

10 July 1935

NRL Report No. B-1174

NAVY DEPARTMENT
BUREAU OF ENGINEERING

FR-1174

Report of

Test on Bells and Buzzers, Contract NOs-37951

Manufactured and Submitted by Chas. J. Henschel
and Company, Inc., Amesbury, Massachusetts.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

Number of Pages: Text - 7 Plates - 12

Authorization: Bu.Eng.let. ENG/508 (8-13-Ds) of 21 August 1934.

Date of Test: April to June 1935.

Tested by:

J.R. Coomes, Sr.Eng.Aide J.S. Bryant, Sr.Eng.Aide

Prepared by:

W.B. Roberts, Sr.Eng.Aide, Chief of Section.

Reviewed by:

W.M. Haynsworth, Jr., Lieut., USN.

Approved by:

H.M. Cooley, Captain, USN, Director.

Distribution Unlimited

Distribution:

Bu.Eng. (5)

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Approved for
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TABLE OF CONTENTS

<u>Subject</u>	<u>Page</u>
AUTHORIZATION FOR TEST.	1
OBJECT OF TEST.	1
ABSTRACT.	1
Conclusions.	1a
Recommendations.	1a
DESCRIPTION OF MATERIAL UNDER TEST.	2
METHOD OF TEST.	3
RESULTS OF TEST	4
COMMENTS ON RESULTS OF TEST	6
CONCLUSIONS.	7

Appendices (Photographs)

12-inch, 115 V. D.C. Vibrating Bell Assembled	Plate 1
12-inch, 115 V. D.C. Vibrating Bell, Case Cover Removed, Showing Assembly of Mechanism.	Plate 2
8-inch, 115 V. D.C. Vibrating Bell Assembled.	Plate 3
8-inch, 115 V. D.C. Vibrating Bell, Case Cover Removed, Showing Assembly of Mechanism.	Plate 4
4-inch, 115 V. D.C. Vibrating Bell Assembled and Case Cover Removed, Showing Assembly of Mechanism	Plate 5
Low Pitch 115 V. D.C. Vibrating Buzzer, 2 views, Assembled, and with Case Cover Removed, Showing Assembly of Mechanism .	Plate 6
12-inch, 115 V. A.C. Vibrating Bell Assembled.	Plate 7
12-inch, 115 V. A.C. Vibrating Bell, Case Cover Removed, Showing Assembly of Mechanism.	Plate 8
8-inch, 115 V. A.C. Vibrating Bell Assembled.	Plate 9
8-inch, 115 V. A.C. Vibrating Bell, Case Cover Removed, Showing Assembly of Mechanism.	Plate 10
4-inch, 115 V. A.C. Vibrating Bell Assembled and Case Cover Removed, Showing Assembly of Mechanism	Plate 11
Low Pitch 115 V. A.C. Vibrating Buzzer, Two Views, Assembled, and with Case Cover Removed, showing Assembly of Mechanism .	Plate 12

AUTHORIZATION

1. This test was authorized by reference (a) and other additional references pertinent to this problem are listed as references (b) to (k) inclusive.

- Reference:
- (a) Bu.Eng.1tr. ENS/508(8-13-Ds) of 21 August 1934.
 - (b) Navy Dept.Specs. SGS(65)-102 of 2 January 1935.
 - (c) Contract NOS-37951 - Requisition Bureau 508 NIRA. Chas.J. Henschel & Co., Inc., Amesbury, Mass., Contractor.
 - (d) Chas.J. Henschel Dwg.20-106, of 12" W.T. Vibrating Bell, 60 cycles, 115 V. A.C. Bureau File No. CL40-S65-627 Alt. O.
 - (e) Chas.J. Henschel Dwg.20-104, of 8" W.T. Vibrating Bell, 60 cycles, 115 V. A.C. Bureau File No. CL40-S65-626 Alt. O.
 - (f) Chas.J. Henschel Dwg.20-102, of 4" W.T. Vibrating Bell, 60 cycles, 115 V. A.C. Bureau File No. CL40-S65-625 Alt. O.
 - (g) Chas.J. Henschel Dwg.20-100 of W.T. Vibrating Buzzer, 60 cycles, 115 V. A.C.
 - (h) Chas.J. Henschel Dwg.20-107 of 12" W.T. Vibrating Bell, 115 V. D.C.
 - (i) Chas.J. Henschel Dwg.20-105 of 8" W.T. Vibrating Bell, 115 V. D.C.
 - (j) Chas.J. Henschel Dwg.20-103 of 4" W.T. Vibrating Bell, 115 V. D.C.
 - (k) Chas.J. Henschel Dwg.20-101 of W.T. Vibrating Buzzer, 115 V. D.C.

OBJECT OF TEST

2. The object of this test was to determine how closely the material submitted complied with the requirements of the specifications, reference (b), contract, reference (c), and its suitability for the Naval Service. It was also desired that comparative tests be made between these bells and buzzers and representative samples of those now used in the Naval Service.

ABSTRACT OF TEST

3. The bells and buzzers submitted, shown by Plates 1 to 12 inclusive, were set up at this Laboratory and closely observed for their operating characteristics while under test for conformance with the specifications, reference (b). Each unit was carefully examined to ascertain whether it was in strict accordance with the specifications in the matter of materials, design, and workmanship.

CONCLUSIONS

(a) In general, these bells and buzzers, manufactured and submitted for test by Chas. J. Henschel and Company and covered by this report, represent an improvement in design. They possess a greater sound output and are more rugged than those now used in the Naval Service.

(b) The equipment, if modified to correct the defects covered under "COMMENTS" of this report, would be suitable for the Naval Service.

RECOMMENDATIONS

(a) In view of the subject material having satisfactorily complied with the major requirements of the specifications, reference (b), it is recommended that it be approved for the Naval Service, subject to correction of defects noted under "COMMENTS" of this report.

CONCLUSIONS

(a) In general, these bells and buzzers, manufactured and submitted for test by Chas. J. Henschel and Company and covered by this report, represent an improvement in design. They possess a greater sound output and are more rugged than those now used in the Naval Service.

(b) The equipment, if modified to correct the defects covered under "COMMENTS" of this report, would be suitable for the Naval Service.

RECOMMENDATIONS

(a) In view of the subject material having satisfactorily complied with the major requirements of the specifications, reference (b), it is recommended that it be approved for the Naval Service, subject to correction of defects noted under "COMMENTS" of this report.

CONCLUSIONS

(a) In general, these bells and buzzers, manufactured and submitted for test by Chas. J. Henschel and Company and covered by this report, represent an improvement in design. They possess a greater sound output and are more rugged than those now used in the Naval Service.

(b) The equipment, if modified to correct the defects covered under "COMMENTS" of this report, would be suitable for the Naval Service.

RECOMMENDATIONS

(a) In view of the subject material having satisfactorily complied with the major requirements of the specifications, reference (b), it is recommended that it be approved for the Naval Service, subject to correction of defects noted under "COMMENTS" of this report.

DESCRIPTION OF MATERIAL UNDER TEST

4. The equipment tested was submitted under Contract NOs-37951 for development of bells and buzzers which will satisfactorily meet the present conditions aboard Naval vessels.

5. The material submitted for test was as follows:

- 1 - 12 inch Vibrating Bell, 115 volts, D.C.
- 1 - 8 inch Vibrating Bell, 115 volts, D.C.
- 1 - 4 inch Vibrating Bell, 115 volts, D.C.
- 1 - Low Pitch Buzzer, 115 volts, D.C.
- 1 - 12 inch Vibrating Bell, 115 volts, A.C.
- 1 - 8 inch Vibrating Bell, 115 volts, A.C.
- 1 - 4 inch Vibrating Bell, 115 volts, A.C.
- 1 - Low Pitch Buzzer, 115 volts, A.C.
- 1 - 12 inch Single Stroke Bell, 115 volts, D.C.
- 1 - 12 inch Single Stroke Bell, 115 volts, A.C.

6. The A.C. and D.C. sample bells and buzzers are essentially the same in design, differing only in the electromagnet windings.

7. The magnetic circuit consists of a "U" shaped laminated core and a laminated armature of rectangular cross section.

8. Each pole piece supports a form wound coil containing a "primary" and "secondary" winding. The two primary windings are connected in series and are also in series with the contacts. Each secondary winding is closed, having no external leads. This tends to reduce the arc at the contacts and improve the power factor.

9. The only internal adjustment of the mechanism is the stationary contact, mounted on a laminated Bakelite base which also supports two line terminals. The movable contact is mounted on a flat beryllium copper spring and is linked to the armature by a phenolized canvas insulator. This insulator is so slotted that the movement of the armature exceeds that of the contact spring, allowing the contacts to remain closed during part of the armature's travel.

10. On the bells, the stroke of the hammer arm is adjustable from the outside. The bronze armature shaft enters the watertight case through a packing gland, and supports the laminated armature. The shaft has ample bearing surface, provided by a yoke, cast as part of the composition case cover on which the entire mechanism is assembled.

11. The buzzer mechanism is identical to that of the bell, except that the noise is produced by the armature striking the laminated core.

12. The gongs on all of the sample bells are stamped stainless steel, highly polished on the outer surface, and have a square hole in their centers. This feature prevents the gong from being turned, thereby assuring a definite relation between the gong and the hammer arm.

13. The watertight cases are cast aluminum alloy provided with four mounting lugs and a handle, and tapped for 3/4" standard terminal tube.

14. Further description of the subject material is given by the manufacturer's drawings, references (i) to (k) inclusive, and Plates 1 to 12 inclusive.

RESULTS OF TESTS

15. Inasmuch as the bells and buzzers were developed primarily to give less noise than those at present used in the Naval Service, it was deemed necessary to conduct a test, comparing them with representative samples of those now used in the Naval Service. The results of this test were submitted to the Bureau under NRL Letter S65-4/L5 of 12 April 1935. The 12-ohm stroke bells proved unsatisfactory and by direction of the Bureau they were returned to the manufacturer for further development.

16. After completion of the comparative sound tests, the bells and buzzers were placed in a compartment having an ambient temperature of 65°C and tested for endurance by operating each one minute, every alternate minute, for 24 hours. The ambient temperature was then lowered to 40°C and each unit again operated one minute, every alternate minute, for 24 hours. During this test the temperature rise of each winding was obtained using the resistance method.

17. Next, each unit was tested for operation at over and under voltages when inclined 30° from the vertical plane in all directions. The A.C. units were also tested at over and under frequency.

18. Following this, the units were tested for current consumption, insulation resistance and dielectric strength. The power factors of the A.C. bells and buzzers were also obtained.

19. Then all units were tested for their audibility ranges in the open air while supplied with their rated voltages.

20. Each unit was then tested for shock integrity by placing it on a Bureau of Engineering shock stand and subjecting it to the shocks required under reference (h).

21. Next, the watertight integrity of the bells and buzzers was determined by submerging each in a tank of salt water to a depth of 3 feet for a period of 1 hour.

22. Finally, each sample was inspected to ascertain whether the materials, design and workmanship were in accordance with the specifications, reference (b).

13. The watertight cases are cast aluminum alloy provided with four mounting lugs and two bosses, one tapped for 3/4" standard terminal tube.

14. Further description of the subject material is given by the manufacturer's drawings, references (d) to (k) inclusive, and Plates 1 to 12 inclusive.

METHOD OF TEST

15. Inasmuch as the bells and buzzers were developed primarily to produce more noise than those at present used in the Naval Service, it was first necessary to conduct a test, comparing them with representative samples of those now used in the Naval Service. The results of this test were submitted to the Bureau under NRL letter S65-4/L5 of 12 April 1935. The 12-inch single stroke bells proved unsatisfactory and by direction of the Bureau they were returned to the manufacturer for further development.

16. After completion of the comparative sound tests, the bells and buzzers were placed in a compartment having an ambient temperature of 65°C and tested for endurance by operating each one minute, every alternate minute, for 24 hours. The ambient temperature was then lowered to 40°C and each unit again operated one minute, every alternate minute, for 24 hours. During this test the temperature rise of each winding was obtained using the resistance method.

17. Next, each unit was tested for operation at over and under voltage when inclined 30° from the vertical plane in all directions. The A.C. units were also tested at over and under frequency.

18. Following this, the units were tested for current consumption, insulation resistance and dielectric strength. The power factors of the A.C. bells and buzzers were also obtained.

19. Then all units were tested for their audibility ranges in the open air while supplied with their rated voltages.

20. Each unit was then tested for shock integrity by placing it on a Bureau of Engineering shock stand and subjecting it to the shocks required under reference (b).

21. Next, the watertight integrity of the bells and buzzers was determined by submerging each in a tank of salt water to a depth of 3 feet for a period of 1 hour.

22. Finally, each sample was inspected to ascertain whether the materials, design and workmanship were in accordance with the specifications, reference (b).

RESULTS OF TEST

23. Specification Requirements.	Test Values 115 volt - 60 cycle A.C. Bells and Buzzer			
	12"	8"	4"	Buzzer
Voltage - 115	115	115	115	115
Frequency - 60 cycles	60	60	60	60
Amperes	0.173	0.075	0.138	0.148
Resistance (By bridge, ambient 40°C)	39.9 ohms	121.0 ohms	235.2 ohms	233.1 ohms
Watts				
12" not over 25 watts	11.6			
8" not over 20 watts		5.5		
4" not over 15 watts			*15.4	
Buzzer not over 15 watts				*16.4
Power Factor - 30% Min.	58.3	63.7	97.0	96.3
Endurance: One minute of operation every alternate minute for 24 hours at 65°C ambient and 24 hours at 40°C ambient.	*See comments Par. 26	Satisfactory	*See comments Par. 27	*See comments Par. 27
Temperature rise: Not over 30°C rise at ambient of 40°C during latter part of endurance test.	27.45°C	29.37°C	28.82°C	30.0°C
Inclination: Satisfactory operation when inclined 30° from vertical in all directions at 10% over voltage (126.5) at 65 cycles and 10% under voltage (103.5) at 55 cycles.	Satisfactory	Satisfactory	Satisfactory	Satisfactory
Shock integrity: Satisfactory operation under shocks when mounted on shock machine as required by specifications, par. F-5c.	Satisfactory	Satisfactory	Satisfactory	Satisfactory
Audibility range: Shall be heard in still air in the open.				
12" 150 yards (min)	400 yds.			
8" 100 yards (min)		430 yds.		
4" 50 yards (min)			300 yds.	
Buzzer 30 yards (min)				230 yds.
Insulation resistance:				
Before immersion - 5 megohms (min)	200 meg.	200 meg.	200 meg.	100 meg.
After immersion - 1 megohm (min) (By 1000 V. Megger)	100 "	25 "	100 "	100 "
Watertight integrity: Shall not leak when submerged in salt water to a depth of 3 ft. for a period of 1 hour.	Satisfactory	*Leaked 30 cc	Satisfactory	Satisfactory

RESULTS OF TEST

23. Specification Requirements.	Test Values			
	115 volt - 60 cycle A.C. Bells and Buzzer			
	12"	8"	4"	Buzzer
Voltage - 115	115	115	115	115
Frequency - 60 cycles	60	60	60	60
Amperes	0.173	0.075	0.138	0.14 ²
Resistance (By bridge, ambient 40°C)	39.9 ohms	121.0 ohms	235.2 ohms	233.1 ohms
Watts				
12" not over 25 watts	11.6			
8" not over 20 watts		5.5		
4" not over 15 watts			*15.4	
Buzzer not over 15 watts				*16.4
Power Factor - 30% Min.	58.3	63.7	97.0	96.3
Endurance: One minute of operation every alternate minute for 24 hours at 65°C ambient and 24 hours at 40°C ambient.	*See comments Par. 26	Sat- isfac- tory	*See com- ments Par. 27	*See com- ments Par. 27
Temperature rise: Not over 30°C rise at ambient of 40°C during latter part of endurance test.	27.45°C	29.37°C	28.82°C	30.0°C
Inclination: Satisfactory operation when inclined 30° from vertical in all directions at 10% over voltage (126.5) at 65 cycles and 10% under voltage (103.5) at 55 cycles.	Satis- fac- tory	Satis- fac- tory	Satis- fac- tory	Satis- fac- tory
Shock integrity: Satisfactory operation under shocks when mounted on shock machine as required by specifications, par. F-5c.	Satis- fac- tory	Satis- fac- tory	Satis- fac- tory	Satis- fac- tory
Audibility range: Shall be heard in still air in the open.				
12" 150 yards (min)	400 yds.			
8" 100 yards (min)		430 yds.		
4" 50 yards (min)			300 yds.	
Buzzer 30 yards (min)				230 yds.
Insulation resistances:				
Before immersion - 5 megohms (min)	200 meg.	200 meg.	200 meg.	100 meg.
After immersion - 1 megohm (min) (By 1000 V. Megger)	100 "	25 "	100 "	100 "
Watertight integrity: Shall not leak when submerged in salt water to a depth of 3 ft. for a period of 1 hour.	Satis- fac- tory	*Leaked 30 cc	Satis- fac- tory	Satis- fac- tory

Specification Requirements	Test Values 115 volt - 60 cycle A.C. Bells and Buzzer			
	12"	8"	4"	Buzzer
Dielectric strength:				
Before immersion - 1230 V. A.C. 60 cycle.	Satis- factory	Satis- factory	Satis- factory	Satis- factory
After immersion - 500 V. A.C. 60 cycle.	"	"	"	"
Case material: Aluminum alloy.	Aluminum alloy	Aluminum alloy	Aluminum alloy	Aluminum alloy
Cover material: Aluminum alloy or approved equivalent.	Comp. M	Comp. M	Comp. M	Comp. M
Gong material: Cast bell metal, pressed brass, bronze, or stainless steel.	Pressed Stainless Steel	Pressed Stainless Steel	Pressed Stainless Steel	--
Total weights.	15 lb. 14 oz.	9 lb. 4 oz.	4 lb. 5 oz.	3 lb. 8 oz.

* Denotes non-compliance with specifications.

24. Specification Requirements	Test Values 115 volt - D.C. Bells and Buzzer			
	12"	8"	4"	Buzzer
Voltage - 115	115	115	115	115
Amperes	0.076	0.080	0.022	0.034
Resistance (By bridge at ambient of 20°C)	111.0 ohms	244.0 ohms	475.0 ohms	422.0 ohms
Efficiency				
12" not over 25 watts	8.75			
8" not over 20 watts		9.25		
4" not over 15 watts			2.50	
Buzzer not over 15 watts				4.00
Endurance: One minute of operation every alternate minute for 24 hours at 65°C ambient and 24 hours at 40°C ambient.	Satis- factory	Satis- factory	Satis- factory	Satis- factory
Temperature rise: Not over 30°C rise at ambient of 40°C. during latter part of endurance test.	19.0°C	23.6°C	11.3°C	10.0°C
Inclination: Satisfactory operation when inclined 30° from vertical in all directions at 10% over voltage (126.5) and 10% under voltage (103.5)	Satis- factory	Satis- factory	Satis- factory	Satis- factory

Specification Requirements	Test Values 115 volt - 60 cycle A.C. Bells and Buzzer			
	12"	8"	4"	Buzzer
Dielectric strength:				
Before immersion - 1230 V. A.C. 60 cycle.	Satis- factory	Satis- factory	Satis- factory	Satis- factory
After immersion - 500 V. A.C. 60 cycle.	"	"	"	"
Case material: Aluminum alloy.	Aluminum alloy	Aluminum alloy	Aluminum alloy	Aluminum alloy
Cover material: Aluminum alloy or approved equivalent.	Comp. M	Comp. M	Comp. M	Comp. M
Gong material: Cast bell metal, pressed brass, bronze, or stainless steel.	Pressed Stainless Steel	Pressed Stainless Steel	Pressed Stainless Steel	--
Total weights.	15 lb. 14 oz.	9 lb. 4 oz.	4 lb. 5 oz.	3 lb. 8 oz.

* Denotes non-compliance with specifications.

24. Specification Requirements	Test Values 115 volt - D.C. Bells and Buzzer			
	12"	8"	4"	Buzzer
Voltage - 115	115	115	115	115
Amperes	0.076	0.080	0.022	0.034
Resistance (By bridge at ambient of 40°C)	111.0 ohms	244.0 ohms	475.0 ohms	422.0 ohms
Watts				
12" not over 25 watts	8.75			
8" not over 20 watts		9.25		
4" not over 15 watts			2.50	
Buzzer not over 15 watts				4.00
Endurance: One minute of operation every alternate minute for 24 hours at 65°C ambient and 24 hours at 40°C ambient.	Satis- factory	Satis- factory	Satis- factory	Satis- factory
Temperature rise: Not over 30°C rise at ambient of 40°C. during latter part of endurance test.	19.0°C	23.6°C	11.3°C	12.0°C
Inclination: Satisfactory operation when inclined 30° from vertical in all directions at 10% over voltage (126.5) and 10% under voltage (103.5)	Satis- factory	Satis- factory	Satis- factory	Satis- factory

Specification Requirements

Test Values
115 Volt - D.C.
Bells and Buzzer

	12"	8"	4"	Buzzer
Shock integrity: Satisfactory operation under shocks when mounted on shock machine as required by specifications, par. F-5c.	Satisfactory	Satisfactory	Satisfactory	Satisfactory
Audibility range: Shall be heard in still air in the open.				
12" 150 yards (min)	417 yds.			
8" 100 yards (min)		400 yds.		
4" 50 yards (min)			333 yds.	
Buzzer 30 yards (min)				250 yds.
Insulation resistance:				
Before immersion - 5 megohms (min)	200 meg.	200 meg.	200 meg.	200 meg.
After immersion - 1 megohm (min)	10 "	15 "	100 "	100 "
Watertight integrity: Shall not leak when submerged in salt water to a depth of 3 ft. for a period of 1 hour.	*Leaked 40 cc	*Leaked 35 cc	Satisfactory	Satisfactory
Dielectric strength:				
Before immersion - 1230 V. A.C. 60 cycle	Satisfactory	Satisfactory	Satisfactory	Satisfactory
After immersion - 500 V. A.C. 60 cycle	"	"	"	"
Total weights	15 lb. 4 oz.	9 lb. 4 oz.	4 lb. 6 oz.	3 lb. 8 oz.

*Denotes non-conformance with specifications.

Note: Case and gong materials same as those of alternating current bells and buzzer.

COMMENTS ON RESULTS OF TEST

25. The power consumed by the four-inch A.C. bell and buzzer slightly exceeded the allowable wattage. However, it is not considered great enough to be objectionable.

26. Under the required endurance test, the 12-inch A.C. bell failed after 12 hours of operation due to the shearing off of the bronze armature shaft. After a steel shaft had been substituted, the bell satisfactorily operated for the required 48 hours. All similar bronze shafts should be replaced with steel.

27. Although the four-inch A.C. bell and buzzer both completed the required 48-hour endurance test, the movable tungsten contact on each became loose. It is believed that this defect could be corrected by placing a washer against the side of the flat spring nearest the armature before riveting.

Specification Requirements

Test Values
115 Volt - D.C.
Bells and Buzzer

	12"	8"	4"	Buzzer
Shock integrity: Satisfactory operation under shocks when mounted on shock machine as required by specifications, par. F-5c.	Satisfactory	Satisfactory	Satisfactory	Satisfactory
Audibility range: Shall be heard in still air in the open.				
12" 150 yards (min)	417 yds.			
8" 100 yards (min)		400 yds.		
4" 50 yards (min)			333 yds.	
Buzzer 30 yards (min)				250 yds.
Insulation resistance:				
Before immersion - 5 megohms (min)	200 meg.	200 meg.	200 meg.	200 meg.
After immersion - 1 megohm (min)	10 "	15 "	100 "	100 "
Watertight integrity: Shall not leak when submerged in salt water to a depth of 3 ft. for a period of 1 hour.	*Leaked 40 cc	*Leaked 35 cc	Satisfactory	Satisfactory
Dielectric strength:				
Before immersion - 1230 V. A.C. 60 cycle	Satisfactory	Satisfactory	Satisfactory	Satisfactory
After immersion - 500 V. A.C. 60 cycle	"	"	"	"
Total weights	15 lb. 4 oz.	9 lb. 4 oz.	4 lb. 6 oz.	3 lb. 8 oz.

*Denotes non-conformance with specifications.

Note: Case and gong materials same as those of alternating current bells and buzzer.

COMMENTS ON RESULTS OF TEST

25. The power consumed by the four-inch A.C. bell and buzzer slightly exceeded the allowable wattage. However, it is not considered great enough to be objectionable.

26. Under the required endurance test, the 12-inch A.C. bell failed after 12 hours of operation due to the shearing off of the bronze armature shaft. After a steel shaft had been substituted, the bell satisfactorily operated for the required 48 hours. All similar bronze shafts should be replaced with steel.

27. Although the four-inch A.C. bell and buzzer both completed the required 48-hour endurance test, the movable tungsten contact on each became loose. It is believed that this defect could be corrected by placing a washer against the side of the flat spring nearest the armature before riveting.

28. When tested for watertight integrity, the 8-inch A.C. bell, 12-inch and 8-inch D.C. bells, leaked at the packing glands and allowed approximately 40 cc of water to enter. This occurred after the endurance test and with the packing gland nuts screwed in as far as possible. This can probably be corrected by substituting a thicker felt packing.

29. The Bureau's attention is invited to the location of the tapped boss on all of the samples submitted. The position is such that it may be difficult to make connections. This is particularly true of the 12-inch bells.

30. The resistance values, as given on furnished drawings, do not check with the values obtained from the samples tested. However, the values furnished in the manufacturer's memorandum are approximately correct.

31. The present method of adjusting the stroke of the hammer arm is unsatisfactory. Adjustment would be facilitated if the hammer arm were provided with two flat surfaces at shaft end to fit a standard end wrench.

32. The specifications require that the bell gong be replaceable in only one position. To meet this requirement, a dowel pin should be provided in the gong bracket and a suitable hole provided in the gong.

33. The terminal bases on all samples submitted are made of laminated Bakelite instead of molded Bakelite as specified on the manufacturer's drawings.

34. No tests could be made at minus 30°C, as required by the specifications, as suitable test equipment is not yet available.

35. The 100-hour salt spray test has not been completed. Upon completion, the Bureau will be informed of the results.

36. This report does not cover tests on the single stroke bells which were returned to the manufacturer for modification. Immediately upon return of the bells, they will be tested and a supplementary report will be forwarded to the Bureau.

CONCLUSIONS

37. In general, these bells and buzzers, manufactured and submitted for test by Chas. J. Henschel and Company and covered by this report, represent an improvement in design. They possess a greater sound output and are more rugged than those now used in the Naval Service.

38. The equipment, if modified to correct the defects covered under "COMMENTS" of this report, would be suitable for the Naval Service.

28. When tested for watertight integrity, the 8-inch A.C. Bell, 2 1/2 inch and 8-inch D.C. bells, leaked at the packing glands and allowed approximately 20 cc of water to enter. This occurred after the endurance test and with the packing gland nuts screwed in as far as possible. This can probably be corrected by substituting a thicker felt packing.

29. The Bureau's attention is invited to the location of the tapered boss on all of the samples submitted. The position is such that it may be difficult to make connections. This is particularly true of the 10 inch bells.

30. The resistance values, as given on furnished drawings, do not check with the values obtained from the samples tested. However, the values furnished in the manufacturer's memorandum are approximately correct.

31. The present method of adjusting the stroke of the buzzer arm is unsatisfactory. Adjustment would be facilitated if the buzzer arm were provided with two flat surfaces at shaft end to fit a standard cam groove.

32. The specifications require that the bell gong be replaceable in only one position. To meet this requirement, a dowel pin should be provided in the gong bracket and a suitable hole provided in the gong.

33. The terminal bases on all samples submitted are made of laminated Bakelite instead of molded Bakelite as specified on the manufacturer's drawings.

34. No tests could be made at minus 30°C, as required by the specifications, as suitable test equipment is not yet available.

35. The 100-hour salt spray test has not been completed. Upon completion, the Bureau will be informed of the results.

36. This report does not cover tests on the single stroke bells which were returned to the manufacturer for modification. Immediately on return of the bells, they will be tested and a supplementary report will be forwarded to the Bureau.

CONCLUSIONS

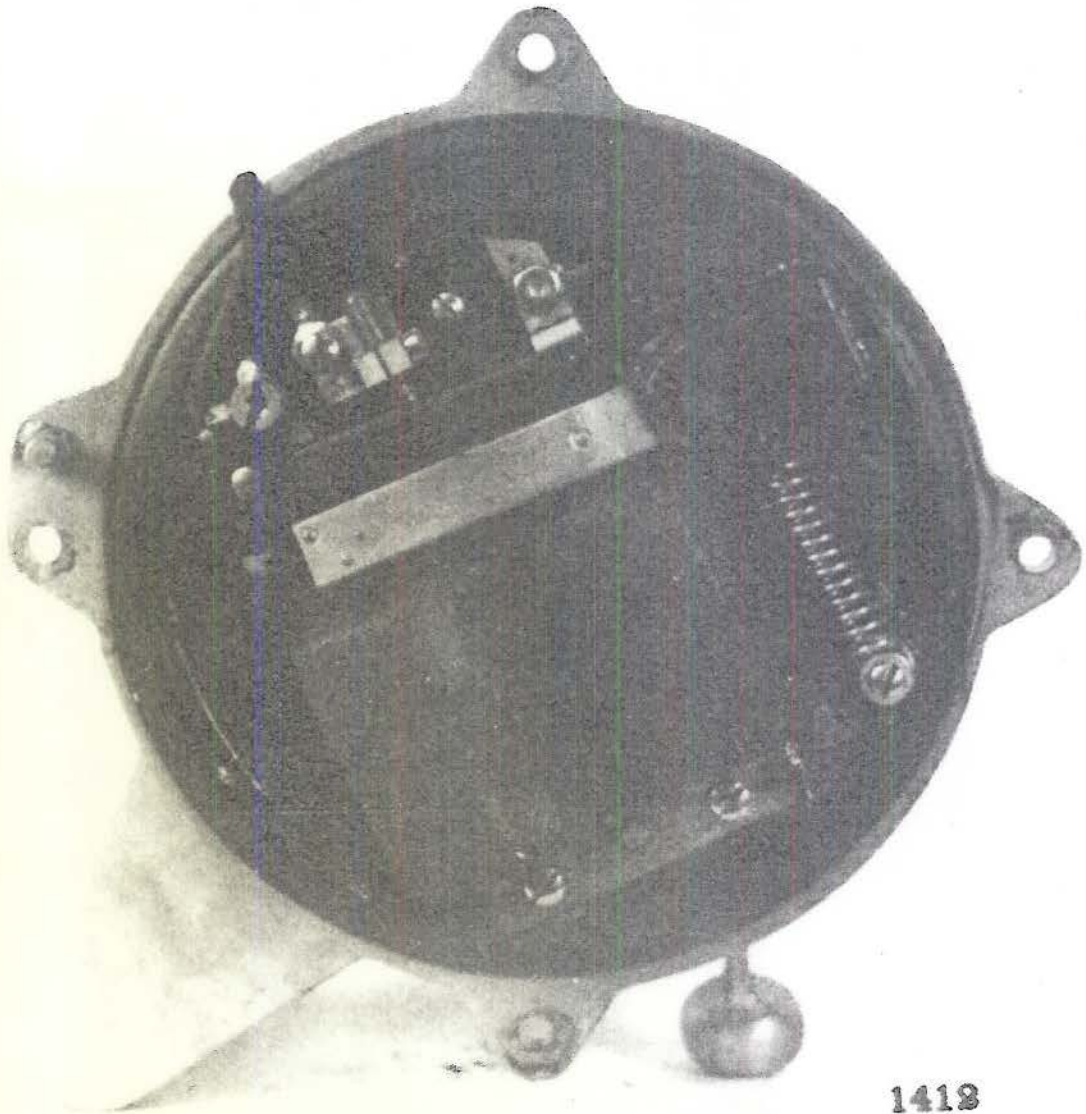
37. In general, these bells and buzzers, manufactured and designed by the late Gen. J. H. Henshaw and Company and covered by this report, represent an improvement in design. They possess a greater speed and are more rugged than those now used in the Naval Service.

38. The equipment, if modified to correct the defects pointed out in "RECOMMENDATIONS" of this report, would be suitable for the Naval Service.



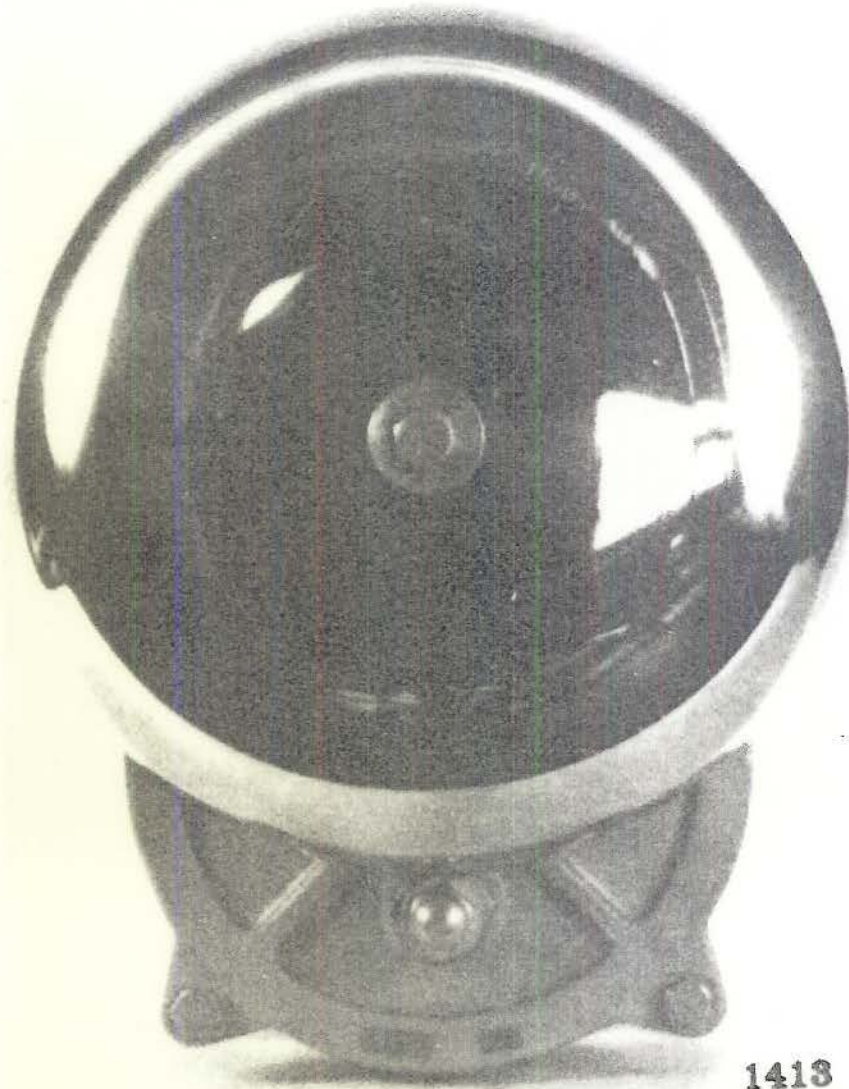
1411

Photo 1

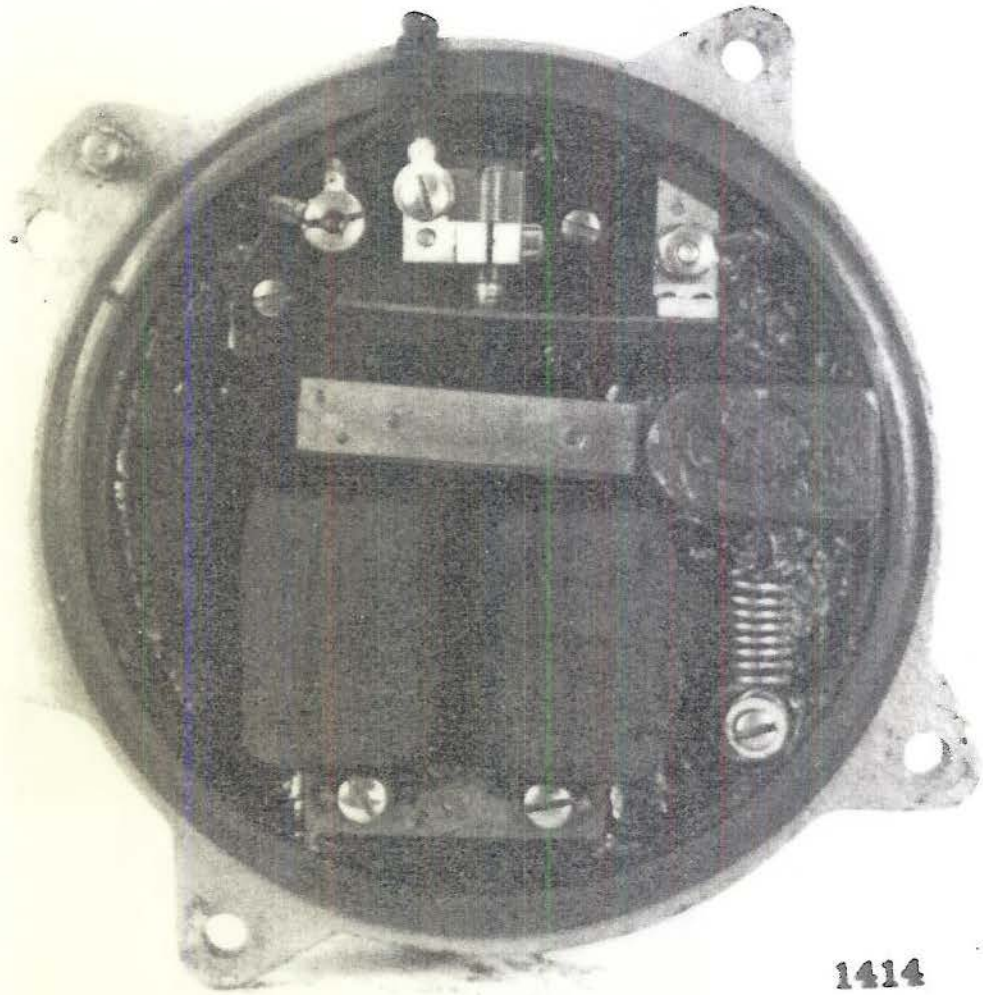


1418

Figure 2



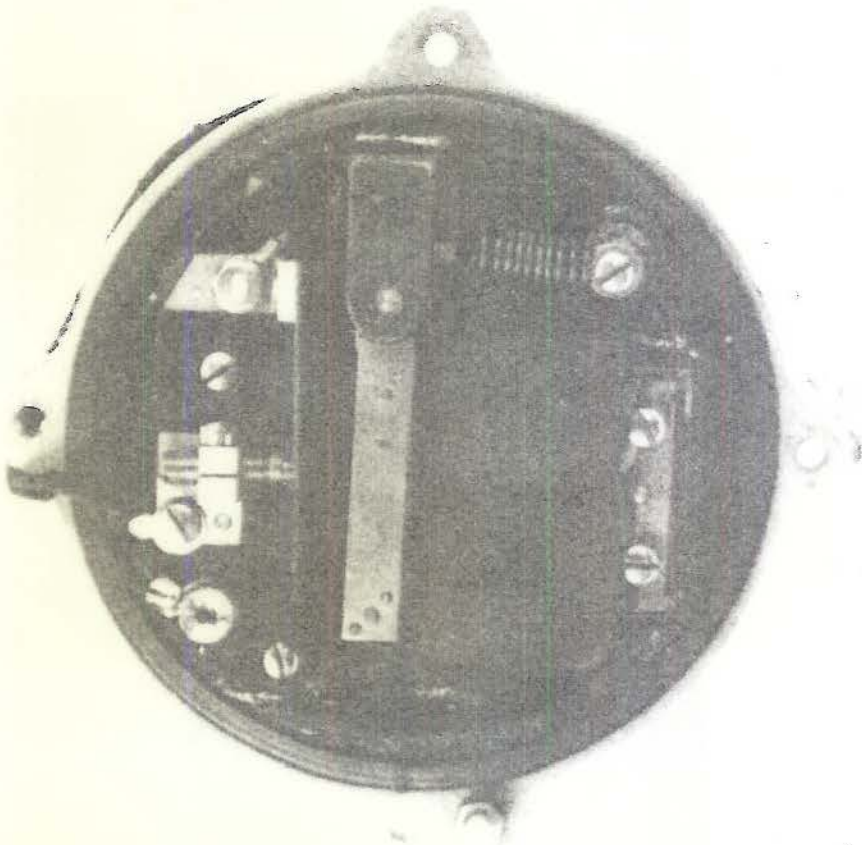
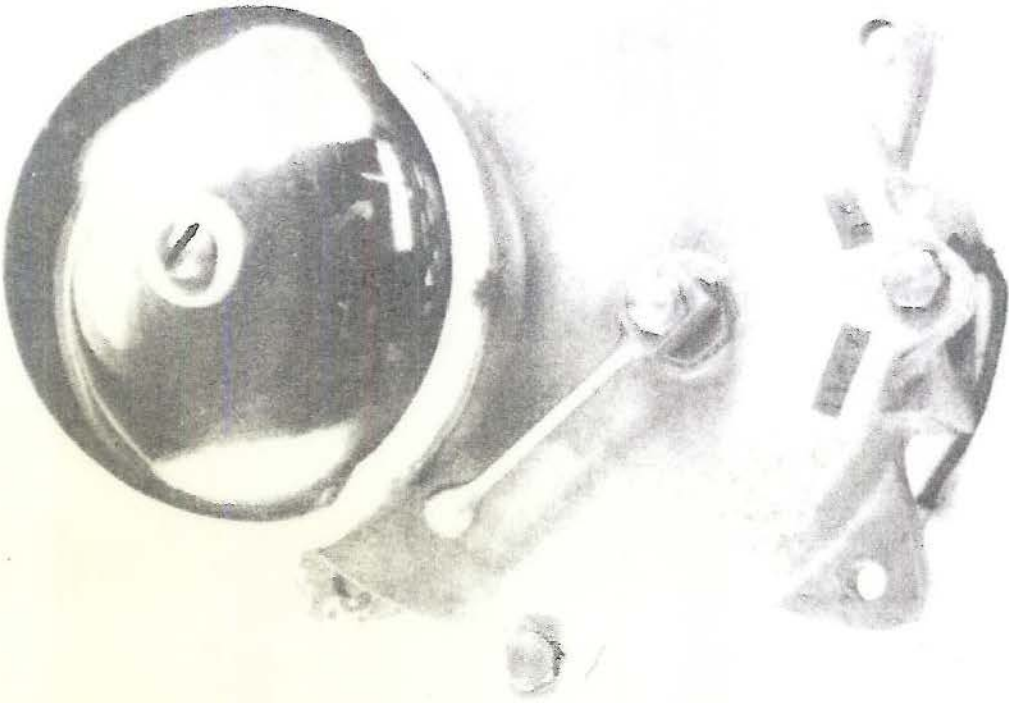
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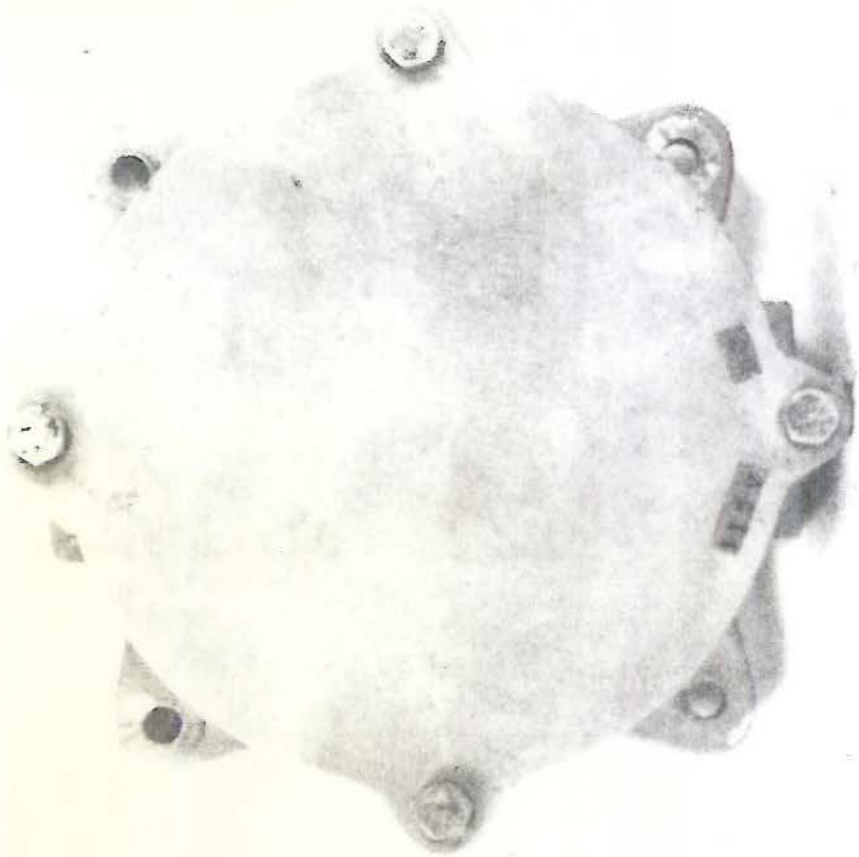


1414

Plate 4

1415





1416

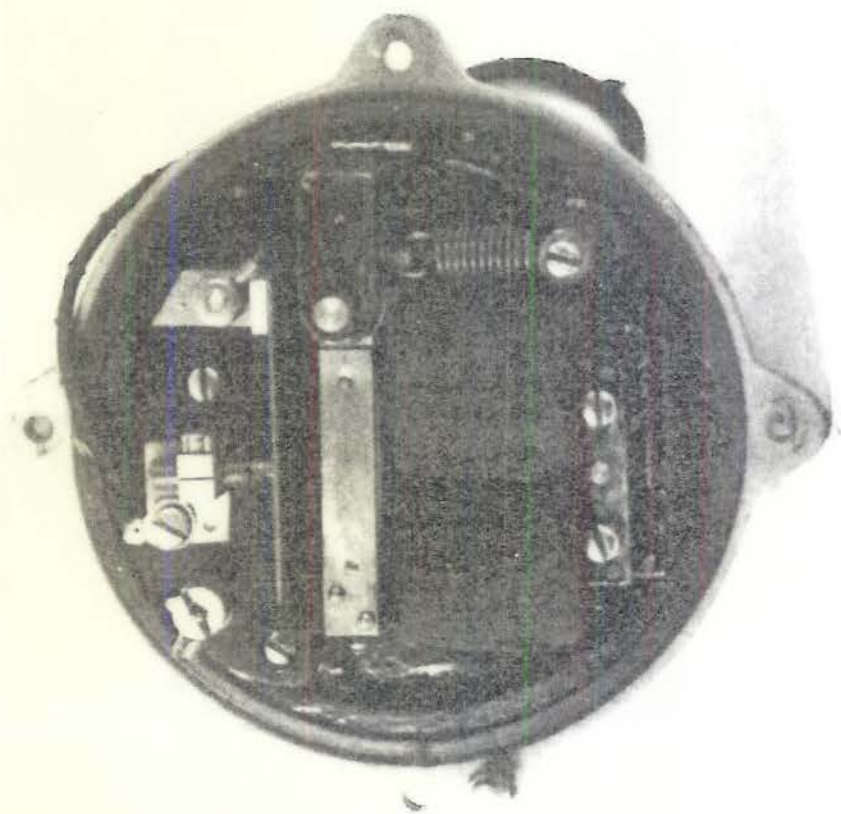
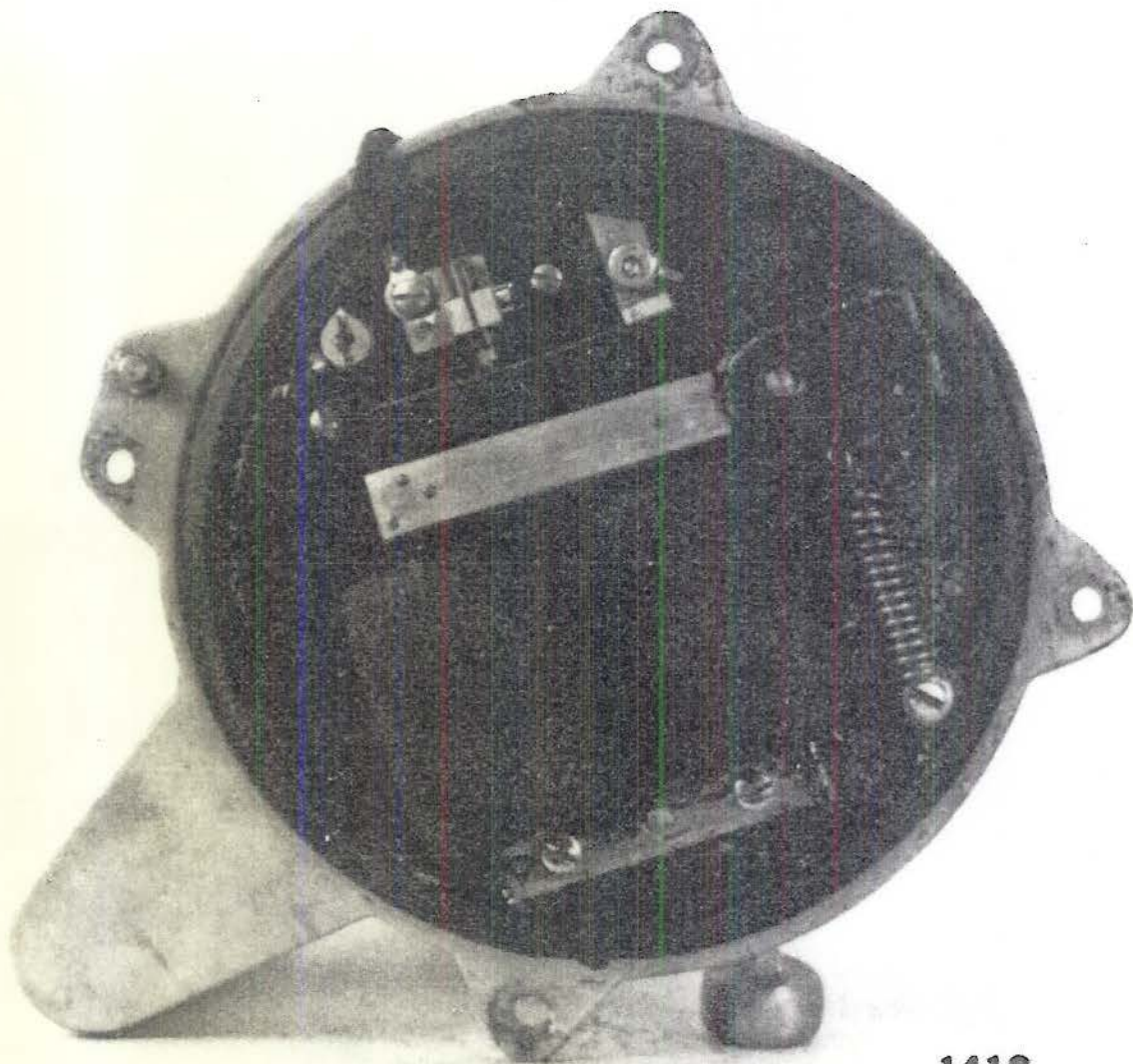


Plate 2



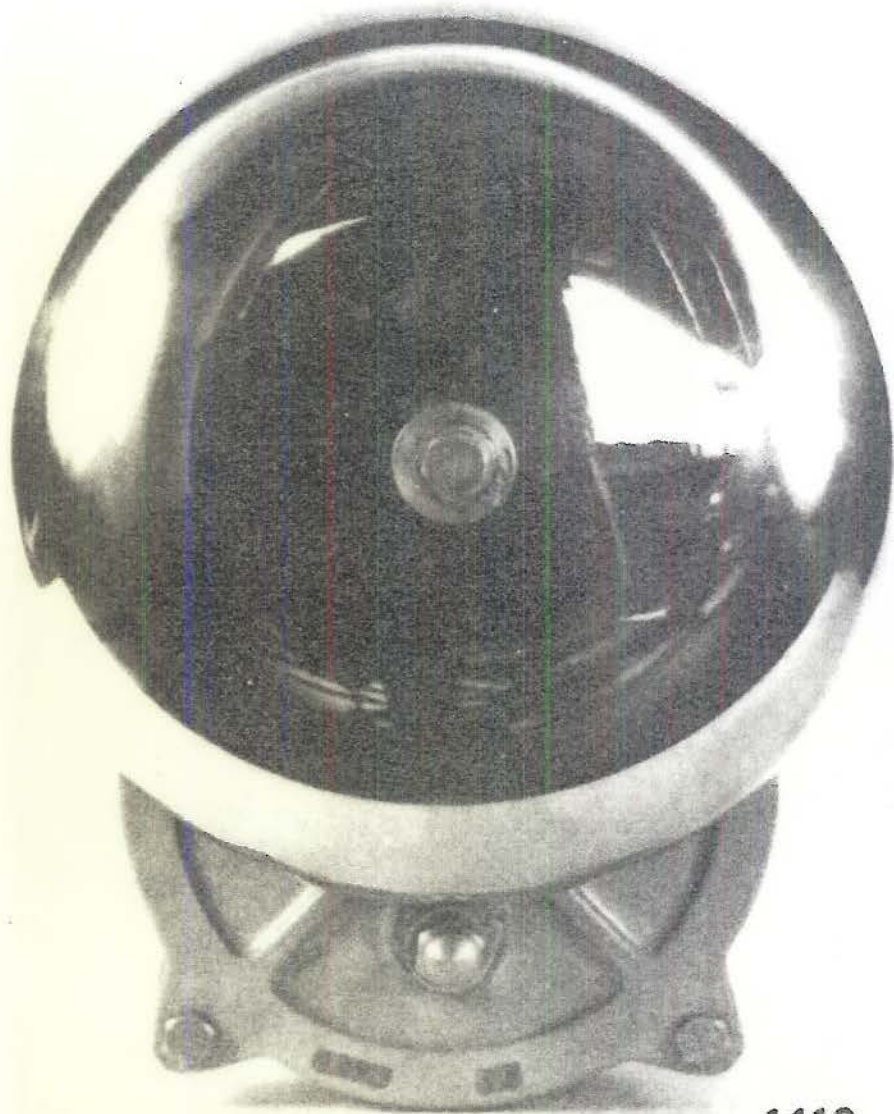
1417

Plate 7



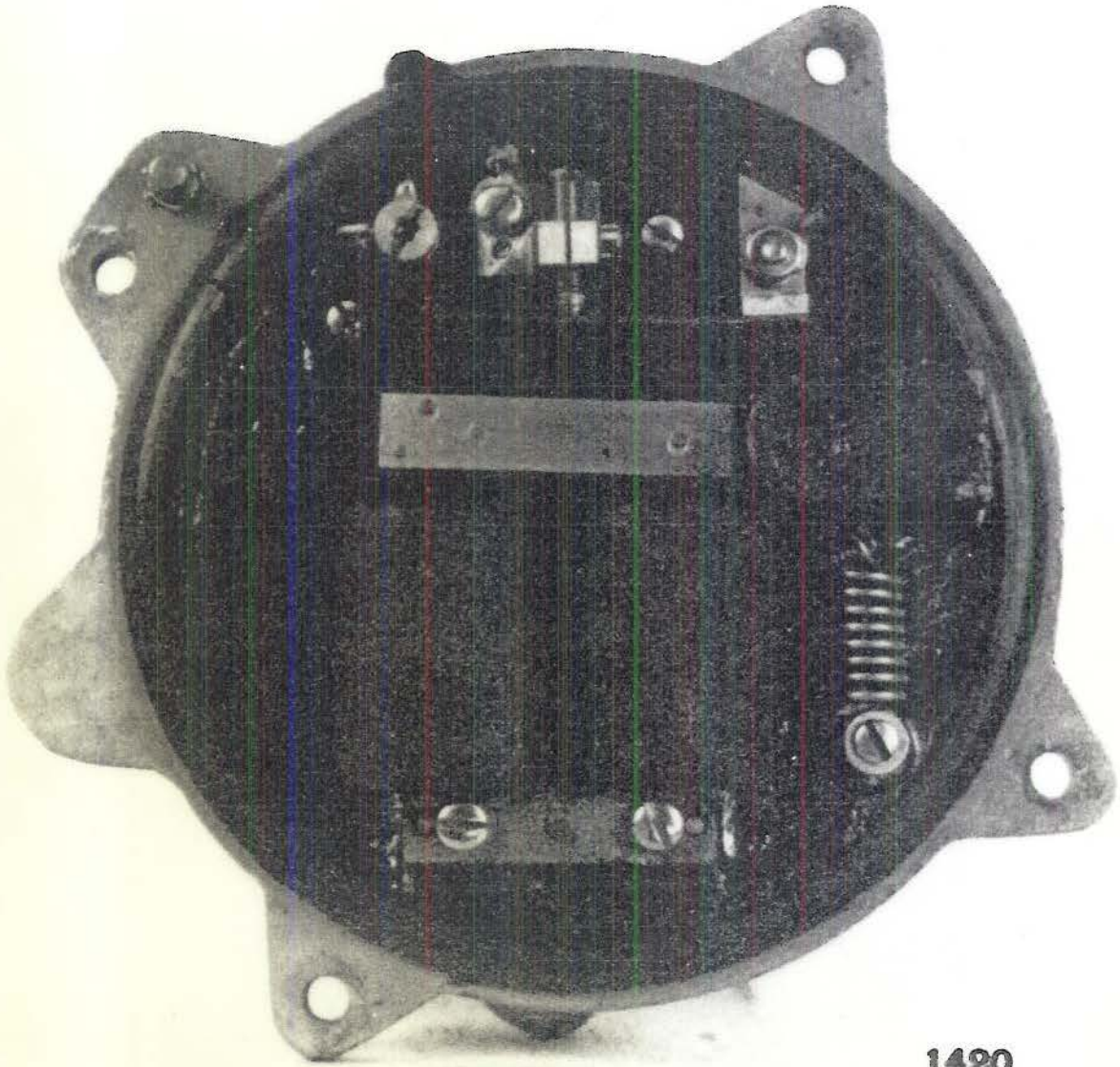
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Plate 8



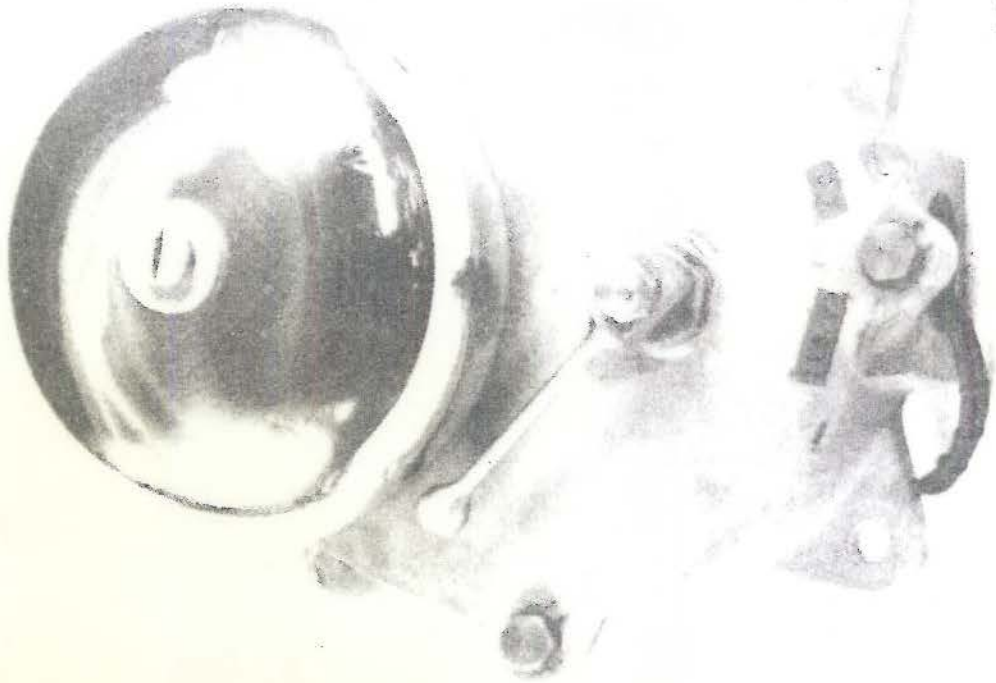
1419

Plate 9

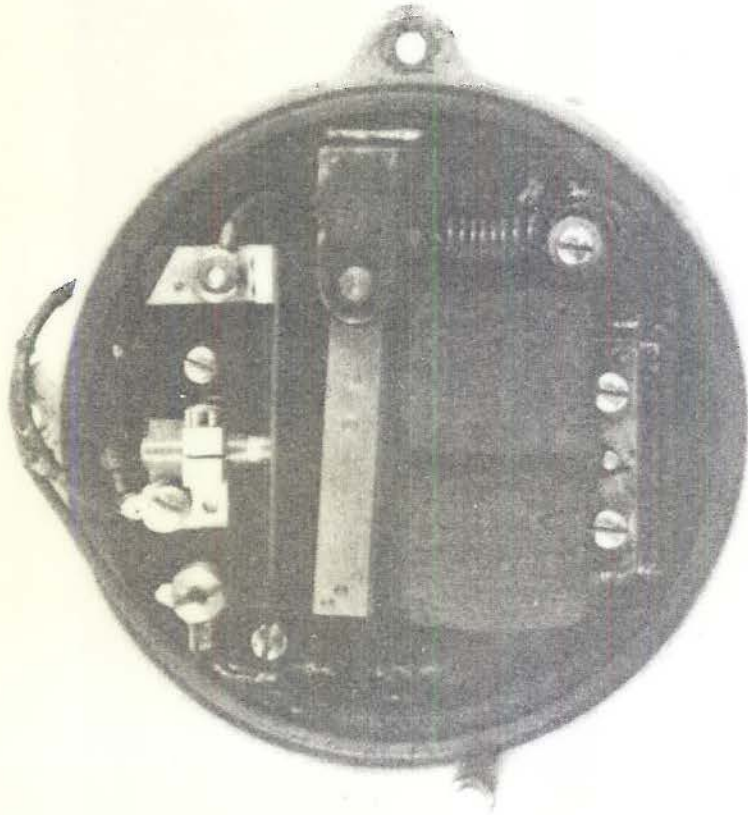


1420

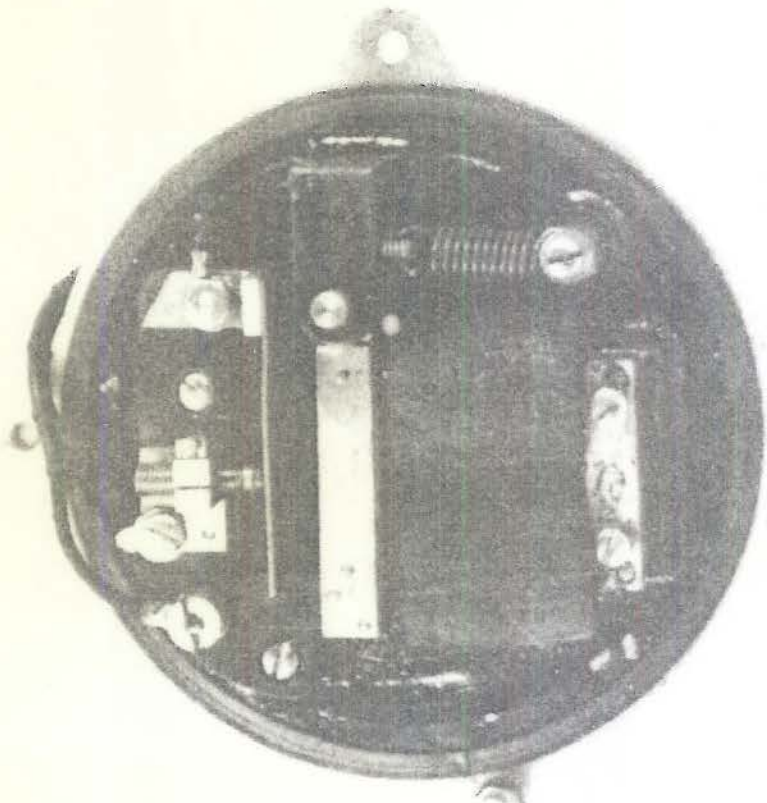
Plate 10



1481



1481



1488



1488