

Chapter 15

RELAYS, B.T.H. TYPE LA

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Introduction

1. The B.T.H. Type LA range comprises a number of basically similar light duty, polarized, electro-magnetic relays which are

fully adjustable and can be set to relatively fine limits. They are therefore suitable for use in system control equipments.

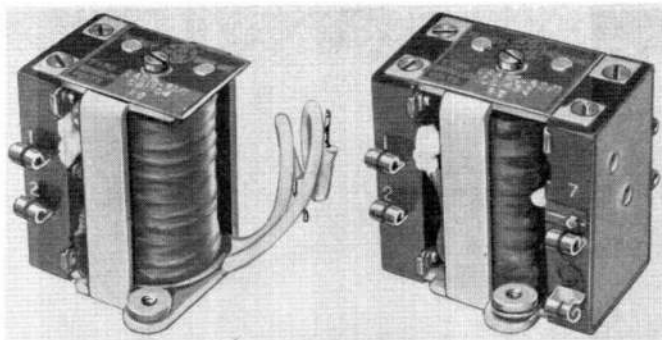


Fig. 1. Relays, Type LA

2. The relays have either one or two pairs of normally open contacts. When two pairs of contacts are fitted, a feature of the relay is that each pair can be adjusted to close at a different value of voltage or current applied to the common operating coil.

3. The relays in the range differ in their coil design or in the contact settings. The coils may be wound for either 28-volt or 120-volt operation, or if the relay is to be

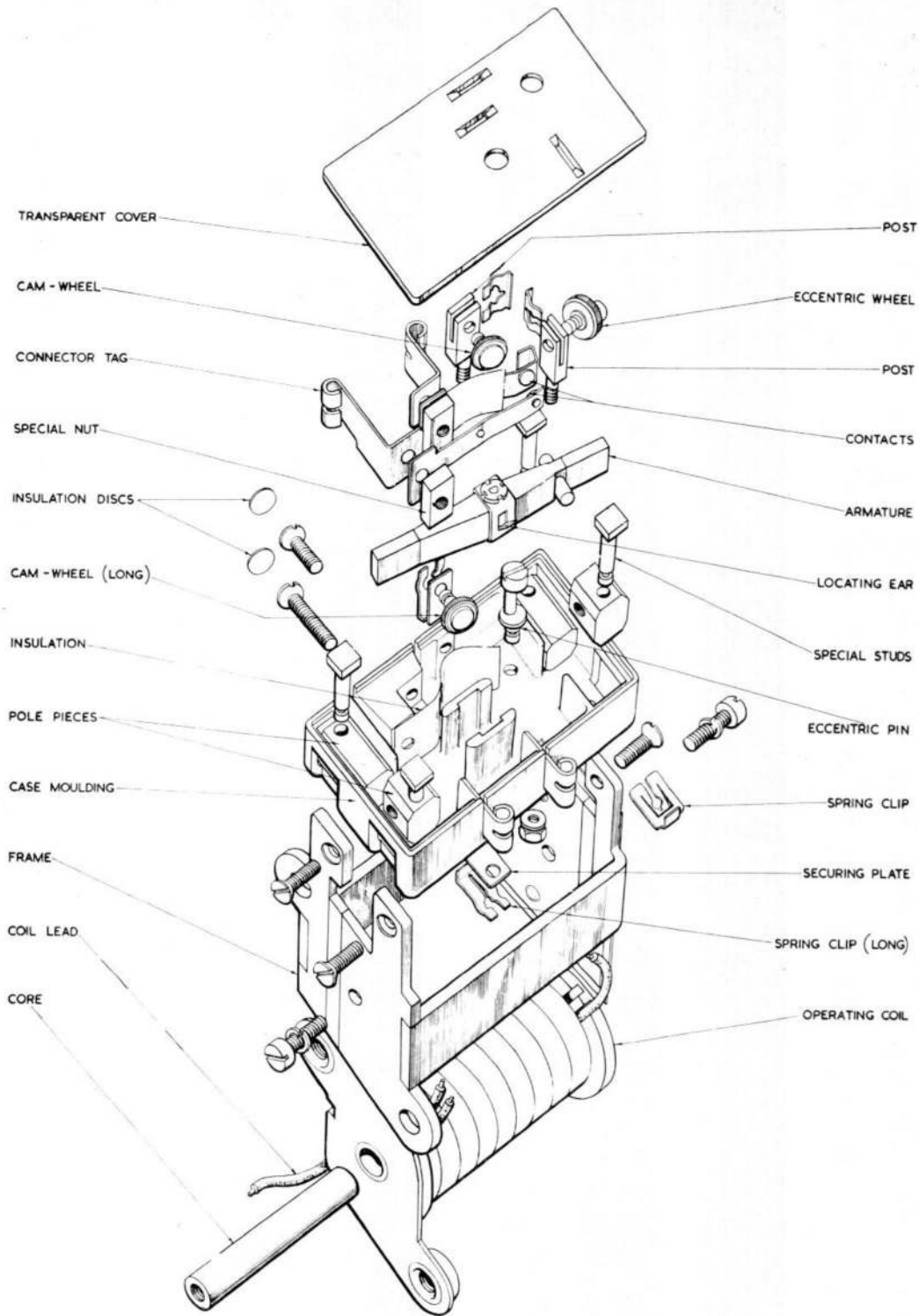


Fig. 2. Exploded view

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series-connected, a low resistance coil is fitted. For differential action or for special applications a relay is fitted with a coil having two or more windings. Reference should be made to A.P.4343C, Vol. 1, for data on particular relays.

DESCRIPTION

4. The relay consists of a rectangular frame which houses the operating coil in the centre, and supports a case unit on either one or both sides. An example of each type is shown in fig. 1.

5. The assembly of a single case unit relay is shown in the exploded view (fig. 2). The twin case unit relay is of identical construction, except that the end plates of the frame are provided with extra pairs of lugs to support the second case unit.

Frame assembly

6. The Mu-metal frame is divided magnetically into two halves by a pair of brass spacing strips inserted in the end plates. The case unit is secured by screws between the end plate lugs. The coil is wound on a brass former with moulded end flanges, and is insulated with varnished glass tape. One end flange is provided with two tapped bushes which are aligned with holes in an additional pair of lugs on the adjacent end plate. The Mu-metal core is held firm between the end plates by a pair of ch/hd. screws.

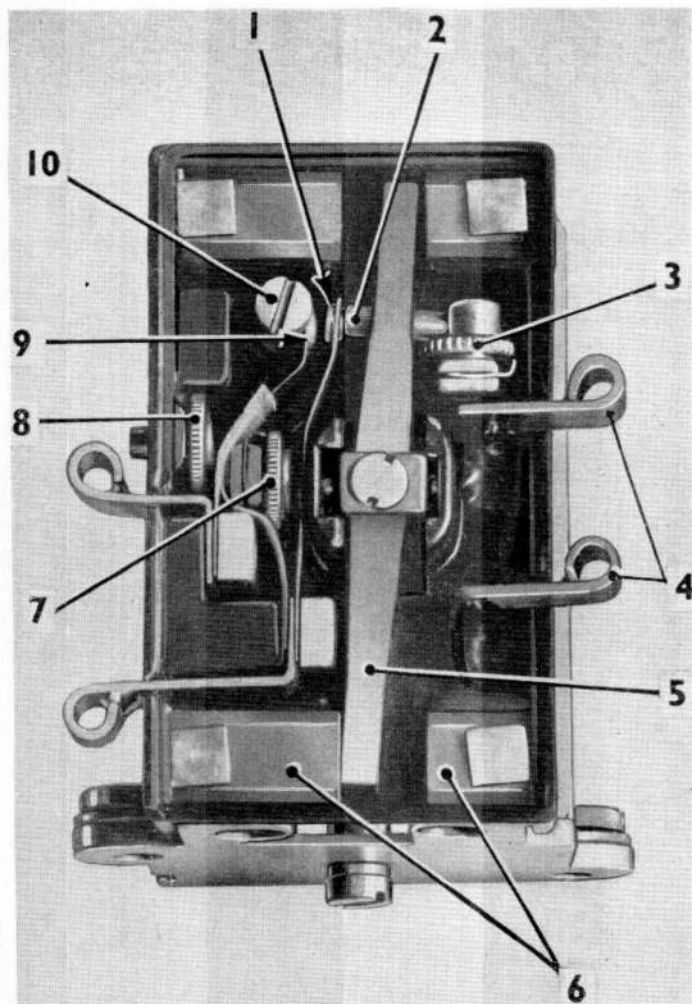
Case unit

7. Special studs secure Mu-metal pole pieces in each corner of the rectangular case unit moulding. These pole pieces are drilled and tapped to take the csk/hd. screws which secure the case unit to the frame lugs. The special studs are secured to the base of the moulding by spring clips.

8. Within the case unit, the cobalt steel armature, fitted with Mu-metal tips, is centrally pivoted between two ball bearings. On older types of relay the armature is suspended on a thin torsion strip. The hub of the armature is provided with a pair of

locating ears which engage in the slotted walls of the moulded armature housing, and serve to limit the swing of the armature. One limb of the armature is fitted with two projecting pegs.

9. The case unit also houses one pair of contacts and their adjusting devices, arranged as shown in fig. 3. The eccentric and cam



- 1 MOVING CONTACT
- 2 ARMATURE PEG
- 3 ARMATURE ECCENTRIC WHEEL
- 4 COIL TERMINAL TAGS
- 5 ARMATURE
- 6 POLE PIECES
- 7 MOVING CONTACT CAM WHEEL
- 8 FIXED CONTACT CAM WHEEL
- 9 FIXED CONTACT
- 10 ECCENTRIC PIN

Fig. 3. View of case unit (cover removed)

wheels are secured by spring clips to posts projecting from the base of the moulding, and, together with the eccentric pin which is also secured by a spring clip, are used to obtain the relay settings. The contact leaf springs are attached to terminal tags by csk/hd. screws which engage in special nuts. After assembly, the heads of these screws are protected by insulating discs. A transparent cover, cut to provide access to the adjusting devices, is sealed within the recessed sides of the case unit moulding.

10. Referring to fig. 3, the armature eccentric wheel bears on one armature peg and so limits the clockwise movement of the armature, and hence the travel of the moving contact. The position of the fixed contact is governed by the eccentric pin. The contact spring pressures may be adjusted by means of the cam wheels.

Terminal markings

11. Two terminal tags protrude from each side of the case unit. Those on one side are connected to the contacts, those on the other to the coil. When a relay is fitted with one case unit the pairs are marked 1, 2 and 3, 4 respectively. Terminals 3 and 4 are the contact terminals, and terminals 1 and 2 are used to secure the coil leads.

12. When a relay is fitted with two case units, the second has terminals marked 5, 6 and 7, 8. Terminals 7 and 8 are the contact terminals, and terminals 5 and 6 may be used for additional coil leads, if any.

OPERATION

13. The armature, which is permanently magnetized along its length, is suspended or

pivoted on the centre line between the pole pieces. With the coil de-energized, and the armature lying along this centre line, the magnetic attraction between the armature and the pole faces is equal in either direction. However, the moving contact leaf spring, bearing on the armature peg (fig. 3), exerts sufficient pressure to swing the armature over to the "contacts open" position. The path of the flux due to the magnetized armature will then be as shown in (a) of fig. 4.

14. When the coil is energized the magnetomotive force developed will either assist or oppose that developed by the armature. If it assists, the relay will be held even more firmly in the "contacts open" position. If it opposes, and is of sufficient magnitude to overcome that of the armature, the latter will swing over to the "contacts closed" position, as shown in (b) of fig. 4. Once the change-over has been made, a new magnetic circuit is formed through the core and armature, and the two fluxes are in the same direction. The holding-in force is thus increased by that due to the armature flux.

SERVICING

15. Unless a relay proves to be faulty, or worn parts require renewal, no dismantling is necessary and servicing is confined to a visual examination of the assembly and of the contents of the case units. In particular, the contact tips should be checked for signs of pitting or burning.

Setting and testing procedure

16. Where Type LA relays are incorporated in control equipments, the servicing procedures for these equipments include instructions for the functional testing and setting of the relays in relation to the operation of the unit as a whole.

17. An individual relay, or one which has been repaired, should be set and tested to the limits quoted in the chapter in A.P.4343C which covers that particular relay. The setting procedure, described in the following paragraphs, involves the adjustment of the eccentric wheels and the eccentric pin. These adjustments may be effected by means of the cam setting tool (fig. 5). The pecker end of this tool is for setting

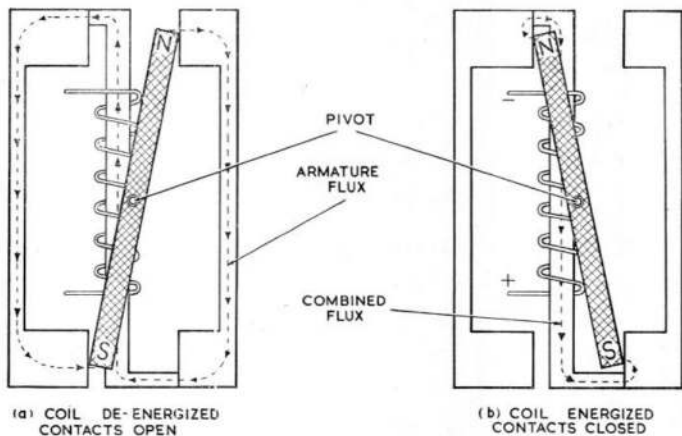


Fig. 4. Magnetic circuits

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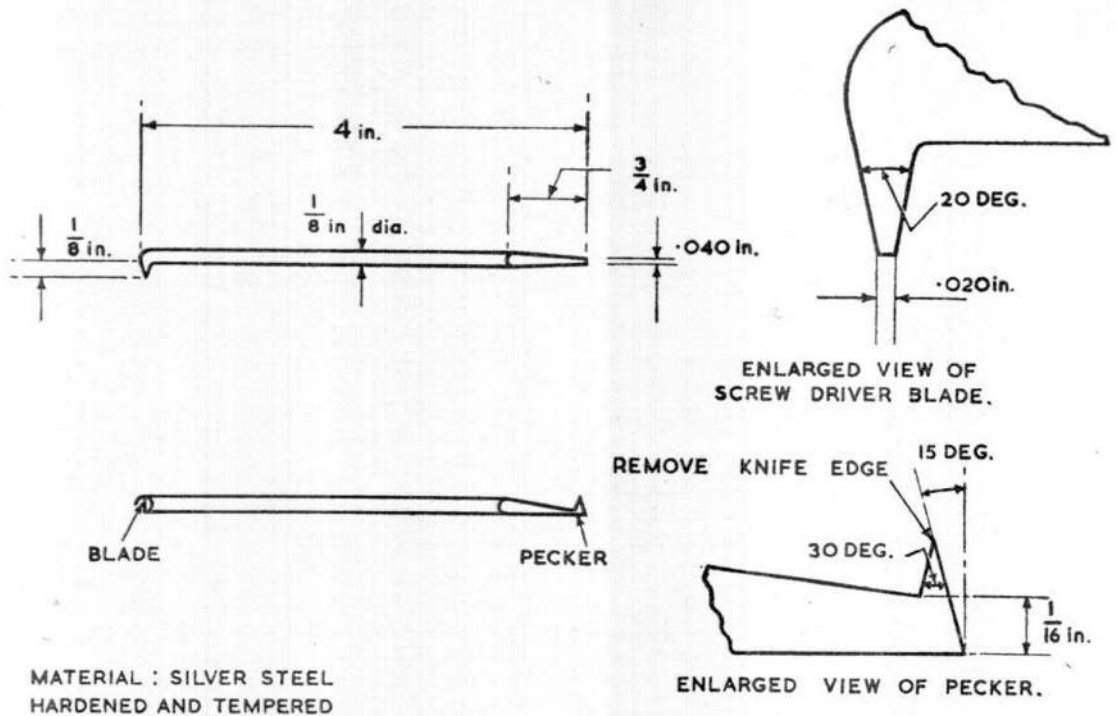


Fig. 5. Cam setting tool

the knurled wheels and the blade end for setting the eccentric pin.

Note . . .

It is important that cam wheels should be adjusted in one direction of rotation only, i.e., clockwise when the cam is viewed from the rear of its supporting pillar. If the desired position is overshoot, the cam should be rotated further in the same direction, and not reversed, since this may cause the spring clips to become loose.

18. When setting twin case unit relays, it will be found that the adjustment of one armature will have some effect on the settings of the other case unit. This is because the frame portion of the magnetic circuit is common to both units. The difficulty can be overcome by setting the units in the order in which they operate, and by arranging that the second unit does not operate while the first is being set. For example, if the pick-up voltages are 10 volts for one unit and 20 volts for the other, set the armature eccentric wheel of the 20-volt unit to its position of maximum pick-up voltage, and then adjust the 10-volt unit to its required setting. Then set the 20-volt unit, and when this has been

completed, re-check the 10-volt unit. Always check both units after making any adjustment to either one.

Coil resistance

19. Measure the resistance of each coil to ensure that, corrected to 20 deg. C., it is within the range specified for the particular relay.

Settings

20. Adjust the relay to obtain the specified pick-up and drop-off limits according to the following procedure:—

- (1) Keeping the moving contact clear of the armature peg, adjust the armature eccentric wheel until the pick-up value is up to 10 per cent lower than the specified lower limit.
- (2) Adjust the moving contact cam wheel until the back face of the contact is bearing on the armature peg with sufficient pressure to bring the pick-up value within the limits.
- (3) Set the eccentric pin to give minimum contact gap. Then adjust the fixed contact by means of its cam wheel so that the back face of the fixed contact spring is just touching the eccentric pin. This condition

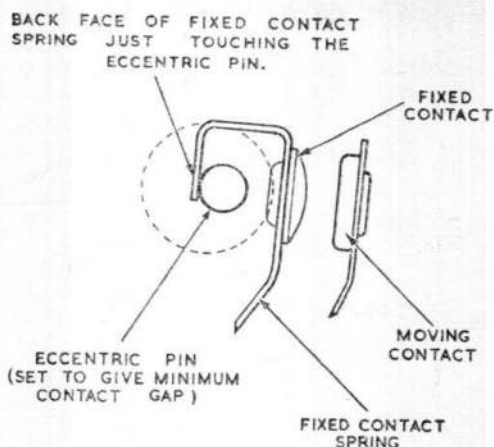


Fig. 6. Initial setting of fixed contact

is illustrated in fig. 6. Note that the position of the screwdriver slot in the head of the pin may vary in relation to the eccentric position, and it should not therefore be used as a guide.

(4) Adjust the eccentric pin to give as large a contact gap as possible without causing the drop-off value to move outside its specified range.

(5) Check that when the relay is operated at its minimum pick-up voltage the fixed contact is deflected firmly against the eccentric pin. If the deflection is insufficient or the contacts merely touch, the fixed contact spring pressure is too high and should be reduced by re-adjusting the fixed contact cam wheel. It is then necessary to re-set the drop-off value by adjusting the eccentric pin, and then again to check the contact deflection.

(6) Gradually reduce the supply voltage and check that the contacts part cleanly when drop-off occurs. If the contacts move to the "contacts touching" position before finally parting, the fixed contact pressure is too low and should be increased by adjusting the fixed contact cam wheel. The drop-off value must then be re-set by means of the eccentric pin, and the contact action during both pick-up and drop-off again checked.

(7) If difficulty is experienced in meeting the drop-off limits, the armature may be biased slightly towards the "contacts open" position by twisting its top suspension cap in a clockwise direction. This should be done with

extreme care as a barely perceptible movement is sufficient. The relay must then be completely re-set. This adjustment is not possible with the pivoted type of armature.

Notes on relay adjustment

21. Relays are usually defective in that the pick-up voltage is high. Always before adjustment, first relieve the pressure between the moving contact spring and the armature. Then use the armature adjustment to obtain the required pick-up voltage and finally re-adjust the moving contact to just touch the armature. If the armature bearing is tight, the relay should be rejected and returned as unserviceable.

22. Under no circumstances should the machine be started up on "no load" when the supply voltage is less than 25 volt, d.c., or, on load. ▶

Insulation resistance

23. Using a standard 250-volt insulation resistance tester (Ref. No. 5G/152), measure the insulation resistance between the coil leads and the frame, and between the contact terminals and the frame. The values obtained should not be less than 10 megohms.

Dismantling

24. Should it be necessary to dismantle a relay for the renewal of worn or faulty components, reference should be made to the exploded view (fig. 2). An instrument screwdriver is required for levering off the transparent cover and for removing the spring clips.

25. Since the relays are polarized, it is important to identify and mark the coil leads so that they may be correctly re-connected. For the same reason, the polarity of the

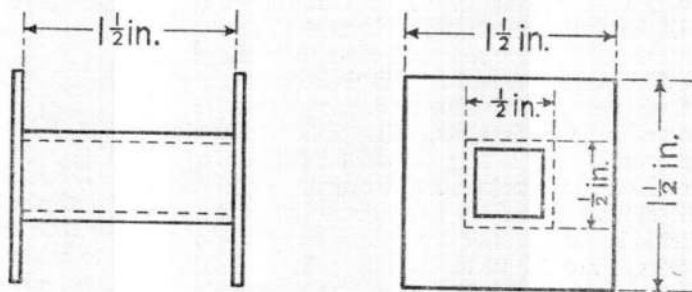


Fig. 7. Former of magnetizing coil

armature in the case unit must be noted, the *north* pole of an armature being marked with a spot of white paint.

Armature magnetization

26. If a new armature requires to be fitted, it must first be magnetized. For this operation a magnetizing coil should be manufactured:—

- (1) Construct a former of a non-magnetic material (e.g., brass) according to fig. 7.
- (2) Wind 500 turns of 20 S.W.G. (0.036 in. diameter) enamelled copper wire in layers on the former. If the former is constructed of metal it must be suitably insulated from the winding.
- (3) Connect the coil, through a switch, to a 24-volt battery or to a 24-volt, 20 amp. supply, and determine the coil polarity.
- (4) Determine the desired polarity of the armature and insert it into the magnetizing coil the corresponding way round.
- (5) Then close and open the switch three times, leaving it in the closed position for about 1 sec. each time. Do not leave the switch closed as the coil will overheat.
- (6) The armature will now be magnetized, and its north pole should be marked with a spot of white paint.

Assembly

27. When fitting the armature, ensure that it is inserted squarely into its housing. Take care to avoid damaging the torsion strip on the suspension type. When positioned, the

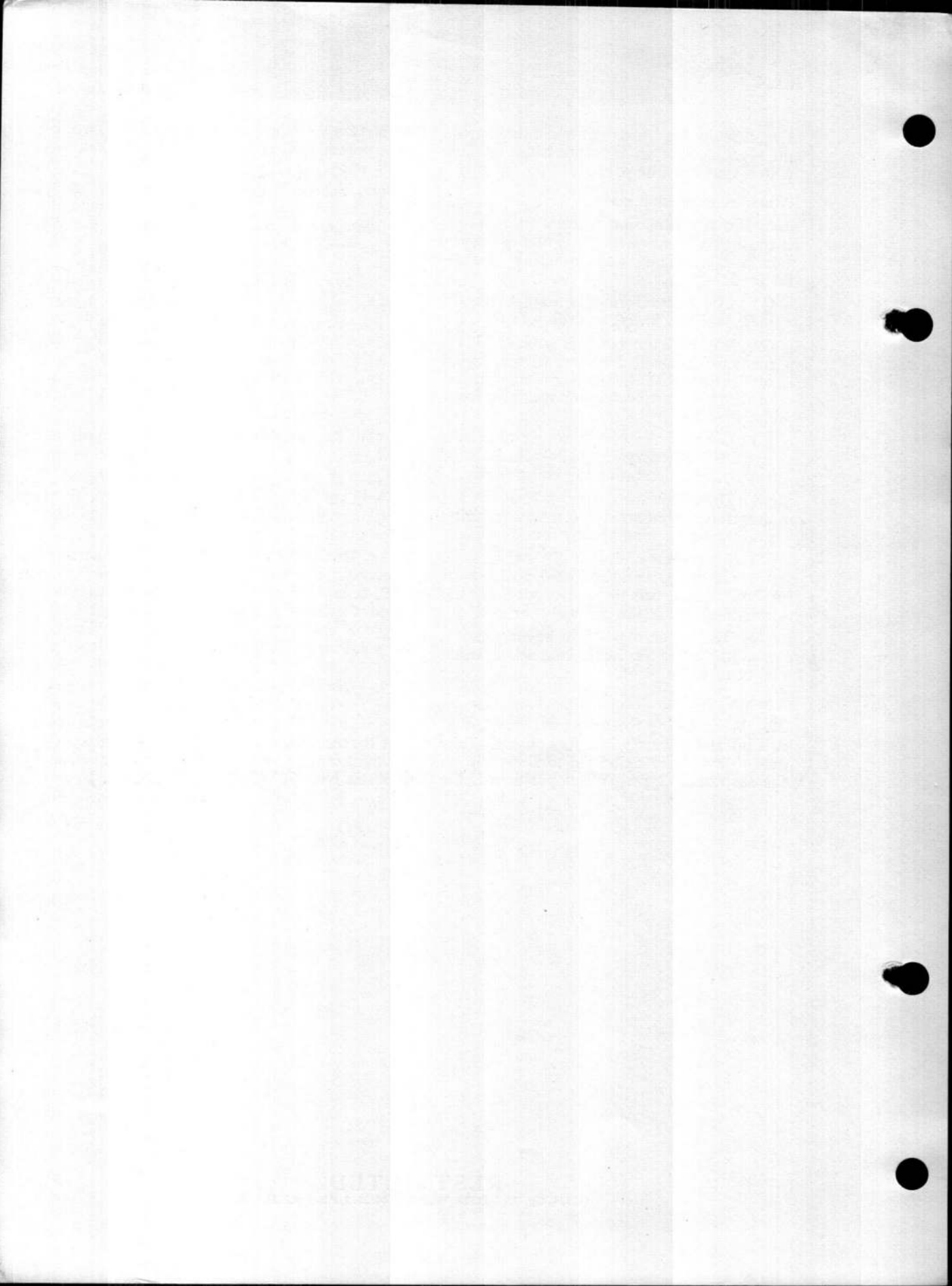
armature must be centrally disposed between the pole pieces, and this is to be checked as follows:—

- (1) Set both the eccentric pin and the armature eccentric wheel to a position allowing maximum swing of the armature.
- (2) Hold the armature firmly in the "contacts open" position, and measure the gap, if any, between each armature tip and the adjacent pole face. The mean of the two gap measurements must not exceed 0.010 in., and also the two gaps must not differ by more than 0.010 in., i.e., the worst setting permissible is a 0.005 in. gap at one end, and a 0.015 in. gap at the other.
- (3) Repeat this check with the armature held in the "contacts closed" position.
- (4) If the gaps are outside the limits, adjustments should be made by bending the appropriate locating ears as required.

28. During the assembly, the csk/hd. screws securing the case unit to the frame, the 10 B.A. nuts securing the knurled wheels, and the bearing pivot screw of the pivoted type of armature, must be thinly coated with special fungicide varnish (Ref. No. 33B/937).

29. Do not over-tighten the case unit securing screws as there is a risk of cracking the moulding. The insulation discs on the heads of the terminal securing screws and the transparent cover should be sealed with adhesive, ◀ Bostik No. 1768 (Ref. No. 33C/1387). ▶

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