COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1966/42

TOOLANGI SEISMIC OBSERVATORY - INSTALLATION AND EQUIPMENT

by

R.G. TOY

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CONTENTS

ILLUSTRATIONS

SUMMARY

Because of traffic disturbances at the old Melbourne Observatory, the seismometers were transferred to a new observatory at Toolangi in 1962. A brief history of the selection of the site, construction of the observatory, and installation of the equipment is given, followed by a description of the peripheral equipment, which includes time standards and time-mark circuits and normal and emergency power supplies.

1. HISTORY AND CONSTRUCTION

After installing Benioff seismic instruments in the old Melbourne Observatory in 1956, it was found that they could not be used with a high sensitivity setting because of local traffic disturbances. It was decided to find a new site.

In January 1958, an area within the State Forest Reserve, near the Potato Research Farm on the Healesville-Toolangi road (see Plate 1) was selected and approval was obtained from the Department of Mines, Department of Agriculture, Lands and Survey Department, and the Melbourne and Metropolitan Board of Works for the Bureau of Mineral Resources(BMR) to carry out geological and geophysical surveys of the area. Existing geological information was obtained from the Department of Mines.

Four main sites within the area were selected for investigation (Plate 1). Site No. 3, on the slope of Mount St. Leonard, was discarded because permission to establish a site within the catchment area of Maroondah Lake could not be obtained from the controlling body, the Melbourne and Metropolitan Board of Works.

Site No. 2, on a hill due south of the Potato Research Farm, was found to be unsuitable, as seismic testing showed a depth of weathering of outcrops of approximately 80 feet.

At site No. 4 there were reasonably high seismic velocities but the site was rejected because of its proximity to traffic.

At site No. 1, on Blue Mount, which is about half a mile to the west of the Potato Research Farm, there were high seismic velocities and the surface geology appeared favourable. On this information, the Department of the Interior was requested to initiate enquiries into the acquisition of the land for the BMR.

Other sites were investigated and discarded for various reasons.

Test drilling of the proposed vault site commenced in January 1959 and samples from the drill hole were identified by the Department of Mines as metamorphic sediments (hornfels) and were said to be fused to underlying basement rock.

The Department of Works were supplied with sketch plans and the approximate location of the proposed vault, and an estimate of costs was requested before June 1959.

Trenching of the area was carried out during April and May 1959.

A property requisition for five acres of land at Blue Mount was submitted to the Department of Interior in August 1959. The Department of Works advised that, during October 1959, tenders for the construction of the vault and office were called for and that the estimated cost would be £9,600. After investigation of power requirements the estimate was increased to £10,600.

Requests for telephone and electrical services to the site were submitted to the appropriate authorities in November 1959.

Construction of the vault began during February 1960 and during excavations, the contractor found clay inter-bedded in the hornfels. However, this proved to be only a surface peculiarity and further drilling in March 1960 beneath the pier showed solid rock to a depth of 50 feet. Construction of the vault was then allowed to proceed.

During 1960, building was retarded because the contractor defaulted on payments to suppliers, was declared a bankrupt, and left sub-contractors to complete the construction.

An inspection in December 1960 showed many faults and deficiencies, and the subsequent 12 months passed in bringing the buildings to the standard required.

Installation of wiring and control equipment commenced in February 1962. The Benioff seismometers and recorders were installed and commenced recording in July 1962. All units were serviced prior to installation.

The site was surveyed by the Department of National Mapping in June and July 1962 and corner pegs of the boundary were placed in position.

Calibration of the Benioff vertical seismometer was carried out in August 1962, and the two Benioff horizontal seismometers were calibrated in November 1962.

Two Sprengnether horizontal component seismometers and a vertical seismometer, all constructed by the Lamont Observatory, Columbia University, New York, USA, and having periods of 15 seconds, were installed in October 1963. Galvanometers of 90-second period were installed and connected to these seismometers. The 70-second galvanometers previously in use were left temporarily connected to the Benioff seismometers until these could be re-calibrated.

During October and November 1964, the 70-second galvanometers were removed, the Benioff seismometer coil configurations changed, and the short-period units re-calibrated. The calibration curves are shown in Plates 12, 13, and 14. The long-period instruments will be calibrated when new suspensions for the 90-second galvanometers arrive from the USA and are fitted.

For security reasons, a 6-ft wire fence enclosing the vault and office was constructed in September 1964.

Photographs of the vault entrance and office buildings are shown in Plate 15.

2. NORMAL OPERATION

General

A 'Westat' battery charger, 'Nife' batteries, and an inverter unit were supplied by the Department of Works. After purchase and installation it was found that the capacity of the equipment to supply emergency power to the seismographs and control units was inadequate and that the inverter unit was unreliable. The inverter is now not in use and the battery charger and batteries are used solely to supply power to the crystal clock, the time-mark relay system, the 'Synchronome' master clock, and the time signal amplifier.

Direct current supply (Plate 2)

Battery charger. This is a 'Westat' 10-ampere battery charger designed to float-charge the 'Nife' batteries to provide manual gas charging of the batteries when necessary.

The following modifications were made:

1. A pair of hinged channels were fitted to the battery compartment to facilitate inspection of the batteries.

2. A clip to hold a hydrometer was mounted in the battery compartment.

3. The positive battery terminal in the battery compartment was grounded to the frame.

4. A Bulgin 2-pin plug was fitted to the right-hand side of the cabinet to standardise all 14-volt d.c. fittings.

Batteries. These consist of ten nickel-cadmium GKT-6 cells in series, giving a total potential of 14 to 15 volts d.c. The cells are normally on float-charge. Stratification, or layering, of the electrolyte in these batteries can occur over a period, therefore it is necessary to gas-charge them at intervals. This has the effect of agitating the electrolyte. For further information on these cells, see the 'Nife' handbook for cell type FA-5 (similar to GKT-6).

Castor wheels were fitted to the bottom of the battery box to facilitate inspection of the cells.

Battery voltage can be read from the meter on the battery charger or the meter installed in the office.

Timing control

Crystal clock and dials. Relays within the crystal clock close at one second intervals and are in simple series with the 'Nife' batteries and the seconds dial of the 'Synchronome' master clock (Plate 2). The time shown on these dials can be corrected by operating the "Advance" or "Retard" controls on the crystal clock or on the panel in the office. These controls alter the operating frequency of the crystal clock internal relays (Plate 7).

Time-mark relay system (Plate 6). The seconds dial mounted in the vault porch is fitted with contacts that close for four seconds at the end of every minute, except on the hour, and these control the time-mark relays on the panel below the dial. These time-mark relays control the time-mark solenoids in the recorders.

As lightning was found to cause sharp increases in line voltage, thus overloading the relay transistor, modifications were made to the 7 R/T relay (see Plate 6).

An additional pair of terminals are available for use, and are mounted at the rear of the relay panel. These terminals are connected to the right-hand side contacts (normally closed) on the 6R relay and give an open circuit for four seconds every minute, except on the hour.

Time signal amplifier (Plate 8). Situated in the office, this allowed the P.M.G. telephone time-pips to be recorded automatically on the seismograms. Three time-pips, each lasting 1/10th second at one-second intervals, are tapped from the telephone junction box and fed into a filter and amplifier circuit. This enables a relay in the unit to operate the recorder solenoids by means of the time-mark relay system.

In the event of failure of the unit, a morse key, in parallel with the amplifier relay, allows manual operation of the time-mark relay system. When the time signal amplifier is switched on, operation of the time-mark relay system is indicated by a lamp mounted on the amplifier panel.

Alternating currents supply

There are two separate circuits in the vault, one for normal power and light outlets, which are connected directly to the mains supply through fuses in the vault porch, and the other for mains/emergency use, which would be connected through the inverter and relay systems if this were operative. At present it is connected directly to the normal mains supply.

Voltage stabiliser (Plate 3). A Westinghouse 'Stabiliser' 600 VA unit was installed between the mains and the panel distributing 240 volts a.c. to the battery charger and recorders (through the mains/emergency circuit).

Crystal clock 115-volt a.c. supply (Plate 3). This unit supplies a 115-volt a.c., 50-c/s square wave to the recorder motors.

3. EMERGENCY OPERATION

Direct current supply.

Clock and relay power supply (Plate 4). Normally not in use, this unit can supply power to drive the 'Synchronome' master clock and all slave clocks, the time-mark relay system, and the time signal amplifier, in the event of failure or removal of the 'Nife' batteries. The supply current can be regulated. A switch at the rear connects this unit in place of the 'Nife' batteries.

Timing control

If the crystal clock fails, the seconds-dial circuit can be switched so that it is operated by the 'Synchronome' master clock (Plate 5), which is normally driving the half-minute dials only. The switch is mounted on the panel in the vault porch.

Each slave dial (second or half-minute) can be removed from the circuit without affecting the operation of the others. A switch beside each dial connects a resistor in place of the dial.

Alternating current supply

As stated in Section 2, this is not in use at present. However, a solid-state inverter and relay system, together with additional 'Nife' batteries, are under construction. When installed, this will enable all units requiring a.c. power to function normally for approximately eight hours after failure of the mains supply.

Recorders

In the event of failure of the crystal clock, which normally supplies 115 volts a.c. to the recorder motors, changeover relays mounted on the vault porch panel allow 115 volts a.c. to be supplied from auto-transformers within each recorder. The 2-pin socket nearer to each recorder motor carries 115 volts a.c. to the motor direct from the auto-transformer. The other socket is connected through the changeover relays.

4. MISCELLANEOUS

Telephone

Extension bells were installed in the darkroom and vault porch. At present, the bell in the vault has to be switched out of circuit when telephoning, as a.c. hum picked up in the office-to-vault wiring drowns out weak signals. The switch is located in the office on the right-hand side of the vault-to-office wiring terminal box.

Office-to-vault wiring (Plate 9)

Terminal boxes were mounted on walls in the vault porch and office. Wiring between them is underground and was installed by the Department of Works. Conduit in the office carries wiring from the terminal box to the control panel. An extra, unconnected wire is in the conduit to pull through any additional wiring required.

Darkroom

A 'Sterlec' room heater was fitted to the floor and is controlled by a thermostat on the east wall. The ceiling of the room was lined with 'Insulwool' to stop excessive heat loss.

The timing switch mounted on the south wall automatically allows the drying and glazing machine to cool before switching off (see Plate 10).

Pilot light panel

Neons indicate when the crystal clock 115-volt a.c., the mains 240-volt a.c., and the emergency 240-volt a.c. (when available) supplies are in operation. The voltmeter on the panel indicates the 'Nife' battery potential.

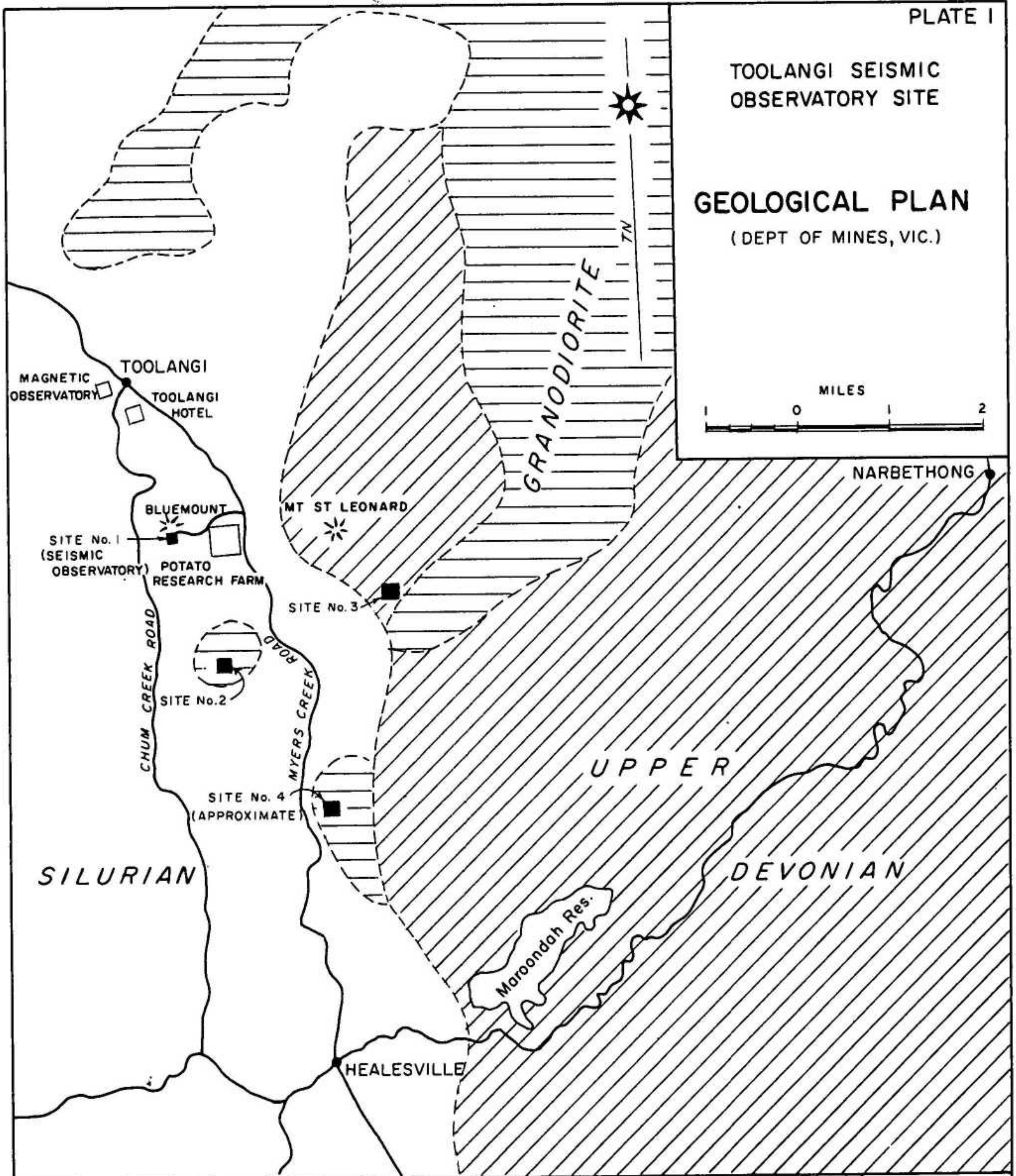
Vault humistat (Plate 11)

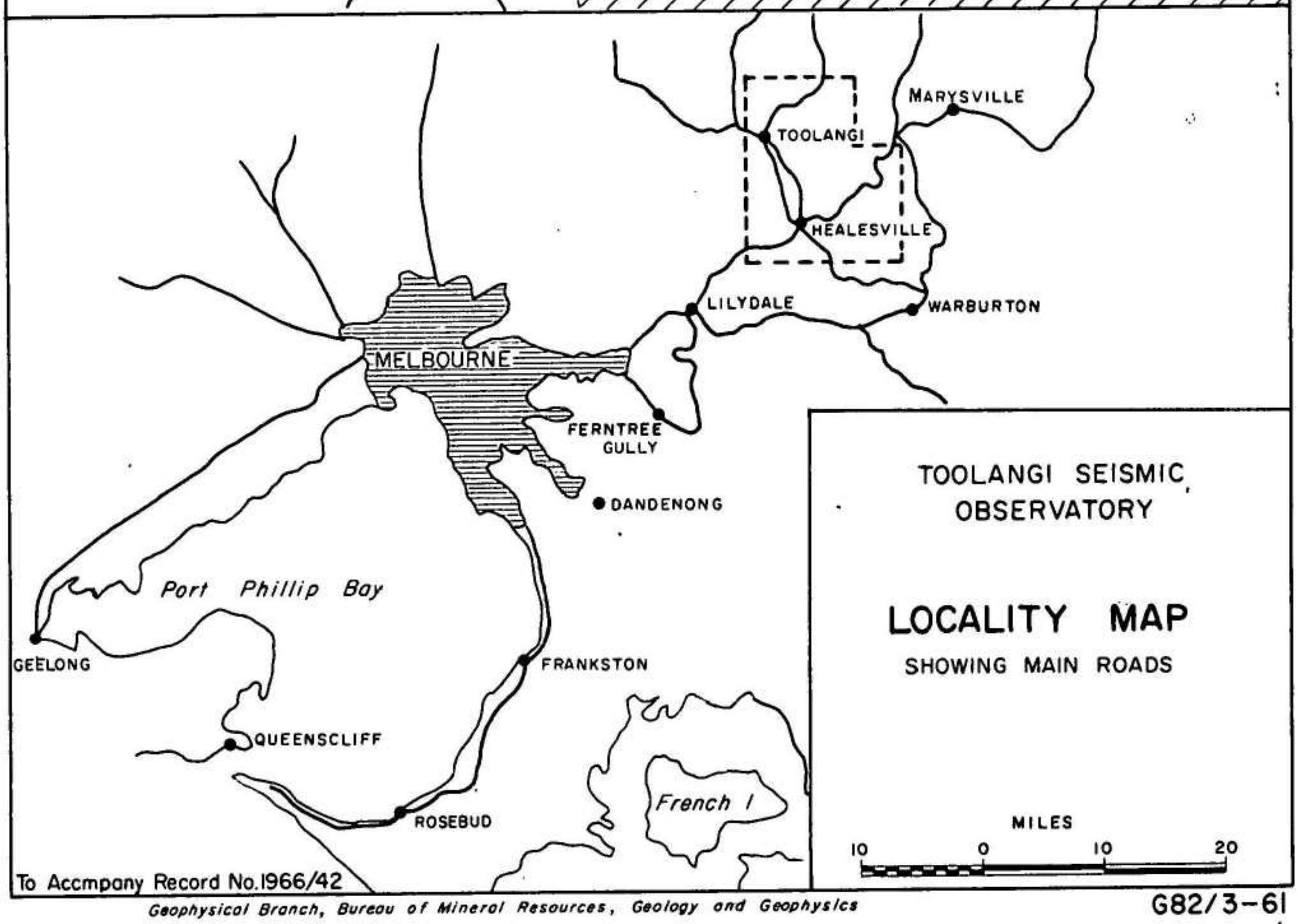
Situated in the vault, this is available for automatic switching of the air dryer, if required.

Seismometer-to-recorder wiring

This is two-core shielded cable and at present the shielding is ungrounded, as a.c. noise is not greatly evident.

Provision was made for plugging in a Willmore bridge or similar calibrating instrument between the seismometer and recorders. The removing of plugs on the panel situated above and between the recorders opens both sides of the circuit between the seismometers and the recorder galvanometers.





Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

G82/3-61

NAME	DATE	AMENDMENTS	ISSUE
R. CAN.	14-1-65.	————————————	1.

To Accompany Record No. 1966/42

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

DRAWING No. S01

SHEET 1

INSTRUMENT TOOLANGI SEISMIC OBSERVATORY INSTALLATION. D.C. BLOCK WIRING DIAGRAM.

PLATE 3

To Accompany Record No. 1966/42

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS	DRAWING No.	SHEET	INSTRUMENT
	S01	3	TOOLANGI SEISMIC OBSERVATORY INSTALLATION. A.C. BLOCK WIRING DIAGRAM.

	DATE	NAME
Orig.	15-1-65.	R. GAN.
Amend.		

COMPONENT LIST.

RESISTORS.

R1 — 4Ω.
R2 — 34Ω.
R3 — 25Ω.
R4 — 25Ω.
R5 — 11KΩ.

CAPACITORS.

C1 — 500μF.

DIODES.

CR1 – CR4 — 6FS.

SWITCHES.

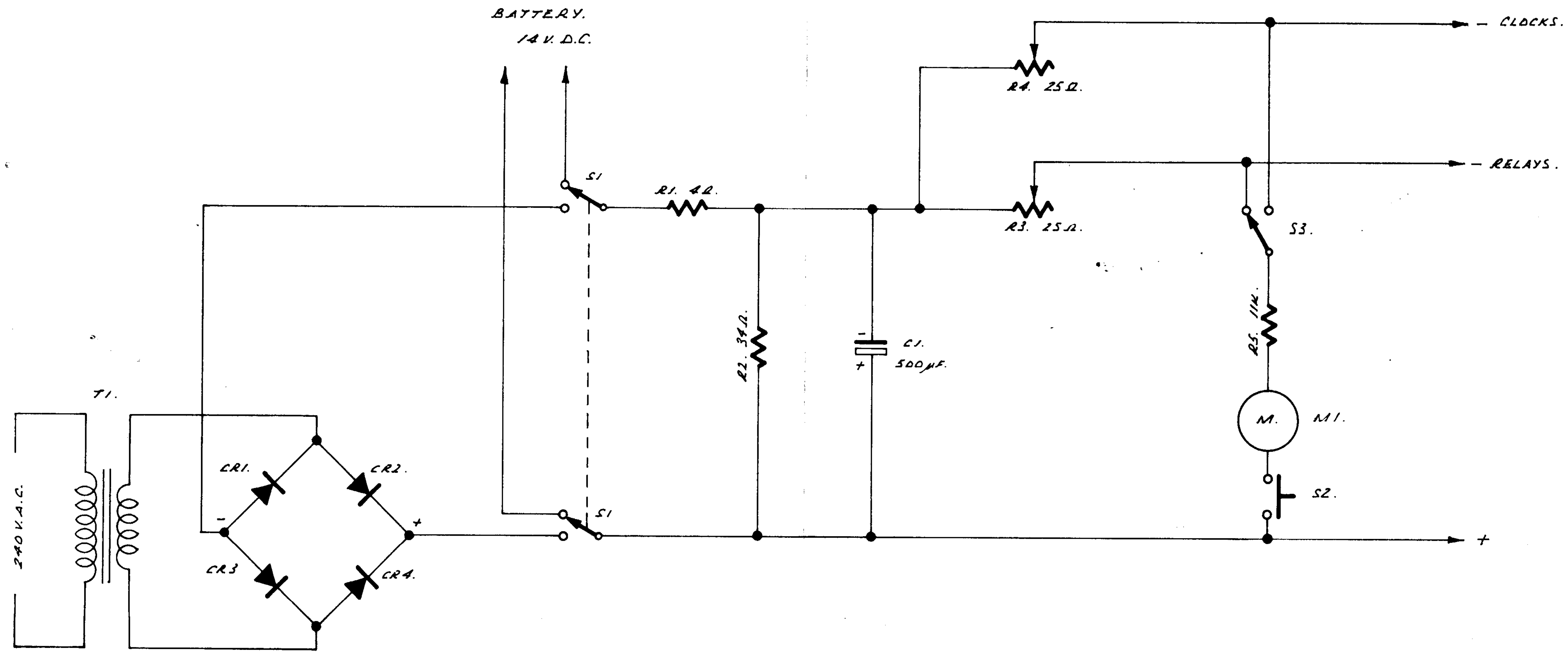
S1. — D.P.D.T. CUTLER HAMMER.
S2 — PLUNGER ALPHA TYPES.
S3 — D.P.D.T. CUTLER HAMMER.

METER.

M1 — MASTER 0–10 V. D.C.

TRANSFORMER.

T1 — 240/12 V.A.C. 40W TRIMAX.

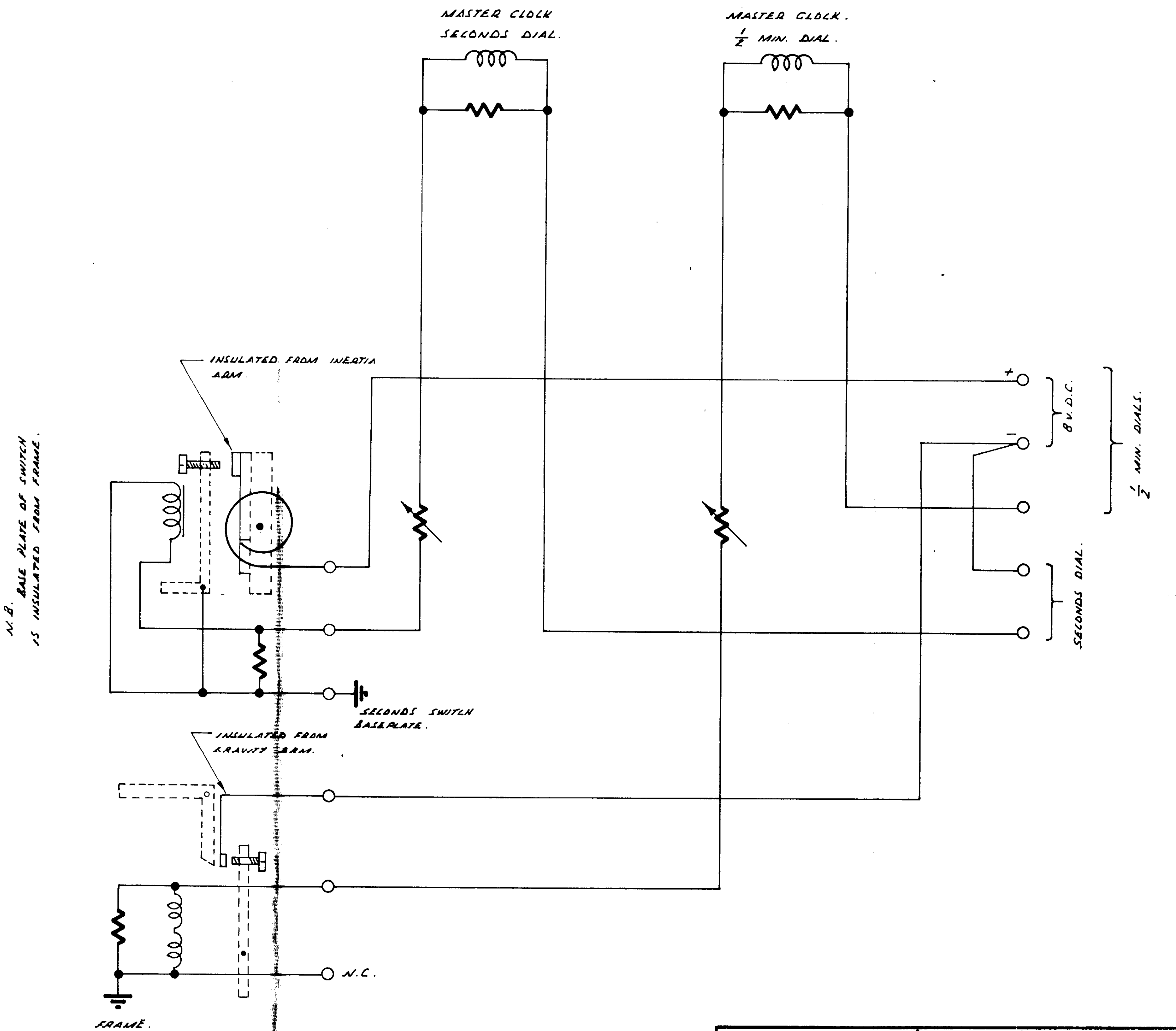


To Accompany Record No. 1966/42

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS	Drawing No. S01. SH.2.	INSTRUMENT TOOLANGI SEISMIC OBSERVATORY INSTALLATION. CLOCK & RELAY POWER SUPPLY SCHEMATIC.

PLATE 5

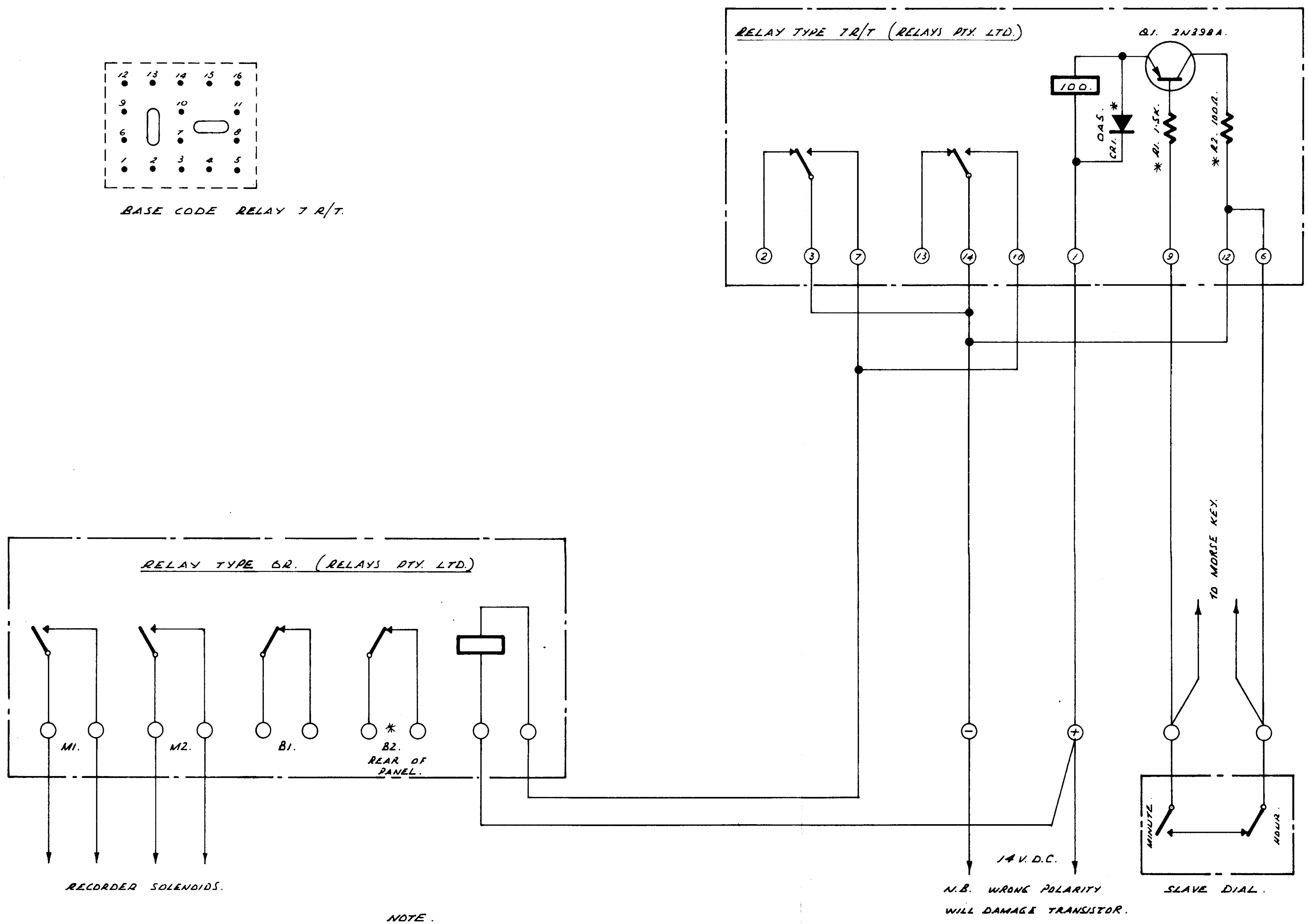
	DATE	NAME
Orig.	20-1-65.	R. GAN.
Amend.		



To Accompany Record No. 1966/42

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SO1. SH. 8.	INSTRUMENT TOOLANGI SEISMIC OBSERVATORY INSTALLATION. SYNCHRONOME MASTER CLOCK INTERNAL WIRING.

	DATE	NAME
Orig.	19_1_65.	R. GAN.
Amend.		

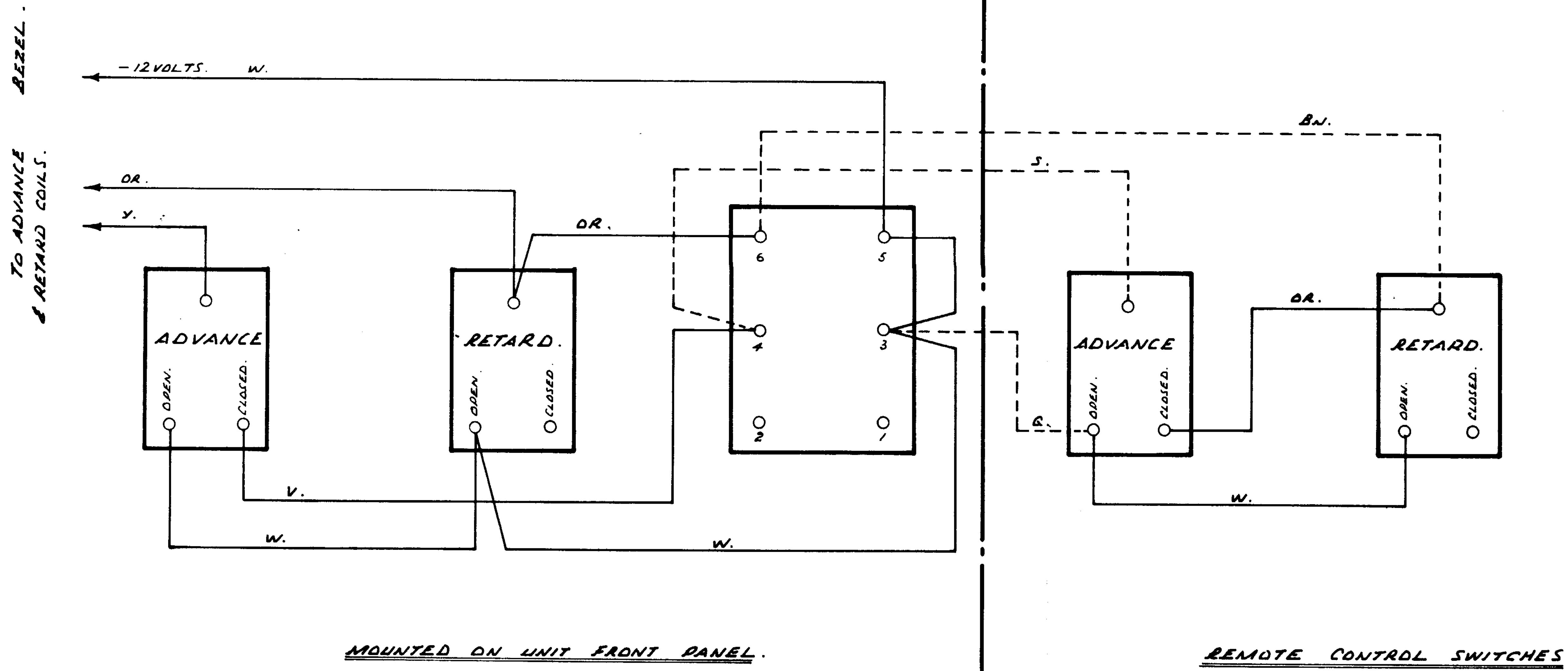


NOTE.
* REPRESENTS ITEMS ADDED DURING MODIFICATION.

To Accompany Record No. 1966/42

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SO1. SH.4	INSTRUMENT TOOLANGI SEISMIC OBSERVATORY INSTALLATION. TIME MARK RELAYS.

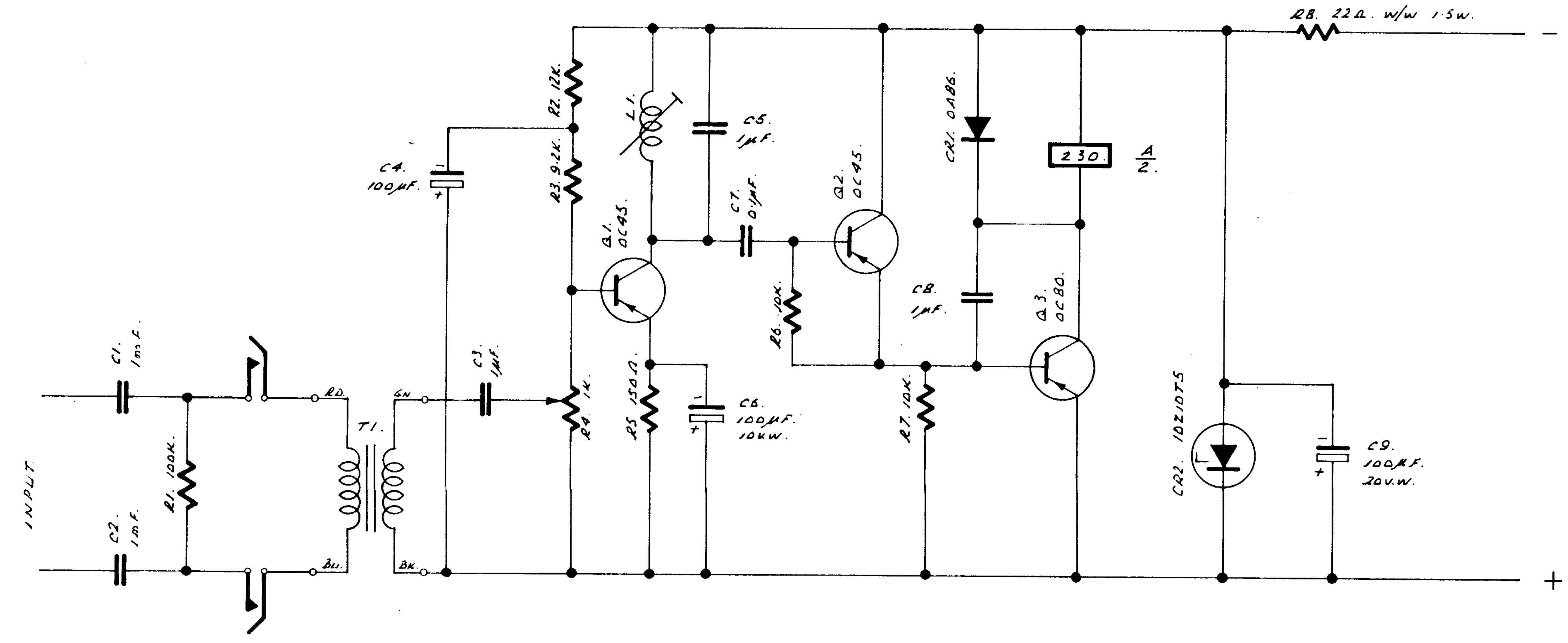
	DATE	NAME
Orig.	18-1-65.	R. GAN.
Amend.		



To Accompany Record No. 1966/42

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOI SH. 5	INSTRUMENT TOOLANGI SEISMIC OBSERVATORY INSTALLATION. ADVANCE & RETARD CONTROL WIRING.

NAME	DATE	AMENDMENTS	ISSUE
R. GAN.	15-2-65	———	1

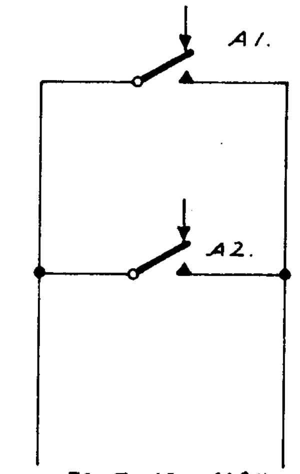


RELAY — SIEMENS HALSKE
TYPE TRLS 6541B 93d.
COIL RESISTANCE 230Ω.

T1 — ROLA TYPE NDR7 4:1.

L1 — 35 mH. CHOKE (ON 30mm VINKOR.)

C4, C6, C9 — TANTALUM ELEC. CAPACITORS.

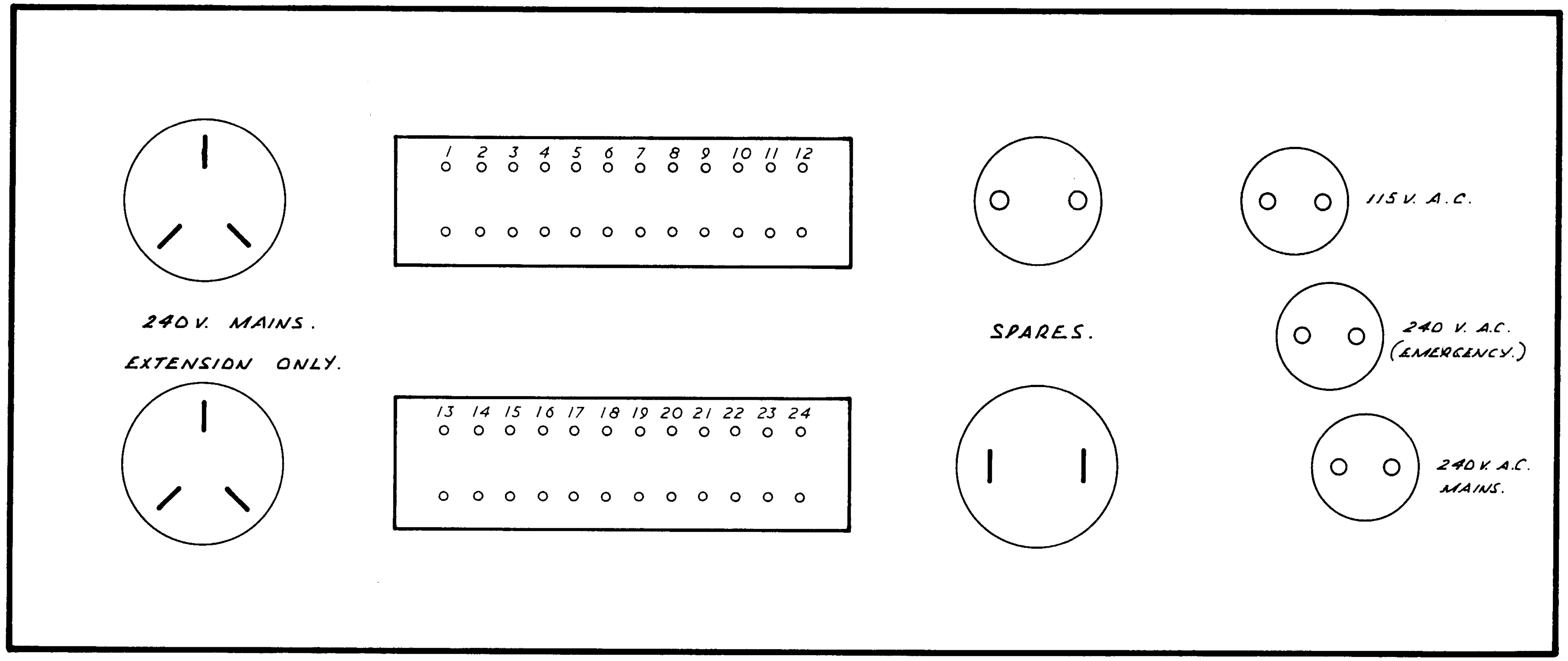


TO TIME MARK RELAY.

To Accompany Record No. 1966/42

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS	DRAWING No.	SHEET	INSTRUMENT TOOLANGI SEISMIC OBSERVATORY INSTALLATION. TIME SIGNAL RELAY CIRCUIT.
	501	6.	

	DATE	NAME
Orig.	19 – 1 – 65.	R. GAN.
Amend.		



1 — YELLOW — RELAY PILOT LAMP.

2 — ORANGE — SECONDS DIAL.

3 — WHITE — TIME SIGNAL RELAY.

4 — BROWN — HALF MINUTE DIAL.

5 — D. BLUE — N. C.

6 — D. GREEN — N.C.

7 — RED — N.C.

8 — GREEN — REMOTE RATE CONTROL X-TAL CLOCK.

9 — L. BROWN — REMOTE RATE CONTROL X-TAL CLOCK.

10 — PINK — N.C.

11 — BLACK — TELEPHONE BELL.

12 — GREY — N.C.

13 — YELLOW — N.C.

14 — ORANGE — SECONDS DIAL.

15 — WHITE — TIME SIGNAL RELAY.

16 — BROWN — HALF MINUTE DIAL.

17 — D. BLUE — N.C.

18 — D. GREEN — N.C.

19 — RED — TIME SIGNAL RELAY POWER (+VE.)

20 — GREEN — " " " " (–VE.)

21 — L. BROWN — N.C.

22 — PINK — N.C.

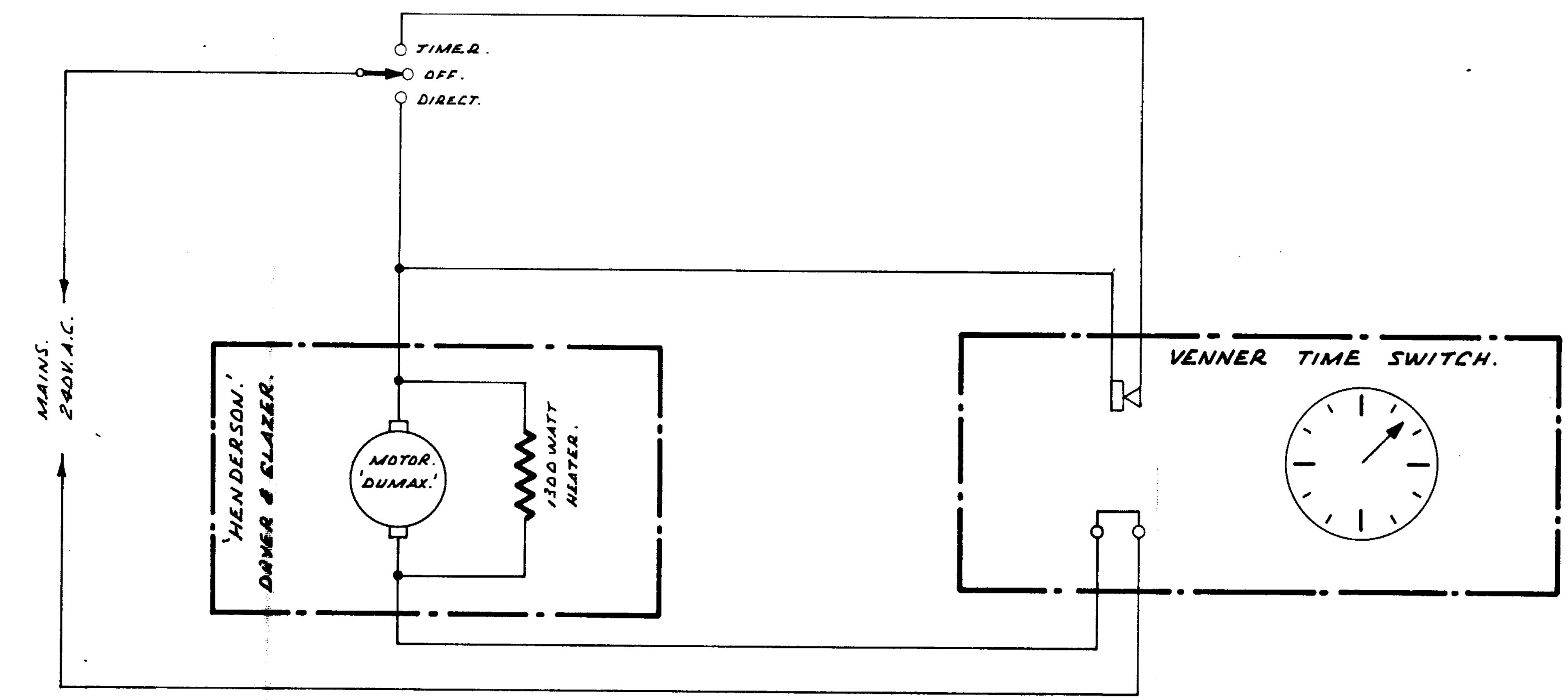
23 — BLACK — TELEPHONE BELL.

24 — GREY — REMOTE RATE CONTROL X-TAL CLOCK.

To Accompany Record No. 1966/42

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SO1. SH. 7.	INSTRUMENT TOOLANGI SEISMIC OBSERVATORY INSTALLATION. OFFICE — VAULT WIRING — TERMINAL BOX.

	DATE	NAME
Orig.	21-1-65.	R. GAN.
Amend.		

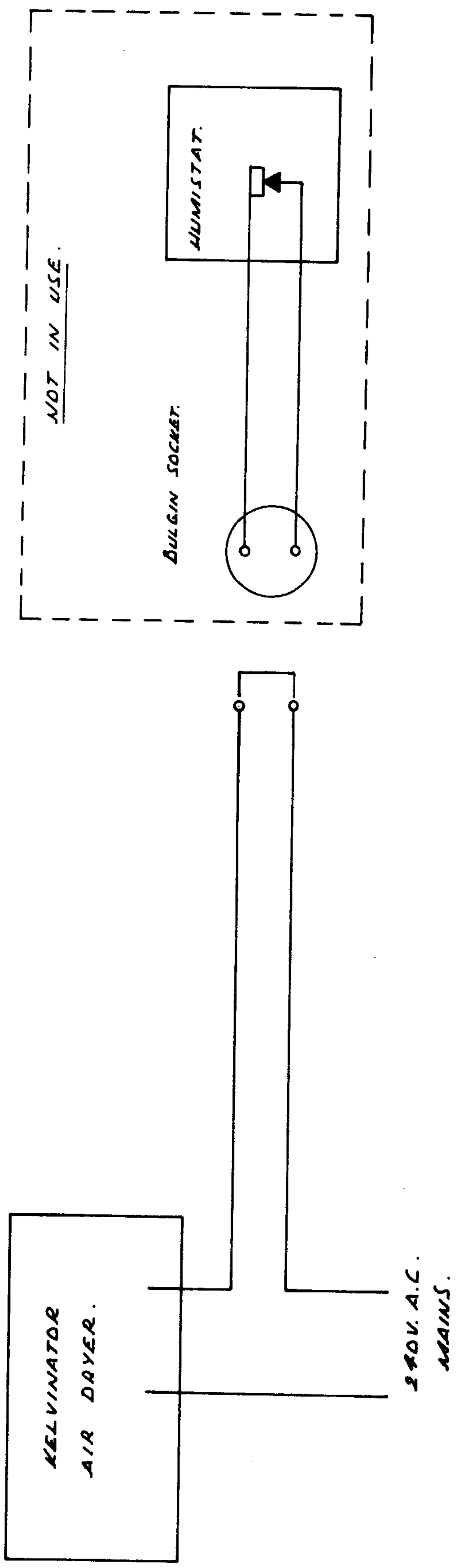


To Accompany Record No. 1966/42

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SDI. SH. 9.	INSTRUMENT TOOLANGI SEISMIC OBSERVATORY INSTALLATION. DRYING & GLAZING MACHINE SWITCH.

PLATE II

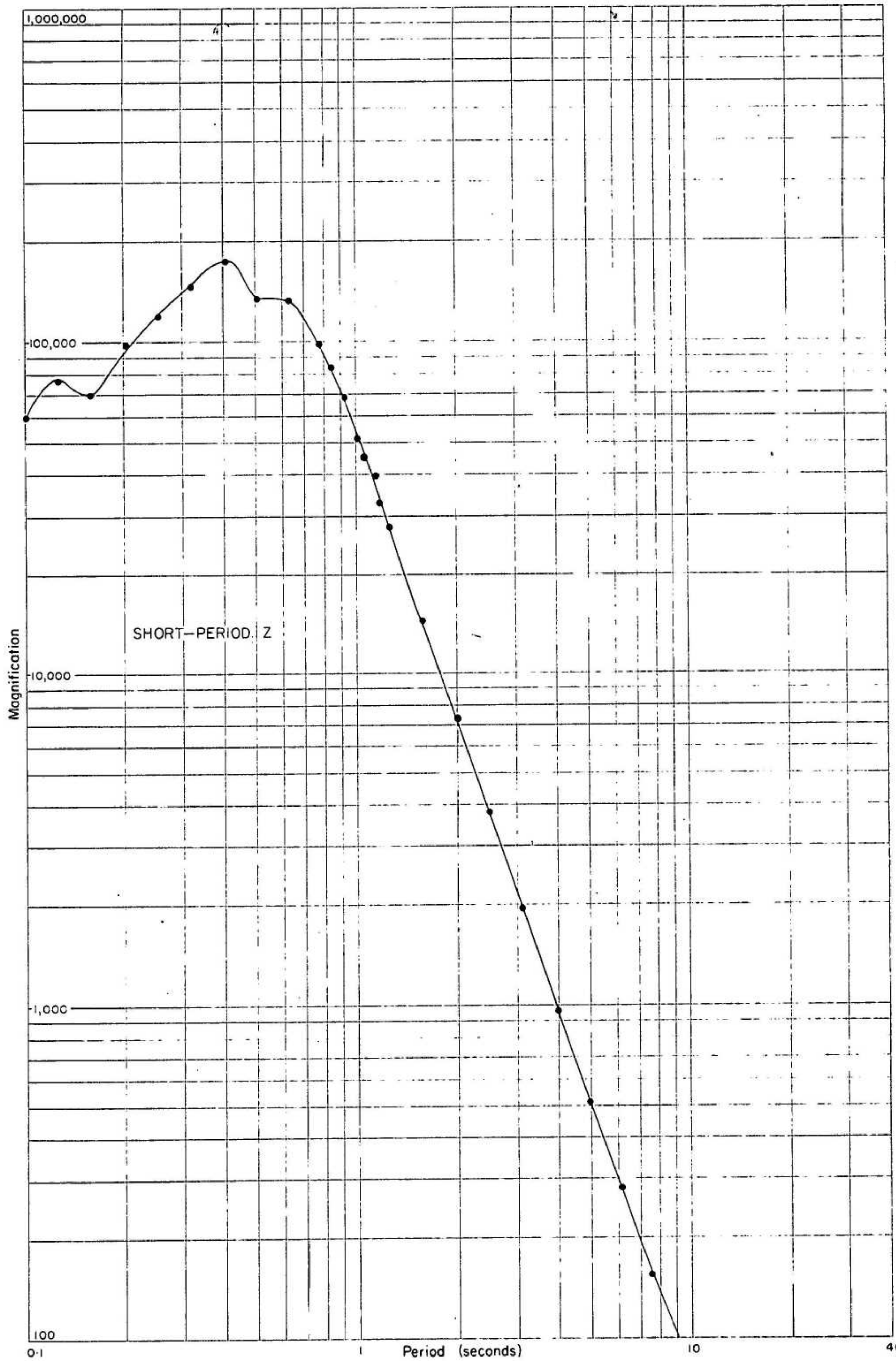
	DATE	NAME
Orig.	22-1-65.	R. GAN.
Amend.		



To Accompany Record No. 1966/42

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SO1. SH.10.	INSTRUMENT TOOLANGI SEISMIC OBSERVATORY INSTALLATION. HUMISTAT CONTROL.

PLATE 12



TOOLANGI, 5th Nov 1964

SEISMOLOGICAL OBSERVATORY

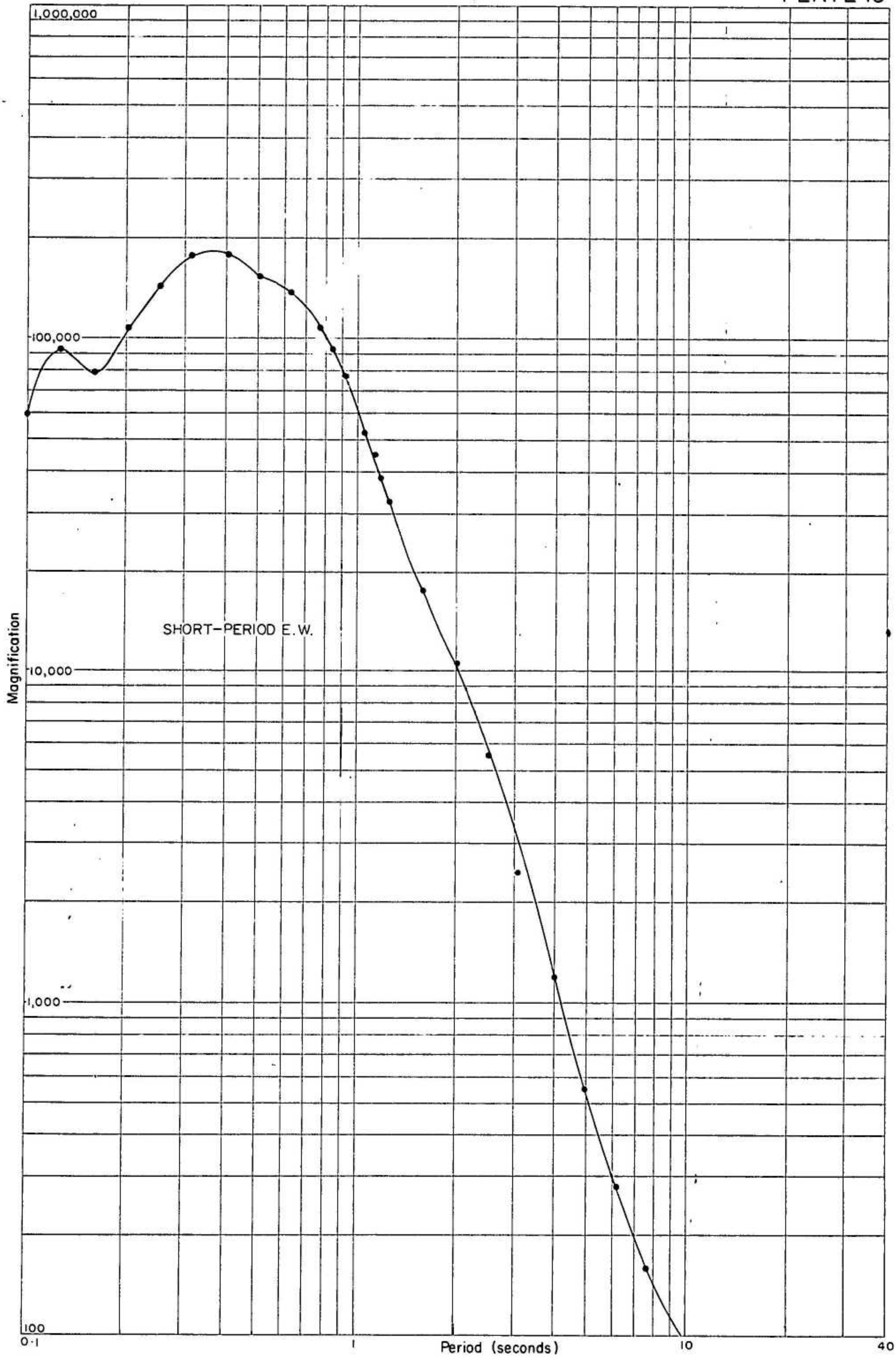
MAGNIFICATION CURVE FOR BENIOFF SEISMOGRAPH
DETERMINED WITH THE WILLMORE CALIBRATION BRIDGE

(Based on G82/2-2)

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS **G82/3-45**

To Accompany Record No. 1966/42

PLATE 13



TOOLANGI, 4th Nov 1964
SEISMOLOGICAL OBSERVATORY

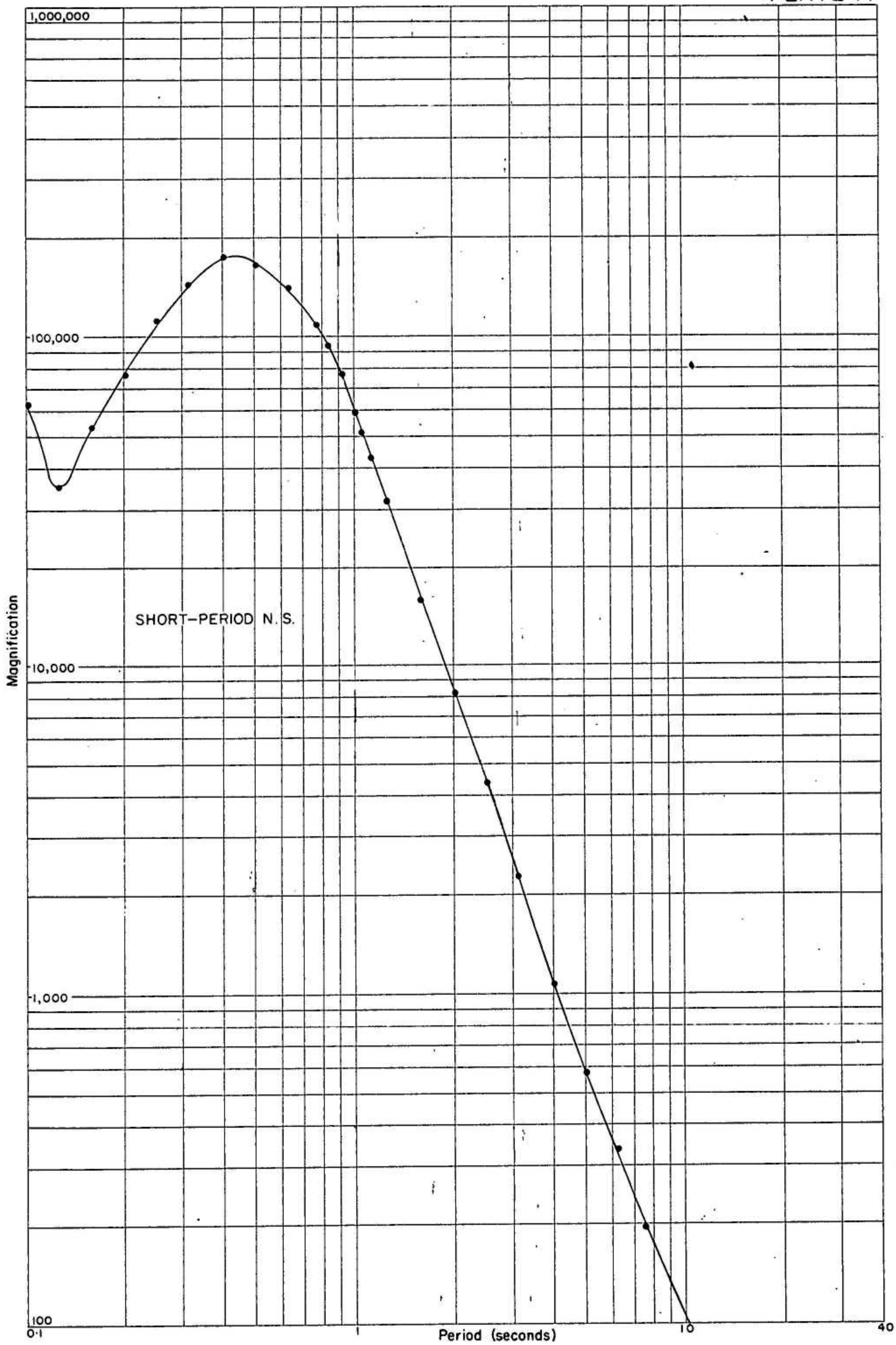
MAGNIFICATION CURVE FOR BENIOFF SEISMOGRAPH DETERMINED WITH THE WILLMORE CALIBRATION BRIDGE

(Based on G82/2-2)

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS **G82/3-44**

To Accompany Record No. 1966/42

PLATE 14



TOOLANGI, 5th Nov 1964

SEISMOLOGICAL OBSERVATORY

MAGNIFICATION CURVE FOR BENIOFF SEISMOGRAPH
DETERMINED WITH THE WILLMORE CALIBRATION BRIDGE

(Based on G82/2-2)

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS **G82/3-46**

To Accompany Record No. 1966/42

1. ACCESS ROAD, PARKING AND OFFICE (LOOKING EAST)

2. OFFICE, AND DARKROOM

3. ENTRANCE TO SEISMOMETER VAULT (UNDERGROUND TO RIGHT)