

NRL Report No. B-1545
Test on General Alarm Contact Maker, Type K, Class I.
Bendix Aviation Corporation, Exhibitor.

FR-1545

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DATE 20 July 1939

SUBJECT

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Bendix Aviation Corporation, Exhibitor.



BY

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AUTHORIZATION FOR TEST

1. This problem was authorized by reference (a) and other references pertinent to this problem are listed as references (b) and (c).

Reference: (a) BuEng.ltr. S62-2/L5 (6-21-Ds) of 1 July 1939.
(b) Specification 17C16 (INT) of 1 February 1939.
(c) Bendix Drawing CAL-5144-1, BuEng. File No. DD-421-S65-505-Alt. 3.

OBJECT OF TEST

2. The object of this test was to determine the conformance of the sample contact maker with the specification, reference (b), and its suitability for Naval use.

ABSTRACT OF TEST

3. The sample contact maker was set up at this Laboratory in suitable test circuits where its performance was carefully observed for compliance with the requirements. An inspection of the sample to determine compliance in the matter of materials, design, and workmanship, concluded the test.

CONCLUSIONS

(a) The subject contact maker was in general satisfactory throughout the test following minor repairs. It was necessary to add a rivet to the angular extensions at the lower part of the relay armature to maintain correct alignment of the armature and to elongate the hinge pin slots in the levers linking the armature and the counter-weight. The screws securing the motor to its base loosened under shock and had to be tightened. Larger screws provided with lockwashers should be used.

(b) The contacts showed no excessive pitting or burning at the end of the test.

(c) An inspection of the contact maker at the conclusion of all tests disclosed that the center laminated springs supporting a movable contact, had broken. In addition, some of the thinner laminations of the remaining springs were found broken.

(d) It was also noted that no provision has been incorporated to prevent radio interference.

(e) The sample contact maker checks with the manufacturer's drawing, reference (c), except that the specified zinc plating was omitted from many of the parts. The mounting panel, piece 3, shown in the sectional views as of one piece, is of two pieces of sheet steel, totaling the thickness shown.

RECOMMENDATIONS

(a) In view of the fact that the laminated contact springs were found fractured at the conclusion of the test, it is believed that the approval of the contact maker should be withheld pending a satisfactory endurance test of the relay. The remainder of the contact maker is of good design, exceptionally rugged, and of excellent workmanship.

(b) In the event the Bureau should require an additional test of the contact maker, it is suggested that the manufacturer submit only a complete set of relay contacts, modified to correct the defects of the present ones.

DESCRIPTION OF MATERIAL UNDER TEST

4. This contact maker is designed for 115 volts, 60 cycle operation. Its mechanism is mounted on a sheet steel panel 11-1/4" x 15-1/4" x 3/8" and protected by a steel cover supported on four studs. The cover is secured by four knurled nuts and is easily removed.

5. The principal parts of the mechanism are the solenoid operated relay, a motor-driven interrupter, and a limit switch.

6. The motor is manufactured by the Bodine Electric Company and is of the self-starting synchronous type, designed for 115 volts, 60 cycles, and rated 1/75 horse power, 1800 r.p.m. A built-in worm gear reduction unit reduces the work shaft speed to 30 r.p.m.

7. Mounted on the motor work shaft is a plate cam which lifts a ball bearing follower three times for each revolution. The lever arm to which the follower is attached carries a spring mounted contact which, with its associated stationary contact, is in series with the operating coil of the contactor.

8. Another plate cam having two drops is driven by the motor through an external worm and worm wheel at a speed of one r.p.m. and operates two spring mounted contacts by means of a ball bearing follower and lever. When the motor is started, the follower rises and closes two sets of contacts which remain closed until the cam has completed one-half revolution.

9. Neither cam is secured to its driving shaft but receives its motion through a pin on an adjacent disc which engages a slot in the cam. The size and shape of the slot are such that, when the follower reaches a depression in the cam, the cam will advance faster than its driving shaft, due to the pressure of the follower spring, and allow a quick break at the contacts.

10. The operation of the unit is as follows: When a single pole external momentary contactor is closed, the motor circuit is completed and the motor begins to rotate. After several seconds, the follower of the one-half minute cam closes two sets of contacts which remain closed for one-half minute. One set shunts the external momentary contactor so that the motor will continue to run after the contactor is released. The other set of contacts completes the circuit between the operating coil of the relay and the 90 impulse per minute interrupter.

11. When the motor starts to rotate, the 30 r.p.m. cam causes its contacts to close at the rate of 90 interruptions per minute, but the relay does not operate until the one-half r.p.m. cam, previously described, closes its contacts. The purpose of this feature is that the relay cannot remain closed at the end of the coded cycle even though the 90 per minute contacts remain in the closed position due to drifting of the motor after it is deenergized.

12. The relay employed is of the alternating current solenoid type and employs vertical motion with combined spring and gravity return for the armature. It was designed as a three-pole relay but the contacts have been connected in parallel to form a 115-volt single-pole relay. It is rated 90 amperes at 30 per cent power factor, 60 cycles, alternating current. It employs two fixed and two spring mounted movable contacts for each pole, making a total of 12 contacts. The silver contacts are 5/16" in diameter and the movable contacts have convex surfaces.

13. Further details are shown by photographs, enclosures (A) and (B), and drawing, reference (c).

METHOD OF TEST

14. The voltage drop across the contacts was first measured at rated load.

15. Then the contact maker was installed in a temperature controlled compartment, connected in a circuit adjusted to rated load, and tested for endurance. The endurance test was conducted in two parts, the first at 0°C. and the latter at 70°C. It was then operated for 48 hours at one operational cycle per minute. Each cycle consisted of operating the contact maker with coded operation for 30 seconds, with primary contacts closed for 15 seconds, and "off" for 15 seconds. During the final hour of the test, the relay was operated at 90 contacts per minute.

16. The temperature rise of the contacts was measured with a thermocouple during the endurance tests.

17. The coded cycle of the contact maker was checked for accuracy.

18. The contact maker was then tested for shock integrity as outlined under the specification and checked for satisfactory operation when supplied with current at over and under voltage and frequency.

19. The insulation resistance and dielectric tests were then made and the contact maker was examined for quality of workmanship and materials and checked against the drawing.

RESULTS OF TEST

20. The results obtained when the contact maker was tested in the order required, were as follows:

<u>Specification Requirements</u>	<u>Test Values</u>
Voltage: 115 volts.	115 volts.
Frequency: 60 cycles.	60 cycles.
Current consumption of motor: Not specified.	1.04 amperes.

Specification Requirements

Test Values

Current consumption of relay solenoid:
Not specified.

0.45 amperes.

Rated load of relay: 30 amperes,
30% P.F. at 115 volts.

Tested with load of 30 amperes,
30% P.F. at 115 volts.

Voltage drop: Shall not exceed 10
millivolts at rated load.

6 millivolts at start of test.

Endurance: Shall operate for 24 hours
at an ambient temperature of 0°C. and
24 hours at 70°C. while operating at
one cycle per minute. Each cycle to
consist of coded operation for 30
seconds, primary contacts closed for
15 seconds, "off" for 15 seconds.
During the final hour the contacts
shall be operated at a rate of 90 times
per minute.

Complied after repair to relay
armature. See "Conclusions."
Maximum temperature rise during
all but last hour of test;
contacts 15.2°C. by thermo-
couple; solenoid 17.57°C. by
resistance method.

Temperature rise: No part of contact
maker shall exceed 30°C. above
70°C. ambient during the last hour
of the endurance test.

Contacts 17.75°C. by thermo-
couple; solenoid 23.45°C. by
resistance method.

Temperature rise of contacts following
endurance: Shall not exceed 15°C.
above 70°C. ambient when held closed
for one hour with rated load.

Contacts 11.1°C. by thermo-
couple; solenoid 13.7°C. by
resistance method.

Accuracy test: The coded cycle shall
be 30 seconds of equal make and
break periods.

Complied; 35 seconds "on";
31 seconds "off."

Operation at voltage and frequency
variations: Shall meet all require-
ments at $\pm 10\%$ voltage and ± 5 cycles
frequency.

Complied.

Inclination: Shall operate satis-
factorily in all planes 45 degrees
to the vertical.

Complied.

Dielectric test: Shall withstand 1500
volts, 60 cycles, for a period of
one minute.

Complied.

Specification Requirements

Test Values

Insulation resistance: Shall be not less than 10 megohms at 500 volts.	Greater than 100 megohms.
Shock integrity: Shall operate satisfactorily under conditions given in specification paragraph F-2e.	Complied.
Wiring: Shall be in accordance with Specification 15C1.	Complied.
Terminal block: Shall be of phenolic material equipped with 9-S-1841-L terminals.	Complied.
Case: Shall be of splash-proof construction, formed of sheet steel, and provided with metal bracket at base of case for terminal tubes.	Complied.
Additional control circuit for gas alarm: Shall be provided.	Complied.
Weight: Not specified.	43-1/2 pounds.
Dimensions: Not specified.	15-1/4" x 11-1/4" x 6-1/2".
Provision to prevent radiation of radio frequency energy: Shall be incorporated if specifically required by requisition or contract.	*None incorporated.

* Denotes failure to comply with the specifications.

CONCLUSIONS

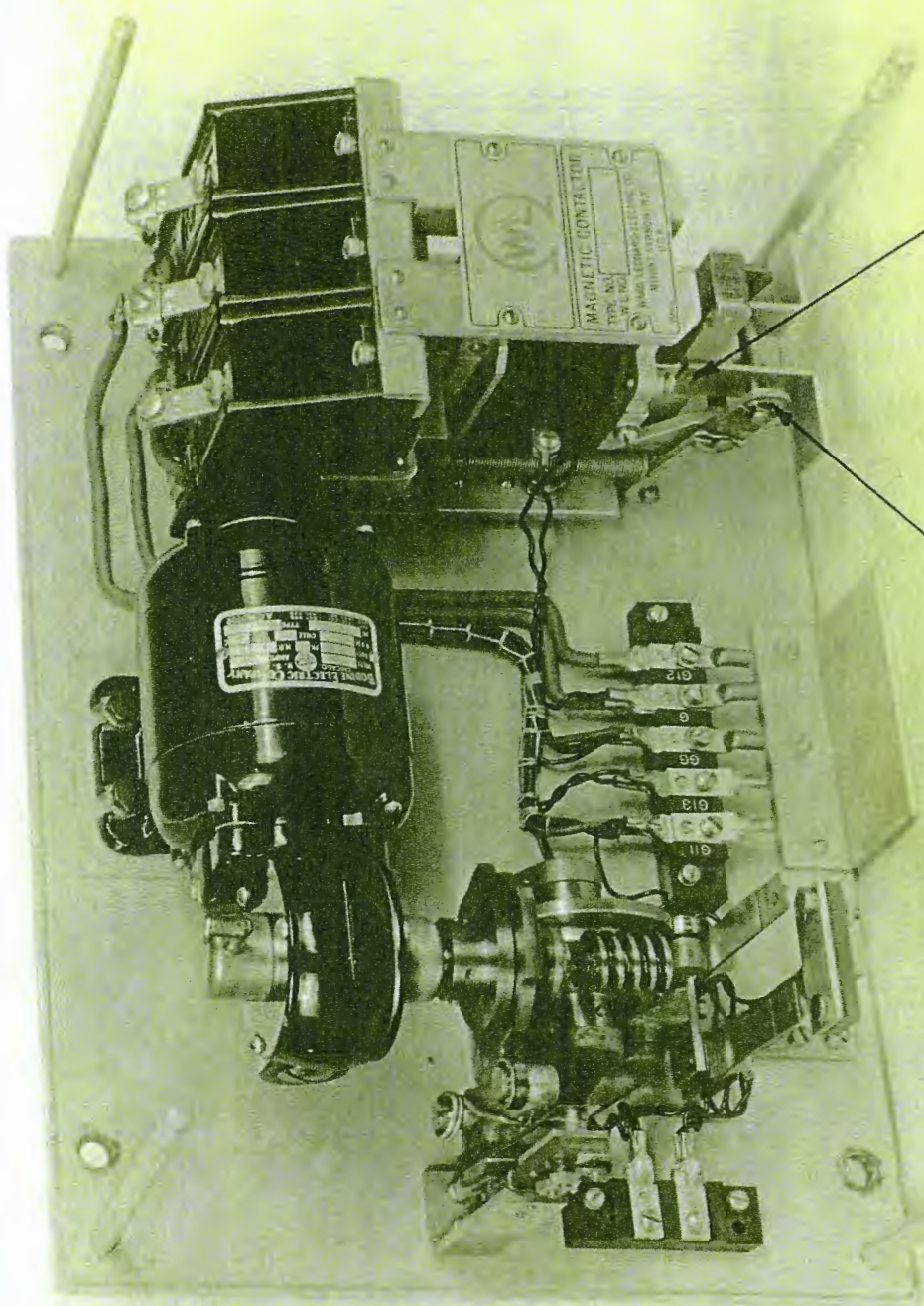
21. The subject contact maker was in general satisfactory throughout the test following minor repairs. It was necessary to add a rivet to the angular extensions at the lower part of the relay armature to maintain correct alignment of the armature and to elongate the hinge pin slots in the levers linking the armature and the counterweight. The screws securing the motor to its base loosened under shock and had to be tightened. Larger screws provided with lockwashers should be used.

22. The contacts showed no excessive pitting or burning at the end of the test.

23. An inspection of the contact maker at the conclusion of all tests disclosed that the center laminated springs supporting a movable contact had been broken. In addition, some of the thinner laminations of the remaining springs were found broken.

24. It was also noted that no provision has been incorporated to prevent radio interference.

25. The sample contact maker checks with the manufacturer's drawing, reference (c), except that the specified zinc plating was omitted from many of the parts. The mounting panel, piece 3, shown in the sectional views as of one piece, is of two pieces of sheet steel, totaling the thickness shown.



Slot increased.

Pin added.