact pins in the front switch, but the rear switch is 'off' and in series with the front switch, so the whole circuit is still 'off'.
At the exact 5 minute interval, both switches are allowed to fall to their anti-clockwise positions. The rear switch turns 'on' and stays 'on'. In the front switch, the mercury must flow back to the left half of the glass container through the U shaped tube which has a restriction in it. The mercury takes 8 to 10 seconds to flow back before the circuit is broken.
Specifications of programmer:-
Case size - 19" square
Pin-wheel diameter - 12"
Slave movement - Half-minute impulse
Twin coils, combined resistance = 34 ohms
Designed to work in a slave loop at 320mA (requires 10.88 volts across the coils).

1.8.2 Example 2

The programmer illustrated below is also badged as English Clock Systems and has the same Synchronome look to it.

Figure 65 – 4 ring programmer

The impulse movement, hour wheel and day wheel are identical to the example above.

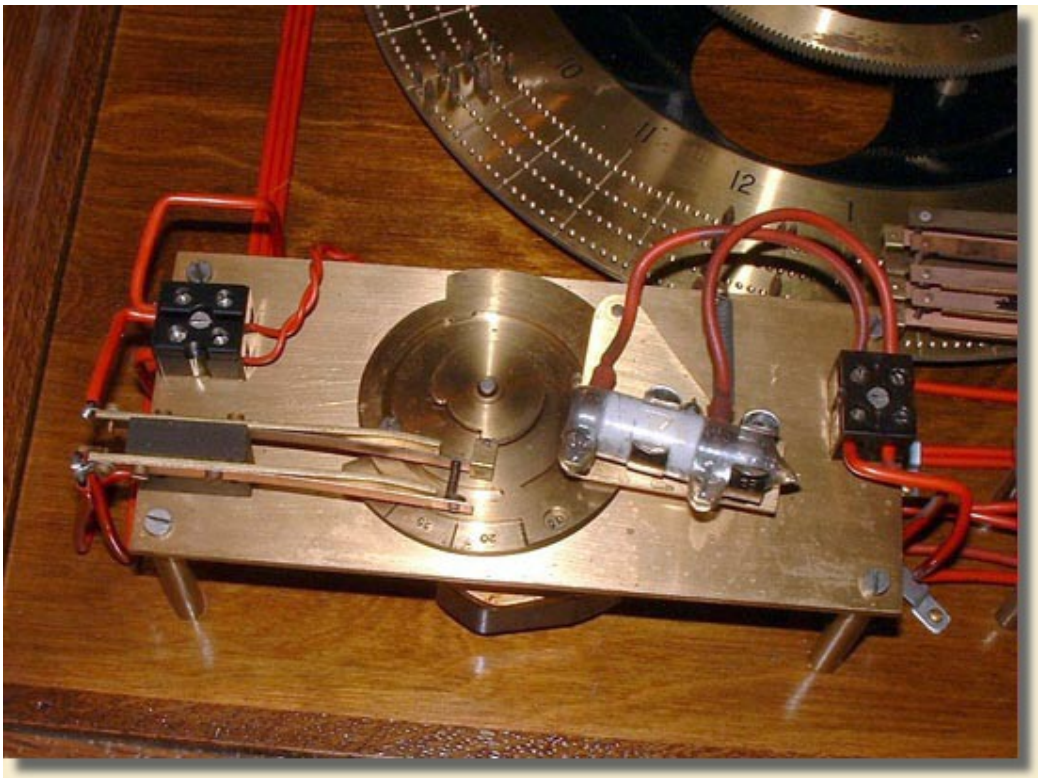


Figure 66 – Duration unit details

The duration controller on this example does not use dual mercury tilt switches as described above.

There is a panel in the lower left of the case that has a synchronous motor geared down to 1 rpm which is started running at the 5 minute trigger time. The motor operates a single mercury tilt switch for a duration adjustable by cams and this mercury switch completes the external bell circuit.

Specifications of programmer:-

Case size - 19" square
Pin-wheel diameter - 12"
Slave movement - Half-minute impulse
Twin coils, combined resistance = 34 ohms
Designed to work in a slave loop at 320mA (requires 10.88 volts across the coils).

The design and construction of the two programmers shown above is virtually identical to those supplied by, and marked as, Synchronome programmers. There is no Synchronome name marked on these examples, simply an ECS badge in the top right corner of the back-board. There are serial numbers on both these impulse movements that appear to be in the same series as the numbers seen on Synchronome programmers. It appears, therefore, that Synchronome, or whoever supplied Synchronome, also supplied ECS with these units.

1.8.3 Example 3 - A Later Design

Figure 67 – Programmer for 30 second impulses

This programmer, or Signal Clock as they were later named, dated August 1964, appears to have been made to an ECS design as it has an ECS slave movement, type 205/28, to drive the dial and programmer wheel.

Figure 68 – Day wheel detail

The programmer wheel still has holes around its circumference to insert pins at 5-minute intervals, and a day wheel to exclude any morning or afternoon of any day of the week.
There are switch contacts on the day wheel, the main programmer wheel and the slave impulse movement. All are wired in series.

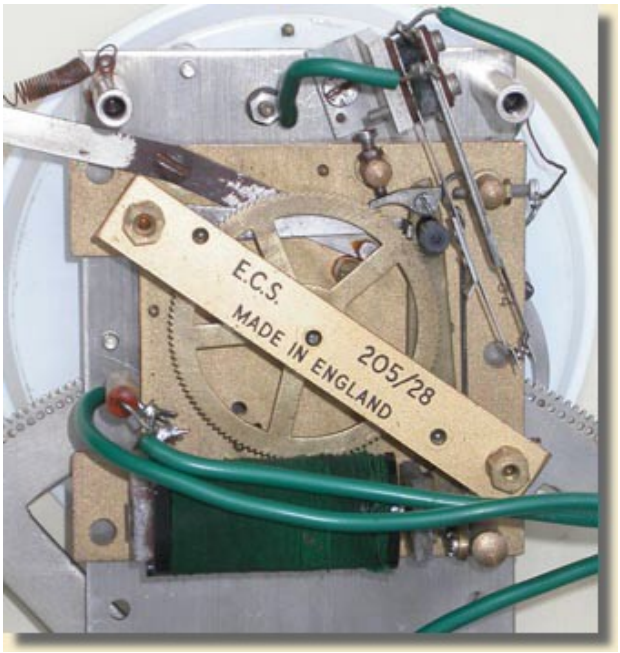


Figure 69 – Impulse movement

The type 205/28 half-minute slave movement in this programmer is the same physical size as the 205/12 and 205/19 standard slave dial movements, but is designed to operate with more power to drive heavier hands on medium sized dials, or in this case, to operate extra mechanical services such as the various switches.
The contact set on this slave is in series with the other contacts in the programmer, and closes by the action of the armature only when impulse is received from the master clock.
The duration of the completed circuit is very short - just the length of the master clock impulse - so either a separate duration controller unit is added to give a duration of around 8-10 seconds, or the slave armature contacts are shorted out, thus giving a duration of 30 seconds (the time between two clock impulses).
The separate duration controller uses two mercury-filled glass tubes in a similar configuration to that shown in Example 1 above.

Specifications of programmer:-

Model - **MBC/2** (shown above)
Case size - 14" x 9"
Pin-wheel diameter - 7.5"
Slave movement - Half-minute impulse - ECS design, Type 205/28
Single coil, resistance = 30 ohms
Designed to work in a slave loop at 320mA (requires 9.6 volts across the coils)
Operates with the 1-second pendulum master clock.

Model **PBC/3** is essentially identical, but with a slave movement suitable for 1 minute impulses from the ECS Memory Master Clock. Again, a duration controller would be supplied.
A third version, Model **SBC/1** has a synchronous motor movement instead of the slave mechanism, and will therefore run independently of a master clock system. This has only two sets of switch contacts; the day wheel and the two pawls working on the 12 toothed wheel. As the mechanism is advancing continuously by means of the motor, the duration of the 'make' contact period is automatically around 10-12 seconds, and a duration controller is not required.

1.9 Additional devices

Peripheral equipment to support the main clock and time distribution system include items such as relays, batteries and battery chargers.
These items are shown from an ECS catalogue.

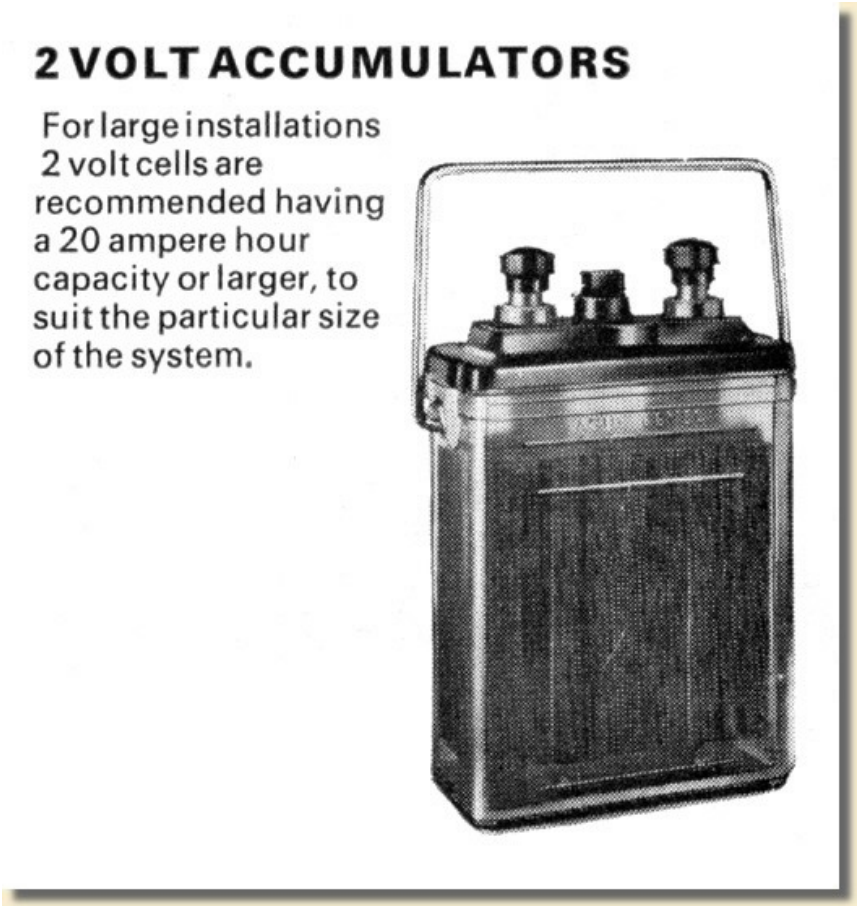
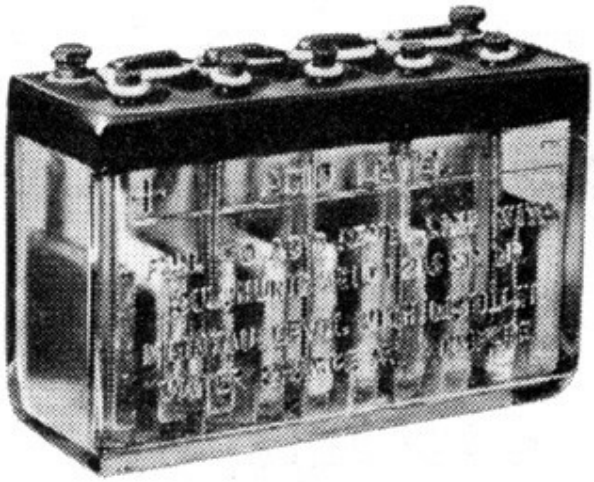


Figure 70 - Single accumulator

ACCUMULATORS CODE WT/10

10 volt unit in a single glass container having a capacity of 10 ampere hours. These cells are recommended for the small Master, slave clock and Time Recorder system.



Height 6″,
Width 8½″,
Depth 3½″.
Weight: 4½ lbs (dry).

Figure 71 - Secondary battery

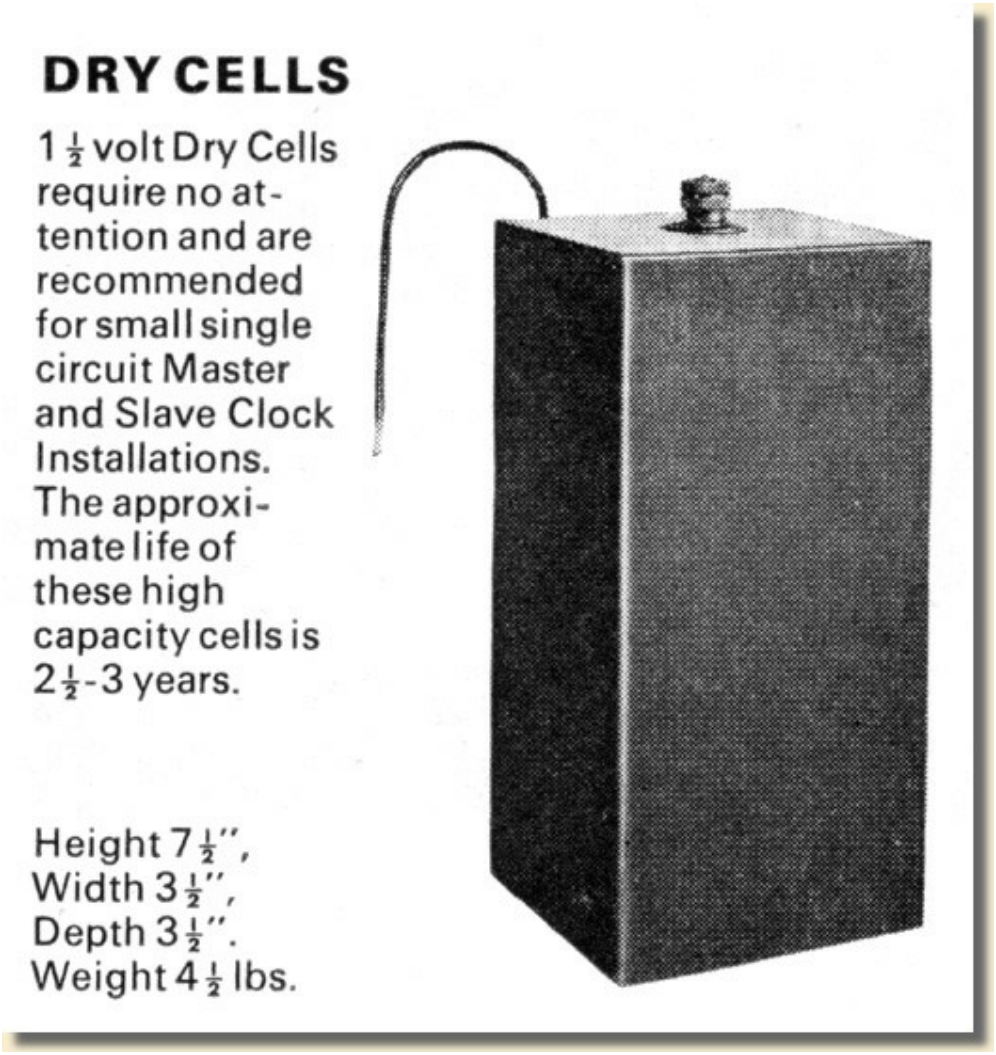


Figure 72 - Dry cell

Figure 73 - Slug relay

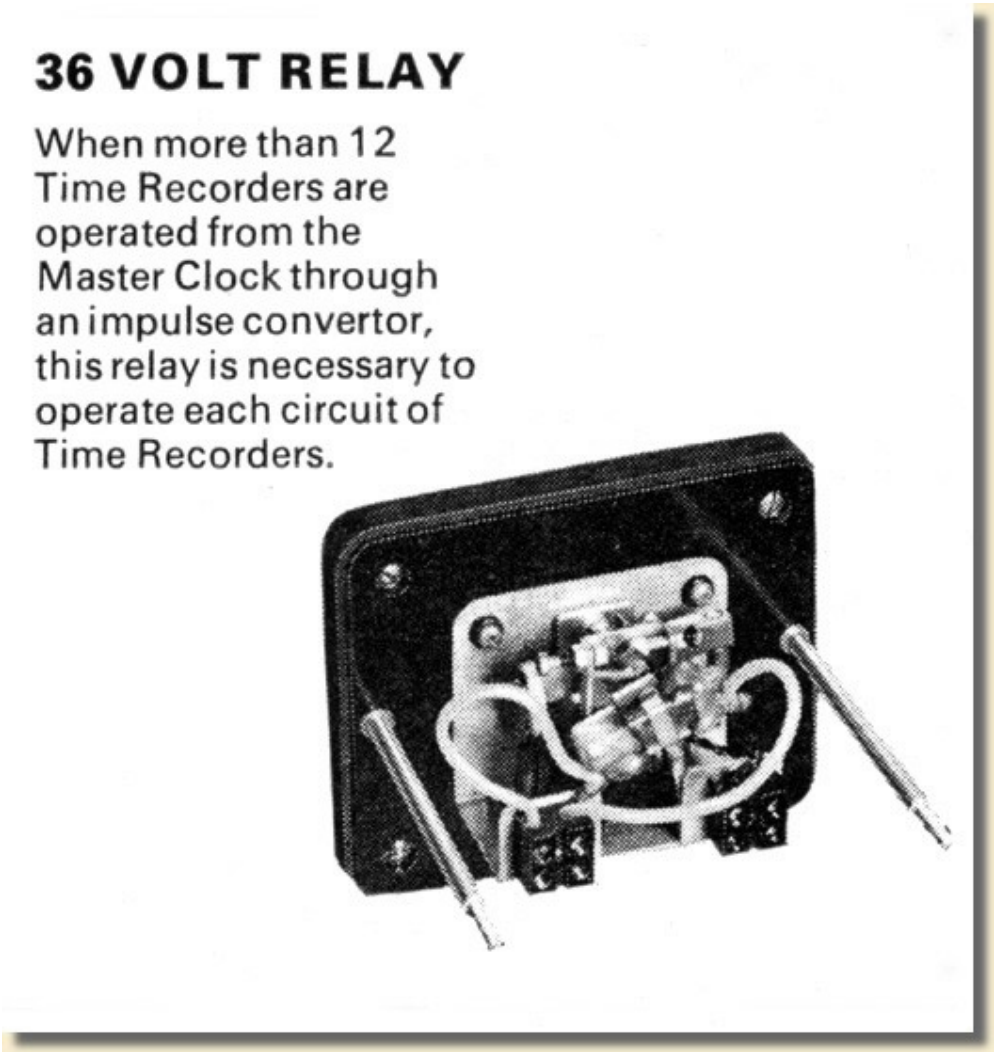
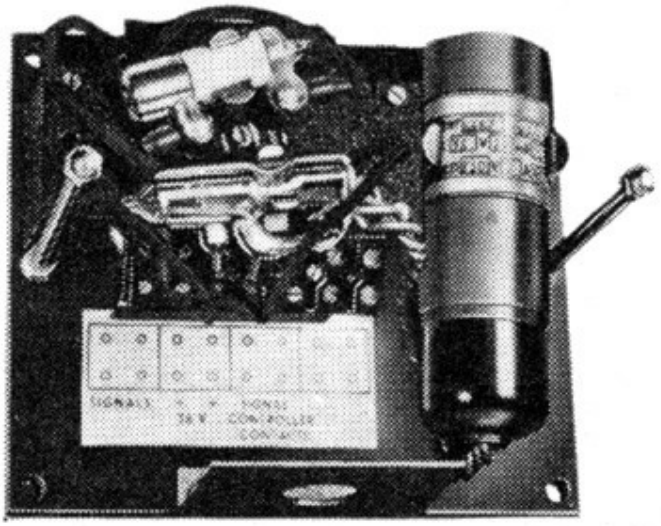


Figure 74 – Relay

DURATION CONTROLLER

The standard duration of signal from the Signal Clock when operated by the Master Clock is 30 seconds. When this signal is considered to be too long, the Duration Controller may be incorporated to reduce the duration of the signal to 8-10 seconds.

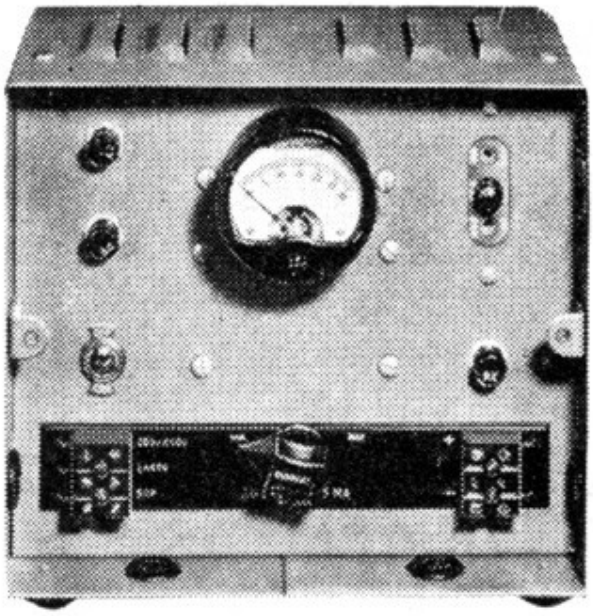


Height $5\frac{1}{4}$"
Width $6\frac{1}{8}$",
Depth $4\frac{1}{2}$",
Weight: 4l bs.

Figure 75 - Duration controller

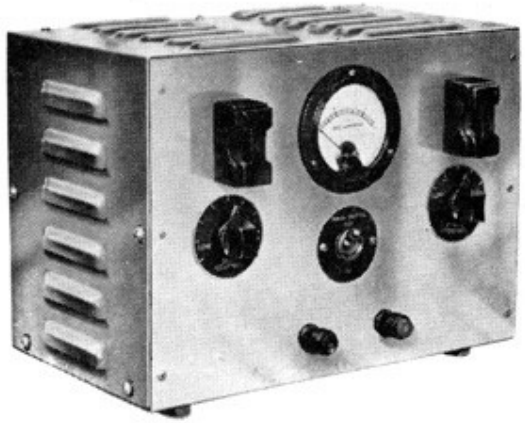
TRICKLE CHARGER CODE O/25

Input 200/250 volts 50 cycles single phase. Output suitable to charge 5 to 30, 2 volt lead acid cells (10 to 60 volts) at 10 to 25 milliamperes. Used for straight forward Master Clock Installations where only one circuit of Clocks is required. It is not for use when Time Recorders are operated from the Master Clock.



Height 5½",
Width 8",
Depth 7",
Weight : 6 lbs.

Figure 76 - Trickle charger



TRICKLE CHARGER Code 15/50/2M

Input 200/250 volts 50 cycles single phase. Output suitable to charge 15 to 50, 2 volt lead acid cells (30 to 100 volts D.C.) at 10 to 200 milliamperes. Used with Master Clock Installations where more than one circuit of Clocks is required or when Time Recorders are operated from the Master Clock. Height 8¾", Width 12", Depth 9". Weight : 13½ lbs.

TRICKLE CHARGER Code 200/36/1

Input 200/250 volts 50 cycles single phase. Output suitable to charge 18, 2 volt lead acid cells (36 volts D.C.) at ·01 to 1 amp. The use of this Trickle Charger is recommended (a) Where the A.C. Mains Supply is not continuous, (b) For large Time Recorder installations. Height 8¾", Width 12", Depth 9". Weight : 14 lbs.

Figure 77 - Trickle chargers

1.10 ECS Memory Master Clock

Around 1962, English Clock Systems Ltd, in conjunction with Gents of Leicester, developed a master clock which used a half-second pendulum, and which generated alternate polarity pulses once per minute for slave dials. This suited many of the Continental European designed slave dials available at that time. European clock designers had devised the alternate polarity system (where the slave is sent one pulse of positive polarity and the next pulse of the opposite polarity) to overcome any problems of a double pulse being sent in error and upsetting the synchronisation of the slave dials. With alternate polarity slaves, repeated pulses of the same polarity cannot advance the slave dial.

ECS named their clock the "Memory Master" and Gents called theirs the "Chronopher"

Figure 78 - Memory master

The 'Memory Master' clock is a clever combination of ac mains power and conventional clockwork. The pendulum controls a dead beat escapement powered by a spring in a barrel. The hands of the master clock's dial are driven mechanically from this clockwork train. Every one minute, a synchronous electric motor is allowed to run to rewind the spring and to operate switches to provide an alternate polarity pulse to the slave dials.

If the ac mains power fails, the clock continues to run on its spring reserve for up to 10 hours, and the master clock's dial will continue to show the correct time. The slave dials will all stop as they are powered electrically by 24 volts derived from the ac mains. However, a mechanical memory stores the duration of the power failure, and, on restoration of mains power, the synchronous motor runs continuously to update the slaves until they show the correct time.

The mains transformer can be seen behind the left side of the dial. The pendulum is of Invar, and the accuracy of the clock is high.

Figure 79 - Memory master case removed

The ac mains powered rewind motor is on the back of the movement. (In the photo, its cover has the three red dots on.)

Below the motor the two memory wheels have smooth circumferences, each with a recess cut to a smaller diameter for part of their circumference, and are geared together at 12:1. The outer wheel is the 'minutes' wheel and inner is the 'hours' wheel. The lever with pins straddling the two memory wheels will only drop into both recesses cut into the circumferences of the wheels when the memory has 'unwound' to zero. This then causes the synchronous motor to be stalled and stops the rewinding of the going spring. During the next minute under the power of the spring, the memory wheels continue to turn and lift the lever with pins onto the larger diameter part of the minute wheel, releasing the motor again.

The two mercury filled glass switches provide alternate polarity pulses of 24 volts dc for the slave dials. The switches are each tilted individually on alternate minutes by pins on a wheel, thus switching the slave current one way then the other.

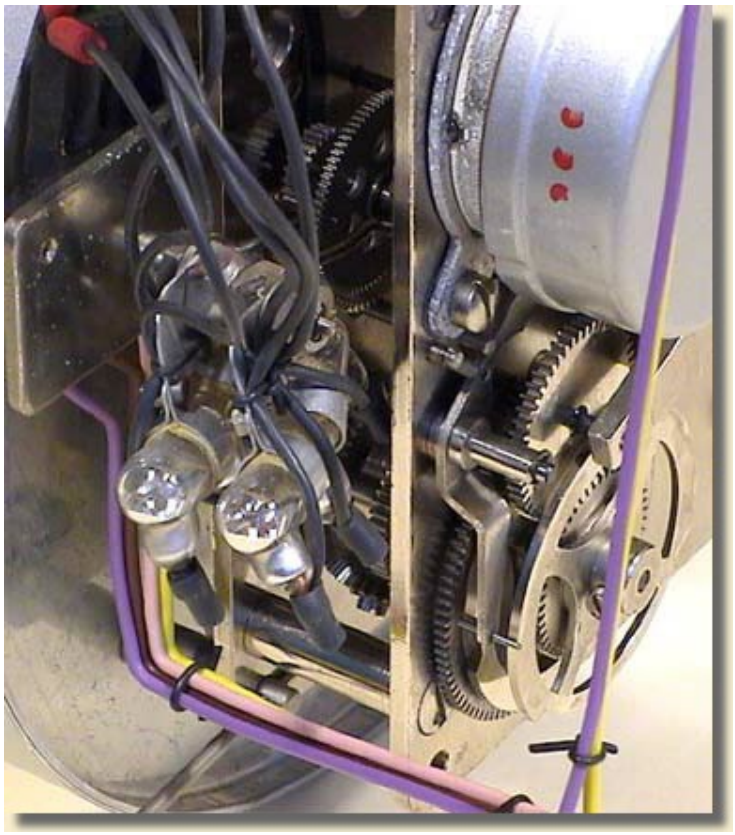


Figure 80 - Memory master mercury switches

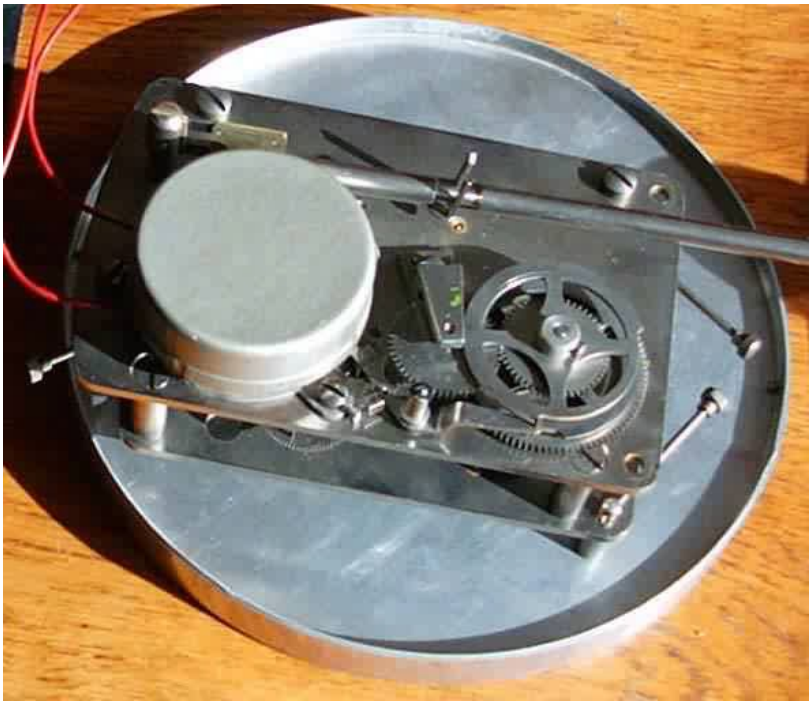


Figure 81 - ECS Memory master movement without mercury switches

1.11 References

Most of the material in this section has been obtained from Martin Ridout's web pages, and pictures of s/n 10143 from Jason Swift. Reference should also be made to the 'Others' Chapter wherein there will be found reference to 'Prouds' who made some clocks based on ECS parts.

APPENDIX

SERIES ½ MINUTE SLAVE MOVEMENT SPECIFICATIONS

Light duty movement EW/205/12 - 12-inch dial maximum (from an ECS document)

Coil resistance	Shunt resistance	Combined resistance	Operating current	Coil part No.
3.5 to 3.8 ohms	33 ohms	3.1 to 3.5 ohms	0.3 to 0.32 amp	EW SEC 220

Coil - 730 turns 26 SWG enamelled copper wire.

G.P.O. Light duty movement EW/205/12/1 - 12-inch dial maximum (from an ECS document)

Coil resistance	Shunt resistance	Combined resistance	Operating current	Coil part No.
8.8 to 9.7 ohms	90 to 110 ohms	7.9 to 9.0 ohms	0.3 to 0.32 amp	P.71691

Coil - 1100 turns 29 SWG enamelled copper wire.

Light duty movement 205/19 - (from survey returns - data from labels on coils, and/or owners measurements)
This movement has the following specification which is identical to 205/12

Coil resistance	Shunt resistance	Combined resistance	Operating current	Coil part No.
3.5 to 3.8 ohms	33 ohms	3.1 to 3.5 ohms	0.3 to 0.32 amp	EW SEC 220

Medium duty movement EW/205/28 - 12-inch to 18-inch dial (from an ECS document)

Coil resistance	Shunt resistance	Combined resistance	Operating current	Coil part No.
6.8 to 7.5 ohms	68 ohms	6.1 to 6.8 ohms	0.3 to 0.32 amp	EW SEC 202

Coil - 1000 turns 28 SWG enamelled copper wire.

Heavy duty movement EW/245 - 18-inch to 36-inch dial (from an ECS document)
Referred to as a No. 3 movement

Coil resistance	Shunt resistance	Combined resistance	Operating current	Coil part No.
2 in series, each 7.0 to 8.5 ohms	150 ohms	12.6 to 15.4 ohms	0.3 to 0.32 amp	EW SEC 233

Coil - 1300 to 1395 turns 26 SWG enamelled copper wire.

ECS states that the working and failing currents of the above ECS dials are the same as similar Synchronome dials, and that they are interchangeable.

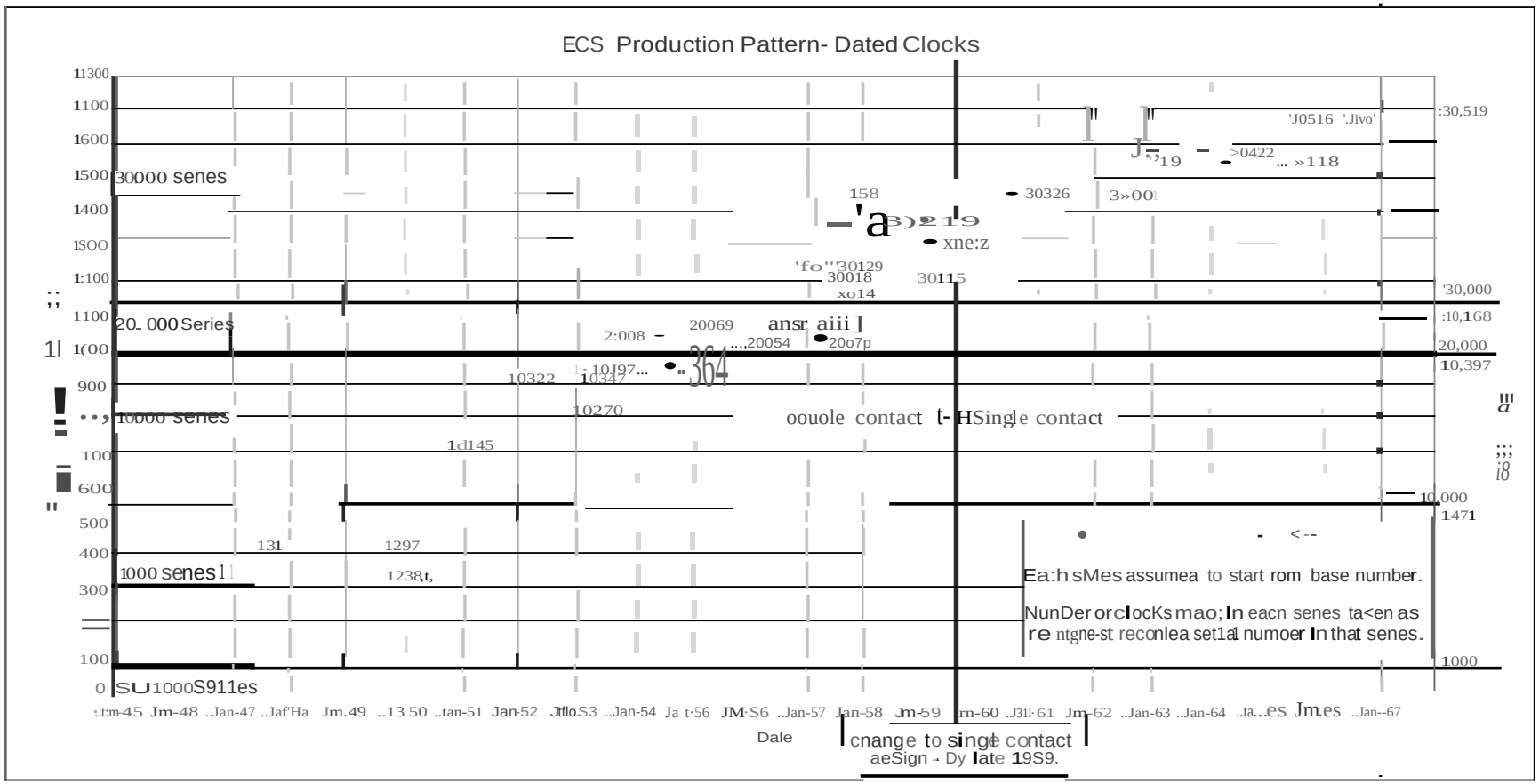


Chart I

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Design Changes

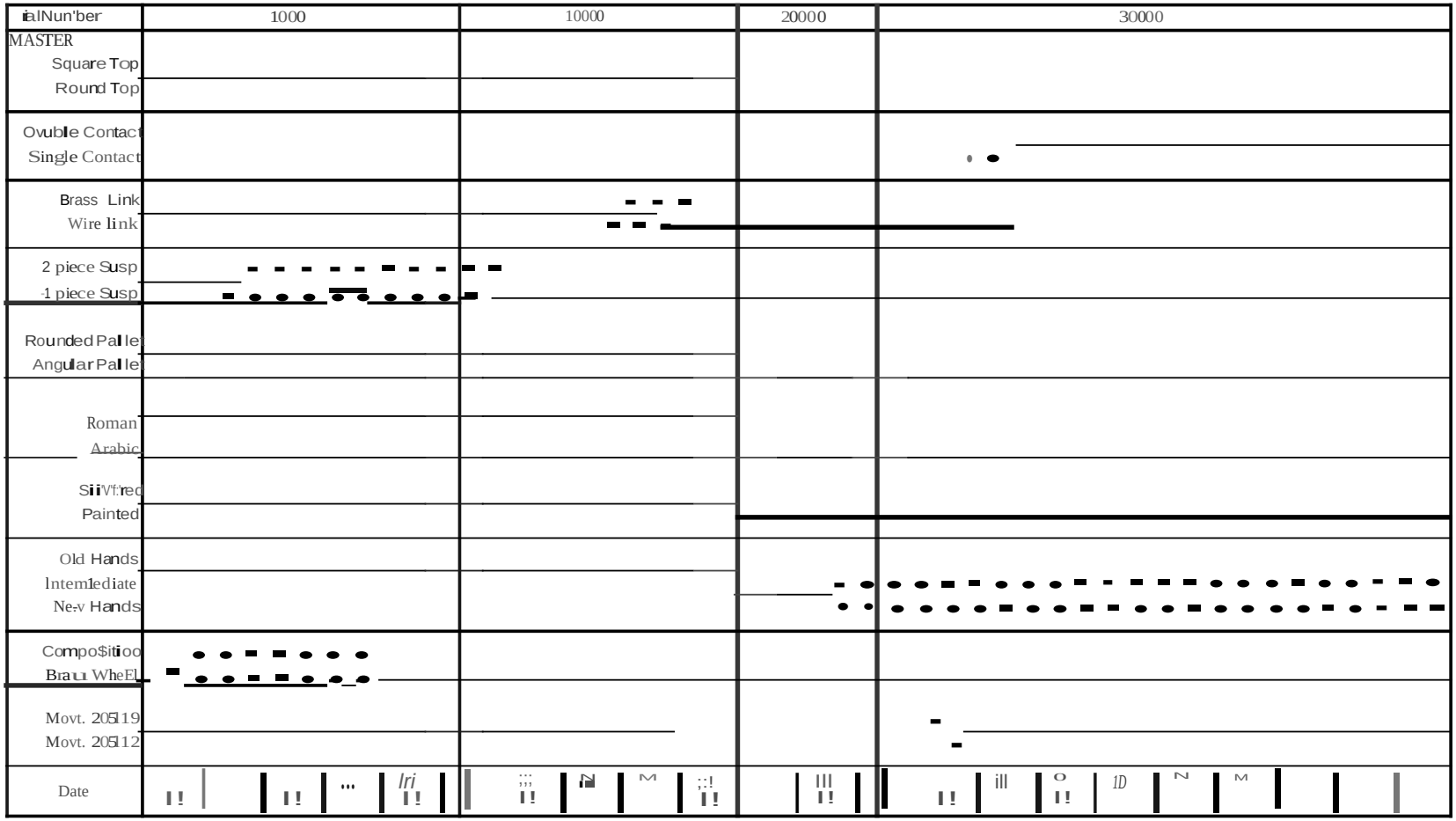

Chart 2