INSTRUCTIONS

FOR THE INSTALLATION & MAINTENANCE OF

GENT

of LEICESTER

PUL-SYN-ETIC CONTROLLED ELECTRIC CLOCK SYSTEM

Publication 246H

GENT
of LEICESTER

Pul-syn-etic Controlled Electric Clock System

INSTALLING

IMPORTANT NOTE

- ***It is important that the Master Clock is properly fixed,***
- ***that the circuit is adjusted to the correct current, and***
- ***that sound connections are made at the accumulators.***

FIXING THE MASTER CLOCK

Care taken in selecting a suitable position for the Master Clock will be amply repaid. It should be fixed so that the mechanism is at eye-level to facilitate close observation of the action.

The wall on which it is fixed should be firm and free from vibration. It should be dry and free from rapid changes in temperature. A position allowing direct sunshine to reach the Master Clock is not recommended, neither is the use of a wooden partition.

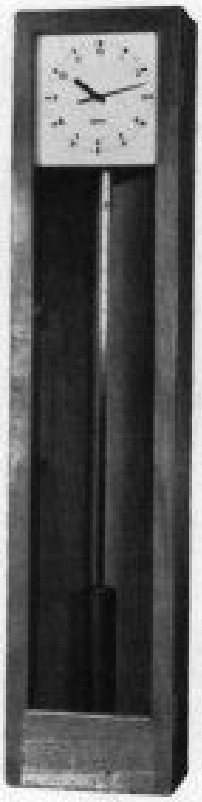
It is essential that the Master Clock be fixed in position securely, as the slightest movement of the case will result in indifferent time-keeping. **All five fixing holes provided must be used,** and when fixed it should be impossible to obtain even the slightest movement of the case.

The outside top fixing should be made first. Next, the two fixings through the slots at the bottom of the case. The latter should be left sufficiently loose to enable the case to be plumbed.

Plumbing is carried out with an ordinary plumb line and the two small brass studs to be found on the front of the Master Clock Case when the door is open, must register with the line. Likewise the two studs at the left-hand side of the case should register vertically.

The remaining two fixings through the pendulum suspension bracket can then be made. **All fixings should then be securely driven home** and the Master Clock Case checked again with the plumb line.

Where the wall to be used is of bare bricks or other uneven surface, it is recommended that a deal fixing board, longer and wider than



MODEL C7
MASTER
CLOCK

the size of the Master Clock, or two stout battens at top and bottom should be employed to take the fixing screws.

The pendulum can now be placed in position in the crutch **with the polished side of the rod to the front.**

STANDARD HALF-MINUTE SERIES CONNECTED SYSTEM.

(For Parallel connected circuits see "Variations" page 4).

Current Supply

This is obtained from a bank of sealed accumulators constantly trickle charged from supply mains. The wiring should be terminated at the accumulators with lead lugs to which the cable should be soldered and beyond an occasional topping up with distilled water, and cleaning and greasing of the terminals, the accumulators will require no attention whatsoever.

Rectifier units not including accumulators are not recommended, as in such cases the clock system will stop if the mains fail.

The Master Clock coils and contacts are in series with the Slave Clocks in a normal circuit (see diagram N.S.99, page 14). The current required in half-minute circuits is 0.22 ampere. The working limits are between 0.17 ampere and 0.27 ampere. In testing the current, the contacts of the Master Clock or Relay must be held closed as the actual impulse transmitted to the circuit by the Master Clock when in operation is too brief to enable an accurate reading by ammeter to be obtained.

To obtain the correct current in the circuit the voltage of the battery required will be in proportion to the length of the circuit wiring and the number of Slave Clocks incorporated. See next column for formula for calculating size of battery required and page 9 for battery charging rates.

Small final adjustments are made by means of the adjustable resistance fitted in the Master Clock Case or Relay. When correctly positioned the set screw in the slider knob should be tightened to prevent alteration.

Larger capacity cells may be required for installations which are divided into sub-circuits.

Calculating Voltage Required

In calculating the number of accumulators required for the system, the following data should be used:—

Total resistance of clocks ¦ line resistance × 0.22 = voltage required.

In working out this formula the following resistances should be employed:—

C.7 Master Clock	33 ohms.
C.6 „ „	30 „
Slave Clocks up to 12″	4 ohms.
„ „ over 12″ & up to 18″	6 „
„ „ „ 18″ & up to 24″	8 „
„ „ 30″	30 „
„ „ 36″	35 „

Where 10-volt accumulators are used and it is found by the formula, that, say, 14 volts are required, then two 10-volt accumulators should be used and the adjustable resistance in the Master Clock positioned until the correct working current of 0.22 ampere is obtained.

Although the number of Slave Clocks which can be controlled by the Pul-syn-etic Master Clock is unlimited it is not recommended that a battery of more than 60 volts is used. Where a Gent Constant Potential Charger is used the voltage must not exceed 48 volts.

If the requirement for a system works out at more than 60 volts by the formula given (or more than 48 volts with a Gent C.P. Charger) the system should be divided into sub-circuits using Model C73 Transistorised Main Relay Units and Model C74 Addition Units. See diagram N.S.97.

SUB-CIRCUITS

The Model C73 Transistorised Main Relay Unit acts as an electronic switch and is connected to the Master Clock as shown on diagram N.S.97. The Battery is connected to +Battery— terminals and the two terminals in the Model C73 unit labelled +Master Clock— are connected to 2 + and 1— in the Master Clock. Terminal 3 in the Master Clock is connected to the positive side of the battery.

When the contacts in the Master Clock close at each impulse a negative bias is applied to the base of the transistor allowing it to conduct to the Slave Clocks in the sub-circuits.

To obtain an indication of the current in the sub-circuit the shorting strap should be removed from the meter terminal block and an ammeter connected. A reading of the circuit current will be obtained when the push is pressed. This should be adjusted by means of the adjustable resistor to 220mA.

Up to three Model C74 Addition Units can be connected in parallel with a C73 Main Transistor Unit each controlling a series connected sub-circuit of clocks. The Model C74 Units each contain a push and meter terminals together with an adjustable resistor exactly as the Model C73 and the same procedure concerning the setting of the current applies.

When it is required to advance the Slave Clocks in a sub-circuit independently of the

clocks in any other sub-circuit the push should be depressed. Each time the push is depressed and released the hands of the Slave Clocks advance ½ minute over the dials.

If more than four sub-circuits are required further Model C73 Main Transistorised Relay Units can be used each capable of controlling up to three Model C74 Addition Units.

IT IS IMPORTANT THAT THE CORRECT POLARITY IS CONNECTED TO THE TERMINALS OTHERWISE DAMAGE TO THE TRANSISTORS WILL RESULT.

Accumulators for Waiting Train Tower Clock Movements

The sealed accumulators, as those used for operating the normal controlled clock system as described above, should be used. The following voltages are required for the various sizes of Waiting Train movements:—

C.40A ... 20 volts. C.40B ... 30 volts.
C.40C ... 40 volts. C.40D & E as necessary.

The current taken by the power magnets of C.40A and C.40B Waiting Train movements is approximately 0.4 amps. and approximately 0.5 amps. for Model C.40C, but special windings are sometimes supplied to instructions.

The frequency with which the motor pendulum takes current depends upon the load on the hands. In high winds, frost or other adverse weather conditions, the pendulum is energised more often. Normally 15 oscillations are made before re-energising takes place, but under favourable conditions this may be as many as 80 oscillations. Should the pendulum for no apparent reason take current more often than this, excessive friction in the hands spindles or motion work should be looked for. See also page 10.

Wiring

Wiring should be carried out preferably in 3/029 cable or equivalent, 240-volt grade, and enclosed in conduit. Cable should either be connected direct to the clock terminals or to terminals in a conduit box from which adequate flexible connections to the clock will be required. Two-pin plugs and sockets should **not** be used at clock points for series connected clocks.

When running clock circuits across yards or in the open, bare wire should not be used, but insulated cable as specified in previous paragraph to prevent short circuits and interferences by telephone linesmen or other people.

If stranded conductors are used, all strands must be clipped under terminals, or, better still, soldered together before connecting.

All joints in line wiring must be soldered or screw type connectors or good quality junction boxes employed. Under no circumstances should the thimble type connector be used.

When the wiring is complete, it is desirable for the foreman or other responsible superviser to assure himself that all joints are properly made and all terminal connections tight. A faulty joint may give rise to considerable trouble. Joints intended to be temporary and left dry are sometimes forgotten causing endless trouble after a time. It cannot be overemphasized, therefore, that all joints should be made properly immediately.

On completion, and before starting up the Clocks, the circuit should be tested for insulation resistance as any leakages to earth or across lines will cause trouble, particularly in a large installation.

Fixing Slave Clocks

The Slave Clocks incorporated in a system may be of any size. 6 in. or 6 ft. Clocks can be included in one circuit provided the voltage of the battery is such that the working current of 0.22 amps. passes through the circuit.

Setting Individual Slave Clocks

Normally Slave Clocks are despatched from our Works each set to the same time. It should, therefore, be found after installing that all clocks are in step, but it is possible that in transit, one or more of these may have been altered and it will, therefore, be necessary to correct individual clocks in order to bring all dials in the system to the same time. If any one clock in the circuit is slow compared with the others, advance the hands by making a series of contacts on the clock terminals with leads from one dry cell. It will be found that this device advances the clock in half-minute steps for each contact made.

Clocks from 18″ to 24″ in diameter require two dry cells connected in series for advancing, and 30″ and 36″ four cells.

Individual clocks which are fast compared with the rest can be stopped for the required period when the system is set going by short circuiting the clock terminals temporarily.

Removing or Adding a Slave Clock

If it is necessary to remove a clock from a circuit in operation, the leads should be disconnected from the clock terminals immediately after an impulse is received and connected together before the next impulse is received, otherwise clocks will lose or be put out of step. In remaking this circuit, be sure that the two leads are in good connection with each other. A binding screw is best for a temporary connection, but a screw type connector or a soldered joint should be used if the connection is to be permanent.

An additional clock may be inserted in a circuit in a similar fashion.

VARIATIONS FOR PARALLEL CONNECTED CIRCUITS

All slave clocks operate on 24 volts or 48 volts. No adjustment of current is necessary and no sliding resistance is therefore included in the Master Clock.

Setting individual slave clocks. Parallel connected clocks are set by pressing the adjusting button on the movement cover.

Removing or adding a slave clock. Clocks can be removed or added by disconnecting or connecting them into the circuit ensuring that the wires are not allowed to short.

Operation of Master Clock

It must be first appreciated that the pendulum of the Master Clock is kept in oscillation by mechanical impulses imparted to it at half-minute intervals by a weighted lever termed the Gravity Lever (see Diagram C.519).

The gravity lever is provided with a roller which rolls down the inclined face of the impulse pallet, thus giving the pendulum crutch a gentle push.

This continues until the contact pieces meet when the electro-magnet is energised by the flow of current through it.

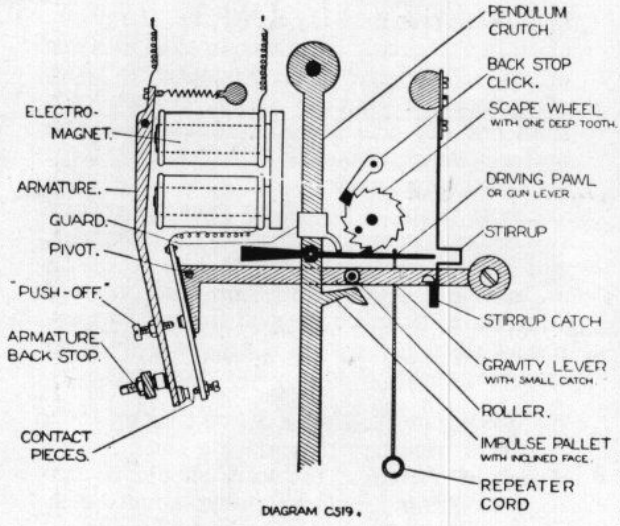


DIAGRAM C519.

The armature is attracted and at once replaces the gravity-lever on to the stirrup catch. Meanwhile the clocks which are connected in circuit with the battery are advanced half a minute. The action is brought about in the following manner:—

The pendulum in oscillating, carries with it the driving pawl which pushes around the 'scape wheel tooth-by-tooth. The back stop click prevents backward movement.

At each complete revolution of the 'scape wheel (which occurs every half-minute) the driving pawl engages a deep tooth and its right-hand extension, instead of passing through the stirrup, engages the stirrup catch just above the stirrup, pushing the stirrup catch and releasing the gravity-lever.

The roller drops on to the dead face of the impulse pallet, then runs down the inclined face, giving it a gentle push. Contact is then made as above described for the dual purpose of operating the Impulse Clocks and replacing the gravity-lever.

The guard shown just above the driving pawl prevents two teeth being taken by the driving pawl in case the pendulum swing is exaggerated by any means.

While holding down the repeater cord, the driving pawl engages the stirrup catch below the stirrup at each oscillation of the pendulum thus releasing the gravity-lever to make contact every two seconds instead of at each half-minute.

Gent Master Clocks are despatched from the Factory properly adjusted and no further adjustment should be necessary except to regulate the pendulum after the Master Clock is fixed.

Regulation of Master Clock Pendulum

This is carried out when all clocks in the system are fixed and wired up in accordance with instructions given on page 3. If Clocks gain, stop the pendulum long enough to correct the time and slow down the pendulum by turning the graduated rating nut at the base of the bob to the left.

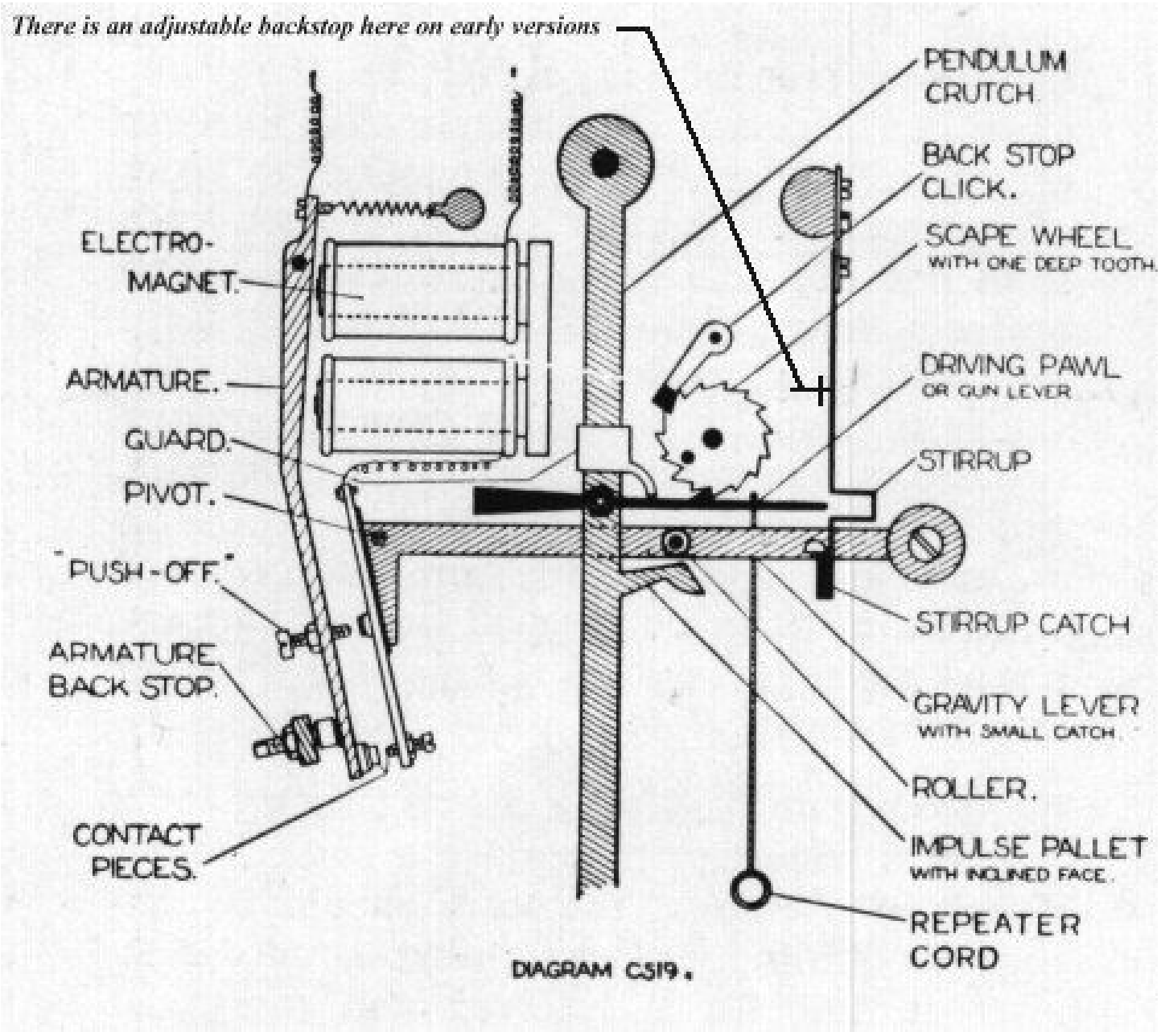
The rating nut is clearly marked in degrees, each of which is equal to approximately one second per day. The pendulum can then be re-started at the correct time and the system again tested for time-keeping.

If the system loses, speed up the pendulum by turning the graduated nut to the right.

For fine regulation, small weights are provided which, when placed in the dish at top of the bob, will speed up the pendulum. If placed on the rating nut at the base of the bob, the pendulum will be slowed down.

Advancing all Clocks

To advance all clocks in the system, the repeater cord is pulled down until the clocks are advanced by the required amount. The cord is then released, and normal time-keeping will be resumed.


There is an adjustable backstop here on early versions
PENDULUM CRUTCH.
BACK STOP CLICK.
SCAPE WHEEL WITH ONE DEEP TOOTH.
ELECTRO-MAGNET.
ARMATURE.
GUARD.
PIVOT.
"PUSH-OFF."
ARMATURE BACK STOP.
CONTACT PIECES.
DRIVING PAWL OR GUN LEVER.
STIRRUP
STIRRUP CATCH
GRAVITY LEVER WITH SMALL CATCH.
ROLLER.
IMPULSE PALLET WITH INCLINED FACE.
REPEATER CORD
DIAGRAM C519.

IMPORTANT NOTICE

Where a Tower Clock operated by a Waiting Train Movement is included in the circuit see special note on page 10 "Advancing a Waiting Train Movement" before advancing the system at the Master Clock.

When it is desired to advance the entire system a few seconds only, the 'scape wheel of the Master Clock can be rotated, each tooth represents two seconds.

To retard all clocks in the system, it is merely necessary to stop the pendulum of the Master Clock for the required period and re-start at the time required.

Time Recorders

Time Recorders are designed to print the time at each definite minute, It is, therefore, convenient for the type wheels to move at one minute intervals and necessary for the impulse movement within the Time Recorder to receive impulses at one minute intervals to ensure an accurate record.

This necessitates a separate circuit from the Master Clock to operate the Time Recorders which are connected in parallel. One minute impulses are obtained either from an Impulse Converter built into the Master Clock itself, or, when the Recorders are added to an existing system, from a separate Impulse Converter. Impulses of increased duration are required and are obtained from auxiliary contacts mounted at the side of the main Master Clock contacts. Each alternate half-minute impulse is suppressed by contacts fitted to the movement driving the dial in the door of the Master Clock. In a system in which Time Recorders are included, the voltage of the Accumulators must not be less than 40 volts.

When Recorders of the electrically operated printing type are included it is necessary for a separate A.C. mains supply to be taken to each recorder for the operation of the stamping mechanism. The wiring connections of a typical system are shown at Diagram N.S.95.

Up to 12 Recorders can be connected in parallel in one circuit but should more than this number be required, relays can be employed, each operating 12 Recorders.

A LITTLE ATTENTION — REGULARLY

The Gent Pul-syn-etic Controlled Electric Clock System requires little attention of any kind once installed and running correctly, but this very fact sometimes leads to neglect and only when the clocks stop is this neglect brought to light.

A **regular** check on the following points will be repaid by a lifetime of trouble-free timekeeping.

(1) Inspect the Trickle Charger and Accumulators at least every two months.

Check the charging rate and the condition of the accumulators—especially the terminals and connections. Check the acid level and top up with distilled water if required.

(2) Inspect the Master Clock every two months.

Check the pendulum arc and note carefully whether it has diminished since the previous inspection. If it has, oil as detailed on page 7, otherwise a stoppage will eventually occur.

Note carefully the gravity-lever. If this is replacing sluggishly it should be regarded as a warning that for some reason there is insufficient current in the circuit. Investigate this before a stoppage occurs.

MAINTENANCE

The Gent Pul-syn-etic Electric Clock System once installed and running correctly requires little maintenance. Such attention as is required can be carried out by the average electrician provided that care is taken in the interpretation of the following notes:—

Circuit

Diagrams N.S.99, N.S.95 and N.S.97 (see page 14) show the three basic types of series circuit. Diagram N.S.102 (see page 15) shows a parallel circuit.

In a small compact series installation, all slave equipment is operated direct from the Master Clock, as in Diagram N.S.99. In the case of larger and more widespread installations, it is often more satisfactory to divide the circuit into a number of sub-circuits, each served by a sub-transmitting unit (Model C73 or C74). These units are operated direct by the Master Clock as in Diagram N.S.97. This division of large circuits enables the voltage in the system to be kept down to the maximum of 60 volts or 48 volts where a Gent Constant Potential Charger is used.

It should be remembered, however, that all series Slave Clocks, whether large or small, near to or at a distance from the Master Clock, take the standard current of 0.22 amps.

Tracing Faults

First, the battery should be checked to see that the necessary current is being supplied. In order to test the current in the circuit with an ordinary ammeter, the contacts of the Master Clock should be held together whilst the ammeter is read, as the normal half-minute impulses are of such short duration that it is impossible to take a reading.

Where clocks are in series or parallel in the event of trouble, the circuit should be checked to ensure that it is complete and free from intermittent faults often caused by loose terminal connections or unsound joints in wiring. Examine all terminal connections and make sure that joins are good and not merely twisted together.

Test the wiring of the circuit with a megger for

(1) Continuity of the circuit from the Master Clock out and return to the other terminal of the Master Clock.
(2) Leakage to earth.
(3) With series connected clocks disconnect the most distant clock and test between conductors.
(4) For parallel connected clocks each conductor should be free from leakages to earth and also between both conductors of the circuit. Before testing between conductors all clocks should be disconnected.

Intermittent faults may cause some Slave Clocks to gain and others to lose, and such faults are often difficult to locate. Look particularly at the battery terminals.

Fault Finding from the Master Clock

Careful observation of the operation of the Master Clock Movement may be useful in tracing a fault, therefore, watch the operation carefully before touching the pendulum or interfering with the mechanism in any way, and note the following points:—

See that the gravity-lever has been thrown up and is actually on its catch. If it is, then the trouble is not likely to be due to a faulty circuit or lack of current, but to the pendulum having insufficient energy to drive the half-minute 'scape wheel. This is often due to sticky oil. Watch the swing of the pendulum and see that well over one tooth is taken at each swing. See that the back-stop click falls easily and cleanly into place. Make sure that the slot in the pendulum rod is clean and that the pin of the pendulum crutch engaging in it is free and not sticky. If thick oil is present, cleaning and re-oiling with correct grade of clock oil is the only remedy. (See page 7).

An intermittent fault may result in the gravity-lever being thrown up at irregular intervals. To test this, hold down the repeater cord and watch carefully. Do not alter the adjustment of the contacts. If the gravity-lever is not thrown up on to this catch and no current passes the cause is probably due to an exhausted battery or to a faulty circuit.

Complete Stoppage in the System

In the event of a complete stoppage, disturb nothing until a careful inspection has been made to make sure if the system has stopped for lack of current, or through a temporary disconnection of the circuit, or if the Master Clock has stopped because of some mechanical fault such as described above. If the stoppage is due to lack of current or a break in the circuit, the gravity-lever of the Master Clock will have disengaged from the stirrup catch, and the roller of the gravity-lever will rest on the pallet; no electrical contact will be made. Such a position of the gravity-lever shows that the release has been properly effected but that the magnet coils have not been energised. Thus, if the battery has not failed, a circuit fault must be looked for.

If the Master Clock has stopped due to a mechanical fault such as undue friction, a derangement or breakage, the gravity-lever will not have disengaged from the catch and the deep tooth of the 'scape wheel will not have reached the disengaging position. If no reason for this is apparent, check the following points:—

See that the Master Clock Case is firmly fixed, and that it is plumb in accordance with the fixing instructions on page 1.

See that the battery power is sufficient. If the power is insufficient the gravity-lever will not be replaced until the pendulum assists lifting action.

Make sure that the end of the driving pawl fairly engages the stirrup-catch when the driving click enters the deep tooth of the 'scape wheel and does not fail occasionally to effect the half-minute release.

When obstructed by dirt in the deep tooth, the remedy is obvious, but if no obstruction is present, bend up the end of the driving pawl a fraction but make sure that it is quite clear of the stirrup catch when in the shallow teeth.

See that the dead face of the pallet swings under but does not touch the roller during normal operation.

See that the pin at the bottom of the crutch is quite free in the slot of the pendulum.

See that the driving pawl (gun-lever) is quite free.

If this is stiff in operation, it may not engage the 'scape wheel correctly or release the stirrup-catch.

See that the crutch swings freely. This must be bent forward a fraction if found to touch on the gravity-lever.

Sudden Gaining

If all clocks suddenly gain, this will probably be found due to the gravity-lever being raised but not held by the supporting catch. It may also be due to a weak battery resulting in the gravity-lever not being lifted high enough and falling back on the contact causing a repetition at each swing of the pendulum. The same effect could be caused if the electrical contacts through mal-adjustment break too soon before the lever reaches the catch. A slight mechanical adjustment of the catch may be necessary. Its spring may be weak, or the felt pad which cushions the upward movement of the gravity-lever may come into operation too soon. Slight adjustment should overcome this.

Only when the Master Clock has been actually disarranged should the contact pieces be adjusted as a remedy.

Oiling the Master Clock

ONLY CLOCK OIL MUST BE USED, and this very sparingly. A piece of 18-gauge wire, flattened at the end, forms the best applicator for clock oil.

Before applying oil, remove any foreign matter or dirty oil from the teeth of the 'scape wheel pivots or other parts. For this purpose a clean duster, free from lint or fluff, should be used.

The following should be oiled very sparingly as may be found necessary:—

(1) One drop of oil for each pivot, pivoted part or pin on which such parts turn. Do this methodically to avoid missing pivots, reaching through the frame from the front to oil the back pivots.

(2) The pin working in the pendulum slot.

(3) Tip of the stirrup-catch.

(4) Small catch on gravity-lever.

(5) The pin on which the roller turns; it is **essential that** great care is taken when oiling this component to ensure that the face of the roller and pallet remain perfectly clean and free from oil.

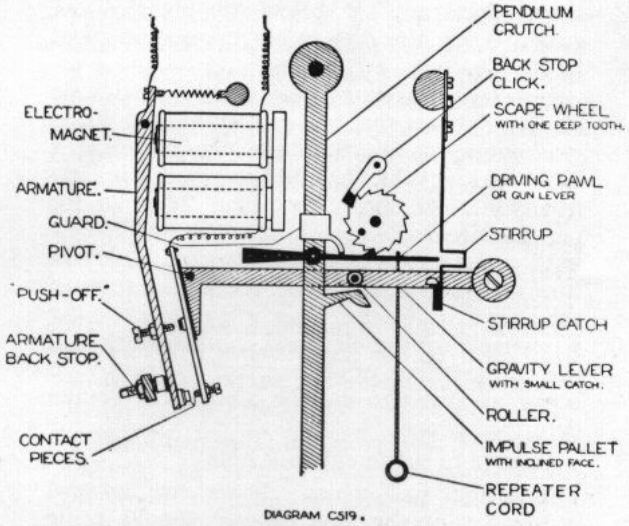


DIAGRAM C519.

Adjusting the Master Clock

It is most unlikely that any adjustment of the Master Clock will be found necessary even after years of working, but the following notes are given for guidance in cases where adjustment has been made necessary through unavoidable derangement of the Master Clock or wear due to prolonged neglect.

All adjustments of the armature and the contacts commence from the correct position of the armature in relation to the magnet, therefore, press the armature flat and square against the poles. Next unscrew the electrical contact screw and the push-off screw clear of everything, and while holding the armature in contact with the poles, screw up the push-off screw until its point lifts the gravity-lever catch on to the stirrup-catch. Next screw in the

electrical contact screw to such a position that its face parts company with the armature contact, when the gravity-lever is within $\frac{1}{16}''$ of engagement with the stirrup-catch.

This is best done with the current "on" and it will be convenient to control the upward movement of the gravity-lever by hand to see in what position the gravity catch is when the "break" takes place.

Lastly adjust the armature back-stop screw against which the armature rests until there is exactly $\frac{3}{16}''$ space between the contact points when the gravity-lever is at rest on the stirrup-catch and the armature is at rest against its back-stop screw. The armature return spring should only be strong enough to return the armature to the position of rest with a "prompt" movement. If this spring is abnormally strong it is obviously acting unduly against the magnet.

The dimension of $\frac{3}{16}''$ applies to Master Clocks in which the contacts are situated $2\frac{3}{4}''$ below the pivot of the gravity-lever. In the case of Master Clocks of an older pattern in which the contacts are $1\frac{3}{4}''$ below the pivot of the gravity-lever, the dimension in question must be $\frac{1}{8}''$ only.

For series circuits if a reliable open-scale ammeter shows that the gravity-lever is lifted (without assistance from the pendulum) at a lesser current value than 0.17 amps., or similarly if a voltmeter shows less than 22 volts for parallel circuits, screw in the 'push-off' screw until an air gap is obtained between the armature and the magnet when the armature is in the attracted position. This will necessitate the screwing in of the electrical contact screw and the unscrewing of the armature back-stop screw, in order to get the adjustment results described above.

Be sure to tighten all lock nuts.

The felt pad which checks the upward movement of the gravity-lever should come in operation just after the gravity-catch has engaged the stirrup-catch. In other words, there should be just a little shake between the felt pad and the gravity-catch.

When the "electric contact" adjustments have been made, the pendulum and escapement must be set in beat as follows:—Hang the pendulum in position and see that the crutch-pin is free in the slot of the pendulum and is oiled. Finally, the 'scape wheel must be set in beat, and this "set" must be such that both the driving pawl and back-stop click just drop equally in position with the minimum swing.

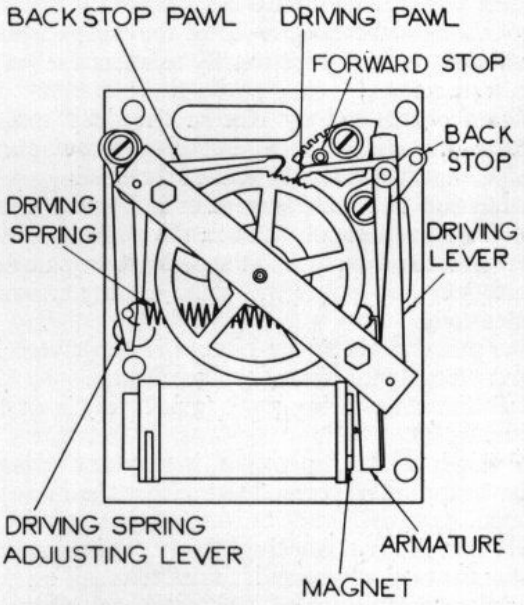
The back-stop click is made adjustable for this purpose.

While the pendulum is still at its minimum swing, it should release, but only just, the gravity-lever when the driving pawl reaches the deep tooth. The gravity-lever catch is adjustable for this purpose.

The stirrup-catch stop should allow the stirrup-catch to travel under the gravity-lever catch until there is $\frac{3}{32}''$ to $\frac{5}{64}''$ between the face of the stirrup-catch and the end of the gravity-lever catch. On the more modern type of Master Clock this is non-adjustable and will require no alteration.

Adjusting Slave Clocks

The function of an Impulse Movement is to advance the hands one tooth only at each electrical impulse. Therefore, adjust the motion



of the driving pawl and back-stop pawl so that this mechanical action takes place. Give that clearance to the adjustments to ensure definite and reliable operation.

The magnet must operate as close to the armature as possible in order to obtain maximum efficiency. When the adjustments are properly set, the armature facing should just touch the magnet at the same time as the top end of the driving lever touches the back stop.

The hands must be quite free of each other, and of the glass and dial. If there is any tendency to stick in any position after careful trial, the cause of the friction must be discovered.

The standard mechanism is set before despatch to operate at a minimum current of 0.13 amps for series operation or 18 volts for parallel operation.

The driving spring of the movement operates against the attraction of the magnet. If, through interference, any Impulse Clock has to be readjusted, the spring must be set by the adjusting lever provided, so that the armature just operates with the minimum setting current

of 0.13 amps., for series operation or 18 volts for parallel operation.

These remarks apply to Clocks of all diameters, sizes and types, also to inaudible movements, and to "Waiting-Train" Turret Clock Relay Magnets.

Should individual clocks through some circuit fault have become "out-of-step" with each other, individual clocks can be brought into step as described on page 3.

Where series connected clocks have no exposed terminals, two connecting studs are provided on the front of the clock for this purpose.

Oiling Slave Clocks

Remarks on page 7 regarding oiling of the Master Clock apply equally to the Slave Clock Movements, but the faces of the ratchet wheel and the pawls must be kept clean and free from oil as must the brass pin forming the forward stop for the driving pawl.

All pivots must be oiled with clock oil only.

The pivot holes must first be cleaned.

The stud on which the driving pawl works must be oiled, but as stated above, the ratchet wheel, the driving pawl and back-stop pawl faces must not be oiled and must be perfectly clean.

Charging Rates for Accumulators

The Gent Constant Potential Charger requires no adjustment. This will automatically keep the batteries in a fully charged condition.

Where a manually adjusted Charger is fitted this should be set to give a charge of 12 to 15 m.a. for a clock system employing one single circuit for half-minute Slave Clocks. Should sub-transmitting units be included in the installation the charging rate should be increased by 2 m.a. for each relay.

A Waiting Train Movement requires approximately 4 m.a. in addition to that necessary for the remainder of the installation, although this will vary to some extent according to the number and size of dials operated by it.

When a seconds indicating clock circuit is included the charging rate must be increased by a further 40 m.a. or when such clocks are controlled by a sub-transmitting unit a still further 40 m.a. increase is required.

In the case of systems employing Time Recorders an increase in the charging rate is necessary equivalent to 3 m.a. for each Recorder.

It is advisable, however, to check the specific gravity of the battery acid during the first few weeks after the system has been put in operation. Obviously this must not be allowed to fall, but on the other hand overcharging will reduce the life of the accumulators considerably.

TOWER CLOCKS

(1) Heavy Duty Slave Movements

The procedure for servicing these is generally in accordance with the information given on page 8. The resistance of the operating coil for series connected clocks will be considerably in excess of those operating the more normal Slave Clocks. This will mean therefore that the voltage of the cells used when setting them will also be increased. In both series and parallel connected clocks the resistance of the coil will vary in accordance with the diameter of the dial and the design and weight of the hands.

An additional feature of these heavy duty movements is a locking device which comes into operation when the operating coil is energised. The movements should be set in exactly the same manner as the smaller ones. The extension of the arm carrying the back-stop pawl should then be bent so that it just touches the peg fixed at the extremity of the arm carrying the driving pawl when the armature is pressed tightly to the magnet face.

(2) Waiting Train Tower Clock Movements

Where a large Tower Clock operated by Waiting Train Movement is incorporated in the system this will generally be installed by experts and no details regarding installation are given here.

The Waiting Train Movement for medium and large size Tower Clocks is so called because the "train" of gears operating the hand spindles remains motionless for approximately three seconds in every half-minute. The cycle of operations of the Waiting Train Movement is, briefly, as follows:—

Motive power for driving the hands is derived from a free swinging pendulum which is energised electrically when its oscillations fall below a predetermined arc.

This pendulum is entirely independent of the timekeeping element of the installation, its function being merely to supply the energy for driving the hands by means of an associated pawl, ratchet and worm gear. The gear ratio is such that the hands are moved through one half-minute on the dial in approximately 27 seconds, when the pawl mechanism, mentioned above, is automatically disengaged from the train of gears driving the hands which then

"wait." They "wait" for the timekeeping element of the installation (the Master Clock) to take over, and this occurs at the exact half-minute to which the hands are pointing. At the half-minute the Master Clock transmits its fleeting impulse to the circuit, the pawl mechanism re-engages and the next half-minute cycle of operations commences.

ADVANCING A WAITING TRAIN MOVEMENT

When a system has been advanced from the Master Clock, as described on page 4 under heading "Advancing all clocks" it is necessary to advance the Waiting Train separately by means of the handle provided on the movement.

The Waiting Train Movement can, therefore, be regarded as a powerful, pendulum operated Slave Clock which is corrected to the exact time every half-minute. The "Waiting" period of the hands is so short that it is quite undetectable and, to all intents and purposes, they move quite smoothly and continuously.

In addition to the great saving in cost, space and installation work, which are common to all the Electric Tower Clocks described in this booklet, the Waiting Train Movement offers a further great advantage over any other type.

Large Tower Clocks with hands exposed to the elements are subjected to resistance caused by wind pressure, rain, snow or frost and this may be sufficient to slow down, or even stop, the clock unless the movement possesses a considerable margin of power as in the case of the Waiting Train type.

The more resistance the electrically energised pendulum of the Waiting Train has to overcome, however, the more power it develops. Under normal working conditions it is re-energised about once per minute or even less, but should the hands be subjected to excessive resistance, the pendulum is automatically energised more often—each complete oscillation if necessary. Under such circumstances the pendulum generates up to 30 times its normal power, making it virtually impossible to stop or slow down the hands.

Waiting Train Power Magnet Supply

See that the current flowing through the power magnet is approximately 0.4 amps. for the C.40A and C.40B movements and 0.5 amps. for the C.40C.

Check contact pieces and see that they are clean and capable of passing the necessary current. A piece of folded fine emery drawn along them will clean both surfaces. An ammeter must be used for checking the current. See also page 3 for further information regarding accumulators.

Circuit Faults

See page 6 for details of the more common faults in wiring and connections. As in the case of the Master Clock, careful observation of the Waiting Train Movement can be of great assistance in diagnosing faults. The following points especially should be noted.

When working normally, the pendulum of the Waiting Train Movement should swing 15 times before being re-energised. In many instances as many as 60/80 swings between energising are experienced. If the figure falls below 15, however, faults are to be suspected.

The pivot of the toggle may be tight and the toggle itself may therefore clear the vee-block without depressing it. In this case the pivot should be cleaned and the pivot holes oiled. The armature roller pallet may be tight on the spindle. Make sure that this is free and adequately lubricated.

Due to lack of oil or the presence of foreign matter the 12-1 gear between the hands or the crown gear may have seized. Test by sliding the connecting rods to and fro. If any particular rod is found to be stiff and difficult to move, this indicates that the hand gear is offering resistance. In such a case it may be necessary to remove the hands and withdraw the spindles, to clear the fault.

Gaining

This is unusual, but should the Tower Clock be found gaining on the time kept by the Master Clock, the following points should be looked for:—

The relay may be holding down and not retaining the masking pawl for the waiting period each half-minute.

This may be due to residual magnetism, or more likely to the facing of the non-magnetic metal surface of the armature being worn or defective.

Oil on the armature face can also cause this fault, as can a defective take-off spring or take-off weight.

Ensure that the armature is pulled down and the masking pawl disengaged at a current of 0.12 amps. This should be measured by ammeter, adjustable resistance and a battery of 2 to 3 volts.

The masking pawl may not be held up by the catch for the waiting period each half-minute. This is due to engagement being defective and the engaging parts if found to be worn should be reshaped or replaced.

The masking pawl may not be held high enough. This can be recognised by the 'scape wheel not waiting. In this case, the right-angled lever should be bent slightly or adjustment made where it is attached to the masking pawl.

Make sure, however, that the masking pawl is not so high as to prevent the driving pawl from operating when released by the armature.

Losing

The movement may be out of level. Test with spirit level across brass studs provided for this purpose. Driving action of the pawls may be out of beat in which case remove the connections to the power magnet and ensure that both pawls drop into position with the shortest swing which will produce this effect ignoring the long tooth.

If the back-stop click fails to drop into position before the driving pawl falls, the result will be that the latter will on occasions fail to gather a tooth on the 'scape wheel and in consequence the 'scape wheel will not

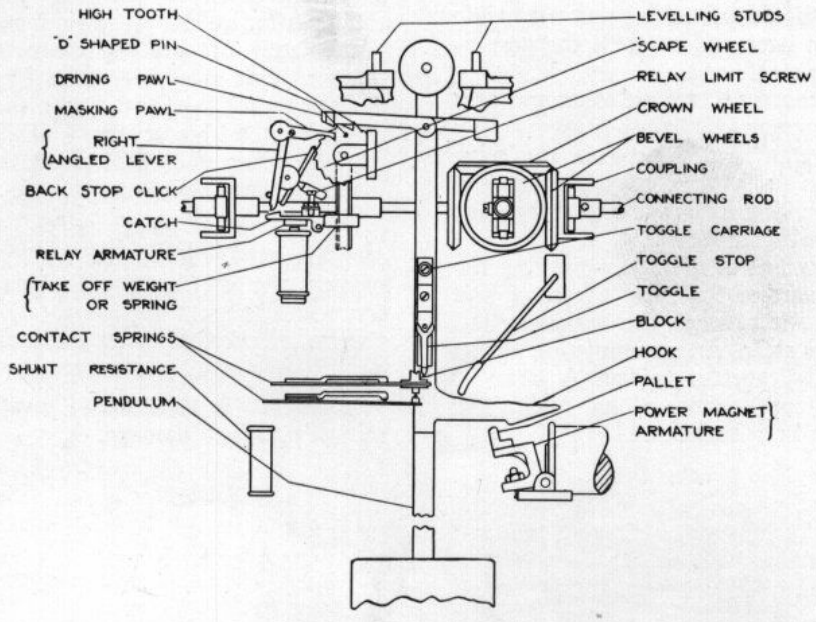


DIAGRAM N.S.29

N.B. The faults referred to above all have the effect of allowing the waiting period of approximately 3 to 4 seconds to be omitted each half-minute. This causes the clock to gain 6 to 8 minutes per hour.

With a Tower Clock installation involving several dials, one dial only gaining or losing would indicate a mechanical fault associated with that particular dial only. For instance, a connecting rod may have become loose in its coupling, or a coupling become loose on the spindle of the minute hand.

Alternatively, the gearing of the crown work may be defective or the bevel gear associated with this particular dial may be loose. Careful examination of these mechanical parts will soon reveal the cause.

complete a revolution in time to be released by the half-minute impulse.

If this is the case, adjust the back-stop click.

The end of the masking pawl must clear the back of the D-shaped pin. If the end of the masking pawl fouls the back of the pin it will not drop clear at the half-minute movement of the relay armature. To test this, move the 'scape wheel forward until the D-shaped pin just passes the end of the masking pawl and the back-stop click just falls into position at its proper tooth. Then press the 'scape wheel backwards against the back-stop click and release the masking pawl to see that it clears the back of the D-shaped pin. In the event of it being found that the end of the pawl is fouling the D-shaped pin, move up the back-stop click,

if this can be done. If not, file a little off the back of the D-shaped pin to give the necessary movement for the masking pawl to fall.

The arc of the pendulum may be found too short and insufficient to feed forward the 'scape wheel.

To test this, move the pendulum slowly to the left and with the 'scape wheel pushed back against the back-stop click and the long tooth in the position of being next gathered by the driving pawl, the driving pawl should drop behind this long tooth before the toggle clears the left-hand side of the vee-block. This setting ensures a sufficient arc at all times for the pendulum to do its work.

If the toggle leaves the block before the driving click drops behind the longest tooth, slide down the toggle carriage so that the toggle leaves the block later and compels the pendulum to maintain a safe arc.

See that the contact pieces are clean and pass the necessary current.

Look for foreign matter between the relay armature and poles as this may prevent the armature from giving its stroke and so prevent the masking pawl from falling.

Examine the point of the screw limiting the upward movement of the relay armature and the place where it touches the armature and see that both are clean. An accumulation of dirt may occasionally cause it to fail. A piece of folded emery cloth drawn along under the screw will clean both surfaces.

The relay may be set at too high a value. It must just operate at 0.12 amps., no more. Test with an ammeter and adjust to operate at the proper value by reducing air gap.

N.B. If this alteration is not effective, the magnet coil may be defective.

See that the pendulum is quite free in the slot of the wooden platform and that it is not affected by draught or other interference. It is always recommended that the pendulum and movement be fitted with some simple form of covering to prevent interference from outside.

Ensure that the masking pawl is not lifted by the D-shaped pin, one tooth before the long tooth is gathered by the driving pawl to such an extent as to be held up by the armature catch. After release it would be lifted again immediately causing the clock to lose half a minute. This may be caused by the masking pawl being too low, and if there is not sufficient adjustment with the screw which holds the masking lever and right-angle lever together, bend the latter outwards.

On the other hand, ensure also that the masking pawl is not lifted too high as this will prevent the driving pawl gathering the long tooth in its proper sequence, thus losing half a minute. If possible lower the masking pawl or bend right-angle lever inwards.

The faults in the last two paragraphs can be caused by actual damage.

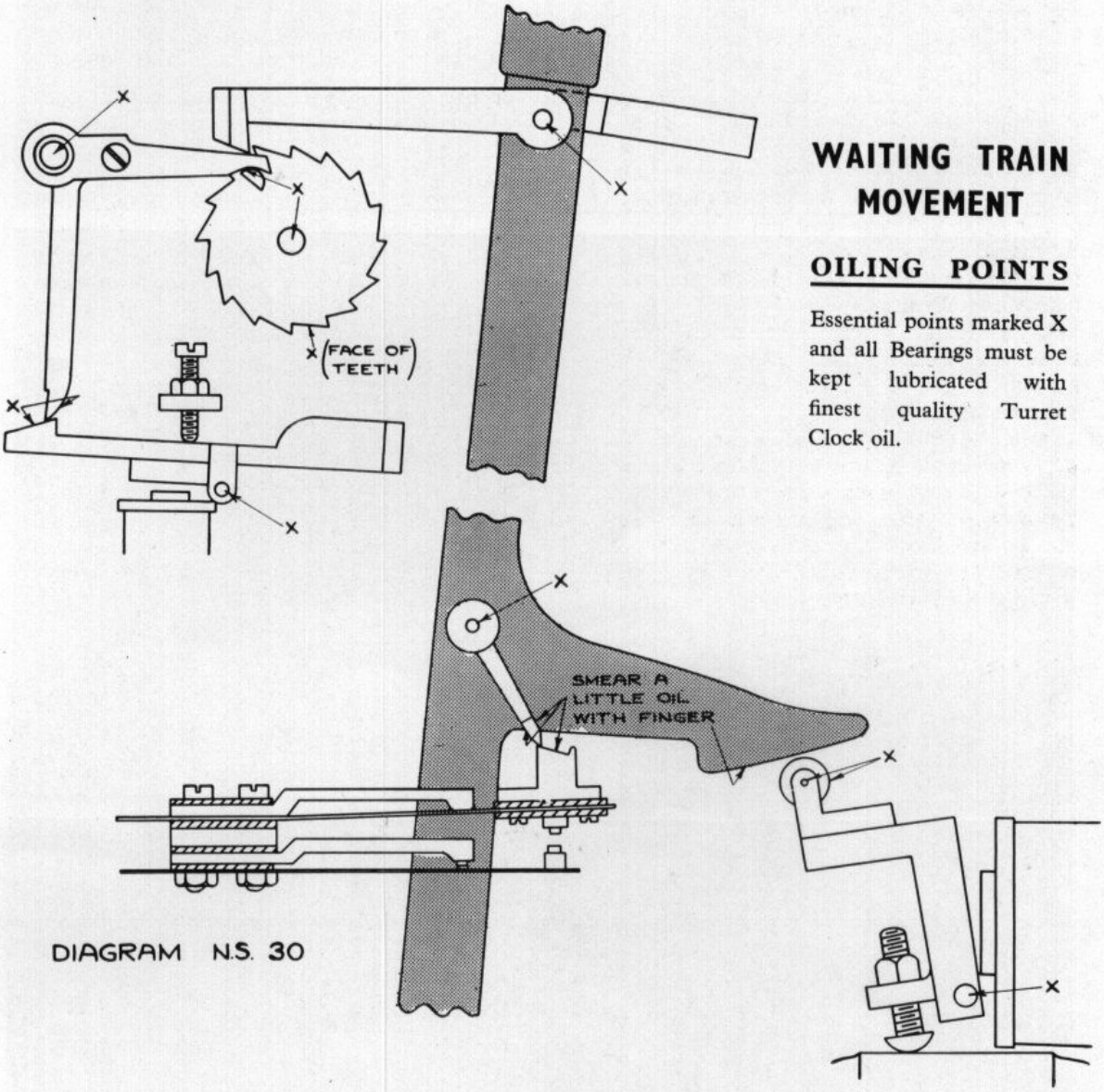


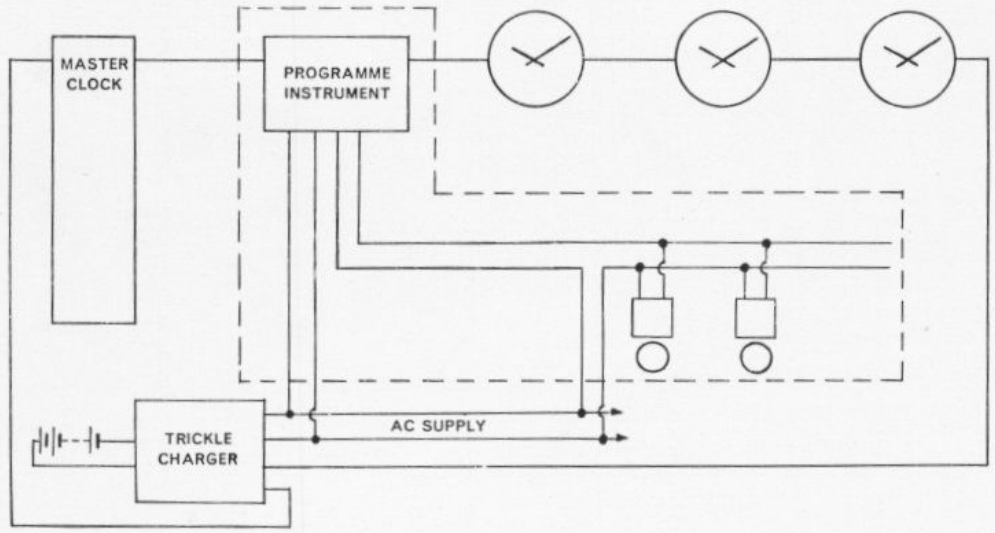
DIAGRAM N.S. 30

WAITING TRAIN MOVEMENT

OILING POINTS

Essential points marked X and all Bearings must be kept lubricated with finest quality Turret Clock oil.

N.S.99



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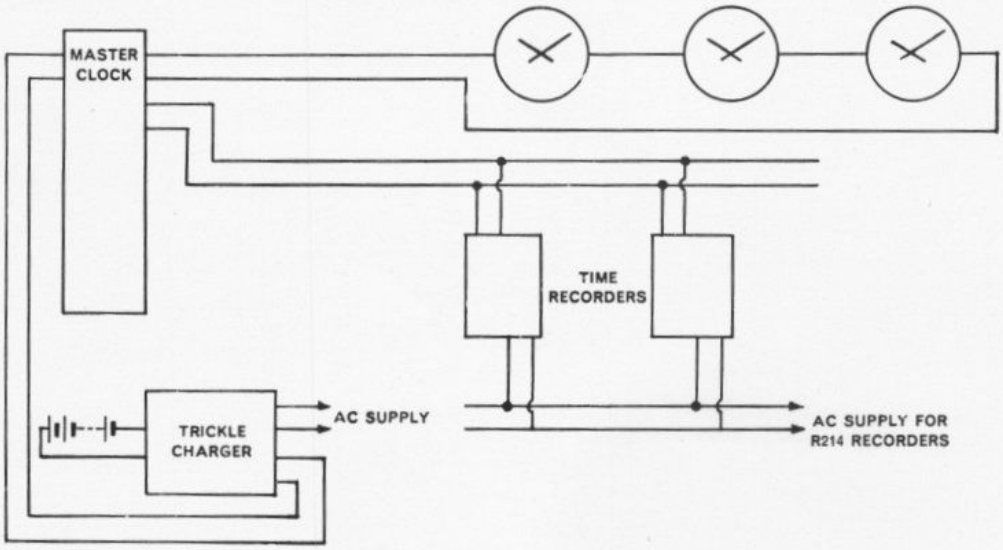

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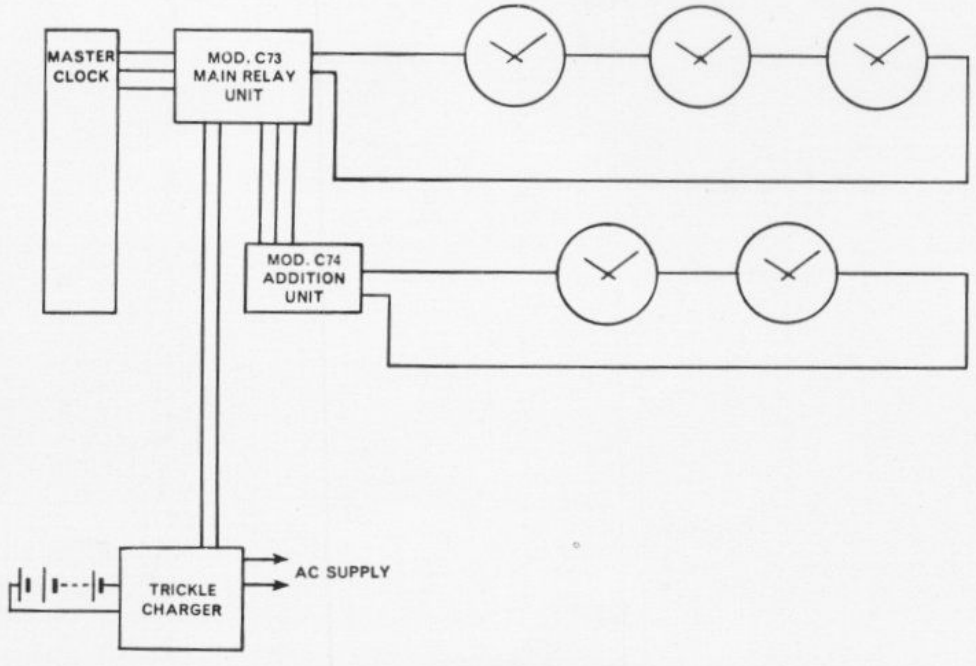

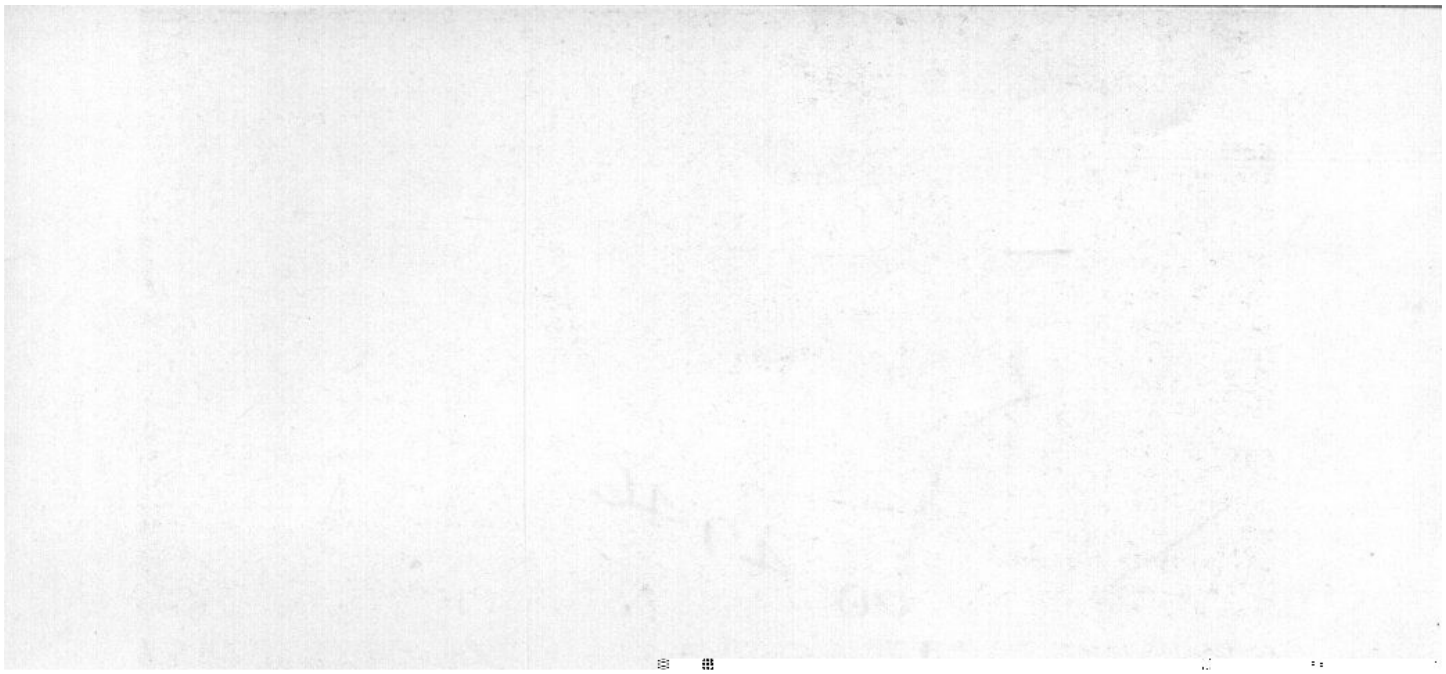

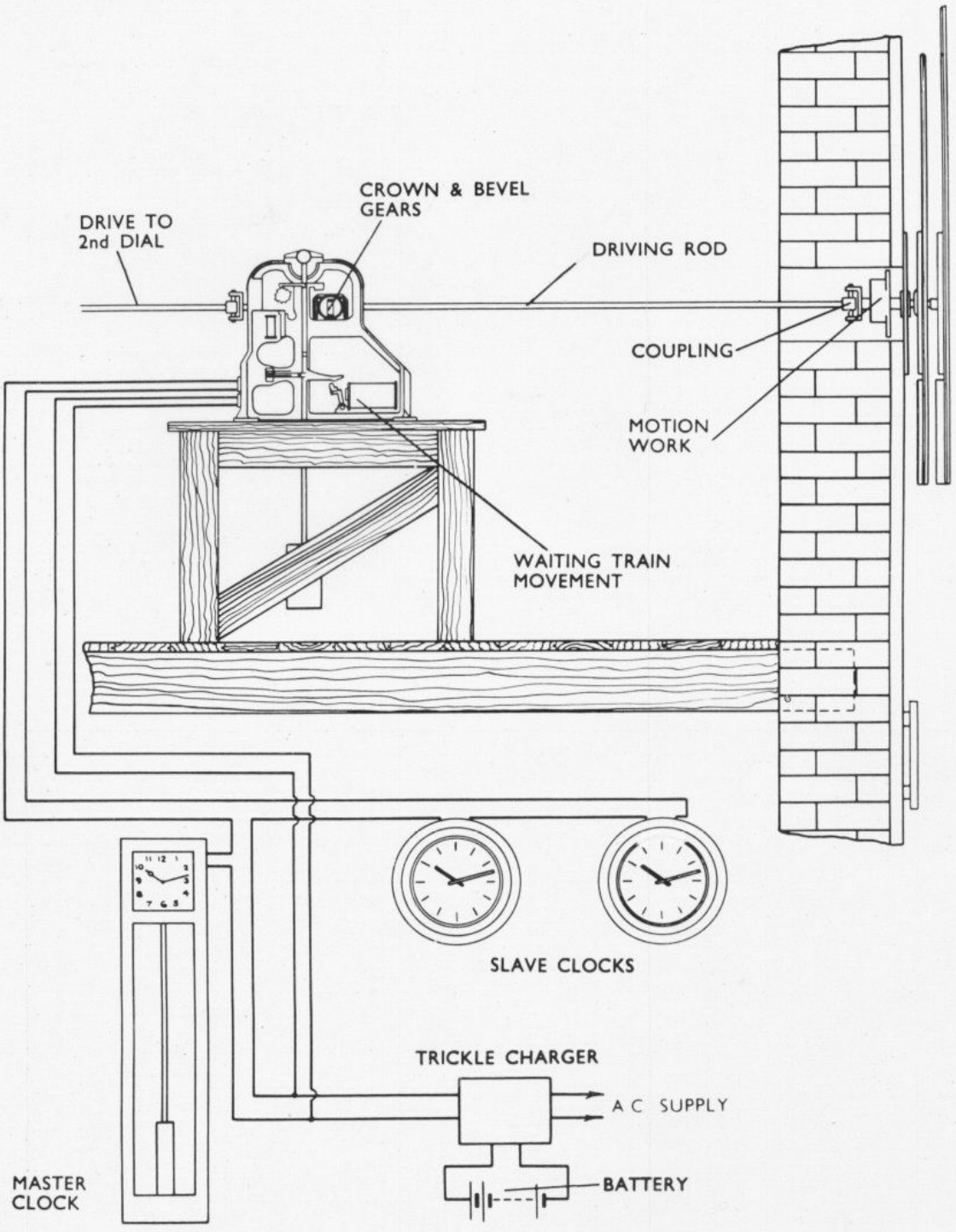

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2M570 May 1970 Edition *Printed in England*