Chapter 2

SERVICING OF ELECTRICAL CONTACTS

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LIST OF ILLUSTRATIONS

Introduction

1. This chapter gives guidance on the servicing of electrical contacts as fitted to various types of airborne switchgear. In general, the information will be applicable to cut-outs and circuit breakers, as described in A.P.4343B, Vol. 1, Book 2, Sect. 10 and 11; manually and mechanically operated switches, as described in A.P.4343C, Vol. 1, Book 1, Sect. 1 and 2; and most types of relay, contactor and magnetic switch as described in A.P.4343C, Vol. 1, Book 2, Sect. 3 and Book 4, Sect. 4, also in Book 3, Sect. 7 and 8, and Sect. 10 and 11. The information may also be appropriate to other types of comparable equipment; it will not necessarily apply, however, to certain types of heavy-duty ground equipment, nor to sealed light-current miniature type relays such as are used in radio equipment and elsewhere.

DESCRIPTION

Contact rating

2. Electrical contacts in such components as those mentioned in para. 1 may be considered under three main categories, according to their current-carrying capacity, i.e.,

(1) Light duty ... up to 20 amp. (approx.)

(2) Medium duty 20–60 amp. (approx.)

(3) Heavy duty... ... over 60 amp.

The servicing of such contacts will be directly related to the current carrying capacity, and will also be influenced by such factors as the contact material, and the application of the relay or circuit breaker concerned; for instance, a certain amount of wear on heavy duty contacts would not seriously affect the continued safe performance of a short-rated component, but would not be permissible in a continuously rated main circuit breaker; it would not be tolerated on light-duty contacts, where little sign of wear should be present.

Contact materials

3. It is general practice for the mating contact surfaces to be of a material distinct from the contact carrier, and related to the current carrying capacity. A common contact material is silver, which may be alloyed by a sintering process with nickel, cadmium, graphite, tungsten etc. to give hardness; these materials are used where the contacts are subjected to considerable mechanical wear due to repeated make and break operations, as in contactors.

4. With light-duty contacts, the material must be such that they cannot oxidize to a degree that the current cannot penetrate. For this reason precious metals such as palladium, gold and platinum are used for carrying very low currents, and in addition the relays are frequently hermetically sealed to keep out the atmosphere, prevent the ingress of dust particles and also minimize the possibility of flash-over at high altitudes. In some relays, the coil is sealed off from the contacts, since organic vapours given off from the coil are liable to attack the contacts under certain conditions.

5. In fig. 1 is illustrated one set of contacts showing progressive stages of wear. These particular contacts were fitted to a short-rated, heavy-duty (150 amp. at 120 volts) reversing contactor, with contacts of silver tungsten. This is a particularly hard sintered alloy, and tends to show considerable discoloration as a result of this particular load.

6. To help ensure that effective contact, i.e., of relatively no resistance, is made, either one or both of the contacts is domed. The contacts have also spring loading and a follow through mechanism, i.e., a certain further movement after the contacts first make to ensure a minimum prescribed value of contact loading. This allows for a certain amount of contact wear, while still maintaining adequate contact load.

7. In certain units the contacts have a wiping action, which not only assists in effective contact by disrupting surface films, but in addition tends to prevent the formation of "pips", i.e., transfer of material from one contact to another. In repetitive switch operation this can still occur, even with a wiping action, and is particularly noticeable in polarized contacts, where the soft metal, e.g., silver in a silver alloy, tends to be transferred from the anode, or positive contact, to the cathode, or negative contact, where it becomes built up in a series of "pips". In severe instances this leads to a "hill and crater" effect; pronounced "pips" should be removed, but it is not essential to attempt to restore the contact completely to its original profile if tests are satisfactory.

SERVICING

8. When servicing electrical switchgear, it is not always necessary nor even desirable to clean the contacts, if tests prove that effective contact is being made between the mating

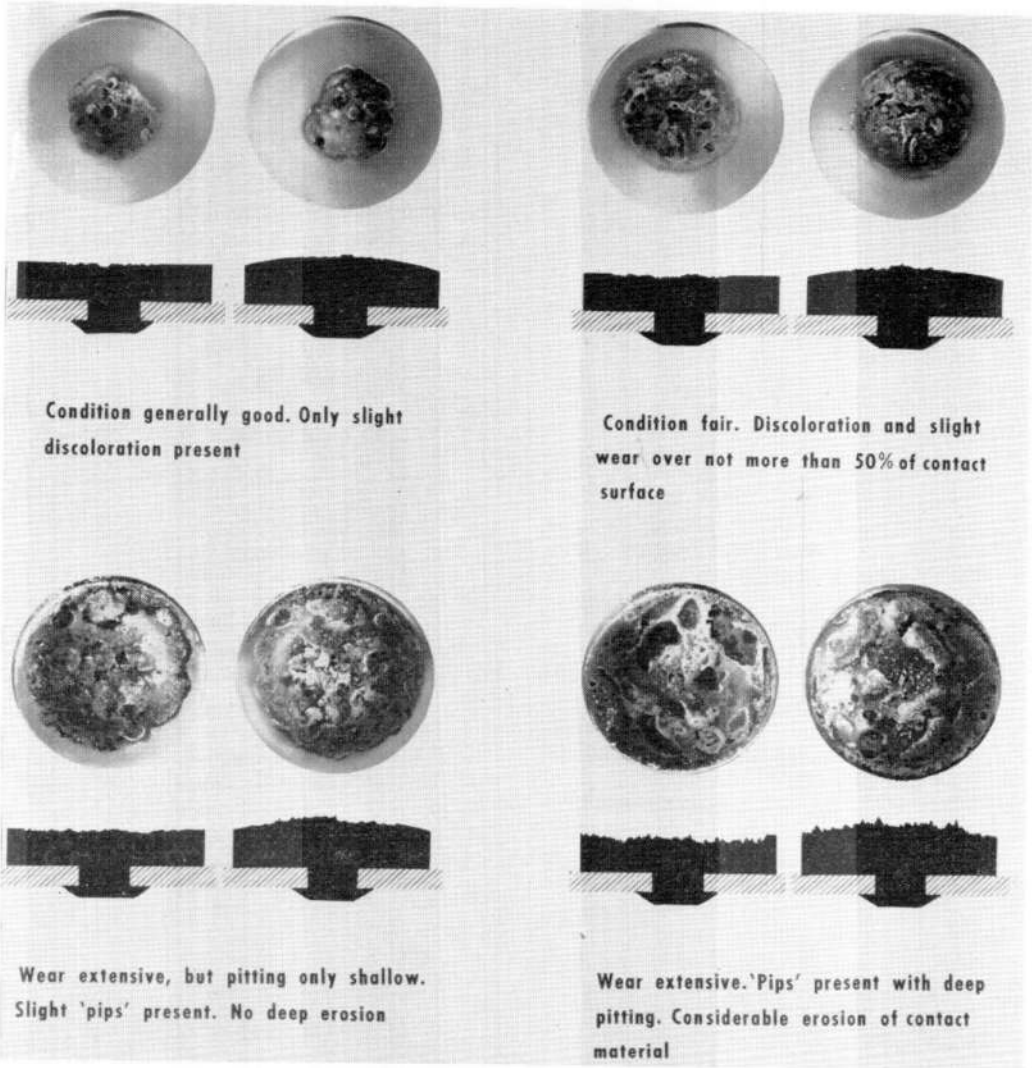

Fig. 1. Stages of contact wear

surfaces. As shown in fig. 1, slight discoloration and even slight superficial pitting is permissible on medium and heavy-duty contacts; on light-duty contacts, however, performance is likely to be affected by even minimum contact wear. Where pitting and discoloration are extensive but still superficial, cleaning may be necessary for continued satisfactory operation of the contacts. Contacts should be rejected in which deep pitting is present, such as to reduce noticeably the depth of contact material.

Millivolt drop measurement

9. The measurement of millivolt drop across a pair of closed contacts with a fixed current flowing is a satisfactory way of assessing the state of the contacts. The resistance of a pair of contacts will increase with use, after a possible initial decrease due to bedding-in action; this increase can also be expected with contacts which have a wiping action, although such contacts have slight self-cleaning properties. The measurement of millivolt drop, giving an indication of contact

resistance, therefore provides a useful guide to the state of serviceability of the contacts. Unless care is taken, however, the results can be misleading and the following points should be noted.

Method of measurement

10. It is essential to differentiate between measurements made directly across contacts, and those made across terminals. In the latter instance the millivolt drop in the connecting leads between the terminals and the contacts will be included. It is normally preferable for the measurements to be across the appropriate terminals; in future, individual chapters will state clearly where it is intended that the measurement should be taken, and the millivolt drop figure will be given accordingly.

Millivolt drop figures

11. Since a greater depth of servicing is now being undertaken, the millivolt drop figures quoted in future chapters will be those laid down by the component manufacturer, and not, as in certain previous instances, a higher concession figure.

Contact pressure and " follow through "

12. The value of the millivolt drop across a pair of contacts depends to some extent on the contact spring pressure and the amount of "follow through". As the contacts wear, the amount of contact load and "follow through" will decrease slightly, causing the millivolt drop across the contacts to increase. Where applicable the relevant chapters will call for measurement of the contact load, and, where possible, "follow through", with adjustment if necessary.

Contact cleaning]

13. As stated previously, contacts should be left untouched if tests prove that they are functioning satisfactorily. If, however, it is found necessary to effect a certain amount of contact cleaning, it is essential that the unit should be subsequently thoroughly cleaned, preferably by air blast, to remove any particles of contact material.

Contact cleaning tools

14. The following tools (for R.A.F. only) are available for cleaning contacts:—

(1) Cleaners, contact (Ref. No. 1A/139, 140, 141). These are spatulas coated with diamond dust, and are suitable for cleaning small contacts.

(2) Brushes, commutator cleaning (Ref. No. 1A/3947). These are used for the larger contacts where the contacts can be completely separated, leaving the whole surface available for cleaning.

15. If a file or steel brush is used, it is most important that it should be reserved exclusively for contact cleaning. Otherwise it is liable to become impregnated with particles of foreign matter which would then be embedded in the contact faces.