73 WHITING STREET, ARTARMON, N.S.W. TELEX 21175. TELEPHONE 439-2333* V9/HB 1900

E.S. RUBIN & CO PTY LTD

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HANDBOOK

PENDULUM SYNCHRONISING FOR TWO MASTER CLOCKS

E. S. Rubin & Co. Pty. Ltd.

3rd December, 1964

SYNCHRONISING MODULE FOR TWO MASTER CLOCKS TYPE EC

If 2 master clock systems are used side by side either in an intergrated system such as duplicated master clock or non intergrated system of 2 master clocks separately reticulated, it is essential that both master clocks operate in synchronism and that the pulses given off by each of the clocks are of the same polarity as otherwise, a discrepancy of as much as 2 minutes would be possible.

Mechanical regulation of pendulums to such degree that they would swing in synchronism is almost impossible and we employ, therefore, a second permanent magnet and system of electro-magnetic regulation of one of the master clocks (which we call the "stand-by" master clock for duplicated systems.) The arrangement corrects the beat of the stand-by clocks pendulum but not that of the main master clock.

It is most desirable that mechanical regulation of the 2 master clocks be as precise as possible and that their respective time-keeping be as close to each other as possible. Any small adjustment in main master clock will reflect automatically on stand-by master clock. The system is capable of correcting a theoretical discrepancy of the 2 pendulum beats of up to 10 seconds per 24 hours.

MECHANICAL DESCRIPTION

The system is enclosed in a rack or panel mounting metal cubicle with 2 magnetic resettable counters Type QZ3R shown on the face which also carries a fuse and an on-off switch.

The 2 relays P/1 and Q/2 are bi-stable (equipped with permanent magnet), are identical and have 2 windings e.g. between tag 1 and 2 - 1000 ohms, 10,000 turns of .09 wire and 5 and 6 - 1000 ohms, 9800 turns of .11 wire and are equipped with 3 changeover contacts of which 1 changeover contact is used on relay P and 1M and 1B contact on Relay Q.

CIRCUIT DESCRIPTION

Coils of relays P and Q are wired in parallel with minute pulses of the master clocks. Relay P is connected to main master clock, Relay Q to stand-by. Relay Q receives a pulse from the stand-by master clock every minute and operates every minute. It causes the synchronising mechanism to be operative on even minutes only (inoperative odd minutes). If Relay Q receives a pulse before Relay P, contact Q1 will be open and will not permit Relay P to operate. Contact P1 determines whether the EMR coil receives an advancing or retarding pulse of one minute duration. If relay Q receives its pulse later, relay P will operate and change over contact P1. The retarding and/or advancing pulses are counted by impulse counters. The system may be rendered inoperative by on-off switch.

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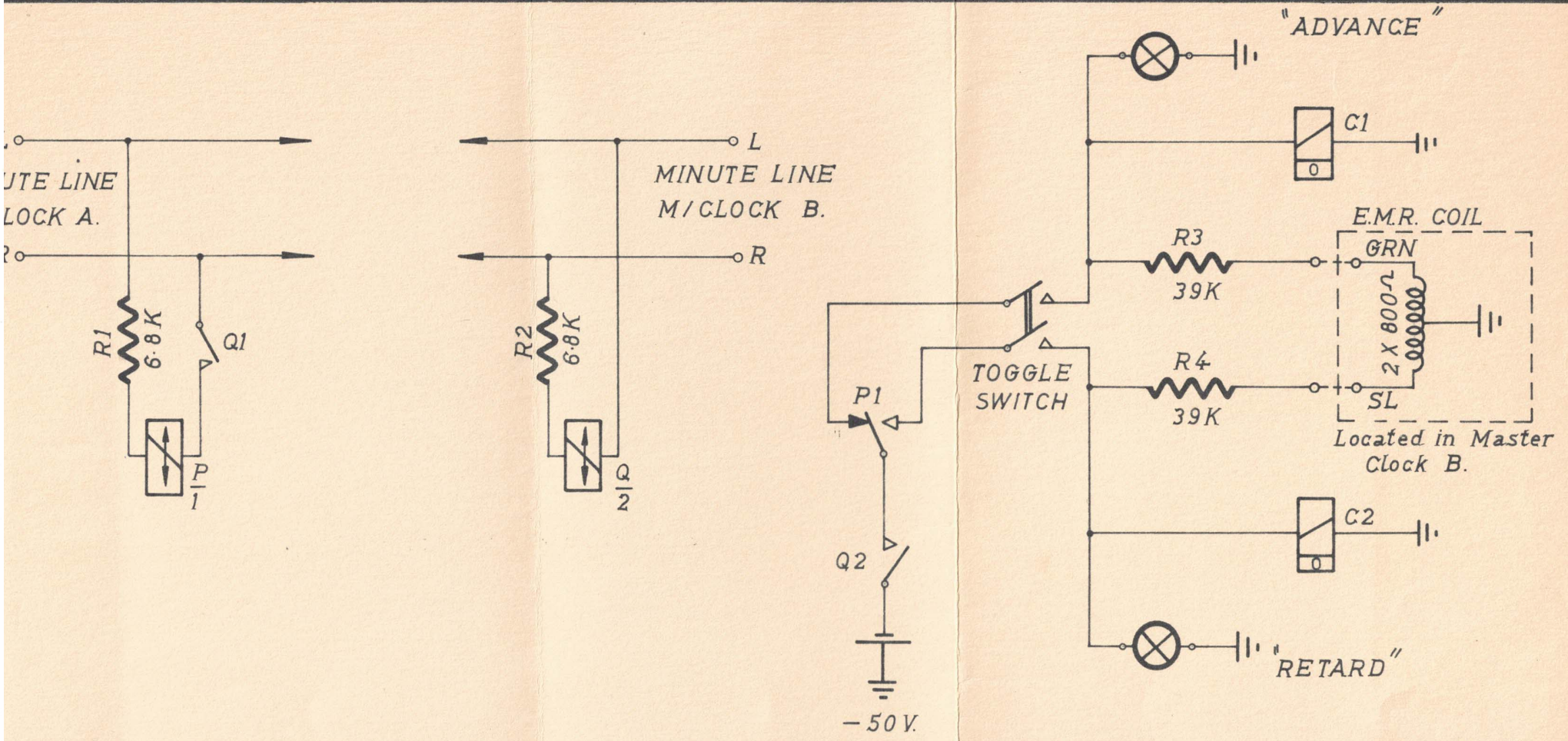
OPERATION

The ideal condition is for the stand-by pendulum to receive alternately one advancing pulse followed by a retarding pulse etc. so that the closer the numbers shown on the face of the counters to each other, the closer accuracy has been achieved. If, e.g. the counter marked + shows much larger figure than counter marked - it would indicate that the stand-by master clock is receiving far more advancing pulses than retarding pulses and, therefore, the mechanical regulation is "slow". It is desirable to adjust this condition by advancing the clock slightly by means of manual EMR of the stand-by master clock or by the retarding by EMR of the main master clock. Which of the actions will be taken (i.e. retarding or advancing action of the respective clock) will depend on comparison of the time kept by the intergrated system with standard time e.g. if the whole system is slow, advance of main master clock is desirable. If the system is on time, advance of stand-by clock is necessary. If the whole system is fast, main and stand-by must be retarded whereby the stand-by will be retarded most severely.

The read-outs of the counters should be logged at least once in 48 hours and after read-out, reset. No resetting to be done during progress of a pulse which will be noted by half position of the single digit.

IMPORTANT

Both master clocks MUST be operating on the same polarity i.e. seconds pulses AND minute pulses.



Relay P, Q. 2X1000Ω in series bi-stable.
Counter C1, C2. 3000Ω QZ3R.

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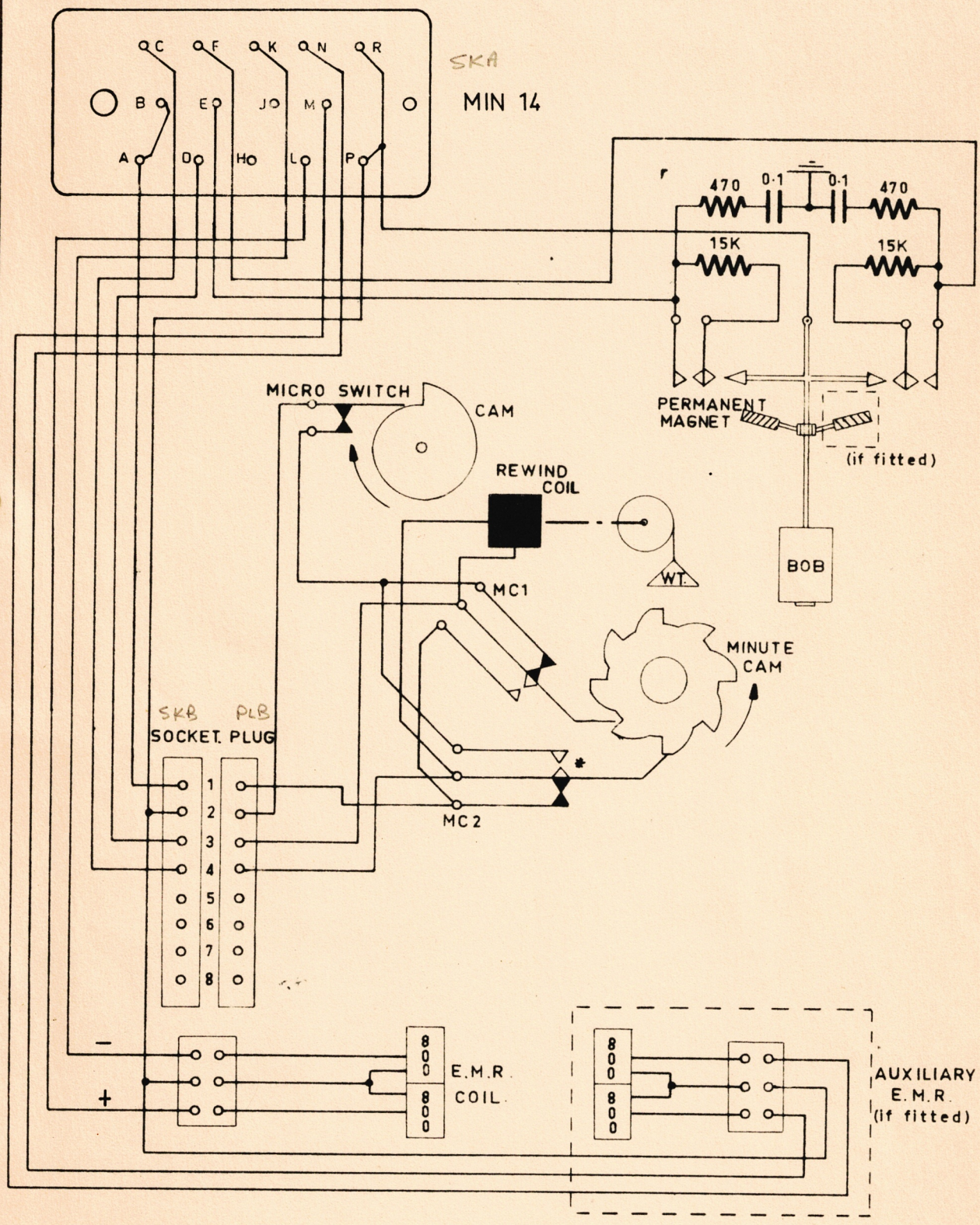
73 WHITING ST, ARTARMON. N.S.W.

MASTER CLOCK SYNCHRONISING
50 V. D.C. SYSTEM



* NOTE:
CONTACT GAP 0·6mm.

E. S. RUBIN &. CO. PTY. LTD.

C.T.W. MASTER. CLOCK.
TYPE EC/DC MOVEMENT WITH MICROSWITCH

DRAWN:	C.G.T.	DATE:	17 - 2 - 66
CHECKED:		AMENDMENTS:	12 · 8 · 70

No. 305 ISSUE No. 2 D2

6. REGULATION OF MASTER CLOCK.

General.

Reliable source of time signals is necessary for proper regulation such as PMG time service, etc,.

6.1. Rough Regulation.

The Master Clock has been tested and regulated at the factory. Each master is accompanied by a "Regulating" log showing adjustments and readings during tests and final setting. As the clock had to be dismantled and re-packed, it is suggested that setting stated in log be adopted as starting point. These adjustments apply to elevation of 200 feet above sea level, and barometric pressure as per recorded readings.

6.1.1. Switch off seconds pulses.

6.1.2. Stop pendulum carefully.

6.1.3. Hold bob in left hand and release counter nut (P/No. 823).

6.1.4. Adjust calibrated nut (P/No. 822) as required.

6.1.5. Hand tighten counter nut (P/No. 823).

6.1.6. Deflect pendulum to starting point (38-40 on scale).

6.1.7. Switch seconds pulses "ON" if required.

6.1.8. Enter variation of adjustment in log.

NOTE: To prevent twisting of pendulum you may insert provided metal pin through hole in bottom of rod to counter leverage exerted by tightening of regulating nuts.

Regulating Data.

Pendulum is of nickel silver alloy (INVAR) and is ambient temperature compensated (refer chapter "Pendulum"). Regulating nut (P/No. 822) has 20 divisions of which every second one is numbered. Each division covers time range of 1.38 seconds per 24 hours. One complete revolution of nut causes a change of 27.5 seconds per 24 hours. Turning nut to the right lifts bob and ADVANCES the clock. Turning nut to the left lowers bob and RETARDS the clock.

Note: Rough regulation is to be carried to a point when the clock is still somewhat SLOW (approximately two seconds per 24 hours).

6.2. Fine Regulation.

Each Master Clock is supplied with a number of small weights, which are to be placed on pendulum dish (see drawing 4163). Addition of weights ADVANCES clock. They are:

3 silver weights for advancing 1 second/24 hours.
3 aluminium strips for advancing 0.5 second/24 hours.
5 aluminium strips for advancing 0.1 second/24 hours.

Note: Use tweezers for placing and removing of weights. It is not necessary to stop pendulum for fine regulation; indeed, avoid disturbing it.

6.3. Electro Magnetic Regulation (EMR).

Clocks equipped with this device may be regulated to very fine limits by this means. EMR should not be attempted during or immediately after initial "rough" and "fine" regulation, but several weeks later after the clock's behaviour has been carefully studied and only if exact comparison time signals are available.

EMR permits regulation remotely; i.e., eliminates necessity of opening clock's housing, which may cause interference with the all-important pendulum swing.

Theory.

Theoretical data for EMR are contained in the Thesis of Dr. Treusein (of Hamburg Hydro-graphic Institute). Variations of pendulum beat rate are achieved by the application of current to coil into which pendulum dips a strong magnet. The effect is the same as changes of gravity would be. (Increase of gravity accelerates).

Regulation.

By changing variable resistance provided in remote control box and selecting ADVANCE (+) or RETARD (-) by lock-out key switch, Master Clock may be influenced in the range of 1/60th to 8 seconds/24 hours.

Barometric Pressure.

Rise and fall of pressure will cause variations in the period of pendulum swing (barometric error). One inch fall of mercury will cause acceleration of approximately 1/3 second per day and vice versa. The rate chart should be coincident with an inverted barograph record. Barometric error must be taken into consideration when (fine) regulating Master Clock by EMR.

7. CONNECTION OF SLAVE CLOCKS.

7.1. Minute Pulses.

1. Check all slave loop wiring with meter for possible short circuit.
2. Set all slaves to indicate same time at two or more minutes behind time shown on Master.
3. Connect minute pulse wires of slaves to terminals 1 and 2.
4. Await one minute pulse from master; if any slave did not step, reverse its leads (polarity). All slaves should now be synchronised as to correct polarity.
5. Operate hand pulsing lever up and down at approximately one second intervals to pulse all slaves to correct (Master Clock) time. PLUS ONE PULSE. If polarity of all slaves is correct, next pulse from Master Clock is not going to move slaves and at following minute the system will be correctly in operation.

7.2. Seconds Pulses.

Proceed similarly to minute pulses. Synchronise all seconds