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DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

A THERMOCOUPLE AUTOMATIC SWITCHING UNIT

by

J. H. McGuire

Summary

An automatic switching unit is described which is designed to connect the outputs of up to twelve thermocouples, one after the other, to a measuring instrument.

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Fire Research Station,
Boreham Wood,
Herts.

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An automatic switching unit has been developed at the Fire Research Station for connecting the outputs of up to twelve thermocouples one after the other to a measuring instrument. Such a requirement arises not infrequently in a laboratory or in industry and in designing a suitable equipment two important though not obvious difficulties must be overcome:-

(1) Where potentials of substantially less than a volt are being switched, conventional contacts, unless operating under high pressures, are quite unsuitable. Thus when a conventional uniselector was used to switch thermocouples the temperature recordings obtained were sometimes hopelessly inaccurate. This effect is probably a result of the high contact resistance of the very thin films of dirt on the contacts which cannot be broken down by the low potentials involved.

(2) Stray thermal e.m.f.s within the unit introduce errors in the temperature recordings.

These difficulties were overcome by using platinum contacts operating at high pressures and by ensuring that the power dissipation within the switching unit itself was kept as low as possible.

The equipment is illustrated in Plates 1 and 2 and a circuit diagram is shown in Fig. 1. Twelve pairs of terminals are switched in turn to a common pair by twelve relays (type 3,000) with platinum contacts and spring pressures of 60 grams instead of the usual 5 grams. The relays are operated by a uniselector which is itself triggered by cam contacts driven by a synchronous motor. To permit manual switching a push-button switch is also connected across the cam contacts.

To ensure that the uniselector contacts have a long trouble-free life the circuit is arranged so that these contacts do not themselves break the current through the relays. Instead the current is broken by a relay (Z in the attached circuit diagram) which is operated from the uniselector interrupter spring. One of the amplifiers to be used in conjunction with the unit becomes overloaded if no input is connected to it for periods longer than 0.1 sec. The subsidiary relay holding circuit incorporating R_1 and contacts A_3, B_3 etc. ensures that this will not occur even if the uniselector is operated indefinitely by the manual push-button.

The uniselector has twenty-five contacts of which twenty-four are used to select the twelve switching relays. The twenty-fifth contact operates a similar circuit but the terminals may be either shorted or connected to a $\pm$ 100 m V supply, whichever action is appropriate, to provide a distinctive reference on the recorder chart.

It would have been possible to have dispensed with the uniselector and to have performed the switching with the relays alone. It was thought, however, that the number of additional contacts required for each relay and the complication of a suitable circuit gave little to choose between the two systems.

The principal source of heat in the switching unit itself is the uniselector and to minimise thermal effects this is mounted well above the relays and terminals, as illustrated in Plate 2. In addition, the impulse applied to the uniselector is made as short as possible so that the coil is scarcely warm even after several hours of operation. It has been found that the thermal e.m.f.s introduced by the equipment are less than those introduced by the measuring system employed which may be of the order 2 μV corresponding to temperature differences of the order of 0.05°C. It is not unlikely that thermal e.m.f.s could be reduced still further if this were necessary by mounting the relays upside down so that the coils were above the contacts. These coils do not attain temperatures which are detectable by hand but, should the equipment be used to measure temperature differences of the order of $^1/_{100}$°C an effect might be noticeable.

Acknowledgment

The work described in this note forms part of the programme of the Joint Fire Research Organization of the Department of Scientific and Industrial Research and Fire Offices' Committee: the note is published by permission of the Director of Fire Research.

Acknowledgment is due to Messrs. A. Reid Manufacturing Co. Ltd, for permission to publish Plates 1 and 2.

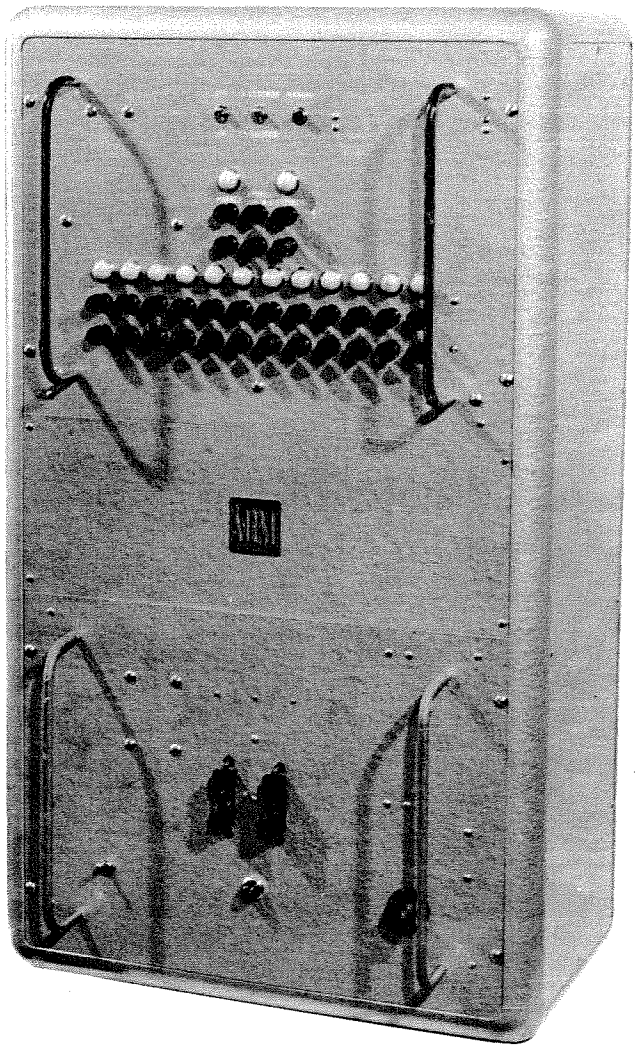

PLATE. I. FRONT VIEW OF EQUIPMENT

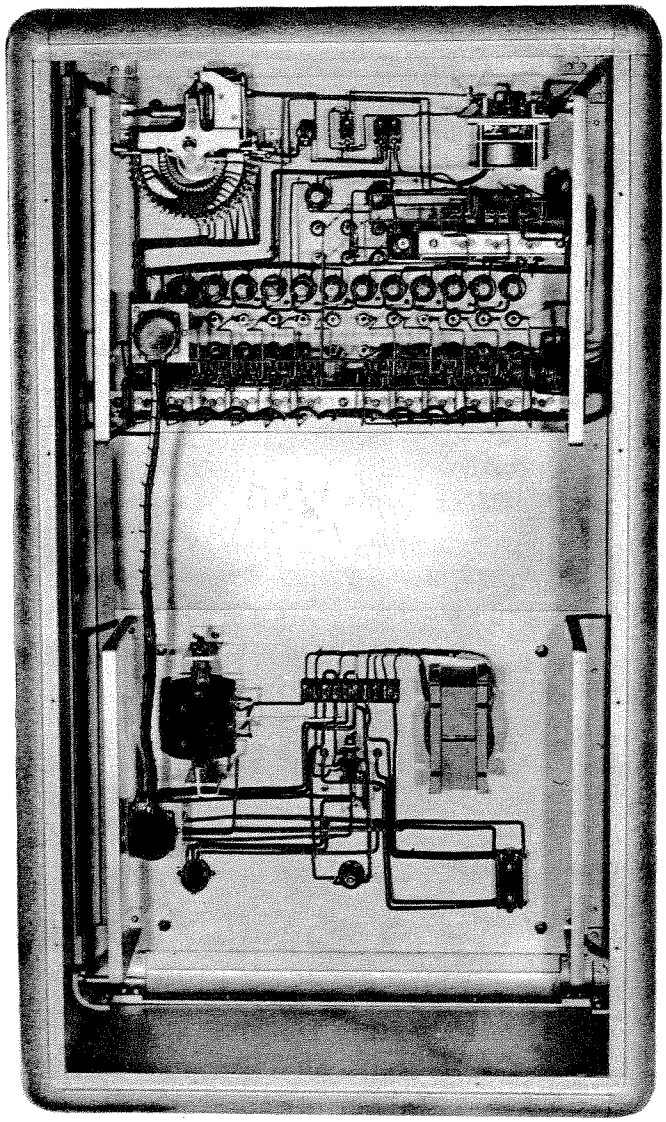

PLATE. 2. BACK VIEW OF EQUIPMENT

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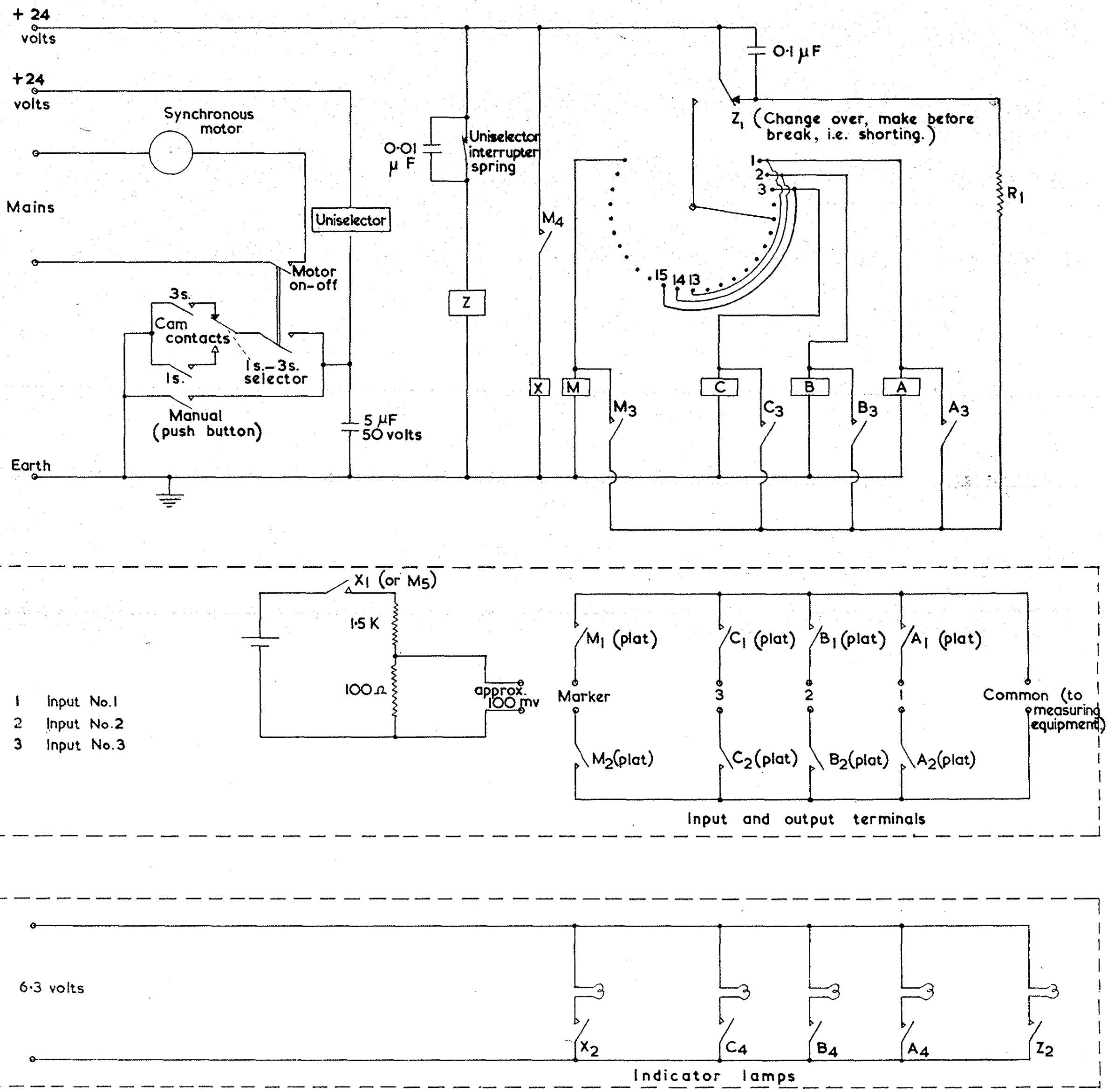

THERMOCOUPLE SWITCHING UNIT — TYPE A

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