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FR-1114

NRL Report No. B-1114
Temperature Indicator for Submarine Engines.

REPORT NO. B-1114

DATE 21 January 1935

SUBJECT

Temperature Indicator for Submarine Engines
manufactured by Weston Electric Corporation and submitted by the Winton Engine Corp.

BY

NAVAL RESEARCH LABORATORY

BELLEVUE, D. C.

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NAVY DEPARTMENT

BUREAU OF ENGINEERING

Report on

Temperature Indicator for Submarine Engines

manufactured by the

Weston Electrical Instrument Corporation

submitted by

Winton Engine Corporation

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
Washington, D.C.

Number of pages: Text - 4 Plates - 4

Authorization: Bu.Eng.let. S87/L5(11-15-Ds) of 19 November 1934.

Date of Test: December 1934.

Prepared by: _____
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Approved by: _____
H.R. Greenlee, Captain, USN, Director

Distribution:
Bu.Eng. (5)

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APPENDICES

AUTHORIZATION FOR TEST

1. This test was authorized by reference (a) and other additional reference to this problem is listed as reference (b).

Reference: (a) Bu.Eng.let. 387/L5(11-15-Ds) of 19 November 1934.
(b) Weston Electrical Instrument Corporation Drawing C.D. 75618 of 13 August 1934.

OBJECT OF TEST

2. The object of this test was to determine the suitability of the subject material for indicating the temperatures of the circulating oil and water systems of submarine engines in the Naval Service.

ABSTRACT OF TEST

3. The indicator as submitted was set up in this Laboratory and tested for accuracy of indications over its entire scale while energized with its rated voltage, (12 volts d.c.). Tests were also made to determine the effect of shock and over and under voltage on the accuracy of the instrument.

Conclusions

(a) The subject indicator, under test, proved to be of sufficient ruggedness and accuracy for its intended purpose.

Recommendations

(b) In view of the satisfactory results of this test, it is recommended that the instrument be approved for indicating temperatures of circulating oil and water systems of Naval submarine engines.

DESCRIPTION OF MATERIAL UNDER TEST

4. This instrument is designed for indicating temperatures of circulating oil and water systems of submarine engines.

5. It essentially consists of two (2) bridge circuits and two (2) galvanometers of the D'Arsonval type, entirely housed in a splash-proof cast aluminum alloy case. The two (2) sensitive resistance bulbs and indicators are electrically interconnected.

6. Each bulb is of watertight construction and is equipped with 1/2" standard pipe threads for insertion in the circulating oil and water systems. When connected to the indicator, each forms one arm of its respective bridge circuit.

7. Temperatures are indicated on a dial having a double scale, calibrated from 20°F. to 220°F. in 2° graduations. The dial is read through a glass window located in the case cover. Provision is made for "zero" adjustments. This unit is designed for switchboard mounting and for operation on 12 volts, direct current.

8. The deflection of the galvanometers is caused by changes in resistance of the bulbs which varies with the temperature.

9. For further details, see plates one and four.

METHOD OF TEST

10. The indicator, as submitted, was connected as shown on plate four and supplied with a potential of 12 volts, direct current.

11. For determining the accuracy of the instrument from 80°F. to 220°F. the sensitive resistance bulbs were immersed in a circulating oil bath. For temperatures from 20°F. to 70°F., alcohol, cooled by "dry ice", was used. Thermometers used during these tests were checked for accuracy against thermometers having Bureau of Standards certificates.

12. During the accuracy test, the sensitive resistance bulbs were connected to the indicator with short lead wires, each having a resistance of 0.015 ohms at ambient temperature of 76°F.

13. In order to determine the accuracy of the indicator when supplied with over and under voltage, a test was made and the results are shown on plate three.

14. Next, the instrument was tested for shock integrity by subjecting it to shocks, of 20 - 25 ft.lbs. applied on a Navy standard shock machine.

15. The test was concluded by subjecting the indicator and its bulbs to an insulation test, using a 500 volt megger and then to a dielectric

test of 500 volts, a.c., 60 cycle, applied between the case and all current carrying parts for a period of one minute.

RESULTS OF TEST

16.

Tested in Circulating Oil Bath -- Constant Voltage -- 12 Volts

OIL TEMPERATURE			WATER TEMPERATURE		
Indicated °F.	Bath °F.	Error	Indicated °F.	Bath °F.	Error
20	22.0	-2.0	20	23.2	-3.2
30	32.5	-2.5	30	33.0	-3.0
40	43.0	-3.0	40	43.0	-3.0
50	53.0	-3.0	50	53.0	-3.0
60	62.5	-2.5	60	63.5	-3.5
70	72.0	-2.0	70	73.5	-3.5
80	82.5	-2.5	80	83.5	-3.5
90	92.8	-2.8	90	93.5	-3.5
100	102.0	-2.0	100	103.5	-3.5
110	113.0	-3.0	110	113.5	-3.5
120	122.0	-2.0	120	123.5	-3.5
130	132.5	-2.5	130	133.0	-3.0
140	142.4	-2.4	140	143.0	-3.0
150	152.0	-2.0	150	152.5	-2.5
160	161.0	-1.0	160	162.5	-2.5
170	171.0	-1.0	170	172.0	-2.0
180	180.5	-0.5	180	182.0	-2.0
190	190.5	-0.5	190	192.0	-2.0
200	200.0	0.0	200	201.0	-1.0
210	208.5	+1.5	210	210.5	-0.5
220	218.5	+1.5	220	220.0	0.0

17. The average current consumed by the indicator at a potential of 12 volts d.c. was 0.067 amperes.

18. The maximum error of the indicator was 3.5°F. However, this error is not too great for the intended purpose of the indicator.

19. The minimum insulation resistance of any part of the indicator to ground was 30 megohms. This occurred in one of the sensitive resistance bulbs when measured with a 500 volt megger.

20. The indicator withstood a dielectric test of 500 volts, a.c., 60 cycle, when applied between all current carrying parts and ground for a period of one minute.

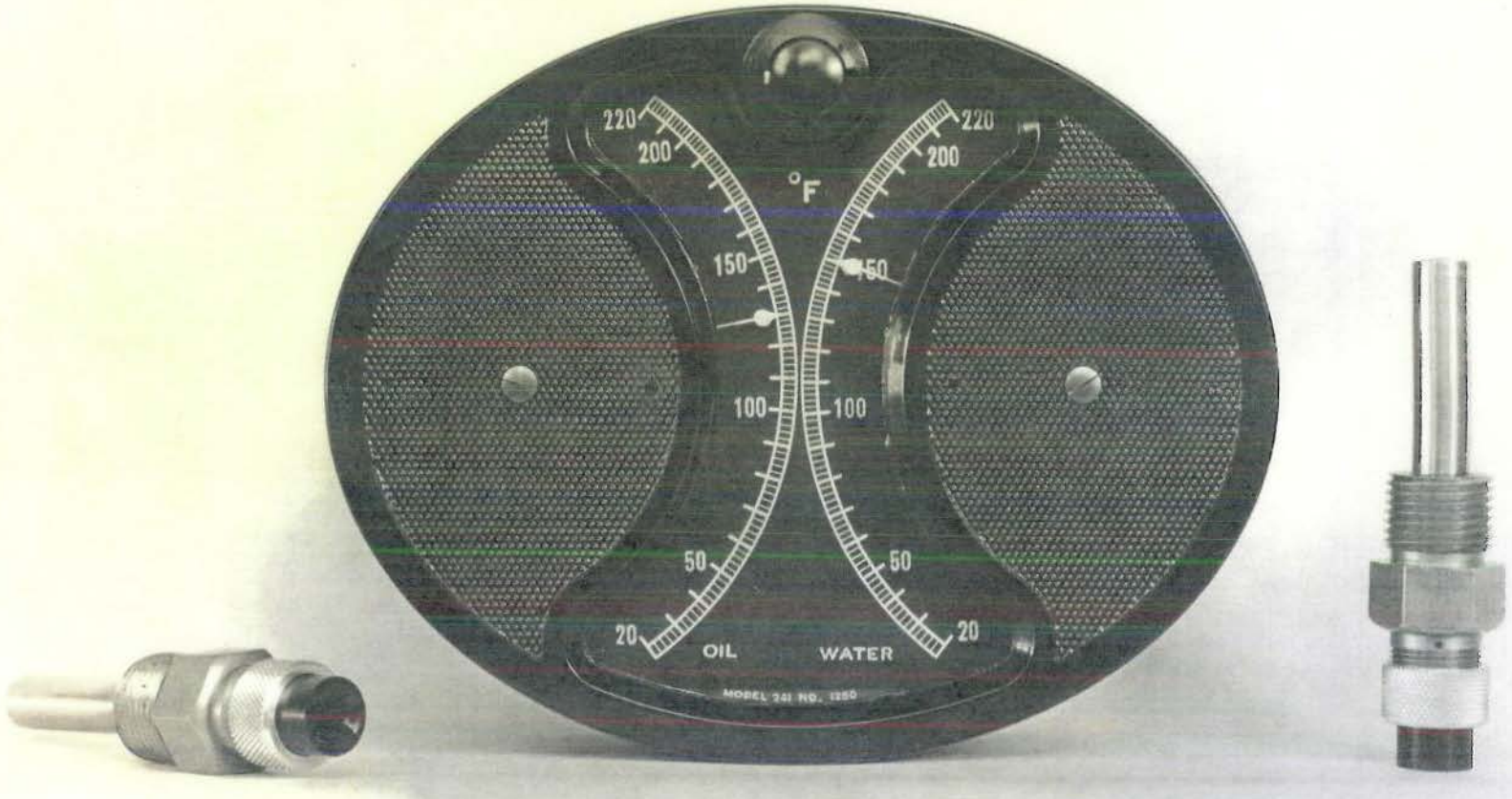
21. This instrument is considered to be of good workmanship and is equipped with a legible dial which can be easily read from a distance of six feet by daylight. Although a socket is provided in the case, it is not connected and no lamp was furnished for illuminating the dial. The lamp required appears to be of a special base design.

22. Under test, this instrument quickly indicated changes in temperature of the sensitive resistance bulbs.

23. It was noted during the test, that varying the voltage introduced an error in the indicator at all temperatures with the exception of 130°F. and 150°F. for oil and water respectively. At these points the two (2) bridge circuits are balanced and varying the line voltage does not cause any error in the indications of the instrument.

CONCLUSIONS

24. The subject indicator, under test, proved to be of sufficient ruggedness and accuracy for its intended purpose.


220
200
°F
150
100
50
20
OIL
WATER
220
200
150
100
50
20
MODEL 241 NO. 1350

1351

PLATE I

PLATE 2

CURVE SHOWING EFFECT OF OVER AND UNDER VOLTAGES
ON ACCURACY OF INSTRUMENT
AMBIENT TEMPERATURE OF INSTRUMENT AND BULBS - 77° F.

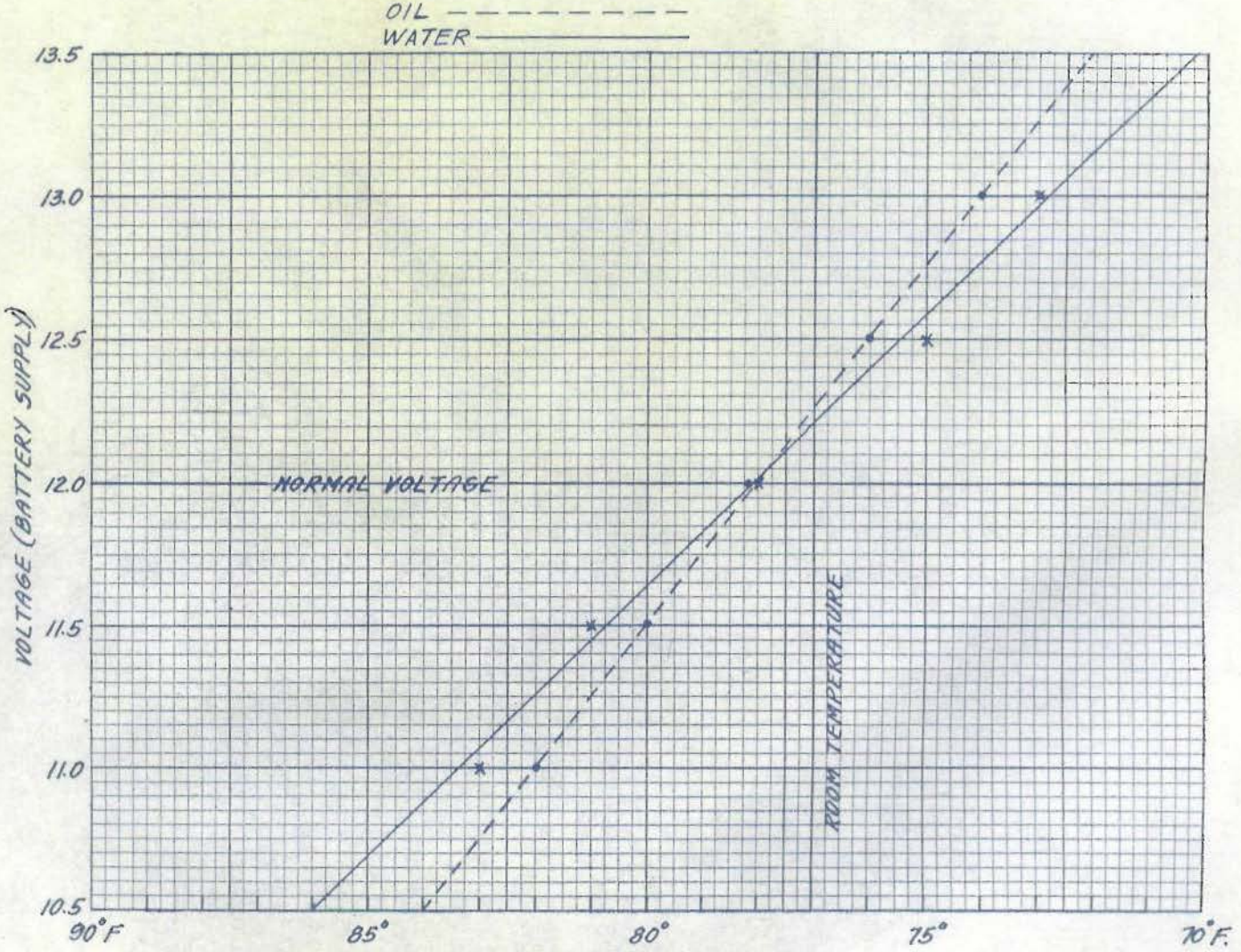


PLATE 3

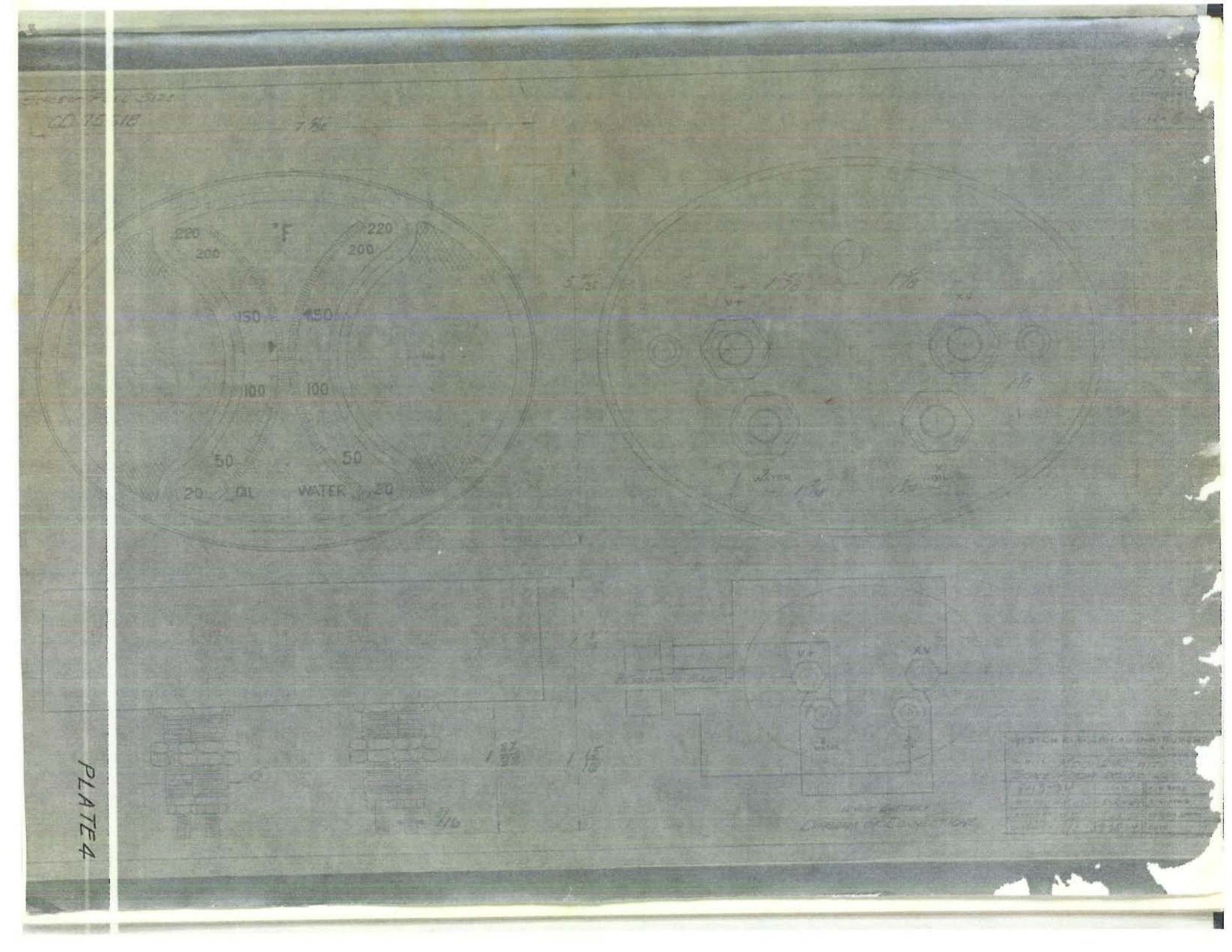


PLATE 4