

REPORT No. B-1408

DATE 8 November 1937

FR-1408

SUBJECT

Sirens, Types A and B
Submitted by
E. D. Bullard Company,
San Francisco, California.



BY

NAVAL RESEARCH LABORATORY

BELLEVUE, D. C.

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NAVY DEPARTMENT
BUREAU OF ENGINEERING

Report
of
Test on Sirens, Types A and B

Submitted by
E. D. Bullard Company,
San Francisco, California.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

Number of Pages: Text - 7 Tables - 1 Plates - 8

Authorization: BuEng.ltr. S65-4/L5 (7-10-Ds) of 24 July 1937.

Date of Test: September and October 1937.

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Distribution:
BuEng. (5)

ejh

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

- Reference: (a) BuEng.ltr. S65-4/L5(7-10-Ds) of 24 July 1937.
(b) Specifications SGS(65)-105, Sirens, Interior Communication, of 15 February 1936.
(c) Manufacturer's Drawing No. 1501.
(d) BuEng.ltr. S48-25(11-20-Df) of 24 December 1936, to E. D. Bullard Company, San Francisco, California, Copy to NRL.
(e) E. D. Bullard ltr. to BuEng. of 10 July 1937.

OBJECT OF TEST

2. The object of this test was to determine how closely the subject sirens conform with the specifications, reference (b), and their suitability for use in the Naval service.

ABSTRACT OF TEST

3. The subject sirens were set up at this Laboratory and tested in strict accordance with the specifications, reference (b), after which they were carefully inspected for quality of workmanship and materials, and suitability of design. Tests were also made in open still air to determine the sound directional features incorporated in the sirens.

CONCLUSIONS

(a) The sample sirens, identified by numbers 1 and 2, comply with the specifications required of Navy type A sirens.

(b) Samples 3 and 4 also meet the specifications, except for failure to meet the temperature rise and audibility requirements. Number 3 siren exceeded the allowable rise by 13.28°C and Number 4 by 4.93°C . These samples were submitted as type B sirens, as will be noted under reference (e).

(c) An inspection of samples 3 and 4, at the conclusion of the salt spray test, showed slight pitting of the anodic treated deflector on number 4 siren, and rusting of the steel lockwashers on both. Both sirens were found watertight and operative. Samples 1, 2 and 3 are finished outside with aluminum paint, and number 4 is finished in sandblast with anodic treatment. It will be noted that the projectors are of formed aluminum sheet while the cases are of nickel aluminum alloy.

(d) The priming coat of zinc chromate paint has been omitted on all of the sirens.

(e) The sirens are of excellent design and workmanship, and free access to the motor brushes and commutator is afforded.

(f) The results of the tests conducted outside in open still air (Table I, Plates 1 and 2), show that the use of the sound deflector and projector features of the sirens is unwarranted for Naval service.

RECOMMENDATIONS

(a) It is recommended that either or both of the samples 1 and 2 be approved for Naval use as type A sirens.

(b) That samples 3 and 4 be not approved as type B sirens because of failure to comply with the temperature rise, audibility range, and pitch of note requirements. It would be preferable to reduce the speed of the 12,000 r.p.m. motor and increase the number of ports in order to obtain the specified pitch of note.

(c) It is further recommended that if the Bureau decides to retain the shallow deflector, it be made of the same material as the case.

DESCRIPTION OF MATERIAL UNDER TEST

4. The four sample sirens submitted for test are manufactured by E. D. Bullard Company, 275 Eighth Street, San Francisco, California. For identifying the samples, numbers 1 to 4 inclusive have been assigned by the manufacturer. The nameplate data of each siren are as follows:

<u>No. 1</u>	<u>No. 2</u>	<u>No. 3</u>	<u>No. 4</u>
Model - Type A	Model - Type A	Model - Type A	Model - Type A
Volts - 115	Volts - 115	Volts - 115	Volts - 115
Cycles - 60	Cycles - 60	Cycles - 60	Cycles - 60
Phase - 1	Phase - 1	Phase - 1	Phase - 1
Amperes - 1.25	Watts - 200	Amperes - 3.0	Watts - 325
R.P.M. - 8000	R.P.M. - 9000	R.P.M. - 12,000	R.P.M. - 12,000

NOTE: Samples 3 and 4 are the manufacturer's commercial type and were submitted primarily to determine their suitability for use as high powered sirens, Navy type B.

5. In construction and design the samples are identical, except that the rotors and stators vary in the number of apertures and in the speed of the motors. The cases are ribbed for strength and to aid in dissipating the heat generated by the motors.

6. The case, rotor and stator, are of cast aluminum nickel alloy. Steel inserts are provided throughout for all of the securing screws.

7. The rotor and stator are each cast in one piece and the rotor is clamped to the armature shaft by means of a split steel bushing which grips the shaft when a steel acorn nut is screwed down. The split steel bushing is secured to the rotor by means of a force fit and a steel drive pin. The rotor is dynamically balanced.

8. The motor is bipolar, series wound, its laminated field assembly being supported by four bosses, cast integral with the case. Steel screws extend through the field core and thread into the bosses. The field structure is in direct contact with the case. Such a method offers less resistance to the dissipation of the heat generated by the motor.

9. Ball bearings are provided for the motor, one being located in a boss in the bottom of the case, the other in a boss in the case cover or motor plate.

10. The motor brush holders are located in bosses on each side of the case and are reached from the outside by removing an oval-headed steel screw, equipped with a rubber gasket for water-proofing.

11. A terminal block of phenolic material, equipped with terminal lugs, is reached by removing a cast aluminum alloy cover from the side of

the case. The terminal block is secured with two steel screws which thread into steel inserts located in bosses. Removal of this block allows one to inspect the commutator and brushes of the motor.

12. Located on each side of the case is a boss tapped for a standard 3/4-inch (IPS) terminal tube. Three mounting lugs, drilled to accommodate 3/8-inch bolts, are located on the bottom of the case.

13. The case is made waterproof by the use of rubber gaskets in connection with the terminal box cover and the motor plate, and by a felt washer placed around the armature shaft where it extends through the plate. This recessed felt washer is held in place by means of a small disc secured to the plate with four No. 8-32 fillister headed machine screws.

14. A circular "V" edge in the flange of the case is forced into a recessed square rubber gasket when the motor plate is secured.

15. Further details in the design of the sirens are given by photographs, Plates 3 to 8 inclusive, and by drawing, reference (c). The interchangeable deflectors and projectors submitted are shown by photographs, Plates 4 to 7 inclusive.

METHOD OF TEST

16. The sirens as received were first tested for power consumption, sound output and pitch of note, at rated voltage and frequency (115 volts, a.c., 60 cycles).

17. Following, the sirens were moved outside in the open air and tested to determine the effect of the interchangeable deflectors and projectors relative to direction and sound intensity.

18. They were next tested for shock integrity by placing them on a Bureau of Engineering shock stand and applying the required number of shocks, specified under paragraph F-2h(3) of reference (b).

19. Then followed the usual test for endurance by placing them in a compartment having an ambient temperature of 65°C and operating them one minute every alternate minute for 24 hours. During this test, the temperature rise of the motors was obtained by the resistance method. The temperature was then lowered to 40°C and the sirens were operated for 24 hours at intervals of one minute every alternate minute.

20. Next, they were tested for operating characteristics when inclined 30° from the vertical in any plane and supplied with current at voltages between 20% under and 10% over normal operating voltage. They were also tested for operation over a frequency range of 55 to 65 cycles.

21. The pitch of note was obtained by beating them against a General Radio beat frequency oscillator, type 513-B. During this test, the voltage to the sirens was maintained at 115 volts.

22. Prior to conducting the splash test, 1500 volts, a.c., 60 cycles, was applied between all current carrying parts and ground for a period of one minute. Upon conclusion, the insulation resistance was measured.

23. The sound output of the sirens was measured in a sound-proof room by a General Radio noise meter, type 559-A, located 18 feet from and on the axis of the siren. The rated voltage (115 volts) was maintained during this test.

24. The watertight integrity was determined by spraying them with a stream of water of one inch diameter, under a pressure-head of approximately 30 feet, played from a hose at a distance of 20 feet, for a period of 5 minutes.

25. The test was concluded by operating the sirens at -30°C and inspecting them to determine any defects resulting from the tests and their conformance with the specifications relative to materials, design and workmanship.

RESULTS OF TEST

26. The test results obtained were as follows:

Requirements	Test Values			
	Type A		Type B	
	Siren No. 1	Siren No. 2	Siren No. 3	Siren No. 4
Voltage: 115 volts	115	115	115	115
Amperes: Not specified	0.773	1.065	2.70	2.27
Frequency: 60 cycles	60	60	60	60
Watts: Not over 200 watts for type A and 500 watts for type B	84	122	280	233
Power factor: Not less than 60%	94.49%	99.61%	90.18%	89.25%
Endurance: Shall operate one minute every alternate minute for 24 hours at ambient temperature of 65°C , and one minute every alternate minute for 24 hours at ambient temperature of 30°C .	Complied	Complied	Complied	Complied
Inclination: Shall oper- ate satisfactorily when inclined 30° from the vertical in any plane and				

Requirements	Test Values			
	Type A		Type B	
	Siren No. 1	Siren No. 2	Siren No. 3	Siren No. 4
(cont'd) supplied with current at voltages between 20% under and 10% over normal operating voltage	Complied	Complied	Complied	Complied
Frequency range: Shall operate satisfactorily over a frequency range of 55 to 65 cycles	Complied	Complied	Complied	Complied
Dielectric strength: Shall withstand 1500 volts, a.c., 60 cycles, applied between all current carrying parts and ground for a period of one minute, prior to a splash test, and 500 volts, a.c., 60 cycles, following, for a period of one minute	Complied	Complied	Complied	Complied
Insulation resistance: Shall be not less than 10 megohms by 500 volt megger prior to splash test and 1 megohm by 500 volts megger following the splash test	Before (megohms)			
	100	100	100	100
Splash test: Shall not leak when sprayed with a stream of water of 1 inch diameter under a pressure-head of 30 feet, from a distance of 20 feet, for a period of 5 minutes	After (megohms)			
	100	100	100	100
Motor bearing: Ball bearings	Complied	Complied	Complied	Complied
Temperature rise: Shall not exceed 35°C at ambient temperature of 65°C during first part of endurance test	20.35°C	23.74°C	*48.28°C	*39.93°C
Pitch of note: 1500 to 2500 CPS	1525 CPS 10 ports	1650 CPS 10 ports	*1020 CPS 5 ports	*1400 CPS 7 ports
Audibility range: Minimum of 200 yards in still air in the open for type A and 3000 yards for type B	94 db Equivalent to 2000 yd.	101 db to - 2650 yd.	100 db *2550 yd.	99 db *2450 yd.

Requirements	Test Values			
	Type A		Type B	
	Siren No. 1	No. 2	Siren No. 3	No. 4
Case material: Shall be made of cast aluminum alloy	Complied	Complied	Complied	Complied
Rotor: Shall be made of aluminum alloy, cast in one piece	Complied	Complied	Complied	Complied
Weight: Not specified	7 lb.2 oz.	7 lb.2 oz.	7 lb.3oz.	7 lb.3oz.
Dimensions: Not specified	5"75 x 6"375 x 7"125 for each siren, without projector or deflector.			
Nameplates: Specifications, par. D-12	Non-corrosive material, engraved lettering.	Cast raised lettering.	Cast raised lettering.	Non-corrosive material, engraved lettering.
Terminal block: Phenolic material, equipped with wire terminal lugs, drawing 9-S-1841-L	Complied	Complied	Complied	Complied
Salt spray test: Par. F-2f	See comments under "Conclusions."			

* Denotes failure to comply with the specifications.

CONCLUSIONS

27. The sample sirens, identified by numbers 1 and 2, comply with the specifications required of Navy type A sirens.

28. Samples 3 and 4 also meet the specifications, except for failure to meet the temperature rise and audibility requirements. Number 3 siren exceeded the allowable rise by 13.28°C , and number 4 by 4.93°C . These samples were submitted as type B sirens, as will be noted under reference (e).

29. An inspection of samples 3 and 4 at the conclusion of the salt spray test showed slight pitting of the anodic treated deflector on number 4 siren, and rusting of the steel lockwashers on both. Both sirens were found watertight and operative. Samples 1, 2 and 3 are finished outside with aluminum paint, and number 4 is finished in sand-blast with anodic treatment. It will be noted that the projectors are of formed aluminum sheet while the cases are of nickel aluminum alloy.

30. The priming coat of zinc chromate paint has been omitted on all of the sirens.

31. The sirens are of excellent design and workmanship, and free access to the motor brushes and commutator is afforded.

32. The results of the tests conducted outside in open still air (Table I, Plates 1 and 2), show that the use of the sound deflector and projector features of the sirens is unwarranted for Naval service.

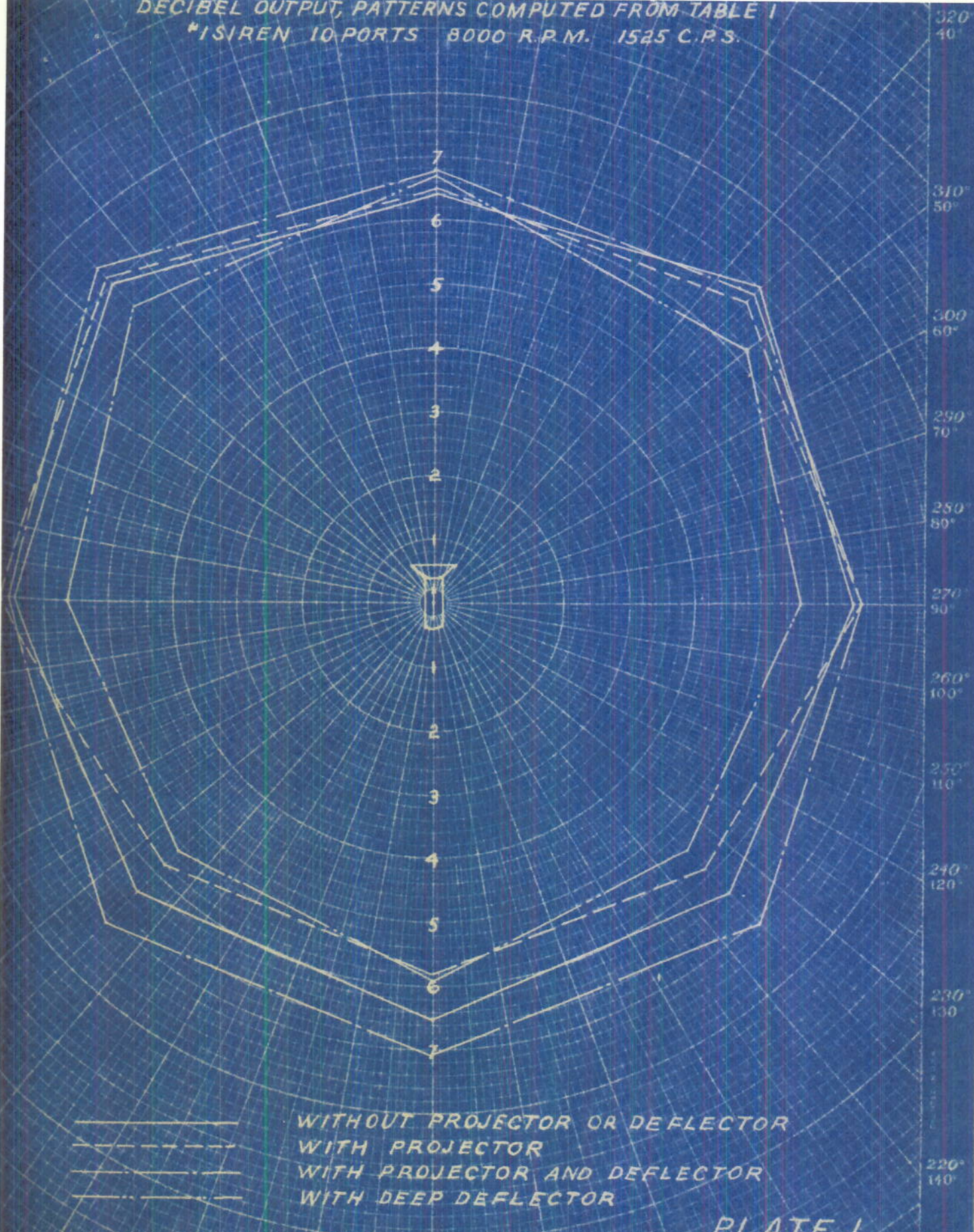
SOUND OUTPUT (IN DECIBELS) AT 60 FOOT RADIUS
USING GENERAL RADIO TYPE 559-A NOISE METER

Position of sound meter in degrees	No. 1 Siren - 10 Ports - 8000 RPM				No. 2 Siren		No. 3 Siren	
	without projector or deflector.	with projector	with projector and deflector	with deep deflector	10 Ports 9000 RPM		12,000 RPM	
					5 Ports	7 Ports	with shallow deflector	with shallow deflector
0	64	65	68	67	63	77	65	
45	70	71	71	65	57	70	61	
90	65	68	66	56	64	65	68	
135	64	58	71	55	60	66	64	
180	65	58	71	59	62	74	63	
225	64	59	71	55	58	72	62	
270	64	65	65	56	63	69	68	
315	70	67	69	62	70	75	70	

Note: A potential of 115 V. A.C., was maintained at the siren terminals during this test.



DECIBEL OUTPUT, PATTERNS COMPUTED FROM TABLE I
 #1 SIREN 10 PORTS 8000 R.P.M. 1525 C.P.S.



WITHOUT PROJECTOR OR DEFLECTOR
 WITH PROJECTOR
 WITH PROJECTOR AND DEFLECTOR
 WITH DEEP DEFLECTOR

PLATE I

150°
210°

160°
200°

170°
190°

180°
180°

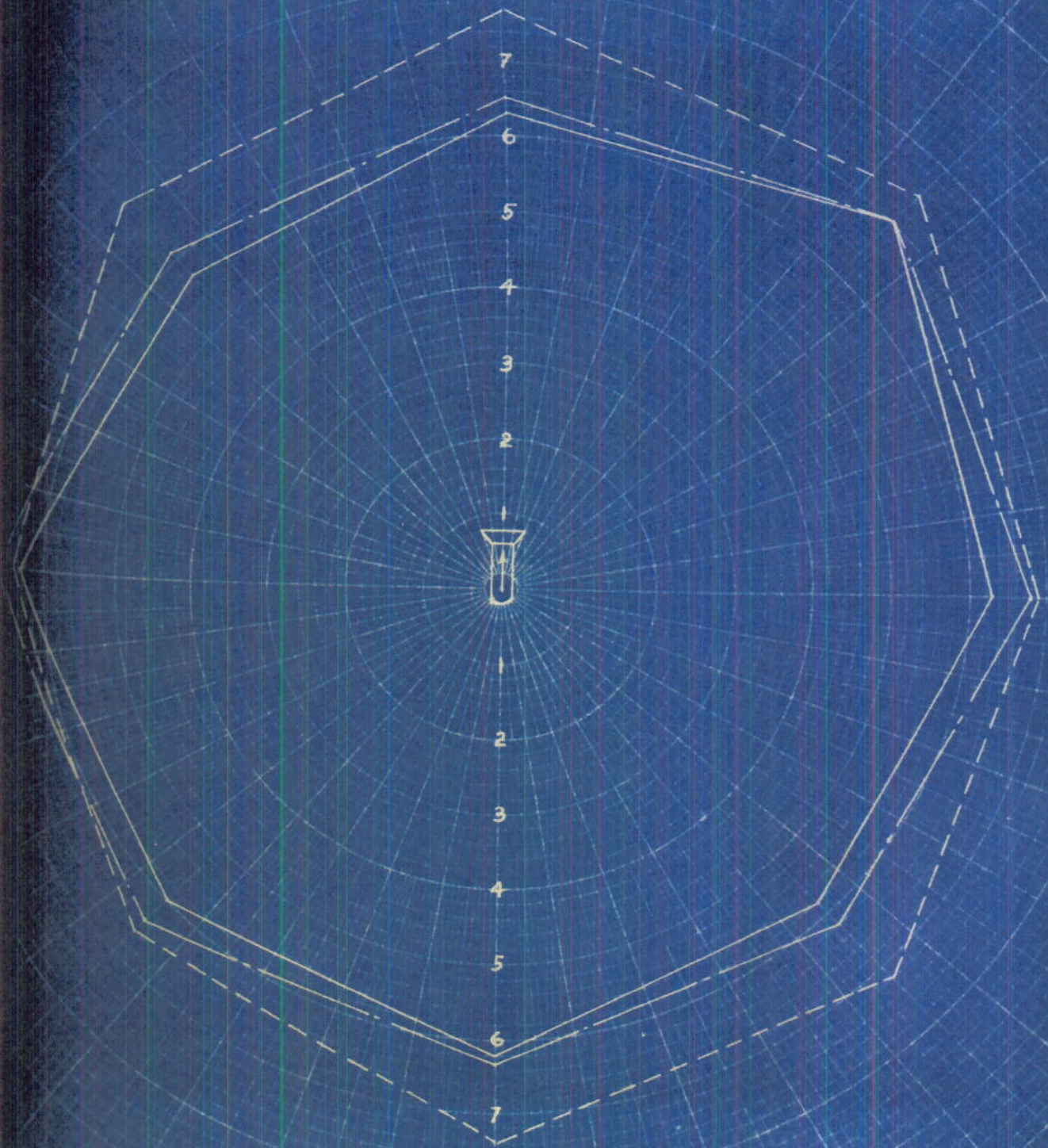
190°
170°

200°
160°

210°
150°

320°
40°
310°
50°
300°
60°
290°
70°
280°
80°
270°
90°
260°
100°
250°
110°
240°
120°
230°
130°
220°
140°

DECIBEL OUTPUT PATTERNS COMPUTED FROM TABLE I



- #2 SIREN SHALLOW DEFLECTOR 9000 R.P.M. (1650 C.P.S.)
- - - #3 SIREN (5 PORT) SHALLOW DEFLECTOR 12000 R.P.M. (1020 C.P.S.)
- · - #3 SIREN (7 PORT) SHALLOW DEFLECTOR 12000 R.P.M. (1400 C.P.S.)

PLATE 2

150° 160° 170° 180° 190° 200° 210°
210° 200° 190° 180° 170° 160° 150°

320°
40°
310°
50°
300°
60°
290°
70°
280°
80°
270°
90°
260°
100°
250°
110°
240°
120°
230°
130°
220°
140°

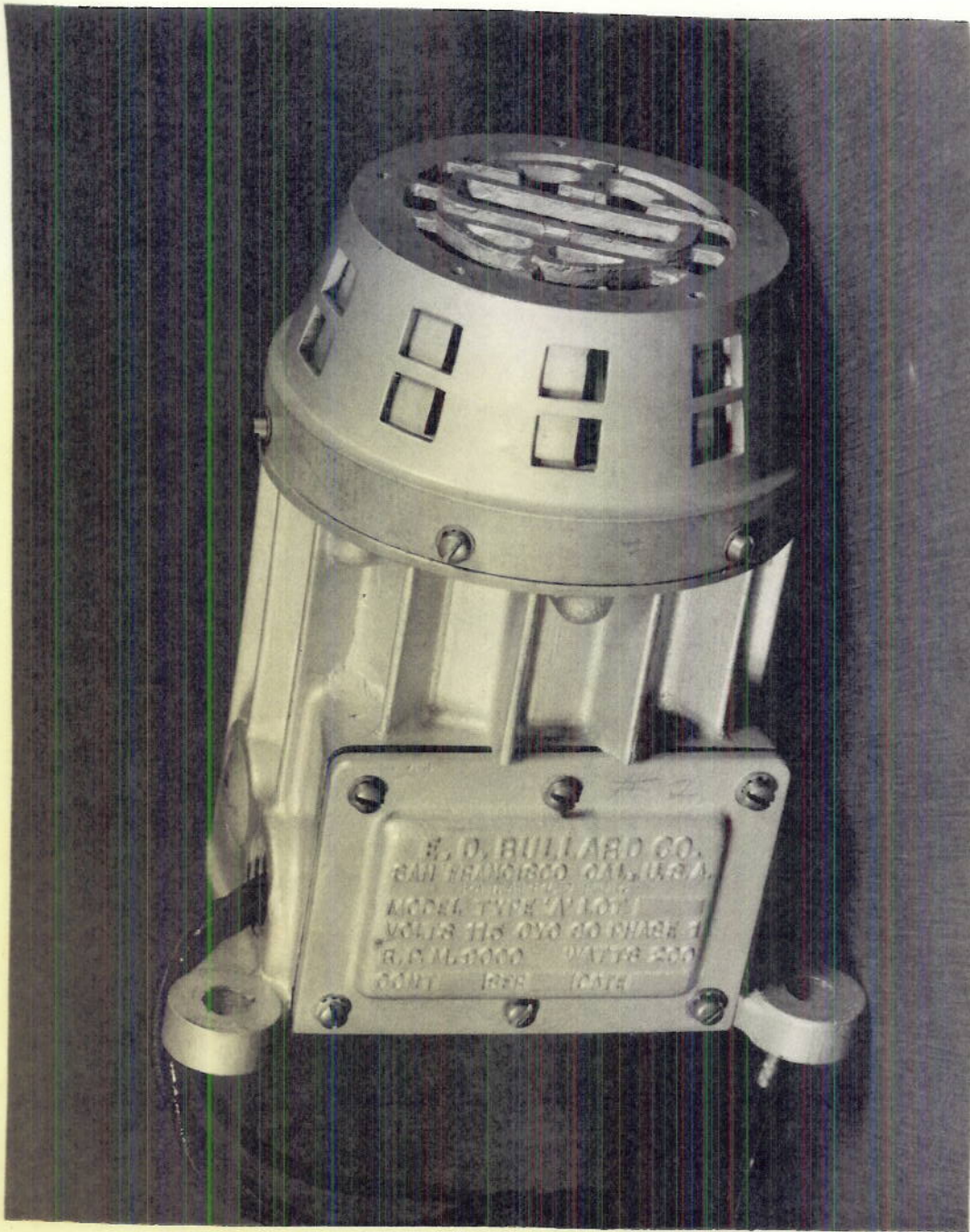


Plate 3

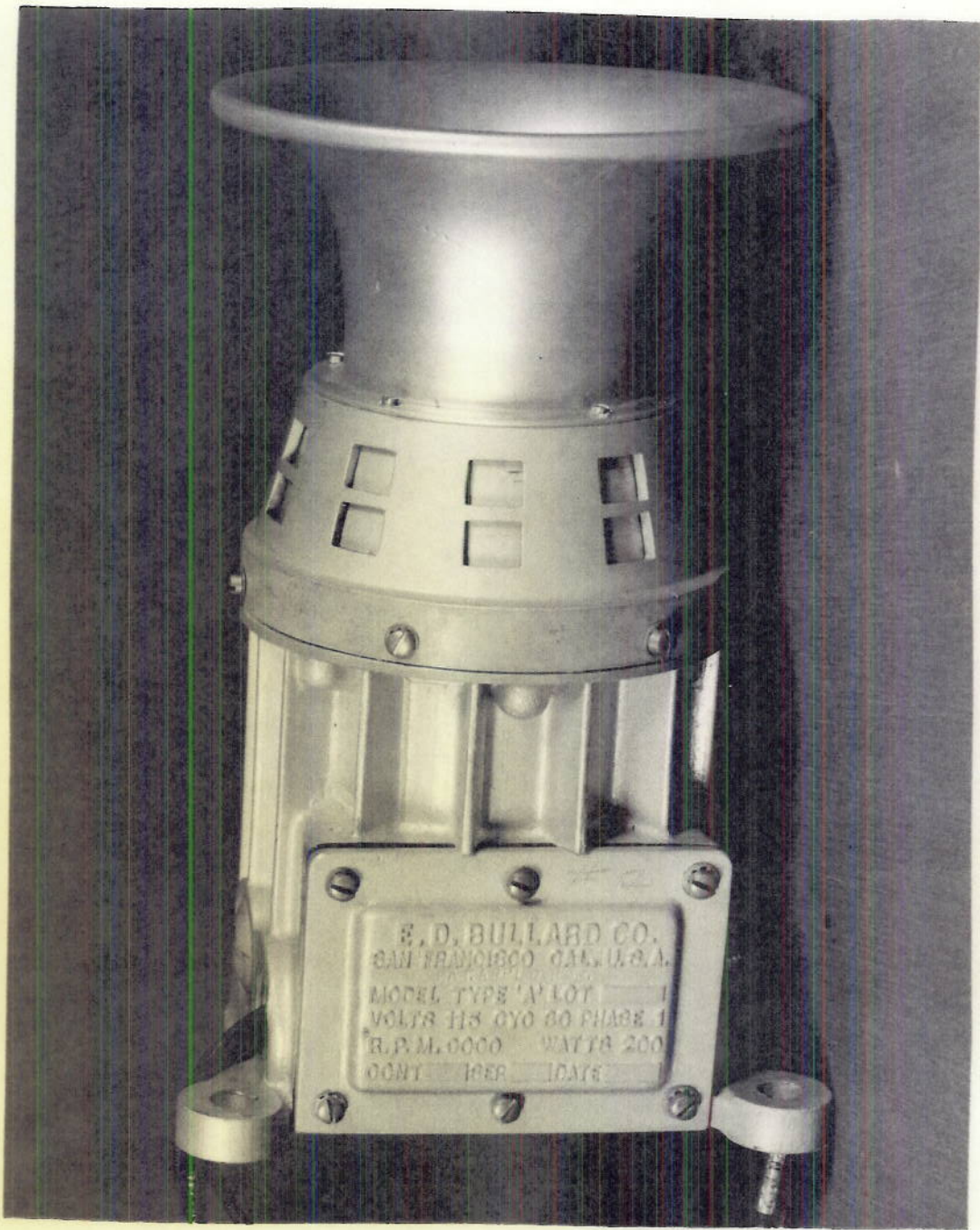
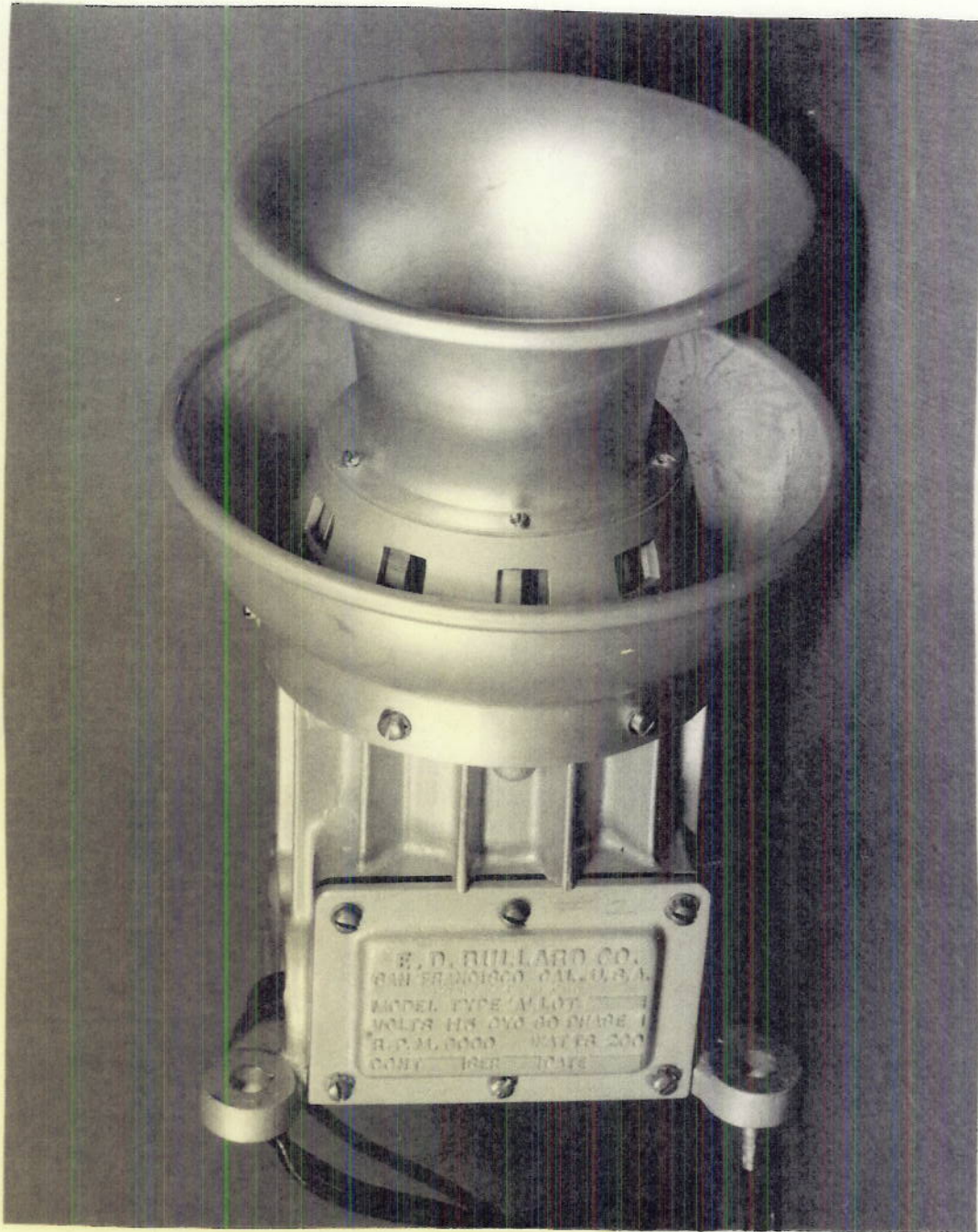


Plate 4



E. D. HULLARD CO.
SAN FRANCISCO CAL. U.S.A.
MODEL TYPE "A" LOT
VOLTS 115 0V0 60 CYCLE 1
R.P.M. 3000 WATER 200
CONF. TRADE MARK

Plate 5.



Plate 6

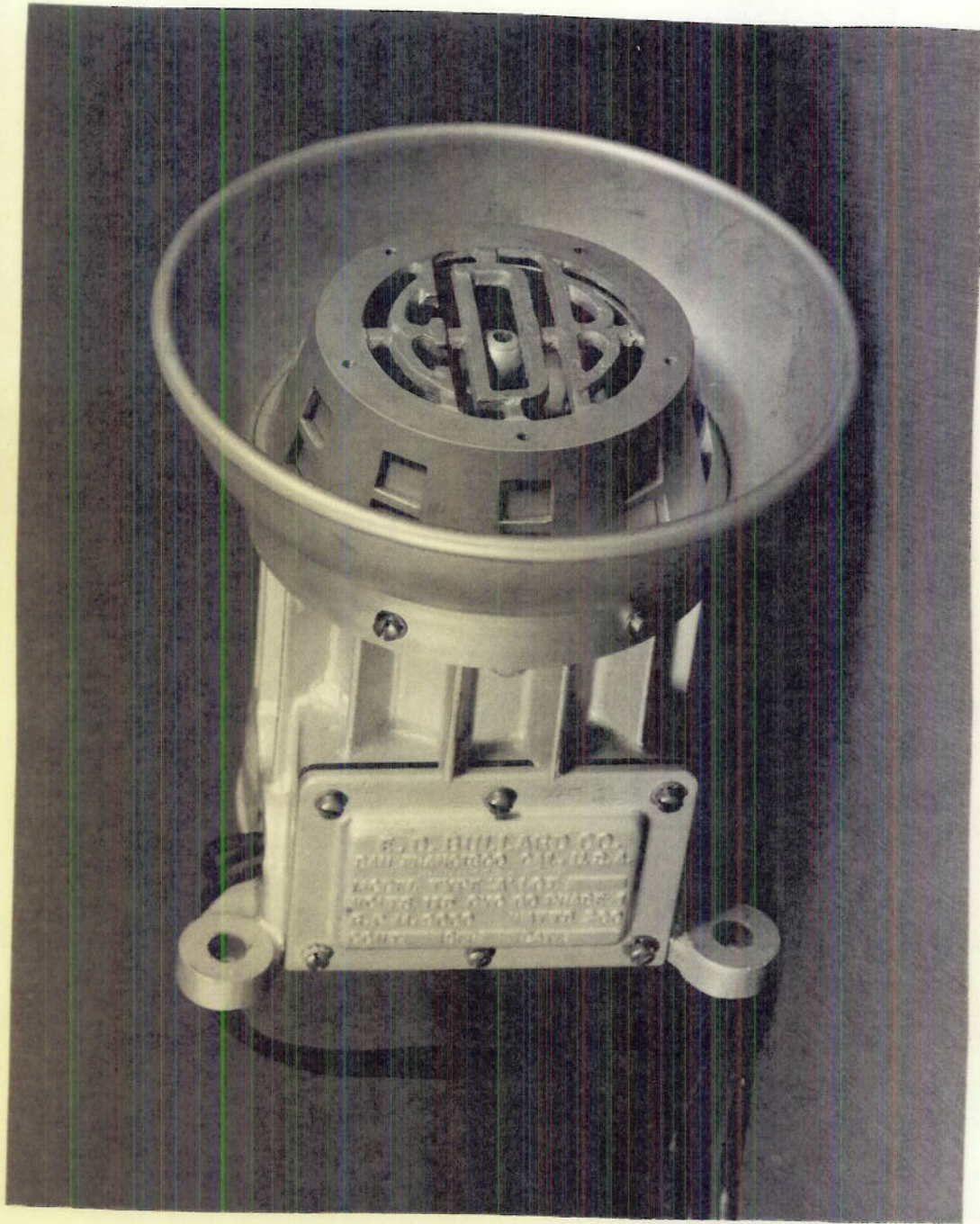


Plate 7

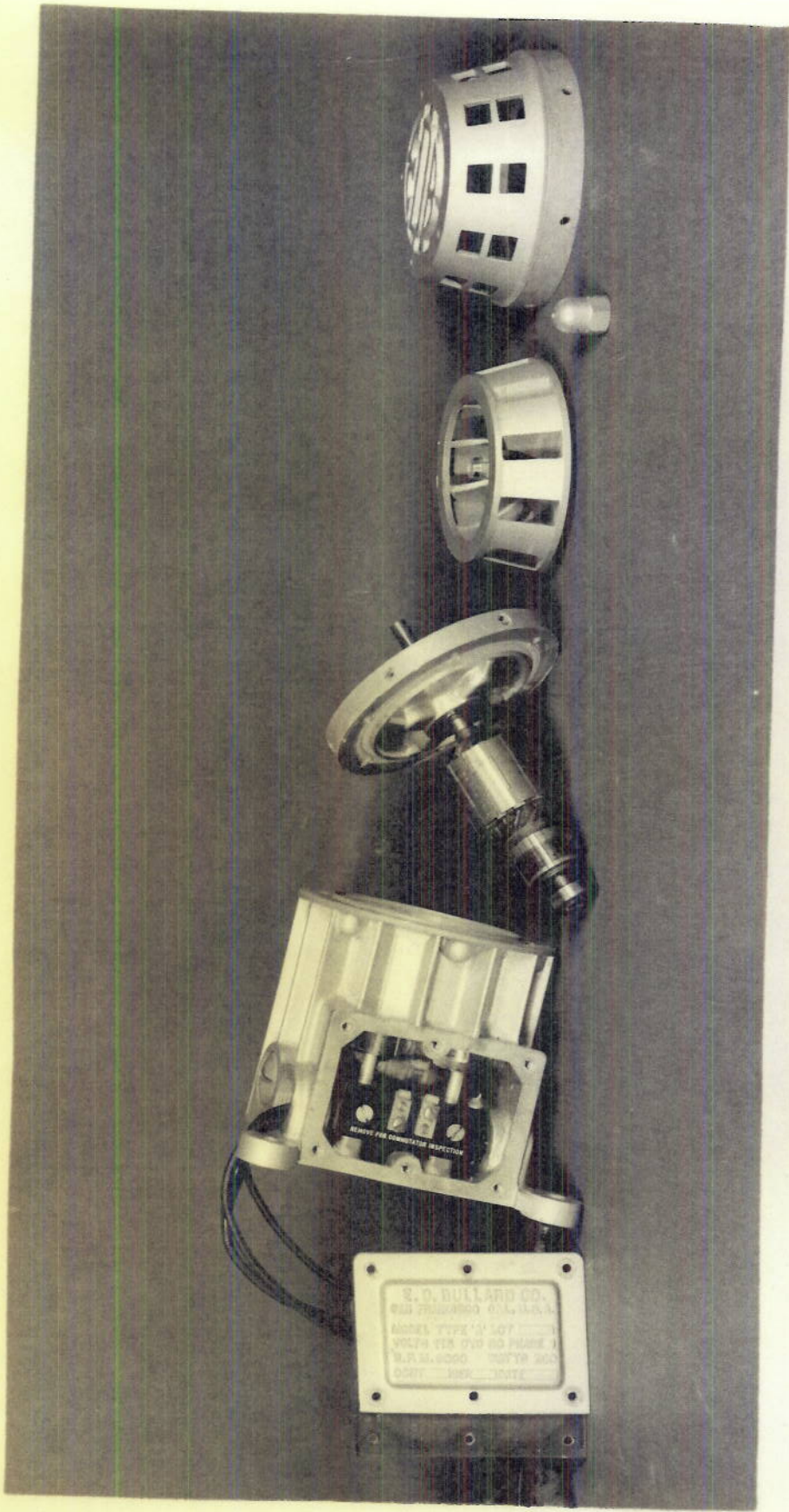


Plate 8