STANDARD ADJUSTMENTS

FOR

P.O. CLOCKS

E.A.297. B.P.O. CLOCK No.36.

E.A.397. B.P.O. CLOCK No.46.

E.A.497. B.P.O. CLOCK No.38.

E.A.597. SECONDARY CLOCKS.

E.A.797. B.P.O. CLOCK No.30.

E.A.897. B.P.O. CLOCK No.32.

E.A.997. B.P.O. CLOCK No.28.

E.A.1097. B.P.O. CLOCK No.60.

B.P.O. CLOCK Nos. 2, 4, 4A, 6, 8, 18, 20, 34, 50A, 52A, 54A, 56A, and 58A

The adjustments and movements of these clocks are given under "Secondary Clock" E.A.597.

AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.

STANDARD ADJUSTMENTS FOR B.P.O. CLOCK No.36.

1. GENERAL.

B.P.O. Clock No.36 see Figure 1 is an electrically controlled master clock having a 1-second beating pendulum. It provides 1-second, 6-second and 1/2 min. impulses.

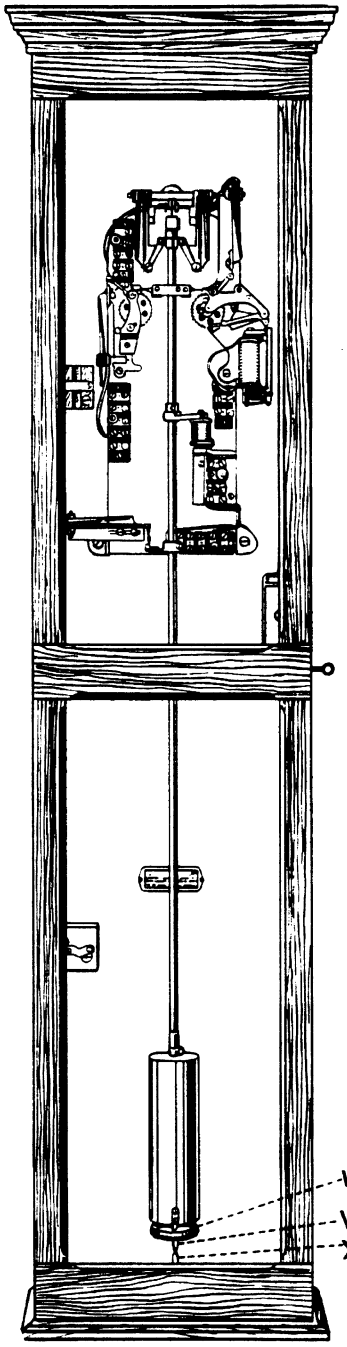


FIG. 1.—"CLOCK No. 36"
GENERAL APPEARANCE

2. MOUNTING.

Fix the master clock firmly to a rigid wall, free from vibrations so that with the pendulum hanging from its suspension and at rest the pointed lower end of the pendulum rod is immediately over the pointer fixed to the bottom of the case.

3(a).OPERATION.

Half minute impulses are provided by a count wheel A see Figure 2 which has 30 teeth on its periphery. This wheel is rotated in a clockwise direction, one tooth for each complete swing of the pendulum, by means of pawl P attached to the pendulum rod B. On the count wheel A are two teeth set diametrically opposite to each other and cut much deeper than the remainder. They permit the pawl P to drop lower and engage the lever-rod D at every half-minute. The lever rod is attached to a contact spring C, which moves to the right under the action of the pendulum and pawl, making contacts C every half-minute.

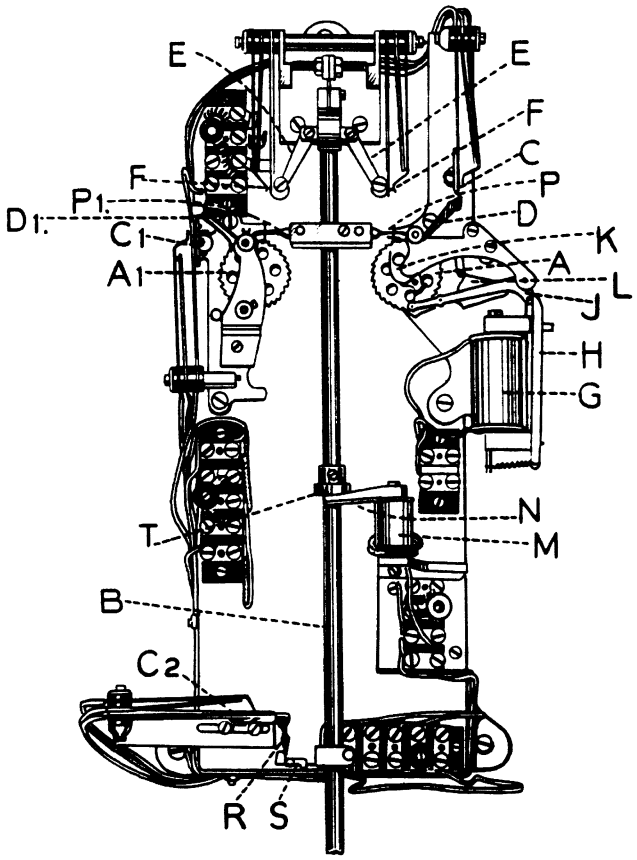


FIG. 2.—"CLOCK No. 36."
MECHANISM

3.(b)Six-second Impulses.

The six-second impulses are produced by a count wheel A.1 which has 30 teeth and is rotated in an anti-clockwise direction by means of pawl P1 in a manner similar to that of count wheel A. Each third tooth is cut deeper than the remainder, allowing pawl P1 to engage with the lever rod D1, making contacts C1 every six seconds.

3.(c)Second Impulses.

The second impulses are produced by contacts F which are operated at each swing of the pendulum by the two arms E.

4. SYNCHRONISER.

The passage of a Time Signal through the electro-magnet of the synchroniser G causes its armature H to be attracted to the left. The upper end of the armature engages a bell-crank lever J, which terminates in a small roller. The lever is raised and the roller is pressed against the heart shaped cam K on the count wheel A. The count wheel is advanced in a clockwise direction or retarded in an anti-clockwise direction, according to the number of seconds the count wheel is slow or fast of the Time Signal. To release the wheel for this operation, the inclined plane L (which is attached to the rear portion of the bell-crank lever) causes another bell-crank lever, situated behind the count wheel to lift the propelling pawl P and a retaining pawl away from the count wheel. This allows free movement of the count wheel under the pressure of the roller of the bell-crank J. On the cessation of the Time Signal, the armature of the synchroniser is released.

5. CLOCK DRIVE.

The swing of the pendulum is maintained by an electro-magnet M having extended pole pieces N, embracing the pendulum rod. Above the pole-pieces and attached to the pendulum rod is a soft iron armature T. Whilst the arc of oscillation of the pendulum lies outside a predetermined minimum, the toggle R trails over the notched agate S attached to the pendulum rod; but when the arc has declined to the minimum the toggle R engages in the notch in the agate and on the return swing of the pendulum, the toggle is raised and its associated contact C2 makes. The driving magnet is connected momentarily to the electro-magnet M, and an impulse is imparted to the pendulum. A potential of 4 volts, connected directly across the coil is required for satisfactory operation.

6. ADJUSTMENTS.

Adjust all impulse springs so that the impulse transmitted has a maximum duration of 0.5 sec. and a minimum of 0.2 sec. The opening between contacts to be 10 mils. minimum. Lever springs to be tensioned against their buffer springs with 5 grammes maximum when measured at the extreme tip of the springs. The contact springs to be similarly tensioned but with 20 grammes.

The pendulum is adjusted by raising or lowering the brass-encased lead bob by screwing up or unscrewing the circular rating nut upon which it rests. If the synchroniser is used, the pendulum should be adjusted to have a gaining rate not exceeding 14 seconds per day. The clock will gain if the bob is raised, or lose if it is lowered.

JSD/RLH/JC.

STANDARD ADJUSTMENTS FOR B.P.O. CLOCK No.46.

1. GENERAL.

"Clock No.46" is an electrically controlled master clock having a 1/2 second beating pendulum. It provides 1-second and 6-second impulses, also three impulses at 1-second intervals during each successive 6-seconds period. The clock is provided at certain telephone exchanges for the purpose of operating "Clock No.38" (Veeder clock) and "Clock No.44" (chargeable-time clock). "Clock No.46" is illustrated in Figure 1.

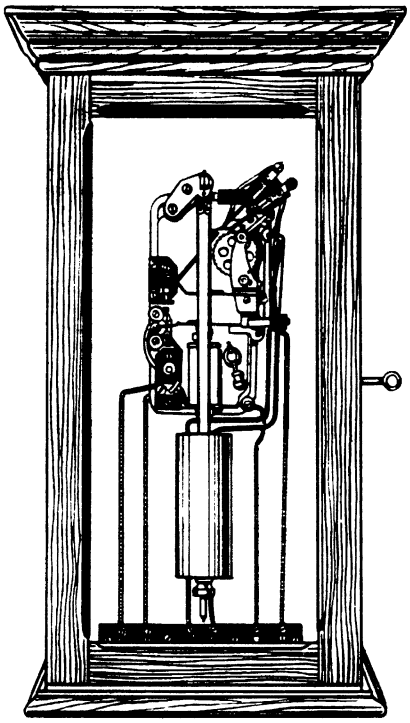


FIG. 1.—"CLOCK NO. 46." GENERAL APPEARANCE

2. MOUNTING.

Fix the clock firmly to a rigid wall, free from vibrations so that with the pendulum hanging from its suspension and at rest the pointed lower end of the pendulum rod is immediately over the pointer fixed to the bottom of the case.

3. OPERATION.

(a) Clock Drive. The swing of the pendulum is maintained by means of the electro-magnet M (Figure 2). Toggle T1 (Figure 3) is mounted in an iron carriage U (Figures 2 and 3), whose lower end forms an armature E. A forked brass detail D attached to the front of the carriage holds the pendulum rod, thus linking

(c) One-second Impulses are produced by the toggle T2 (which is linked to the pendulum) engaging the agate G2 on each return swing of the pendulum to the left. This action makes contacts C2 once every second. The contact will normally make for a period of 0.150 second, but it can be adjusted to 0.080 - 0.225 second by moving the agate to the right or left as required. The relevant circuit diagram should be consulted to see if any variation is required.

(d) Three 1-second Impulses at 6-second Intervals are produced by the normal 1-second impulses which are interrupted by contacts F at three seconds make, three seconds break, intervals. The interruptions to contacts F are provided by a cam wheel, situated behind and attached to the wheel A.

4. ADJUSTMENT.

The pendulum is regulated by raising or lowering the pendulum bob P by means of rating nut W. Raising the bob causes the clock to gain and lowering causes the clock to lose.

RRR/RLH

STANDARD ADJUSTMENTS FOR
ELECTRIC CLOCK, IMPULSE TYPE B.P.O. No.38.

1. DESCRIPTION.

"Clock No.38" is of the Veeder type and is provided for checking the "Clock No.46". It is similar in appearance to a subscriber's meter. The clock is driven by an impulse every six seconds. It is illustrated in Figures 1 and 2. In Figure 1 an elapsed time of 12 hours 9 minutes, is indicated.

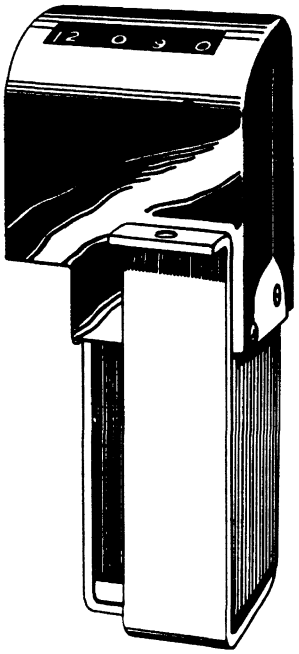


FIG. 1.—"CLOCK No. 38."
GENERAL APPEARANCE

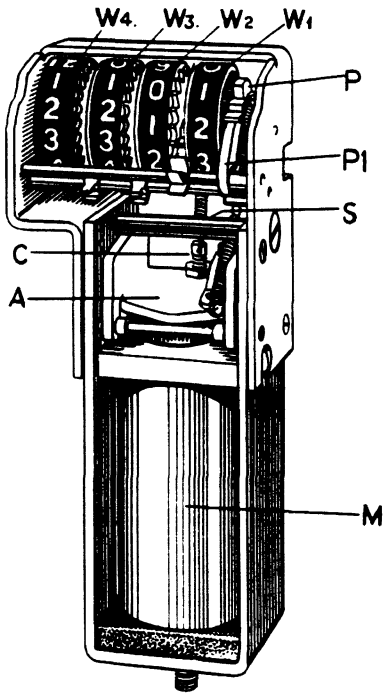


FIG. 2.—"CLOCK No. 38."
COVER REMOVED

2. OPERATION.

The electrical impulse energises the electromagnet M (Figure 2) which attracts the armature A. Pawl P, attached to the armature, rotates the numeral wheel W.1. one tenth of a revolution for each impulse. The pawl P.1. prevents backlash. The numeral wheels W.2. W.3 and W.4. are so arranged that one revolution of W.1. causes W.2. to be advanced one step, one revolution of W.2. causes W.3. to be advanced one step, and half a revolution of W.3. causes W.4. to be advanced one step.

3. NOISE.

To reduce the operating noise, the back stop S is fitted with a rubber sleeve, and the armature stroke stop C is covered with a buffer.

4. RESISTANCE AND OPERATING CURRENT.

The electro-magnet has a resistance of 500 ohms and requires a minimum operating current of 40 MA.

JSD/RLH/MM.

STANDARD ADJUSTMENTS OF SECONDARY CLOCKS.

1. GENERAL.

(1) All secondary clocks contain a step-by-step mechanism the different types being illustrated in Figures 1, 2 and 3. There are two terminals on the bottom of the base of the movement cover. If adjustments are necessary these terminals can be shorted if the individual clock is fast or advanced by means of a dry cell if slow.

(2) Secondary clocks are fitted in various parts of the exchange to give the local time.

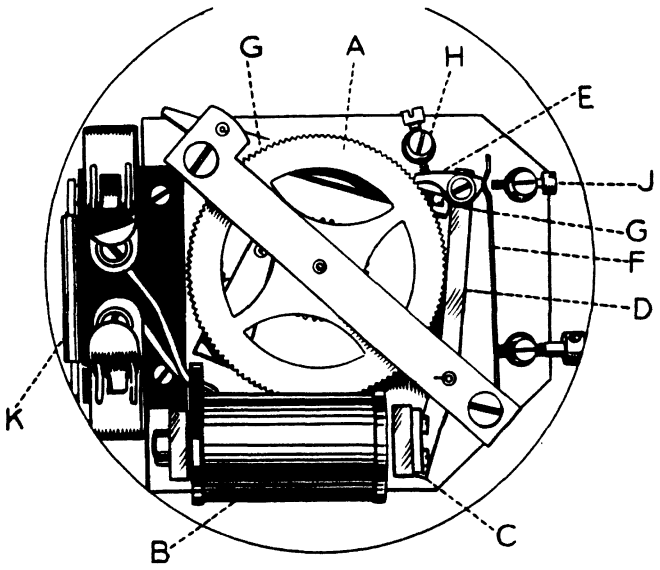


FIG. 1.—IMPULSE CLOCK.
RATCHET MOVEMENT.

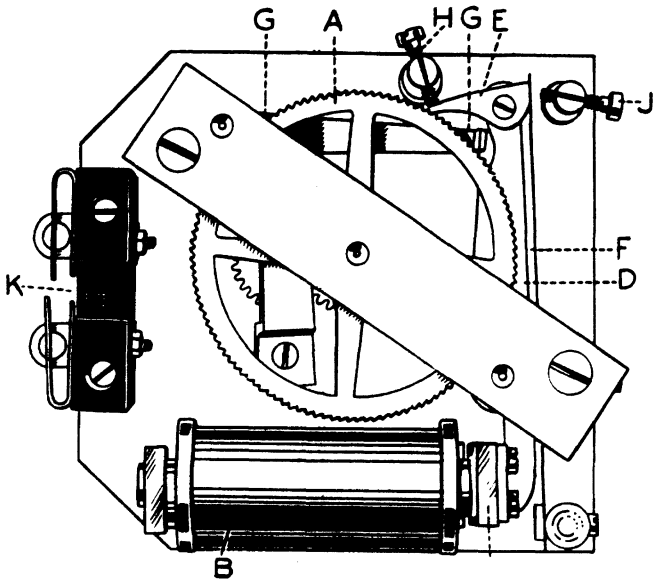


FIG. 2.—IMPULSE CLOCK.
RATCHET MOVEMENT

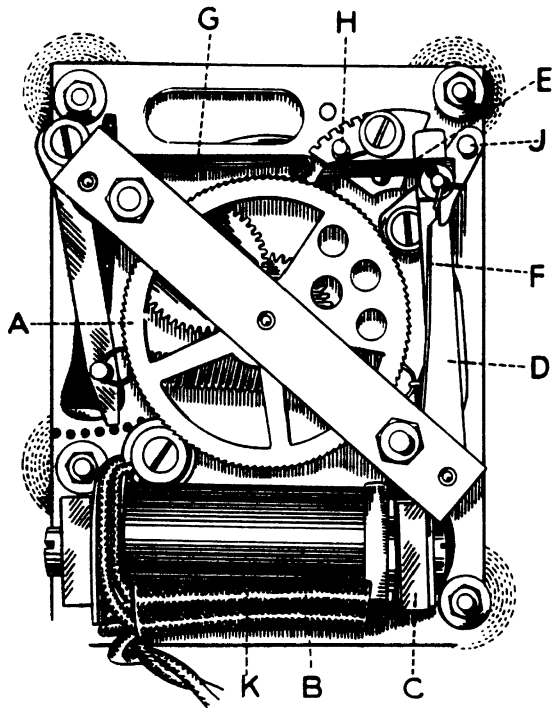


FIG. 3. IMPULSE CLOCK. RATCHET MOVEMENT

2. OPERATION.

(a) There are twelve main parts of the clock.

A is the main ratchet-wheel, having 120 teeth.

B the operating electro-magnet.

C the armature.

D the armature lever.

E the driving pawl, which moves the ratchet-wheel one tooth on the release of the armature.

F the driving spring, which normally holds the driving pawl in engagement with the ratchet wheel, and the armature away from the electro-magnet.

G the back-stop lever, which prevents movement of the ratchet-wheel when the armature is attracted, as might be possible from vibration or in cases of clocks with exposed dials, by pressure of wind on the hands.

H the momentum stop, which prevents the ratchet-wheel being moved more than one tooth per impulse and, with the pawl E, locks the ratchet-wheel between impulses.

J the stroke-limit stop, which limits the travel of the armature.

K the non-inductive shunt, permanently connected across the electro-magnet coil.

L adjusting lever for armature restoring spring.
M armature restoring spring.

3. MAGNET ADJUSTMENT.

(1) The magnet must operate as close to the armature as possible. The armature face must just touch the magnet coil at the same time as the top end of the driving lever touches the upper stop.

The driving spring of the movement operates against the armature, and the spring must be set by the adjusting lever so that the armature operates on 120 milliamps.

4. HANDS.

(1) The hands must be free of each other and of the glass dial. If there is any tendency to stick in any position after trial, the cause of the friction must be removed.

5. The silent or polarized movement is illustrated in Figures 4 and 5. The parts and operation are as follows:-

A is the electromagnet

B the permanent magnet

D the moveable keeper

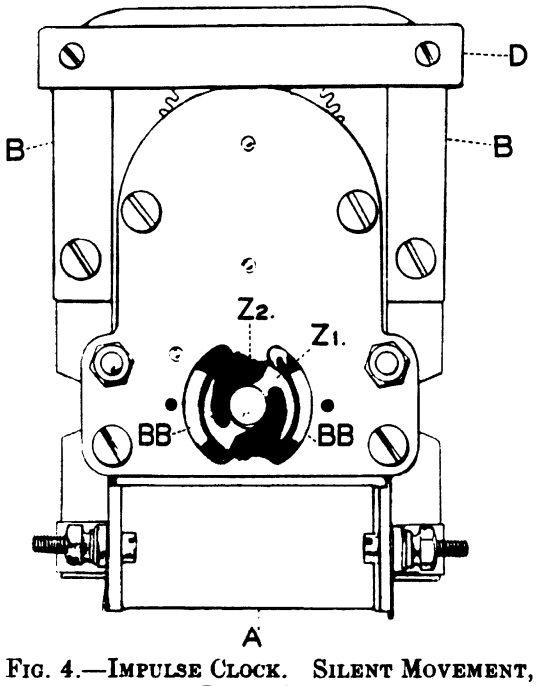


FIG. 4.—IMPULSE CLOCK. SILENT MOVEMENT, REAR VIEW

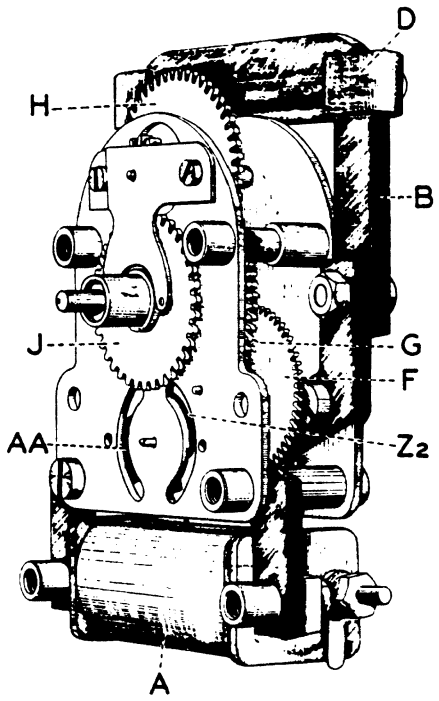


FIG. 5.—IMPULSE CLOCK. SILENT MOVEMENT, FRONT VIEW

Z1 and Z2 are two Z-shaped soft-iron armatures, located within pole-pieces AA and BB of the magnets A and B.

F. G, H and J are reduction wheels for driving the hands. The hands are normally held in position by the influence of the permanent magnet on the armature Z1; a mechanical locking device is not provided.

6. When the electromagnet A and its pole-pieces AA are energized by an impulse from the "Clock No. 36", the electromagnetic influence on armature Z2 overcomes the retaining force on Z1 and the armature spindle is rotated through 90°, i.e. to a position where the armature Z2 embraces the greatest number of lines of force from the pole-pieces AA.

7. On the cessation of the current through electromagnet A, the armature Z1 is again influenced by the permanent magnet B and its pole-pieces BB, and is rotated a further 90°. The armature spindle will now have rotated through an angle of 180° from its original position, which will carry the hands a half minute on the dial face. The spindle carrying the armatures Z1 and Z2 is coupled to the wheels F and G to provide a 60 to 1 reduction gear to drive the 'minute' hand. A further reduction gear of 12 to 1 is provided by

wheel H and its pinion, in conjunction with wheel J, to drive the 'hour' hand.

8. When connecting the silent type of movement in circuit, it is essential to ensure that the clocks are joined up correctly for polarity in accordance with the marking on the movement.

9. LUBRICATION.

(1) All specified parts shall be oiled with G.B.E. clock oil.

(2) Before commencement of lubrication all dirt and dirty oil shall be removed.

(3) One drop of oil shall be applied to each pivot, post or pin and the stud of the driving click.

(4) No oil shall be applied to the ratchet wheel, driving ends of the pawls, and the brass pin forming the forward stop of the driving pawl.

10. ELECTRICAL TESTS.

The clock should be set to work on 220 milliamps, but in no case should the current be less than 180 milliamps and not more than 270 milliamps.

11. REMOVING OR INSERTING SECONDARY CLOCKS.

If it is necessary to disconnect a clock or break the circuit for the insertion of a new clock, this should be done immediately after an impulse and be reconnected before the next impulse; failure to do this will result in the clocks being slow or out of step.

Upon further clocks being added, it may be necessary to reduce the value of the series resistance to cover the electrical tests. Para. 10.

STANDARD ADJUSTMENTS FOR B.P.O. "CLOCK NO. 30"

1. GENERAL

"Clock No. 30" which is provided for use on impulse clock installations for the purpose of synchronizing 1/2-minute secondary dials, is illustrated in Figs. 1 and 2, and is connected in the clock circuit in the manner indicated on the relevant diagram.

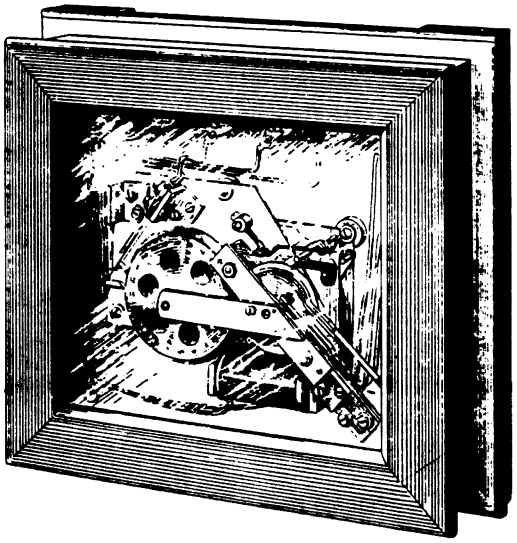


Fig. 1—"CLOCK No. 30"—GENERAL APPEARANCE

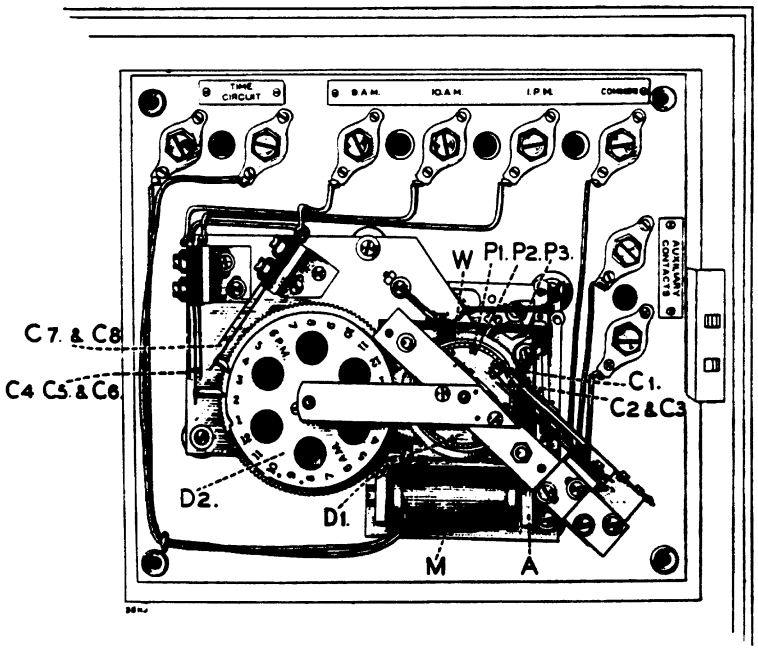


Fig. 2.—"CLOCK No. 30"—DETAILS

2. OPERATION

Half-minute impulses energize the electromagnet M (Fig.2), which attracts the armature A to the left. This causes the pawl P3, attached to the extension of

the armature, to be moved to the right and to engage the next tooth in the propelling wheel W. On the cessation of the impulse, a spring (not shown in the illustration)returns the pawl to its original position, thus carrying the propelling wheel forward one tooth, which is 1/120th of its circumference. Rigidly attached to the wheel W is an index disk D1 carrying, near its periphery, two pins P1 and P2. During the revolution of wheel W, these pins engage contacts C1 and C2. The pin P1, which is in contact with the frame, and situated near the periphery of D1, makes contact with C1 for a period from 1.1/2 minutes before, to 1.1/2 minutes after, the hour. The springs carrying the contact C1 can, however, be adjusted to provide for the operation of C1 at one minute before, and one minute after the hour. The spring and associated insulator are slotted for this purpose. This adjustment will only be necessary when the synchronizing signal is provided by a second sub-chronopher. Three minutes before every hour, the pin P2 operates contact C2 and C3, and allows them to break exactly at the hour. The propelling wheel W drives by means of a 24 to 1 reduction gear, the 24-hour disk D2, which has on its periphery a projection at a point representing 10.0 a.m. and a detent at a point representing 1.0 p.m. Two sets of springs having contacts C7 and C8, and C4, C5 and C6, are situated adjacentto the disk D2 in such a position that contacts C7 and C8 and are made to operate a few minutes before 9.0 a.m. by the projection on the periphery of the disk D2, and contacts C4 and C5 are operated a few minutes before 10.0 a.m. Contacts C5 and C6 are operated a few minutes before 1.0 p.m. by the detent on the periphery of disk D2.

NOTE:- The contacts C7 and C8 are situated in such a position relative to the disk D2 that they are operated exactly one hour in advance of the operation of contacts C4 and C5. The actual time the projection on D2 is opposite contacts C7 and C8 is, therefore, 9.0 a.m.

3. The internal connexions of the clock are shown

on the relevant diagram. The resistance of the electro-magnet is between 7.5 and 10 ohms.

4. SYNCHRONIZATION OF ½-MINUTE SECONDARY DIALS

The "Clock No. 30" is driven by the master clock in series with one of the secondary-dial groups. Half-minute impulse clocks and "Clock No. 32" are synchronized by the operation of the synchronizer in the master "Clock No. 36". The maximum variation that can be corrected by the synchronizer is ± 20 seconds. For a period of 1½ minutes, or 1 minute where "Clock No. 30" has been adjusted, a contact on "Clock No.30" operates and extends the line from the sub-chronopher to the synchronizer of the master clock. The signal is received, synchronization is effected as described in E.A.297 and, after 1½ or 1 minute, as the case may be, the line from the sub-chronopher is disconnected.

5. Mounting - The clock is suitable for wall mounting and should be fixed in a position adjacent to the master clock ("Clock No. 36").

RRR/RLH

STANDARD ADJUSTMENTS FOR B.P.O
"CLOCK NO. 32"

1. GENERAL

"Clock No. 32" is provided for synchronizing 1-second dial clocks in conjunction with "Clocks Nos. 30 and 36". The clock is illustrated in Figures 1 and 2 and is connected in circuit in the manner indicated on the relevant diagram.

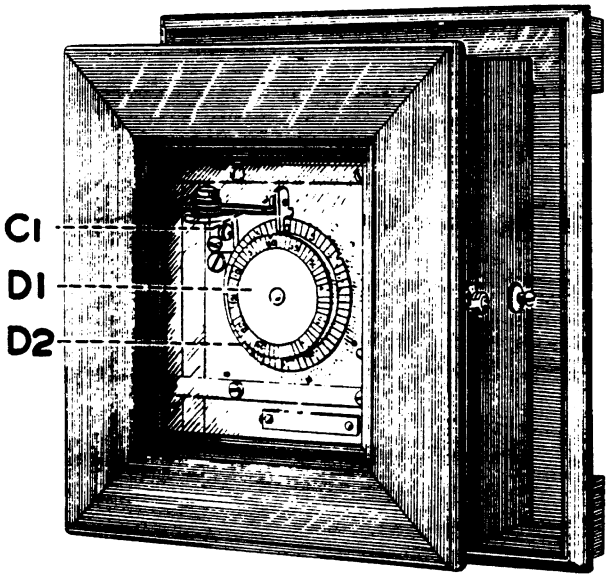


FIG. 1.—"CLOCK NO. 32." GENERAL APPEARANCE

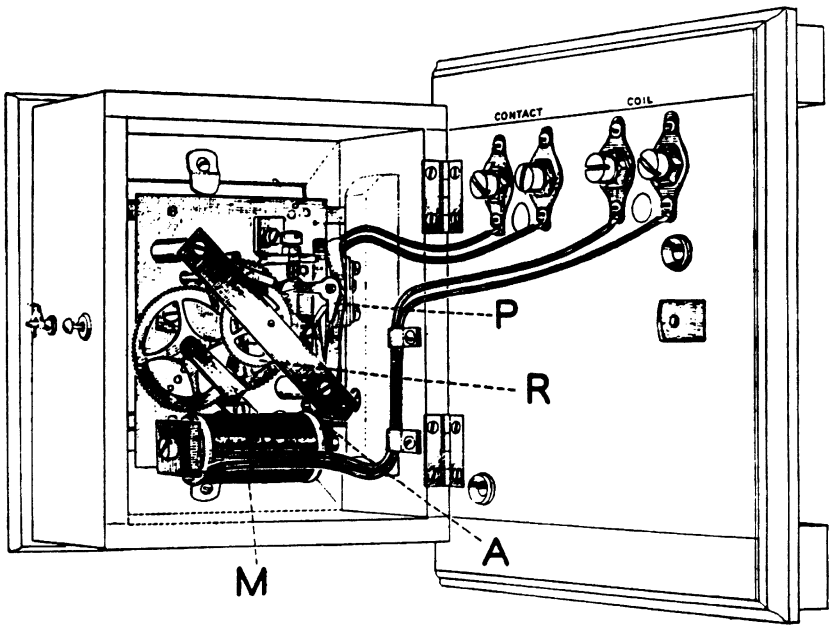


FIG. 2.—"CLOCK NO. 32." MECHANISM

2. OPERATION

One second impulses from the pulse distribution circuit energize the electromagnet M attracting the armature A (Fig.2) to the left. To an extension of

the armature is attached a spring-controlled pawl P, which rotates a propelling wheel R, one tooth for each impulse received. To the arbor of this propelling wheel are attached two disks D1 and D2 (Fig.1); the foremost disk D1 rotates once a minute, and disk D2 once an hour. In the periphery of each disk is a V-shaped notch situated at the index 60. Adjacent to these disks is a contact C1, which is normally closed in all positions of the disks except when the two notches are in alignment. The contact C1 is then broken and the circuit through the electromagnet is interrupted. The circuit remains broken until the "Clock No. 30" reaches the hour, whereupon the circuit is completed by the release of the relay which provides an alternative circuit for driving the "Clock No. 32" Contact C1 is remade upon receipt of the next impulse.

3. SYNCHRONIZATION OF 1-SECOND SECONDARY DIALS.

To synchronize 1-second clocks, the master clock must be given a slightly gaining rate not exceeding 14 seconds per day. Synchronization is effected at the hour following the receipt of the synchronizing signal. The "Clock No. 32" is driven by 1-second impulses which are independent of the $\frac{1}{2}$-minute impulses. When the $\frac{1}{2}$-minute count wheel of the master clock is retarded by the synchronizing signal, the $\frac{1}{2}$-minute clocks are corrected by virtue of the increased lapsed time before the following $\frac{1}{2}$-minute impulse. The 1-second clocks and the "Clocks No. 32" will therefore be fast, relative to the $\frac{1}{2}$-minute clocks, until the hour following.

4. It will be seen on reference to the relevant diagram that the contacts in "Clock No.32"are normally short-circuited by contact SP1. At three minutes before every hour, relay SP is operated by the contacts in "Clock No.30". The short-circuit is removed from the contacts of "Clock No.32" by the opening of contact SP1, and the driving circuit of "Clock No.32" (and the seconds impulsing clock) is left dependent upon its own contacts. As the "Clock No.32" (and the 1-second clocks)is now fast with respect to the "Clock

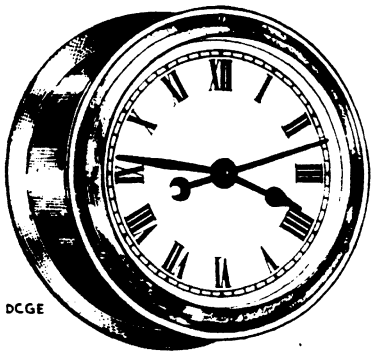
No.30", it reaches the hour in advance, breaks its own contact and so disconnects its own driving circuit.The 1-second clocks are not driven again until the interval of time they were in advance has been lost, i.e. when the contacts in "Clock No.30" which control relay SP are broken exactly at the hour. This releases the SP relay,contact SP1 restores the circuit for starting the drive of "Clock No.32" and the seconds impulsing clocks, which will now register correct time.

RRR/RLH

STANDARD ADJUSTMENTS FOR
ELECTRICAL CLOCKS - IMPULSE TYPE
B.P.O. CLOCK No. 28.

1. DESCRIPTION

"Clock No.28"is a seconds-indicating clock;the general appearance is shown in Figure 1 and the movement is illustrated in Figure 2.



Overall Dia. 5½ in.
Dia. of dial, 4 in.
Depth (back to front), 3¾ in.

FIG. 1.—"CLOCK NO. 28"

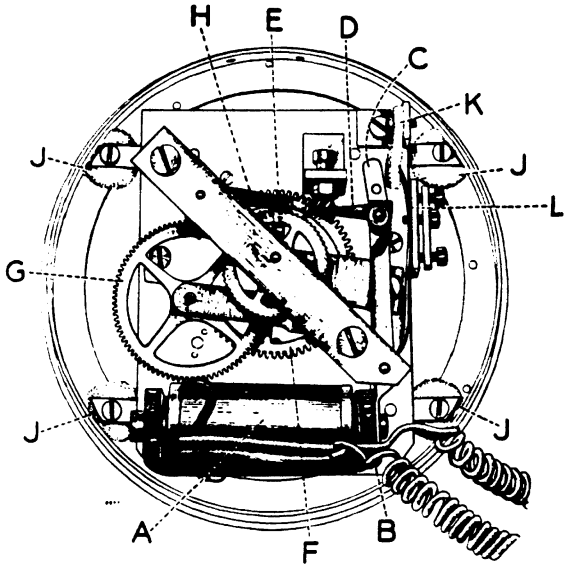


FIG. 2.—"CLOCK NO. 28"—MOVEMENT

2. OPERATION

The current impulse passes through the electromagnet A, attracting a spring-controlled armature B. From the upper extremity of armature B, the extension C carries a spring-controlled pawl D engaging with the ratchet wheel E. This ratchet wheel has 60 teeth and is fixed by the 'seconds' arbor carrying the 'seconds' hand. The ratchet wheel drives the 'minutes' hand by means of the 60 to 1 reduction wheels F and G. A further 12 to 1 reduction gear, situated between the pillar plate and dial (not shown in the illustration), controls the 'hour' hand. A gravity-controlled retaining pawl H is provided to prevent back-lash, and to maintain the 'seconds' hand in position during the passage of the impulses. Felt or rubber washers J are inserted between the movement and the dial, to reduce the sound of the clock action. The felt buffer K is provided to absorb the blow occasioned by the action of the armature lever against the limiting spring L.

3. OPERATING CURRENT.

The normal operating current for "Clock No. 28" is 200 mA., and care should be taken to ensure that a current of 250 mA. is not exceeded.

4. MOUNTING.

When "Clocks No. 28" are fitted on service observation panels, it is essential that they should operate with a minimum of noise. In all cases where the operating noise is considered to be excessive, arrangements should be made for a rubber sponge pad, one inch in thickness, to be inserted between the clock and the mounting.

RRR/RLH

STANDARD ADJUSTMENTS FOR
ELECTRICAL CLOCKS - IMPULSE TYPE
B.P.O. CLOCK NO.60.

1. GENERAL

"Clock No. 60" is provided at U.A.X.s No.7 and No.14 to effect the change-over at pre-determined times of the line-finder control set lock-out alarm from 'prompt' to 'deferred' and vice-versa.

2. The clock, which is suitable for operation with half-minute impulses, is illustrated in Figures 1 and 2.

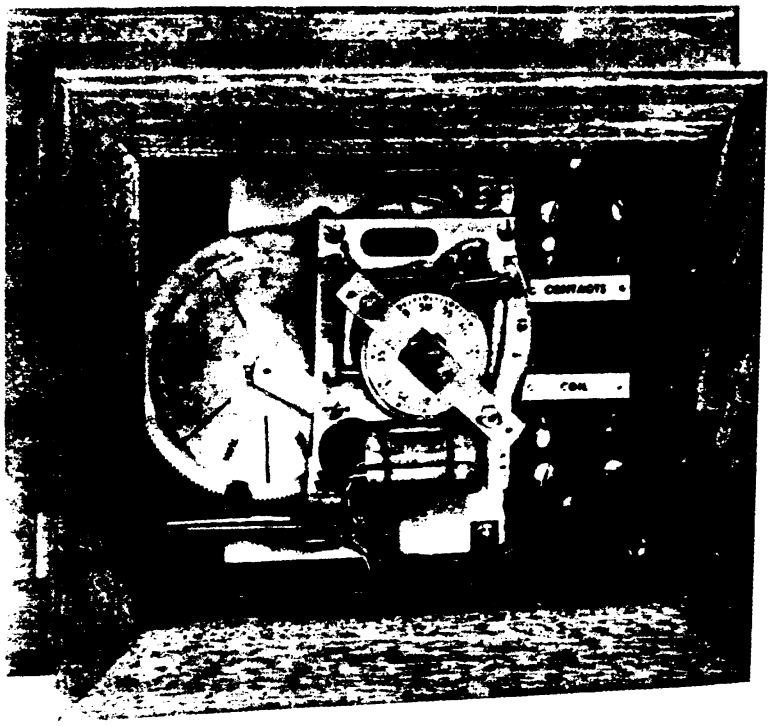


FIG. 1

3. DESCRIPTION

The clock consists of a standard half-minute impulse movement of the ratchet and pawl type similar to that described and illustrated in E.A.597, with the addition of two wheels W1 and W2 (Figure 2) and the spring-sets S1 and S2. The whole mechanism is contained in a glazed wooden case, measuring 12 in. x 10 in. x $4\frac{1}{2}$ in.

4. The impulse mechanism shall be adjusted as E.A. 597, the ancillary equipment is described and set as follows.

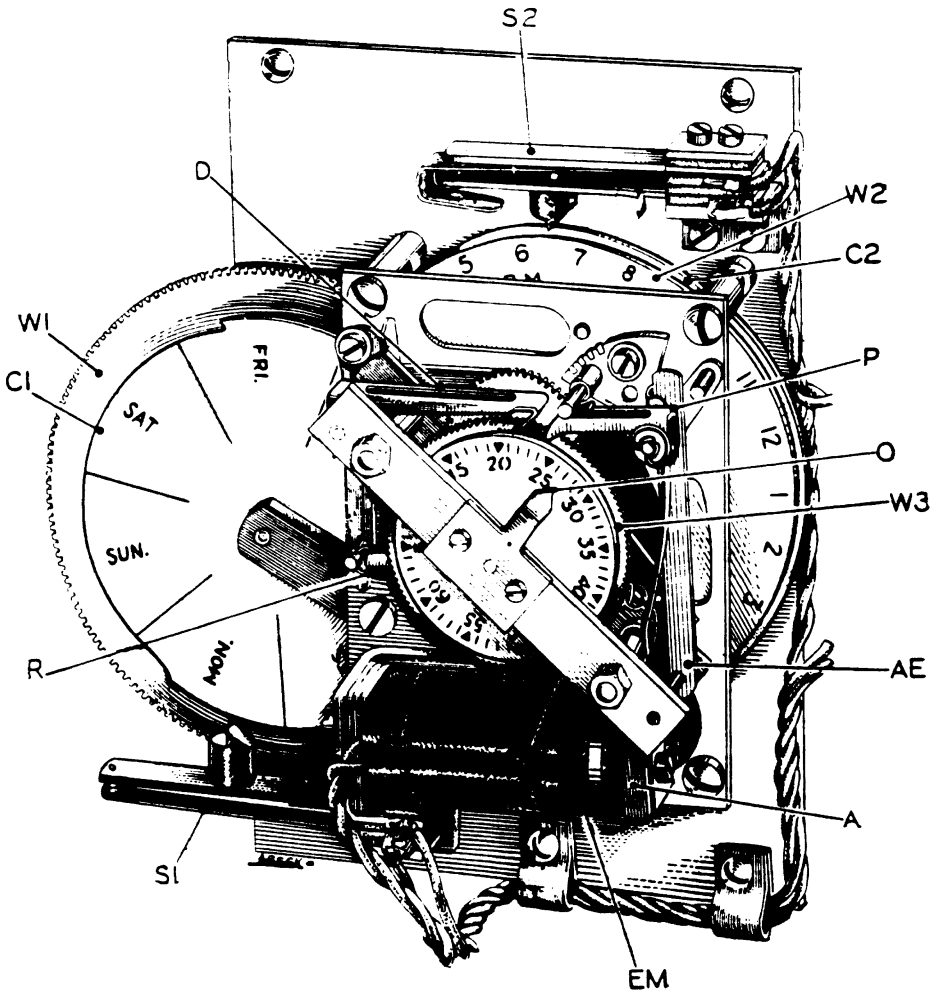


FIG. 2

5. OPERATION

Half-minute impulses energize the electro-magnet EM (Figure 2) which attracts the armature A to the left. This causes the pawl P attached to the armature extension AE to be moved to the right and engage the next tooth of wheel W3. On completion of the impulse, the restoring spring R returns the armature to its original position, thus carrying the wheel W3 forward one tooth. As wheel W3 has 120 teeth it rotates once every hour. Connected to wheel W3, by suitable gearing, are the wheels W1 graduated in days and W2 graduated in hours, and which revolve once in 7 days and 24 hours respectively.

Fitted to the wheels W1 and W2 are the cams C1 and C2 which control the operation of the spring-sets S1 and S2 connected in series. The cams are so shaped that the spring-set S1 'makes' from 8 a.m. Monday to 5 p.m. Friday, whilst the spring-set S2 'makes' from 5 p.m. to 8 a.m. daily. This arrangement provides a 'make'

contact to operate the relay which changes the alarm from 'prompt' to 'deferred' at all times other than 8 a.m. to 5 p.m. each day Monday to Friday.

To set the clock to the correct time and day, the pawl P and detent D should be lifted clear of the wheel W3 with the minutes disk attached. Wheel W3 is then rotated in an anti-clockwise direction until the tips of the lifting studs associated with spring-sets S1 and S2 and the pointer O indicate the day, hour, and minute at the time of setting. In Figure 2 the clock indicates the time as Monday 6.27 p.m.

6. ELECTRICAL DETAILS

The electro-magnet has a resistance of approximately 8.5 ohms and requires a current of between 250 and 300 mA. for satisfactory operation.

7. MOUNTING.

The clock is suitable for wall mounting and should be fixed in a position adjacent to the master clock (Clock No.36).

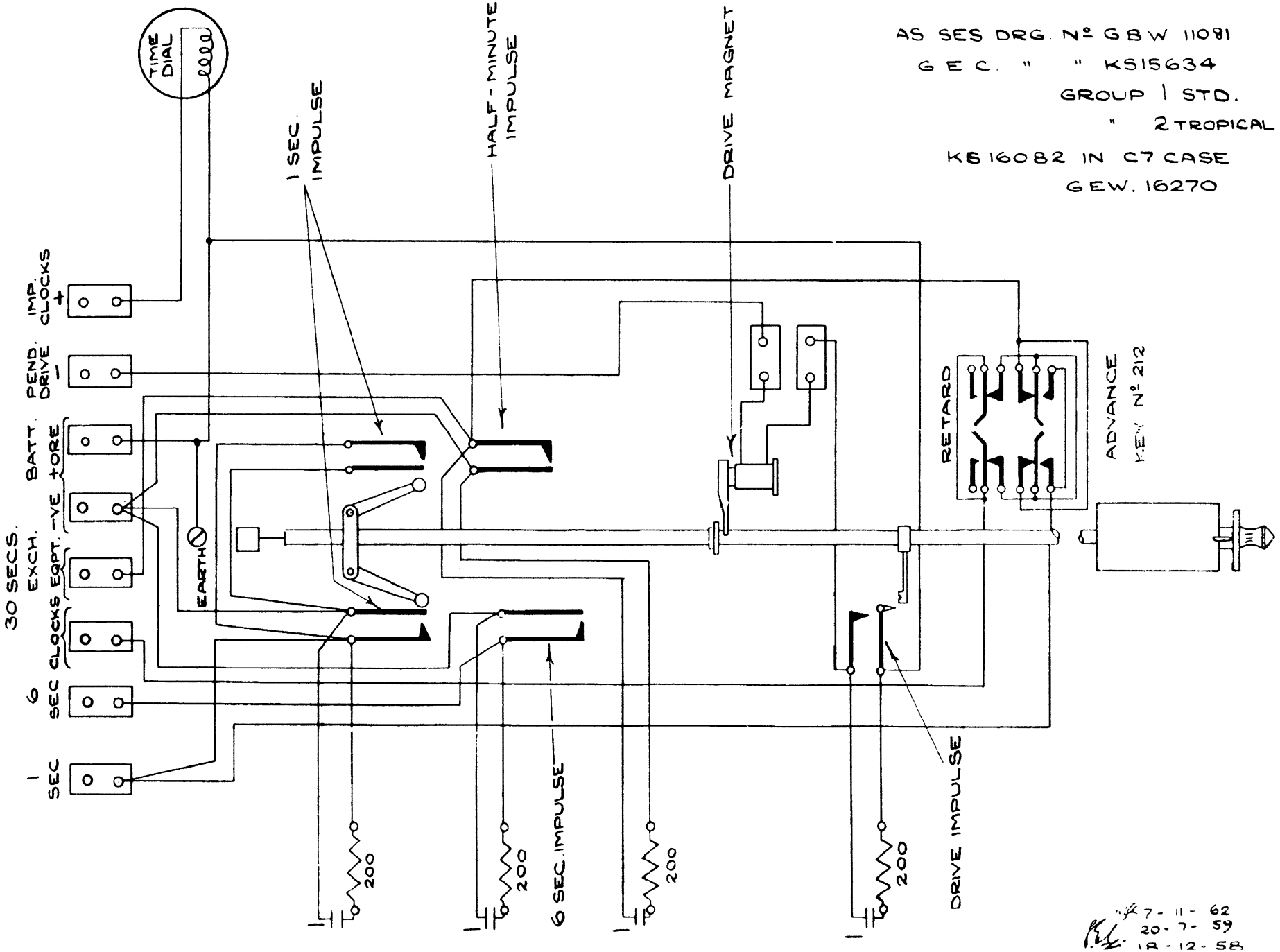
RRR/RLH

A1908/5

INTERNAL CONNS. FOR G.P.O. CLOCK Nº 36 WITH TIME DIAL

705630

A1908/5



AS SES DRG. Nº G B W 11081
G E C. " " KS15634
GROUP 1 STD.
" 2 TROPICAL
KS 16082 IN C7 CASE
G E W. 16270

7 - 11 - 62
20 - 7 - 59
18 - 12 - 58