the dials are advanced or retarded as required to correspond with local time. Power supply for ships' clocks is frequently taken from the lighting mains or from a low-voltage "ring main" specially provided for the operation of clocks and other instruments.

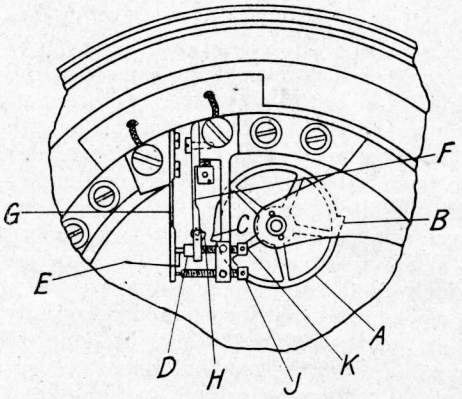

FIG. 107. CHRONOMETER CONTACT
(*Thomas Mercer, Ltd.*)

The Mercer Marine System

One of the best-known systems of ships' clocks is that of Messrs. Thomas Mercer, Ltd., of St. Albans, a company world-famous for its marine chronometers.

The ship's navigating chronometer is used as the master clock, contacts being fitted to enable an impulse to be sent out every half-minute. The impulse actuates a relay in the control panel, which in turn controls the entire circuit of secondary dials.

Fig. 107 illustrates the manner in which the half-minute impulses are taken from the chronometer.

The wheel *A* makes one revolution per minute, and has on its periphery two projections *B* and *C*. *D* and *E* are platinum contacts mounted on springs *F* and *G* respectively, and normally "open." As the wheel rotates, one of the projections wipes against catch *H* on spring *F*, and raises the platinum

points into contact, thereby completing the circuit to the clock-operating relay. Parts *B*, *C*, and *H* are shaped so as to give a quick break. The normal current to be broken is only 0·1 ampere. The contacts are adjusted by means of screws *J* and *K*.

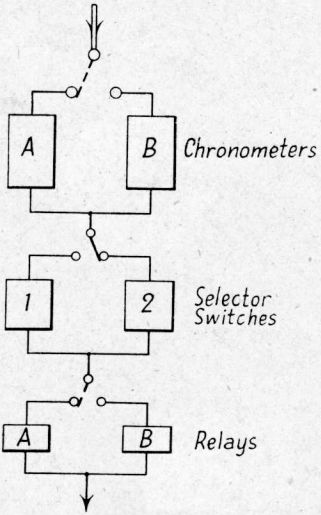

FIG. 108. SHOWING DUPLICATION OF COMPONENTS IN SYSTEM

Although the attachment of these light contacts makes no difference to the timekeeping qualities of the chronometer, there is a limit to the loading of the contacts, and in large installations contact is made every ten seconds, a selector switch directing the impulse to each of three main relays in turn.

The passage of the current through an actuating magnet moves the switch on to the next contact in readiness for the next impulse.

The chronometer is spring-driven but electrically wound by an impulse taken from the time circuit every half-minute. The spring normally runs with three hours' "reserve," but

should the winding gain upon the rate of discharge, owing, for example, to the chronometer having been stopped, the winding circuit is cut out automatically when the spring

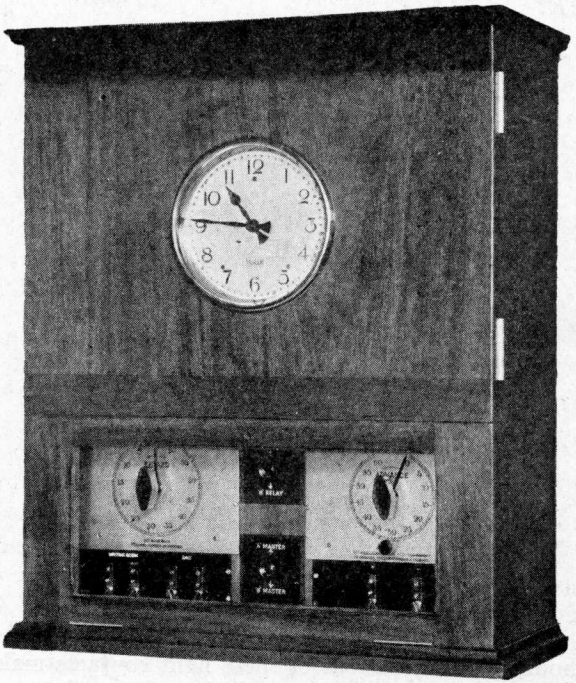

FIG. 109. MERCER MAIN CONTROL PANEL
(*Thomas Mercer, Ltd.*)

becomes fully wound, and remains out for one hour, when the chronometer restarts, thus restoring the three-hour reserve working point of the spring.

In large installations, to ensure reliability and to permit of servicing without affecting the time service, the chronometers, selector switches, and main relays are duplicated, and switches provided so that either chronometer can be used with either

relay and either selector switch, as shown diagrammatically in Fig. 108.

Fig. 109 shows the external appearance of the main control panel, and Fig. 110 the same opened to show the chronometers and the three-relay units.

In the lower portion of the cabinet are the automatic

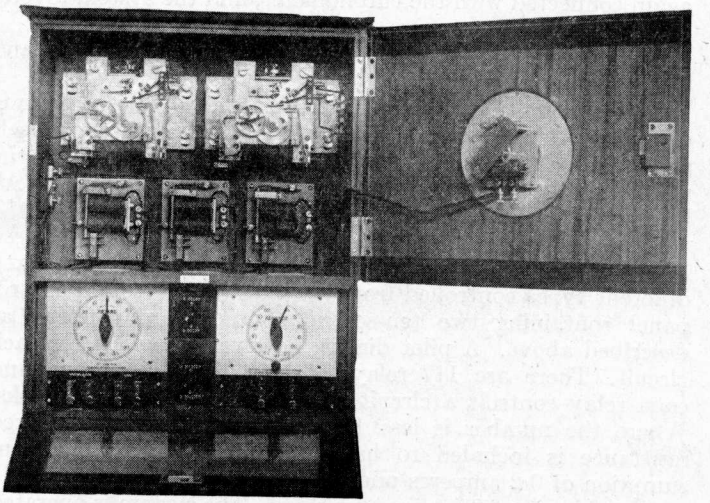

FIG. 110. INTERIOR OF CONTROL PANEL
(*Thomas Mercer, Ltd.*)

mechanisms for advancing and retarding all the clocks simultaneously to allow for change of longitude. To advance the clocks, the pointer of the "Advance" dial is set forward the required number of minutes and the button at the bottom of the dial is pushed home.

The effect of these operations is to wind a spring which, in running down, actuates a contact-maker which transmits a series of impulses in rapid succession to the clocks, instead of at half-minute intervals.

The pointer returns to zero during the transmission of the impulses, and on completion of the correct number the circuit returns to normal half-minute operation.

For retarding, the pointer on the "Retard" dial is set to the required number of minutes and the button pressed home. This actuates a switch which diverts the impulses from the chronometer to the retarding mechanism, instead of to the main relays, thus stopping all the clocks.

The impulse drives the retard pointer back in half-minute steps and, when zero is reached, the main clock circuit is again connected with the chronometer, and the system reverts to normal.

The dial movements are similar to those illustrated and described in Chapter II.

Special attention is given to finish—the spindles are made of stainless steel, ground and polished. Hard brass wheels and pinions are used throughout, with the exception of the wheels in the silent type, which are of bakelized fabric. All brass work is tinned on nickel.

As an example of a large installation, that of the *Queen Elizabeth* may be cited. There are 689 clocks of over sixty different types controlled from the chart-room from a control panel containing two ten-second contact chronometers, as described above. A pilot dial is, however, provided for each circuit. There are 117 relays of 1000 ohms resistance, and each relay controls a circuit of not more than eight clocks. Where the number is less than eight, an equivalent fixed resistance is included to balance. Each clock has a consumption of 0·2 amperes under a pressure of 2 volts, but will work safely on a 50 per cent overload. The system is operated from the ship's 25-volt D.C. main.

Fig. 111 gives a circuit diagram of the installation. The positive main is shown on the left side and the negative on the right.

It is convenient to trace the circuit from the top right corner—the negative—instead of the conventional method of starting with the positive. The circuit is first via the switch *X* by which the chronometer in service is selected, through the chronometer contacts which are closing and opening every ten seconds, thence to the advance switching mechanism. Contacts 2 and 3 are normally closed, but when advancing, as described previously, contacts 2 and 3 are opened, and 3 and 4 closed by pressing the button.

The cam spindle for operating the advance revolves and

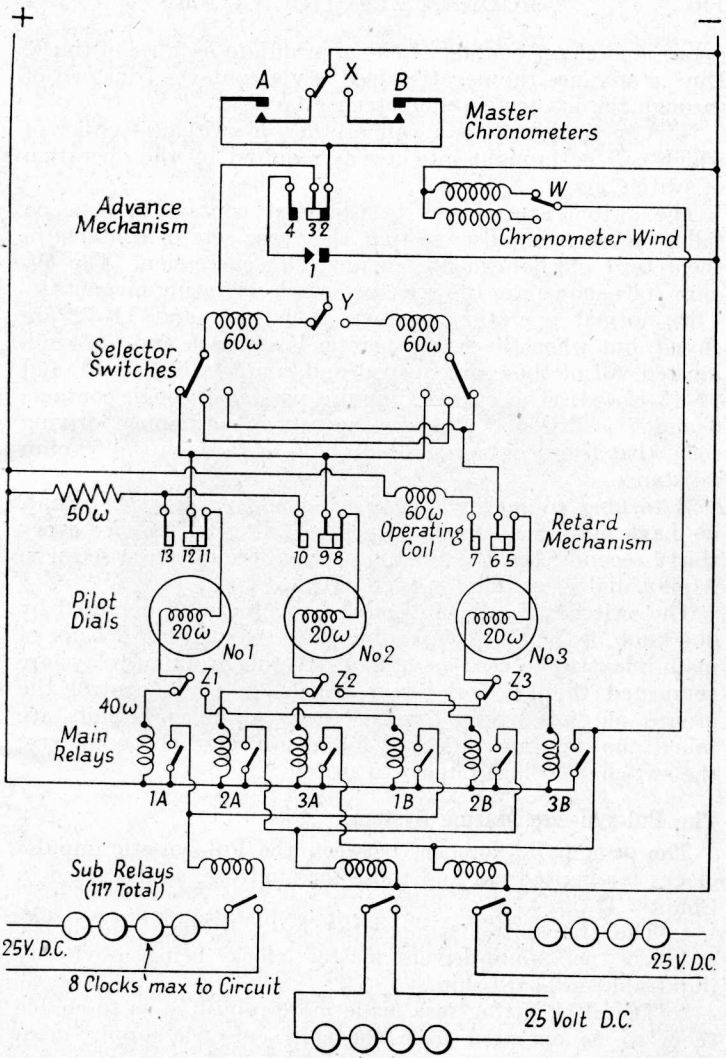

FIG. 111. WIRING DIAGRAM OF THE MERCER CLOCK SYSTEM ON S.S. *Queen Elizabeth*

opens, and closes contacts 1 the appropriate number of times. During advance the negative feed is via contacts 1 instead of through the master chronometer contacts.

Next in the circuit is a pair of selector switches—either of which can be brought into use as required by the operation of switch *Y*.

The switch arm moves to the next contact in rotation following each impulse, so that the three sets of contacts in the retard mechanism are energized in succession. The 60-ohm coils shown are the selector switch-operating magnets.

In normal operation contacts 5–6, 8–9, and 11–12 are closed, but when the retard pointer is set back and the knob pressed, all of these are opened and contacts 6–7, 9–10, and 12–13 closed. The current impulse passing through contacts 6 and 7 is diverted through the retard mechanism driving coil; that from contacts 9–10 and 12–13 through the 50-ohm resistance.

Returning to normal operating conditions in the circuit, we have now three circuits, each receiving an impulse every thirty seconds, but the time in each differing by ten seconds. A pilot dial is included in each circuit.

The switches Z_1, Z_2, Z_3, coupled together and operated by one knob, as in Fig. 109, enable either *A* bank or *B* bank of main relays to be used as desired. To this group of relays are connected the 117 sub-relays which, in turn, control the groups of dials. From one of these sub-relay circuits are taken the winding impulses for the master chronometers; the switch *W* being coupled to switch *X*.

The Pul-syn-etic Marine System.

The principal differences between the Pul-syn-etic impulse clocks for marine use and those for land use, as described in Chapter II, are—

1. The transmitter is operated by a balance wheel, the ordinary pendulum-driven master clock being obviously impossible on board ship.

2. The clock fittings are made more robust so as to enable them to be operated from the ship's electric supply main through a potentiometer. For this reason the operating current of marine dials is standardized at 0·38 ampere instead of 0·22 ampere of the land type.