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FAULT CARRYING CAPACITY - SANTON 200A ADMIRALTY TYPE ROTARY SWITCH, (U)

ADMIRALTY ENGINEERING LAB WEST DRAYTON (UNITED ...

25 SEP 1964

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Report No. 2423/3776/1

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ELECTRICAL DEPARTMENT

ADMIRALTY ENGINEERING LABORATORY

WEST DRAYTON, MIDDLESEX

FAULT CARRYING CAPACITY - SANTON 2000 ADMIRALTY TYPE ROTARY SWITCH.

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ELECTRICAL DEPARTMENT,

ADMIRALTY ENGINEERING LABORATORY,

WEST DRAYTON, MIDDX.

FAULT CARRYING CAPACITY - SANTON 200A ADMIRALTY TYPE ROTARY SWITCH.

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SUMMARY

An investigation was made into the ability of a 200A Triple Pole Santon Rotary Switch, Admiralty Type. to carry heavy fault currents until they were cleared by the overload release of a feeder breaker. The tests described in this report are of the nature of a 'go' - 'no go' variety, and were made with direct current. The maximum safe current was found to be of the order of 10 000A at 628v D.C. (closing).

No attempt was made to strip and inspect the switch between tests.

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FAULT CARRYING CAPACITY – SANTON 200A TRIPLE POLE ADMIRALTY TYPE SWITCH

1. Introduction

This type of switch is already in use in the service, normal type tests having been carried out under E.I.2989. Tests to explore the capacity of the switch to carry large fault currents, until cleared by a feeder breaker, however, had not been made. This is of greater importance, now that fault levels in ships are higher, and it became necessary to know if these switches need fuse protection. Tests were conducted, using direct current and were witnessed by Mr. S.H. Wardell of V/171/S.

2. Requirements

The maximum time of operation of a feeder breaker was given as 0.25s, and it was required to know the highest current that the switch could be closed on, and carry for this period of time. Tests on a 440V a.c. supply were called for, but heavy current supplies were not available. Direct current was therefore used in accordance with Paragraph 4(d) of the initiating memorandum. An amendment to this clause required d.c. tests to be conducted at a voltage equivalent to the peak a.c. voltage of a 440V a.c. supply. It was also laid down that the switch should be rotated 1000 times in each direction on no load, prior to the current tests.

3. Description of Switch

The Santon 200A Triple Pole Switch is a quick make/quick break, rotary action switch, with self aligning Rotor-mounted silver plated sliding contacts engaging with pairs of spring loaded silver plated fixed contacts. The type used in this investigation had been developed for Admiralty service.

Whilst tests on Santon 200A Triple Pole Rotary Switch Type H2036. HA79 was specifically asked for, this was not possible without unacceptable delay. Instead, tests were carried out on a makers reconditioned 200A Triple Pole Switch Type H2026 HA10, which happened to be available.

The HA79 and HA10 types of switch are of similar design, differing only in the number of poles, and in the arrangement of contacts.

4. Test Rig

The switch was mounted unenclosed as shown in Fig. 1, and the batteries of the test station were grouped to supply 628V. Connections were made to allow current to flow through the 2 pairs of contacts (2 moving, 2 fixed) in series, which formed one way or "cell" of the switch. Resistances were arranged to give prospective currents of about 5000A, 10 000A, 15 000A and 20 000A, but no inductance was added to the test circuit, and the time constants were of the order of 0.004s. As the time of application was 0.25s, the current rose to the full prospective level in each test. Although not specified in the requirements, it was decided to differentiate between capacity for "through", and for "closing" current. For the former test the switch was closed under open circuit conditions, the fault breaker being closed subsequently to complete the circuit, and remaining closed for 0.25s. For the latter test the fault breaker was initially closed, and the Santon switch was closed by hand (For safety precautions see Fig. 1). The fault breaker was set to open 0.25s after the Santon switch was closed.

......../5.

5. Tests

It was agreed to apply "through current" and "closing current" tests consecutively, at increasing levels of fault current. All switching operations were made in one direction only, namely clockwise. The same pair of contacts were used for the first six tests, since very little damage was sustained up to Test No. 5. Tests 1 to 7 revealed the approximate loads at 628V at which the switch would fail, and the results are listed in Table 1. The condition of the contacts are shown in Fig. 2. Oscillograms of current flowing, against a time base are shown in Figs. 3 and 4. The d.c. equivalent, (628V), of the peak voltage of an a.c. supply at 440V R.M.S. was used. To determine if the application of 440V D.C., i.e. the equivalent to the R.M.S. value, had a less severe effect, at the same current, Test No. 8 was made. Unused contacts were connected for this test, but the switch failed as before, unfortunately no oscillogram was obtained in this case.

6. Results of Through Current Tests

Tests 1,3 and 5 indicated that the switch would carry 15 000A for the required time. with slight pitting of the contacts, which would not prevent normal use. Records shown in Fig. 3(a) (b) and (c) prove that the current was uniform, without arcing. Test No. 7 showed that a current of 20 000A would destroy the contacts. This is backed up by the oscillograms shown in Fig. 3(d) which shows the current decreasing as the contacts heat up, followed, after an interval of 0.16s, by violent arcing.

7. Results of Closing Current Tests

Tests 2 and 4 indicate that the switch could be closed on a prospective fault current of 10 000A, and carry this consistently for the required time. This is confirmed by oscillograms shown in Fig. 4(a) and (b). In Test No. 6, the switch was closed on a prospective current of 15 000A, and arcing occurred which practically destroyed the contacts. Fig. 4(c) shows a slight decrease of current as the contacts became hot, followed, after 0.09s, by violent arcing.

8. Analysis of Results

No sign of mechanical parting, due to magnetic effect, of the contacts was apparent from the oscillograms taken when the switch carried current successfully for 0.25s, Fig. 3(a) (b) and (c). Fig. 4(a) and (b). The two cases in which the switch failed, show a gradual decrease of current until the contacts began to arc, probably as a result of developing hot spots, Fig. 3 (d) and Fig. 4(c). This condition may have been accelerated in the second case when the switch was closed on the fault current, by initial pitting of the contacts. If failure of the contacts was due solely to heating, this effect would be the same for a given current and conditions, either a.c. or d.c. It would be advisable to verify this by some comparative a.c. tests, and these will be undertaken as soon as plant is available.

9. Conclusions

From the limited number of tests possible, with only one switch available, it would appear that,

(a) The 200A Santon Switch Type H2026 HA10 will carry a through current of 15 000A for 0.25s, without serious damage, but 20 000A applied for the same period will destroy the contacts.

...../(b)

(b) The maximum current which the switch can be closed on, and carry for this period, without damage is 10 000A.

(c) The incidence of arcing, following heating of the contacts, determined the fault carrying capacity of the switch, and this should be the same for a.c. and d.c; but tests with a.c. may be necessary to investigate any other effects.

(d) Where fault levels in excess of 10 000A are possible, fuse protection for these 200A Rotary Switches is deemed necessary.

TABLE 1

FAULT CARRYING CAPACITY - SANTON 200A ADMIRALTY TYPE SWITCH

List of tests

Test No.	Supply (V)	Type of Test	Prospective Current (A)	Result
1	628	Through current	5440	No effect
2	"	Make	"	" "
3	"	Through current	10 000	Slight sticking of contacts.
4	"	Make	"	" " "
5	"	Through current	15 800	Slight effort needed to separate contacts which were quite free afterwards
6	"	Make	"	Contacts burst completely away, flash over to Earth.
7	"	Through current	19 700	Contacts practically burnt away.
8	440	Make	14 950	" " "

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FIG.1.

FAULT CARRYING CAPACITY - SANTON 200A ADMIRALTY TYPE SWITCH.

TEST RIG.

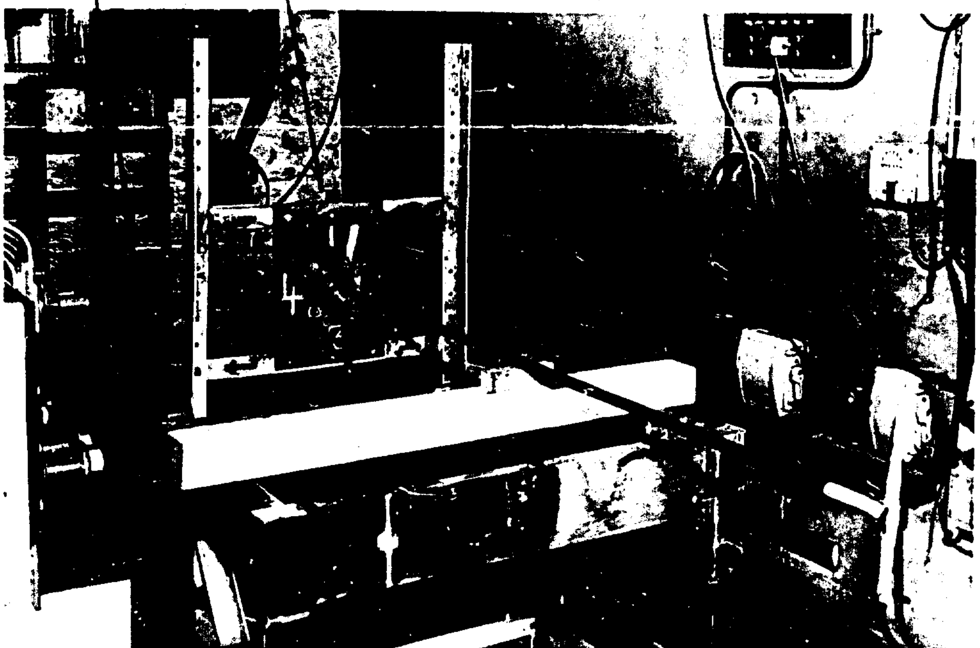

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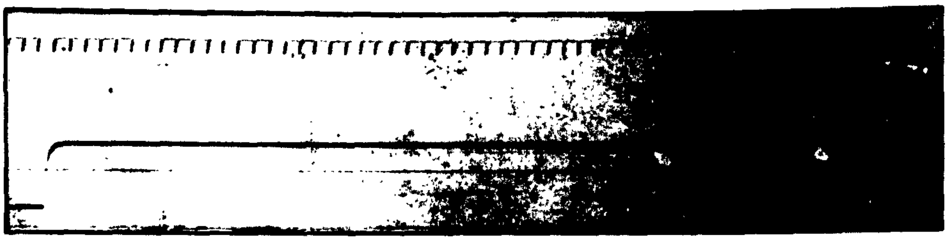
FIG. 3.

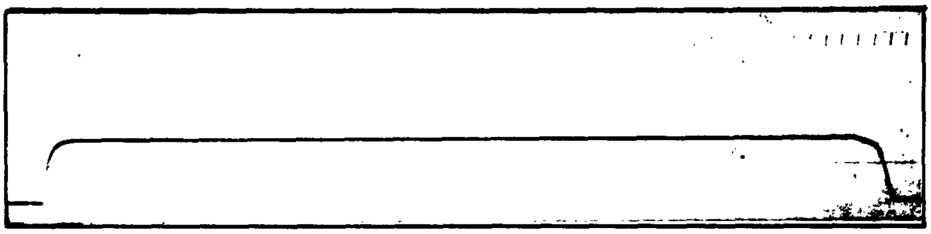
FAULT CARRYING CAPACITY - SANTON 200A ADMIRALTY TYPE SWITCH.

OSCILLOGRAMS OF CURRENT

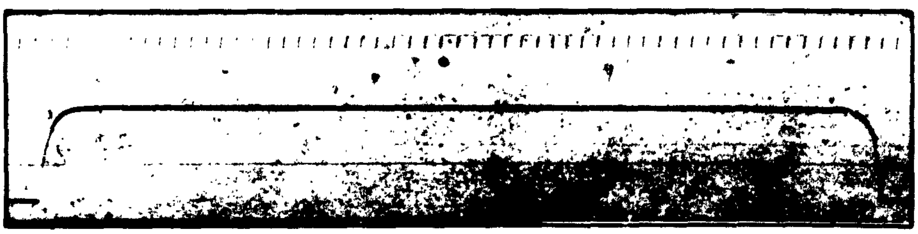
SWITCH CARRYING FAULT CURRENT FOR 0·25s.



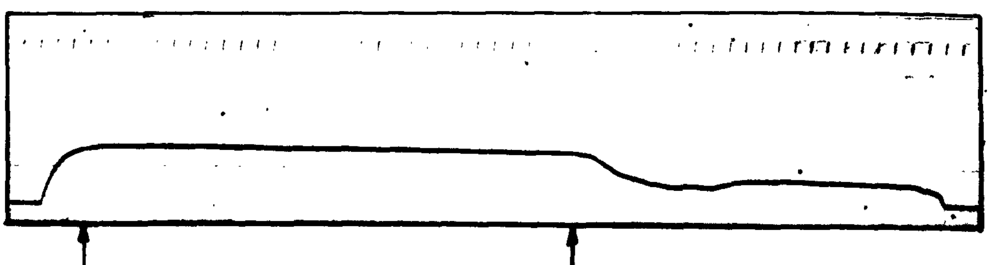
(a) 5440 A



(b) 10,000 A



(c) 15,800 A



(d) 19,700 A ←----0·16s-------→ 14,700 A

TIME INTERVAL 0·005s.

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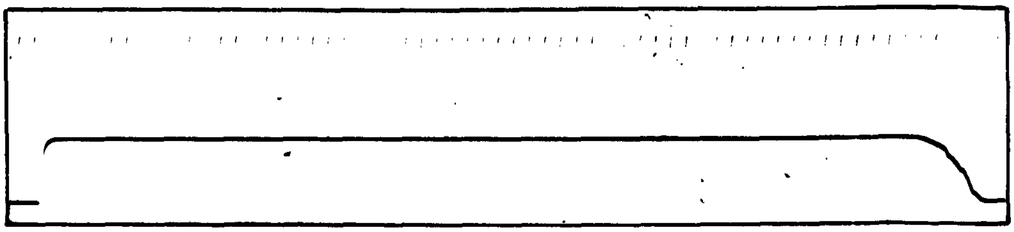
FIG. 4.

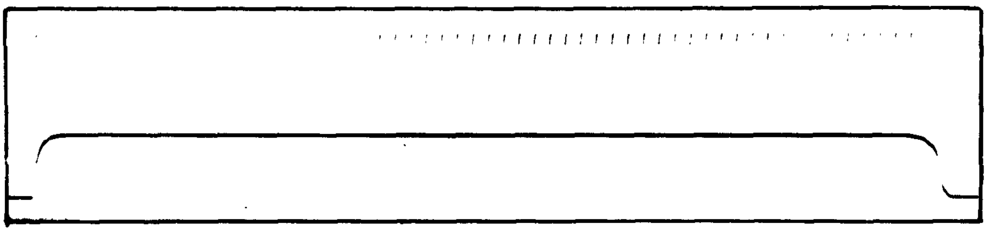
FAULT CARRYING CAPACITY – SANTON 200A ADMIRALTY TYPE SWITCH.

OSCILLOGRAMS OF CURRENT.

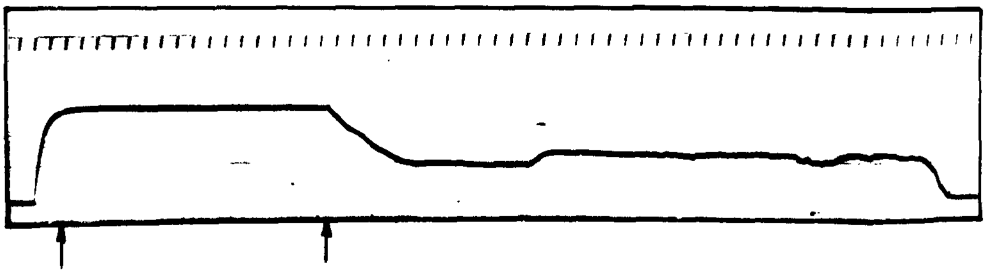
SWITCH CLOSING ON, AND CARRYING FAULT CURRENT FOR 0·25 s.



(a) 5440A



(b) 10,000A



(c) 15,800A ← 0·09s → 15,700A

TIME INTERVAL 0·005s

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