HANDBOOK FOR THE USE OF ELECTRICIANS IN THE OPERATION AND CARE OF ELECTRICAL MACHINERY AND APPARATUS OF THE U.S. SEACOAST DEFENSES

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649598649

Handbook for the Use of Electricians in the Operation and Care of Electrical Machinery and Apparatus of the U.S. Seacoast Defenses by Anonymous

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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Trieste

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HANDBOOK

FOR THE

USE OF ELECTRICIANS IN THE OPERATION AND CARE

OF

ELECTRICAL MACHINERY AND APPARATUS

OF THE

U. S. SEACOAST DEFENSES.

PREPARED UNDER THE DIRECTION OF THE LIEUTENANT GENERAL COMMANDING THE ARMY.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

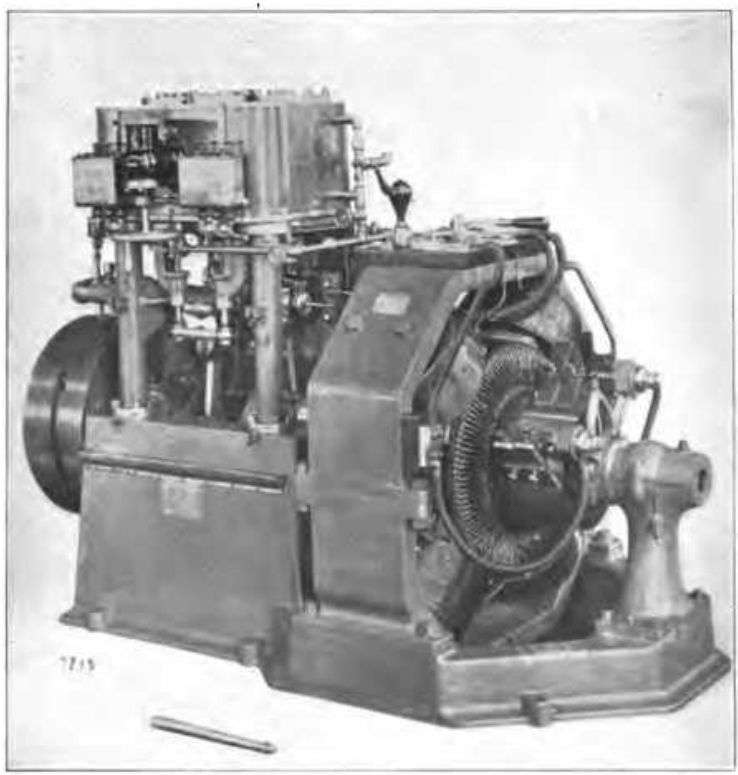
PREFACE.

The installation and management of the electric machinery in United States battleships merit the attention of electricians in forts. Its character and object in the two situations are similar, and the conditions of dampness, limited space changing personnel and reliability are equally severe.

Every implement or portion of the fortification plant must be simple, certain in operation, effective, proved in the industries as standard in its class, and it should only be intrusted to the care and management of an efficient engineer. To be efficient he must have ambition, intelligence and the skill gained by careful handling. The good order and working of his machinery at all times furnish the only reliable testimonial regarding his fitness.

The preparation of the Handbook was suggested and aided by the electricians of the class of 1900, Fort Monroe. It contains in full the latest instructions issued by designers and constructors. The portion relating to land and sea mines is intended for separate publication. The diagrams were drawn by First Sergt. Karl P. Runa. Notice of errors in this first edition will be thankfully received.—G. L. A.

Boston, 1902.



1. United States Navy D. C. Set Constructed by General Electric Company. 5

HANDBOOK FOR ELECTRICIANS.

SPECIAL INSTRUCTIONS TO ELECTRICIANS.

1. Your special duties are to secure the cleanliness and the best working order of every part of the fortification electrical equipment given to your care, whether it be a Schukert 60-inch projector or a glass insulator.

2. Upon taking charge of a plant, inspect it very carefully, and for your future protection, in a letter for file report everything found not in order, even to the tool marks on the machinery.

3. For ten days, if practicable, the retiring engineer should operate, in your presence, all apparatus to be turned over and you, in turn, in his presence.

4. Take written notes in your notebook of the information he gives you. Secure all diagrams, plans and instructions relating to the machinery.

5. Keep posted on boards, or in frames, in a lighted and frequented place as soon as convenient:

(1) Oil Engine Directions obtainable from The De la Vergne Company, East 138th Street, N. Y.
(2) The exact order of operating valves and switches in starting, running and stopping made out by yourself.
(3) Instructions, Electric Storage Battery Company, Philadelphia, Pa.
(4) Diagram of pipe connections, Engineer Office or yourself.
(5) Wirings of dynamo and switch board, Engineer Office or contractor.
(6) Blueprint of emplacements showing wires, lamps, etc., Engineer Office.
(7) Diagram of search-light connections, General Electric Company or Engineer Office.
(8) Diagram of each outside independent circuit under your charge.

6. Take care of the equipment in the following order of importance:

(1) Storage battery.
(2) Steam boiler.
(3) Generating set, steam or oil.
(4) Switch board.
(5) Searchlight.
(6) External and internal wiring.
(7) Lamps and outlets.
(8) Motors and hoists.
(9) Firing, night apparatus.
(10) Telephones.
(11) Telegraphs.
(12) Night signals.
(13) Anemometers.
(14) Lines.
(15) Electric bells.

7. Keep all machinery rooms clean, dry, ventilated and well lighted; all surfaces free from rust and dust, even if a banked fire or a kerosene burner is necessary.

8. Do not delay work or repairs because exactly what you need is not at hand. Proceed with that which is obtainable and do the best thing possible so as to avoid making excuses. Even a good excuse is unfortunate.

9. Make timely requisitions for only the necessary and the best stores. Use best mineral oil only.

10. If boiler, engine, dynamo or any iron piece or tool is to remain unused, its polished surfaces will be thoroughly cleaned in full light in a dry room on a dry day and covered with a thick, uniform coat of cosmic, with 25 per cent of resin added if interval will be long. Every three months clean off, repolish and renew.

11. "Prevention" is the rule for machinery troubles, not "Cures."

12. In case of accident, "the other man" can not be pleaded by the electrician. The clearest evidence regarding his capacity is furnished by a single boiler fixture leaking, dirty water, incrustation or corrosion in boiler, an unsteady

steam gauge, water glass, or fire, an unusual noise in engine, a hot bearing or coil, a scratched or sparking commutator, an oil engine's chronic cough or thick exhaust, density, voltage or gassing of storage cells not uniform, battery standing at low voltage, burn-outs and tool marks on search light or other apparatus, dust, rust, or damp on any part, unsoldered joints or leaky circuits, and by other things.

13. A neat and well-fitting uniform will invariably be worn outside of the emplacements.

14. Always charge a storage battery at its given normal rate to full charge (density, 1.200; voltage, 2.5 per cell); do not discharge above the normal rate except in emergency, and never below density of 1.175 and voltage of 1.8 per cell.

15. Keep density, voltage and gassing of all cells uniform. To cover plates ¼ inch, water (or solution, 1.400, rarely) is added at the top directly after charging begins. If little used, the battery is partially discharged and regularly charged once each week.

16. Blow off boiler in starting at 10 pounds from water high, one or two gauges; oftener if necessary. Maintain uniform fire, water level, and pressure. Frequently inspect fire tubes for dirt, and boiler interior for deposit and corrosion.

17. Handle all machinery and apparatus with great care. Let their loads be increased and decreased uniformly and slowly. Guard against sudden rise of temperatures. Never hesitate to allow a machine to take its full load under these conditions, but not to exceed it.

18. An engine is always started as slowly as possible. A good engineer turns valves and switches deliberately while watching the effect; his order of starting and stopping is always the same.

19. Keep exposed conduit, cut-out, switch, junction and lamp boxes cleaned and painted, and all openings tightly sealed, so that the whole system is essentially air-tight.

20. For more complete information, electricians are referred to Crocker's (two volumes) Electric Lighting, Sheldon's Dynamo Electric Machinery, General Electric Company's Bulletins and Instructions, Westinghouse Company's Bulletins, Dawson's Electric Traction, Treadwell's Storage Battery, Goldingham's Oil Engines, Miller's Telephony, Maver's Telegraphy, Cushing's Wiring, Stromberg's Steam Engine, Hawkins' Catechisms of Electricity and Steam Engine.

21. The efficiency of all your machinery was long ago proved. The opinions, sometimes heard, that search lights, for instance, can not be controlled from a distance, that storage batteries are inefficient, that telephones near guns are inoperative, that oil engines and submarine mines are unreliable, result from the kind of knowledge which is dangerous.

22. In more than nineteen cases out of twenty in which a standard machine or apparatus, properly installed, fails, the fault rests with the attendant.

23. Remember that if there is any portion or piece of the fortification electrical equipment under your charge not in perfect working order, or not clean, and not reported as irreparable, and if you being for duty, are working less than ten hours daily on week days, you will be held blamable.

I.—HANDLING AND CARE OF STEAM FIRE-TUBE BOILERS.

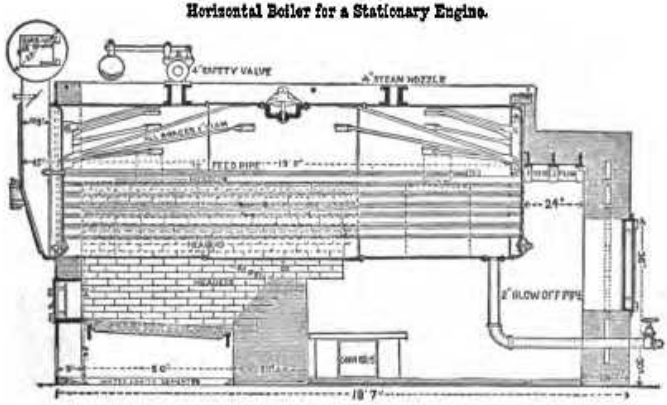
(A) RAISING STEAM.

1. To start the fire in a small furnace, clean the grate of clinkers and the pit of ashes. See that grate works freely. Cover it evenly with shavings and wood and light the fire. When the upper stratum of hard wood is blazing well, throw on a uniform 2-inch layer of soft coal, closing furnace and opening the pit doors. When the coal is red, add a second similar layer. A third feeding should leave a greater depth of coal around the sides than in the center.

2. If the furnace is large, cover the grate all over with a 2-inch layer of hard coal, except a space in front for wood and shavings. Cover the coal at the back with a little heavy wood and light the fire. Add coal to the upper hard wood when aglow, as above, and so continue.

3. Regulate coal and draft for at least one hour's rise to full pressure in a small warm boiler, two hours for a small cold water boiler and five or six hours for a large cold boiler.

Horizontal Boiler for a Stationary Engine.



2. Horizontal Return Fire-Tube Steam Boiler.

4. After lighting the fire see that:
   (*a*) Gauge glass agrees with gauge cocks and is not choked.
   (*b*) Water stands to upper gauge at least.
   (*c*) Safety valve is in working order by raising it once or twice.
   (*d*) Steam feed, throttle, and blow-off cocks are closed.
   (*e*) Pump is oiled.
   (*f*) Upper gauge is temporarily open to equalize the pressure within.

5. At 10 to 15 pounds pressure blow off to second gauge to drive out mud and create circulation for even temperature.

(B) FIRING.

1. Before opening the furnace door have plenty of coal at hand—no piece larger than the fist. Spread the coal by throwing to the rear first and so on to the front in a thin uniform layer. Most firemen heap on too much fresh coal.

2. The thickness of coal fire is from 5 to 8 inches. If the necessary thickness makes too hot a fire, reduce the grate area by putting in fire brick, 8 inches high, around the sides of the furnace.

3. If the fire burns unequally, fill the vacant spots. Allow no air holes in the bed of fuel.

4. The cleaning tools are: The hoe for pulling or pushing the fire over the bars, slice bar for breaking up the fire, clinker hook and the T-bar for raking lengthwise of the bars beneath the fire to cause the ashes to fall through, and scoop shovel.

5. Clean or rake the fire as rarely and as quickly as possible, but always when clinker and ash are closing the grate, usually two or three times a day if coal is

hard. Dark spots, heavy smoke, and blue flame give warning. But leave the fire alone so long as it is at uniform glow and its light shows in the ash pit beneath.

6. To clean a fire, have plenty of water in the boiler, open damper and one furnace door, pack half of the fire to one side, raking out the dead clinkers and ash; then move the whole fire to the exposed grate and clean the other half; finally spread the fire evenly and throw on fresh dry coal. Cleaning reduces the depth of fire and lowers the boiler pressure. Shaking the grate is the best way to clean when it can be done.

7. The most effective and economical fire is moderately thick, steady, uniform and regulated, as far as possible, by the chimney damper. Enough air should be admitted above the fire through the door air holes to consume the rising gases and thereby increase the heat. With a steady fire the combustion is more perfect and there are less clinkers, less cleaning and less cold air.

8. The construction of a damper should not admit its closing the chimney entirely, as gases may otherwise collect in the flue and cause explosion.

9. To bank a fire, have three gauges of water. Allow fire to get low, clean and push it to the rear in a compact pile and cover it thickly with small coal or wet ashes. Leave clinker and ash on the front of grate. Leave fire doors open and close the pit doors tightly and the chimney damper partially. If the fire is found too cold the next morning less grate should be uncovered and the pile of fire be less compact. Banking the fire preserves the boiler by keeping its temperature more nearly even, saves time in starting, but is dangerous if not properly done.

10. To start a banked fire, clean out ashes and clinker or shake the grate, spread the fire evenly, feed a little wood for draft and add coal gradually.

11. Ashes left high in the ash pit may cause warping or burning out of grates.

12. When fuel and water are irregularly fed, or pressure is always changing, or the safety valve is now and then popping, or dampers and doors are being frequently opened and closed, or if there is a leaking of water, steam or oil, or room is dirty, the boiler's tender is outside of his sphere of usefulness.

13. Give the last two or three minutes in a boiler room to its inspection to make sure that everything will be left in order. Then close and lock all doors and windows.

(C) CARE AND MANAGEMENT OF STEAM BOILERS.

1. The steam boiler is the most important element of an electric plant.

2. An indifferent or intemperate fireman and a cheap boiler are alike dangerous.

3. The first thing on taking charge of a boiler is to inspect its safety-fitting and feeding apparatus.

4. Let the ear aid the eye in detecting troubles.

5. Never exceed the working pressure given by the builder or inspector.

6. Never open nor close a throttle, a blow-off or other steam outlet suddenly, nor leave it before it is closed.

7. Repair a leak or a damage in boiler or fitting as soon as possible. See that furnace, combustion chamber and smoke flue are tight.

8. Much smoke from the chimney shows that combustion is not perfect. All air must go through the grate bars or the little smoke burners.

9. The boiler room should be day lighted, well ventilated, spacious and dry. Never leave it while boiler is under steam.

10. Dry steam only is wanted. If a small jet from the upper gauge cock, close to the orifice, is transparent or even has a grayish-white color, the excess of moisture is less than 1 per cent. If the jet is strongly white, the excess is 2 per cent or more. Steam containing less than 3 per cent excess of moisture is fairly "dry."

11. Empty a boiler working daily once a fortnight. If water is muddy blow out 6 inches daily and use the surface blow-out more frequently. To avoid serious results examine blow-out and check valves whenever the boiler is filled.

12. Procure the manufacturers' directions of boiler and its fixtures.

13. Blisters and cracks may occur in the best boiler plate. Then put the boiler out of service and repair.

14. In case of low water, immediately open furnace doors and chimney damper, close pit doors tight and quickly cover the whole fire with ashes, soil or coal (wet if possible). Leave all steam outlets as they are. Do not draw fires until the pressure has dropped, nor turn on feed water, nor start nor stop engine, nor lift safety valve until the fires are out and the boiler is cooling. If water has only just disappeared there is no immediate positive danger. If the water gets too high, carefully open blow-off and let out gradually a gauge of water.

15. Foaming or priming is due to forcing the boiler or to small steam space or to other bad design or to dirty or high water or to opening the throttle