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SHIP-SHORE RADIO DIVISION  
RADIO COUNTERMEASURES SECTION

2 August 1946

FR-2917

SHOCK AND VIBRATION TEST  
OF  
WESTON SENSITRON 813 SERVO MIXING RELAY

BY

Howard M. Ikerd  
- Report R-2917

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Commodore H. A. Schade, USN  
Director,  
Naval Research Laboratory

Preliminary Pages.....a-c  
Numbered Pages .....2  
Plates .....4  
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BuShips Problem S-536R

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ABSTRACT

The Weston "Sensitron" 813 Servo Mixing Relay described in this report meets the electrical requirements for general Naval use. However, it fails to meet the vibration and shock requirements.

  
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TABLE OF CONTENTS

ABSTRACT.....b  
INTRODUCTION.....1  
DESCRIPTION OF SUBJECT RELAY.....1  
VIBRATION TEST.....1  
SHOCK TEST.....1  
CONCLUSIONS.....1  
REFERENCE.....2  
PLATE 1.     Vibration Characteristic Data  
PLATE 2.     Impact (shock) Characteristic Data  
PLATE 3.     Photograph of Weston "Sensitron" 813 Servo  
              Mixing Relay  
PLATE 4.     Relay Arm Position Detecting Circuit

## INTRODUCTION

1. In general a mixing circuit for the two speed servo systems consists of a relay operated by a tube. The Weston relay "Sensitron" 813 operates directly from the synchro voltage. This feature eliminates one tube from the servo system.

## DESCRIPTION OF SUBJECT RELAY

2. The relay as shown on Plate 3 is mounted in a sealed glass envelope on ~~an~~ octal tube base, and the relay itself is constructed very similar to a permanent magnet direct current meter. There is a small meter type rectifier, which permits operation from alternating current voltage, also mounted in the envelope. A resistor, which provides the proper impedance of the unit is also mounted in the envelope. The relay is single pole double throw, has approximately 8400 ohms impedance at 2 volts 60 cycles per second, the pole leaves the low contact at 1.84 volts and contacts the high contact at 1.90 volts, and is designed to withstand a momentary overload of 55 volts. The contacts are intended to handle the small power that is used in small vacuum tube grid circuits.

## VIBRATION TEST

3. The vibration (resonance) test applied to the Weston 813 "Sensitron" was identical to the test applied to "ruggedized" tube samples submitted to the laboratory for type approval, i.e. frequency range 10 - 100 cycles per second, amplitude of the NRL vibromotor is adjusted to the maximum sin amplitude at 10 cps and the output of a Sperry Pick-Up Model C-506 at 10 cps is maintained constant for all frequencies in the range. This specification is covered in JAN specifications for ruggedized tubes (no specification number assigned). This test is called "Mechanical Resonance", e.g. Type 5U4WG of 3 April 1945. The relay was mounted rigidly to the vibramotor by clamping the metal ring at the base of the envelope and the data on Plate 1 were recorded.

## SHOCK TEST

4. After the vibration test was completed the relay was mounted on the NRL standard Electronic Impact Machine, NRL Blueprint No. RA10F 390A. The relay was shocked from four directions, 10 blows for each direction in 50 "G" steps from 50 "G" to 250 "G" as indicated on Plate 2. After each set of 10 strokes beginning with 100 "G" the operating voltage of the relay was measured and recorded on Plate 2.

## CONCLUSIONS

5. Since the relay arm tended to move away from the lower contact "L" with 1.6 volts on the coil at frequencies above 11 cycles per second

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as shown on Plate 1, it is considered to have failed to pass the vibration test. Also as recorded on Plate 2, the relay coil was dislodged from its bearings at 250 "G" shock so it is considered to have failed the shock test. The electrical characteristics are considered to be satisfactory.

REFERENCE

1. BuShips Ltr. (938-916M of 25 November 1934 to Dir., NRL (SRPPB)(S536R)

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Vibration Characteristic Data

Weston 813 "Sensitron" Relay

Operating voltages of relay at beginning of test:\*

- L - Low contact - 1.84 volts 60 cycles/sec.
- N - Neutral - 1.88 volts 60 cycles/sec.
- H - High contact - 1.90 volts 60 cycles/sec.

\*These values were the same at end of vibration test.  
Vibration frequency 7 to 100 cycles/sec. varied continuously.

Volts on Coil	Results and Comments
Vibration directed parallel to plane of coil and base of envelope	
0	7 to 42 cps arm remained closed on L. 42 to 100 cps arm vibrated from L but did not contact H.
1	7 to 33 cps arm remained closed on L. 33 to 100 cps arm vibrated from L but did not contact H.
1.6	7 to 11 cps arm remained closed on L. 11 to 100 cps arm tended to move from L.
1.88	7 to 85 cps arm moved back and forth from L to H 85 to 90 cps arm remained closed on L. 90 to 100 cps arm tended to swing away from L.
1.9	7 to 60 cps arm remained closed on H. 60 to 100 cps arm tended to move away from H.
3	7 to 30 cps arm remained closed on H. 30 to 100 cps arm tended to move away from H.

(continued on Plate 1 (cont'd))

R-2917

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PLATE 1

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Impart Characteristic Data  
Weston 813 "Sensitron" Relay

Operating voltage at beginning of test:

- L - Low contact - 1.84 volts 60 cycles/sec.
- N - Neutral - 1.88 volts 60 cycles/sec.
- H - High contact - 1.90 volts 60 cycles/sec.

- V<sup>1</sup> = Coil parallel to direction of shock.
- V<sup>2</sup> = Coil perpendicular to direction of shock.
- HB = Shock directed toward base of envelope and coaxial to coil.
- HF = Shock directed opposite to HB.

Hammer Angle Degree	Peak Accel. "G"	No. of Relay Blows	Relay Position	Operating Voltage After Each Set of Blows		
				L-Low Contact	N-Natural	H-High Contact
6	50	10	V <sup>1</sup>			
6	50	10	V <sup>2</sup>			
6	50	10	HB			
6	50	10	HF	1.86	1.90	1.95
12	100	10	V <sup>1</sup>	1.88	1.94	2.01
12	100	10	V <sup>2</sup>	1.82	1.90	1.96
12	100	10	HB	1.86	1.95	2.05
12	100	10	HF	1.81	1.88	1.99
18	150	10	V <sup>1</sup>	1.80	1.83	1.96
18	150	10	V <sup>2</sup>	1.77	1.83	1.94
18	150	10	HB	1.86	1.87	2.06
18	150	10	HF	1.77	1.82	1.94
24	200	10	V <sup>1</sup>	1.76	1.83	1.94
24	200	10	V <sup>2</sup>	1.76	1.82	1.96
24	200	10	HB	1.83	1.88	1.98
24	200	10	HF	1.75	1.82	1.94
36	250	10	V <sup>1</sup>	1.77	1.80	1.93
36	250	10	V <sup>2</sup>	1.75	1.78	1.94
36	250	10	HB	Coil dislodged from its bearings - test ended.		

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Volts on coil

Results and Comments

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Vibration directed perpendicular to plane of coil and parallel to base to envelope

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0	7 to 48 cps arm remained closed on L. 48 to 100 cps arm vibrated from L but did not contact H.
1	7 to 24 cps arm remained on L. 24 to 100 cps arm tended to move from L.
1.6	7 to 14 cps arm remained closed on L. 14 to 100 cps arm moved back and forth from L to H.
1.88	7 to 100 cps arm moved back and forth from L to H.
1.9	7 to 85 and 88 to 100 cps arm remained closed on H. 85 to 88 cps arm tended to move away from H.
3	7 to 31.5 cps arm remained closed on H. 31.5 to 100 cps arm chattered on H.

R-2917

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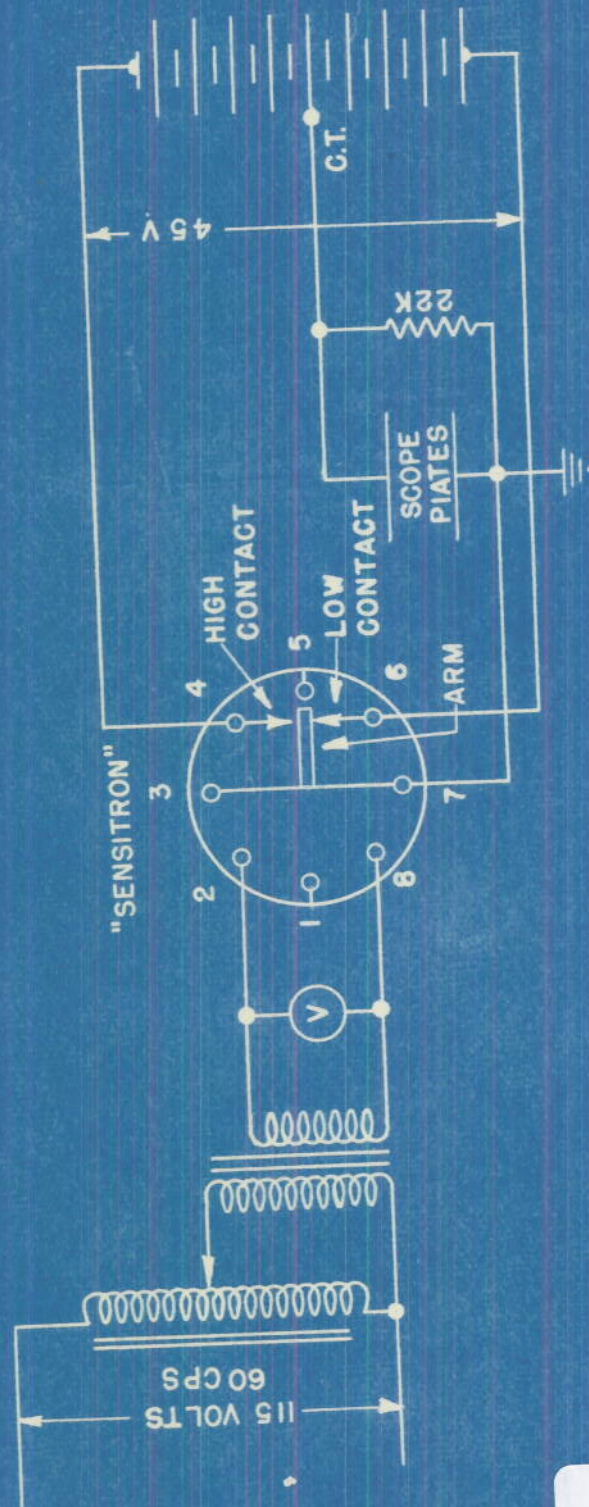


WESTON "SENSITRON" 813 SERVO MIXING RELAY

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PLATE 3



RELAY ARM POSITION DETECTING CIRCUIT

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