A princely master

Roy Conder describes the workings of the Princeps master clock.

CHARLES Edmond Prince took out his first patent relating to an electric clock in 1922. The basic principle of the clock is that the pendulum is almost entirely free and has only to make a light electrical contact at each swing, the pendulum being impulsed by a solenoid.

In a further patent in 1923, the design was improved in that the impulse to maintain the pendulum is provided by a light spring. The spring receives the energy used to maintain the pendulum from the electrical system and is designed to be constantly independent of variations in the electrical supply.

The Princeps is a master clock with a facility for operating other slave clocks and was manufactured by Prince Electric Clocks Ltd, who had an address in New Bond Street between 1924 and 1928. Manufacture was then taken over by the Telephone

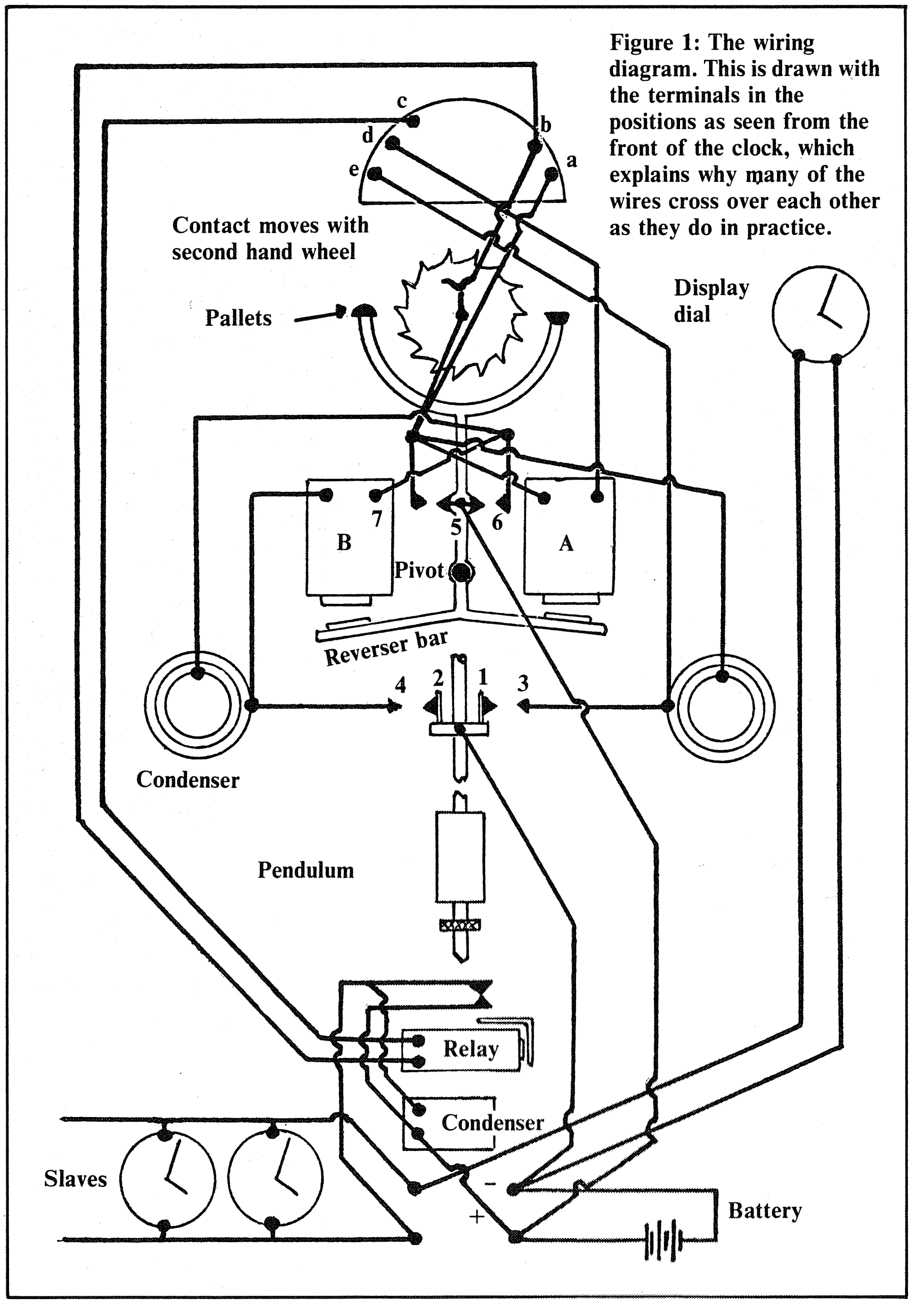

Figure 1: The wiring diagram. This is drawn with the terminals in the positions as seen from the front of the clock, which explains why many of the wires cross over each other as they do in practice.

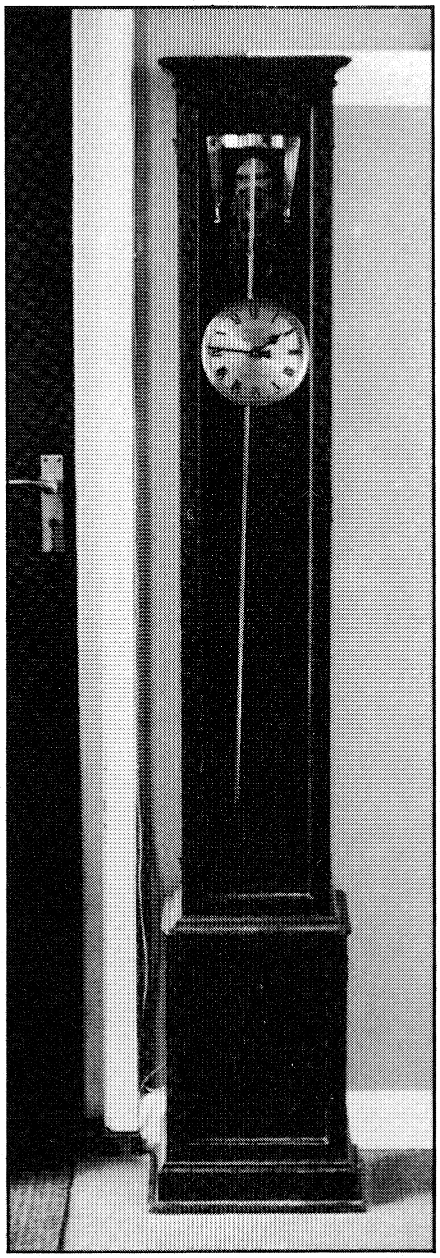

Figure 2: General view of the clock.

Manufacturing Company who produced the Princeps New System clocks with further improvements to the design, and this is the clock described here.

The clock appeared in a local auction some years ago and I was not sure what it was at first. The movement was disconnected and separate but all appeared to be very well made mostly of brass, was obviously a clock as it had a dial, and with a multitude of wires, seemed very complicated and a real challenge. As an amateur clock restorer I had not 'done' an electric clock ▷

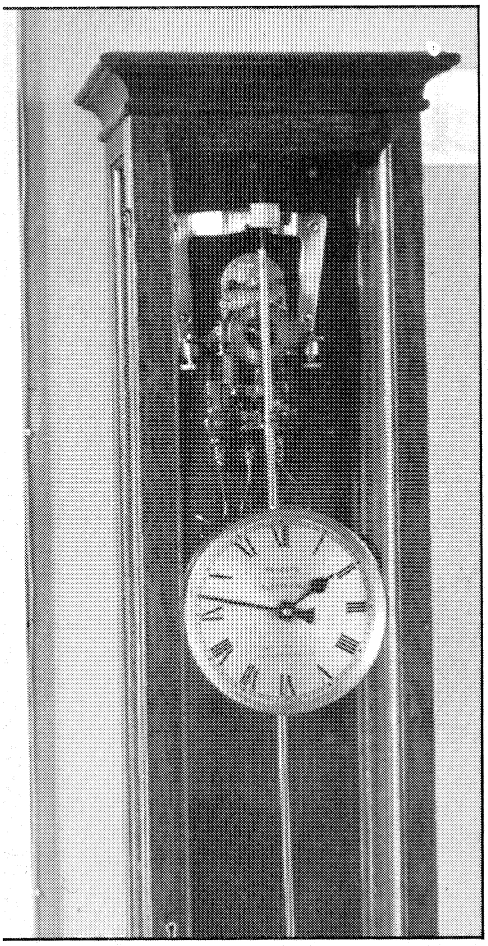

Figure 3: Close-up of top of clock.

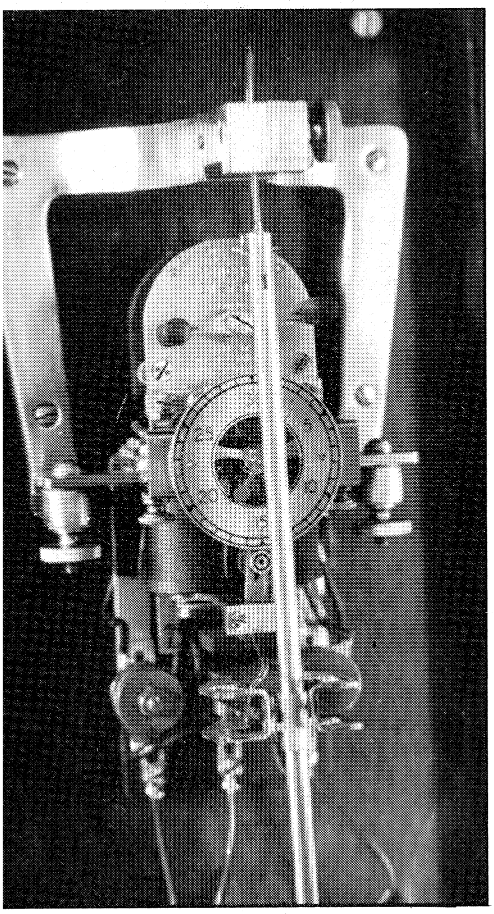

Figure 4: Movement in position.

before so I bought it. Someone else at the auction must have known what it was because the price I had to pay was higher than I had anticipated.

The clock stands 5ft 6in high in a well made oak case which in the top portion has glass to the sides and front door. The base has solid sides and front.

I did not know that the base of the clock had a door until I got it home and then discovered the relay unit and lots more terminals and wires.

It turned out to be complete including the seconds pendulum with heavy cylindrical bob and a $^5/_{16}$in diameter rod which later research indicates is made of invar.

My first job was to search through all my back numbers of *Clocks* magazines to see if I could find any reference to this latest purchase. There was only one reference that I found confirming that the clock was late 1920s and that the Princeps was mostly used in large houses rather than factories. This probably explains the rather elegant appearance of the clock but when it was overhauled and running I found it really too noisy, with a very loud tick, to be anywhere near a living room. Perhaps in use, the servants in their quarters had to put up with it.

On the movement are two patent numbers so I sent for copies of these which can be obtained from the Patent Office in Orpington. These were very interesting in outlining the principle of the clock but did not give any clues on how to set up and adjust for running, and did not give a wiring diagram.

A lot of the wires on my clock were disconnected and perhaps some missing and the movement itself had lots of wires within it. I set about to dismantle the movement, making sketches and notes as I went.

There was enough information in the patents to understand the theory and with the aid of a torch battery and bulb circuit tester I was able to deduce which items were connected electrically and which were insulated. A lot of the brass components making up the movement are insulated from each other as these form part of the circuit. Everything was dismantled and cleaned to make sure that all mechanical and electrical connections were sound. After a lot of circuit testing I came up with the wiring diagram shown.

At this stage I learned that the Science Museum in London had one of these clocks and they kindly sent me some information which confirmed and added to my knowledge. I spent many hours tracing all of the circuits against the theoretical wiring diagram I had deduced, and making sure that as the clock was re-assembled these circuits were established. A quality feature built into the clock is that all of the contacts etc have facility for adjustment. Came the great day for the first test run I half expected the whole thing to burst into flames but amazingly it ran very well.

The clock operates from a DC supply. I have not found any information on voltage

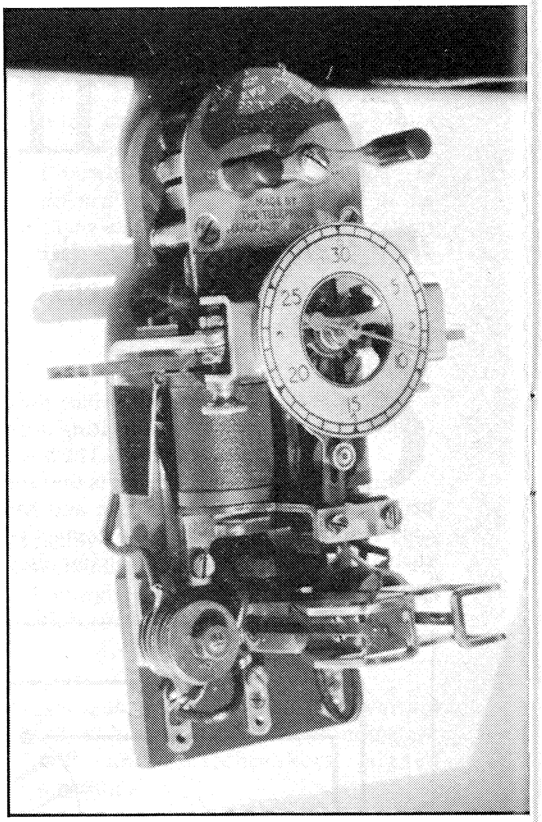

Figure 5: Movement of Princeps master clock

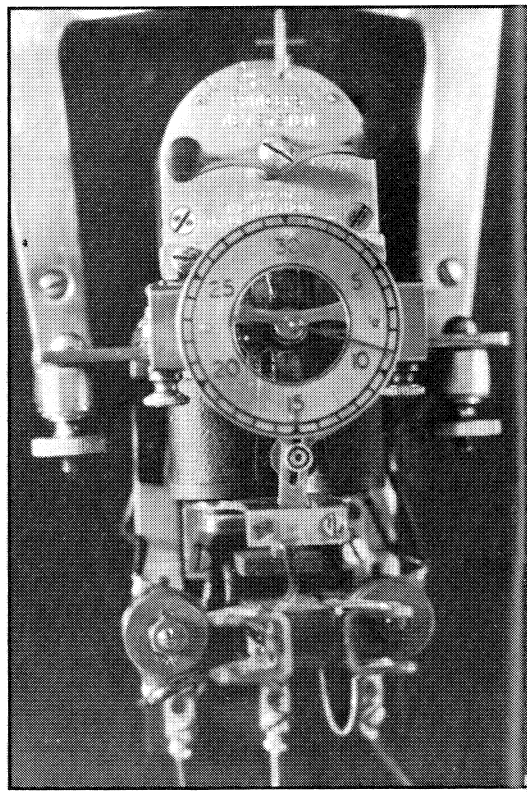

Figure 6: Front view of movement.

but by experiment a 6 volt supply seems to work well with one or two slaves.

The pendulum rod is suspended from a substantial brass horseshoe shaped support bracket screwed to the back of the case and hangs on a suspension spring clamped in this frame. The suspension spring was missing but a normal longcase spring works very well. The position of the pendulum is adjustable front to back within the support bracket. In order to line up the pendulum whilst at rest centrally to the contacts 3 and 4, the whole movement is adjustable in a sideways direction.

The bracket and hence the pendulum rod is connected to the negative side of the battery and carries two contacts, 1 and 2. A magnetic reverser bar on a brass carrier rocks on a pivot and has a contact (5) wired to the battery positive, which makes with contacts 6 and 7 attached to coils A and B. At the top of the reverser carrier are two brocot-like 'pallets' (red jewels in my clock) which, as the reverser rocks from side to side, *drive* a brass toothed wheel, carrying a second hand. The pallets can be adjusted to give correct locking. This second hand wheel incorporates a contact and goes round once every 30 seconds.

When this contact touches a fixed contact it completes a circuit which imparts an impulse every half minute to the relay in the base. This contact is also adjustable and has to be set to pick up the impulse from contacts 5/7 in co-ordination with the position of the toothed wheel and the pendulum making contacts 1/3. The second hand can also be moved on its arbor so that it reads zero at the time the pulse contact is made. This also thereby synchronises this remote second hand with the main display dial.

As the pendulum moves to the right, contacts 1 and 3 connect and activate coil A through 7 and 5 already connected. Contacts 3 and 4 are light springs and yield to the action of the pendulum. Coil A repels the reverser bar immediately breaking 5/7 and connecting 5/6. Contacts 5/6 remain together waiting for the reverse circuit to be made by the pendulum. This action also indexes the second hand wheel by one space. There was some confusion in determining the wiring diagram in that first thoughts were that the coil would attract the reverser bar but in fact it repels it. As the pendulum now swings to the left, contacts 2/4 are made which activates coil B and again rocks the reverser bar. Built up plate condensers are connected across the coil contacts to reduce sparking. These consist of alternate rings of brass and insulating material on a central screw. The term condenser is used, as this appears in the original patent rather than the modern term capacitor. The sequence repeats as the pendulum oscillates.

A maintaining force for the pendulum is provided by a light leaf spring which is built into contact 3. As the reverser rocks each second under the action of the coils, a tail attached to this imparts a small set to the spring in advance of the pendulum coming in contact with it. As the pendulum touches the spring contact this causes the reverser to return and the maintaining spring is left in contact with the pendulum. It imparts its stored energy as the pendulum returns and

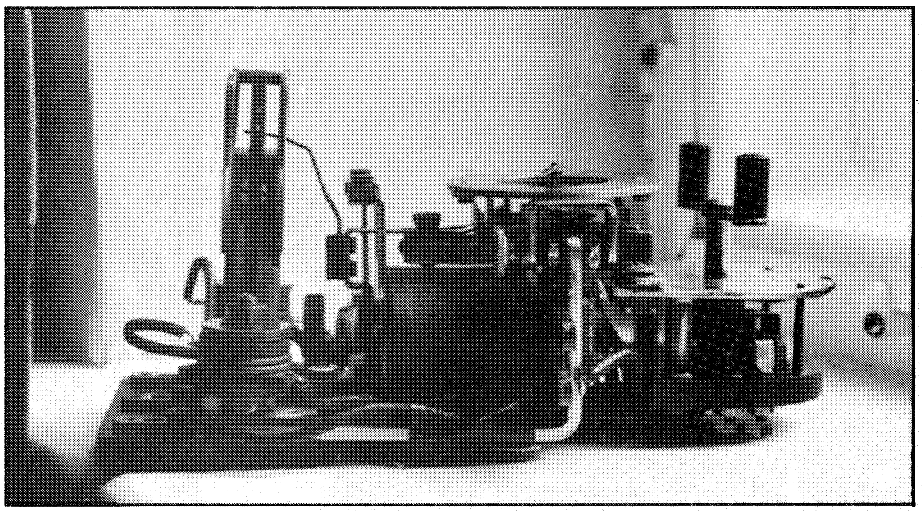

Figure 7: Side view of movement.

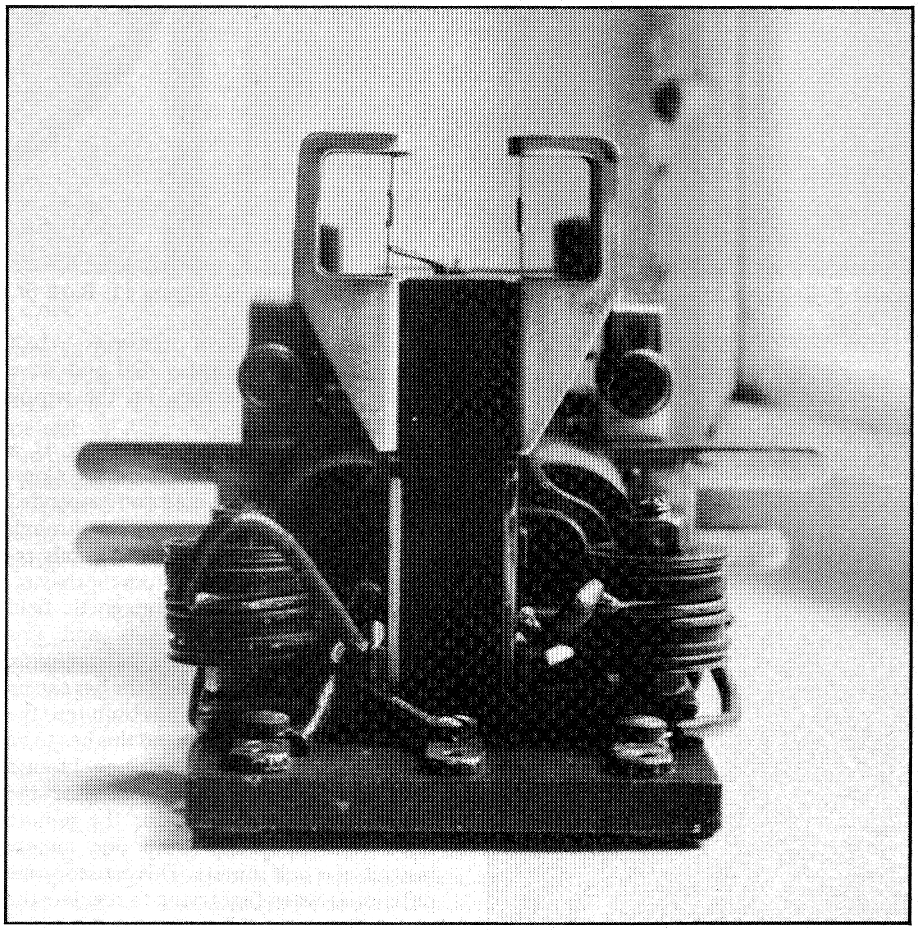

Figure 8: View of movement from underside.

this is sufficient to maintain the small amplitude. The amount of set on the spring is adjustable for different strengths of pendulum suspension spring in order to retain the pendulum's amplitude. A scale at the bottom of the case measures the amplitude and normal running is about one inch either side of centre. As the battery begins to run down the amplitude decreases caused by less vigorous action of the coils indicating a requirement for re-charging or replacing the battery.

At the top of the movement is a switch which can be rotated by hand to engage different combinations of the electrical contacts. This allows the operator to adjust the time displayed by the system by running up, stopping the clock, or stopping the slaves. Running up the system provides a pulse every two seconds through contact 7 instead of every half minute via the seconds dial contact. The method of achieving this can be followed on the wiring diagram.

The contacts connected together by the switch are:

Going – c,d,e.
Run up – a,b and c,d,e.

▷

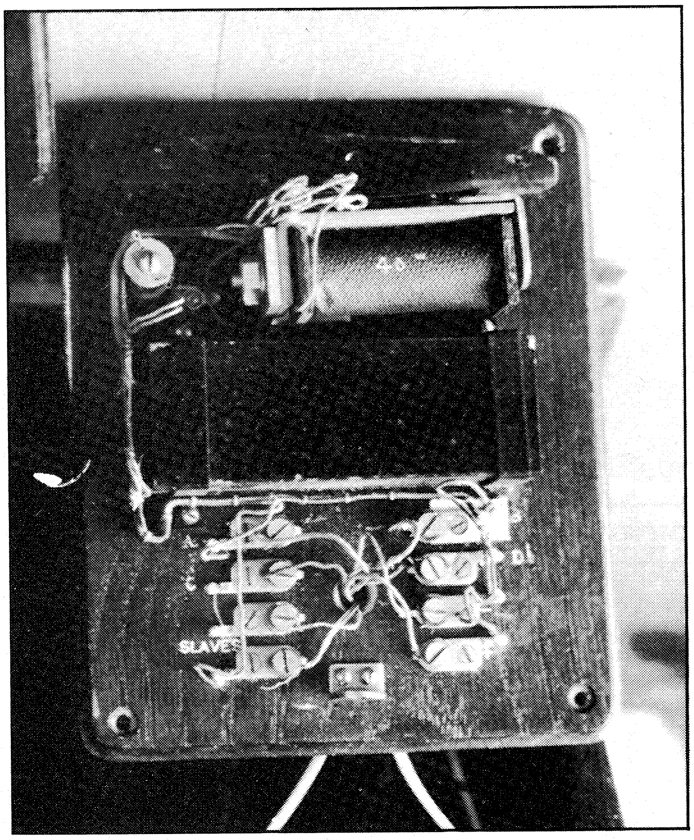

Figure 9: Relay unit.

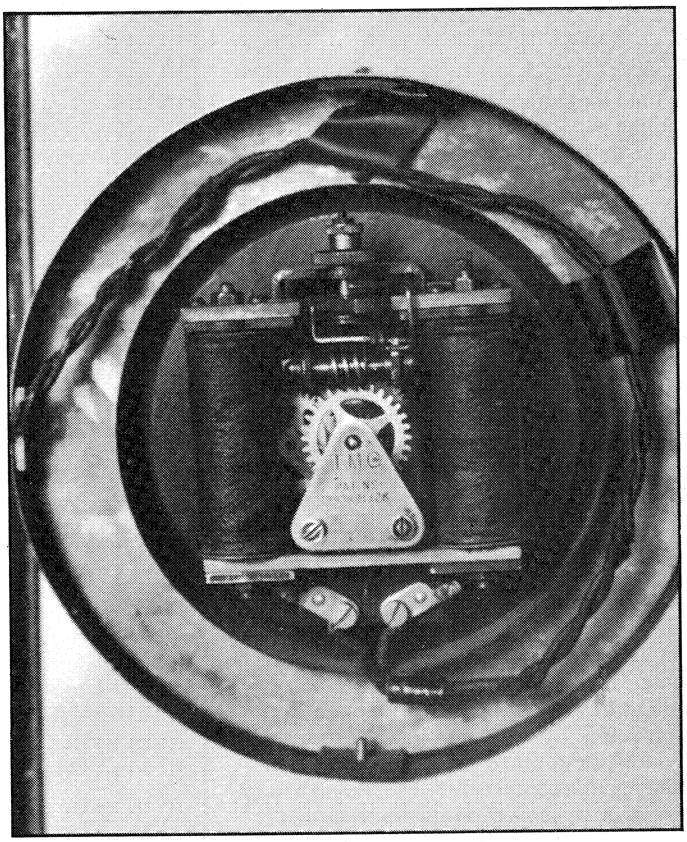

Figure 11: Back of display dial.

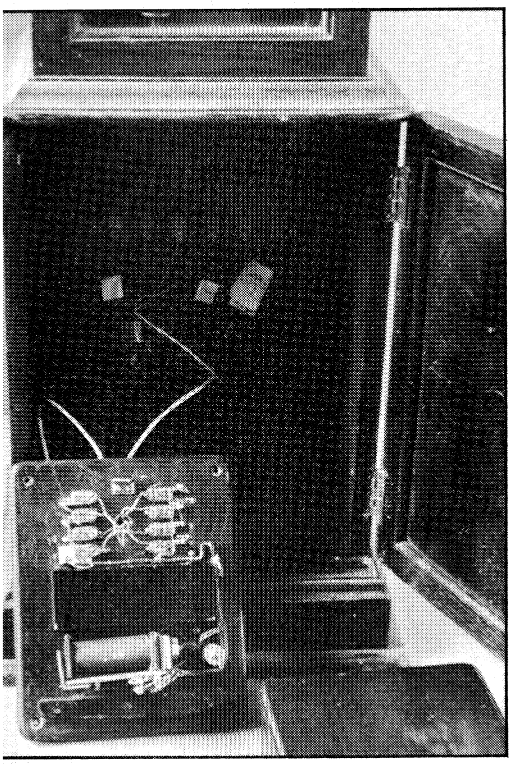

Figure 10: Base and relay unit.

Stop slaves – d,e (also stops display dial).
Stop – none.

In the base of the clock an electrical relay system and terminals accepts the supply current; connects this to the various contacts on the clock; receives the pulses from the movement and through a relay/condenser arrangement transmits a half minute pulse to a display dial and slave clocks. This can be seen on the wiring diagram.

The display dial on the clock is a patented Telephone Manufacturing Company design. A bar pivoted and suspended between two coils is connected through gearing to the hands. When the coils receive an electrical impulse from the master, the bar is rotated by the magnetic field occurring between the coils and this indexes the minute hand, by half a minute. The amount of movement of the bar can be adjusted by light coil springs built into the knurled mounting screws and this has to be set up when the master is working. I found that there was a tendency, because the impulse was too strong, for the minute hand to occasionally jump one minute instead of a half minute. This caused some difficulties when first trying to regulate the master but some trial and error with setting the tension on the spring in the display clock cured the problem.

I have not found any information on how many of these clocks were made but this is the only one I have come across in many years interest in clocks, whereas Synchronomes, Gents, etc are quite common. I have also no information on how many slaves the clock would operate but would imagine that about ten would be all right with the existing relay. No doubt a larger number could be accommodated with suitable line relays.

My clock quite happily drives two half minute slave dials of a different make and initially ran for three months on a 6 volt

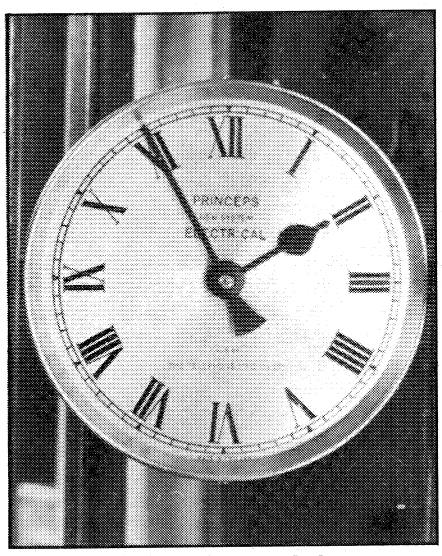

Figure 12: Front of display dial.

lantern dry battery. I now use an old 6 volt car battery as the power source which I charge up about every three months and this seems a good arrangement. For a larger installation of slaves, a trickle charge arrangement might be better.

The clock is now installed in my garage as the tick is too loud to have it in the house. The loudness of the tick is caused by the reverser bar rotated by and striking the coils. This has built in cushioning pads but is still very loud and does not seem to diminish even with a reduced voltage. It has kept near perfect time for over two years and, whilst not an antique, is surely worth preserving as an interesting example of developments in horology. □