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SUBJECT

Contact Maker, Type N

(Local Switching)

Submitted by

United Electric Controls Company

NAVAL RESEARCH LABORATORY

BELLEVUE, D. C.

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NRL Report No. B-2001

NAVY DEPARTMENT

Report of Test

on

Contact Maker, Type N (Local Switching)

Submitted by

United Electric Controls Company  
Boston, Massachusetts

NAVAL RESEARCH LABORATORY  
ANACOSTIA STATION  
WASHINGTON, D. C.

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1942.

Date of Test: January - February 1943:

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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).

- References: (a) BuShips Ltr. S62-2(350) of 29 October 1942.  
(b) Specification 17C16 of 1 August 1941, 17C16a of 2 March 1942 and Amendment 2 of 1 August 1942.  
(c) United Electric Controls Company Plan No. 150.

OBJECT OF TEST

2. The object of this test was to determine conformance of the sample contact maker with 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 equipment where its performance was carefully observed for compliance with the specification. An inspection, to determine compliance in the matter of materials, design, and workmanship, concluded the test.

## CONCLUSIONS

(a) The subject contact maker is of a simple design and good workmanship, but failed to meet specification, reference (b), in the following respects:

- (1) The operating range is adjustable from 110° F. to 234° F. instead of 100° F. to 225° F.
- (2) The instrument failed to maintain the accuracy requirements at an ambient temperature of 50° F.
- (3) The accuracy tolerance of  $\pm 5^{\circ}$  F. was exceeded at a rate of temperature rise of 5° F. per minute.
- (4) The expansion chamber is soft-soldered to the pipe connection.
- (5) The nameplate furnished is of steel in lieu of a satisfactory plastic material and has commercial type data rather than Navy type data and ratings.
- (6) The use of brass composition for the housing appears to be a violation of the critical material requirements.

(b) If resubmitted, it is suggested that the unit be built into a steel case and be provided with a balanced lever linkage having a spring to keep the lever from vibrating excessively when the contact maker is subjected to vibration. The adjusting dial should be provided with a locking device to prevent shift of operating point and the limiting device (two pins) should not prevent operation at lowest and highest settings.

RECOMMENDATIONS

(a) That the subject contact maker be NOT approved for Naval use in its present form in view of the deficiencies noted under "Conclusions".

## DESCRIPTION OF MATERIAL

4. The sample Type N local switching contact maker is designed to close a circuit when the temperature of the liquid in which the expansion chamber is immersed reaches a certain pre-determined value.
5. The mechanism embodies a bellows assembly which responds to the pressure developed in a brass expansion chamber partially filled with liquid. A small plunger, actuated by the bellows assembly, raises a pivoted actuating arm by means of a long adjustment screw, threaded into the arm.
6. The actuating arm pushes the plunger of a "micro-switch", causing its normally open contacts to close.
7. The operating temperature of the contact maker is varied from  $110^{\circ}$  F. to  $210^{\circ}$  F. by means of a calibrated dial wheel on the adjustment screw. This varies the distance between the adjustment screw and the plunger on the bellows assembly.
8. A green and black "Kalperswitch" type "Micro-switch" is secured to the cast brass housing by means of two No. 6-32 brass screws threaded into two raised bosses on the back of the housing. Two brass terminals are secured to the "micro-switch". Fiber, of 1/32-inch thickness, is provided for additional insulation between terminals and inner surface of housing.
9. A flat rubber gasket, 1/16-inch thick, is provided between the housing and housing cover to insure watertightness when the steel cover is secured to the housing by four No. 10-32 fillister-headed steel screws, threaded into the housing. A boss, suitable for a 3/4-inch I.P.S. tap is provided in the side of the housing for the installation of a terminal tube. The expansion chamber is designed for attachment to a piping system by threading into a 3/4-inch I.P.S. hole.
10. Further details are shown in drawing, reference (c), and photographs, plates 1 and 2.

## METHOD OF TEST

11. The operating range of the contact maker was determined in an oil bath. The instrument was then mounted on the cover of an insulated, water-tight tank. Water was forced through the tank by a pump. By means of immersion heaters in the tank and a coiling coil, suitable rates of temperature rise could be obtained. The tank and contact maker were placed in a compartment in which the ambient temperature could be maintained at  $50^{\circ}$  F.,  $104^{\circ}$  F., and  $158^{\circ}$  F.
12. The reference temperature of the contact maker before the tests was determined at  $104^{\circ}$  F. ambient temperature by raising the temperature of the water in the tank at the rate of approximately  $0.25^{\circ}$  F. per minute. The temperature was determined by means of a thermometer extending from the tank.
13. The operating point was checked at  $50^{\circ}$  F. and  $158^{\circ}$  F. ambient temperatures, and after the endurance, shock and vibration, over-temperature and hydrostatic tests had been conducted, as outlined in specification, reference (b).

METHOD OF TEST (Cont'd)

14. Tests for dielectric strength, insulation resistance, and water-tight integrity, and a careful examination of the sample to determine compliance in the matter of design, materials, and workmanship, concluded the tests.

RESULTS OF TEST

15. The test results obtained were as follows:

Requirements

Test Values

Operating range: Shall be capable of adjustment over a range of 100° F. to 225° F.

\*110° F. to 234° F.

Self-compensation: Shall be self-compensating for any ambient temperature between 50° F. and 158° F.

\*Accuracy tolerance was exceeded at 50° F. ambient temperature. (See Table 1).

Contact load: Switch shall be capable of breaking a load of 4 amperes, 0.5 P.F., 115 volts, 60 cycles.

Complied.

Endurance: Shall operate 48 hours, one complete cycle each five minutes, with contacts carrying rated current.

Complied.

Accuracy: Operating point shall not vary more than  $\pm 5^\circ$  F. for a rate of temperature rise of or less than 5° F. per minute.

\*Tolerance was exceeded at low ambient temperature, and at rapid rates of temperature rise. (See Table 1).

Shock and vibration: Para. F-2e.

Complied.  
(See Table 1).

Overtemperature: Expansion chamber shall be subjected to a temperature of 300° F. for five minutes without damage.

Complied.

Hydrostatic: Expansion chamber shall be designed for operation when submerged in a liquid at or less than 50 lbs./sq.in.

Complied.  
(See Table 1).

Expansion chamber: Shall be of corrosion-resisting material, such as to minimize electrolysis when submerged in hot salt water in the presence of copper.

\*Soft solder is used where expansion chamber is attached to pipe connection and to seal end of chamber.

Dielectric: Shall withstand 1250 volts, 60 cycles, for one minute between open contacts and to ground.

Complied.

RESULTS OF TEST (Cont'd)

Requirements

Insulation resistance: Shall be not less than 10 megohms at 500 volts.

Watertight integrity: Shall be submerged in 3 feet of water for 1 hour without the entry of water into the case.

Clearance: Shall not be less than 1/4-inch between electrical circuits and ground unless separated by at least 1/8-inch of approved insulating material.

Dimensions: Shall not exceed the following:  
Width: 4-15/16 inches  
Depth: 3-3/4 inches  
Length: 9 inches  
Weight: Not specified

Attachment to piping system: Shall be threaded 3/4-inch (I.P.S.) and shall not project into the system more than 1/2 inches.

Nameplate: Shall be of a satisfactory plastic material.

Test plans: Para. H-3b.

Test Values

Complied.  
Greater than 100 megohms at 500 volts.

Complied under test but adjustment stop screw should not penetrate case and bellows housing should have gasket.

\*Fiber washers provided to obtain greater clearance to ground at switch terminals are not "approved insulating material". Clearance could be increased by bending terminal lugs. The unimpregnated fiber used in the vicinity of switch is not required.

Complied.  
Width: 3-5/8 inches  
Depth: 1-5/8 inches  
Length: 3-1/2 inches  
Weight: 2 lbs., 10 ounces.

Complied.  
1-7/8 inches from tip of expansion chamber to first thread on pipe connection.

\*Nameplate furnished is of steel and serves as housing cover.

Complied.

\*Denotes failure to comply with the specification.

## CONCLUSIONS

16. The subject contact maker is of a simple design and good workmanship, but failed to meet specification, reference (b), in the following respects:

- (1) The operating range is adjustable from 110° F. to 234° F. instead of 100° F. to 225° F.
- (2) The instrument failed to maintain the accuracy requirements at an ambient temperature of 50° F.
- (3) The accuracy tolerance of  $\pm 5^\circ$  F. was exceeded at a rate of temperature rise of 5° F. per minute.
- (4) The expansion chamber is soft-soldered to the pipe connection.
- (5) The nameplate furnished is of steel in lieu of a satisfactory plastic material and has commercial type data rather than Navy type data and ratings.
- (6) The use of brass composition for the housing appears to be a violation of the critical material requirements.

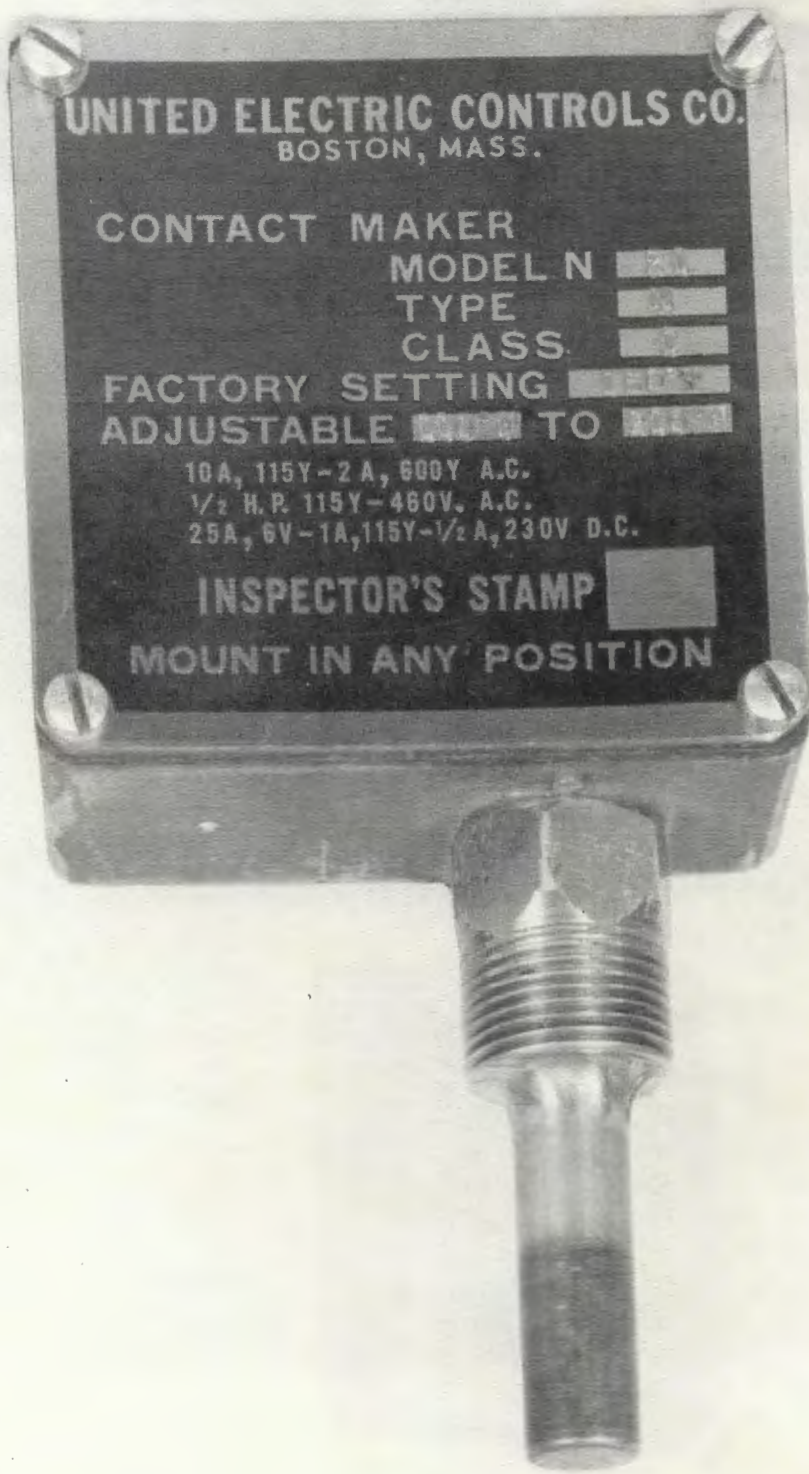
17. If resubmitted, it is suggested that the unit be built into a steel case and be provided with a balanced lever linkage having a spring to keep the lever from vibrating excessively when the contact maker is subjected to vibration. The adjusting dial should be provided with a locking device to prevent shift of operating point and the limiting device (two pins) should not prevent operation at lowest and highest settings.

TABLE 1

## Operating Points of Type N Contact Maker

Condition	Ambient Temp. °F.	Operating Point °F.	Contacts Open °F.	Differential °F.	Rate of Rise °F./min.	Error based on reference setting °F.
Start of Test	104	*142	138	4.0	0.29	-
	104	143	138	5.0	2.6	+1.0
	104	145.5	138	7.5	5.1	+3.5
	158	139	136	3.0	0.26	-3.0
	158	141	136	5.0	2.3	-1.0
	158	143.5	136	7.5	4.8	+1.5
	50	147.5	143	4.5	0.33	+5.5
	50	149.5	143	6.5	2.5	+7.5
	50	152	143	9.0	5.3	+10.0
After Endurance	104	143	140	3.0	0.24	+1.0
	104	145	140	5.0	2.1	+3.0
	104	148.5	140	8.5	5.3	+6.5
After Shock and Vibration	104	143	139	4.0	0.26	+1.0
	104	145	139	6.0	2.1	+3.0
	104	148	139	9.0	5.1	+6.0
After over-temperature and hydrostatic tests	104	142	138	4.0	0.25	0
	104	145	138.5	6.5	2.2	+3.0
	104	148	138.5	9.5	5.1	+6.0

\*Reference setting used as basis for determining errors.



UNITED ELECTRIC CONTROLS CO.  
BOSTON, MASS.

CONTACT MAKER

MODEL N

TYPE

CLASS

FACTORY SETTING

ADJUSTABLE  TO

10A, 115Y-2 A, 600Y A.C.

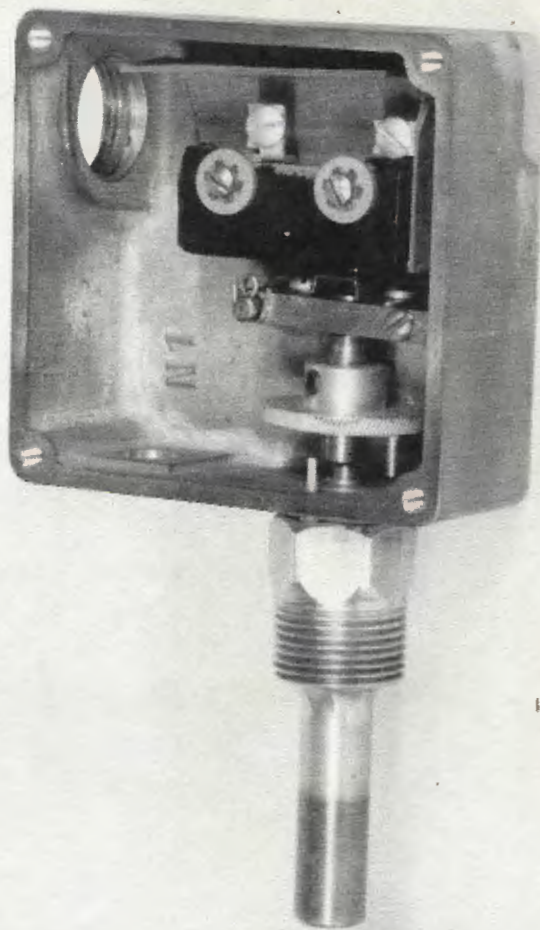
1/2 H.P. 115Y-460V. A.C.

25A, 6V-1A, 115Y-1/2 A, 230V D.C.

INSPECTOR'S STAMP

MOUNT IN ANY POSITION

This is  
of  
XMS  
back



This is  
of  
X-ray  
of

of  
of