Chapter 1

INTEGRATOR UNIT AND RELAY, TYPE S170 (SANGAMO WESTON)

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LIST OF ILLUSTRATIONS

Introduction

1. The integrator unit has been designed to work in conjunction with the sensitive relay Type S170, to provide warning of a change in loading on heater mats used on aircraft for de-icing purposes. The system operates from a 3-phase supply and the principle employed is that of summation of the 3-phase current, the variation of which produces a corresponding variation in the calibrated shunt across a relay, causing the relay to operate at predetermined values.

DESCRIPTION

2. The heater mats, referred to in para. 1, are connected to a 3-phase, 208V, 400c/s supply. The integrator unit is energized from three Type S117 current transformers which are inserted into the lines of the 3-phase supply. The integrator unit circuit is arranged to summate the current from each phase and the summated current is then used to actuate the sensitive relay, Type S170. The relay contacts are set to close at a predetermined value of current, and the closing of these contacts operates a slave relay or an alarm circuit.

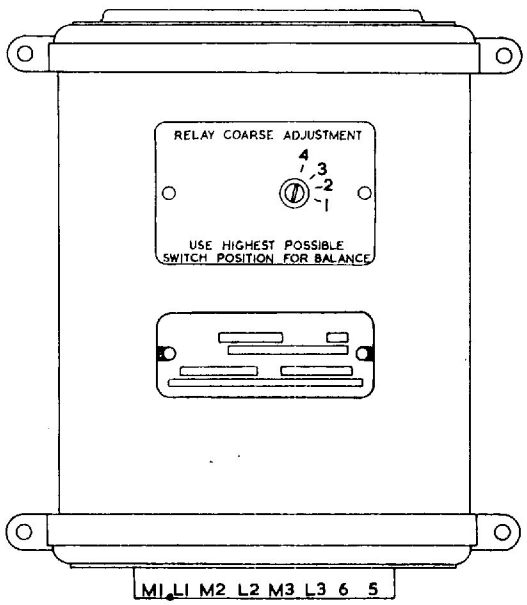

Fig. 1. Integrator, external view

RESTRICTED

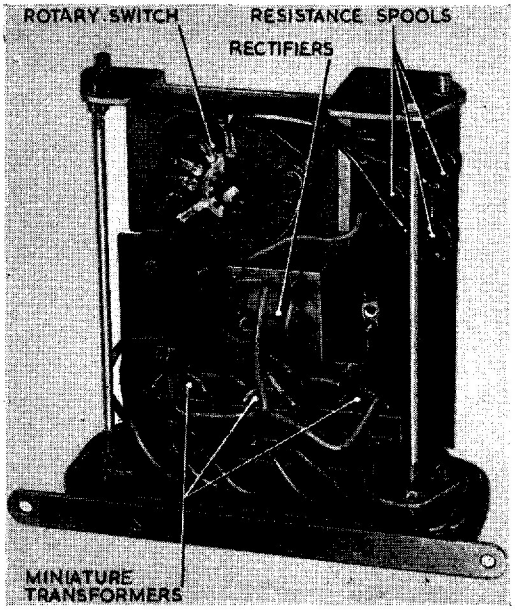

Fig. 2. Integrator with cover removed

Transformers, Type S117

3. These transformers are ring type current transformers designed for use in 400c/s circuits. The rating of the transformers is as follows:—

Transformer primary range	250 amp maximum
Transformer secondary range	1 amp maximum
Load	1 VA

The primary is formed by turn(s) insertion and the range is deduced from expression:
Primary amperes × insertion turns = 250

Accessory box

4. This box summates the three phase currents and this summated current is then rectified and used to energize the sensitive relay, Type S170. The accessory box contains the following components:—

3	Miniature transformers	
	Primary range	1 amp
	Secondary range	20 mA
6	Silicon diodes	
1	Rotary switch, 4-way	
1	Terminal block, 8-way	
4	Resistances	

Relay, Type S170

5. This relay is basically a milliameter relay adjusted by spring suppression to make the low contact at 4·775 mA, and the high at 5·225 mA. The closing of the contacts is used to energize a slave relay or an alarm circuit. When the relay is unenergized, the relay control arm makes hard against the low contact. With 5 mA flowing the relay takes up its centre scale position. The 5 mA current corresponds to the balanced position of the 3-phase load for either air or ground position of the integrator circuit.

6. The centre arm, therefore, makes either the low or the high contact for a current change in the relay moving coil of 0·225 mA. This current corresponds to a change in the 3-phase loading, from balance position, of 5 per cent in the three phases or 15 per cent in any one phase.

7. The relay incorporates four resistances, A, B, C and D (*fig.* 5). Resistances A and B are connected in series with the relay coil. Resistances C and D are brought out to terminals and can be shunted across the relay coil and resistances A and B by means of an external switch or link. For final adjustment of the relay a resistance poten-

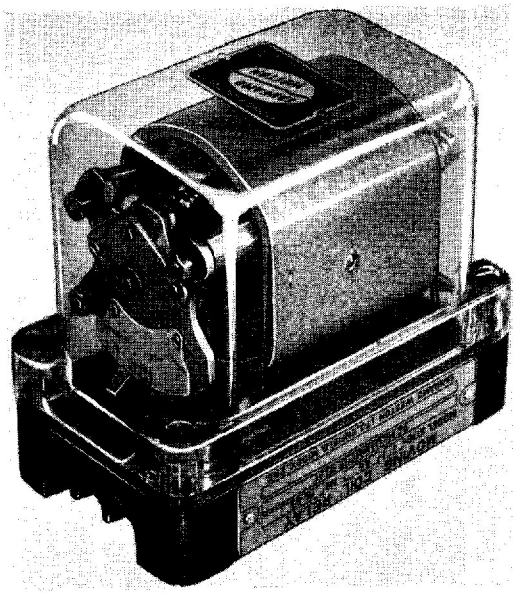

Fig. 3. Relay, Type S170

tiometer is connected across terminals 4 and 5.

Adjustment of relay

8. If necessary, the relay can be adjusted by adjusting the spring tension at mid-scale to give a moving scale sensitivity of 5 mA ± 0·3 mA. This is made by slackening two extreme screws of the locking plate (*fig.* 4) and rotating the middle (adjusting) screw, with the current of 5 mA flowing through the instrument coil. Adjust the position of the low contact to allow the control arm to make at 4·775 mA ± 0·3 mA. Adjust the position of the high contact to allow the control arm to make at 5·225 mA ± 0·3 mA.

Note . . .

All adjustments of the relay must be made with the relay vertically mounted.

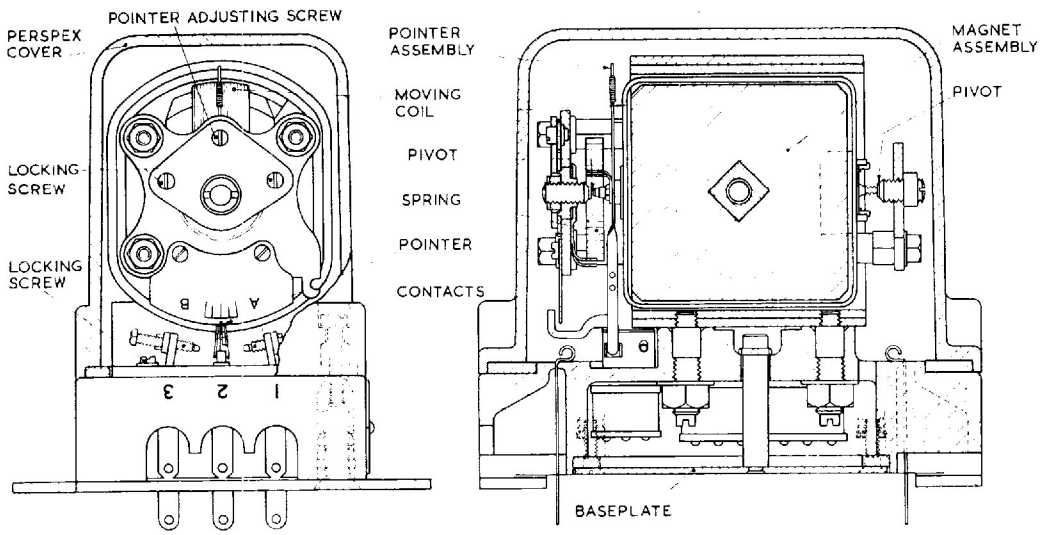

Fig. 4. Sectional view of relay, Type S170

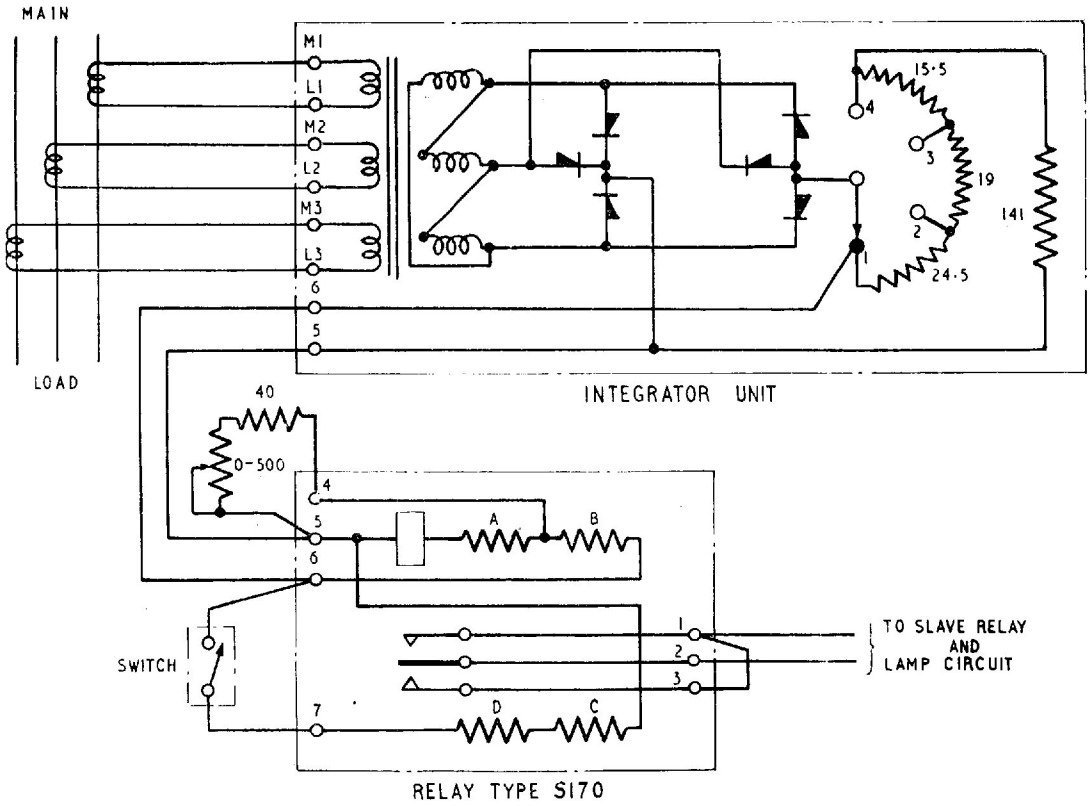

Fig. 5. Circuit diagram of system

SCOPE OF UNIT

9. The system is capable of adjustment to cover variation in the 3-phase loading from 170 to 255 amp. This adjustment is achieved by switch selection of a tapped shunt connected, via the accessory box, across the sensitive relay, Type S170. Final adjustment is made by means of a resistance potentiometer connected across part of the relay circuit and referred to in para. 7.

10. An additional shunt is connected in the relay circuit and is brought into operation by closing of an external switch or link (*para.* 7). The switch or link is left in the closed position when the aircraft is in flight and in the open position for ground testing the integrator unit. After ground testing of the unit, the shunt is closed and the relay contacts will then make when four times the ground testing current is passed through the unit.

Note . . .

With the aircraft on the ground the normal heater current required in flight would be excessive for the heater windings. For test purposes on the ground, a quarter of the normal heater current is used.

OPERATION

11. The secondaries of the Type S117 transformers are connected to terminals L1-M1, L2-M2 and L3-M3. The currents from the three phases are rectified and the summated current output is fed to terminal 5 and returned to the circuit via terminal 6 and the rotary switch.

12. The spools A, B, C and D are series shunts connected across terminals 5 and 6 of the box. The sensitive relay is also connected to these terminals, and when the 3-phase load is connected to the unit the rotary switch position is selected to bring the relay control arm to approximately its centre scale position. Final balance is achieved by adjusting the 500 ohm potentiometer connected across terminals 4 and 5 of the relay.

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13. The relay high and low contacts are adjusted to operate the alarm circuit when the 3-phase load corresponding to the scale centre position changes by 5 per cent.

SERVICING

14. The following tests should be carried out on the system.

Ground check test

15. Connect the unit as shown in the circuit (*fig.* 5) and open the switch or link between terminals 6 and 7.

16. Apply the 3-phase ground testing current for the unit being checked.

17. Set the rotary switch to bring the relay control arm to approximately its scale centre position, and then adjust the 500 ohm potentiometer to bring the control arm directly over the scale centre position.

Note . . .
For the highest accuracy between ground and air settings, set the switch to its highest possible numbered position on the rotary switch.

18. Now alternately increase and decrease the 3-phase ground current required to give scale centre position by 5 per cent. The control arm should make the high and low contacts respectively and actuate the alarm circuit.

Air position check test

19. After adjustment of the unit in its ground check position, close the switch or link across terminals 6 and 7. No further electrical adjustment must be made on the unit.

20. With the aircraft in the air apply four times the ground check current required to align the relay control arm over its scale centre position.

21. Check that the control arm aligns over the scale centre position. Now vary this 3-phase current by ± 5 per cent and check that the control arm makes the respective contacts and actuates the alarm circuit.

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