COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1962/151

MACQUARIE ISLAND GEOPHYSICAL OBSERVATORY WORK, 1961

by

P.J. Milne

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ILLUSTRATIONS

SUMMARY

The author was responsible for the operation of the seismic and magnetic observatories at Macquarie Island during 1961. This Record describes the operation of those observatories during that year.

Scientific results will be published later in separate reports.

1. INTRODUCTION

The seismic observatory at Macquarie Island has been in operation since 1950 and the magnetic observatory since 1951. An insensitive magnetograph was installed during 1960. During the author's year of occupancy a Benioff short-period seismograph was installed, replacing the Grenet and Wood-Anderson seismographs.

The author was geophysicist-in-charge of both observatories during 1961; he relieved C.H. van Erkelens on 9th December 1960 and was succeeded by R.J.S. Cooke on 10th December 1961.

Previous Records, e.g. those by van Erkelens (1961), Hollingsworth (1960), and Turpie (1959), provide adequate descriptions of the observatory buildings, equipment, and routines.

2. MAINTENANCE

Batteries

An additional 6-volt accumulator was required for the new seismic equipment. This was housed with the existing one in the battery cupboard in the office. None of the batteries in use required any attention during the year. Once a week they were checked with a hydrometer and topped up with distilled water as required.

Battery chargers

The present seismic installation requires the use of two 6-volt chargers. The spare 12-volt charger was found to be faulty and would operate only when a damp base completed the circuit. Dismantling and cleaning revealed that the earth lead was connected to the positive terminal. This fault was corrected.

The battery charger for the magnetograph gave satisfactory operation.

A spare 6-volt charger was ordered for 1962.

Building repairs

No major repairs were effected during the year. A recommendation was made to have the galvanised iron of the storeroom replaced. Painting of the roof was difficult because of the bad condition of the iron.

Caulking and tarring

Preparatory to seismograph installation the vault roof was caulked to prevent water dripping on to the pier. All efforts to locate and prevent the leak just inside the door of the seismic vault failed. It is assumed that, owing to the nature of the roof construction, the water seeps in from the hill. Minor leaks that developed in the office during winter were overcome when the roof junction between the office and vault was tarred later in the year.

Caulking was done on the eaves of both magnetic buildings, the window frames of the absolute hut, and an area near the peak of the variometer hut through which rain was seeping during southerly storms.

Darkroom water supply

During June the Furphy water tank belonging to the camp hot-water and darkroom reticulation system developed extensive leaks due to rusting. It was replaced by one originally destined for Green Gorge. On several occasions the outlet hose taking water from the Furphy to the camp system was broken by seals. This was eventually supported by a stake where it crossed the seal wallows.

Electrical wiring

Before installing the seismograph, the vault wiring was tidied up. All hanging leads were eliminated by strapping them to the walls and ceiling. A separate white-light switch was installed above the recorder power point.

Linoleum and matting

The linoleum of the office bench was replaced. In order to preserve the linoleum floor covering, matting was put down on the office and darkroom floors.

Painting

During April and May both magnetic buildings, including the battery stand, piers, and paint box, were painted. The exposed west walls were given a second coat before the winter. As previously recommended, it is important that at least those walls that are exposed to the prevailing winds should receive at least one coat of paint before the winter. This is even more important now, as the buildings are showing signs of wear.

As part of the station painting programme, all observatory buildings were painted between September and November, and again the west walls of both magnetic buildings were given a second coat. The office and darkroom interiors were completely repainted. The darkroom benches and solution tray covers were painted with black bituminous paint, which successfully prevented corrosion due to spilt photographic solutions. Painting of the darkroom sink prevented any further rusting.

Power supply

Current leaks occurred in the seismic power line on several occasions towards the end of the year. These were traced to leaks in the junction box outside the wash-house. The junction was cleaned and rejoined, thus preventing any further trouble from this source. During the 1961 changeover another leak developed in the line, which necessitated re-laying a section between the diesel shed and the wash-house.

Tools

The shadow box, with its internal heating, proved adequate to prevent the tools rusting. The vice was cleaned regularly with 'Penetrene'. It was customary to clean and oil all tools after use. With the assistance of the engineer, all tools were checked and dimensions recorded, so that they are now correctly named and specified.

Wireless aerial

This had to be restored on one occasion in May, when high winds had brought it down. Owing to corrosion it was necessary to reconnect the wireless earth-lead to the pipe set outside the office.

3. MAGNETIC OBSERVATORY

Introduction

The magnetic recording equipment consists of a set of normal-sensitivity and a set of insensitive La Cour magnetographs. The former has been in continuous operation since 1951, and the latter since April 1960. During 1961 no adjustment to the variometers was necessary, as orientation tests and adjustments had been made the previous year.

Baselines

Baseline control observations were made approximately four times a month.

La Cour clockwork drives

Because of clockwork drive failures, over a hundred hours' loss of trace occurred, most of it during the first half of the year, and in particular during April and May. This type of failure seems common at Macquarie Island, and is generally attributed to dust or corrosion in the drive mechanism. Only when a second stoppage occurred shortly after the first was the drive replaced.

Magnetograph recording

Satisfactory traces were obtained for the whole year, and the optical system required no adjustments. On one occasion in June, fogging occurred on the insensitive variometer lenses and prisms, with consequent trace fading for the last three hours of the day. Only once did a lamp require replacing.

La Cour clock

Apart from a few occasions when the rate became erratic, the clock gave no trouble during the year. Changes were generally caused by wind vibrations. However, the rate generally returned to normal later, so that rate adjustments were rarely necessary.

Scale-values

These were carried out on an average of four times monthly, depending on the level of magnetic disturbance. During some months it was possible to do them more often.

Milliammeter 11386, which had been in use for some years, was compared with the sub-standard meter at 15, 20, 25, and 40 milliamps in response to a request from head office. The corrections were found to be too small to account for the difference in magnetograph scale-value when using different currents. This difference was apparent in the previous year's normal-sensitivity Z scale-value determinations.

From the beginning of April all scale-value determinations were made using the sub-standard meter. Ammeter 11386 was returned to Australia at the end of the year for overhaul and checking.

Time-mark relay

A transistorised relay was taken to Macquarie Island with the intention of replacing the existing one, which required $4\frac{1}{2}$ volts in addition to the normal 6 volts. Investigation revealed poor contacts between the relay and base plug. These contacts were cleaned, with the result that the $4\frac{1}{2}$-volt battery could be removed from the circuit. Thereafter the existing relay operated satisfactorily from the 6-volt supply.

Absolute instruments

The DCK 158 magnetometer was used for declination measurements. On several occasions the fibre broke.

QHM 177 and QHM 178 were used for H observations, while QHM 179 was retained in Melbourne for intercomparisons. Early in November the mercury in the thermometer of QHM 178 developed the habit of sticking to the walls, and all efforts to overcome this failed. Consequently the thermometer from QHM 177 was used for both QHMs, and a replacement thermometer was ordered from Melbourne.

BMZ 64 was used for Z observations.

Intercomparison observations

During the December 1960 changeover, the Macquarie Island semi-absolute instruments were compared with long-range BMZ 221A, Askania Declinometer 580339, Askania HTM 5010154, and QHM 178. QHM 179 was then returned to Melbourne and QHM 178 left at the island.

Similarly during the December 1961 changeover, a set of intercomparisons was made between the Macquarie Island instruments and long-range BMZ 221A, Askania Declinometer 580339, QHM 174, and QHM 179. QHM 177 was then returned to Melbourne and QHM 179 retained at the station.

All intercomparisons were made through the magnetogram baselines, as the closeness of the piers does not permit two sets of simultaneous observations.

4. SEISMIC OBSERVATORY

Introduction

A short-period three-component Benioff seismograph was installed during December 1960 and January 1961, and continuous recording commenced on 23rd January, two and a half months after recording with the Grenet and Wood-Andersons had ceased.

Seismograph installation

Uncrating. The boxes were raised to the top of the steps by means of a block and tackle. Two 2-in. diameter pipes were run parallel up the steps to facilitate this operation. Uncrating had to be done outside, as the crates would not pass through the doors. For this purpose, an improvised platform was constructed just outside the seismic office.

Installation. The setting up of the seismometers and recording unit was carried out as instructed in the manuals provided by the manufacturing company. All instruments were accommodated on the existing pier (see Plate 1). A part of the shelf above the pier had to be cut to allow room for the recorder.

Replacements. A replacement lens was fitted to galvanometer No. 1536. This was supplied by the manufacturing company, as the original one had been chipped.

The only apparent damage in transit was a broken upper ribbon assembly, in horizontal seismometer No. 115. This had to be replaced.

Recording unit modifications. To overcome fluctuations in the lamp intensity because of possible variations in station power-supply voltage, it was decided to operate the recorder lamps from an external D.C. supply. The lamp connexions at the back of the recorder were tapped, and connexions were made to the terminal board on the northern wall of the vault. The unconnected leads from the internal supply were insulated with black adhesive tape.

After recording commenced, intermittent operation of a recorder time-mark relay necessitated dismantling the time-marker assembly and adjusting the residual screw, which had apparently loosened in transit. The screw was set closer, and the relay operated satisfactorily thereafter.

Poor connexions in the recorder lamp circuit sometimes caused variations in lamp intensity. The lamp control circuit was investigated and the trouble traced to dry joints on the resistors. The panel lock nuts from the potentiometer and switch were removed, thus allowing the resistor to be lowered to an accessible position without having to shift the recorder.

Seismic control circuit (see Plate 2)

Control Panel. With some modifications to accommodate the new installation, the existing office control panel was used (see wiring diagram Plate 3). The indicator meter was retained in parallel with the recording lamps, and proved a useful guide to the condition of the lamps and batteries. The ceramic-base potentiometer was retained for intensity control, but fine control of each lamp was obtained by means of the potentiometer in each branch of the recorder-lamp circuit. Extra resistance was required to reduce the voltage from 12 to 8 volts for lamp operation. The lamp switch was used as a master for all lamps during record change. Separate 6-volt terminals were available for the time-mark relays and the relays of the thermostatically controlled strip heaters.

Time-mark relay board. The terminal board, which previously sat loosely on the pier, was screwed to the northern wall of the vault. It was also used as a time-mark relay board (see wiring diagram, Plate 4).

Chronometer. This functioned well throughout the year. Each afternoon it was compared with GMT by means of time-signals from radio station WWVH. Rate adjustments were made by varying the tilt of the chronometer. The correction was generally kept to within a few seconds. Use of the transistorised relay in the time-mark circuit meant that only 0.4mA flowed through the minute-contact. 56mA was drawn through the hour-contact.

Manual time-marker. A manual time-marking system was installed. This consisted of a Morse key fitted to the southern wall of the office, and connected in parallel with the time-mark switch and the clock minute-contact.

Seismic recording

Recording with the Benioff seismograph commenced on 23rd January and continued satisfactorily for the remainder of the year. On one occasion the recorder motor stalled, and the recorder worm and worm drive gear had to be greased to overcome excessive friction in the drive. A few hours' loss of time-marks occurred because of a sticking armature-returning-spring in relay type 6R.

As mentioned in previous reports, the high microseismic background obscures much valuable record. By increasing the attenuation when microseismic activity is high, the microseisms are prevented from ruining the record entirely. The attenuation on all components was generally 18 to 24 db , but on occasions was increased to as much as 36 db.

Seismological station reports

P, pP, S, and sS phases were read daily from seismograms, and reported twice weekly to head office, for transmission to USCGS.

Seventy earthquakes recorded at Macquarie Island were reported by the USCGS, the most distant being from near Japan (distance approximately 90°). At least twenty local and near shocks were recorded at other stations.

5. ACKNOWLEDGEMENTS

The author wishes to express his thanks to all members of the 1961 Macquarie Island expedition for their willing assistance throughout the year, and in particular during installation of the seismic equipment.

The technical assistance of Mr Alan Thomas proved invaluable, and the cooperation of the O.I.C., Mr Fred Stean, enabled the year's programme to run smoothly.

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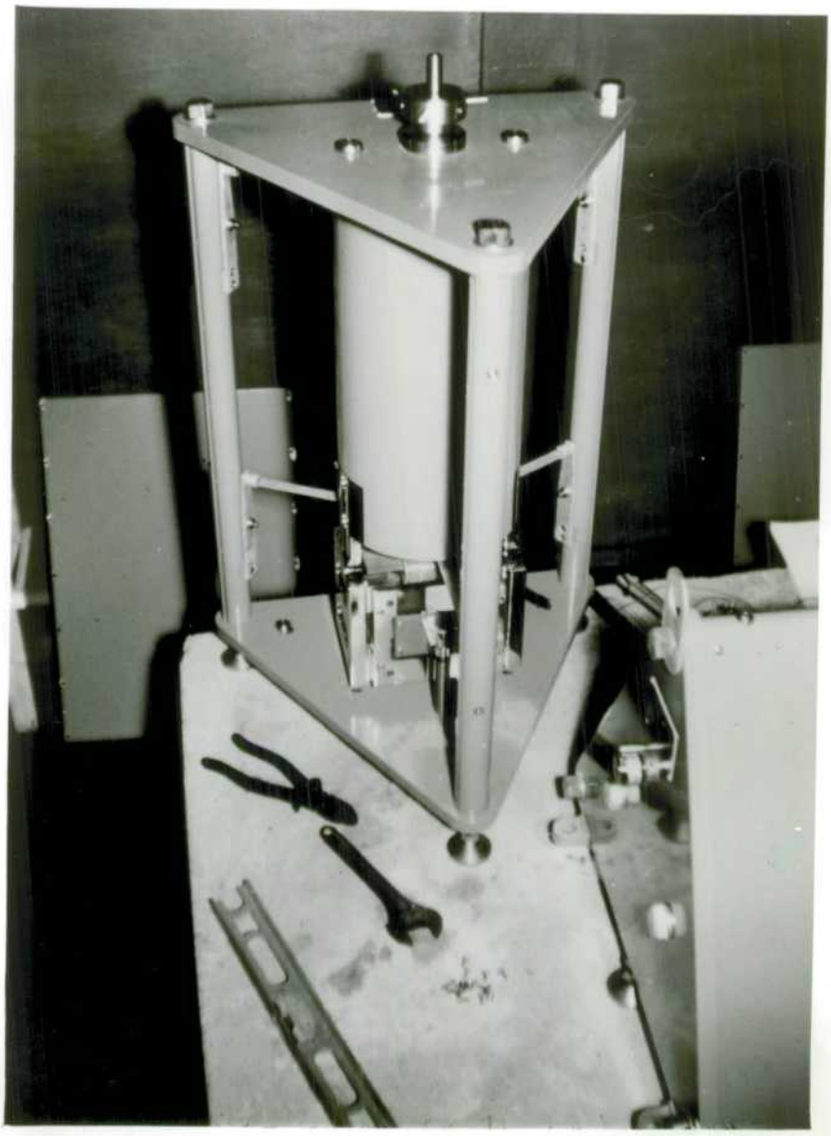

VERTICAL SEISMOMETER

DURING INSTALLATION

MACQUARIE ISLAND 1961

SEISMIC CONTROL CIRCUIT

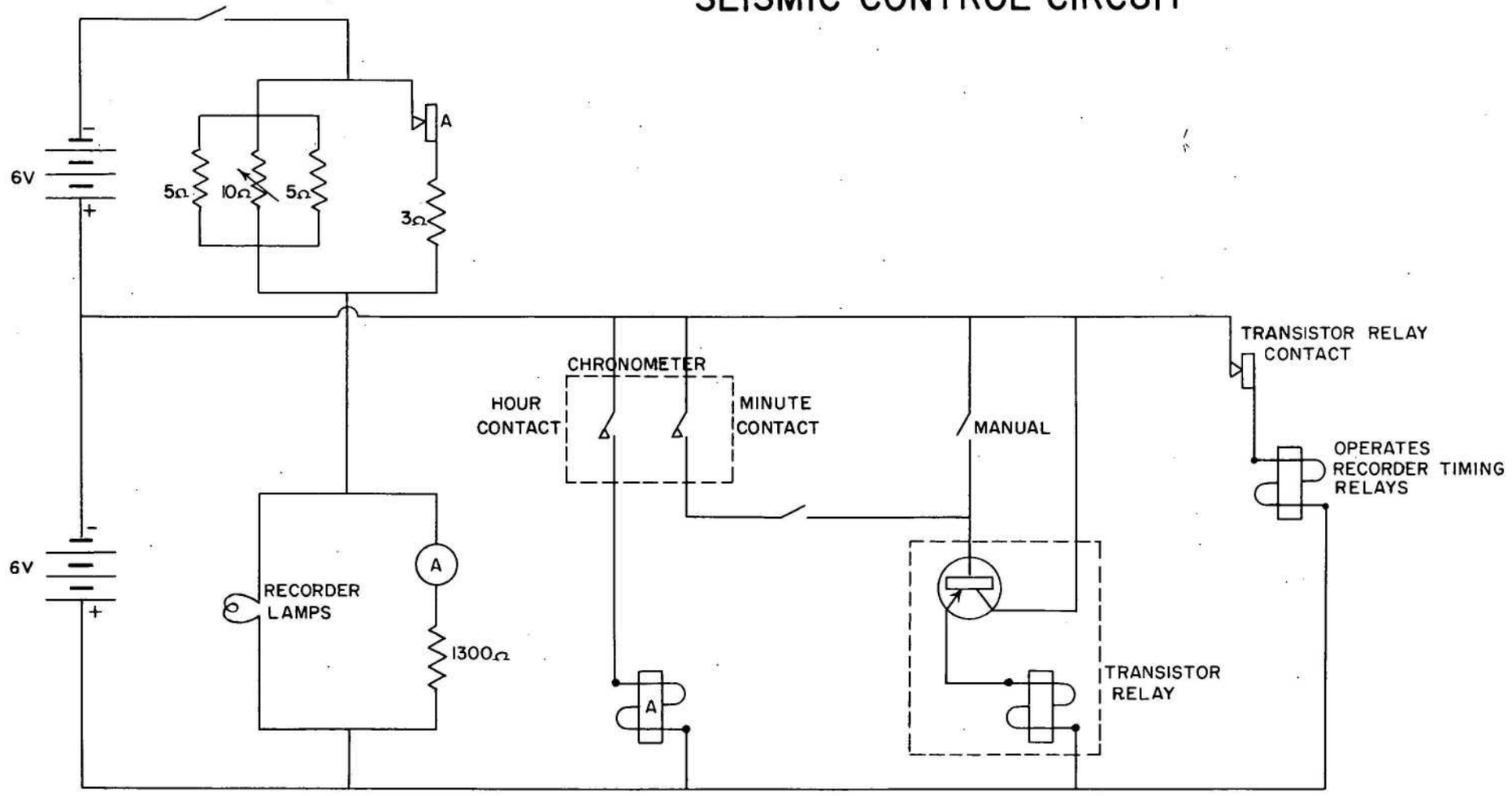

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PLATE 2

SEISMIC CONTROL PANEL
WIRING DIAGRAM

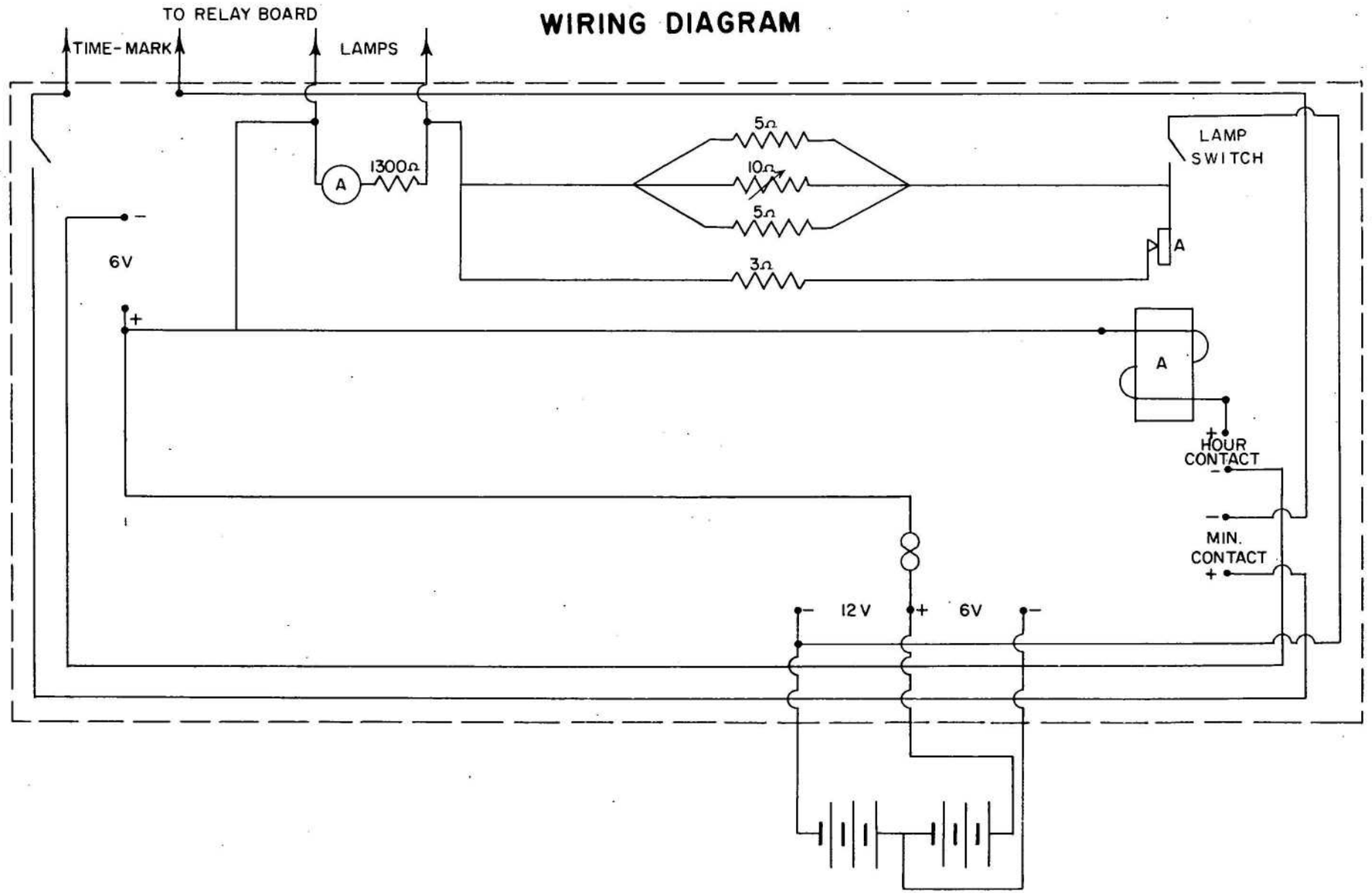

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PLATE 3

MACQUARIE ISLAND '1961

TIME-MARK RELAY BOARD

WIRING DIAGRAM

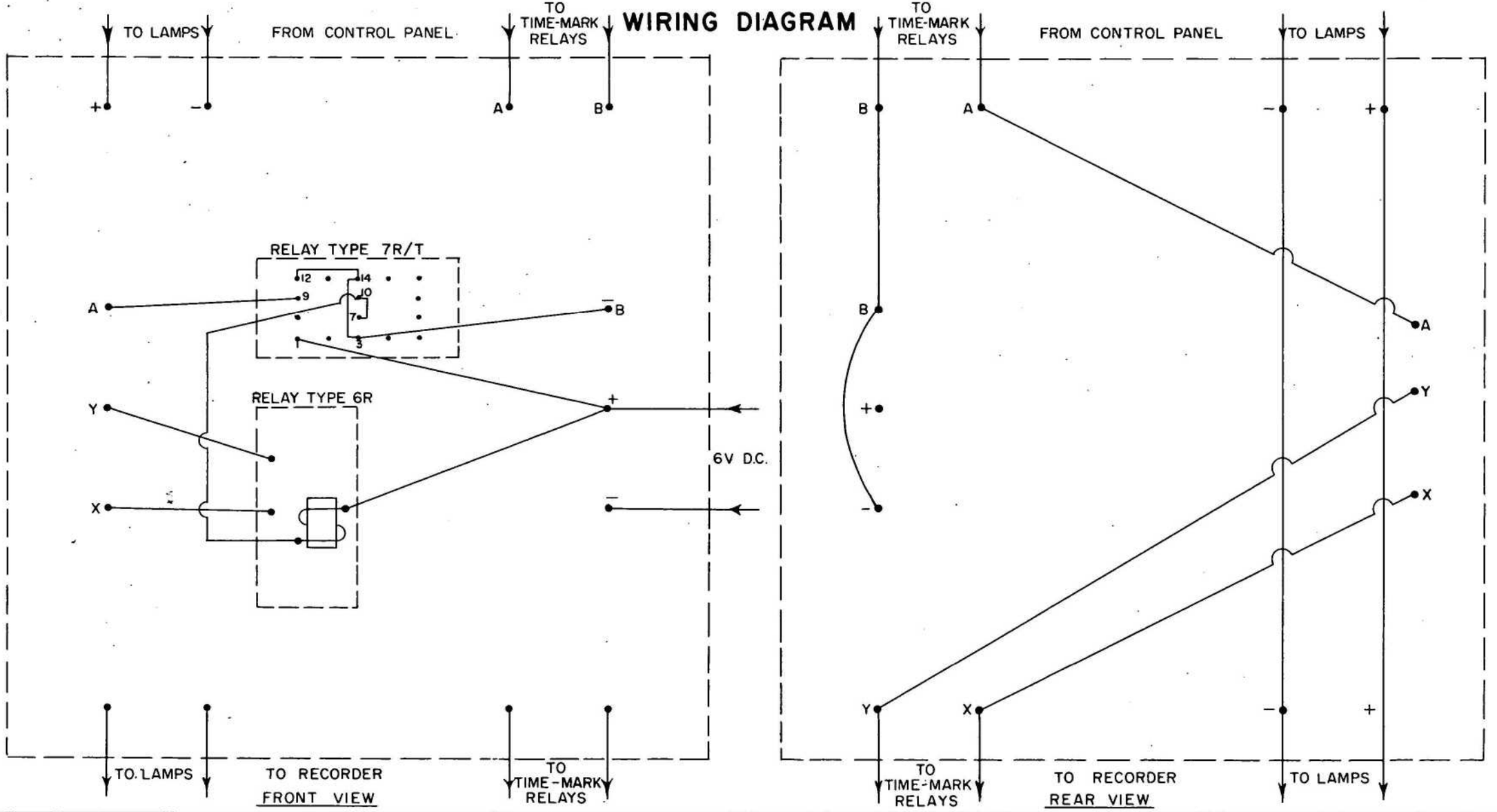

PLATE 4

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