

THE SYNCHRONOME MASTER CLOCK FOR  
OPERATING HALF MINUTE IMPULSE DIALS ONLY

The Master Clock is fitted in a polished hardwood case, 50 inches long, 10 ½" wide and 6 inches deep; it is fitted with a 7" diameter half minute impulse dial having minute and hour hands.

The pendulum movement consists of a substantial baseplate on which the pendulum impulsing and electrical switching mechanism is fitted and the pendulum suspended.

The pendulum is of one seconds length, that is to say, its length is such that it will take one swing from left to right or vice versa, in one second of time.

The pendulum rod is of Invar, a nickel steel alloy, having a negligible temperature coefficient, the pendulum bob is of steel and weighs 16 lbs. The construction of the pendulum is such that it is well compensated against temperature changes, and it is given impulse every 30 seconds from a detached gravity system which impulses the pendulum around the zero position, this combination enables the clock to keep time to within 2 seconds per week., and often much better.

The impulsing to the pendulum and the electrical switching every 30 seconds is illustrated and described on the enclosed Print No. 20007.

ERECTION.

Unpack the clock, the pendulum and the bob.

It is necessary to fit the clock on a substantial wall which is free from vibration if the best result in timekeeping is to be obtained. The clock should be erected so that the case is about 6 feet above the floor level; this will bring the clock movement to a convenient height for fitting up and for attention in the future.

The clock should first be hung on its hanging plate, drill and plug the wall, and fit a 1 ½" x No. 12 wood screw into the plug so that the screw head projects about ¼" from the face of the wall. Hang the clock onto the screw by its hanging plate. Open the door of the clock and hang a plumb line from the top left side of the case and bring the clock to an upright position as indicated by the plumb line. Mark off the wall, thro' the three holes, two at the top, and one near the bottom in the backboard of the case. Remove the clock from the wall and drill & plug the wall in the three positions. Replace the clock on the wall, and screw back through the three holes firmly to the wall, for this purpose three 2 ½" x No. 12 roundhead wood screws should be used.

Ascertain with the plumb line that the clock is not leaning out or in at the top, i.e. checking that the wall is upright. If the clock is not hanging right in this respect, the fixing screws should be slackened off and hardwood packing of the right thickness placed behind the top or bottom batten to bring the clock upright. Finally, tighten the screws.

Having got the clock firmly fixed to the wall, remove the ties from the gravity lever, backstop etc. and proceed with the assembly of the pendulum.

It will be seen that the pendulum rod is already fitted with the brass suspension spring chop at the top end; the impulse pallet and the bottom bob collar and pendulum bob supports or rating nut at the bottom end. Remove the rating nut and bottom bob collar from the thread at the bottom end of the pendulum rod. Get the pendulum bob and slide it over the thread and onto the rod until the rating thread projects well from the bottom of the bob, be sure that the brass domed collar fitted into the bob is at the top, place the bottom bob collar onto the rating thread and slide it onto the bottom of the bob so that the smaller diameter of it fits into the bottom of the bob. Screw the rating nut back onto its thread; allow the bob to rest on it and screw it up until the domed collar in the top of the bob is level with the mark on the pendulum rod. This will be about the right position of the bob to enable the pendulum to keep good time, altho' further adjustments will be necessary after a time, mainly owing to the difference in gravity between London and the place where the clock is being erected.

The trunnion, top chops and suspension spring will be found as one unit, clamped tight under the wing nutted straps at the top of the Master Movement frame, also the jewelled click and the case key in separate envelopes. Release the wing nut and remove the trunnion fitting and proceed to fit it to the top end of the pendulum. To do this, first remove the screw passing through the bottom chop already fitted to the top end of the pendulum. Take hold of the top chop with the spring already fitted, and insert the spring carefully into the slot of the bottom chop until the hole in the spring exactly lines up with the screw hole in the bottom chop; at the same time, making sure that the spring clamping screw head in the top chop is on the same side as the spring clamping screw will be on the bottom chop. Tighten the screw in the bottom chop until the spring is clamped firmly but not gripped dead tight.

Now remove the jewelled click from its envelope and fit it into the special slotted screw at the back of the impulse pallet so that the arm of the click comes to rest at the bottom of the circular slot.

Hang the pendulum in position by placing the cross bar or trunnion on top of the pendulum bracket at the top of the movement frame or baseplate. Be careful to get the pivots of the trunnion resting on the bracket and see that the trunnion is square, i.e. is parallel to the back of the case, also that the pendulum is positioned so that the rod is centred at the same distance from the back of the baseplate as the 15 toothed wheel, in this position the gathering click will correctly engage the wheel at the centre of the 'D' shape on the jewel.

Having hung the pendulum satisfactorily, the impulse pallet should be in the correct position relative to the impulse roller on the gravity lever. The top corner of the impulse curve of the pallet should swing under the roller with a clearance of 1/100 of an inch when the gravity lever is supported on its catch. If necessary, the pallet should be readjusted on the pendulum for height to obtain the clearance of- 1/100 of an inch if for any reason it is not so.

The position of the pendulum from right to left has been set correctly but should be checked as follows: When the pendulum is hanging still at zero the gravity lever should be unlocked from its catch and the gravity lever roller allowed to rest on the curved part of the pallet. In this position, the pivot of the gravity lever should be level, horizontally with the top corner of the impulse curve of the pallet. If adjustment is required, slacken the suspension top chop and move it along the trunnion, tighten screw. Take great care if any adjustment is made to the pallet that it is finally tight on the rod and in line with the plane of the swing of the pendulum. The jewelled click should be in the correct position for gathering one tooth only of the 15 toothed wheel for each complete swing of the pendulum however large the arc. The click arm should be bent up or down slightly if the gathering action is too shallow or too deep.

The working current in the half minute switch circuit is .33 amp and the resistance in the Master Clock which is in the half minute circuit can be adjusted to ensure this. The half minute circuit has a pair of output terminals which are bridged over to complete the series circuit.

Exterior half minute impulse dials, relays or other instruments may be added in series with the half minute impulse circuit by removing the bridge across the output terminals and connecting the external clocks etc. which should be connected in series to each other, to them. The resistance in the half minute circuit would require readjusting when external dials or instruments are added to maintain the required working current of .33 amps.

### THE MASTER CLOCK DIAL MOVEMENT

The dial movement is fitted onto the dial on the door of the case.

The propelling of the dial wheel work is by means of reciprocating brass lever having the armature plate at its bottom end which is attracted at each impulse passed through the coil. At the top end of the reciprocating lever is fitted a driving click which engages and drives to main centre wheel. The wheel is held steady and prevented from moving by the backstop lever, the steel squared end of which will be seen resting on a tooth of the wheel immediately below the driving click.

To set the hands to time, press with the finger on the left hand end of the backstop lever which will be seen projecting from the top lefthand corner of the movement, this will disengage the wheel work from the click and backstop square and leaves the large wheel free to revolve by hand. Set to time and release backstop..

### THE BEAT SCALE ON WOODEN BLOCK

The beat scale block should be stood on the bottom of the case so that the '0' in the centre of the scale is exactly in line with the bottom point of the pendulum when the pendulum is hanging still at zero. The scale should be about 1/8" behind the joint of the pendulum, when in the correct position the block should be pressed to the bottom of the case, it has two sharp projections on its underside which will hold it in position.

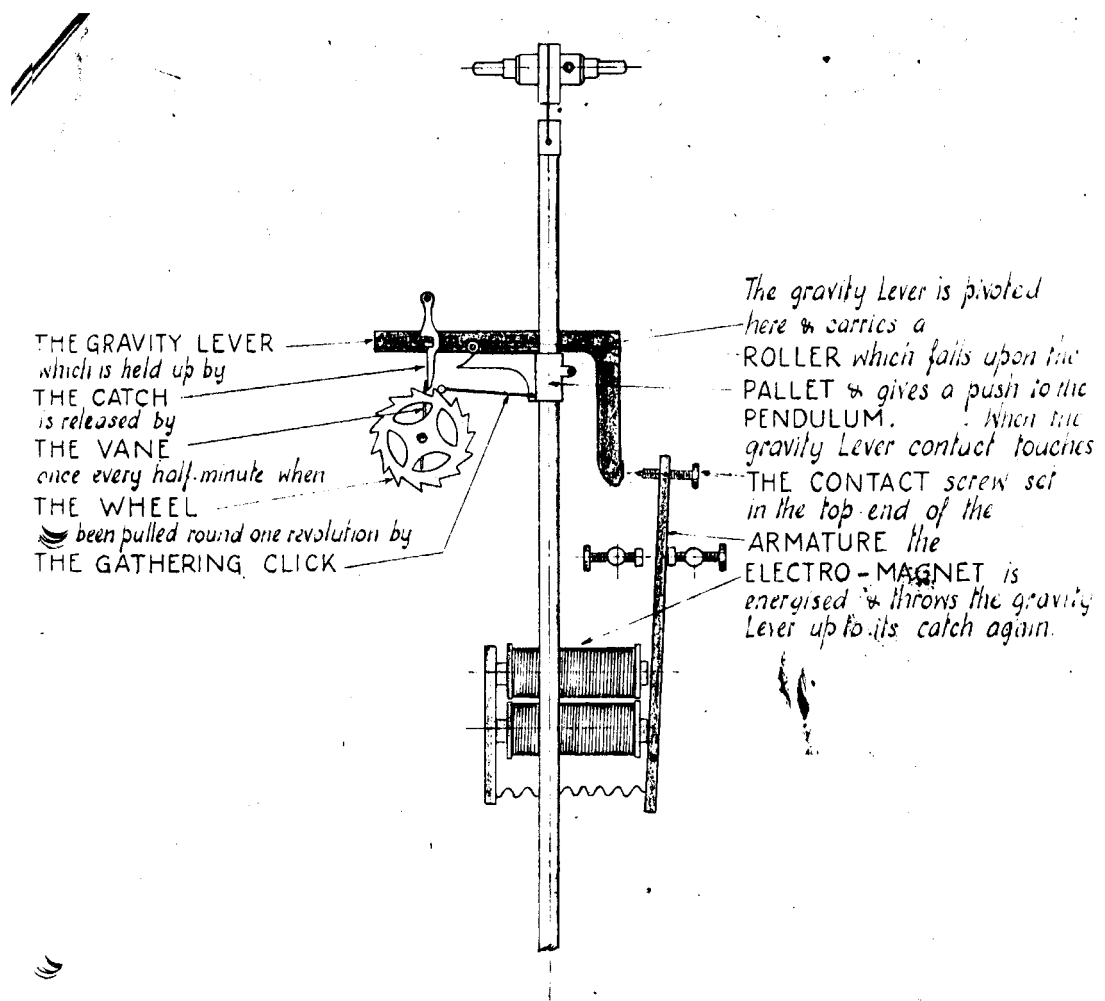
### BATTERY

The Master Clock on its own requires 4Volts for its operation but if further dials or instruments are added to the outset terminals (all in series with each other) the battery voltage must be increased at the rate of 1 volt for every 3 ohms of circuit resistance.

Where an adjustable resistance is fitted in the Master Clock for the purpose of regulating the current in the half minute impulse circuit, more voltage may be in use than is required by the circuit. In this case, the resistance should be adjusted to keep the current at .33 amps.

When everything is ready to start the Master Clock, swing the pendulum until the pointer at its bottom end shows just over 20 + 20 millimetres the scale, at which arc the gathering click will gather the 15 toothed wheel one tooth for each complete cycle of the pendulum and the gravity lever will impulse the pendulum at each 30 seconds. Leave the pendulum to increase its arc, so that after about one hour, the arc should be 36 + 36 millimetres to 40 + 40 millimetres.

After one hour, the arc should remain perfectly steady. A constant arc between the figures given above indicates the clock is in good working order and very good timekeeping may be expected.



The Synchronome Switch.

SYNCHRONOME CO. LTD. Westbury, Wilts.

Drawing No 20007

## MAINTENANCE INSTRUCTIONS

The information so far has dealt with the setting up of the clock and the performance which may be expected from it. There will come a time, however, when the clock needs attention, due to infiltration of dirt into the pivot holes and other parts, drying up of the lubricating oil, or wear or breakage of some parts or parts.

The clock should work for about one to two years without need of oiling or adjustment, during which time the arc of the pendulum should have remained, within a little, quite steady. Whilst the arc does remain steady and the clock is giving a satisfactory performance it should be left alone.

If the arc appreciably decreases or keeps varying it is generally a sign of increasing or fluctuating friction and the clock may soon stop.

Oiling all the pivots and the working surface of the catch may get over the trouble, but if it does not, the clock will have to be stripped down.

It is not usual to get trouble with the switch contacts which are made of platinum unless they are being overloaded without adequate spark suppression,

In a normal Synchronome Master Clock System operating a number of dials, all the coils in the system are individually bridged with a non-inductive shunt resistance which reduces sparking at the Master Clock contacts to a point which is negligible, and no other precaution is necessary. When the Master Clock is operating several hundred dials in a number of paralleled series circuits, a special spark suppressor is used in addition to the normal shunting this ensures complete protection of the contacts.

If the Master Clock should stop, the stoppage will either be caused by friction in the mechanism or a break in the electrical circuit either of which may be ascertained as follows:-

If the gravity lever is resting on its catch then friction in the mechanism is the cause of the stoppage. If the gravity lever is not resting on its catch, but its roller is on the pallet on the pendulum then a break in the electrical circuit is indicated, the break may be within the Master Clock but usually it is in the wiring of the external dials. Assuming the clock has stopped through friction in the mechanism and oiling the pivots and catch, as previously mentioned, does not get over the trouble, it will be necessary to dismantle the mechanism for cleaning and oiling.

To do this it is not necessary to remove the pendulum from its set position. The electrical circuit should be opened by removing the wire from the gravity lever terminal or break the circuit at any other convenient point.

Release the gravity lever from its catch and let its roller rest on the curve of the impulse pallet. Now remove the two screws holding the bridge and take out the 15 toothed wheel, the backstop and the catch, being careful when removing the bridge that these parts do not fall out. Clean the parts if possible, by washing them in benzine, petrol or tetro, drying and wiping perfectly clean with clean dust-free rag.

If it is not possible to wash the parts, clean them off well with clean dust-free rag. Clean the bridge plate and the back plate, and clean the pivot holes out with a tapered pegwood twisted in the holes, and scraped clean several times for each pivot hole, until the pegwood comes out clean.

Having cleaned the 15 toothed wheel, see that the pivots are perfectly clean and polish the long surfaces of the teeth of the wheel, they have already been burnished but may now be tarnished. It is best to clean the teeth with a metal polish, such as Blue-bell, do not touch the short upright parts of the teeth beyond wiping them clean.

When the backstop and catch have been wiped clean, this assembly is ready to be re-assembled. Before placing the back pivots in the pivot holes in the back plate, oil them with good quality clock oil. Be careful not to bend any of the pivots and that the light catch spring is resting in the little nick on the right hand side of the catch. Replace the bridge carefully, guiding the pivots into the holes and screw the plate down firmly. The catch must be on the right of the catch piece (U catch) on the gravity lever. Next the gravity lever should be taken out for cleaning, first remove the flex from the terminal, take out the screws securing the top pivot plate, take the plate off and remove the gravity lever. Unscrew the top plate holding the steel roller and take out the roller. Wipe the gravity lever clean, clean all the old oil off the U catch, clean out the roller pivot hole with pegwood, wipe the gravity lever pivots thoroughly clean and if the platinum contact plate is pitted, clean it with very fine glass paper until the pitting is removed. Clean the steel roller and its top plate and replace them on the gravity lever seeing that the roller is the right way round, i.e. the body of the roller is nearest the top plate, oil the roller pivots.

Before replacing the gravity lever attention should be given to the impulse pallet and the gathering click on the pendulum. Remove the gathering click from its bearing screw by lifting the jewelled end of the click and sliding its pivot end out of the hole, backwards. Wipe off the jewel and the pivot end of the click and clean the bearing screw with pegwood.

Wipe the pallet clean, particularly the top surfaces and the impulse curve, if these surfaces still appear to be dirty or stained, rub them carefully with a little metal polish on a rag and clean off, when clean replace the click but do not oil its pivot.

Now the gravity lever can be replaced, first clean the back bearing plate and the top bearing plate, pegging out the pivot holes, replace the gravity lever, first oiling the back pivot. See that the U catch is on the left of the catch, which must be pushed well to the right against its return spring, to do this, re-connect the gravity lever flexible lead to its terminal.

The armature should next be taken out, first unhook the tailspring and unscrew the continuity flexible lead from the baseplate, unscrew the top plate, remove it and the armature. Wipe the armature clean and clean the platinum tip of the screw with a very fine glass paper keeping it flat on the surface. Clean the top plate and back plate and the pivot holes.

Wipe the two magnet poles clean and replace the armature first oiling the back pivot, re-connect the continuity flex to the baseplate and hook up the spring.

Oil all front pivots, i.e. the front pivots of the 15 toothed wheel, the backstop, the catch, the gravity lever and the armature. Do not oil the teeth of the wheel or the click jewel or its pivot bearing. Oil the catch step, i.e. the part of it which supports the gravity lever U catch. Re-connect the electrical circuit when the clock is now ready to be set going again but before doing this check over the various settings as given in the "ERECTION" section and check and re-set the gaps at the contacts if necessary.

To re-set the gaps, first, with the gravity lever on its catch push the armature against its left hand buffer when the air gap between the armature and the top magnet pole end should be .01 inches adjust the left hand buffer until this is so. Next, with the armature still held against the left hand buffer and the gravity lever on its catch, measure the air gap between the contacts. It should be set at .070 inches (1.8 millimetres), to set this gap adjust the contact screw at the top of the armature. Finally, allow the armature to fall back on its right hand buffer and with the gravity lever still on its catch the air gap between the contacts should be set at .212 inches (5.4 millimetres). When these adjustments are completed see that all screws are held tight with their lock nuts.

Give a final check over to see that the wheel spins freely and all pivots are quite free in the bearing holes, the catch return spring has a moderate pressure and the electrical circuit is re-connected.



The Master Clock dial will probably need no attention, but if it should the procedure to be carried out is dealt with in the instructions on Maintenance of Dial Movements.

The Master Clock is now ready to be set working. Swing the pendulum just sufficiently to see the 15 toothed wheel is being gathered and the gravity lever is being released and operating every 30 seconds. This Master Clock Switch has been designed to operate itself and a circuit of series connected dials at a working current of .33 amp. Excessive current will make the switch operate with some violence but the switch and the clocks in circuit will continue to operate correctly providing the current does not exceed about 0.4 amp. Indeed, it will operate correctly with a reduction of current down to .26 amp, at which point the contact duration which is normally .06 to .08 second, suddenly increases to approximately .3 second. This increase is most noticeable visually at the Master Clock and audibly at the Master Clock and at every dial in the circuit. This is usually a warning that the battery needs attention, However, If the battery is found to be in good order, it could be that there is excessive resistance in the circuit. The weight of the gravity lever the distance the contacts are apart, the strength of the armature tailspring and the coil winding are all arranged to bring about the above conditions.

## EDITORIAL NOTES

The above text has been reproduced by scanning an old typed manuscript. The quaint style of writing, 'warts and all', conveys the spirit of the age, and has been retained.

Paragraph 10, reference is made to "... the two screws holding the bridge ...", whereas there is only one, both in early and later designs.

Paragraph 13, midway through states, "Unscrew the top plate holding the steel roller and take out the roller." In later models, the 'top plate' is integral with the gravity arm and the roller is held in place by a removable bearing bush screwed in at the back of the gravity arm.

Paragraph 17 states, "... unscrew the continuity flexible lead from the baseplate, ...". In some early models, the 'earthy' side of the coil is connected directly to the armature, hence the so-called continuity flex should be unscrewed from the armature not the baseplate.

Further to the setting up procedure, when the clock has been fully re-assembled, and is standing 'at rest', ie with the gravity lever on its catch and the pendulum hanging at the mid-point, the flat face of the jewel in the gathering click should be situated exactly mid-way between two teeth on the 15 toothed wheel. When operating normally, observe that the distance between the jewel and the tooth about to be gathered, when the pendulum is at its extreme left swing, should be the same as the distance between the jewel and the tooth just gathered when the pendulum is at its extreme right swing.

This very important detail, which is automatically correct if the click is original, should be noted if the click has to be replaced.

Also, after the gaps have been set as per the above given instructions, the final adjustment (the right hand buffer) may be slightly varied to give optimum operating characteristics if the following effects are noted:

- a) unscrewing the buffer (increasing the contact air gap when at rest) allows the roller to run further down the impulse pallet and may increase the pendulum arc;
- b) screwing in the buffer (decreasing the air gap when at rest) causes the gravity lever to reset before the roller has fully run down the impulse pallet and may shorten the pendulum arc;

Variation a) extends the impulse duration, and variation b) shortens it. Also, if the air gap is increased too much, the gravity lever reset may be so sluggish that it is hit by the returning impulse pallet. This is the same as the so-called 'battery warning condition' and must not be allowed under normal operating conditions. It should never be necessary to increase the operating current above the specified .33 amp to compensate for this action.

When regulating the clock for accurate time-keeping, first check all the settings and adjustments described above to ensure that the clock is functioning correctly mechanically and electrically. Rough setting of the bob is made with reference to the mark on the rod, and the clock should be set to the correct time and allowed to run for 24 hours before any fine adjustments are attempted.

Note the arc of swing after 24 hours and the error. Adjust the rating nut up (to speed the clock) or down (to slow the clock) then restart the pendulum with the same arc as it had attained on its own, and let it run again. At each correction, note and record the error and the correction (by the position of the marks on the rating nut) and always restart the pendulum at the same arc. Everything else being equal, an accuracy of about 2 seconds per week should be achievable.

When the clock has been seriously deranged, or where missing parts have had to be made, the setting up information given above is barely sufficient. In particular, for correct operation of the clock, the exact point of release of the gravity arm, and the point at which it falls onto the impulse pallet are not specified in the standard instructions.

To check these settings, stop the clock and move the 15-tooth wheel by hand to rest at the tooth at which the gravity arm catch is about to be released. Move the pendulum to the left until the gathering click just gathers the tooth, then slowly move it to the right (which draws the catch also to the right). Note the exact point at which the roller meets the impulse pallet.

At the point of release, the roller should just fall on the dead face of the impulse pallet, ie. just before the commencement of the inclined face. If it falls on the inclined face, some of the impulse energy is lost, and there will be a 'clunk' when the arm is released as it falls freely onto the pallet. This will be transmitted as a shudder to the pendulum rod, and precise timekeeping cannot be expected under these conditions. If the roller falls on the flat land, as this is also 'dead', there should be no shudder, but the travel of the roller along the land will drain some energy from the pendulum.

To obtain the correct point of release, all the settings as prescribed must be correct, in particular:

- a) the case must be vertical (check with a plumb-line);
- b) the vertical position of the impulse pallet must be correct (1/100" clearance below the roller);
- c) the vane which releases the catch should just touch the catch when it is in its pre-release position - this requires the glass roller to be in the correct position;
- d) the left-right position of the trunnion chops must be correct (check by resting the gravity arm on the impulse pallet and checking that the roller pivot is horizontally in line with the top face of the impulse pallet)

The length of the gathering click arm is not specified in the standard Synchronome setting up procedure, and yet this has an over-riding effect on the point of release of the gravity arm. It is too long, even with all the other settings as specified, the release will be late (resulting in the 'clunk' mentioned above). If too short, the roller will fall on the dead land of the impulse pallet.

To ascertain the correct length for the gathering click (if, for example it is lost or broken as often happens with old clocks), follow this simple procedure. With the clock at rest, measure the distance between the click support hole (in the impulse pallet) and the mid-point between the top tooth on the 15-tooth wheel and the tooth previously gathered. Make a simple click exactly this length using a piece of thin wire and test its operation. When operating normally, the distance between the jewel and the tooth about to be gathered (when the pendulum is at its extreme left swing) should be the same as the distance between the jewel and the tooth just gathered (when the pendulum is at its extreme right swing).

When the test click is the correct length, remove it and use it as a pattern to make a proper one including, if possible, a replacement jewel (a Brocot escapement pallet jewel will do admirably). If no jewel is available, a half round "jewel" of hardened steel works well.