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S65-4/L5-

NAVY DEPARTMENT
BUREAU OF ENGINEERING

Report on
Test of Low Pressure Alarm Contact Maker
for Circulating Oil System
(Submitted by Butte Electric and Manufacturing Company,
San Francisco, California)

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AUTHORIZATION FOR TEST

1. This problem was authorized by Bureau of Engineering letter reference (a), and other additional references pertinent to this problem are listed as references.

- Reference: (a) BuEng let. S65-4/L5 (7-20-Ds) of 26 July 1934.
(b) BuEng let. S65-4(3-21-Df) of 21 August 1934 to Butte Electric Company.
(c) BuEng let. S65-4(3-21-Df) of 17 April 1934 to Butte Electric Company.
(d) Butte Electric Company let. of 6 July 1934 to Butte Electric Company.

OBJECT OF TEST

2. The object of this test is to determine the suitability of this material for the Naval Service and compliance with specifications outlined in reference (a).

ABSTRACT OF TEST

3. The contact maker was set up at this Laboratory in an air pressure system and closely observed while under operation for endurance. At the conclusion of the endurance test it was subjected to over pressure, shock, insulation, dielectric, and watertight integrity tests.

(a) Conclusions

The contact maker complied with the specifications with the exception of the accuracy of operation requirement. The maximum allowed change in the operating point is $\pm 1/2$ lb. At conclusion of over pressure and shock tests the operating point had changed from 3.8 lbs. to 3 lbs. However, after 250 operations at normal pressures it dropped to 2.3 lbs, but returned again to 3 lbs. after 500 operations.

There were several instances after the shock test where the contact maker failed to close the alarm circuit at zero pressure.

If changes are made in the location of the line terminals and in the operating points arising from over pressure and shock tests, the contact maker would be suitable for the Naval Service.

(b) Recommendations

That specifications include a cut off point expressed as a definite pressure greater than the operating pressure.

That the line terminals be changed to allow free access to the spring adjustment nuts.

That contact maker as at present manufactured be not approved for the Naval Service.

DESCRIPTION OF MATERIAL

4. This contact maker is built into a cast BE composition case of watertight construction, having three mounting lugs. The pressure chamber casting is secured to the case with fillister head screws, firmly clamping a gasket and diaphragm between it and the bottom of the case. Resting on the diaphragm is a metal disc of slightly smaller diameter and having a convex surface. The movement of the disc is limited to that which is necessary to operate the switch mechanism.

5. At pressures above the operating point, the diaphragm forces the disc to its upper limit where it protects the diaphragm from injury.

6. The switch mechanism has two fixed contacts mounted on an insulated block and provided with terminals for connecting to line. A second pair of contacts is secured to a self-alignment metal strip on the moveable portion of the switch. The switch has a quick make and break action and requires considerable movement of the diaphragm for operation.

7. The pressure chamber is furnished with two 3/8" IPS tapped holes, one for connection to the oil system and one for connection to the drain line.

8. The cover is also of BE composition, has raised lettering on its outer surface and printed instructions pasted inside.

9. To accommodate a Navy standard terminal tube, a 3/4" IPS tapped hole is provided in the upper end of the case.

METHOD OF TEST

10. The contact maker was installed in an air pressure system and operated at rated pressures by means of a mechanically driven cam which opened a release valve, thereby lowering the pressure to the operating point.

11. The contact maker was then operated for endurance at the rate of ten operations per minute until the completion of 14,400 operations.

12. At the completion of the endurance test, the contact maker was subjected to the over pressure, shock, inclination, dielectric, insulation, and watertight integrity tests. Following the over pressure and shock tests, the contact maker was set up in the pressure system and tested for accuracy of the operating point.

13. The instruments used on tests were as follows:

Voltmeter - Weston, Model 45, No. 19579
Ammeter - Weston, Model 45, No. 17744
Air Gauge - Ashcroft, 0-15 lbs., No. 37068001
Megger - Jas. Biddle, 1000 volts, No. 178144

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DATA RECORDED DURING TEST

14. The operating characteristics of the contact maker during the endurance, over pressure, and shock tests are shown by table, Plate 3.

DISCUSSION OF PROBABLE ERRORS

15. Inasmuch as this test required only one pressure gauge for checking the accuracy of contact maker, the chance of error is negligible. The gauge used was tested for accuracy before and after the test and corrections made.

RESULTS OF TEST

| <u>16. Specifications</u> | <u>Requirements</u> | <u>Test Values</u> |
|---------------------------|---|--|
| Voltage at contacts | 115 volts | 120 volts (rating by manufacturer) |
| Current | Alternating, 60 cycle | Direct (See comment, pg.4) |
| Contact load | 2 amperes at 30% P.F. | 5 amperes at 120 volts, d.c. |
| Endurance | 14,400 operations at the rate of 10 operations per min. | 14,400 operations at the rate of 10 operations per min. |
| Operating pressures | Adjustable between 3 and 10 lbs. | Adjustable between 3 and 10 lbs. |
| Accuracy of operation | Consistent operation within $\pm 1/2$ lb. | Complied with during the endurance test, but failed from thereon. |
| Over pressure test | 200 lbs. per sq. in. in pressure applied for 15 periods of 10 seconds each without change in operating point. | 200 lbs. per sq. in. in pressure applied for 15 periods of 10 seconds each. (Changed its operating point) |
| Shock Integrity | Twenty blows of 250 foot lbs. each without change in operating point. | Twenty blows of 250 foot pounds each. (Changed its operating point) |
| Watertight integrity | Submerged in 3 feet of salt water for 12 hours without leakage | Submerged in 3 feet of salt water for 12 hours. (No leaks occurred.) |

| <u>Specifications</u> | <u>Requirements</u> | <u>Test Values</u> |
|-----------------------|---|---|
| Dielectric test | 1240V. a.c. 60 cycle applied for one minute between all current carrying parts and case. | 1240 V. a.c. 60 cycle applied for one minute between all current carrying parts and case. (No breakdowns occurred.) |
| Inclination | Contact maker shall operate satisfactorily when inclined 30° from the vertical plane in all directions. | Complied with. |
| Insulation | Not less than 5 megohms between all current carrying parts to case. | 200 megohms by 1000 V. megger. Scale 0-200 megs. |

(1) The load specified for the electrical contacts is 2 amperes, 115 volts, a.c., 30% power factor. The rating of the contacts by the manufacturer is 5 amperes, 120 volts. As the type of current was not specified, the contacts were tested on direct current, the more destructive of the two.

(2) The specifications require that the contact maker, when once adjusted to its operating point, should maintain that point within plus or minus 1/2 lb. over the entire test. This requirement was complied with under the endurance test (14,400 operations) but dropped below the allowed operating point from there on.

(3) The accuracy of operation of the contact maker was checked daily.

(4) The present location of the line terminals do not allow free access to the spring adjustment nuts.

(5) The pressure at which the alarm circuit is cut off is approximately 8 lbs. No cut off point is given in the specifications.

CONCLUSIONS

17. (a) The contact maker complied with the specifications with the exception of the accuracy of operation requirement. The maximum allowed change in the operating point is $\pm 1/2$ lb. At conclusion of over pressure and shock tests, the operating point had changed from 3.8 lbs. to 3 lbs. However, after 250 operations at normal pressure it dropped to 2.3 lbs. but returned again to 3 lbs. after 500 operations. There were several instances after the shock test where the contact maker failed to close the alarm circuit at zero pressure.

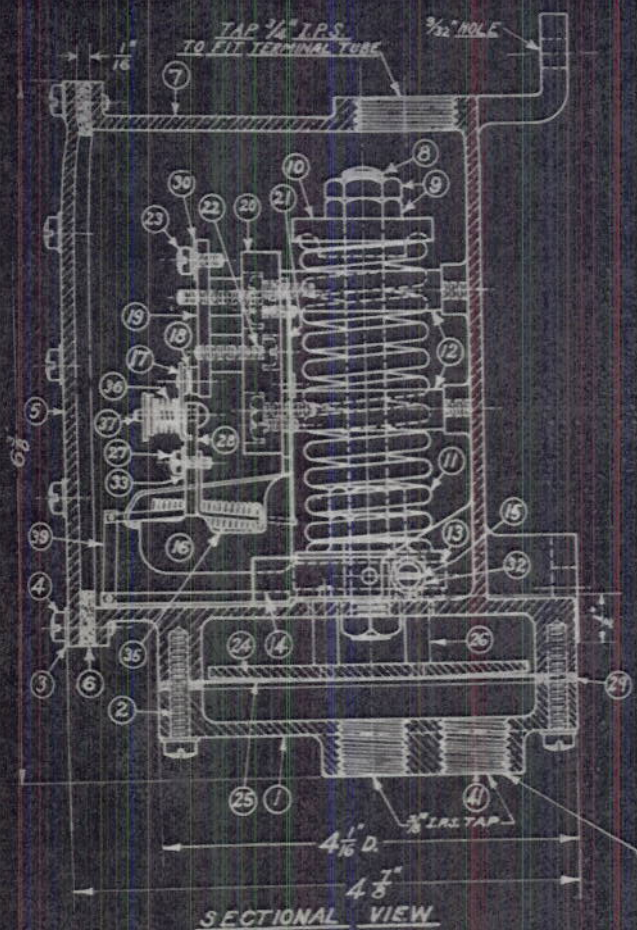
(b) If changes are made in the location of the line terminals, and in the operating points arising from over pressure and shock tests, the contact maker would be suitable for the Naval Service.

Table of Data - Butler Low Pressure Contact Maker

| | | Air Pressure in lbs. per sq. in. | | | | | | | | | | |
|-------------------|--|----------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|--|--|-------------------------------------|---|---|
| Operating Time | | 2.0 | 3.85 | 3.85 | 5.75 | 1.50 | 3.80 | | 3.2 | 3.0 | 2.3 | 3.0 |
| Test Total | | 8.0 | 8.2 | 7.8 | 8.1 | 8.2 | 8.2 | | 8.2 | 7.7 | 8.2 | 8.75 |
| | At start of test, adjusted by transformer | | After 3,800 operations | After 3,800 operations | After 8,800 operations | After 8,800 operations | After 14,000 operations | | After 150 operations at 200 lbs. p.s.i. | After about 20 250 p.s.i. cycles | After 200 operations normal pressure | After 7,000 operations normal pressure |
| | Test Day | | Test Day | | Test Day | | | | | | | |

Readings taken at start and end of each day during endurance test

Weight = 9.75 lbs.



OPENING CLOSED BY A 3/8" BRASS PLUG. THIS BOSS AND TAPPED OPENING WILL NOT BE FURNISHED UNLESS THUS SPECIFIED.

LIST OF MATERIAL

QUANTITIES ARE FOR ONE CONTACT MAKER.

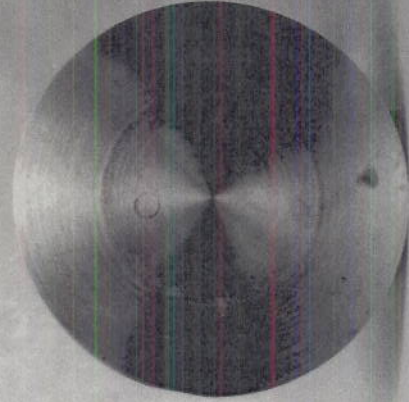
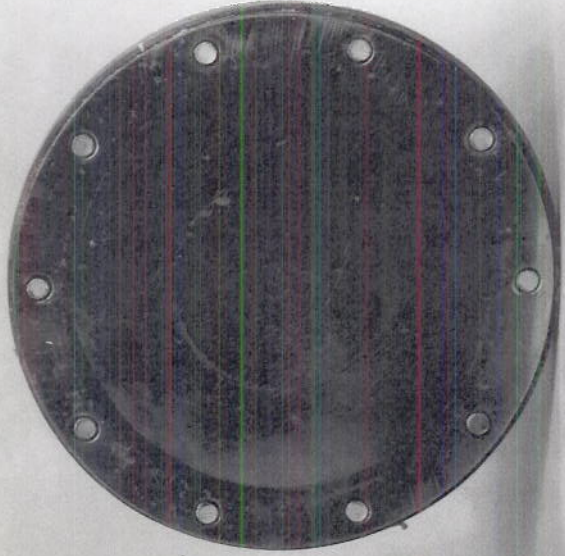
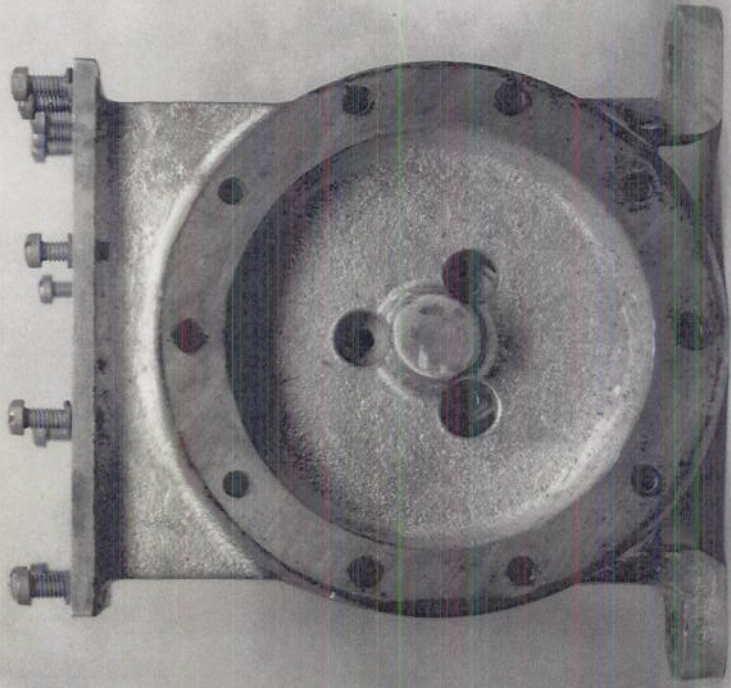
| PIECE NUMBER | NAME OF PIECE | NUMBER WANTED | MATERIAL | MATERIAL SPECIFICATION |
|--------------|---|---------------|-----------------|------------------------|
| 1 | COVER FOR PRESSURE CHAMBER | 1 | B.E. COMP. | 46 B24 b |
| 2 | .190-32 MACH. SCR. FILL HEAD, 1" LONG. | 12 | STEEL | CADMIUM PLATE |
| 3 | SPRING WASHER, 3/32" DIA., 3/16" HOLE, 3/16" THICK | 26 | STEEL | " " |
| 4 | .164-32 MACH. SCR. FILL HEAD, 1/2" LONG | 18 | BRASS | " " |
| 5 | COVER PLATE, 1/8" THICK. | 1 | B.E. COMP. | 46 B24 b |
| 6 | GASKET, 1/16" THICK | 1 | RUBBER | COMMERCIAL |
| 7 | BOX | 1 | B.E. COMP. | 46 B24 b |
| 8 | STUD SCREW, 3/8" x 24 x 1/8" LONG | 1 | BRASS | |
| 9 | NUT, 3/8" x 24 | 4 | BRASS | |
| 10 | COLLAR | 1 | BRASS | |
| 11 | SPRING, 3" Long, NO. 4 WIRE, MITCH - 3 T. PER INCH. | 1 | STEEL | CADMIUM PLATE |
| 12 | STUD, 3/8" x 1 5/8" LONG | 4 | BRASS ROD. | |
| 13 | COLLAR | 1 | BRASS | |
| 14 | LEVER | 1 | BRASS | |
| 15 | PIVOT SCREW, .190-32-SPECIAL | 2 | STEEL | " " |
| 16 | QUICK MAKE & BREAK MECHANISM | 1 | STEEL | " " |
| 17 | CONTACT PLATE | 1 | PHOSPHOR BRONZE | |
| 18 | CONTACTS | 4 | SILVER | |
| 19 | BACK CONTACT SUPPORT & WIRE TERMINAL | 2 | BRASS | |
| 20 | BASE, 3/16" THICK. | 1 | SHEET BAKELITE | 17-I-14 |
| 21 | FLAT SPRING, .010 THICK | 1 | STEEL | CADMIUM PLATE |
| 22 | .164-32 MACH. SCR. FILL HEAD, 3/8" LONG | 2 | BRASS | CADMIUM PLATE |
| 23 | .164-32 MACH. SCR. FILL HEAD, 3/8" LONG | 5 | BRASS | " " |
| 24 | PRESSURE PLATE | 1 | BRASS | |
| 25 | DIAPHRAGM PLATE, .011 THICK | 1 | PIANO WIRE | |
| 26 | PINS, 1/8" ROD. | 3 | BRASS | |
| 27 | .138-32 MACH. SCR. FILL HEAD, 1/4" LONG. | 2 | BRASS | " " |
| 28 | CONTACT BASE | 1 | SHEET BAKELITE | 17-I-14 |
| 29 | GASKET, 1/16" | 1 | PHOS. BRONZE | |
| 30 | WASHER, 3/8" DIA., 3/16" HOLE, .032 THICK | 2 | BRASS | CADMIUM PLATE |
| 31 | 3/8"-24 SCREW - SPECIAL | 2 | BRASS | |
| 32 | SPRING WASHER, 5/16" O.D., 7/16" I.D., .055 T. | 2 | STEEL | " " |
| 33 | WASHER, 3/16" O.D., .147 I.D., .028 T. | 2 | BRASS | " " |
| 34 | WASHER, 3/16" O.D., 3/16" I.D., .030 T. | 4 | LEATHEROID | |
| 35 | SPRING, #17, .039 WIRE, 13 T. OVER 3/16" ROD. | 1 | PIANO WIRE | " " |
| 36 | SPRING, #22, .025 WIRE, 5 T. OVER 1/4" ROD | 1 | PHOS. BRONZE | |
| 37 | 1/8" RIVET, 3/8" LONG. | 1 | BRASS | |
| 38 | CUP WASHER - SPECIAL | 1 | BRASS | |
| 39 | LINK, 3/32" x 1/8" x 7/8" LONG. | 1 | BRASS | |
| 40 | PLUG, 3/8" I.P.S. | 1 | BRASS | |

NOTE 1: GASKET - PIECE NO. 29 - IS DESIGNED NOT TO DISINTEGRATE WHEN USED IN LUBRICATING OILS.

NOTE 2: INSTRUMENT IS ADJUSTED TO CLOSE CONTACTS WHEN THE PRESSURE FALLS TO POUNDS.

NOTE 3: WEIGHT IS APPROXIMATELY 9 POUNDS.

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PLATE 3