Chapter 20

BALANCER RELAY, TYPE MA3

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Balancer relay, Type MA3	Stores Ref. 6A/
Voltage	24
Current	5 amp.
Weight	60 oz.
Dimensions	7 in. × 4 in. × 3·875 in.

Introduction

1. The balancer relay, Type MA3, is used in certain Smiths-Waymouth fuel gauge installations to presever a certain ratio between the contents of various tanks as their fuel content changes. It is operated by the differential current between the indicator circuits from two amplifiers, and therefore can be incorporated only in an installation which has two or more amplifiers, each serving a tank or groups of tanks. The relay thence controls the circuit to the relevant fuel tank pump to correct the state of unbalance.

DESCRIPTION

2. This balancer relay (*fig.* 1) incorporates two moving coil assemblies and two double-pole, normally-open slave relays, with associated resistors and capacitors. The components are mounted on

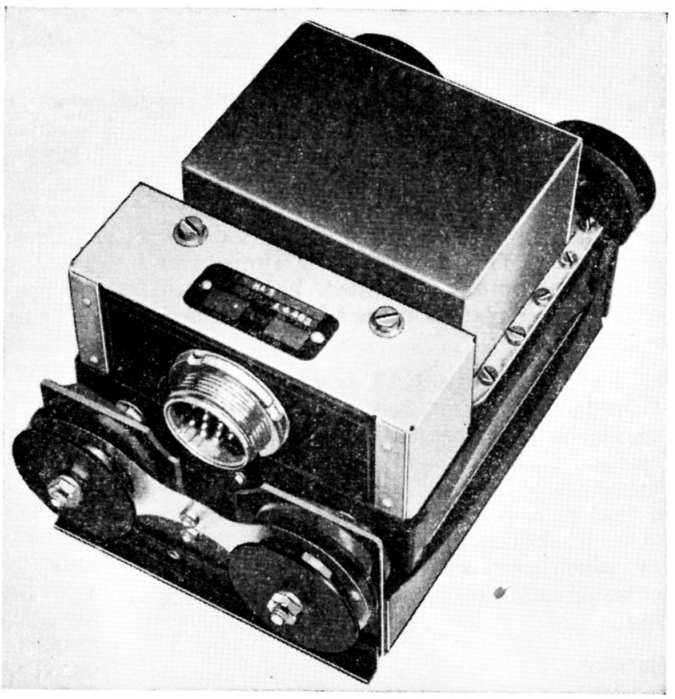

Fig. 1. Balancer relay, Type MA3

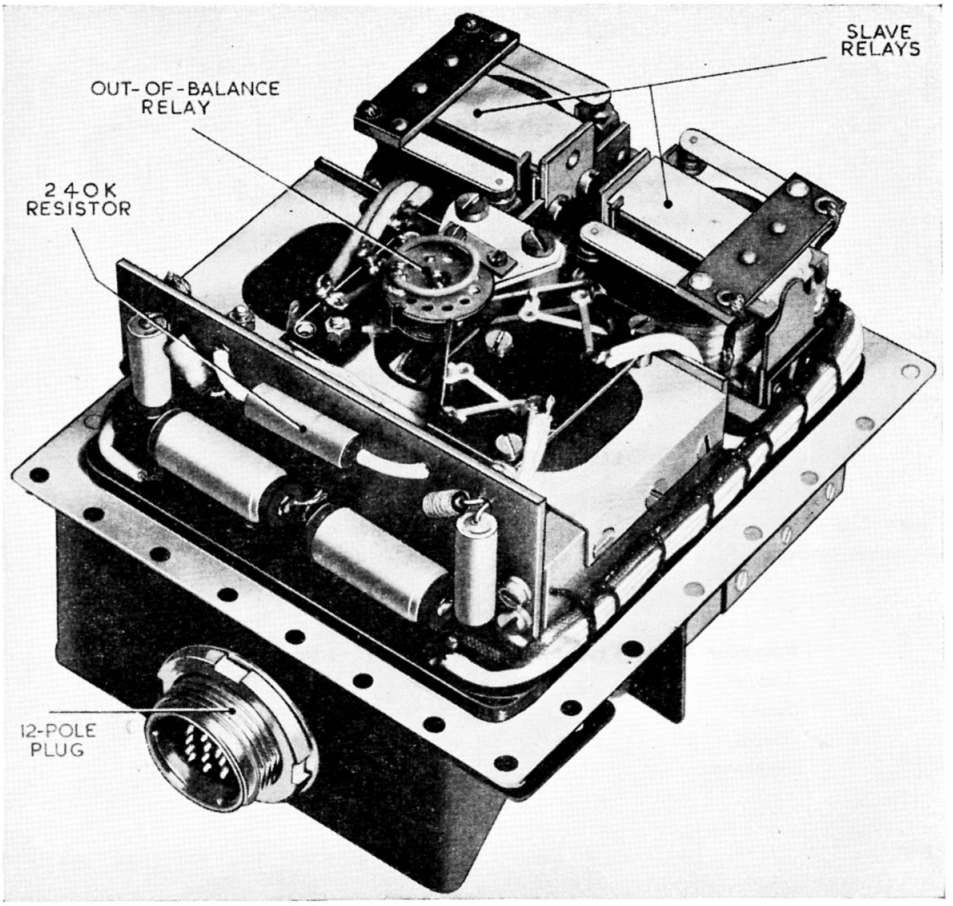

Fig. 2. Relay with covers removed

opposite sides of a light alloy base plate, as shown in fig. 2 and 3, and the complete unit is hermetically sealed in a standard fuel gauge amplifier case with anti-vibration mounting. This mounting is similar to that used for the amplifier, but has an extra damper plate because of the increased weight.

3. The relay, Type MA3, is generally used for more complicated fuel systems where an unequal ratio is required between wing and fuselage tanks as against a more simple system where the need is for equal quantities of fuel in a number of tanks. This ratio factor is obtained by two resistors R2 and R3, which form a shunt for the fuel gauge indicator, and are housed in the instrument itself.

Operation

4. A circuit diagram of the balancer relay is given in fig. 4. If the currents between amplifiers A and B and the indicator are in the correct ratio to each other, there will be no voltage drop across the resistor R3 and no current will pass through the resistor. If, however, an out-of-balance current has been set up between the amplifiers, a P.D. will be created across R3, and current will flow, both through R3 and through the two moving coils, shown in fig. 4 as the "out-of-balance coil" and the "out-of-trim coil".

5. The out-of-balance coil controls the operation of the two slave relays, each of which operates a circuit to the appropriate fuel pump control and a holding circuit; the out-of-trim coil operates one of two trim indicators to show when the fuel load reaches a certain degree of unbalance. The two moving coil relays are so constructed that a greater current is needed to operate the out-of-trim coil than the out-of-balance coil. This means that the warning indicators are not operated until the fuel distribution begins

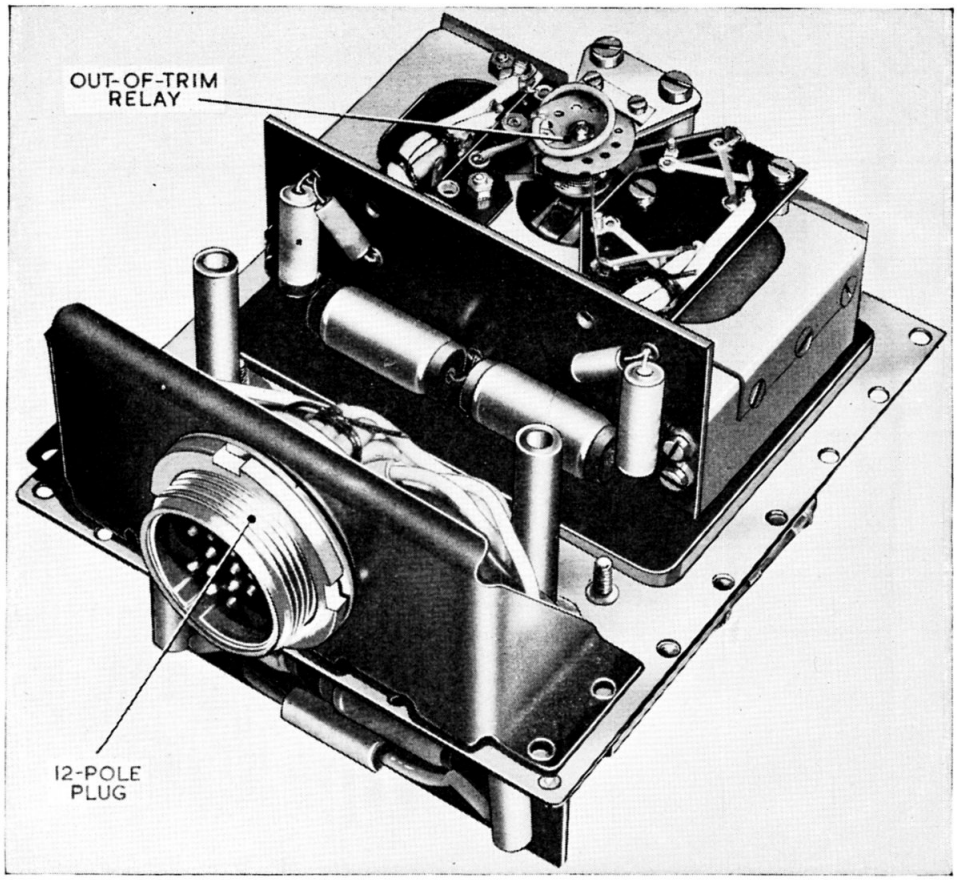

Fig. 3. Underside view with covers removed

to affect the aircraft trim, and thus in most instances the relay controlled by the out-of-balance coil will correct the fuel distribution before the aircraft trim is sufficiently affected.

6. When a current of between 0·1 mA and 0·15 mA flows through the out-of-balance coil, the positive contact swings over from a centre position to close on one of the side contacts, thus energizing one or other of the slave relays. In each of these relays, one pair of contacts, shown as No. 1, has a gap of 0·040 in., whilst the other pair, No. 2, has a gap of 0·025 in. When the coil is energized, No. 2 contacts close first, and complete a hold-in circuit through the 240K resistor, thus increasing the current through the moving coil assemblies by a further 0·1 mA.

7. No. 1 contacts in the relay then close, which connects the positive supply to the relevant pump control circuit, to correct the relative contents of the tanks. The hold-in current ensures that the contacts of the out-of-balance relay are kept closed until the indicator currents through the coil are once more in balance. If the hold-in current were not added to the current through the moving coils, the relay contacts would cut out again as soon as the fuel pump had caused the out-of-balance factor in the coil to drop a little below the cut-in figure. This would still leave a relatively large out-of-balance current in the moving coils, and as soon as this had increased a fraction, the process would be repeated, causing the system to hunt. With the hold-in current method, however, only a very small out-of-balance factor remains when the relay is de-energized and the additional current in the moving coils is cut out.

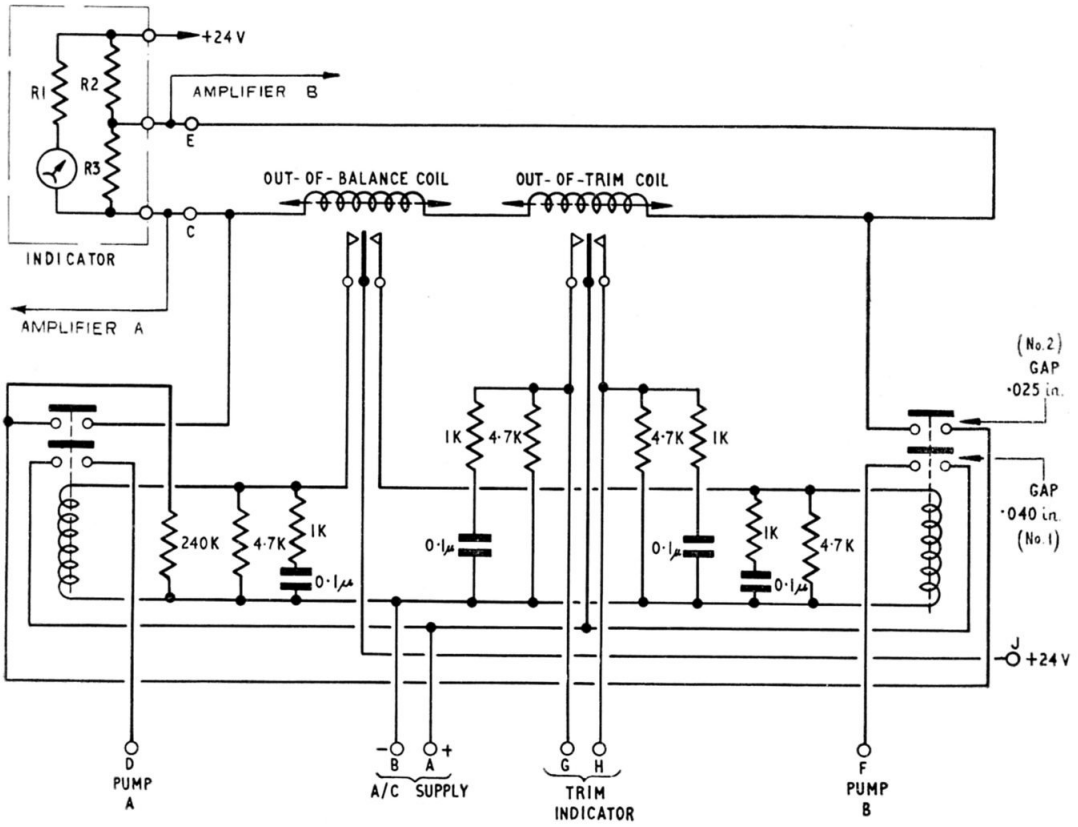

Fig. 4. Circuit diagram

8. The resistors and capacitors which are connected in the circuit are incorporated to prevent arcing at each of the moving coil relay contacts.

INSTALLATION

9. Electrical connection to the relay is made at a 12 pole Mk. 4 miniature plug on the end face. The relay should be mounted vertically, with the plug at the bottom. Details of a particular installation will be found in the relevant Aircraft Handbook.

SERVICING

10. Since the complete unit is hermetically sealed, no servicing of the balancer relay is possible. A functional test may be given, to ensure that the relay operates with an out-of-balance current of 0·1 mA to 0·15 mA.