2506

NATIONAL BUREAU OF STANDARDS REPORT

2506

A STUDY OF TWO 3/4 HP STERLING
AIR CONDITIONERS

by

R. L. Dillard
Henry Karger
C. W. Phillips

NBS

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

U. S. DEPARTMENT OF COMMERCE

Sinclair Weeks, *Secretary*

NATIONAL BUREAU OF STANDARDS

A. V. Astin, *Director*

THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section is engaged in specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant reports and publications, appears on the inside of the back cover of this report.

Electricity. Resistance Measurements. Inductance and Capacitance. Electrical Instruments. Magnetic Measurements. Applied Electricity. Electrochemistry.

Optics and Metrology. Photometry and Colorimetry. Optical Instruments. Photographic Technology. Length. Gage.

Heat and Power. Temperature Measurements. Thermodynamics. Cryogenics. Engines and Lubrication. Engine Fuels. Cryogenic Engineering.

Atomic and Radiation Physics. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics. Neutron Measurements. Infrared Spectroscopy. Nuclear Physics. Radioactivity. X-Rays. Betatron. Nucleonic Instrumentation. Radiological Equipment. Atomic Energy Commission Instruments Branch.

Chemistry. Organic Coatings. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Gas Chemistry. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

Mechanics. Sound. Mechanical Instruments. Aerodynamics. Engineering Mechanics. Hydraulics. Mass. Capacity, Density, and Fluid Meters.

Organic and Fibrous Materials. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Organic Plastics. Dental Research.

Metallurgy. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion.

Mineral Products. Porcelain and Pottery. Glass. Refractories. Enameled Metals. Concreting Materials. Constitution and Microstructure. Chemistry of Mineral Products.

Building Technology. Structural Engineering. Fire Protection. Heating and Air Conditioning. Floor, Roof, and Wall Coverings. Codes and Specifications.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Machine Development.

Electronics. Engineering Electronics. Electron Tubes. Electronic Computers. Electronic Instrumentation.

Radio Propagation. Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services. Frequency Utilization Research. Tropospheric Propagation Research. High Frequency Standards. Microwave Standards.

Ordnance Development.
Electromechanical Ordnance.
Ordnance Electronics.
These three divisions are engaged in a broad program of research and development in advanced ordnance. Activities include basic and applied research, engineering, pilot production, field testing, and evaluation of a wide variety of ordnance matériel. Special skills and facilities of other NBS divisions also contribute to this program. The activity is sponsored by the Department of Defense.

Missile Development. Missile research and development: engineering, dynamics, intelligence, instrumentation, evaluation. Combustion in jet engines. These activities are sponsored by the Department of Defense.

- Office of Basic Instrumentation
- Office of Weights and Measures.

NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT **NBS REPORT**

1003-40-4700 May 18, 1953 2506

A STUDY OF TWO 3/4 HP STERLING
AIR CONDITIONERS

by

R. L. Dillard
Henry Karger
C. W. Phillips
Heating and Air Conditioning Section
Building Technology Division

for

Headquarters
United States Marine Corps
Department of the Navy
Washington, D. C.

NBS

A Study of Two 3/4 HP Sterling Air Conditioners

Abstract

Calorimeter tests were made of a specimen 3/4 HP console-type Sterling air conditioner as received and in several steps as modifications were made to reduce the air leakage between the condenser air circuit and the evaporator air circuit in the cabinet. Two air conditioning units were submitted because capacity tests of the first compressor unit showed that it was defective. Subsequent inspection revealed a ruptured cylinder-head gasket which caused one of the two cylinders to be ineffective in producing refrigeration. Inspection showed that both test specimens submitted had poor cabinet construction. The total net cooling capacity of the specimen that was tested as a unit was increased from an as-received value of about 400 Btu/hr (with a defective compressor) to about 6400 Btu/hr after modification and with a good compressor. Detailed instructions for making similar improvements in the 150 units of the same model purchased by the U. S. Marine Corps are given and a field test for evaluating the results is described.

I. INTRODUCTION

In accordance with a request by Headquarters, United States Marine Corps, dated June 3, 1952, tests and inspections were made of two specimen air conditioning units manufactured by Sterling Equipment Company, Columbus, Ohio, to determine the reasons for the poor performance of these units and whether or not enough improvements could be made in similar units in the field to warrant their installation. This report is a summary of the tests made of the two specimens both before and after modification and contains recommendations for sealing and other changes to the cabinets of the units so that their cooling capacity can be increased. A simple field test to determine approximate capacity is explained.

II. DESCRIPTION OF TEST SPECIMEN

Two air conditioning units were supplied by the United States Marine Corps for the tests. The second unit was supplied after tests showed that the compressor of the first unit was defective. The majority of tests were made with the cabinet of the first unit, the defective compressor having been replaced with the compressor of the second unit. The first unit submitted was identified as follows:

(NBS Test Specimen 86-52)
Sterling Equipment Company, Columbus, Ohio
Serial O.E. 2268
3/4 Horsepower

The specimen was a console-type air conditioning unit, designed for placement near a window or other suitable wall opening. Ducts for the condenser air supply and discharge were furnished with the unit and were intended to communicate with the outside air through the window or wall opening. The unit was enclosed in a sheet steel housing, with the front and rear panels, as well as the top panel, removable to provide access for repairs and adjustments.

A 10"x16"x1" filter of the throw-away type was provided in the return air circuit of the evaporator. It was mounted between the return air grill and the evaporator coil face, and could be replaced by removing the return air grill.

The electrical controls for operation of the air conditioning unit were located on the right side of the unit, underneath a small metal flap. Operation of fans and compressor could be controlled by means of a selector switch located there. The unit was built for operation on alternating current, 115 volts, single phase, 60 cycle.

A small damper, 2-3/4"x5", was located on the side of the unit, several inches below the electrical control switch. The opening in which this damper was located provided communication with the low-pressure side of the condenser fan, and enabled the user to exhaust some air from the room to the outside.

Both condenser and evaporator fans were of the centrifugal type. The evaporator fan was located in the top section of the unit, behind the cooling coil, and discharged its air through the top of the unit. The condenser fan was located in the lower section of the air conditioner, next to the compressor. Each fan was driven by a separate motor. A thermostatic expansion valve was used as the refrigerant flow control.

A side view of the unit showing the small sheet metal flappers mentioned above, as well as the front panel and the condenser shroud, is shown in Fig. 1. Fig. 2 shows a side view of the evaporator air intake grille, as well as the evaporator air outlet, located in the top section of the air conditioner. A front view of the unit with the front cover removed is shown in Fig. 3. The arrangement of the major components can be seen clearly in this view.

The unit was equipped with a Tecumseh compressor, Model B-7616, nominal 3/4 horsepower. The condenser fan motor was a Wagner Type RB motor, rated at 1/4 horsepower, 4.4 amperes and 115 volts, 1000 rpm. The evaporator fan motor was a Wagner Type TM, 1.5 amperes and 115 volts, 1725 rpm. The expansion valve was a Detroit, Model 673. Dichlorodifluoromethane was the refrigerant employed.

III. TEST PROCEDURE AND RESULTS

The capacity of the air conditioning unit was determined by the calorimeter method. The testing procedure and method is outlined in detail in National Bureau of Standards Report #2238 entitled "Performance of a York 3/4 HP Window Air Conditioning Unit, Model 24-1", submitted to the United States Marine Corps under date of February 2, 1953.

All capacity tests of the unit were made at the standard ASRE rating conditions of 95°F DB, 75°F WB temperature at the condenser inlet of the unit, and 80°F DB, 67°F WB temperature on the room side of the unit. Measurements were also made of the air circulating capacity of the evaporator and condenser fans. The air circulating capacity of the evaporator fan was found to be 270 cfm, and of the condenser fan, 500 cfm.

The first unit furnished for test had a total net cooling capacity of approximately 400 Btu/hr as received, compared to 8000 Btu/hr for a well-designed unit of similar size. The net cooling capacity, as the term is used here, is the amount of latent and sensible heat that the unit will remove from the space in which the unit is installed, not the amount that the unit is able to extract from the air passing through it. This air circuit often includes unwanted ventilating air which is exchanged between the evaporator (room side) and condenser (ambient) portions of the unit. The cooling required to lower the latent and sensible heat content of this unwanted ventilating air to that of the conditioned space does not result in cooling of the conditioned space but does utilize a portion of the refrigerating effect produced by the unit.

The penalty imposed by unwanted ventilating air, for example, is of the following order: Each 100 cfm of air introduced at 95°F DB and 75°F WB requires a cooling capacity of approximately 3000 Btu/hr to reduce it to 80°F DB and 67°F WB.

The unwanted ventilating air exchanged between the outside and the conditioned space by this first test was found to be in excess of 150 cfm, or more than 55 percent of the total circulating capacity of the evaporator fan. After inspecting the unit, steps were taken to reduce the undesired ventilating air as much as possible by sealing the cabinet with masking tape and by other means. A capacity test subsequent to the sealing revealed a total net cooling capacity of approximately 2600 Btu/hr for the unit.

From these results it was concluded that the compressor of the unit might be defective. The compressor was removed from the air conditioner, and a capacity test of the compressor was made with a secondary refrigerant calorimeter. The capacity of this compressor, at conditions of temperature and pressure approximately equal to those observed when the compressor was in the air conditioning unit, was found to be approximately 6100 Btu/hr. A normal capacity of 11,000 to 12,000 Btu/hr is indicated by the manufacturer's rating for this compressor. The compressor was dismantled, and an examination revealed that a head gasket had ruptured and a portion of the gasket was jammed between seat and disc of one of the discharge valves, preventing closure of this valve. Consequently only one of the two cylinders of the compressor was doing useful compression work. The valve plate with the ruptured

gasket can be seen in the center of Fig. 4. The valve from the other cylinder is also shown on the right of Fig. 4 indicating the proper position of the section of the gasket which provides the seal between the suction and discharge sections of the heat assembly. The head assembly shown on the left in Fig. 4 is from the cylinder with the defective gasket.

A second Sterling air conditioning unit of the same model was then supplied by the United States Marine Corps for test. The compressor of this second unit was removed and its capacity determined on the secondary refrigerant calorimeter. The capacity was approximately 11,500 Btu/hr at conditions nearly equal those observed during actual operation of the air conditioner with the defective compressor.

The compressor of the second air conditioner was then installed in the original air conditioner and capacity tests were resumed. The unit was recharged with 5 lbs. of dichlorodiflouromethane, the amount shown on the unit nameplate. The net cooling capacity was approximately 5300 Btu/hr, and the unwanted ventilating air amounted to 23 cfm during this test.

It appeared during this test that the condensing temperature was higher than should be expected during normal operation of the unit under the ASRE standard conditions. To determine if this was due to an excessive refrigerant charge, the refrigerant was discharged from the unit, and the unit was recharged with 3-1/2 lbs. of dichlorodiflouromethane (instead of 5 lbs. as shown on nameplate). This smaller charge proved to be adequate. In addition, the expansion valve superheat was reduced to the lowest value that appeared possible without causing flooding of refrigerant into the compressor. Further sealing was made of the unit cabinet. A capacity test then indicated a total net cooling effect of approximately 5800 Btu/hr. The undesired ventilating air during this test averaged about 15 cfm. A final capacity test was made after installation of a baffle on the condenser shroud to prevent short-circuiting of condenser discharge air into the intake duct, and after removal of the filter from the evaporator air circuit. Under these conditions the totalnet cooling capacity of the unit was approximately 6400 Btu/hr, and the undesired ventilating air averaged about 9 cfm. It appeared that this was the maximum capacity which could be obtained from the unit without a major redesign of the refrigerant circuit.

IV. RECOMMENDATIONS

Based on the test results outlined in Section III of this report, it appears that the net cooling capacity of this model of air conditioning unit can be increased by reducing the amount of air exchanged between warm and cool sections of the unit.

The following procedures are recommended for the field repair of these units and it is suggested that the steps in such field repairs be carried out in the order listed below so unnecessary labor may be avoided.

No special tools are required to effect the work required. An electric drill will be advantageous in drilling holes for #8 and #10 sheet metal screws but a hand drill can be used. The two drill bit sizes needed are 1/8" (for #8 sheet metal screws) and 9/64" (for #10 sheet metal screws). Hand tools required are:

1 - Drill (electric, or hand)
1 - Drill bit - 1/8"
1 - Drill bit - 9/64"
1 - 6" or 8" x 1/4" screwdriver
1 - Center punch
1 - Small machinists hammer
1 - Knife
8 oz. Solvent (benzine, naptha, or gasoline) for cleaning surfaces to which self-adhesive sponge rubber is to be attached.

List of Materials Required to
Process One Air Conditioning Unit

Item No.	Quantity	Description
1	1	Sheet metal collar for evaporator air discharge, in accordance with Fig. 16
2	1	Wood filler strip, in accordance with Fig. 9.
3	2-1/2 lbs	Mastic-Type sealing compound, such as Permagum #545.2, made by Presstite Engineering Co., or equal.

Item No.	Quantity	Description
4	1	Air baffle for condenser shroud, in accordance with Fig. 20.
5	17 ft.	Self-adhesive sponge rubber, 5/32" thick x 5/8" wide
6	13 ft.	Self-adhesive sponge rubber, 3/4" thick x 5/8" wide
7	5	#8 x 1/2" Sheet metal screws, self-tapping, binding head, (3 for condenser air baffle, 1 for wood filler strip, 1 for condenser shroud)
8	2	#8 x 1" Sheet metal screws, self-tapping, binding head, (for wood filler strip)
9	2	#10 x 1" Sheet metal screws, self-tapping, binding head (for side panels)
10	9	#10 x 1-3/4" Sheet metal screws, self-tapping, binding head (for front and rear panels)
11	150 cu.in.	Hairfelt, or other filler material

The outline of steps, which follows, refers to various figures (photos and drawings) which are a part of this report. Item numbers refer to the preceding list of materials. The outline is divided into two major sections - Part A, which suggests certain cabinet modifications and explains how to seal the cabinet to reduce unwanted air exchange, and Part B, which describes a test which will show, after the repairs have been complted, the approximate capacity comparison between the field-repaired unit and the test unit described in Section III of this report after the latter was repaired.

Part A - Sealing of Cabinet

1. See Figs. 1 and 2. Remove front panel, rear panel, top panel and condenser shroud from unit.

2. See Figs. 5, 6 and 7. Fig. 5 is a front view of the machine compartment with all panels removed, and otherwise in the condition as received. Fig. 6 is a rear view of the machine compartment. Mastic sealing compound (Item 3) should be applied generously at all points indicated in Figs. 5 and 6. Note that these are interior openings which require sealing. After application of the sealer the cabinet should appear as shown in Fig. 7. The condensate drain should be checked at this time.

3. See Figs. 7, 8 and 9. The wooden filler strip (Item 2) as shown in Fig. 8 should be installed below the condenser as shown in Fig. 7 and should be secured by means of 2 - #8x1" sheet metal screws (Item 8) at points marked "b" in Fig. 7 and 1 - #8x1/2" sheet metal screw (Item 7) located at point marked "a" in Fig. 7. This wooden filler strip should be covered with the 5/32"x5/8" self-adhesive sponge rubber (Item 5), as shown in Figs. 7 and 8. Dimensions for the wooden filler strip (Item 2) may be found in Fig. 9.

4. See Fig. 7. The 5/32"x5/8" sponge rubber material (Item 5) should be applied to the edges of the machine compartment on the rear side of the unit cabinet, as shown at points marked "c" in Fig. 7. The sponge rubber seal should not extend higher than the wooden filler strip, and a 1/8" space must be left on the sides as indicated in Fig. 7 to provide clearance for the metal sides of the rear panel.

5. The rear panel should now be installed on the cabinet. Note that the interior surface of this panel is fitted with 1/2" fiberboard type sound-deadening insulating material. In addition, a separate sheet of this material (29-3/4"x26-1/2"x1/2") is recessed into the rear surface of the machine compartment. If either of these insulating surfaces are broken or missing they should be replaced and installed at this time. The insulating board in the panel is necessary for satisfactory sealing of the panel.

6. See Figs. 10 and 11. The large void between the condenser air duct and the side of the cabinet, as shown in Fig. 10, should be filled with hairfelt or other suitable filler material (Item 11) to within approximately 1/2 inch of the surface of the condenser air duct. On top of the filler material mastic sealer (Item 3) should be applied to a thickness of about 1/2 inch. Attention should be given to good bonding of the mastic material to both the condenser air duct and the cabinet side, top, and condensate pan. The finished treatment of this point can be seen in Fig. 11. Additional sealing with mastic against the back panel should be applied at points "a", Fig. 11, and at the power cord, point "b", Fig. 11.

7. See Fig. 12. Sponge rubber gasketing material, 3/4 inch thick and 5/8 inch wide, (Item 6) should now be applied around the machine compartment in the front of the unit, as shown at points "a", Fig. 12. A 1/8 inch space must be left on the sides as shown in Fig.12 to provide clearance for the metal sides of the front panel.

8. As can be seen from Fig. 13, the front cabinet panel has two ears at its bottom, which hook over the bottom cabinet channel. These ears should be cut off.

9. A sheet metal collar (Item 1) with 3/4 inch thick x 5/8 inch wide self-adhesive sponge rubber (Item 6) in place is shown in Fig. 8. Dimensional data for construction of this collar are given in Fig. 16. It should be installed over the evaporator fan discharge as shown at point "c" in Fig. 11. The collar is intended to slip into the fan opening. It is expected that some fitting will be necessary due to normal production variations of the aid conditioning units.

10. Install top panel on the unit.

11. Install front panel on cabinet. Note that the interior surface of this panel is fitted with 1/2 inch fiberboard type sound-deadening insulating material. In addition, a separate sheet of this material (29-3/4 x 26 x 1/2") is recessed into the front surface of the machine compartment. If either of these insulating surfaces are broken or missing they should be replaced and installed at this time. The insulating board in the panel is necessary for satisfactory scaling of the panel.

12. See Figs. 14 and 15. Five #10x1-3/4" sheet metal screws (Item 10) should now be installed to secure the front and rear panels to the cabinet at the points marked "a" in Fig. 14 and 15, in addition to the existing screws. At the locations marked "b" in both Figs. 14 and 15, a screw (Item 8) should be installed to secure each side panel to the condensate pan. The fastening of the front, rear, and side panels to the condensate pan should be done in a careful manner, so as to minimize the air flow between condenser and evaporator compartments. It is important that these screws always be replaced after any servicing of the air conditioning units.

13. Fig. 17 shows the cabinet side of the condenser shroud. The sheet metal edges of the shroud, if bent, should be straightened, and 5/32 inch thick by 5/8 inch wide sponge rubber (Item 5) should be applied along these edges as shown in Fig. 17 at points "a". Sponge rubber should not be placed across the center dividing strip of the shroud, since sealing at this surface will be effected by the sponge rubber attached to the wooden filler strip previously installed.

14. The condenser shroud should then be installed on the cabinet. An additional sheet metal screw (Item 7) should be used approximately at the center of the lower flange, as shown by point "b", Fig. 17.

15. A sheet metal baffle (Item 4) should be installed between the discharge and intake plenum of the condenser shroud at the dividing strip, as shown in Fig. 18. Three #8x1/2" sheet metal screws (Item 7) should be used at points marked "a" in Fig. 18.
<u>NOTE</u>: <u>IMPORTANT</u> If a particular air conditioner is located so that the condenser air baffle would be hazardous to passersby, it is recommended that it be eliminated or suitably guarded.

16. All of the preceding 15 steps outlined are important if the maximum results are to be realized.

If this work has been done carefully, the unit is now ready for the test described in Section B below.

Part B - Test of Air Conditioning Unit

1. The purpose of the test described herein is to enable the United States Marine Corps to determine (after modifications described previously) whether other Sterling air conditioning units of the same model have sufficient capacity to compare favorably with the test unit, or whether additional repair of the refrigeration systems by qualified refrigeration personnel is needed to bring the capacity of the units up to a satisfactory value.

The results of the test should be checked against Fig. 19, which shows, for various temperatures of inlet evaporator and condenser air, the maximum evaporator air discharge temperatures that should be observed if the capacity of the unit is to be as large as that of the test unit after it was repaired.

The test results shown in Fig. 19 were obtained with the unit submitted for test and are based on an air delivery of approximately 270 cfm from the evaporator fan, with filter removed and a clean evaporator. It is believed that other units of the same model will have approximately the same air delivery for the evaporator fan.

2. The assembled unit, with all panels and the condenser shroud in place should be set up for test in a room, or other enclosed space, such as a garage, hall, or shop. The evaporator air and the condenser air should both be drawn from within the enclosed space, i.e., the unit should not be installed at a window but should be free-standing in the enclosed space. The filter should be removed for the test unit and the evaporator and condenser surfaces should be free from dust or other obstructions to normal air flow. The air conditioning unit should be turned on by setting the selector switch in the "Cool" position.

3. The only equipment needed for the test is a sling psychrometer (wet- and dry-bulb thermometer) and two mercury-in-glass or alcohol-in-glass thermometers.

4. All thermometers, including those in the sling psychrometer, should be calibrated against each other in an ice bath, containing a mixture of crushed ice and water. Any deviation of the thermometers from the ice-point (32°F) should be carefully noted for each individual thermometer. This deviation is approximately linear for other parts of the scale on most thermometers, hence if a thermometer reads 34°F when immersed in the ice bath, it would mean that 2°F should be subtracted from any reading on this thermometer; for example, if a subsequent measurement on this thermometer shows 68°F, the true temperature would be 66°F. If a thermometer should read lower than 32°F when immersed in ice, the amount of error should be added to the reading, of course.

5. After calibration, one of the thermometers should be laid over the evaporator air outlet of the unit. The other should be suspended in front of the evaporator air inlet. The sling psychrometer should be used as follows: The wick should be wetted well with distilled water, and the psychrometer revolved rapidly in a vertical plane parallel to and approximately 1 foot away from the evaporator air inlet. After whirling the psychrometer for about 15 seconds, the temperature of the thermometer with the wick should be read. Then the psychrometer should be whirled for another 10 seconds, the temperature read again, whirled again for 10 seconds, and the temperature read for a third time. If, during any one measurement, any temperature reading of the thermometer with the wick has risen after a prior reading, the wick should be wetted again, and the procedure described should be repeated. The lowest temperature read on the wet bulb thermometer should be considered as the wet bulb temperature of the air. This temperature will always be lower than the dry bulb temperature of the air observed on the thermometer without a wick.

6. The following readings should be recorded at 10-minute intervals during the test of the unit: The wet bulb temperature of the air entering the evaporator, the dry bulb temperature of the air entering the evaporator, and of the dry bulb temperature of the air leaving the evaporator. The test should be continued for 40 minutes or longer, after readings become steady. These recorded readings should be averaged after the test and compared with Fig. 19.

7. Fig. 19 shows the maximum dry-bulb temperature of the evaporator discharge air which the unit should produce under certain inlet wet- and dry-bulb temperatures. Curves are shown for a range of wet-bulb temperatures for three inlet dry-bulb temperatures, 70°F, 80°F, and 90°F. The use of Fig. 19 is illustrated by the following example: Assuming that the dry-bulb temperature of the evaporator inlet air is 80°F, and the wet-bulb temperature is 70°F, enter the graph at the bottom, follow the 70 degree wet-bulb line up until the curve marked 80°F D.B. Inlet is reached. From this point of intersection proceed horizontally to the left to read the expected dry-bulb outlet temperature. For this example, the dry-bulb outlet temperature should be 65°F or lower.

If inlet dry-bulb temperatures between 70°F and 80°F, or between 80°F and 90°F are encountered, a curve can easily be approximated between these limits on Fig. 19.

8. If the dry bulb temperature of the evaporator discharge air during the test is the same as or lower than the dry-bulb outlet temperature shown in Fig. 19, the unit is suitable for installation. If the dry bulb temperature of the evaporator discharge air is higher than shown in Fig. 19 by as much as two degrees it indicates a capacity reduction ranging from 10 to 30%. The greater loss of capacity corresponds to the higher ambient temperatures. Under these conditions, it is likely that the refrigerating system of the air conditioning unit needs servicing or that there are additional significant air leaks not sealed by the procedures described in Part A of this report, and appropriate arrangements should be made in that case for further examination of the unit.

V. CONCLUSION AND DISCUSSION

Both of the two sample Sterling air conditioning units submitted for examination by the United States Marine Corps were of poor cabinet construction in that excessive air exchange between the condenser and evaporator sections lowered the net cooling capacity to such a value that the units would not warrant installation.

In addition one of the units had a defective compressor. Representatives of the compressor manufacturer stated that the particular type of failure was quite rare.

A thorough sealing of the cabinet is necessary to increase the net cooling capacity of the unit. Detailed steps outlined under the "Recommendations" Section of this report show how this can be done. A relatively simple test procedure to be followed after sealing is completed is also described which will determine whether the unit is of sufficient net cooling capacity to warrant installation.

Based on calorimeter tests of the sample unit, after sealing of the cabinet had been completed, and assuming that units in the field are similar, a net cooling capacity of approximately 6000 Btu/hr (at A.S.R.E. Standard Test condition of 95°F DB, 75°F WB ambient and 80°F DB, 67°F WB room) can be expected from these units if they are sealed as outlined.

If a unit in the field, after sealing is completed, fails to indicate a satisfactory capacity based on the test procedure outlined, it must have air leaks not found in the specimens tested here or the refrigeration system must be faulty and in need of skilled attention.

Materials required to effect the sealing of one unit are listed under the "Recommendations" section of this report. Item 1, a sheet metal collar, Item 2, a wood filler strip, and Item 4, an aluminum baffle, require fabrication and dimensional drawings are included. It is suggested that a sufficient number of kits of this material, packaged on a unit basis, be prepared at a central source for the number of units to be serviced. This method should be economically advantageous as compared to local procurement of the necessary items, and should not exceed $8 per kit, exclusive of packaging and distribution costs.

The on-the-job time required to seal and test one unit should not exceed one man-day for the sealing and other modifications and one-half man-day for the test. This is exclusive of the time required to remove a unit from the window, or reinstall it, or uncrate a unit, etc.

<u>Photographs and Drawings</u>

Figure 1. Front right quarter view of assembled air conditioning unit as received for test, with all panels in place.

Figure 2. Front left quarter view of assembled unit, showing evaporator air inlet grill on left side.

Figure 3. Front view with front and top panels removed showing arrangement of internal components.

Figure 4. Two valve plate assemblies and one cylinder head from motor-compressor of first test unit, showing ruptured cylinder-head gasket.

Figure 5. Front view of the machine compartment. Arrows indicate certain places where mastic sealing material is to be applied.

Figure 6. Rear view of the machine compartment. Arrows indicate certain places where mastic sealing material is to be applied.

Figure 7. Rear view of unit showing wood filler-strip and self-adhesive gaskets in place on rear surface of machine compartment.

Figure 8. Wood filler-strip and evaporator air discharge collar, each with self-adhesive gasket attached.

Figure 9. Dimensional drawing of wood filler-strip.

Figure 10. Front view of evaporator section. Arrow designates void to be filled and sealed.

Figure 11. Same as Fig. 10, but showing mastic sealer in place and evaporator air discharge collar installed.

Figure 12. Front view of unit showing self-adhesive gaskets in place on front surface of machine compartment.

Figure 13. Inside surface of front and rear panels, showing mounting ears which are to be cut off.

Figure 14. Right front quarter view of assembled unit showing points where additional sheet metal screws are to be installed in the front and right hand panels.

Figure 15. Right rear quarters view showing where additional sheet metal screws are to be installed in the rear and left panels. The air filter, behind the evaporator air inlet grill, can be seen clearly in this picture.

Figure 16. Dimensional drawing of the sheet metal collar for the evaporator air discharge opening.

Figure 17. View of the machine-end of the condenser shroud, showing where self-adhesive gasket is to be applied.

Figure 18. View of the outdoor-end of the condenser shroud showing air baffle in place.

Figure 19. Graph of capacity check curves.

Figure 20. Dimensional drawing of condenser air baffle.

FIG. 1

FIG. 2

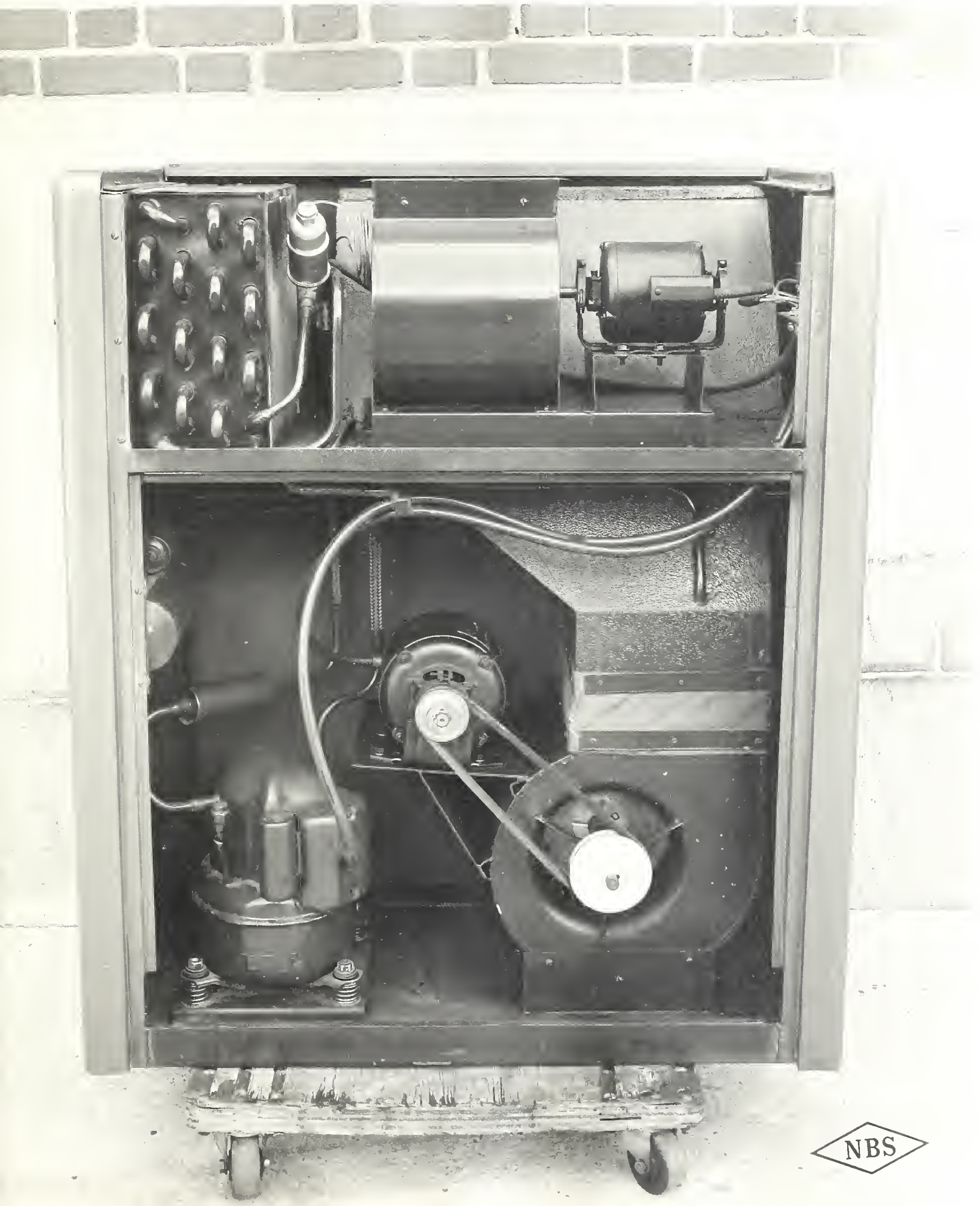
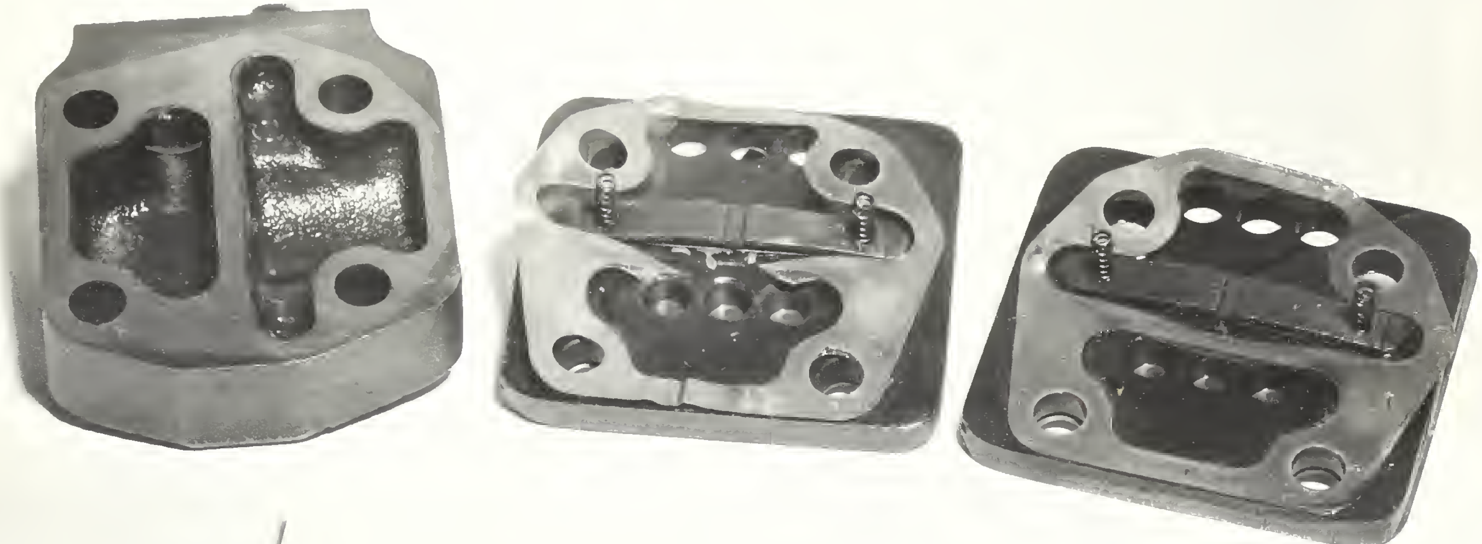
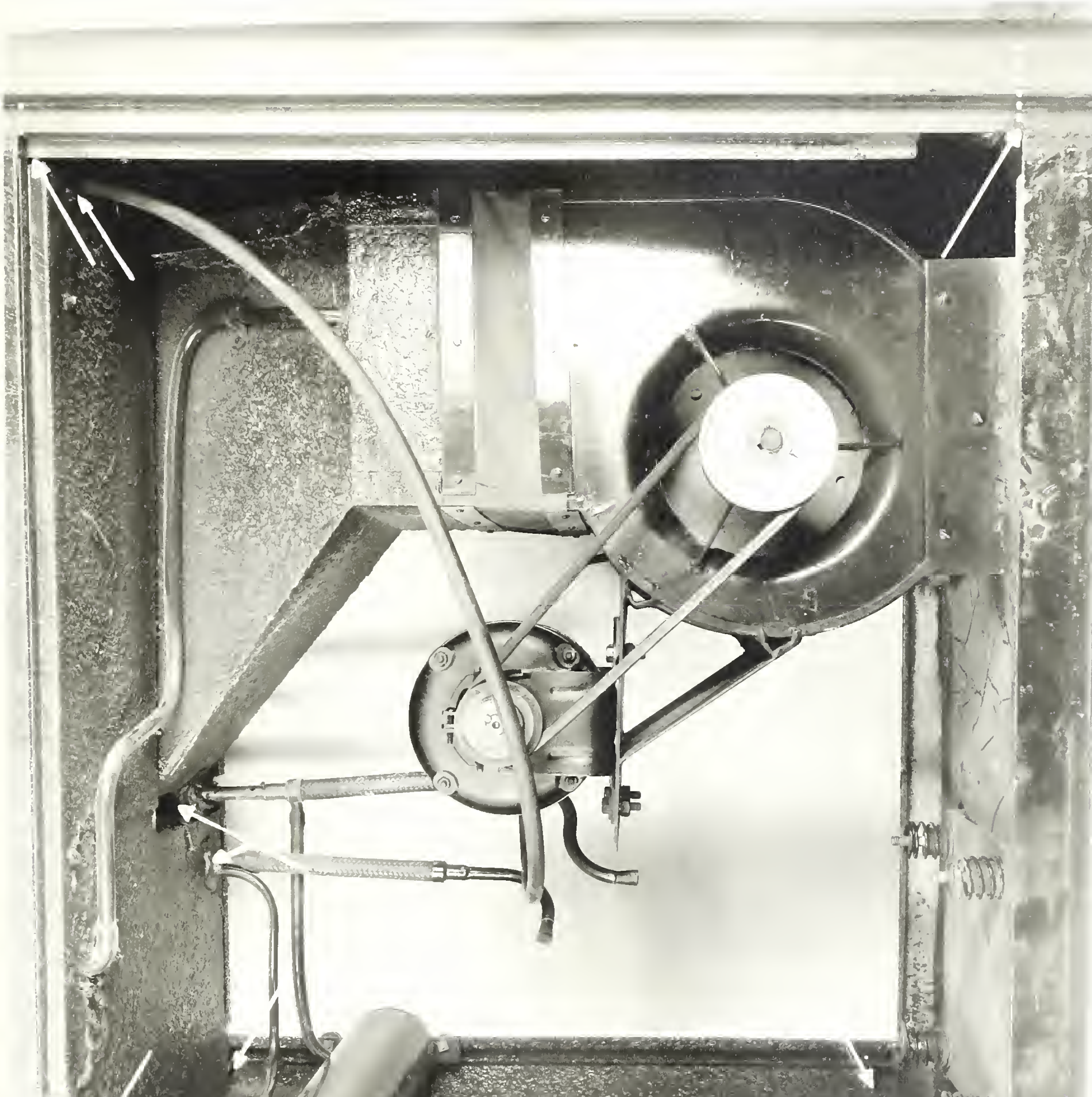


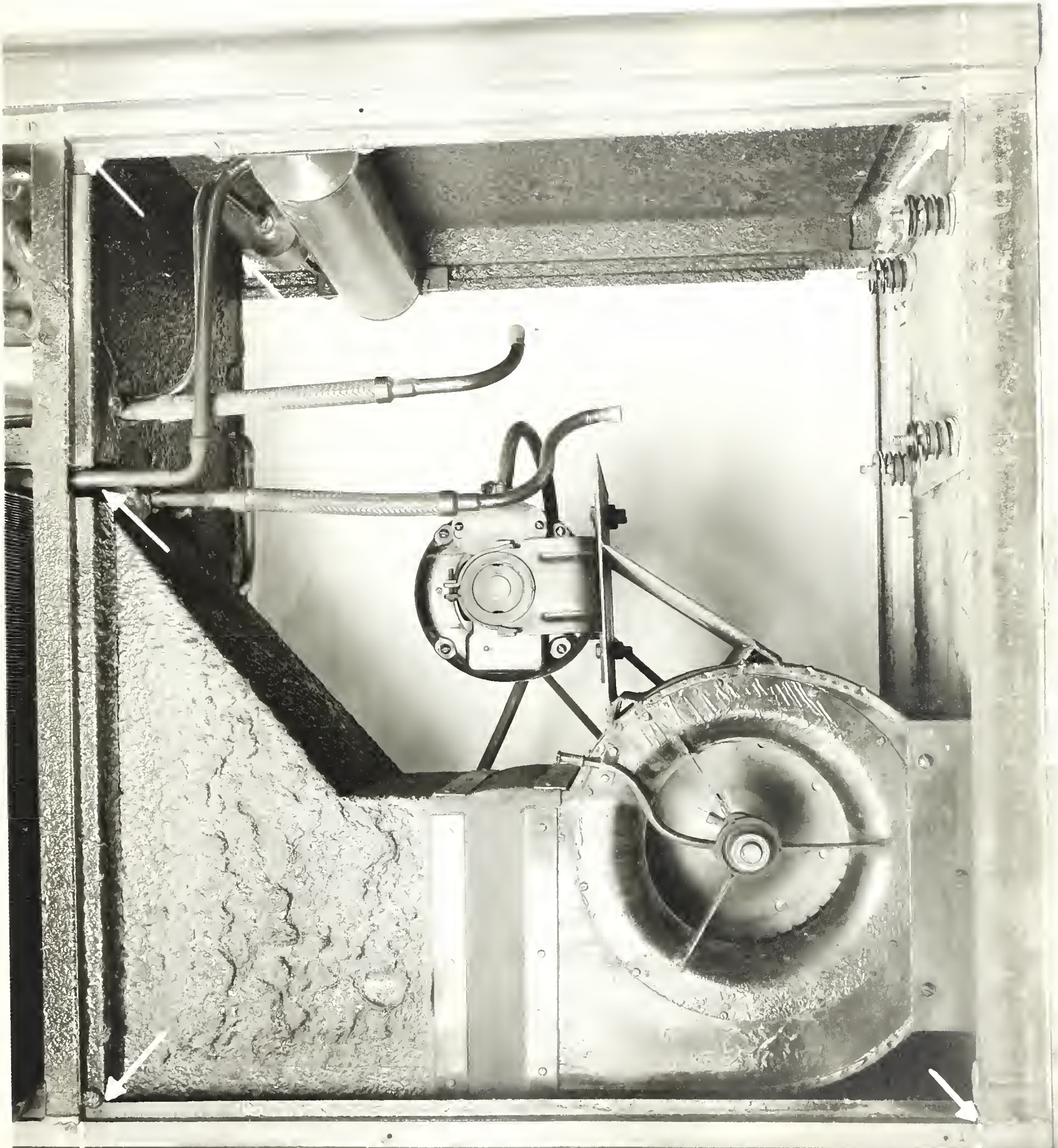
FIG. 3



August 15, 1952
Tecumseh compressor- Sterling Air Conditioner
U.S. Marine Corps

FIG. 4






C
Leave
"space
Leave
"space

WOOD FILLER STRIP (ITEM 2)

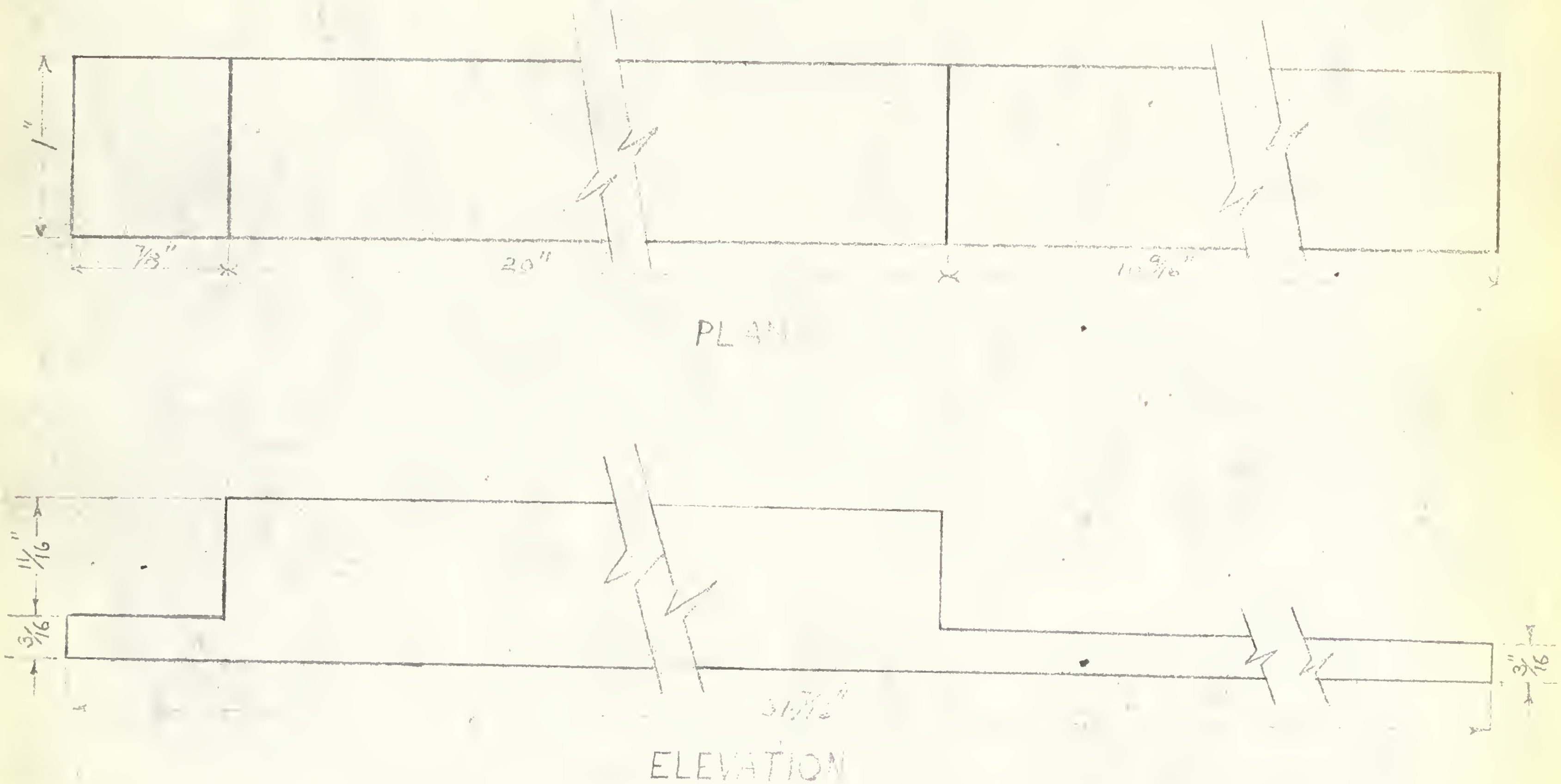


FIG. 9

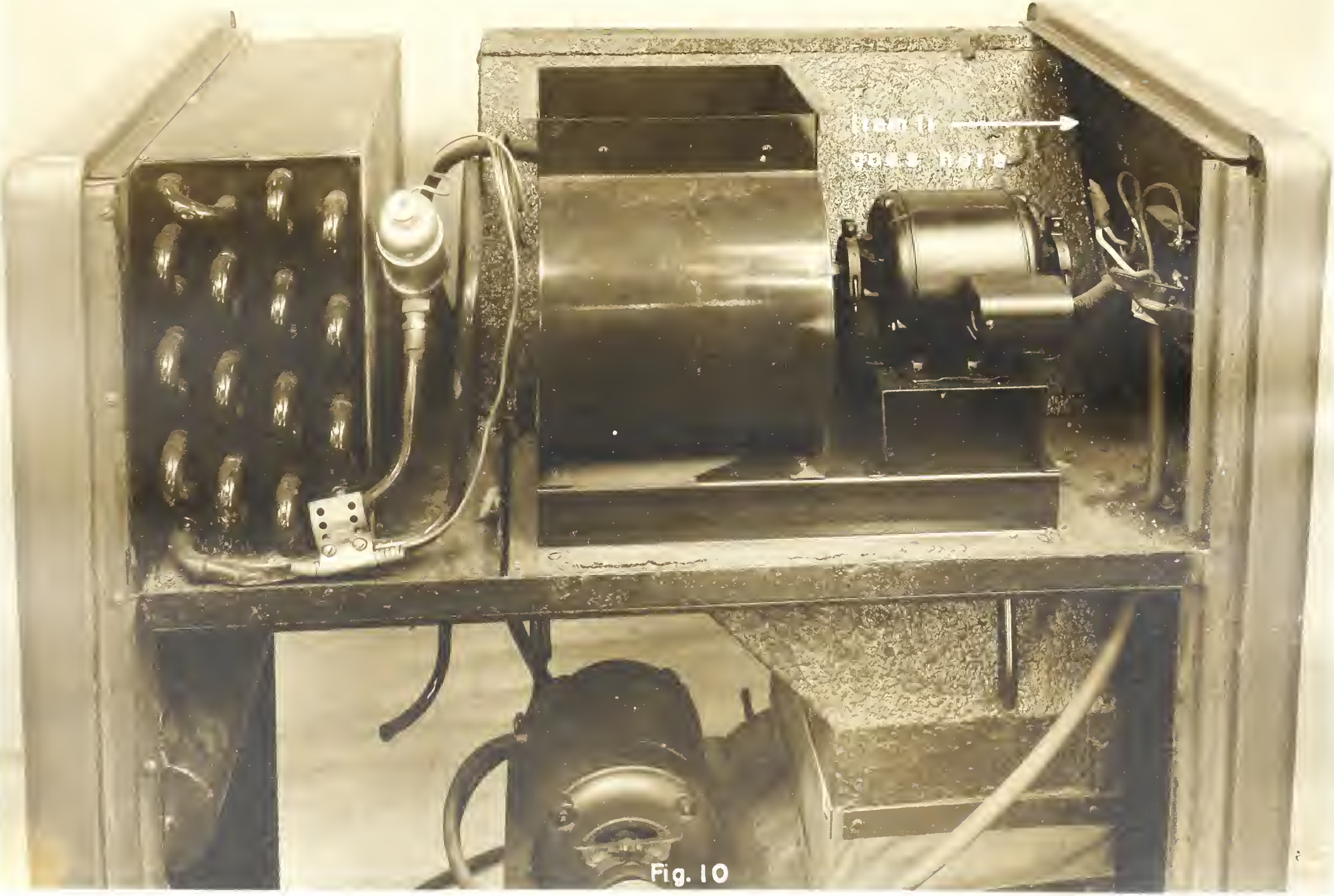
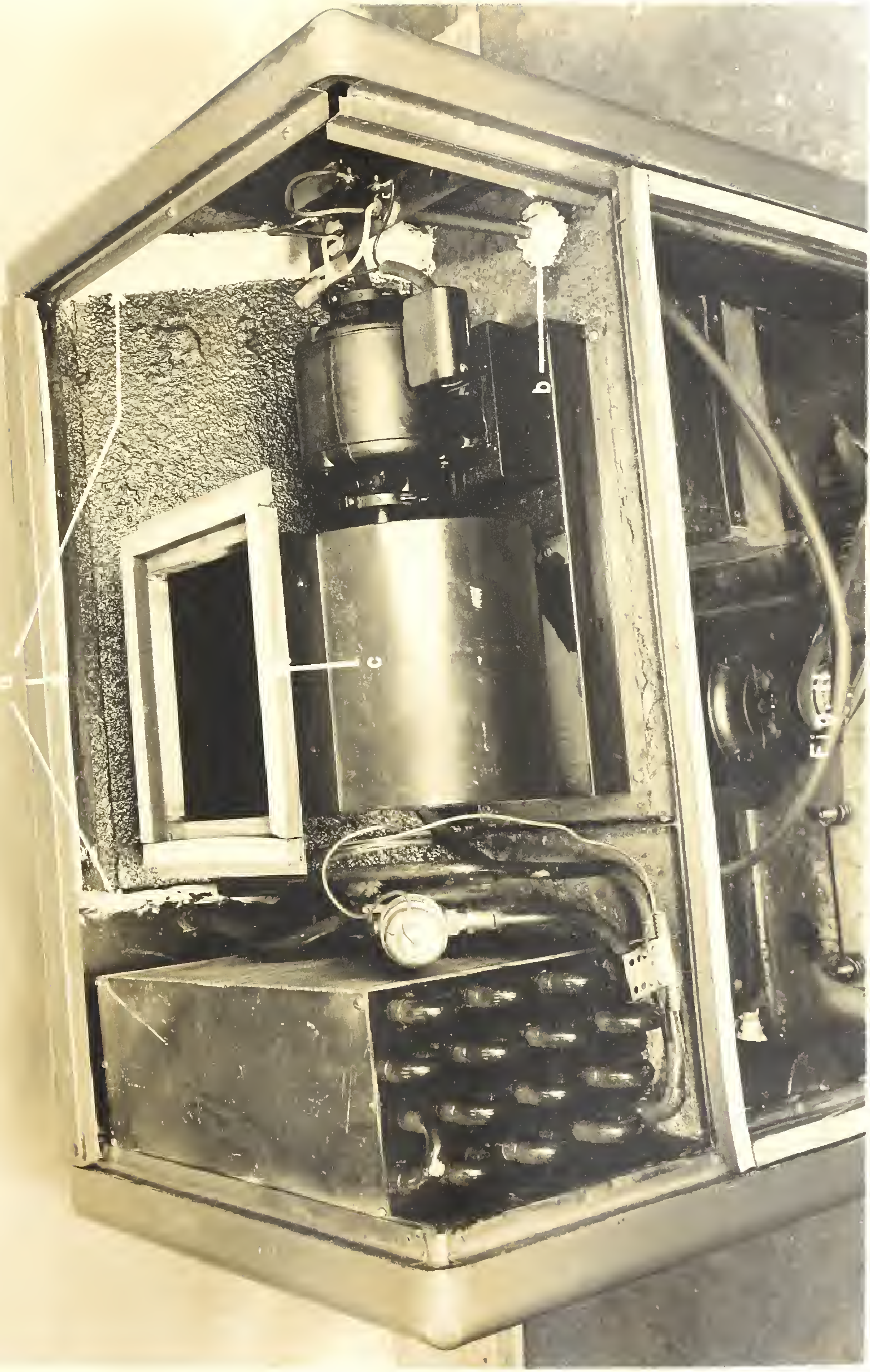
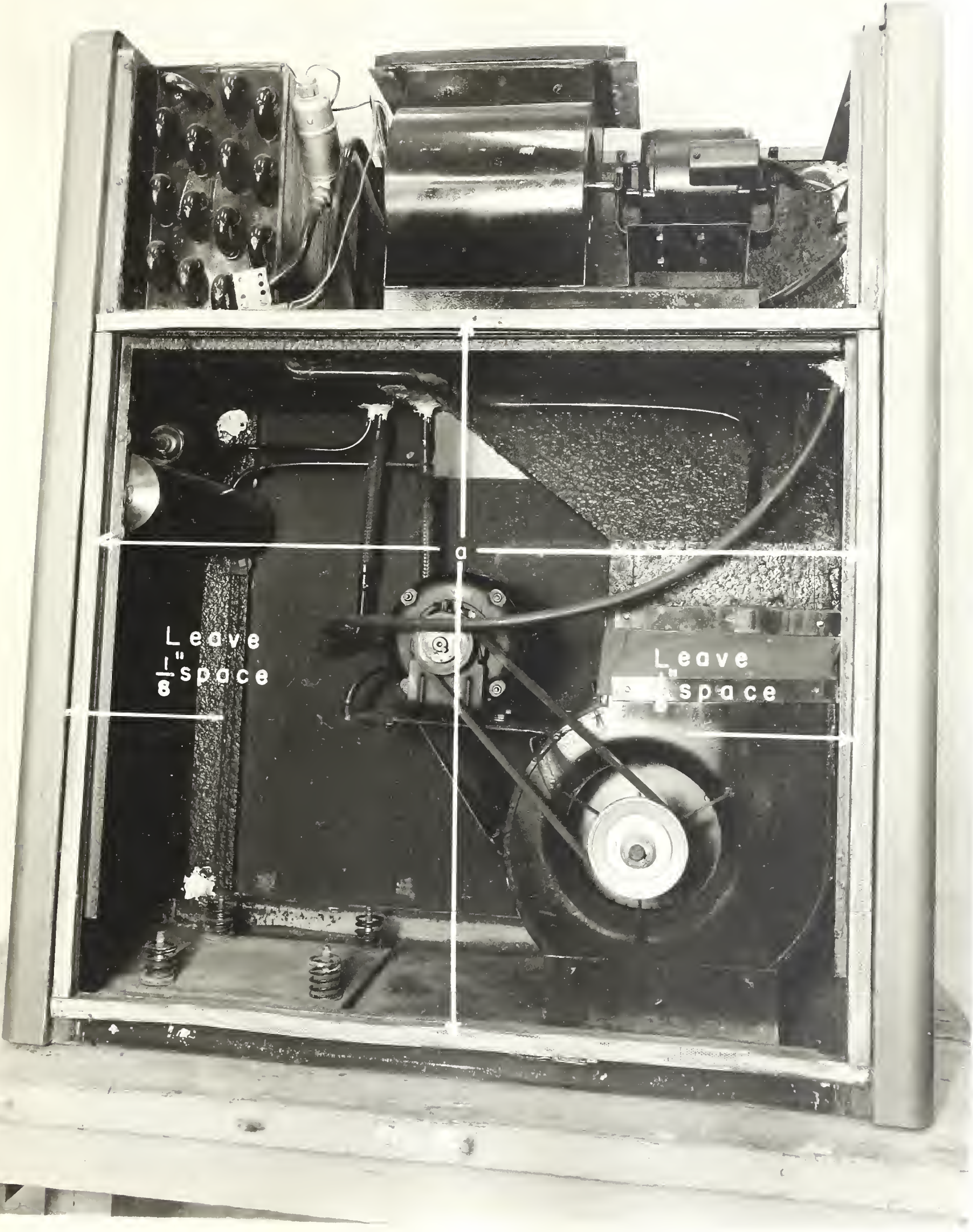


Fig. 10


b
c


a
Leave
1/8" space
Leave
space

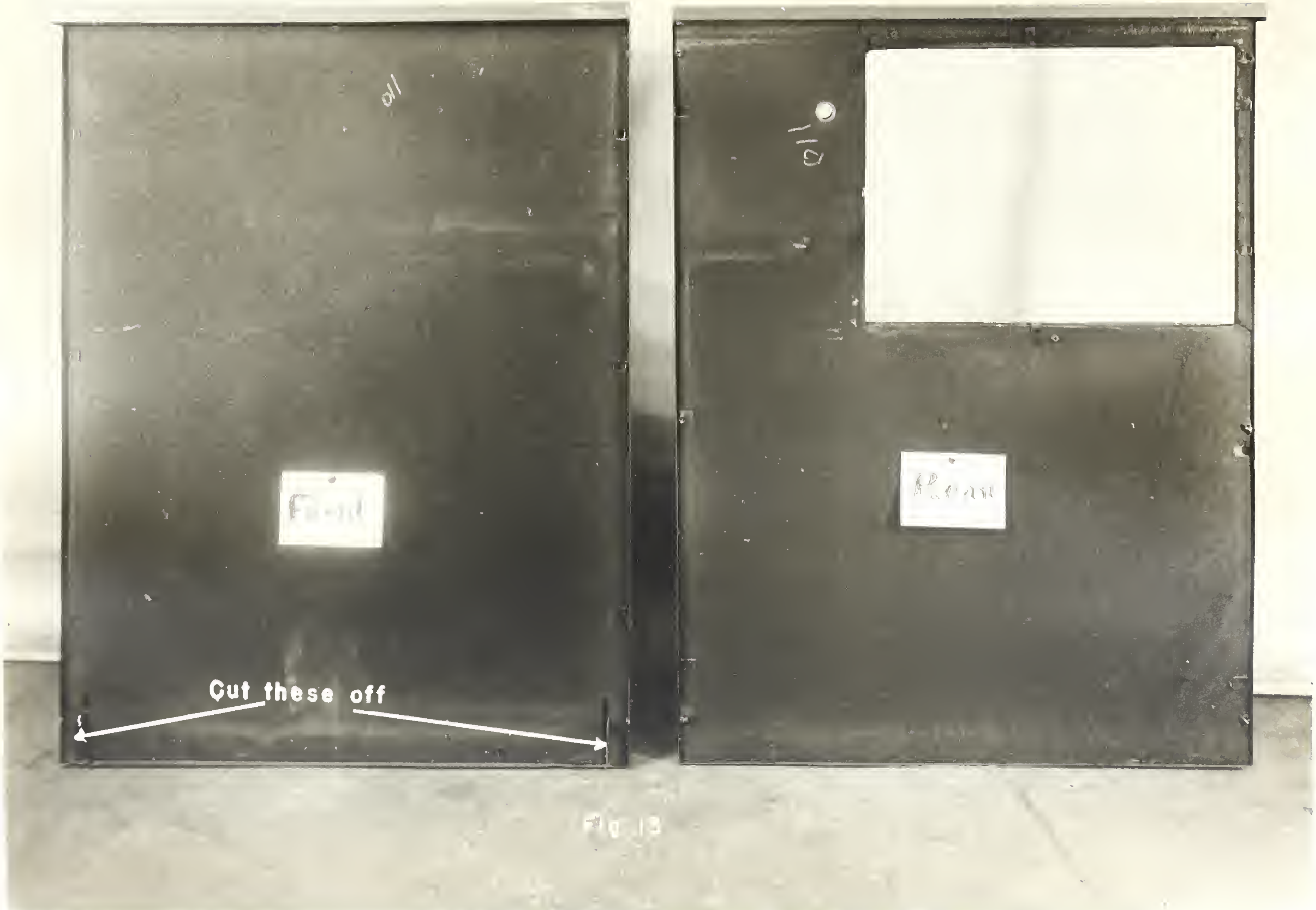
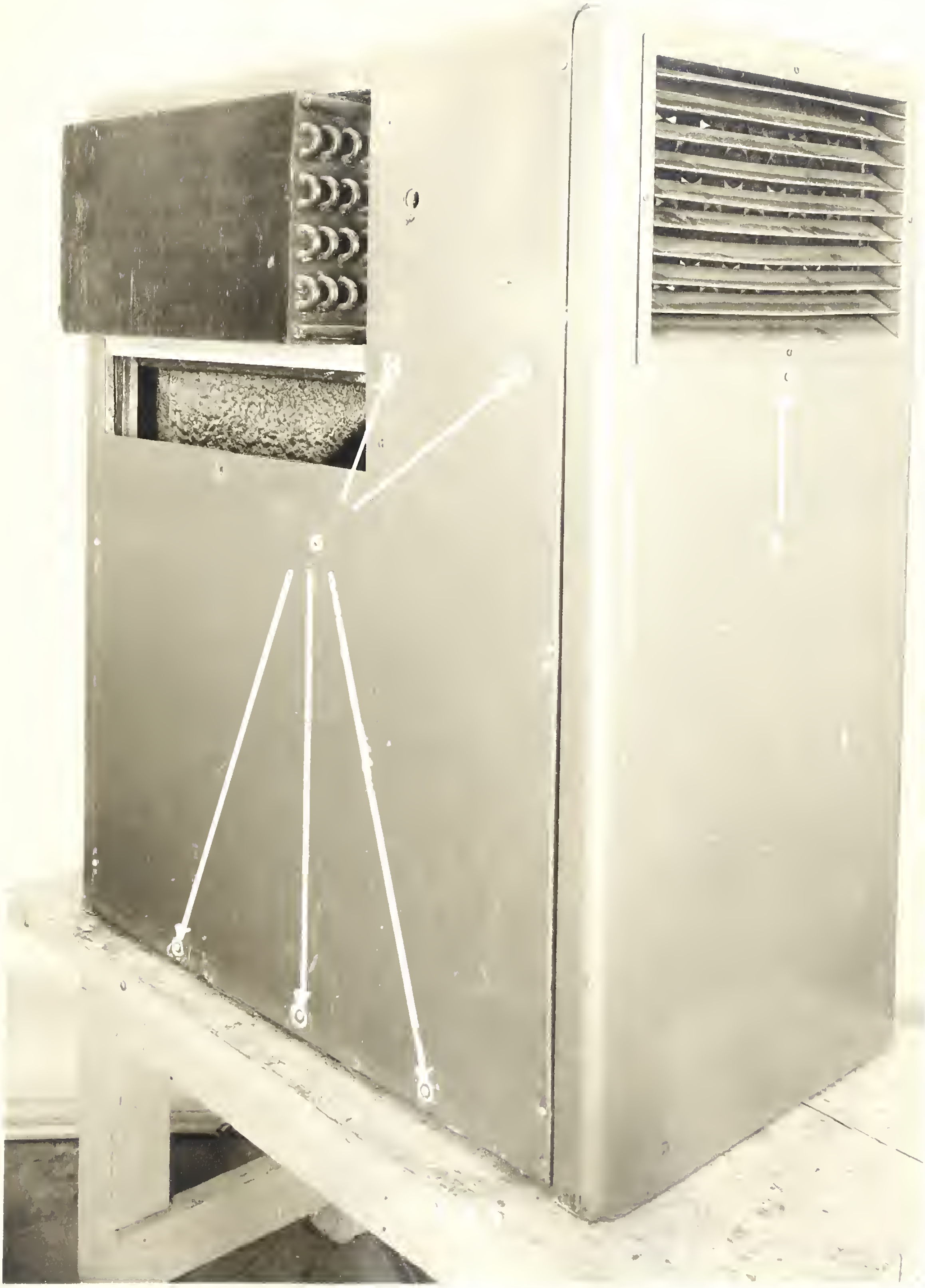
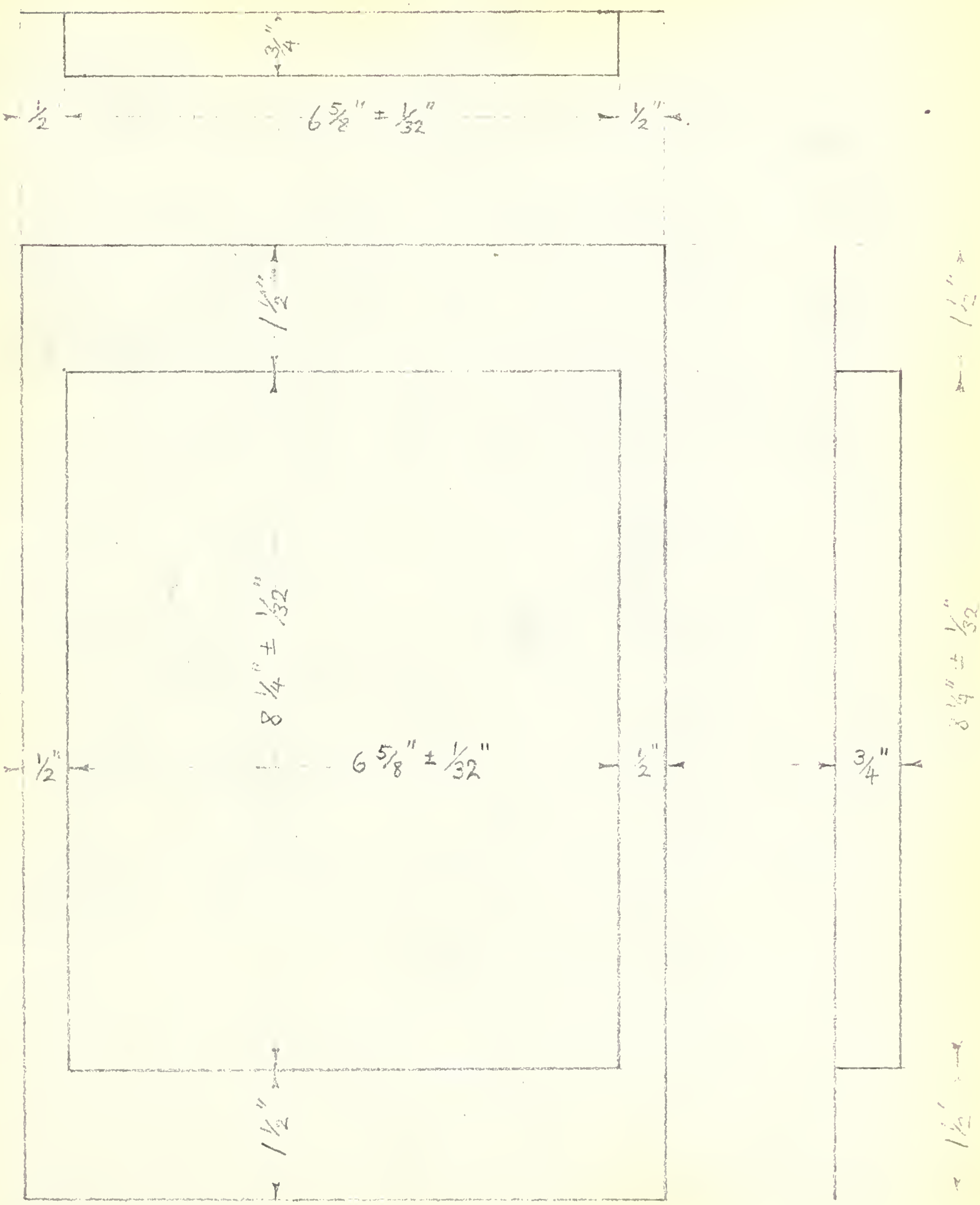

Front
Rear
Cut these off
Fig. 13

Fig. 14



EVAPORATOR AIR DISCHARGE COLLAR
(Item 1)



20 GAUGE GALVANIZED IRON

FIG. 16


a

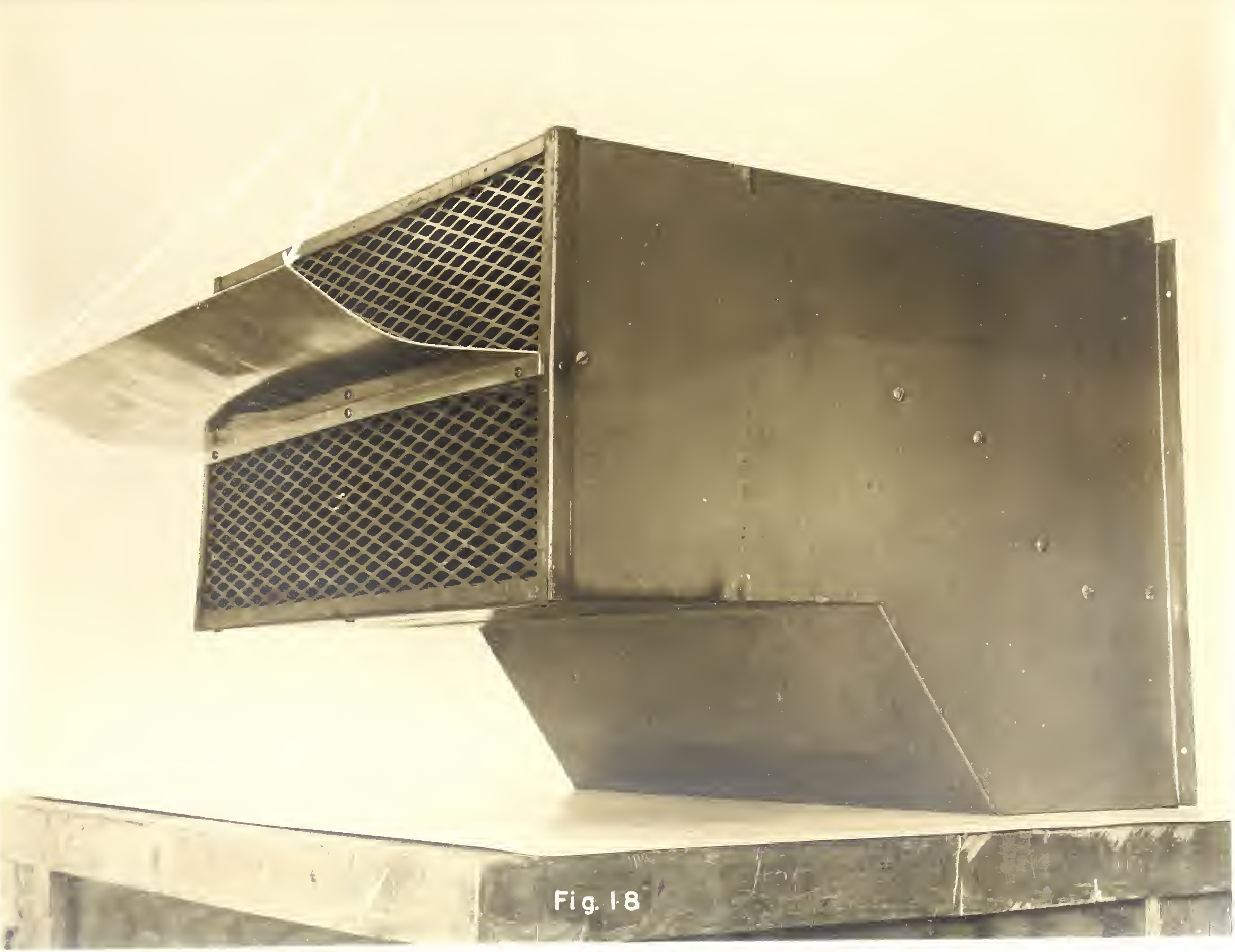


Fig. 1·8

CAPACITY CHECK CURVES

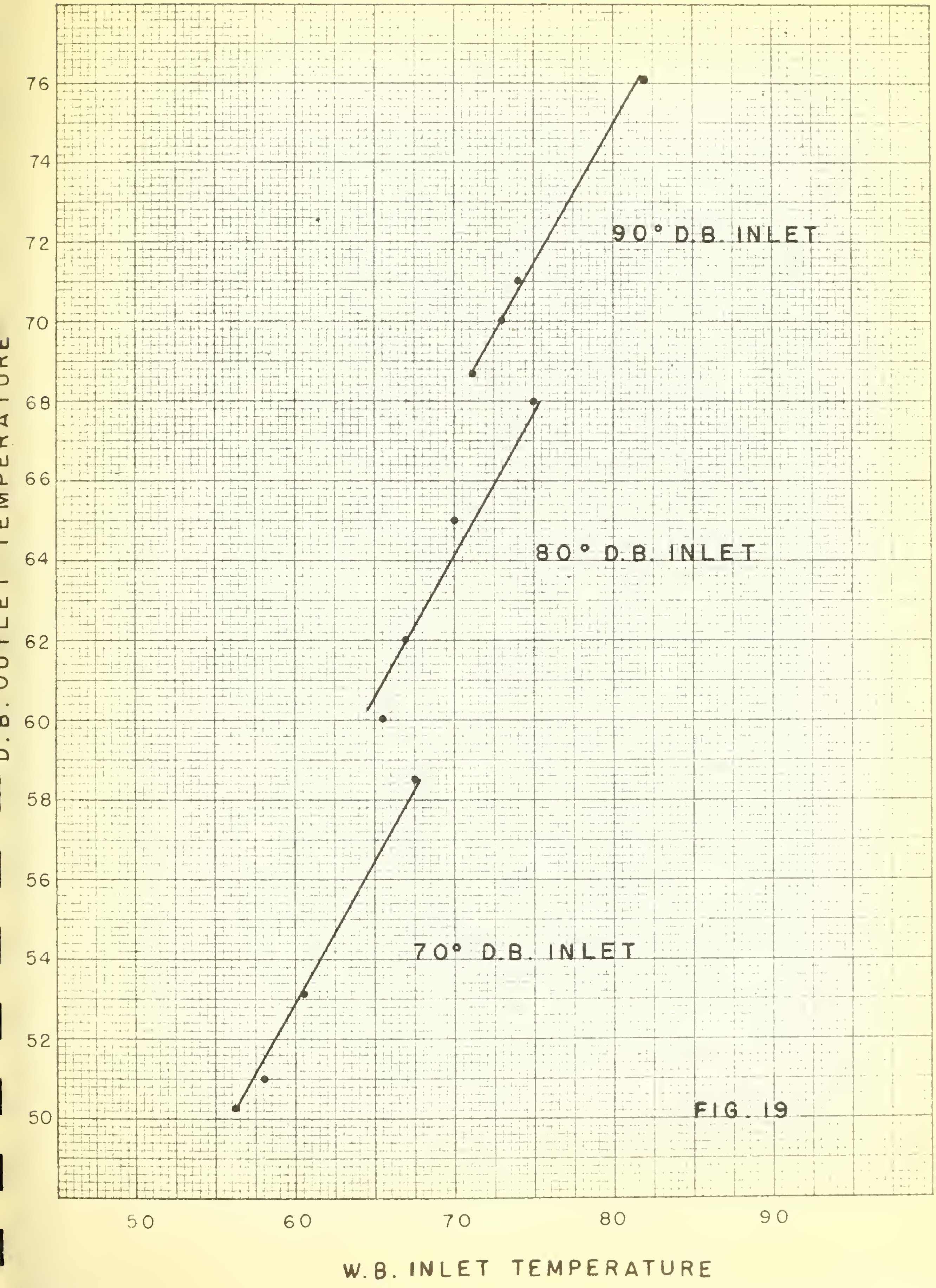


FIG. 19

CONDENSER AIR BAFFLE (Item 4)

0.0625" ALUMINUM

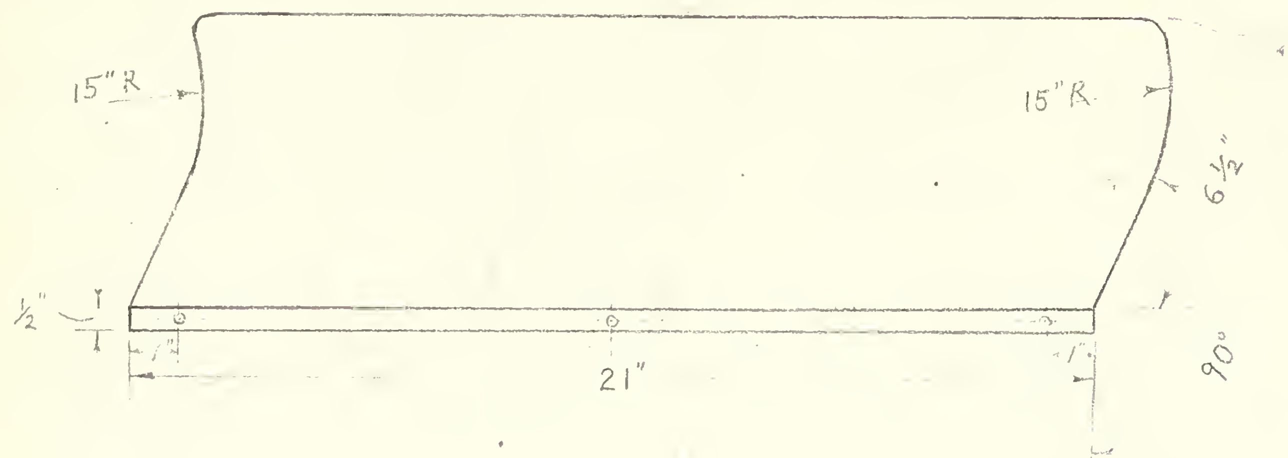


FIG. 20

THE NATIONAL BUREAU OF STANDARDS

Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the front cover.

Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards ($1.00). Information on calibration services and fees can be found in NBS Circular 483, Testing by the National Bureau of Standards (25 cents). Both are available from the Government Printing Office. Inquiries regarding the Bureau's reports and publications should be addressed to the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.

NBS