THE ELECTRIC REMONTOIRE

David Read*

This article discusses electrical self-winding of an otherwise traditional clock. It starts with the moving coil method as exemplified in the clocks of Paul Garnier at the beginning of the twentieth century and then deals in turn with the pivoted armature systems of Perret Fils et Cie, Leon Schmid et Cie, and Schild et Cie.

INTRODUCTION

The accuracy of spring-driven clocks, even those with the best escapements, is worsened by variations in the driving force of the mainspring since this varies with the tightness of wind and ageing of the spring itself. The fusee, placed between the mainspring and the wheel train, enables a more even force to be applied and is well known to enthusiasts of traditional clocks and watches.

Another solution is the remontoire. Here, the power of the hand-wound mainspring does not itself drive the escapement via a wheel train, but is used to wind a remontoire with a small weight or shorter and weaker spring. The remontoire is rewound frequently, enabling the middle portion only of the weak spring to be used and, therefore, a constant force to be applied to the escapement.

The system was perfected by John Harrison in his marine clocks H2, H3 and H4 and Lieut-Commander Rupert Gould, in a lecture given in 1935, provided a remarkable account of its use in H3:

> There is a remontoire, let off every 30 seconds. It is the only mechanically perfect remontoire I have ever met with – and I have studied more than a hundred devices of this kind. It gives an absolutely constant torque at the escape wheel, whether its driving springs are fully wound , half run down, almost due for rewinding or actually being wound.[1]

The mechanical remontoire belonged in the realm of specialised and expensive clocks, which is where it would remain for 150 years until the use of electricity in horology began in the second half of the nineteenth century. The first use of electricity in horology took place in association with the new science of telegraphy and initially followed three lines of development:-

1) The use of a good quality hand-wound regulator fitted with contact switches in order to pass pulses of current to slave clocks for the distribution of railway or standard time.

2) Electrical self-winding of an otherwise traditional clock.

3) Maintaining a pendulum in oscillation by electro-magnetic impulses.

The second of these is the subject of this article.

Electrical re-winding was the first to achieve widespread use because it enabled an effective and economical remontoire to be developed in the mass market for domestic clocks in which the principles employed were applied to smaller clocks with balance wheels rather than pendulums.

It brought with it the added advantage that the need for regular winding of a mainspring was eliminated and replaced by a battery needing replacement only once a year.

Electric power in replacing the mainspring presented a number of choices with respect to how a remontoire could be rewound. For example, the weak spring or small weight driving the escapement could be re-wound every minute or so by an electro-magnet with pivoted armature, or by an electric motor, or by a moving coil, all without using a conventional wheel train thus saving both space and expense.

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1. Meeting of the Nautical Research Society and reported in *Journal* Vol.XXI, No.2, April 1935.

Fig. 1. Self-winding master clock by Paul Garnier.

PAUL GARNIER, PARIS

In France, Paul Garnier, the celebrated maker of clocks and scientific instruments, supplied the railways with their first master clocks with electric contacts for output to slave dials in 1845.

His master clocks were at first wound by hand but in due course an independent self-winding master clock was introduced. An example of a Garnier pendulum clock with dead beat escapement and electric remontoire is shown in Fig 1. The dial is signed Paul Garnier Paris together with the words Distributeur Électrique, showing that it was made for the distribution of time. Such a clock could be used to drive slave clocks in any buildings where

Fig. 2. Slave clock by Paul Garnier.

standard time was required such as railway stations and offices.

It could also be used simply as an independent accurate clock that did not require hand winding. Two 1.5 volt cells in the top of the case provide power to wind the remontoire.

A typical slave clock made by Garnier for hotels and apartments is shown in Fig.2.

The movement of the master clock is shown in Fig.3 and reveals the rewinding mechanism in which a mobile coil is mounted on a pivoted arm and used to lift a counterpoise.

The movement has a permanent magnet fixed within its plates and when electrical contacts are briefly closed by the wheel train, current from the 3 volt battery induces a magnetic field in the coil which pulls it closer to the magnet, so pivoting the counterpoise upwards. When the current is switched off, the coil is returned to its position of rest by the weight of the counterpoise and at the same time the ratchet and pawl mechanism co-axial with its pivot re-winds the remontoire. Maintaining power is provided to ensure that there is no momentary loss of force to the dead beat escapement at the moment of rewind. The black counterpoise is visible between the two plates of the movement and immediately behind it can be seen the small barrel containing the short weak spring of the remontoire.

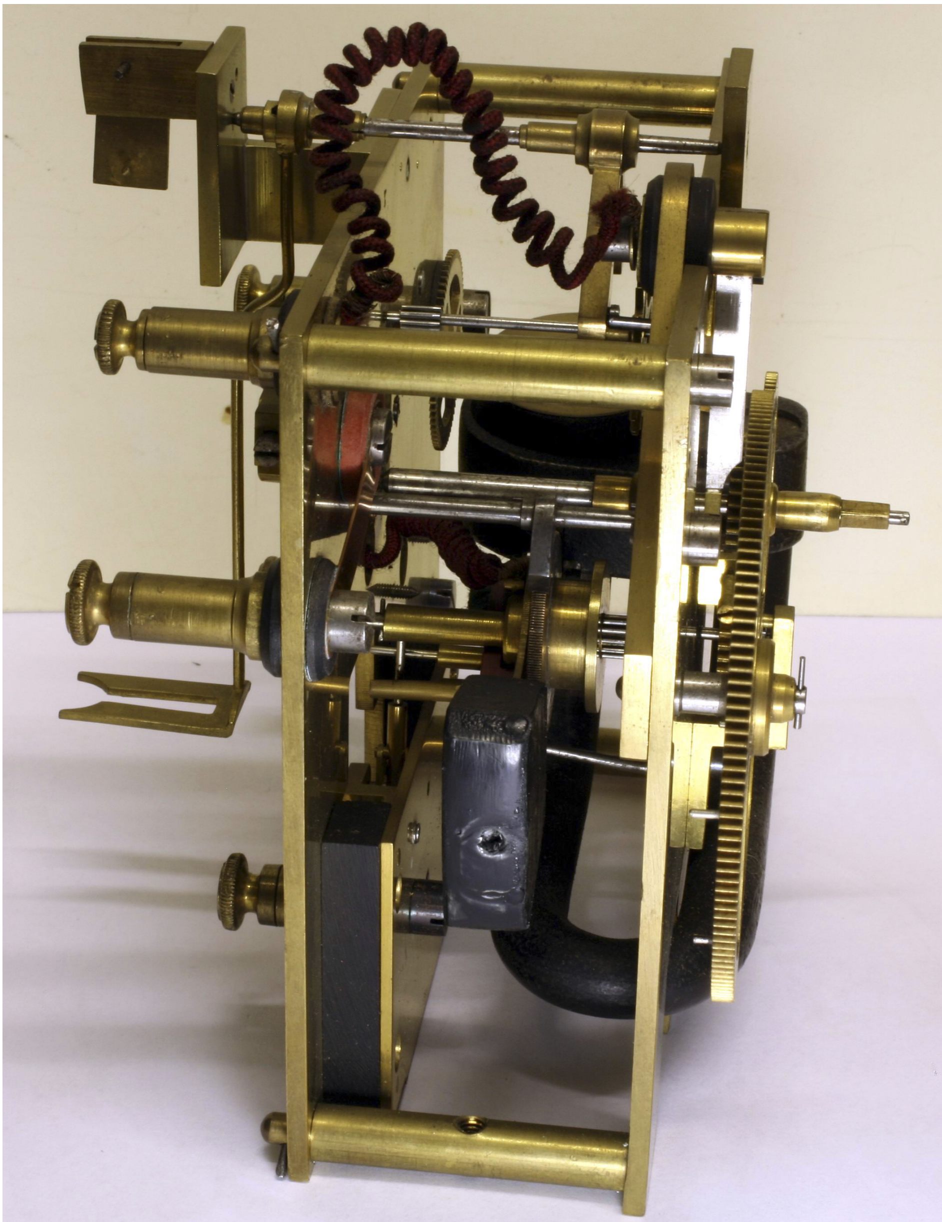

Fig. 3. Paul Garnier self-winding movement with one minute outputs.

The slave movement is designed to be impulsed once a minute by a pulse of current from a master clock such as the Garnier illustrated above. As in the master, the movement contains a fixed magnet and a pivoted arm carrying a coil and counterpoise; however, for the slave clock the movement of the arm is transformed into rotary motion by rocking a jeweled anchor that acts as a stepping motor to drive the index wheel and motion work.

Developments that took place in electrically rewound clocks, such as those of Paul Garnier, were soon miniaturized by many manufacturers so that small portable clocks with balance wheel escapements made their appearance. The variety of electro-mechanical designs and the ingenuity hiding behind the dials of these clocks is remarkable and I have chosen three successful systems, made in Switzerland and spanning a period from 1900 to about 1965 to illustrate the progress made.

Fig. 4. Mantel clock by S.A. Des Horloges Électriques Chaux-de-Fonds with one minute remontoire by David Perret.

DAVID PERRET FILS ET CIE, NEUCHATEL

The watchmaking firm of David Perret was created in 1854. His son (also David), a graduate engineer from the Federal Polytechnic in Zurich, had in the late 1890s created David Perret Fils et Cie which in 1902 was incorporated as a limited liability company in order hold the ownership of his patents. In 1900 he deposited a pendulum clock with a one-minute electric remontoire at the Neuchatel Observatory whose performance was so good that Dr. A. Hirsch, Director of the observatory wrote:

> The ordinary clock which he has placed in the observatory in order to try his system has given such surprising results that we have every reason to hope that this system when applied to a clock with a pendulum of ferro-nickel will compete with our Hipp-Clock as to precision.

Based on this result a new astronomical regulator by David Perret was placed at the observatory in April 1902 for the transmission of time signals by telegraphy to various locations.

A testimonial written by the director of the observatory in October 1902 confirmed that the performance of the Perret regulator had proved equal to that of a first class astronomical clock.

Most of Perret's clocks were made for the general rather than precision market and the majority of these were fitted with balance wheel escapements. Nevertheless, using the same one minute-remontoire as in his pendulum regulators, these were capable of keeping very good time.

Illustrated in Fig. 4 is a mantel clock in a bird's eye maple case in the Boulle style with gilded brass mounts. It was made by the Société Anonyme Des Horloges Électriques at La Chaux-de-Fonds and fitted with David Perret's movement with platform escapement. Two standard 1.5 volt cells are concealed in the base and provide power for at least two years.

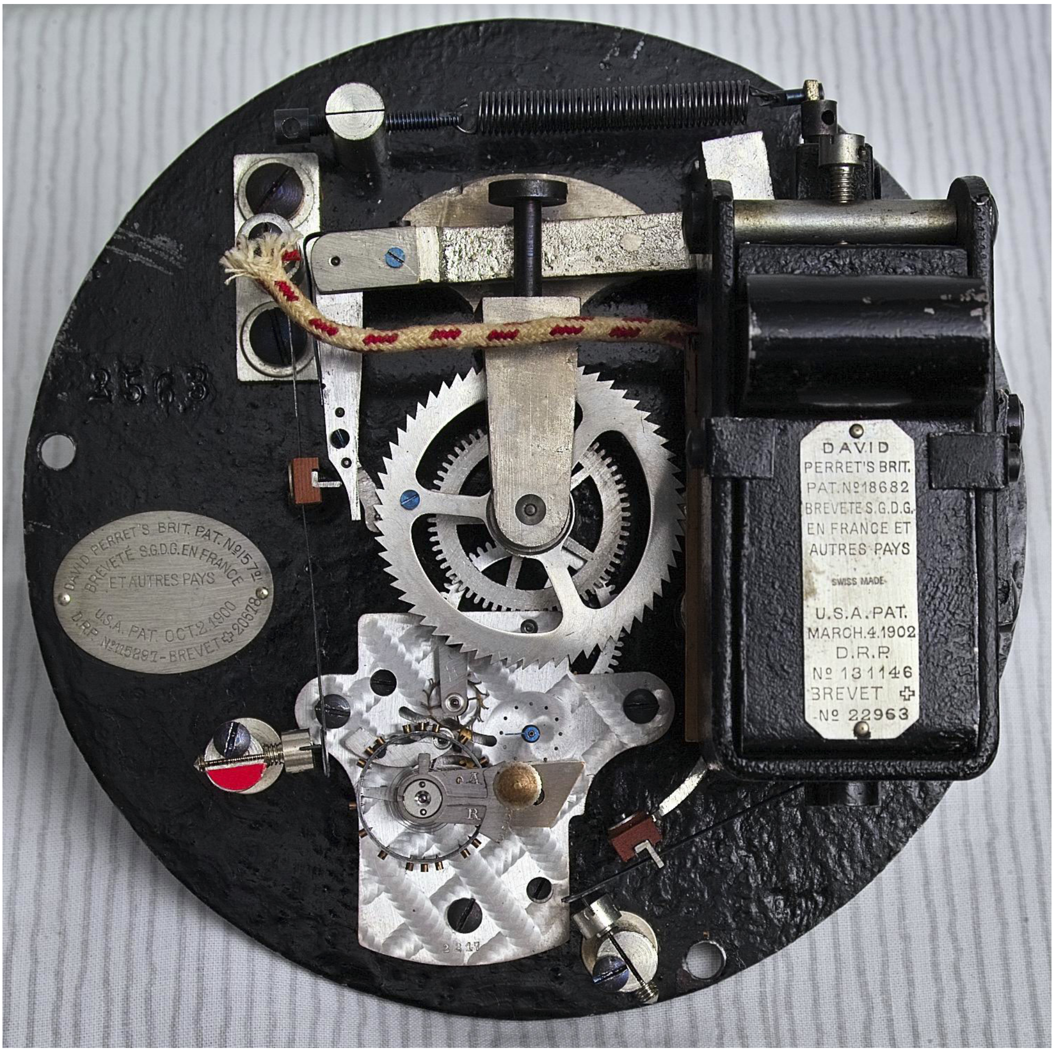

Fig. 5. One minute remontoire movement by David Perret.

The movement with plates quoting patents from 1900 is shown in Fig. 5. An electro-magnet and pivoted armature is enclosed in the metal clad assembly on the right. Once every minute, a brief pulse of current flows through the electro-magnet, causing its armature to lift the cocking arm above the centre ratchet wheel so that its driving pawl gathers a tooth. In so doing, the spring is stretched and pulls the arm downwards, driving the centre wheel and platform escapement with constant force. The patented switching action in which one contact switches on the current and the other breaks it is unique to Perret clocks, and provides better security of operation and improved resistance to wear at the contact points than in single switch systems.

David Perret died in 1908 after a most distinguished career. In 1877 he was awarded first prize by the Cantonal Industries of the Jura for the construction of a precision measuring instrument for watchmakers and in the following years up to and including 1900 he was a Jury President of several international watchmaking Exhibitions held in Paris and Geneva. His widow continued the business for a few years and an advertisement placed by the company in 1911 shows an image of this clock at the observatory with the words 'David Perret provides the exact time throughout Switzerland'. However, the second decade of the twentieth century was a period of very rapid development in electrical engineering and without the leadership provided by its founder, David Perret Fils et Cie soon went into liquidation.

Fig. 6. Clock by Ericsson with Supremo movement.

VVE. CHS. LEON SCHMID ET CIE, LA CHAUX-DE-FONDS

The trademark Supremo, seen below the name Ericsson in the photograph Fig. 6, was registered in 1911 by the firm Charles Leon Schmid – successor to the famous firm of Georges Frederic Roskopf.

The use of revolutionary new plastic materials enabled moulded shapes for Art-Deco designs which had not previously been seen in quantity production. Bakelite mouldings became important from the 1920s and can be closely linked to the rising industries of the motor car, electrical components and the wireless. The architect Wells Coates' designs in 1933 for radios in moulded Bakelite were described in 1977 by Carol Hogben at the Victoria and Albert Museum as 'uncompromisingly apt to modern buildings'.[2]

The Supremo clock for Ericsson, shown in Fig. 6, in its superbly designed case made of Bakelite and chrome in the Ziggurat style of decorative arts, can be seen in this context.

Schmid had been a young employee in the Roskopf business, and growing up in the innovative environment of seeking to find new ways of making affordable watches using pin-pallet escapements perhaps helps to explain why he was open to the new technologies of electricity and plastics that were routinely resisted by the normally conservative watch and clock trades.

The Supremo remontoire is shown in outline in Fig. 7, based on a drawing in *Horlogerie Électrique* by R.P. Guye and M. Bossart published by Scriptar S.A. Lausanne in 1948. It is simple, reliable and extremely quiet in operation and was chosen by several companies for use in small battery clocks under their own names. An armature is pivoted between the two poles of an electro-magnet. A click engaged

2. Introduction to 'The Wireless Show', a loan exhibition presented by the V & A in association with the British Vintage Wireless Society, October to December 1977.

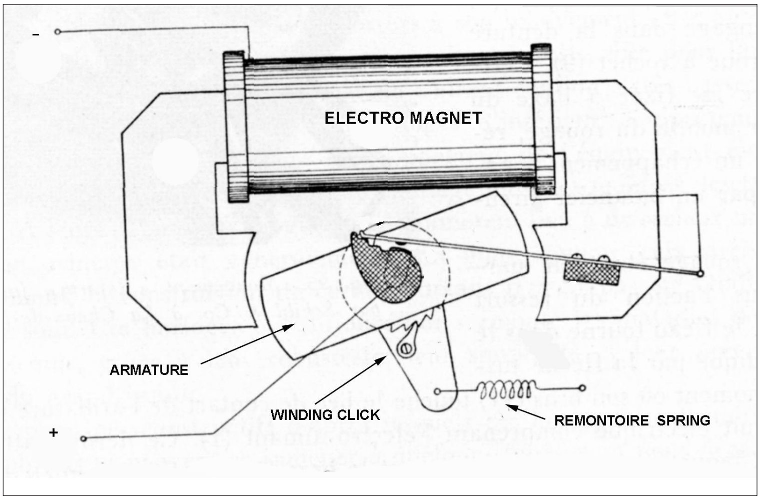

Fig. 7. Supremo remontoire drawing.

Fig. 8. Clock by Riverside Manufacturing with Electrora movement.

with the ratchet wheel that is co-axial with the armature, transfers power from the remontoire spring to the balance wheel escapement. The contacts that switch current to the electro-magnet close when the armature is completing its turn anti-clockwise. As they close, magnetism induced in the poles of the electro-magnet cause the armature to re-cock the spring by instantaneously turning clockwise in alignment with its poles. In so doing the contact blade mounted on the right hand pole is lifted by the stepped finger on the pivot of the armature and breaks the circuit. The spring again transfers power and the cycle is repeated. Maintaining power for the escapement is provided for the moment when the remontoire is being cocked.

SCHILD ET CIE, LA CHAUX-DE-FONDS

In the world of art, Modernism deliberately reflected the functional world. Art and technology were strongly influenced by each other with manufacturers employing industrial designers and the art world embracing industry. Electricity was central to these trends and the styles chosen for electric clocks reflected this in their Art Deco themes.

The clock shown in Fig. 8 has 'electrical' hands whilst the case style case in moulded Bakelite reflects the Art Deco obsession with Egyptian designs that followed the discovery of Tutankhamun's tomb. It contains an electric remontoire movement named Electrora, made by Schild and retailed in the UK by the by the Riverside Manufacturing Co. of Hammersmith.

Schild et Cie manufactured two designs of electric remontoire. They are known as the Electrora and the Reform and are without doubt the best known and most commercially successful of all the many varieties of electrically-rewound clock movements that were on the market from the late 1920s onwards.

Both designs employed a pivoted armature closing onto an electro-magnet to kick-wind a

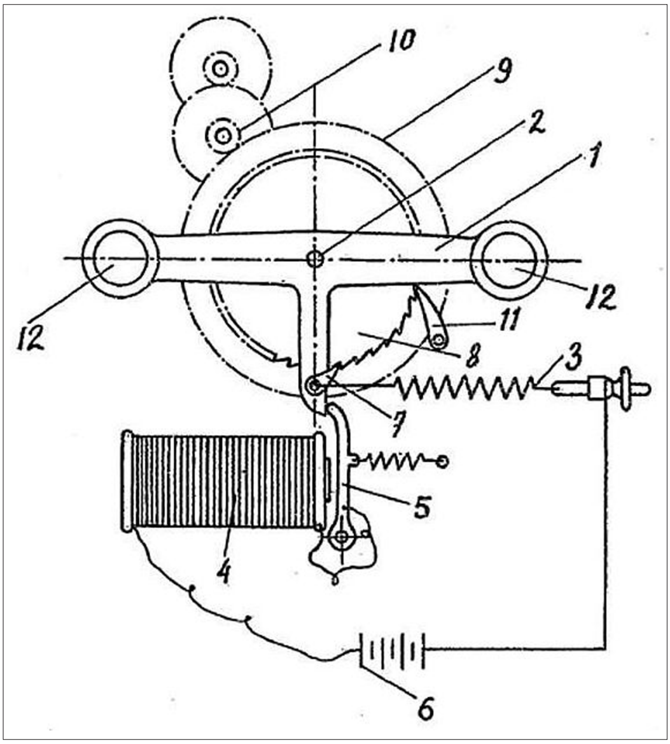

Fig. 9. Electrora remontoire patent drawing.

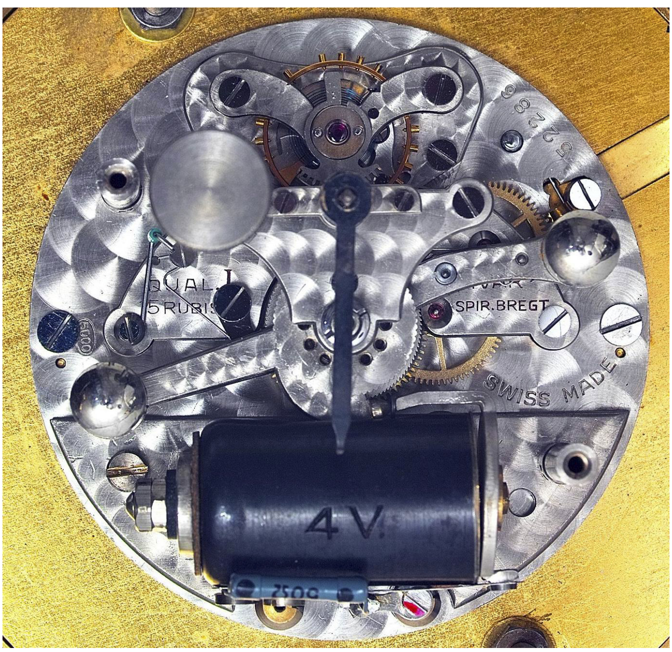

Fig. 10. Reform Calibre 5000 movement.

weak spring directly through the faces of the contacts. The basic concept applied for in the French Patent FR621121 on 6 September 1926 is illustrated in Fig. 9.[3]

Here can be seen the familiar dumbbells 12.12 on a pivoted arm coaxial with wheel 8/9. The short arm at right angles provides a winding lever on which the armature 5 closes to provide the winding momentum.

The current path is through the contact faces on the tip of the armature and end of the winding lever carrying click 7.

When the contacts are closed, current through the electro-magnet causes a sudden closing of the armature 5 which in turn kicks the winding lever clockwise, whilst the detent click 11 ensures that the wheel 8/9 does not move. The rapid acceleration of the dumbbell weights 12.12 provides sufficient momentum to stretch the remontoire spring 3. The force is applied through the surface of the contacts which ensures both a reliable contact pressure and a wiping action which helps to keep the contacts clean. The pivoted arm and dumbbells are returned anti-clockwise by the spring and this returning force is applied to the train and platform escapement by the click 7.

This patent also outlined possible variations; in particular a spiral spring contained within a barrel coaxial with wheel 8/9 and this is the arrangement that was made in quantity production as Calibre 3000 known as 'Electrora'. Schild's calibre 3000 movement for small clocks was very successful and found throughout Europe in the dashboards of automobiles, as aviation clocks and in a variety of domestic case styles reflecting the influences of the modern age.

On 3 April 1945, patent CH235319 was published for a greatly improved version of the same

3. It is likely that a Swiss Patent was also applied for; however, searches up to now have failed to find it.

Fig. 11. Girard Perregaux desk clock with Reform movement and seconds synchronising button. The movement of this clock is shown on the front cover.

basic invention. This was made to a very high grade specification with damascened plates, fully jewelled and with a seconds hand that could be set to a time signal. The movement was called 'Reform' and is the most widely known name of any small electric remontoire clock movement (Fig. 10).

The name had become ubiquitous to the extent that Electrora movements (i.e. all Schild movements from 1926) are now routinely referred to as Reform. It is worth noting, however, that the name Reform was not introduced by Schild until the introduction of the high grade calibre 5000 version in 1944.

The operation of the remontoire is the same as in the Electrora already described but with a spring barrel as standard. The balance is fitted with a Breguet spiral spring made of Invar and fitted with a micrometer regulator.

The Reform calibre 5000 was advertised as high grade, indeed the movement cover was sometimes engraved to this effect.

The image shown in Fig. 11 illustrates a precision desk clock by Girard Perregaux in a sloping hardwood case with decorative veneer. The press button for setting to a time signal can be seen protruding from the dial bezel at six o'clock. The movement of this clock is shown on the front cover, with its name proudly engraved on the bridge supporting the winding dumbells. The dumbells themselves now have curves on both arms and in this final and highly refined form it remained in production until the late 1960s; however, by then the transistor had made electronic switching in small clocks a practical proposition and the electric remontoire with its mechanical contact systems became obsolete.

EPILOGUE

The electric remontoire had been developed in a many forms, exploiting innovative electro-mechanical techniques of which only three have been touched on here. After about seventy years of successful operation its time had ended and balance wheels would, thereafter, be driven directly by electro-magnetic impulsion. Before long they, in turn, would give way to other oscillators such as quartz.

But that is another story.

NOTE

Photographs were made by the author from clocks in his own possession and descriptions of 'how things work' are based on investigation of and work done on the actual mechanisms. Advertising material and ephemera in the author's files have also been used.

Relevant patents are referred to in the text and historical data with respect to the Swiss companies can be found in Kathleen Pritchard, *Swiss Timepiece Makers, 1775–1975* (West Kennebunk: NAWCC, Phoenix Publishing, 1997).