

**INSTALLING AND MAINTENANCE**

**A quick guide to running your clock system**

Before we deal with complete systems, I will clear up a few points that have arisen over time, using the information from the G.P.O. itself!

**Contacts** - I have followed a debate about running slave clocks directly from the Master. While it is true that the 30 second pulse contacts generally spent their working life driving two 5000Ω relay coils in parallel; one for exchange equipment, the other for clocks; the contacts for all the spring-sets in the clock 36 are made of an alloy containing 90% Platinum and 10% Iridium. The drive magnet usually operates more often than the 30 second pulse contacts, and it has a nominal 450mA running through it. Therefore, running only 200-300mA through the 30 second pulse contacts should not be a problem. Having said that, I would still suggest getting a miniature relay with a coil resistance of at least 500Ω

**Drive magnet voltage** - While we are on the subject of power, I will just say that one of the usual questions that I get asked is; "What is the voltage required to run the Clock 36's drive magnet?" There seem to be two answers for this!

To explain:-

In the GMT 34, resistor R3 is in series with the 10Ω drive magnet, across the supply voltage. Using the chart from diagram GMT 34/1, we see the values given for this resistor for various supply voltages.

24V	40V	50V	60V
50Ω	90Ω	110Ω	135Ω

adding the 10Ω for the drive magnet coil, we get:-

24V	40V	50V	60V
60Ω	100Ω	120Ω	145Ω

this gives us current in amps of:-

0.4	0.4	0.4167	0.414
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multiply the current by the drive magnet resistance to get:

4V	4V	4.167V	4.14V
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therefore, the drive magnet seems to be designed to run between 4 and 4.2 volts, and the actual figure of 4V is found in paragraph 3.3 of PR479B, which outlines the specification for the Clock No. 36.

"The pendulum shall require not more than one driving impulse for every 15 complete oscillations when a battery of 4 volts is connected to the terminals of the driving coil."

A copy of this specification can be seen by clicking here.

So with the standard resistance of the drive magnet being 10 ohms, the supply should be 4 volts at 0.4 Amps.

But there again...

The Tests & Routine instructions, Z5503 states that the drive current should be between 450-500 mA.

After proper adjustment of the spring pressures, etc., my Mark 6 was found to require a driving impulse every 8-9 complete swings of the pendulum, using approximately 430mA, about 4.3V. Ignoring the conflict of information above, somewhere between 4.25 and 4.5 Volts keeps a nice balance between the number of complete swings made, and the volume of the pendulum "rattle" as the magnet is cut off.

*A most important point on any new installation is to check the current of both the drive magnet and the slave clock circuit(s) and adjust the resistances accordingly.*

**System power supply (mains adaptor)** - There are two points to consider here. Firstly, the number of slave dials that you intend to run, and secondly, whether you also intend to use a relay, GMT 34 or 35 unit, or some of the other equipment that was available for Master clock systems (Programmers and the like!).

For a simple Clock 36 - slave dial installation, a small 'plug in the wall' 4.5 or 6 volt mains adaptor should suffice as long as it has a rating of at least 450mA. A 4.5V adaptor will run the clock 36 directly and also 2-3 slave dials. If you intend to use a relay, then get a 6V adaptor, as this is a common voltage for small relays. 6V will run 3-4 slave dials, but you will also need a 5Ω resistor in the drive magnet circuit.

For 12V supply, a 20Ω resistor in series with the drive magnet will run half a dozen or so slave dials.

For the above voltages, you will also need a resistor in the slave dial circuit if using less than the maximum number of dials.

**System power supply (Battery)** - The main advantage of this system, is that the clocks continue to run in the event of a mains failure.

Although dry cells work, even the D size alkaline cells did not last more than a few days when I tried them, so I do not recommend them. The best way I have found, is to get a 'no maintenance' sealed lead acid battery with a plug in the wall charger. 6V does work OK, but if you intend to expand your system or maybe even obtain a GMT 34 or 35, then I suggest getting 12V. A 2Ah battery is not very big or expensive either.

It is important to use a modern 'plug in the wall' lead acid battery charger which looks very similar to a mains adaptor, and again, these are not very expensive and after initially charging the battery, they switch over to trickle charge, thus avoiding damage due to over charging.

**VERY IMPORTANT** - Never, ever, even consider using a lead acid battery without putting a 1 or 1.5 AMP fuse on one of its leads.

To explain - If the battery has a capacity of 2Ah, that means it is designed to supply current at the rate of 2 amps for 1 hour. it will also supply 1 amp for 2 hours, 4 amps for 30 minutes, 8 amps for 15 minutes, and (possibly)... 120 amps for one minute. This last figure is probably more than twice the current that is needed to start an average motor car, not the sort of condition you would want flowing through your clock system if something were to go wrong! Not only that, but a dead short across this type of battery even for a few seconds, will seriously damage or totally ruin it!

**Clock systems** - First we will look at the most basic system possible.

**Basic mains system** - This comprises of a Clock 36, some wire, a 3 way terminal block, one resistor, a 4.5 volt power supply and 1-3 slave dials.

Inside the Clock 36, use a short piece of wire to link together the pendulum drive+ and the battery+ or E terminals. Connect one side of the power adaptor to either one of these linked terminals. Now link the pendulum drive- and battery- together (4.5v adaptor ONLY) and connect the other adaptor lead to that. Take one wire for the clock circuit from the terminal marked 30 sec. clocks, and another from either of the positive + terminal. (G.P.O. Strowger exchanges were positive earth systems, which is why the positive terminal is marked + or E). take the two leads to two of the three terminals on the terminal (or connecting) block. If you have 3 slaves, then connect the clock circuit to the same two terminals otherwise; connect one lead to one of the two terminals that are connected to the clock 36. and the other wire to the spare terminal. There will be two positions left in the connector block for the resistor. For 2 slaves use a 5-7 $\Omega$  resistor, for 1 slave; 10-14 $\Omega$ .



As long as the Clock 36 and slaves are adjusted properly, turn on the power, slowly increase the swing of the pendulum until the hipp toggle catches, and everything should work fine.

**Relay output system** - You will need a supply voltage that will run the relay coil. 6v or 12v is a good value, remembering that you can run a 6v relay from 12v as long as you put a resistor that is the same ohm value as

the relay's coil, in series with it. You will now need an additional resistor for the pendulum drive, 5 $\Omega$  for 6v, 20 $\Omega$  for 12v.

At this point it starts to get hard to hide everything in side the clock itself. One idea it to have a small box, preferably of wood to match the finish of the clock case, that can either just sit on top of the clock or you could just locate the extra stuff further away.

For supply voltages over 4.5v, you will need to run 4 wires into the Clock 36. These are:-power for the pendulum drive, power for the spring-sets, a common return and also the output from the 30 sec. clock spring-sets.

You will need to connect a number of wires to both side of the power supply. A neat way to do this is to use a connector block, 8 terminals long and connect the negative power lead to one end. Along that side of the block, link every other terminal to the power lead, leaving the terminals in between them spare. For the positive, use a 3-4 connector block and link all the terminals down one side

Using a relay, there are three power circuits.

**DRIVE MAGNET CIRCUIT** - take the correct resistor for the voltage that you are using, connect between a power terminal and the spare next to it on the negative connector block. connect a wire from the resistor to the Clock 36's -ve pendulum drive. connect a wire from the +ve pendulum drive to the +ve connector block.

**RELAY CIRCUIT** - If the relay coil voltage is less than the supply, then use a resistor on the -ve power connector as above, otherwise; take a wire from one of the -ve power terminals to the -ve battery terminal in the Clock 36. Take another wire from the 30sec. clock terminal to one side of the relay coil, and a last wire from the other side of the relay coil to the +ve connector.

**SLAVE CLOCK CIRCUIT** - It can be wise to add a 500mA fuse into a large slave circuit, which would be in series with the clocks. You would need 2 spare terminals on the -ve block and proceed as follows;- take a fuse holder and wire between one of the -ve power terminals and a spare next to it. connect a resistor (dependent on the number of slave dials) between that and another spare terminal. take a wire from the resistor terminal to one side of the 'Make' contacts on the relay. You can use a meter; set to resistance; to test which contacts make when the relay is operated. Take a wire from the other side of the make contacts, and also a wire from the +ve terminal block, and these two wires connect to your slave dials in series. If you are not using a fuse, then wire as above for the other two circuits, adapting for whether or not you need a resistor.

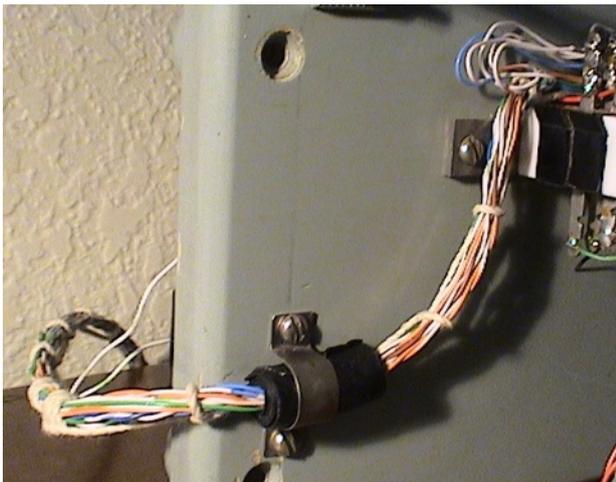
**Adding a GMT 34 or 35** - You will need at least 12v to run this unit. The relay armatures tent to pull in a little slower on 12V and you might need to adjust the spring-sets in the clock so that they give a longer pulse. To do this, carefully bend the springs at the buffer block end, so

that the springs are very slightly nearer to the pendulum. Also, you might find that you need to take a small amount of tension off the GMT's relay lever springs, these are the ones nearest to the relay armatures.

These units can be a little noisy and it can be a good idea to either mount these remotely from the clock, or if noise is not a problem then they can be fitted in a purpose made wooden case, designed to fit just under the Clock 36. A nice wooden case with a glass panel is excellent if you wish to leave the cover off the GMT 34 to show the relays working. Not only that, but the box could also house all the other parts; fuse holders, etc. including the lead acid battery, and to make that look in keeping, a paper label can be pasted around it, one idea for the common 12v 2.1Ah size of 178 x 66 x 34 mm is shown here.



Another consideration for both noise and power usage, is whether you require all of the relays to function or just the ones for the 30 sec. slave dials. You will need to run a minimum of 4 wires into the clock for just the 30 sec.



pulses, 8 wires to run the whole unit. There are two ways to run the wires to the Clock 36, the first is a multi core cable as used on telephone and alarm systems, or you can use single wires, laced together with twine, which can look quite good.

Here we see the inside of a GMT 34, which is still as initially supplied with 5 relays. If you examine one of these units, then it could have any number between 5 and 8 relays, the extra ones would have been fitted locally to supply extra slave dial circuits.



Now to check the voltage that the unit was wired for. If it came from an exchange, then it should be 50v, from an administrative building; 24v. The resistor coil No. 9's are the ceramic cotton reels to the lower right of the unit (Left in the picture below.), hopefully topped with a black disc, marked to show which resistor is which. If there is more than one resistor in a 'stack' then the label had a radius line on it, and you read the resistor names R1, R3, etc. in a clockwise direction. The first number relates to the top resistor.



To check for the original supply voltage, locate R3. This resistor is for the pendulum drive and it will be 110Ω for 50v, and 50Ω for 24v. To run on 12v, you will need to change this either for a 20Ω resistor or if you want to get the drive supply exact, a 25Ω wire wound variable resistor. Now for R2, which is a resistor coil No.12 (Right side of picture.) and located in the back of the unit, along with the terminal block. At 50v, its value

would be 500Ω, at 24v (and 12v) it would not be needed. Sometimes it was taken out of the unit, but the more usual way was for both wires to be joined on one side of the resistor, using it more as a connecting tag, while leaving the other end disconnected. This is what you will need to do with yours, unless you are running it on a voltage greater than 24v.

**Fuses** - below is pictured a typical installation, with all the whistles and bells, including the smaller Clock No. 46!



There are 2 type of fuses here. At the top is a block containing the type 44 fuses. There are four in use, which run the pendulum drive and clock spring-sets at 1.5 A; one to run the 30 sec. Relays at 1.5 A; and two 3A fuses, one for the battery jack in the GMT 34, the other as a further fuse between all the slave dial circuits and the battery. If one of these fuses blew, part of the fuse would spring onto the bar in the middle of the fuse block, which would then light the lamp at the top left to indicate a blown fuse. The lamp circuit had its own fuse at the right end of the block.

Below these are the individual slave circuit fuses. It seems that there are six circuits in this installation. These are the type 36 1¼ inch (32 mm) glass fuses rated at 500 mA.

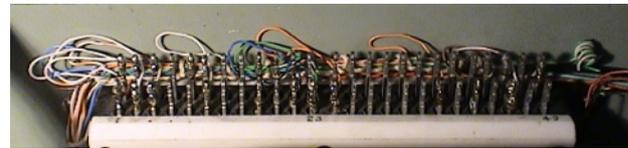
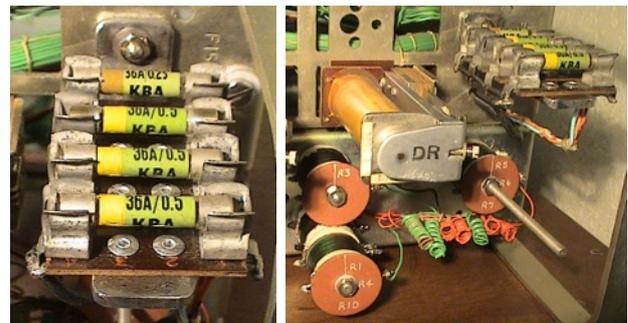
There are four power circuits that usually leave the unit as they use an external 44A type fuse mounting, before the individual power leads return to the GMT 34. Of



course, you do not need to make a set-up like this, as small 36A type fuse carriers can be fixed and concealed inside the GMT 34 if need be as shown below.

You will need diagram GMT 34 (with synchroniser), or GMT 34/1 to show which circuits run to which terminals, or failing that; I have composed a list below.

The front left tag is number 1, the rear right is number 50. Odds at the front, evens at the back.



Red highlighted terminals indicate the bare minimum, blue to run all the relays, Green indicates the 1 sec. and the additional 30 sec. clock circuits (if installed), black concerns other equipment and is shown for completeness.

**GMT 34 terminals and connections**

1	power -ve	AP, BP, CP, DP via 1.5A fuse
2	Clock 36	-ve drive magnet
3	Clock 36	-ve to pulse springs
4	Clock 36	1 sec pulse BR
5	Clock 36	30 sec, clocks AR
6	Clock 36	6 sec. pulse CR
7		
8		
9	Clock cct	1 sec. Clocks (installed)
10	power -ve	Battery to drive magnet and pulse springs via 1.5A fuse, R2 and R3
11	Clock cct 1	AP1 springset
12	Clock cct 2	AP2 springset (installed)
13	Clock cct 3	BP1 springset
14	Clock cct 4	BP2 springset
15	Clock cct 5	CP1 springset
16	Clock cct 6	CP2 springset

17	Internal +ve to DR1 springset	
18	Exchange DR1 30 sec. pulse	
19	Internal +ve to BR1 springset	
20	Exchange BR1 1 sec. pulse	
21	Internal +ve to CR1 springset	
22	Exchange CR1 6 sec. pulse	
23		
24		
25	Clock 36	Drive magnet +ve
31	Clock 36	Synchroniser
34	Internal +ve to CR2 springset	
35	Exchange CR2 6 sec. pulse	
36		
37	Clock 36	30 Sec. exchange equipment DR
41	Clock cct 7	DP1 springset
42	Clock cct 8	DP2 springset
43		
44		
45	Power +ve	provides earth to AR BR CR DR and whole unit
49	Spare	Use for -ve if installing internal fuses
50	Internal Battery jack -ve	

Having got the system wired up, it is wise to check a few adjustments on the Clock 36, before turning the whole lot on!

**Installing the pendulum** - I have had some practice but I still find this manoeuvre a little tricky, so please read all of this first and try not to take shortcuts, every time I try and do that, something gets bent!

First check the two suspension springs at the top. These are 1¼ inch by ¼ inch, and should be straight and flat. If there are any signs of cracking or breaking, or if they are severely bent, then you will need to get replacements. It is better to do this now, then to have the possibility of the very heavy pendulum coming adrift when the clock is running.

More detailed information about the suspension spring is available by clicking here.

Next down from those, are the two arms that operate the 1 second contacts. Push them in towards the pendulum rod (You would have probably needed to adjust these anyway, so get them out of the way now. Check that the sleeves that push against the contact springs rotate freely, and if not, investigate why.

Now come the two pawls which operate the six and thirty second count wheels. The screws that hold the pawls in, have pin point ends and if adjusted correctly, the pawls should move up and down freely, with no sideways movement. If you need to adjust these then loosen one

locking nut, tighten until the pawl just begins to stick, then loosen a fraction of a turn until it falls and travels freely. Tighten the lock-nut whilst preventing the screw from turning (Can be tricky!) having locked the nut up, give the pawl a final check. Take note of the face of the pawls that travel along the count wheels. Take an elastic band, slip it over one pawl, up over the one second cams and then down over the other pawl. This should keep the pawls in their uppermost position, and out of the way of the count wheels.

The next item is the iron pole piece that the drive magnet attracts. Usually, this is in about the correct position, as is the agate for the Hipp toggle below it. Leave these for now and with luck, we will not need to do anything about them yet.

The Hipp toggle spring-set is screwed to the clock casting. This is the usual thing that gets bent up just as you think you have successfully made it! It will probably need to be adjusted anyway, so it is a good idea to remove the two screws from the casting, and then carefully let the whole assembly hang.

Now you are ready to install the pendulum. Remember that it quite heavy and that a little mental preparation can go a long way. It is also quite useful to read the next section a few times while studying how to get the thing in by looking at the parts on the main casting.

Before you start, place a small slotted screwdriver inside the bottom of the clock case on the right hand side. Hopefully, you will not need this, but if you do, then it becomes vital that you can get hold of it easily!

Rotate the pendulum until the Hipp toggle agate is pointing to the left. Hold the rod near to the top (if right handed) and take the weight with the other hand. Do not hold the big 'bob' as it can slide up. Hold either just above or below the bob.

Keeping the bottom of the pendulum about one foot (30 cm) away from the clock case, aline the suspension bar at the top of the rod with the locating casting at the top of the main casting. There are two small slots for the suspension bar to fit into, carefully help it to drop into these. You may need to rotate the pendulum a little to help the suspension bar into the casting.

Slowly move the bottom of the pendulum toward the clock whilst checking first that the one second arms clear the contacts, and then the same with the pawls and count wheels. At about this point, you will need to swing the pendulum to the left, for the rod to clear the drive magnet. If you did not unscrew the Hipp toggle spring-set, then this is the time to keep an eye on it!

When the rod has passed the front drive magnet arm, slowly allow it to move to the right, until it is hanging naturally. Check to make sure that the suspension bar is still located properly.

If the drive magnet fouls the pendulum, then grab the screwdriver and loosen the pole piece screw on the rod, move it up until it clears.

**Initial adjustments** - Check the position of the pendulum against the register that is screwed to the case below it. If the pendulum is a little behind or in front of it, then it means that the wall is not quite plumb. The clock has a good tolerance and this should not be a problem. To adjust a left or right error, go to the suspension rod at the top and loosen the lock nut on the side that you wish to move the pendulum. As you tighten the nut on the other side, the pendulum will slowly move across. Adjust these two nuts until the pendulum is in the correct position, then tighten them both, followed by a final check.

Next item is the Hipp toggle and agate. Even if the bottom of the pendulum is either forward or backward of the register, then the adjustments are still basically the same. Firstly, when at rest, the Hipp toggle should be hanging freely, just a fraction to the left of the agate, but not quite touching it. There are two slots on the main casting to adjust this and you will probably find that the correct position is almost as far to the left as the toggle assembly will go.

Next, align the toggle springs with the agate holder. If your clock is perfectly vertical, then they should both line up with the swing of the pendulum. If not, then you will need to adjust both of them, until they are pointing directly at each other. It can be useful to have a small mirror and position it so that you can look along the line of the toggle and agate. It is quite important to make sure that the Hipp toggle is aligned as centrally as possible to the agate.

Now to check the agate/spring-set height. Firstly, check that the pawls are either still held out of the way or are sitting on the count wheels correctly, before moving the bottom of the pendulum to the left. Be careful not to pull it forward or backward, as the pawls tend to drop off the count wheels and foul things up! Move the pendulum so that the toggle (if roughly adjusted correctly) rides up the agate and then falls into the gap between the agate and pendulum. Slowly move the pendulum left and right so that the toggle travels the whole length of the gap. The toggle should *just* clear the bottom of the gap for its whole length of travel. Either adjust the agate holder itself, or with care, bend the bottom buffer (thick) spring of the spring-set, by using spring adjusters, or with care, thin nosed pliers. It is best to adjust these as close to the buffer block end (Not the contact end!) as possible by putting the adjusters over both the buffer and contact spring, and giving a little twist in the direction that you want the spring to go. Err on the side of a wider gap as opposed to the toggle touching the bottom of the gap.

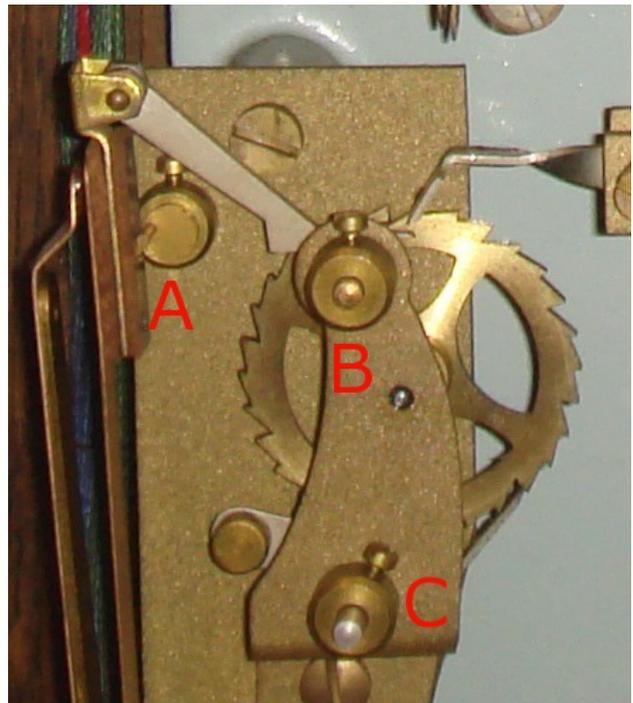
The last check is the gap between the two toggle spring contacts. This is covered in Tests & Inspections, Routine Z 5503, but I will repeat it here for convenience.

*Ensure that contact springs are straight against their buffer springs or stops, and check the alignment of the*

*contacts. Check that all contact separations (springs normal) are 10 mils minimum. Check that all lever springs are tensioned against their buffer springs or stops with a pressure of 5 to 8 gm, measured at the tip. Check that all 'make' springs have pressures of 15 to 20 gm against their buffer springs, measured at the tip.*

The lever springs are the ones that move first, the make springs being the ones that the lever springs contact. There is more in-depth information in Z 5503.

**Clock 36 spring adjustments** - these are made to adjust the length of the 30 and 6 second pulses and also the count wheel detents or "stops". I refer to the letters in the picture below.



'A' and 'B' have an off-centre bar, whilst 'C' has an eccentric cam. Assuming that you now have the Hipp toggle adjusted and a supply of 4V to the magnet drive, then give the pendulum a few increasing swings until the Hipp toggle operates. Usually, it will operate 3 to 4 times in a row as it gets the pendulum into its normal range of operation.

The first adjustment is 'C'. As the pawl moves the count wheel, the detent or 'stop' behind 'C' should fall into the next tooth and continue until it is about 20% along the next tooth before the pendulum and count wheel reverse, when the detent should stop the wheel. To adjust:- loosen the screw at 'C'. Move the centre rod forward or backwards to centre the detent on the count wheel, turn it to alter the 'stop' position. When set correctly, the pawl at the top should also fall 20% past the next tooth. Again, refer to Z 5503 for more information.

Having noted the action of the count wheels, detents and springs, it is actually better to have the clock stopped to adjust 'B' and 'A'.

Adjustment 'B' is for setting the height of the arm that operates the spring set. The correct height is obtained when riding on the normal (shallower) teeth, the pawl *just misses the arm*, and that when riding in either of the two deeper teeth, the pawl engages and moves the arm. Again, loosen the screw and turn to set the height. Check that the arm is sitting on the bar, but take care not to push the rod in too far, or it can foul the count wheel.

'A' is for setting the length of the pulse. The gap between the two springs should be adjusted *after* setting the length of pulse. 'A' can be moved forwards and backwards to position the rod on the lever spring, and rotated to adjust pulse length. Moving the spring nearer to the count wheel increases the length of pulse. One cause of having slave clocks going out of sync with each other, is having too short a pulse which leads to one or more of the slaves not having time to operate, especially at minimum pendulum swing (just before the Hipp toggle operates.). The correct length of pulse is between 200 and 500 ms. To save power, especially on a battery run system, try to get nearer the 200 ms timing, remembering that the difference between the pendulum's minimum and maximum swing will affect this slightly. Having set that, then adjust the gap between the two springs, by bending the thicker buffer spring as near to the buffer block as possible. The last check is that the lever spring pushes the make spring enough to just lift it off the thick buffer spring when the pendulum is at its minimum swing. I find it easier to disconnect the drive magnet power, then wait until the Hipp toggle operates, checking the springs on the swing after that. The toggle will keep operating for several swings after that, so restoring the power quickly can save having to help the pendulum manually.

The one second contacts are less complicated. The two arms that operate the contacts should be positioned so that at the pendulum's minimum swing, they still move the lever springs far enough to lift the make springs off their respective (thick) buffer springs. The nearer the arms are to the springs, the longer the pulse will be. Try to adjust both arms, so that the alternating 1 second pulses are of the same length!

**GMT 34, 35 Relay and spring-set adjustments** - as above with lever spring about 5-8 gm, make springs 15-20 gm, but if running on 12V, then the lever springs need to be nearer to 5 gm, for the relay to operate satisfactorily. The complete set of adjustments for 3000 type relays, including spring-sets, armatures, etc. can be found in Telephones, Automatic, B 5144.

**Synchroniser Adjustments** - Firstly, let us identify the differences between the mark 4, 5 and 6 Movements.



The Marks 5-6, shown in the left picture, never had a synchroniser, whereas the Mark 4 in the centre picture tells a familiar tale of a clock that has had the synchroniser removed during refurbishment. There are a few examples that still contain the synchroniser, shown in the picture on the right.

There are three items that should be checked.

There is a spring at the bottom of the armature (not shown), This should have enough tension to return the armature to the non-operated position.

Referring to the picture below, the two round nuts (C) should be adjusted so that the main lever (A), is just clear of the momentum stop (B). The vain adjusting nut (D) should be loosened. The vain should contact the detent arm roller (E), in such a position that the following conditions apply. 1) When the clock is correct and the synchroniser operates, causing 'A' to hit 'B', the detent 'F' lifts a little but is still engaged in the count wheel teeth, preventing it from turning backwards. 2) when the point of the heart shaped wheel is opposite the main arm roller, the detent has lifted just enough to allow the count wheel to rotate freely by the time the roller touches the heart shaped wheel.



If it is not possible to get it adjusted as above then lower the main arm 'A' by turning the nuts 'C' a little, then re-adjust the vane 'D' again.

The synchroniser operates at 20 Volts, the pulse being 1 second in duration.

For more on G.P.O. synchronisation, click [HERE](#).

**Oil and lubrication** - Firstly, a little about the type of oil that should and should not be used. Some of the horrors to be avoided at all costs come with names like "3in1", "WD40" and "penetrating oil". These products are very good at doing the tasks that they were designed for, but they are much too thin to be of any use on a clock mechanism (any clock mechanism!). The engineering instructions suggest Wakefiled's Superfine Oilit (No longer available!), or 'Oil, Bearing No. 16' but a decent clock oil or Marklin HO model train oil is fine along with any good oil with a viscosity of S.A.E. 10. The synthetic versions do not tend to thicken if they evaporate, and are considered more suitable. A small bottle of good quality oil may incur some expense; but with the amount used; it should be a lifetime purchase and therefore justified.

**Without Synchroniser** - There are only 4 (or 6) places on a clock 36 that should ever be oiled! A small drop should be applied to the front and back pivots of both count wheels, with an option of oiling the two pivots on the Hipp toggle if necessary. Putting oil around the count wheel teeth or anywhere else does more harm than good, as minute particles of dirt can get stuck into the oil and cause more wear than normal. If your clock has visibly dirty or hardened oil, then it is better to clean it off by disassembling the section concerned and using lighter fluid applied either on a small artists paintbrush or a matchstick to clean the old dirt from the pivot holes. Finish up by removing any other dirt by bathing and/or wiping.

Putting fresh oil over very old and dirty oil, usually results in the dirt being pulled into the bearings and accelerating wear.

**With Synchroniser** - A drop of oil may additionally be used on the bearing at each end of the three rollers. These are located as follows:- 1) on the right of the main arm, contacting the electromagnet armature. 2) On the left side of the main arm, contacting the heart shaped wheel, and 3) On the bottom of the detent (stop) that prevents the 30 second count wheel from turning backwards.

Oil the six bearings of the three spindles (count wheel, main arm and detent.)

Officially, a 'drop' of oil is defined in E.I. Telephones, Automatic, B 5137, Paragraph 1d as:-

*The amount pendant from the end of a piece of 23 S.W.G. Gauge wire (9¼ lb. per mile copper wire) after immersion in oil to a depth of 5/8 in.*

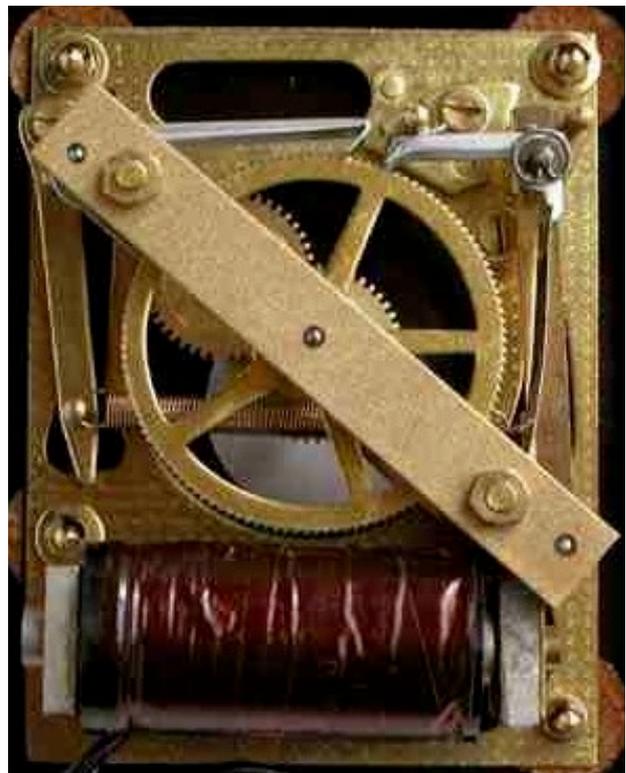
Click here for B 5137.

Yes, even a drop of oil was described in a specification somewhere!

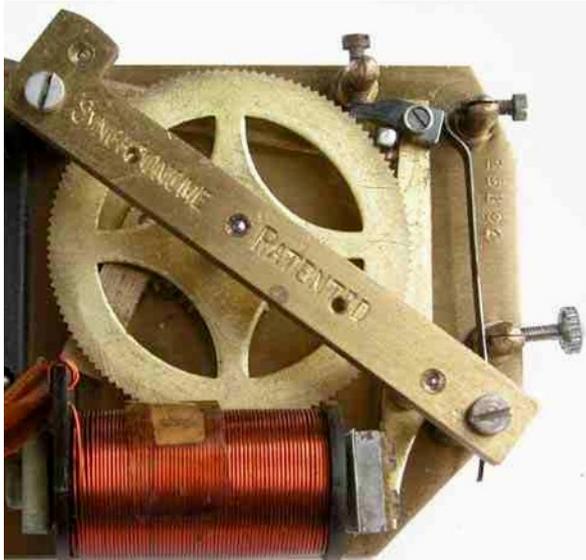
**System Installation - Slave dials** - Firstly, we take a look at the slave dials. having a good multi meter is preferable, especially a digital display type, but although desirable, this is not a necessary.

**No multi meter** - Take a 1.5 volt battery, connect a pair of short wires to the first slave clock's terminals. keeping the clock upright, with the back facing you, connect the battery for half a second and watch the movement. on connection, the solenoid armature should pull in, making the pawl on the large toothed wheel advance by one notch. on disconnection, the armature should return promptly, with the pawl advancing the toothed wheel and minute hand by one half minute. If this fails to work correctly, then refer to Z 5506 for more detailed tests and adjustments.

**Multi meter** - The G.P.O. recommended that the slaves were tested with short pulses of 200ma (minimum) and 300ma for correct adjustment and operation, but it is possible to run these slave as low as 170ma without sacrificing accuracy. There are two good reasons for using the lower figure, the first is obviously less power used, which is important in a battery run system. The second point becomes more important where noise is concerned as the lower the current, the less noise that the slaves tend to make.



**Gents Movement** - Loosen the screw that can be seen at the top of the spring lever shown to the left of the movement and carefully adjust the lever for the correct spring tension.



Synchronome movement.

**Synchronome and most other types** - Adjust the lower and larger screw, seen to the lower right of the picture.

To adjust for the lower current, connect the meter in series with the slave, low voltage power supply or battery, and a variable resistor (or resistors) adjusted so the the circuit had a current of 160ma. turn the power on and off and see if the movement steps. If the solenoid failed to operate then adjust the movement as shown below, in small stages until the solenoid operates. There should still be enough spring pressure to advance the slave dial's hands when the power is disconnected. If the slave will just step on 160ma, then it should definitely run reliably on 170ma! All slaves will need to run at 170ma for a low power circuit to run reliably!

Ensure that the slave dials are wired in series with the correct resistor (if needed) so that on the half minute pulse the circuit passes a current of 170ma (or at least 200ma for normally adjusted slaves.)

**System Initialisation** - Set all the slave dials to the same time, as this can save a lot of work later on. Check that you have installed (any) fuses in their holders and power up the system. Assuming that none of the fuses have blown (If one or more has blown then go and check those circuits out first before restoring power.) Check that the Advance/Retard key is in the Retard (lower) position and then give the pendulum a few gentle nudges until the Hipp toggle engages. Within a few seconds, the pendulum should have settled into a nice steady pattern. A good Clock No. 36 when properly adjusted, will operate the Hipp toggle about every 8-9 complete 2 second swings.

**GMT 34, Fully wired** - The following relays should already be operating:-

BR	1 second
CR	6 second

DR 30 second Exchange equipment.

If you have a circuit of 1 second slaves, then these should be operating now. Move the Advance/Retard key to the Normal (Central) position and study the 30 second count wheel. A few seconds before the 30 second contacts are due to operate, watch the relays in the GMT 34. AR and AP should operate almost together as the AP relay is operated from AR's contacts closing. You may have up to 4 relays on the top section marked AP, BP, CP and DP, and these should all operate together. If all is correct, then move the key to the Advance position until your slave dials show the correct time, then restore the key to the normal position.

**TROUBLESHOOTING** - A copy of Diagram GMT 34 or 34/1 is almost essential, either on a handy computer, or printed out onto paper and stuck together.

**Pendulum drive** - With the power on, test for 4 to 4.5v across the Hipp toggle contacts. if present then either the wiring in the clock is faulty, or the coils of the magnet drive are faulty. With the power off, test the coils for a resistance of 10Ω. if correct, then check the internal wiring of the clock. If there is no power across the Hipp toggle contacts or the pendulum drive terminals at the top of the clock, check fuse FS12 (which also provides power for the AR to DR relay coils). if the fuse is fine, then check the magnet drive circuit for continuity, remembering that the Hipp toggle will be open circuit in it's normal position.

**All relays not working** - If none of the relays seem to be operating, then press in the armature on AR. This should operate AP (to DP). If nothing happens, then check fuse FS10 and also check that the contacts are closing on the AR relay. If still bad then refer to Diagram GMT 34, or 34/1, to test the complete circuit. If AP operates, then check fuse FS12 which supplies power to the coils of AR-DR relays. Also visually check that the 1, 6 and 30 second contacts are operating in the Clock 36.

**One or more relays are operating** - Manually operate the AR relay and watch to see if AP (to DP) pull in. These (1-4 depending on your GMT 34) relay coils are operated from the contacts on AR and are wired in parallel. if one fails to pull in, then check the spring tensions (especially on 12v operation) and if need be, the wiring. If one or more of the AR-DR relays are not operating, then again, check the spring tensions and also the contacts in the Clock 36.

Another good point to check is the contacts themselves, as even a very minuscule particle of dirt or grit can get in between the contacts and stop them from conducting electricity!

**Slave Dials not working** - For installations with more than one slave circuit: If all clocks have failed, check fuse FS13, if at least one circuit is working then check fuses FS1 to FS8 depending on the number of circuits installed. For 1 second clocks, check fuse FS9 and FS13.

For a single clock circuit installation, only one fuse is required, FS13 with a value of 0.5A.

For each clock circuit, check the right resistor is installed and that the current is correct for the slave dials. check for a pulse on the terminal block between the tag and +ve earth (circuit 1 = tag 11, circuit 2 = tag 12, as per diagram GMT 34 or 34/1). check the continuity of the clock circuit itself.

If only one slave dial on a circuit is losing time or not working, then check the adjustments to ensure that the movement steps correctly for the current that the rest of the circuit runs on. Refer to Maintenance Routine Z 5506.

**GMT 34, Partially wired** - Same as above, but you will probably only have the AR and AP relays, and the clock circuit(s) to check.

**Clock 36 and relay systems** - Check the pendulum drive as above ignoring the fuse if there is none fitted. Check continuity of the relay coil circuit, including power

supply, the 30 second contacts, any resistor fitted and the coil. Check the Slave circuit, including the continuity of the power supply, relay contacts, resistor (if fitted) and the slave dial wiring.

**Clock 36, no relay** - check that there is 4 to 4.5V across the pendulum drive terminals, and that the Hipp toggle contacts operate correctly. With the power off, check for a resistance of  $10\Omega$  across the drive magnet coils. For the slave dials, check the 30 second contacts are operating correctly, and that there is continuity between power supply, 30 second contacts, the resistor (if fitted), the slave dials, back to the power supply again, remembering that there is no continuity except when the 30 second contacts are actually operated!

**SYSTEM MAINTENANCE** - For Clocks No. 36 and No. 46, refer to Z 5503, for slave dials refer to Z 5506. System accuracy tests are covered in Z 5501, and if you really have a huge system, then Z 5502 covers change over of duplicate Clocks No. 36. The frequency of these routines is shown in Z 5014.

**E N D**