

Instructions for erection and setting to work of Master Clock
with normal half minute electrical impulse switch and seconds
electrical impulse switch.

The Master Clock is fitted in a polished hardwood case, 50 inches long, $10\frac{1}{2}$ inches wide, 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 second length, that is to say, its length is such that it will make 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, 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.

It is necessary to fit the clock on a substantial wall free from vibration if the best results in timekeeping is to be obtained.

The clock should be erected so that the top of the case is about 6ft, above the floor level, this will bring the clock movement to a convenient height for fitting up and for attention in the future.

Plug the wall and fit a $1\frac{1}{2}$ " screw into the wall so that the head projects about $\frac{1}{4}$ ". Hang the clock on this screw by its hanging plate, open a door of the clock and hang a plumb line from the top left side of the case and bring the case to an upright position. Mark off wall through the three holes in the backboard of the case. Remove the clock and plug the wall in the three positions. Replace the clock and screw back through the three holes firmly to the wall, using three $2\frac{1}{2}$ " screws for the purpose.

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 upright in this respect, the fixing screws should be slackened off and hard wood packing 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 proceed with the assembly of the pendulum and remove the elastic ties from the seconds switch lever and the half minute lever.

Proceed now to assemble the pendulum.

It will be seen that the pendulum rod is already fitted with the suspension bottom chop, the toggle for operating the seconds switch catch, the impulse pallet and weight tray.

Remove the bob supporting nut (rating nut) and bottom bob collar from the thread at the bottom 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 into 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 and arrange that it is screwed on far enough so that when the bob is resting on it the mark on the pendulum rod above the bob is brought level with the domed collar at the top of the bob. This will give a rate somewhat near correct but will be found that further adjustment will

be necessary after a time test 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. Release the wing nuts and remove this fitting and proceed to fit to the top 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 with the wheel at the centre of the D shape on the jewel. Having hung the pendulum satisfactorily all the working parts should be correct for position. The toggle for releasing the seconds switch catch should engage with the catch jewel just sufficient so that when the pendulum is swinging, the toggle blade lifts the catch arm and the catch releases and allows the heavy switchlever to fall. The catch lever should be lifted aside so that its catch face just slides clear of the jewel support of the heavy switch lever plus $\frac{1}{2}$ millimetre before the toggle lets it fall back again.

This adjustment will probably be found correct but should a re-adjustment be required the screw holding the toggle frame to the rod may be slackened off and the toggle frame moved up or down the rod, as required, the screw being finally tightened.

Next, the half minute impulse pallet should be checked for position relative to the roller on the half minute gravity lever. The top corner of the impulse curves of the pallet should swing under the roller with a clearance of $1/100$ th of an inch when the gravity lever is supported on its catch.

If necessary the pallet may be re-adjusted on the pendulum for height by slackening the screw which holds it to the rod.

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. If adjustment is required, slack screw in 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 master Clock is now ready to be started up and the battery supply is applied to the terminals marked + and -.

The Series Half Minute Circuits.

Connect the required number of $\frac{1}{2}$ minute impulse dials into this circuit at the terminals, provided, remove the shorting link and insert a suitable ammeter in series in the circuit and hold the master clock half minute switch contacts closed so that a reading may be taken of the current flow through the circuit. The current should be adjusted to .33 amp by means of adjustable resistance R_1 , the band of which must be slackened off to adjust and tightened after the adjustment has been made. .33 amp is the correct working current for this circuit but it may vary between .27 and .4 amp without detriment to the working of the master clock and dials.

For carrying out the above adjustments the volt battery must, of course, be connected to the appropriate terminals of the master clock.

The Series Seconds Circuit.

Connect the number of external dials required into this circuit, master clock terminals marked Series Sec., Dwg. No. ? insert suitable ammeter in series in the circuit and hold the master clock seconds switch contacts closed so that a current reading is shown on the ammeter. The current should be adjusted to 75 millamps by means of the resistance marked SER.Sec. Should no dials be used on this circuit, it must be kept closed at the master clock SER. SEC. terminals by bridging a wire across them but the working current should still be adjusted to 75 millamps.

The current may vary between 60 and 90 millamps in the seconds circuit without detriment to the operation, it is advisable, however, to set it up to 75 millamps.

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 $\frac{1}{4}$ " behind the point of the pendulum, when in the correct position the block should be pressed onto the bottom of the case, it has two sharp projections on its underside which will hold it in position.

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 on the scale, at which are 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.

No.1. Seconds Switch.

The object of this instrument is to transmit electrical impulses every second for the operation of impulse dials or instruments which require impulses of this frequency.

OPERATION:-

The Action of the switch may be followed by reference to the print Drg. No. 9616.

An inertia bar (5) is almost balanced about its central pivot and is normally held in a vertical position by the engagement of the D shaped agate (10) with the steel catch (9).

In the end of the steelwire (14) which is part of the catch (9) is fixed an agate jewel (18). This jewel is depressed by the steel toggle (16) as the pendulum swings and passes through zero, just sufficient to unlock catch (9) from jewel (10) the inertia bar (5) then tips over in an anti-clockwise direction until the contact on its spring touches the top of the contact screw (2). An electric circuit is then established through the coil (1) causing the armature to be attracted and as lever (4) and contact screw (2) is all part of the armature assembly, the contact screw (2) pushes against the contact on inertia bar (5) causing the bar to recoil in a clockwise direction until (10) is again locked into position by catch (9).

This operation is repeated for each motion of the pendulum from left to right and right to left.

Adjustments:-

Every seconds switch is correctly adjusted and given a running test before leaving our works. If, however, it is necessary to dismantle the switch at any time for cleaning or repair the correct adjustments may be re-established by checking the following points:-

The flat face of the jewel (10) should be vertical when resting against the catch (9). If this is not so a faulty catch action may occur. The jewel may be turned in its hole by slackening the pinch screw which holds it firmly, turn the jewel and tighten screw.

The amount of locking (or overlap of 9 or 10) may be adjusted by screw (11), the catch stop should overlap the jewel by one millimetre. The wire arm (14) is held in position on the catch arbor by a grub screw, the length of the arm from the arbor to the jewel may be adjusted by loosening this screw, setting the arm to the correct length and tightening screw again.

Assuming the toggle bracket is adjusted squarely on the pendulum rod at a height just sufficient for the toggle (16) to safely unlock the catch (9) from jewel (10), the length of the jewel arm should be such as to give evenly spaced seconds beats.

Adjustment of Contact Cams.

With the inertia lever jewel (10) resting against catch (9) and the contact screw (2) in a position of rest i.e. armature gap open, the distance between the contact should be 3.4 millimetres.

With the inertia lever still in the same position and the armature against the magnet pole the gap between the contact should be 2.2 millimetres. Adjust armature stop screw (18) or contact screw (2) or both, until the correct adjustments are obtained.

Tension spring (7) is adjusted by screw (8) and this spring ensures the safe return of the armature after operation. The spring should have sufficient tension to ensure the armature returning smartly to its stop screw (8) and no more.

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The switch will operate correctly at a minimum current of 50 milliamps up to over 100 milliamps. Below 50 milliamps the magnetic pull is too weak to return lever (5) to its catch and double impulse will occur. Excessive current will cause violent hunting and damage parts of the switch.

All lock nuts or adjusting screws should be tightened when the screws have been set correctly.