# Silent Electric Permanent Magnet Additions

## 1. Introduction

This is not intended to be a guide to the Silent Electric system, or it's slave movement and some familiarity with how this half minute single polarity system works is assumed.

Silent Electric slave movements typically come in two types (excluding larger models), both using a permanent magnet and a pair of coils acting as an electromagnet energized by the impulse from the master clock. The differences are in the arrangement of the main parts, early models having the coils set on a line diagonally across the main chassis, and late models (as discussed here) having the coils on a horizontal line. An iron 'stator' surrounds a small iron 'rotor' and the stator is provided with magnetic inputs from a permanent magnet and a pair of coils. The change in the magnetic field when the coils are energized is used to give a quarter turn to the rotor, which, when the electromagnetic field ceases gets pulled the remaining quarter turn by the permanent magnet. It is then loosely held in that position by the permanent magnet. Hence each impulse causes a half turn to the rotor, which in the usual slave arrangement advances the minute hand by a half minute. The action is indeed very quiet if not completely silent.

In order for this to work correctly it is important that the balance between the magnetic field provided by the coils and that provided by the permanent magnet is correct, since the two have to operate together to give the correct movement. The electromagnetic field depends on the coils (number of turns) and the current which is correctly 250 mA I believe. The system is polarity sensitive and will not operate correctly with the wrong polarity applied. The permanent magnetism comes from a 'U' shaped permanent magnet with an adjustable keeper that can be used to reduce the magnetic field at the pole pieces by 'shorting out' the poles (to use the electrical analogy)

Both of the slave movements I have in operation have been somewhat temperamental in operation and I have long believed this to be due to weak permanent magnetism in these approximately 90 year old movements.

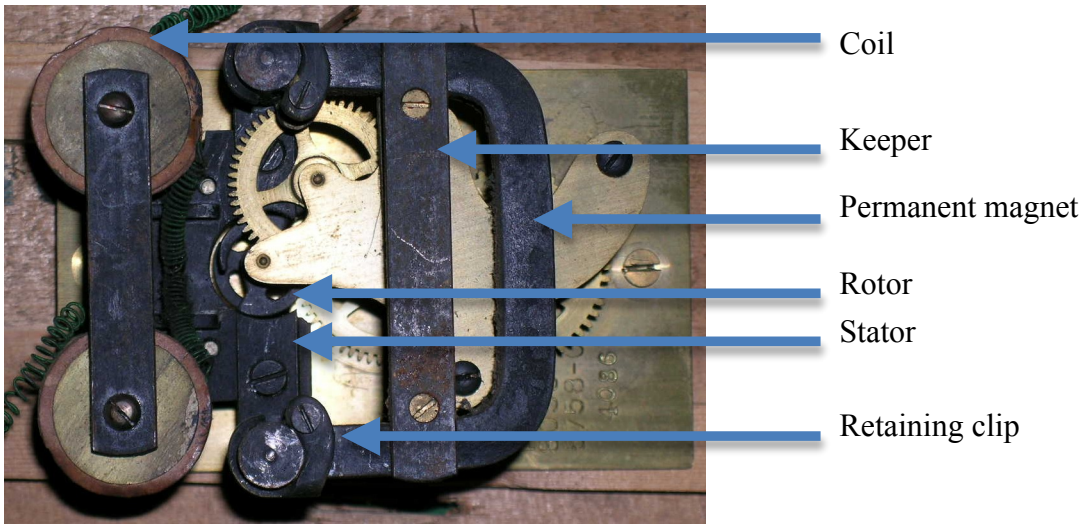


Figure 1 - Silent Electric slave movement

**Figure 1** shows the general arrangement and the main parts. All photographs used in this article are on an additional 'spare' movement which gave better access for photography, but has not yet been cleaned and tidied, so is very much 'as found'.

## 2. Work carried out

I decided that in order to improve the reliability I would need to increase the permanent magnetism, since on both of my slave movements that I had in use the keeper had to be set to give minimum reduction to the permanent magnetism and I still found that operation was erratic. There would have been two ways to carry this out, firstly to re-magnetise the existing permanent magnet using a coils would around it and a large pulse of current. This can be done and I'm sure others have done it successfully, but it needs care to get right and accidents can easily happen with the large currents available form a car battery, often used as the low impedance high current source. In addition there was no indication how permanent such a re-magnetisation would be. The other solution is to use small modern permanent magnets 'hidden' in the magnetic circuit. This has been used and demonstrated elsewhere by another AHS and group member, and it is to him I'm grateful for the idea.

I decided on the second approach, as I really didn't relish the idea of large currents and car batteries! I measured the square section of the permanent magnet used by the SE movement. It is an 8mm square section, so I looked for this 8mm round or square magnets, magnetised so that the large faces were the pole pieces. (i.e. if the magnet was coin shaped, the poles would be on the head and tail faces.) A suitable 8mm x 1mm thick round magnet was found at www.first4magnets.com and a set purchased. Two would be used in each movement, one on each end of the old permanent magnet.

Work went as follows;

### 2.1 Dismantling the permanent magnet

The permanent magnet is removed by loosening the two retaining clips shown in **Figure 1** and close up in **Figure 2**.

Figure 2 - Retaining clip

The parts then come apart as shown in **Figure 3**. This is as much dismantling as is needed for this operation.

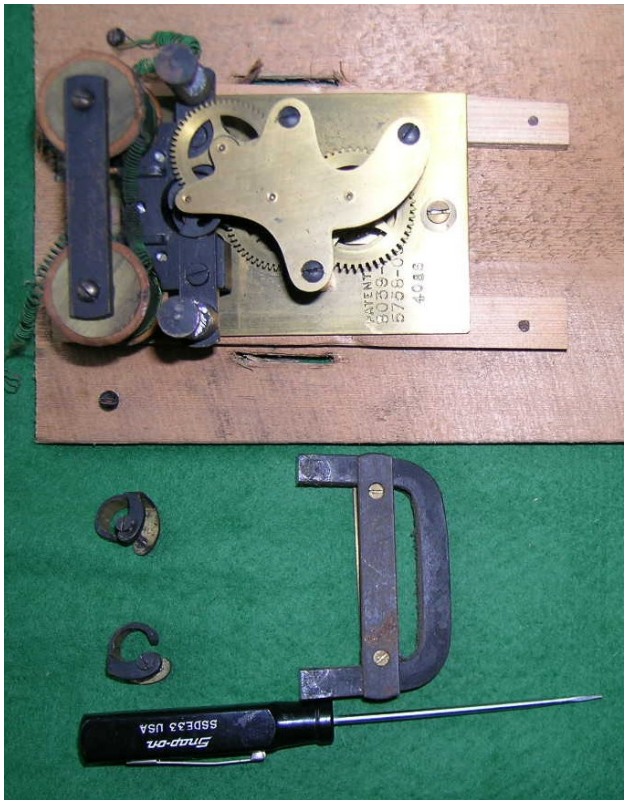

Figure 3 - Movement with permanent magnet separated

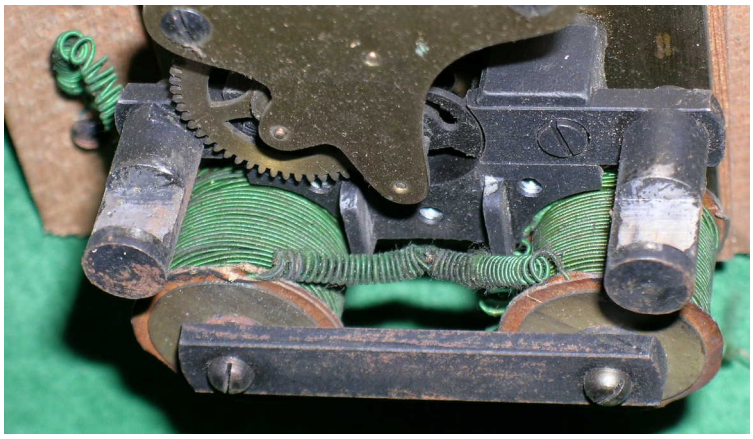
Figure 4 - pole piece receptacles on the stator assembly

## 2.2 Identifying the poles

Next it is necessary to identify the poles of the existing permanent magnet. I have used the convention that a 'north' pole is that which attracts the north end of the compass needle. If using a good grade compass, be careful to keep magnets at a distance because strong magnets can damage the compass if brought too close. Check which of the permanent magnets attracts the north needle of the compass. On all three slave movements I have seen so far this has been the left hand side pole as the magnet was mounted on the movement and when viewed from the rear. This is shown in **Figure 5**. I also checked that the other pole was showing south (**Figure 6**)


Figure 5 - Identifying the north pole


Figure 6 - Checking the south pole

Having identified the poles of the original permanent magnet, the new disc magnets have to be fitted such that they *add* to the existing magnetism (not oppose it) and so retain the original magnetic arrangement. To do this the poles must be arranged such that the new magnet attaches to the old N-S – i.e. the south pole of the new disc must be against the north pole of the original magnet. To check this – the new magnets are checked against the compass. This is rather fiddly and can be seen showing the north pole in **Figure 7**. Its best to attaché the magnets to the original permanent magnet immediately this is done, or they can be marked with a felt tip pen. **Figure 8** shows the new magnets in place on the old magnet (apologies for the photo quality).

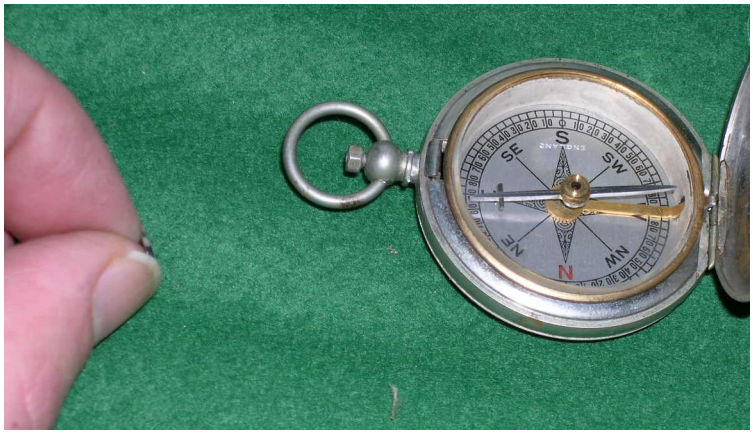

Figure 7 - Checking the polarity of the new magnet

## 2.3 Reassembly

Figure 8 - New magnets in place on old magnet

The permanent magnet can now be refitted to the stator assembly and the retaining clips refitted. This is quite fiddly, but the main thing to watch for is that if the magnets get displaced at all, they MUST be refitted with their polarities correct.

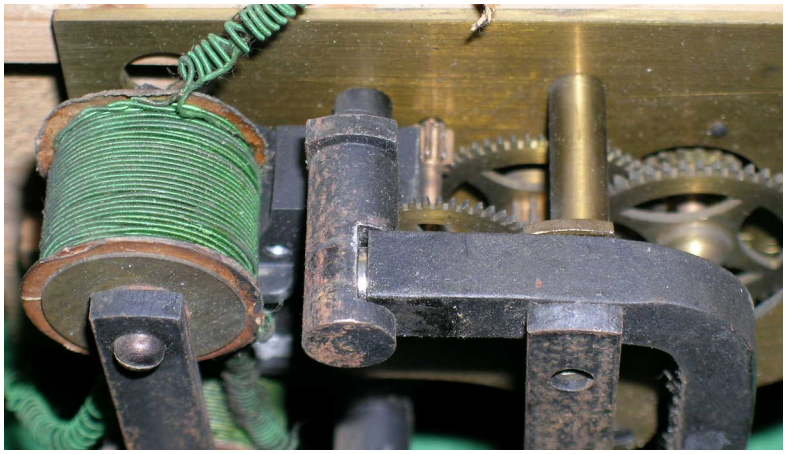
Figure 9 - Magnet replaced showing inserted new magnets

**Figure 9** shows the new magnet in place between the pole piece of the old magnet and the pole piece receptacle on the stator assembly. This has been assembled for the photograph without the retaining clips.

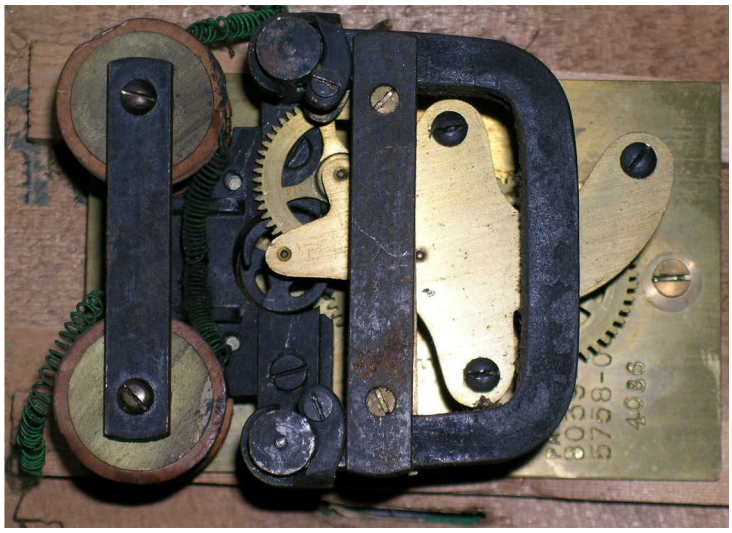

Figure 10 - Final assembly

**Figure 10** shows the final assembly with the keeper now set in place to reduce the magnetism as much as possible. It was found on the two slave movements on which I carried out this modification that they now operated perfectly on 250 mA with the keeper set to almost reduce the magnetism as much as possible. The clock and slave are shown below in **Figure 11**.

Figure 11 - Silent Electric clock and slave