SPECIFICATIONS

FOR BUILDING

SINGLE-SCREW STEEL VESSELS

FOR THE

U. S. REVENUE-CUTTER SERVICE

1910

REVENUE CUTTER No. 22 (Tampa)

AND

REVENUE CUTTER No. 23 (Unalga)

WASHINGTON
GOVERNMENT PRINTING OFFICE
1910

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SPECIFICATIONS FOR BUILDING HULL AND APPURTENANCES.

1. PRINCIPAL DIMENSIONS.

Length over all	feet..	200
Length between perpendiculars	do...	180
Breadth of beam, molded	do...	34
Depth at side from base line, molded	feet..	18
Displacement to mean load draft of 13 feet 11½ inches above base line, with 300 tons of coal and 15,425 gallons of water on board and ready for sea	tons..	1,324

2. PLANS.

The following-named preliminary plans accompany these specifications and form part of them:

No. 1. Sheer, half-breadth, and body.
No. 2. Midship and other sections.
No. 3. Inboard profile, spar deck, and bridge.
No. 4. Main and berth decks, and holds.
No. 5. Outboard profile.

The intent of the above plans is to show the general arrangement, not every minor detail, of the vessel, and the absence of such details from the plans will not excuse the contractor from fitting them.

The several parts, compartments, fittings, appurtenances, etc., of the vessel will be located where shown on these plans, unless otherwise directed in writing.

The contractor shall make and submit, for the approval of the Superintendent of Construction and Repair, three blueprints of the various plans of the details of the hull and fittings before the work on each part shall be commenced; two of these prints will be returned—one for the use of the inspecting officer and the other for the contractor. These drawings must be made to conform to the specifications and the plans furnished by the Government; approval of them does not carry approval of parts or details not in such conformity unless the departures have been brought in each instance specifically to the attention of the approving officer by letter. In other words, the Government shall not be deprived of the right to have all such intentional or unintentional departures from the specifications corrected because they have been

overlooked in the approval of the plans. All departures not specifically approved as such must be corrected, when required, at any time before the completion of the vessel. Plans furnished by the contractor and properly approved, as above indicated, become official plans.

A set of dimensions taken from mold loft will be furnished. Within one month after the completion of the vessel a set of corrected tracings of all the various plans and details of the hull and fittings shall be furnished by the contractor, and forwarded to the Superintendent of Construction and Repair for the files of his office. These various plans must be in such detail as will permit of duplicating the entire hull and appurtenances thereto without additional plans. Detail plans must be made to a scale of not less than 1½ inches to the foot, and general plans to a scale of ⅜ inch or ¼ inch to the foot.

3. INTENT OF THE SPECIFICATIONS.

The intent of these specifications for the hull and its fittings and appurtenances is that the contractor shall build, launch, equip, and complete the vessel ready, in all respects, for service, so far as the items enumerated in the specifications and the work indicated on the plans are concerned, whether the details are fully described in the specifications or shown on the plans or omitted from one or the other, or imperfectly described or shown; that the contractor shall provide at his own cost the necessary plant, tools, materials, and labor for the work, and that materials and workmanship shall be first class in every respect and satisfactory to the Government.

Any dispute that may arise relative to the true meaning or intent of the specifications or plans, or concerning any omissions or imperfections that may be in them, shall be referred to the Secretary of the Treasury, whose decision shall be final.

The specifications and plans must not be departed from except by direction or authority of the Secretary of the Treasury, or of the Chief of Division of Revenue-Cutter Service; and when any suggested departure from the same shall be considered a benefit to the Government, and not unjust to the contractor, it shall be made by the contractor without extra compensation.

Should the contractor depart from the specifications or plans, except by proper direction or authority, as above mentioned, the Government shall be at liberty at any time, before or after completion of the work, to cause such work to be removed, remade, or replaced at the contractor's expense, and all work injured by such alterations must be made good by the contractor and at his expense.

It is not the intention of these specifications that the contractor shall furnish the arms or armament of the vessel, boats, sails, awnings, canvas covers, movable furniture (except as specified), navigators' instruments, nor articles of general outfit, such as mattresses, bedding, tableware, etc., but it is understood that it is not practicable to enumerate herein all the details of fittings or appurtenances of the vessel, nor is it necessary to do so, and that they shall be supplied by the contractor, without extra compensation, notwithstanding such omissions.

4. CORRESPONDENCE.

All correspondence with the Government, of any character whatever, regarding the hull, its fittings and appurtenances, must be submitted in duplicate to the inspector of labor and materials for the hull, who shall forward the original of each letter, over his signature, to the Superintendent of Construction and Repair and retain the duplicate for the files of his office. In forwarding letters from the contractor suggesting or recommending changes in the plans or specifications, etc., the inspector of labor and materials will invariably state his opinion of the matter or matters in his indorsement. All letters from the Government to the contractor will be forwarded through the inspector of labor and materials.

5. MATERIALS, TESTS, AND WORKMANSHIP.

All materials for hull plates and shapes shall conform to the following requirements:

Ultimate strength, 60,000 to 70,000 pounds per square inch.

Elastic limit, not less than one-half of the ultimate strength.

Percentage of elongation (in a length of 8 inches, except as modified by Rule 12 of Manufacturers' Standard Specifications for "medium" steel), 1,400,000 divided by the ultimate strength.

Bending test, 180 degrees, to a diameter equal to the thickness of the piece tested, without fracture on outside of the bent portion.

The limitations as to weight are to be as prescribed in Rule 13 of the Standard Specifications, revised February 6, 1903.

It is understood that the Government will not inspect this material at the place of manufacture, but that any of it that fails during its incorporation into the vessel will be rejected, and must be replaced by good material. Copies of all orders for hull plates and shapes, together with copies of test reports from the mills, must be furnished.

Unless otherwise specified, the weights of shapes are "per running foot" and of plates "per square foot."

On no account are "jump" welds to be made in important forgings.

Butts and seams of plating will be lapped or strapped as particularly specified in each case, and where not specified must be as directed. The width of edge strips, laps, and butt straps, the weight of straps, the size, form, and pitch of rivets and angles of countersink are to conform to the best practice, as approved.

The workmanship throughout must be first class in every particular, and care must be taken to insure fair lines, smooth surfaces, and perfect water-tightness.

All plates are to be rerolled to remove surface irregularities as directed.

The riveting must be done in the most thorough and careful manner, the greatest care being taken in punching to prevent unfair holes. All unfair holes are to be reamed fair before riveting, and a rivet suitable to the increased size of the hole inserted. Where unfairness can not be overcome by reaming, new material must be substituted. The use of the drift punch for correcting unfair holes must not be allowed. All

holes must be clean cuts, without torn or ragged edges, and the rivets must completely fill them and be thoroughly laid up. Special care must be taken not to burn rivets when heating them. All rivet work must be tested, and all loose, burned, or broken rivets, or rivets not thoroughly laid up, must be cut out and replaced by new rivets.

The inspecting officer may require holes to be drilled and bolts turned for them, or he may substitute bolts for rivets, whenever he deems it desirable, without additional charge.

Riveting is to be finished flush on hatch coamings and skylights where exposed to view, bulkheads in quarters, engine and boiler casings, and elsewhere as may be necessary to present a smooth surface or to prevent the notching of margin strakes of deck planking. All countersinking must be done in the most careful manner.

All butts, seams, moldings, etc., must be thoroughly calked.

Any portion of the work, whether partially or entirely completed, found defective must be removed and satisfactorily replaced by the contractor without extra charge.

6. LUMBER.

All lumber must be of the kind specified for each particular place, well seasoned, of satisfactory quality for the purpose intended, and subject to the inspection and approval of the inspecting officer when being worked into the vessel.

Wood decking shall be the best quality of fine-grained long-leaf yellow pine that has not been tapped, from the Gulf ports; it shall be in lengths exceeding 16 feet and averaging not less than 24 feet, and in width and thickness when finished as specified; it shall be quarter-sawed and laid edge grain. In square-cut decking one face next the sap, and in other decking the wide face next the sap, must be absolutely clear and all heart and edge grain; the remaining faces of all sizes must be all heart and free from shakes, sap, splits, heart centers, wormholes, or other defects, excepting that an average of one sound red knot, not more than 1 inch in diameter, in every 10 feet of such faces will be allowed.

Margin pieces on all decks except the spar deck will be of the same grade and quality of yellow pine as the decking, and sawed and laid in the same manner. Margin pieces on spar deck will be of selected East India teak.

The quartered oak will be white oak, natural finish. The ash shall be clear white ash. The sycamore shall be clear, quartered sycamore.

7. TESTING WATER-TIGHT COMPARTMENTS, TANKS, ETC.

All compartments adjacent to the outside plating and required to be water-tight must be tested before launching. Trimming tanks, built-in fresh-water tanks, and ammunition rooms must be tested to a pressure equivalent to a height of water of 8 feet above the mean load-water line, and must be absolutely tight under that pressure. Tests for water-tightness must be made before the compartment is either painted or

cemented, and in all cases, where practicable, water-tightness must be secured by metal calking only. Air ports and water-tight covers to hatches, bunker openings, and skylights must be tested by the hose under steam pressure, and must be tight under that pressure. Waterways and scuppers must be tested by filling them with water. Decks must be tested for water-tightness by flooding them with water. Any leaks which develop under tests must be stopped, and the tests repeated and continued until water-tightness is secured. All testing of compartments, tanks, etc., and the stopping of leaks must be done by and at the expense of the contractor and in the presence of the inspecting officer. Compartments, bulkheads, flats, etc., must stand the test pressures required without permanent set or serious deflection, and any deficiencies in stiffening discovered by the tests must be made good by and at the expense of the contractor. The absolute water-tightness of all flats on which tiling is to be laid, and of coamings, bounding angles, skylights, etc., must be secured.

8. INSPECTION.

The work of constructing the vessel and its appurtenances shall be open at all times to inspection by officers appointed or detailed for the purpose by the Secretary of the Treasury. Every facility must be afforded such inspectors for the prosecution of their work, and all handling of materials necessary for purposes of inspection must be done by, and at the expense of, the contractor.

The contractor must provide a suitable office, properly furnished, lighted, and heated, and the necessary service for keeping it clean and in order, for the exclusive use of the inspecting officers.

9. CENTER LINE. WATER LINE.

The fore-and-aft and vertical center lines of the vessel must be permanently marked on suitable plates, or center-punched, as directed, where they will be plainly visible.

In each compartment extending to the side of the ship and embracing the deep-water line the latter will be indicated in a conspicuous place on the shell plating or on the ceiling, as the case may be, by a black mark in oil paint, $\frac{1}{2}$ inch wide by 6 inches long, the mark in each case to be designated by the letters "W. L." Should the compartment extend the entire beam of the ship, a mark must be placed on each side; should the compartment be more than 10 feet long, additional marks shall be placed so that they shall not be more than 10 feet apart.

10. HEELING.

At a suitable time shortly before the vessel leaves the hands of the contractor she must be heeled for the purpose of determining the location of the center of gravity. Staging and other materials on board for the purpose of facilitating work must be removed before the experiment takes place. Compartments must be free of water, and tanks and boilers must be either full or empty, a note of their condition in this respect being made in the report. All weights on board to be

incorporated into the construction of the vessel are to be located as near their final positions as possible. All doors and fittings subject to change of position on inclining the vessel must be properly fixed in place. All cribbing and other material and all labor for heeling will be furnished by, and at the expense of, the contractor. A tabulated statement, in duplicate, of the heeling test, giving results, will be furnished the Superintendent of Construction and Repair.

11. CLEANING DURING CONSTRUCTION.

All dirt, chips, etc., must be cleaned out daily, in the discretion of the inspecting officer, and no water shall be allowed to remain in the vessel. Particular care must be taken that all foreign matter is removed, and that all parts are thoroughly cleaned, before the application of paint or cement.

The vessel must be thoroughly clean and the paint in good condition when delivered to the Government.

12. GROUNDING.

Great care must be taken that the vessel does not at any time take the ground. Should grounding occur before completion she must be docked, thoroughly examined, and all injury repaired to the satisfaction of the inspecting officer, and by and at the expense of the contractor.

Injuries resulting from collision, docking, or other causes must likewise be made good by, and at the expense of, the contractor.

13. CEMENT. TILING.

In trimming tanks, around all foundations, between frames and and waterway bars, and elsewhere where necessary for forming water courses, including waterways on spar and main decks, cement of about 1 part Portland cement and 2 parts sand will be used, the quantity to be limited to the minimum required for the purpose. Cement will also be worked in the lower corners of coal bunkers to protect the angles. At the forward extremity of the vessel, and at other places where more than the ordinary quantity of cement is required, a thin coat of cement will be applied first, the spaces filled with coke, cork chips, or other suitable material, as approved, and liquid cement poured over this until the whole mass is solid and impervious to water. The sharp places aft and under the stern tube will be filled in to the line shown on "Inboard Profile" with cement formed of 1 part Portland cement and 2 parts sand—coke or other light material is not to be used in this part of the vessel. Great care will be taken that the surfaces are perfectly clean and not painted when the cement is applied, and that perfect adherence of the cement to the surface is obtained, the work to be tested to determine this. Where good adherence is not obtained the cement must be removed and reapplied until a perfect adherence is secured.

On the interior of fresh-water tanks the sides and tops will be coated with three or more layers of cement and fire-clay wash; the bottoms

will be cemented sufficiently thick to cover the laps and the rivet heads.

The plating and angles of trimming tanks will be given three good coats of cement wash.

Vitreous tiling, as selected, about $\frac{7}{16}$ inch thick, and not more than 2 inches hexagonal, will be worked in washrooms, water-closets, bath rooms, galley, and bakery. The tiling will be laid in 2 inches of Portland cement. Borders of tiles of appropriate patterns, as approved, will be worked in such of the inclosures above mentioned as may be directed. Special care must be taken to secure the water-tightness of all flats and the coamings bounding them on which tiling is to be laid. All fittings for sinks, urinals, and water-closets, and all deck castings for piping, will be so designed that the deck stools, or castings, or the piping, may be removed without disturbing the tiling.

14. PAINTING, VARNISHING, GALVANIZING, ETC.

The hull of the ship inside and outside, in all its parts, and all appurtenances and fittings which are not to be kept bright, shall be thoroughly painted, except the sides and bottoms, inside, of water tanks, trimming tanks, etc., where Portland cement is to be applied.

Care will be taken that no paint is applied to iron and steel work which is to be cemented, except as noted below.

All iron and steel work to be painted must first be carefully scraped, scaled, and cleaned.

All hull steel, except faying surfaces of same, will be allowed to stand, either before or after working, without painting long enough, if possible, for corrosion to remove the mill scale, but not long enough for the material to become pitted. Before being painted it must be thoroughly scraped, scaled, and cleaned.

All faying surfaces, before being riveted or otherwise fastened together, will be thoroughly coated with red lead.

Care will be taken that all steel and iron work to be ceiled or covered with wood or other material is first given two good coats of red lead, and the faying surface of decking and other woodwork must also be painted.

In general, all iron and steel work to be painted, whether outside plating, bulkheads, deck plating, plating of flats, etc., will be given two good coats of red lead and in addition such other coats of oil or other paints as are herein specified. The red lead to be used shall be pure, mixed with pure raw linseed oil to form a paste, and allowed to stand at least twelve hours; when about to be applied it shall be thinned with turpentine only. After the first coat is applied, all rivet heads and flush seams and butts of outside plating, hatches, skylights, plating of deck houses, bulkheads on main deck, and, in general, wherever a smooth, neat surface is required, will be covered with a satisfactory rivet cement.

Before launching, the under-water body, including the rudder, to a suitable distance above the water line, will be given one coat of an approved anticorrosive paint.

The vessel will be painted throughout in the colors prescribed in the painting regulations of the Service. Where white or spar color is used, at least two coats will be given in addition to the red lead above specified. Compartments finished in red lead will be given at least three coats in all. Soft woods will be covered with a coat of white shellac and at least three coats of best oil paint. In living quarters, pantries, and elsewhere where directed, two coats of best porcelain finish will be applied over the white coats.

Bright woodwork will be filled, shellaced, varnished, and polished in a thoroughly satisfactory manner.

Wood decks in living quarters (except as below noted), pantries, storerooms, lockers, deck houses, pilot house, covered passageways, and the main deck forward of the engine room casing, will be faired and smoothed and given three coats of rug-red navy deck paint. The deck in the cabin and cabin staterooms will be faired and smoothed and finished bright, the best floor varnishes to be used.

Exposed wood decks must be oiled and protected during building by a thick covering of turpentine and sawdust, which must be renewed as often as necessary in the opinion of the inspecting officer. The underside of exposed planking will be coated with oil during the building of the vessel.

Cork paint will be applied to such interior surfaces in living quarters (shell plating and side of metal ceiling next the same), storerooms, holds, hawser room, quadrant space, etc., as are directly exposed to chilling by conduction of the metal from the action of the outside air or water, and will be of the following proportions: Ninety pounds of bolted sifted whiting, 6¼ gallons of best hard-oil finish, 1¼ gallons best spar varnish; granulated cork will be applied to this surface, covering it evenly and completely, after which it will receive at least two good coats of best oil paint. Deck beams will not be cork painted.

The ship's name and all trucks will be gilded, the best gold leaf to be used.

Before delivery to the Government the vessel will be docked, and, if in thoroughly good condition, will be given one coat of anticorrosive and one coat of antifouling paint of an approved brand; if not in good condition, additional red-lead and anticorrosive paints will be put on before the antifouling paint is applied. Where evidences of corrosion exist, great care will be taken to remove the paint and all rust before more paint is applied.

In every case each coat of paint and varnish must be allowed to become dry and hard before another coat is put on.

When the vessel is delivered to the Government the whole of the paint work must be perfectly clean and in good order for service, and to produce this result, as many coats of paint as may be necessary, in addition to those specified, must be applied by the contractor, and at his expense.

No paints, oils, varnishes, etc., shall be used on the vessel except those of the very best grades.

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All steel and iron fittings to wood decks and to platforms, and all fastenings of ceilings and battens in holds, coal bunkers, storerooms, and elsewhere, shall be galvanized, the work to be first class in every respect and satisfactory to the inspecting officer.

Each beam of each deck will be conspicuously marked with black oil paint, as directed, with a number corresponding to the number of the frame to which it is attached.

15. HARDWARE, LOCKS, KEYS, TAGS, ETC.

All hardware must be of the very best quality, of ship design, of substantial make, and as approved.

Locks, and all parts of each lock, must be of solid bronze or of brass.

Knobs, door hooks, coat and hat hooks, drawer pulls, catches, slip bolts, etc., must be of solid bronze.

Hinges must be of solid bronze or of brass, with composition pins.

Screws for securing hardware, woodwork, fittings, etc., must be of brass.

Doors must have suitable hooks, hinges, stops, and locks complete.

In addition to locks, all lockers in cabin, wardroom, steerage, staterooms, furniture, and elsewhere, when directed, shall be fitted with approved spring catches.

Suitable locks will also be fitted to all drawers, ditty-boxes, chests, hatches, etc., which may be required to be locked. Lockers, etc., which are not required to be locked shall be fitted with approved catches.

The keys for each lock must differ from those of every other lock in the vessel, except that where there are more doors than one to the same compartment, as to pilot house, galley, etc., the locks to the doors of each of these compartments shall have the same key, and it shall be different from all other keys in the vessel.

Each locker or compartment, as a ditty-box, intended for individual use must have a key different from every other key in the vessel.

In any compartment, as the cabin or a stateroom, intended for the use of one person only, as many locks as possible shall be alike, and fitted with similar keys. In staterooms intended for two or more persons the drawers, lockers, etc., for each occupant must have locks and keys alike, if possible, and they must differ from all other locks and keys in the vessel.

Each lock must have duplicate keys. All keys to the same compartment must be fitted on rings, the duplicates on separate rings. All single keys and groups of keys must have brass name-tags; the duplicates must be similarly marked.

Locked keyboards must be installed in the executive officer's office; they must be fitted with numbered hooks for all the keys of the vessel.

Coat and hat hooks, in number as approved, will be fitted in staterooms, clothes lockers, water-closets, wash rooms, bath rooms, and elsewhere, as directed.

Hooks for swords and revolvers will be placed in staterooms of commissioned officers.

Brass name-plates will be secured over the entrances of such compartments as may be directed.

16. FLAT PLATE KEEL.

This keel will be formed of 24-pound plates, 33 inches wide for three-fifths the vessel's length amidships, reduced at ends to 20 pounds, and tapering as may be required for working and obtaining proper connections to garboard strakes. These plates will be continuous from stem to stern and worked in lengths of about 20 feet, or agreeably to a proper shift of butts with vertical keel and outside plating. The butts and edges will be planed, well fitted, and calked, metal to metal, in the most careful manner; the butts will be fitted on inside with treble, chain-riveted butt straps, in width $16\frac{1}{2}$ times the diameter of the rivets and in thickness not less than $\frac{1}{16}$ inch greater than the plates, and to extend in one piece the full width of the plates. The hood ends of the flat plate keel will be secured to stem and to sternpost with tap rivets or through rivets, as directed.

17. VERTICAL KEEL.

The vertical keel will be $22\frac{7}{8}$ inches deep, generally, and formed of 18-pound plates for three-fifths the vessel's length amidship, reduced to 15 pounds at ends, and worked to fit snugly against outer plating. Under the engine bedplate and the thrust bearing, and in the tank bottom, it will be increased in depth sufficiently, as shown on plan, to connect directly with the bedplate, thrust bearing, etc., and with the tank top, care being taken to preserve its continuous strength by tapering the plates down to the ordinary depth of the keel through at least three frame spaces at each end of each increased depth. It will be continuous through bulkheads and will merge, without a break in strength, into the bow and stern framing. All butts will be planed and accurately fitted and have double butt straps, treble-riveted, alternate rivets in the third rows being omitted. The butt straps will each be in thickness $\frac{1}{16}$ inch greater than half the thickness of the vertical keel and in length $16\frac{1}{2}$ times the diameter of the rivets, and will extend between the upper and lower longitudinal angle bars. The upper longitudinal angle bars will be 4 by 3 inches of 8.5 pounds, will extend as shown on plans, and will be well riveted to the vertical keel, flat keelson plates, and reverse bars and straps. The lower longitudinal angle bars will be 4 by $3\frac{1}{2}$ inches of 9.1 pounds, and will extend to stem and sternpost and be connected to them in a substantial manner. These longitudinal angle bars will be worked continuous, and the butts of both upper and lower bars will be fitted with bosom pieces, each long enough to take three rivets on each side of butt. All vertical keel plates, and the continuous angle bars to them, will be worked in the greatest lengths obtainable.

Limber holes 3 inches in diameter will be cut in every frame space above the lower longitudinal angle bars, as shown on plans.

18. STEM.

The stem will be made of the best American wrought iron, 7½ inches wide by 2 inches thick, and bent to the shape shown on official plans. It will be made in one piece and palmed out at the lower end to make a good connection with the flat plate keel, to which it will be secured by double, staggered riveting.

19. STERN FRAME.

The propeller post and the rudderpost, with the portions between them forming counter and shoe, and including bosses for taking the pintles of rudder, are to be made of the best hammered iron in one forging, and shaped as shown on the plans. The propeller post will be 7 inches wide by 4¼ inches thick, and will have worked in it an eye for the stern tube. That part of the stern frame forward of the propeller post which constitutes a part of the keel will extend with a fair taper into vessel not less than 10 feet from the forward side of the propeller post. The hub on the propeller post will be not less than 3 inches on each side of the hole for receiving the stern tube, and will be bored on the inside to receive said tube.

The holes for the rivets of hood ends of outside plating will be drilled zigzag-fashion to receive ⅞-inch diameter rivets.

The shoe connecting the propeller post to the rudderpost will be broadened out, and directly under the propeller will be 8 inches wide by 3½ inches deep; where it joins the propeller post and the rudderpost it will have bold fillets. There will be a clearance of not less than 2 inches between the upper side of the shoe and the ends of the propeller blades.

The forward side of the rudderpost will be located about 5 feet 6 inches aft of the after side of the propeller post, forming a well for, and sufficiently large to allow, the removal of the propeller designed. The rudderpost will be 7 by 3½ inches, pear-shaped on the fore side, and provided with rudder stops to prevent the rudder from passing through an angle of more than 40 degrees each side of the center line of the vessel.

Two gudgeons and one stop will be forged solid to the after side of the rudderpost to receive the rudder pintles; the gudgeons will be bushed with lignum-vitæ and bored $\frac{1}{32}$ inch larger than the size of the outside diameter of the pintles.

A horn, to which the floor plate will be connected by means of double clips 4 by 3 inches, of 8.5 pounds, will extend into the vessel directly over the rudderpost; it will extend 24 inches above the top of the stern frame and be 5½ inches wide by 3 inches thick.

Protectors of rolled zinc, not less than ¾ inch thick and of sufficient area, as directed, will be fitted to the sternpost and the rudderpost, and on bossing in wake of propeller shaft; the zinc plates will be bedded in red lead and secured by flathead iron machine screws. Care will be taken that the outer surface of this zinc is not painted.

20. RUDDER.

The rudder frame will be of the best hammered iron, forged solid in one piece, with a sufficient number of solid-forged cross-stays, and will have a heavy flange to connect with upper portion of stock, secured with steel key and fitted bolts. It will have cheek pieces forged on just above the upper pintle to prevent the rudder from passing through more than 40° of arc each side of the center line. It will be covered with 12½-pound plates, riveted through the frame and calked water-tight. White pine will be fitted in solid between the rudder plates. An eyebolt with eye nut will be fitted to the back of the frame at top; to this will be secured ⅝ inch galvanized-iron rudder chains, which will lead to spar-deck molding and be properly lashed to suitable eye-bolts fitted under the molding for that purpose. The least diameter of the rudderhead will be 5½ inches; it will extend up to the spar deck, be made square at the end to receive a tiller, which will be furnished by the contractor, and fitted with a flush composition bearing, with flush composition screw cap at deck. An eyebolt 1 inch in diameter will be fitted into the top of the rudderhead for hoisting.

The pintles will be 3 inches in diameter, of the best hammered steel, and fitted with brass sleeves ¼ inch thick with solid bottoms. The pintles will be tapered where they fit the rudder and will be secured in place with wrought-iron nuts, fitted with cross pins to keep them in place.

A plate-steel rudder trunk and a cast-iron stuffing box, so designed as to allow the removing of the rudderstock, will be fitted in connection with the stern frame, the rudder trunk to be flanged to outside plating, sternpost, and framing; the stuffing box will be fitted with a composition bushing and packing gland made in halves.

A composition bearing will be fitted at the main deck; it will be designed in connection with a cast-iron bearing with composition ring fitted to take the weight of the rudder off the pintles; the bearer proper, of cast iron, will be so designed that the rudder can be shipped or unshipped when the vessel is afloat. The upper part will be made in halves, secured together with steel bolts and composition nuts, and properly keyed to rudderstock.

21. TRANSVERSE FRAMES.

These will be of wrought steel angle bars 4 by 3 inches of 8.5 pounds; they will stand square with the base line, as shown on plans, and spaced throughout 24 inches between centers. They will butt against the lower continuous angle bars of the vertical keel and extend in one piece to head at underside of stringer plates of spar deck.

In the wake of the tank bottom the frames and reverse frames will be cut and secured to the bulkheads of the coal bunkers by 16-pound bracket plates.

At transverse water-tight bulkheads the frames will be double angle bars 3½ by 3 inches of 7.9 pounds.

22. BELT FRAMES.

Belt frames will be located in engine and boiler spaces, as shown on plans, and extend to main deck. They will be formed of 15-pound plates, 12 inches deep, and have double reverse frames 3 by 3 inches of 7.2 pounds on their inner edges. Their frame angles will be single bars 4 by 3 inches of 8.5 pounds. The side stringers and the longitudinal angle bars of the berth-deck stringers will pass through them. They will butt at berth-deck stringers and be secured to them by double angle bars 3 by 3 inches of 7.2 pounds, fitted to upper and under sides of the stringers. They will be secured to coal-bunker bulkheads by double angle clips 3 by 3 inches of 7.2 pounds, and elsewhere to floors by treble-riveted butt straps.

23. REVERSE BARS AND CLIPS.

The reverse bars will be wrought steel angle bars 3 by 3 inches of 7.2 pounds for one-half the vessel's length amidships and 3 by 3 inches of 6.1 pounds at ends. They will butt against the vertical keel plates. Forward and aft of engine and boiler spaces and coal bunkers they will be single and extend 6 inches above berth-deck stringers and to spar-deck stringers, alternately; their heels will be connected together on opposite sides of floor plates by 3 by 3 inches of 6.1-pound angle straps about 2½ feet long and passing through the holes in the vertical keel plates cut for them.

Within the engine and boiler spaces, including coal bunkers, all the reverse bars will be carried to 6 inches above main-deck stringers and to spar-deck stringers, alternately, and angle bars 3 by 3 inches of 7.2 pounds will be worked to form double reverse bars to extend in one piece between the fore-and-aft coal-bunker bulkheads, and from bilge to bilge abaft the coal bunkers.

Clips will be worked on frames and floor plates at their intersection with keelsons and stringer angle bars, one where there is a reverse bar fitted and two where no reverse bar is fitted; the clips will be of the same size and weight as the reverse bars, and not less than 6 inches long.

24. FLOOR PLATES.

The floors for three-fifths the length of the vessel amidships will be of 16-pound plates and forward and aft of this of 14-pound plates. They will be 18½ inches deep in the throat, secured to vertical keel by double angle clips 3 by 3 inches of 7.2 pounds, and their ends will be carried well up on the turn of the bilge. Transom floors will be of 16-pound plates and 24 inches deep at center line of the vessel.

In the water bottom, under the engine, and in the shaft alley, as indicated on plans, the floors will be increased in depth sufficiently to be connected directly, by means of suitable angles, with the tank top, engine bedplate, and thrust bearing.

The outboard ends of floors in water bottom will be connected to the fore-and-aft coal-bunker bulkheads with double angle clips 3 by 3 inches of 7.2 pounds.

Except at transverse water-tight bulkheads all floors of whatever depth, where consistent with the required strength, will be lightened with holes, as shown on plans, or as directed, and will have limber holes 3 inches in diameter cut in them to permit water to flow to the bilge suction pipes.

Limber chains of $\frac{1}{4}$-inch galvanized iron, with suitable gears for working them, will be fitted in engine and boiler spaces.

25. FLAT KEELSON PLATES.

These will be of 17-pound plates and extend 11 inches on each side of vertical keel. They will be fitted between frames 6 and 41, 46 and 56, and 71 and 83, tapered at the ends as required, and well riveted to the longitudinal angle bars of vertical keel and to reverse bars and straps of same. These plates will be worked in the longest lengths practicable, the butts arranged to make proper shift with those of the vertical and flat plate keels, and fitted with double-riveted butt straps on underside.

26. KEELSONS AND STRINGERS.

The side keelsons will be worked in continuation of the fore-and-aft coal-bunker bulkheads, and forward and abaft of them will be worked intercostally, fitted close between the floor plates, and extend above the latter sufficiently to take the deep flanges of continuous double angle bars 4 by 3 inches of 8.5 pounds. These intercostals will be formed of 14-pound plates in the machinery space and $12\frac{1}{2}$-pound plates at the ends, will extend as far forward and aft as possible, and will be fitted with suitable limber holes; they will be secured to skin plating and to floors at their forward and after ends by single bar clips 3 by 3 inches of 7.2 pounds. Their continuous angle bars will extend between the bulkheads on frames 6 and 83 and be efficiently connected to them.

The intermediate keelsons will be formed of $12\frac{1}{2}$-pound plates from frame 6 to frame 22 and elsewhere of 14-pound plates, except as below stated, worked intercostally between the floors and secured to them and to the skin plating with angle clips 3 by 3 inches of 7.2 pounds. They will extend above the floors to the height of the deep flanges of double continuous angle bars 4 by 3 inches of 8.5 pounds, between which they will be riveted, and will be carried as far forward and aft as practicable. Under the engine, under the thrust bearing, and in the water bottom they will be of 16-pound plates and will be increased in height and connected to the bedplate with double angle bars. Manholes and handholes will be cut in these intercostal plates to provide access to all parts under the engine foundation and in the water bottom.

Bilge stringers will be worked at turn of the bilges, as shown on plans. These stringers will be formed of double continuous angle bars 4 by 3 inches of 8.5 pounds, will extend as far forward and aft as possible, and will be efficiently riveted to each other and to reverse

bars and clips. At ends these stringers will be 4 by 3 inches of 7.2 pounds and secured to plates forming breasthooks or crutches.

All continuous angle bars to keelsons and stringers will be worked in as long lengths as possible, care being taken to make good shifts of butts. Angle butt straps 4 by 3 inches of 8.5 pounds, and long enough to take three rivets in each flange on each side of butt, will be fitted at the butts of these angles. Clips will also be fitted on all frames, one where there is a reverse bar and two where no reverse bar is fitted, and the longitudinal angles will be riveted to the clips and to the reverse bars, the clips to be 3 by 3 inches, of same weight as the reverse bars, and 6 inches long.

All keelsons and stringers must be carried continuously through water-tight bulkheads, and the scores in bulkheads through which they pass must be covered on each side of the bulkheads with angle collars, which are to be fitted and riveted water-tight.

Where keelson plates are increased in depth in wake of water bottom, etc., care must be taken to preserve continuity of strength by tapering down to the ordinary depth.

27. BREASTHOOK.

A breasthook of 14-pound plate will be fitted forward, as shown on plans, and secured to the skin plating with angle clips 3½ by 3 inches of 7.9 pounds; it will connect the upper side stringer angles together.

28. SPAR-DECK BEAMS.

The beams of the spar deck will be of steel angle bulbs 6 by 3 inches of 13.5 pounds. They will have a spring of 8½ inches in 34 feet, and one will be fitted at each alternate frame. Additional beams and framing will be worked in way of windlass, towing bitts, gypsy, gun foundations, etc., as directed, and as shown on plans.

The beams will be connected to the frames by 14-pound bracket plates, each secured with eight ¾ inch rivets.

Each beam will be numbered as provided in Article No. 14.

29. MAIN-DECK BEAMS.

These beams will be of steel angle bulbs 7 by 3 inches of 18.25 pounds, reduced to 16 pounds at ends when 20 feet or less in length. They will have a spring of 8½ inches in 34 feet, and one will be fitted at each alternate frame. Additional beams and framing will be worked for gun foundations, etc., as directed, and as shown on plans.

The beams will be connected to the frames by 16-pound bracket plates, each secured with ten ¾-inch rivets.

Each beam will be numbered as provided in Article No. 14.

30. BERTH-DECK BEAMS.

The berth-deck beams will be steel angle bars 5 by 3 inches of 9.8 pounds, a beam to be on every other frame forward, except over forepeak and fresh-water tanks, magazines, and aft from frame 67, inclu-

sive, where there will be a beam on every frame, as shown on plans, and all to be worked straight. Additional framing will be worked under the steering engine, gypsy engine, mast steps, etc., as directed, and as shown on plans. The beams will be efficiently connected to the frames by 14-pound bracket plates.

Each beam will be numbered as provided in Article No. 14.

31. SPAR-DECK STRINGERS AND PLATING.

The stringers will be of 15-pound plates for one-half of the vessel's length amidships, reduced to 12-pound at ends, 22 inches wide, and worked in lengths of about 20 feet, their butts to be fitted with double chain-riveted butt straps on underside, and arranged to make good shifts with butts of sheer strakes of outside plating. In the way of bitts, the stringers will be widened to take the holding-down bolts.

They will be connected on upper sides to sheer strakes by continuous angle bars 3 by 3 inches of 7.2 pounds; the butts of these angle bars will be covered with suitable angle straps.

The continuous angle bars forming the gutterways and backing for the deck planking will be 3 by 2½ inches of 6.6 pounds, placed to form a waterway 10 inches wide, including the angles, and will be worked in long lengths, with butts suitably strapped, and made water-tight.

The tie plates around hatches, houses, etc., on this deck will be of 10.2-pound material, 10 inches wide; plating of 7.5 pounds will be worked over galley, and of 12.5 pounds under guns, gypsy, windlass, and elsewhere as shown on plans. The plating over galley will be covered with ⅛-inch asbestos before the deck planking is laid. Under the spar-deck beams, over the galley, No. 14 galvanized sheet iron, lined with sheet asbestos ½ inch thick, will be worked as a protection to the deck.

Additional strengthening will be worked under the stringers and plating in wake of bitts, windlass, guns, gypsy, davits, etc.

32. MAIN-DECK STRINGERS AND PLATING.

For one-half the vessel's length amidships the main-deck stringer plates will be of 16-pound plates 34 inches wide, then reduced gradually to 14 pounds by 23 inches wide at ends of the vessel, as shown on plans. They will be worked in lengths of about 20 feet, their butts to be connected with double, chain-riveted, butt straps on underside, and all to make good shifts with the butts of outside plating. They will be fitted close to the outside plating, and connected to the same on upper side by angle clips 3½ by 3 inches of 7.9 pounds, and to the reverse bars by continuous angle bars 3½ by 3 inches of 7.9 pounds, worked in the longest lengths practicable, the butts of these angle bars to be covered by suitably riveted butt straps, the spaces between the frames to be filled in water-tight with coke and cement. The continuous angle bars forming the gutterways and backing for the deck plank will be 3 by 2½ inches of 6.6 pounds, placed and extending as shown on plans to form waterways 10 inches wide, including the angles,

and worked in the longest lengths obtainable, with their butts suitably strapped, and all made water-tight. Between the main-deck stringer plates, plating of 10.2 pounds will be worked as shown on the deck plan, the fore-and-aft seams to be single riveted, the butts to be strapped and double riveted.

Plating of 10.2 pounds will be worked over boilers, coal bunkers, and engine rooms, and under galley, wash rooms, and water-closets, and elsewhere as shown on plans.

Under the main-deck beams over boilers, No. 14 galvanized sheet iron, lined with sheet asbestos $\frac{1}{2}$ inch thick, will be worked to form a protection for the deck.

33. BERTH-DECK STRINGERS AND PLATING.

The stringers on the ends of the berth-deck beams are to be of 14-pound plates by 25 inches wide for three-fifths the vessel's length amidships, reduced to 12-pound by 19 inches wide at ends; they are to be connected to the outside plating by angle clips 3 by 3 inches of 7.2 pounds, and to the reverse bars and the clips riveted to frames by continuous angle bars 3 by 3 inches of 7.2 pounds, fitted in the longest lengths obtainable, with butts suitably strapped. The spaces between these angle bars will be filled in with coke and Portland cement, and made water-tight. These plates are to be worked in lengths of about 20 feet, their butts double riveted, with the butt straps fitted on underside, and arranged to make good shifts with the butts of the outside plating. Between frames 30 and 71, a 3 by 3 inch of 7.2-pound angle bar will be worked on upper side of inner edge of stringer; in engine space, the plate will be supported on every other frame by a bracket plate 26 by 18 inches of 14 pounds, connected to the plate by angle clips 3 by 3 inches of 7.2 pounds.

Tie plates 10 inches wide of 10.2 pounds will be worked around hatches, and elsewhere as indicated on the plans. The plating for mast steps will be of $12\frac{1}{2}$ pounds. Plating of 10.2 pounds will be worked between frame 67 and the stern, frame 6 and the stem, frames 27 and 30, and elsewhere as shown on plans, and calked and made water-tight.

34. DECK STANCHIONS.

These stanchions will be of extra-heavy wrought-iron pipe, with heads and heels welded in solid. In the engine room and under the berth deck forward they will be $3\frac{1}{2}$ inches in nominal diameter, and elsewhere 3 inches in diameter. They will be located where shown on plans, and elsewhere as directed, and will be firmly secured to the beams, etc.

On forward main and berth decks they will be placed generally on the center-line of the vessel, and on after main and berth decks and in steerage, will be formed by the bulkhead stiffeners, as approved. In the engine room they will be placed as required by arrangement of the machinery. Care will be taken to efficiently stanchion that part of the after berth deck which extends forward of the bulkhead below. Stanchions

under the berth deck forward will be placed in general on the center-line of the vessel.

Great care will be taken that the stanchions are so arranged as to provide a continuous line of support to the framing of the vessel.

Under heavy weights, stanchions and special framing will be fitted as approved. The stanchions under the chain lockers and the forward magazine will be arranged so as to facilitate the cleaning and painting of that part of the vessel. The stanchions under the machine shop will be placed to suit the arrangement of tools, and for their efficient support.

35. OUTSIDE PLATING.

The outside or skin plating will be of steel, worked as shown on midship section, and of the following weights for one-half the vessel's length amidships: Garboards, 19 pounds; bottom, 15 pounds; bilge, 17 pounds; side, 15 pounds, and strake at main deck, 20 pounds; spar-deck sheer strake, 18 pounds for three-fifths the vessel's length amidships. The garboards and the boss plates connected to propeller posts will be of the midship thickness of their respective strakes; other strakes at the ends will be reduced to the following weights: Garboards, 17 pounds; bottom, 13 pounds; bilge, 14 pounds; side, 13 pounds; strake at main deck, 17 pounds; and spar-deck sheer strake, 15 pounds. The side plating between strake at main deck and spar-deck sheer strake will be 15 pounds for one-half the length amidships, reduced to 13 pounds at ends.

All plates will be in length of from 16 to 22 feet, with butts as nearly as possible in the middle of the opening between the frames.

Butts in adjoining strakes must be shifted clear of each other not less than two frame spaces. Butts in alternate strakes must have a clear shift of not less than one frame space. Butts of garboard strakes must be kept clear of keel butts, and must have a clear shift of at least two frame spaces from each other on opposite sides.

Butts of sheer strakes must be shifted not less than two frame spaces clear of the butts of the stringer plates adjoining them.

All plates ending on the stem and the sternpost must be double riveted, and tap-bolted thereto where required.

All the butt straps, etc., are to be of the same quality as the plates they connect, $\frac{1}{16}$-inch thicker than those plates, and double riveted, except the butts of sheer strakes, which shall be secured with treble-riveted butt straps 4 pounds heavier than the plates they connect for three-fifths the vessel's length amidships.

The butt straps of the inner strakes of outside plating are to be the whole width of the plates; those of the outer strakes are to extend only between the edges of the adjacent inner strakes.

The longitudinal laps of sheer strake, strake at main deck, and bilge and garboard strakes must be double chain-riveted, except the upper edge of strake at main deck, which will be single-riveted to topside plating.

Bow chocks of 15-pound plates will be worked to extend from stem aft to frame 17, as shown on plans. They will be stiffened vertically every 4 feet by angle clips 3½ by 3 inches of 7.9 pounds, and by galvanized wrought-iron stanchions, 1½ inches in diameter, with flanged heads and heels and center struts, which will be securely riveted to waterway angle bars, rail, and vertical stiffeners. The upper edge of the chocks will be connected to, and stiffened by, a steel rail of 15-pound plates, shaped as specified under "Guard Rails and Stanchions." A breasthook of 14-pound plate will be worked at stem, as approved. The after ends of the chocks will be stiffened on the inside by wrought-iron, half-round moldings 3 by 1½ inches. Cast-iron warping chocks will be fitted as shown on plans.

A hollow wrought-iron, half-round molding 3 by 1½ inches will be fitted to the tops of sheer strakes and at knuckle of stern and line of its prolongation, all as shown on the midship section and profile.

All half-rounds are to be secured with water-tight riveting and the edges calked water-tight.

Doubling plates will be fitted to extend about 12 feet aft of the stem on each side and about 2 feet above and 2 feet below the mean load-water line.

Solid liners are to be fitted between the frames and the outer strakes of skin plating, and fill in one length the entire space between the edges of the inner strakes; they are to be of the same thickness as the adjacent plates and the full width of the frames to which they are attached; the liners at water-tight transverse bulkheads will be as specified under "Transverse Water-tight Bulkheads."

All laps, butt straps, and faying surfaces of the plates are to be cleaned from rust before being worked, the edges of butts planed and accurately fitted, and all joints calked in the most careful manner, metal to metal; no canvas, red lead, or other substance is to be inserted in the seams to make them water-tight, except by permission of the Superintendent of Construction and Repair, United States Revenue-Cutter Service.

Galvanized-iron pad eyes for handling propeller, and for gangway ladders, grab ropes, etc., will be secured to outside plating as directed.

All holes cut through the outside plating must be kept well clear of the frames; reenforcing plates will be worked wherever required or directed. All holes for rivets not fair will be reamed; the use of a drift punch will not be permitted.

To drain the vessel when in dry dock, screw plugs of composition will be fitted in the flat plate keel in number and location as directed; reenforcing plates will be riveted around the holes and care taken that the latter are not filled with cement or otherwise obstructed.

36. DOUBLE BOTTOM.

The double bottom will extend between frames 41 and 46, which will be made water-tight. The center strake of plating will be of 18 pounds, 36 inches wide, the other strakes of 14 pounds; the outer ones will be connected to the fore-and-aft coal-bunker bulkheads by con-

tinuous angle bars 3 by 3 inches of 7.2 pounds, calked and made water-tight. The laps or edges of all strakes will be single-riveted; the plates in these strake must be continuous (without butts) between the frames specified.

About midway between the middle-line and the fore-and-aft bulkheads on each side, 16-pound intercostal plates will be fitted between the floor plates and secured to them and to skin plating and inner-bottom plating with angle-bar clips 3 by 3 inches of 7.2 pounds. Forward of the double bottom these intercostal plates will be tapered down, in three frame spaces, to the height of the ordinary floors, continued forward as far as practicable, and of the same weight and construction as specified for "Side Keelsons" (Article No. 26). Manholes will be cut in these longitudinals to provide access to all parts of the double bottom. Hinged water-tight manhole plates will be fitted to the inner-bottom plating as shown on plans and as directed. Air pipes of good size and test cocks, easily accessible, must be fitted, the air pipes arranged so as to be always open. Air vents to give a free passage of air to the air pipes will also be provided. The arrangements for filling and for pumping from this compartment will be to the satisfaction of the Engineer in Chief, United States Revenue-Cutter Service.

37. TRANSVERSE WATER-TIGHT BULKHEADS.

These bulkheads will be located where shown on the plans, and formed of steel plates worked horizontally from side to side in out-and-in strakes. The bottom strakes of all except collision bulkheads will be of 13 pounds, middle plates of 12 pounds, and the top plates of 10.2 pounds; all plates will be lap-butted and double-riveted, and lap-jointed and single-riveted, and stiffened on one side by vertical angles 4 by 3 inches of 8.5 pounds, spaced 24 inches between centers, and on the other side by horizontal angles of the same size as the vertical ones, spaced not more than 48 inches between centers. All will be calked and made thoroughly water-tight.

The angle bars for taking the decks and for connecting the bulkheads to the outside plating will be double, 3½ by 3 inches of 7.9 pounds.

Solid liners will be fitted to these water-tight bulkheads and will extend on each side of the frame angle bars sufficiently to take two additional rows of rivets on each side; these rows of rivets must not be in line with the rivets in the edge fastenings of the outside plating. The pitch of the rivets, and also the shape of the water-tight liners, will be such as to bring the strength of the water-tight frames up to the strength of the ordinary frames.

The collision bulkheads will be located where shown on plans; their plating will be 13-pound material below main deck and 10.2-pound above, and riveted and stiffened the same as the other transverse water-tight bulkheads.

Brass sluice valves will be fitted to the after side of bunker bulkheads at frames 35 and 56 and at lowest part of the bunkers; they will be arranged to operate from the boiler and engine spaces and also from the

main deck. Deck plates showing whether the valves are open or shut will be fitted as directed.

38. FORE-AND-AFT COAL-BUNKER BULKHEADS.

The fore-and-aft bulkheads forming coal bunkers will be located as shown on official plans, the bottom strakes to be of 14-pound plates, the middle of 12-pound plates, and the top of 10.2-pound plates, all to be lap-jointed and single-riveted; the butts will be strapped and double-riveted, the upper edges to be connected to the main-deck plating and transverse bulkheads by angle bars 3 by 3 inches of 7.2 pounds, worked in staples around the beams. These bulkheads are to be made water-tight, and are to extend down to the shell plating and be connected to the same with continuous angle bars of 3½ by 3 inches of 7.9 pounds.

Angle bars 2½ by 2½ inches of 5 pounds will be fitted on bulkheads to take the bunker flooring.

The bulkheads will be stiffened vertically and horizontally by angle bars 3½ by 3 inches of 7.9 pounds, the vertical stiffeners spaced 24 inches between centers, their tops to be connected to the main-deck beams by 18 by 18 inch 12½-pound bracket plates, as shown on the midship section, and the horizontal stiffeners spaced 48 inches between centers. They will be braced at berth-deck line, on every other vertical stiffener, by an angle bar 4 by 3 inches of 8.5-pounds, connected to the frames and to the vertical stiffeners of the bulkheads by 10 by 10 inch 10.2-pound bracket plates.

Composition sluice valves will be fitted in each of these bunkers at the lowest point, to drain into the fireroom bilge; these valves will be arranged to operate from the fireroom.

39. COAL-BUNKER CEILING.

The bottoms of the coal bunkers will be ceiled with 1¼-inch tongued and grooved yellow pine, doubled, with broken joints, and made in sections, each section to have two battens secured on under side with galvanized-iron bolts, and two galvanized-iron sunken handles on upper side, so that the sections can be handled easily. This ceiling will be made perfectly dust proof, and so arranged that it can be taken up and the floors and outside plating under it cleaned and painted, and the ceiling replaced and the edges of the sections calked. It will extend to just above the bilge stringer on each side, where it will be worked out to the outside plating and be made water-tight. Above this there will be no ceiling in the coal bunkers. A loose flooring of like material will be temporarily secured in the bunkers, to break the force of the falling coal. In cross bunkers, and elsewhere where bilge suction pipes are led on top of floors, this ceiling will be built over the casings of the pipes on a suitable framework of 3½ by 3 inches of 7.9 pounds, efficiently stanchioned, as approved.

40. AIR LOCK.

This will be built as shown on plans. The plating will be of 10.2 pounds throughout, bounded by angles 2½ by 2½ inches of 5 pounds, and

stiffened vertically and on top and bottom by angles of same size. It will be calked air-tight, and fitted with water-tight doors as specified in Article No. 43. Brass sliding air valves will be fitted to these doors, as approved, to equalize the pressure.

41. SHAFT-ALLEY BULKHEADS.

The fore-and-aft bulkheads forming the shaft alley will extend between frames 71 and 83, and from the berth deck down to the skin of the ship; they will be made water-tight around frames by "stapling." These bulkheads will be knuckled about 18 inches from bottom edges, in order to avoid excessive beveling at the skin plating; the reverse bars and berth-deck beams will be cut in way of the bulkheads and bracketed to the vertical stiffeners and plating; the angle bars on the inside of the shaft alley at berth deck will be made continuous. The bottom strake of plating will be of 13 pounds and the other strakes of 12 pounds. The angle bars connecting these bulkheads to the skin plating and to the berth deck will be 3 by 3 inches of 7.2 pounds; the vertical stiffeners will be 3½ by 3 inches of 7.9 pounds, spaced 2 feet between centers and connected to berth-deck beams by 10.2-pound gusset plates. Intercostal clips will be worked between the vertical stiffeners to receive the wood flats of storerooms.

Fore-and-aft angle-bar clips 2½ by 2½ inches of 5 pounds, will be fitted on inboard sides of these bulkheads to take the shaft-alley flat.

42. BULKHEADS BETWEEN MAIN AND SPAR DECKS.

The bulkheads forming engine and boiler casings will be of steel throughout, and located where shown on plans. The lower coamings will be of 12-pound plates, 12 inches deep, and secured to the main-deck plating by angle bars 3½ by 2½ inches of 7.2 pounds, riveted water-tight to coamings. The upper coamings will be of 10.2-pound plates, 10 inches deep; they will be cut out in wake of deck beams, around which plate collars will be neatly worked, and will be secured to deck plating by angle bars 2½ by 2½ inches of 5 pounds.

The butts of coaming plates will be double riveted, with straps on inside.

Between the upper and lower coamings 10.2-pound plating will be worked vertically, with single-riveted seam straps on outboard sides forming panels. These bulkheads will be stiffened vertically by angle bars 3½ by 2½ inches of 6.6 pounds, spaced 2 feet between centers and secured to deck beams by two ⅝-inch rivets.

Doors and other openings in boiler casing will be made air-tight.

These casings will be insulated with asbestos air-cell boards 1½ inches thick covered with 5-pound steel plates secured to light steel angle bars on inside of casing with round-head, brass, machine screws.

The boundary bulkheads forming cabin, wardroom, wardroom passage, and steerage staterooms, and the bulkhead at forward end of steerage, except as below noted, will be formed of 7½-pound coaming plates connected to deck plating by 3½ by 2½ inch 7.2-pound angle bars; above the coamings the plating will be 2½ pounds. These bulkheads will be

stiffened by Phoenix shapes No. 192, or equivalent, arranged to form pilasters and stanchions and fitted with cast-iron ornamental caps and pedestals; $2\frac{1}{2}$ by $2\frac{1}{2}$ inch 5-pound angle bars will be worked at the top of the bulkheads and clipped to the beams; galvanized expanded metal panels, as approved, will be worked between the beams of fore-and-aft bulkheads. The divisional bulkheads within the boundaries of the pilastered bulkheads will be in general of $2\frac{1}{2}$-pound plating and $2\frac{1}{2}$ by $2\frac{1}{2}$ inch 5-pound angle bars, and stiffened vertically with double 3 by $\frac{1}{4}$ inch flat bar straps.

The fore-and-aft bulkhead under the towing bitts and the transverse bulkheads at forward and after ends of wardroom will be constructed in general as specified for transverse bulkheads between main and spar decks, excepting that they are to be stiffened and finished to compare with the stateroom bulkheads.

The fore-and-aft and end (athwartship) bulkheads forming compartments on the sides of the vessel on main deck forward of wardroom and on afterberth deck will be of steel. The lower coamings of the bulkheads will be of 10.2-pound plates, 10 inches deep, and secured to main-deck plating by angle bars $3\frac{1}{2}$ by $2\frac{1}{2}$ inches of 7.2 pounds, riveted water-tight to the coamings. The upper coamings will be of 8-pound plates, 8 inches deep, and will be secured to deck beams by continuous angle bars and by clips, $2\frac{1}{2}$ by $2\frac{1}{2}$ inches of 5 pounds.

Between the upper and lower coamings $7\frac{1}{2}$-pound plating will be worked vertically, with single-riveted seam straps on outboard side to form panels.

The bulkheads will be stiffened vertically by angle bars $2\frac{1}{2}$ by $2\frac{1}{2}$ inches by 5 pounds, spaced generally about 2 feet between centers.

Galvanized expanded metal panels will be worked between the beams, excepting at prison, where the space will be filled in with plating punched with small vent holes.

The divisional bulkheads for these compartments will be in general as specified for their fore-and-aft bulkheads, except that no coaming plates will be fitted.

The bulkheads, above the lower coaming plates, forming the outboard sides of galley and bakery, and the bulkhead between galley and bakery, and the doors in them, will be formed of wire mesh built up in panels of $\frac{3}{4}$-inch channel bars and made portable, the mesh to be 1 inch, the gauge of wire to be not smaller than $\frac{1}{16}$ by $\frac{1}{4}$ inch wide. The bulkheads will be made rigid.

Air ports, fixed lights, and *doors* will be fitted in all bulkheads, as shown on plans, or as directed. Doors will be made in halves where required.

43. WATER-TIGHT DOORS AND MANHOLES.

Water-tight doors will be fitted in bulkheads where shown on plans, the plating of the doors to be of the same weight per square foot as the bulkheads in which they are fitted. These water-tight doors will have flanged door frames, and will be fitted with wrought-iron hinges with brass bolts, wrought-iron dogs with brass glands through bulk-

head, brass wedge pieces, and rubber gaskets held in place by metal strips secured by composition machine screws, all in accordance with plans to be approved. Back of doors to coal bunkers, wrought-iron slats 3 by ¼ inches, made to ship and unship, will be fitted to prevent coal from blocking the doors when the bunkers are full.

Brass sliding air valves will be fitted to the doors in air lock to equalize the pressure.

Manholes of size and pattern as approved, and fitted with dogs and water-tight covers, will be installed in number and location as shown on plans and as may be directed.

Miscellaneous openings not otherwise specified will be provided with manhole covers of suitable design, or with bolted plates to suit special requirements, as directed.

44. BILGE KEELS.

Bilge keels to extend for about 60 feet amidship, as shown on plans, will be fitted, formed of 20-pound plates, with double angle bars 3 by 3 inches of 9.4 pounds on their inner edges, riveted to the plates and to the outside plating; double half-rounds 1½ by ¾ inches will be worked on their outer edges. They will be 15 inches deep, tapered at ends; the butts of the plates will be fitted with double straps, and of the angle bars with bosom straps, and all calked metal to metal and made water-tight. They will stand square with turn of the bilge, as shown on midship section.

45. ENGINE FOUNDATION.

The foundation for the main engine will be built up from, and form a part of, the framing of the vessel. Deep floors of 16-pound plates, fitted with double reverse bars, will be worked in this foundation. These floors will be stiffened longitudinally by the 16-pound intercostal plates of the intermediate keelsons, secured to floors and to skin plating by angle clips 3 by 3 inches of 7.2 pounds, and to cap plate of foundation by angle clips 4 by 3 inches of 9.8 pounds, or as below indicated.

The cap plate, or top, of the foundation will be of 25-pound plates, fitted in two or more pieces, secured together with butt straps on under side. It will be well riveted to the reverse bars, intercostal angles, etc., the intercostal angles being of suitable size and arranged to take the foundation bolts of the engine bedplate and the thrust bearing. Access to all parts of vessel under engine and boilers, for cleaning and painting, must be provided.

The seats for auxiliary engines, pumps, dynamos, etc., will be built of shapes and plates as approved.

These seats, and the foundation for the main engine, will be of sufficient strength to bear, without yielding, all strains which may be brought upon them.

46. BOILER FOUNDATIONS.

The boiler foundations will be built of plates and shapes, as approved, for the support of the water-tube boilers to be installed.

47. TRIMMING TANKS.

These tanks will be formed by the hull proper and water-tight bulkheads and flats. The forward tank will extend from the transverse bulkhead at frame 6 forward to the stem and up to the berth-deck plating, and the after one from frame 83 aft and up to the berth-deck plating. Water-tight manholes, to be located as shown on plans, with the necessary dogs, frames, rubber gaskets, etc., as approved, will be fitted to the tanks. The tanks will be fitted with flood pipes and cocks for filling, with suction pipes connected with the drainage system, and with vent pipes extending to main deck and ending in goose necks; the vent of the forward tank will serve for the overflow, but there will be an overflow pipe fitted to after tank leading to shaft alley and fitted with a brass valve. The sea valves, to be worked from the deck above, will be provided with approved means for indicating when they are open and when closed. All pipes and valves will be fitted to the satisfaction of the Engineer in Chief, United States Revenue Cutter Service, and drawings of the same will be submitted to him for approval. Swash plates of 10.2-pound plates, stiffened by flanges, will be fitted as shown on plans. The bottoms of these tanks will be filled in with Portland cement, as prescribed in Article No. 13; the sides of the inner surfaces will be covered with three coats of bituminous cement and solution, as approved.

48. FRESH-WATER TANKS.

The four fresh-water tanks formed by the hull proper, water-tight bulkheads, and top plating, will be located at the after end of the main hold, will be of dimensions called for by plans, and will have a combined capacity of approximately 11,685 gallons. These tanks will be separated by divisional bulkheads of 10.2-pound plating, stiffened vertically by angle bars 3 by 3 inches of 7.2 pounds, connected to bulkheads, shell plating, and top plating by continuous angle bars of 3½ by 3 inches of 7.9 pounds, and fitted with swash plates, manholes, pipe connections, sounding tubes, air escapes, and overflows, as required, and as approved.

The two wing tanks, holding about 4,896 gallons, will be for feed water for boilers.

The piping to these tanks will be of heavy, galvanized iron, and the valves of composition throughout, of the gate pattern, and located free from the action of bilge water. The filling pipes from deck will be 2½ inches inside diameter and fitted with brass screw deck plates, properly marked for identification. The tanks will be connected at their forward ends by piping 2 inches inside diameter, with a valve adjacent to each tank; a pipe of the same diameter will be led to the pump suction. The suction pipe between tanks will also be used as an

equalizing and drain pipe, valves to be fitted in this pipe for that purpose.

They will have proper pipe connections with the fresh-water pump, the distilling plant, and the hand pumps of the vessel.

The tanks will be coated inside as specified under Article No. 13.

49. CHAIN LOCKERS.

These will be of the dimensions given on plans, and located as thereon shown. The bottom plating will be 12½ pounds, and the division and side plates 10.2 pounds, the plates to be connected together by angle bars 2½ by 2½ inches of 5 pounds, and stiffened by half-round bar stiffeners 3 by 1½ inches, worked on inside, as shown on plans. The boundary angle bars will be 2½ by 2½ inches of 5 pounds; the beam supporting the bottom will be 3½ by 3 inches of 7.9 pounds, and will be bracketed and stanchioned in a substantial manner. Wrought-iron gratings will be fitted in the bottom of each locker on top of 2 inches of Portland cement; they will be in sections of suitable size for passing through the hatches. Provision will be made for securing and slipping the cables by means of shackles and ringbolts, as approved. Hand and foot holes will be cut in the divisional bulkhead between the lockers to permit of access to them. For drainage a 3-inch limber hole will be cut in the bottom of each locker, and a pipe will be led from this to the bilge. Means of access will be provided for examining, cleaning, and painting the vessel under the lockers.

50. SAIL AND BREAD ROOMS.

These rooms will be located where shown on plans. The floors, after bulkhead, and dividing bulkhead at center line will be formed of 7½-pound plates, the bulkheads stiffened by vertical angle bars 2½ by 2½ inches of 5 pounds. The supporting beams will be angle bars 3½ by 2½ inches of 7.2 pounds, bracketed to the frames of the vessel, and stanchioned as required for other beams. Both rooms will be calked and riveted water-tight.

In these rooms, battens will be worked on the reverse bars as required for other storerooms, and similar battens, fastened to clips, will be worked on the steel bulkheads. Hard-wood rollers will be fitted in the hatch of the sail room, and white-pine shelves in the bread room, as approved.

The steel plating and the frames in these rooms will be thoroughly covered with cork paint before the battens are secured in place. The woodwork, except the rollers in the sail-room hatch, will be well painted on both sides.

51. AMMUNITION AND ORDNANCE STOREROOMS.

There will be two of these storerooms, one forward and one aft, where shown on plans. For the after storeroom the dividing bulkhead will be formed of 10.2-pound plates, stiffened by vertical angles 3 by 2½ inches of 5.6 pounds; the supporting beams to flats will be angle bars 3½ by 2½ inches of 7.2 pounds, bracketed to the shaft-alley bulk-

head and to the frames of the vessel. A portable flooring of tongued and grooved yellow pine 1⅛ inches thick will be fitted over these beams. The side of the vessel will be ceiled up step-fashion agreeably to the outside dimensions of the ammunition boxes to be stowed thereon, in order to provide economical stowage, this work to be of seasoned yellow pine so arranged and secured as to be readily removable.

The plates for the flat and for the bulkheads of the forward ammunition and ordnance storerooms will be of 10.2-pound material; the bounding angle bars, 2½ by 2½ inches of 5 pounds; the beams (spaced every frame), 3½ by 3 inches of 7.9 pounds, and the vertical stiffeners 3½ by 2½ inches of 7.2 pounds, spaced 24 inches between centers.

A navy standard electric magazine light will be located in each of these rooms, the glasses to be thick, of good, clear quality, and protected with brass-wire screens.

Racks and shelves of seasoned yellow pine will be worked in these storerooms to the best advantage, and as approved. All woodwork will be thoroughly painted on all sides.

Battens will be fitted to the bulkheads in these compartments as required for other storerooms.

Arrangements will be made and fitted for flooding these rooms direct from the sea by means of pipes and valves, the rods for working the same to be operated from the main deck, as directed. Indicators will be fitted to show clearly whether the valves are open or shut, the direction for opening the valves to be indicated by arrows, and the turning of the gears in the deck plate for closing the valves to be to the right. Arrangements will be made for locking the valves and the hatches. Test cocks will be fitted as approved.

A drain pipe and valve will be fitted in each room for freeing it of water, and each will have a properly fitted vent pipe.

The rooms will be calked water-tight. A water-tight hatch, as approved, will be fitted to each, and suitable steps, or ladders, will be provided.

In each ammunition room a suitable tube will be fitted for a thermometer. The upper end of this tube, in the deck above, will be closed by a brass screw-cap suitably marked.

All deck plates, cocks, valves, locks, etc., will be of composition.

52. ENGINEER'S STOREROOM BELOW BERTH DECK.

The engineer's storeroom will be located aft of the engine room, as shown on plans, and will be fitted with galvanized-metal shelves, lockers, racks, bins, and hooks, arranged in accordance with the standard plan, which will be furnished the contractor. No ceiling will be worked in this room. The floor will be as called for under machinery specifications.

A water-tight swinging door, located where shown on plans, will be worked in the engine-room bulkhead. The plating and the frames in this room will be thoroughly covered with cork paint.

53. FORWARD DECK HOUSE.

This house will be of the dimensions and shape shown on the plans, the height in the clear under the beams to be 6 feet 9 inches; coaming plates at top and bottom will be 10.2 pounds, 15 inches high at bottom and 8 inches deep at top, with double-riveted butt straps; angle bars around base, and against which the margin plank will butt, will be 3½ by 2½ inches of 7.2 pounds; angle bars around top, outside, connecting ends of beams of roof will be 2½ by 2½ inches of 4.1 pounds; tie plates on top of house will be 7.5 pounds, worked as shown on plans; intermediate plating will be 7.5 pounds, run vertically, with flush-riveted vertical seam straps on outside between coaming plates, worked panel-fashion; vertical stiffeners will be 2½ by 2 inches of 3.7 pounds, spaced generally about 2 feet apart, but so arranged as not to interfere with air ports and doors, as shown on plans; beams will be of angle bars 2½ by 2 inches of 4.5 pounds, their ends connected to the fore-and-aft angle at upper coaming plate and to vertical stiffeners.

Openings will be cut in the upper coamings at staterooms in this house. These openings will be fitted with ventilators of type as directed.

The margin strake of the planking of roof will be of yellow pine, 2½ inches thick by 6 inches wide, and secured to carlings of white pine 1⅞ inches wide by 2½ inches deep, which will be secured to the horizontal sides of the angle beams by ½-inch galvanized-iron carriage bolts and nuts placed about 15 inches apart. A face plate will be fitted as directed.

The top of the house will be scuppered—two scuppers, one in each after corner—to the spar deck, as directed, the pipes to be galvanized iron 1½ inches inside diameter, with upper ends of lead fitted with brass gratings.

The planking and finish on top of house will be as specified in Article No. 68.

Air ports and doors will be fitted in number, location, and size, as shown on plans, and as stated in these specifications, the air ports to be fitted with drip pans and drains.

A 1¼-inch galvanized-iron pipe grab rod, with galvanized-iron sockets, will be fitted around the front and on the sides of the house, as directed.

The doors will be of well-seasoned teak, painted or varnished, as directed, to correspond with outside and inside of house. A circular fixed light, 15 inches in diameter, will be placed in the upper panel of the door to each stateroom. Teak sill pieces covered with heavy sheet brass will be fitted to doorways.

The interior of the house will be divided into the following compartments, located as shown on plans: Navigator's office, quartermasters' stateroom, locker for boat gear, locker for life-preservers, room for wireless-telegraph apparatus, and stateroom for ship's writer and electricians.

The divisional bulkheads at the after end of the navigator's office and at the forward end of the room for the wireless-telegraph apparatus,

and the bulkhead separating the latter from the lockers for boat gear and life-preservers, will be of 7.5-pound plating, worked flush, the angle bars connecting them to the spar deck to be 3½ by 2½ inches of 7.2 pounds, the stiffeners 2½ by 2 inches of 3.7 pounds; the bounding angle bars, except as otherwise specified, to be 2½ by 2½ inches of 5 pounds. The other divisional bulkheads in this house will be of 2.5-pound plating, suitably stiffened by angle bars.

The navigator's office will be fitted with desk, lockers, book shelves, transom seats, racks, etc., as approved; the woodwork will be of well-seasoned quartered white oak; the transom seats and back will be upholstered as specified for transoms in cabin and wardroom. Ceiling, as provided for pilot house, will be worked in this room.

The staterooms for quartermasters and for ship's writer and electricians will be fitted with galvanized-iron pipe berths in number as indicated on plans, drawers, lockers, hooks, racks, mirrors, lavatories, etc., similar in all respects to the staterooms for other petty officers, as specified in Article No. 134. The sides of house in these rooms will be ceiled with 2.5-pound plating, secured with round-head, brass, machine screws to light stiffening angles, etc., as approved.

The wireless-telegraph room will be arranged as directed for the installation of a wireless-telegraph apparatus, and as approved. Locker, table (with drawers under), etc., will be of quartered white oak. The room will be made sound-proof with sheet cork 2 inches thick on sides, ceiling, and deck, secured to wood battens let into the cork. A covering of cotton canvas will be laid over the cork, and secured and painted as approved; the canvas on deck will be No. 1, No. 2 to be used in other places.

The lockers for boat gear and for life-preservers will be arranged with shelves, lockers, racks, etc., of white pine, as approved, the shelves to have nosings and removable battens of hard wood. No ceiling will be worked in these lockers.

54. AFTER DECK HOUSE.

An after deck house will be constructed on the spar deck over the entrance to the cabin; its location and size will be as shown on plans. It will be built in general in accordance with the specifications for constructing the forward deck house. No ceiling will be worked in it. The planking and finish on top of house will be as specified in Article No. 68, covered in a similar manner, and strengthened, as approved, for an 18-inch searchlight. Two small lock boxes, as approved, will be fitted in the house for the stowage of detonator primers. A galvanized-iron ladder to top of house will be fitted where directed. A portable galvanized-iron pipe framing will be fitted over the searchlight for the latter's protection.

55. PILOT HOUSE AND EMERGENCY CABIN.

These will be of dimensions and shape shown on plans. The upper and lower coamings will be of 10.2-pound plating, 10 inches deep; the lower coaming will be secured to tie plates by angle bars 2½ by

2½ inches of 5 pounds, and the upper coaming to tie plates at top of house by angle bars 2½ by 2½ inches of 4.1 pounds. The plating between coamings will be of 7.5-pound plates, fitted with vertical seam straps on outside to form panels, and will be stiffened vertically on inside by angle bars 2 by 2 inches of 3.2 pounds. The tie plates on top of the house will be of 7.5-pound plating. The beams will be angle bars 2 by 2 inches of 3.2 pounds, to which white-pine carlings 1¾ inches wide by 2¼ inches deep will be secured by ½-inch galvanized-iron carriage bolts and nuts worked as specified for the forward deck house.

The top of the structure will be fitted in all respects as specified for the top of the forward deck house, except that No. 2 cotton canvas shall be used.

The windows will be in number and location as shown on plans, their casing and frames to be of teak, fitted with Chamberlain metal weather strips, operated with side weights adjusted to work noiselessly, glazed with ¼-inch American plate glass, and fitted with the necessary window lifts, fastenings, etc. Inside slatted blinds of teak, to operate with brass balance springs, will be fitted to windows in the emergency cabin. Window pockets will be lined all the way up with sheet lead, made portable and water-tight, and fitted with efficient drains.

The pilot house will be fitted up for the reception of binnacle and steering gear, and with voice and sounding tubes, and racks for spy and binocular glasses, signals and signal holders, megaphone, flags, barometer, etc., as directed.

A 1¼-inch galvanized wrought-iron pipe grab rod, with galvanized sockets, will be fitted around the front of the house, as approved, and a brass pipe grab rod, of same size, and with brass sockets, will be fitted inside of pilot house, forward, between the doors.

A galvanized-iron pipe frame, covered with No. 4 cotton canvas, will be fitted around forward part of pilot house, above the windows, to form a visor.

The emergency cabin will be fitted with an extension transom seat, desk, chartboard, chartrack, book shelf, and clothes locker, all of quartered white oak, and also with a polished quartered white oak folding lavatory 66 by 20 inches over all, depth when closed 8 inches, with adjustable French plate-glass mirror, glassware rack, copper reservoir and waste receiver, large vitro-adamant basin with splash rim, china soap and brush holders, nickel-plated brass self-closing faucet, nickel-plated brass trimmings, and cut glass carafe and tumbler. The transom seat will be similar to those in cabin. The desk will be a flat-top, cloth-covered desk about 48 inches long, 34 inches wide, and 30 inches high, and made double, with one large drawer under top, with smaller drawers on one side and partitions for books with door in front on the other side; drawers to be divided by partitions as directed. The chartrack and chartboard will be fitted above this desk, the case to be about 48 inches long, 10 inches deep, and to extend from top of desk to underside of beams. This rack will have solid panels, with front to hinge down, and will be fitted with the necessary

supports, hinges, and catches; the inside will be fitted as directed for holding charts.

Brass coat and hat hooks will be located where directed.

The bulkhead between the pilot house and the emergency cabin will be of narrow, tongued-and-grooved, quartered, white oak, 1¼ inches thick, with beveled edges. The door in this bulkhead will also be of quartered white oak, and paneled, with brass lock and other fittings, as approved.

The entire structure will be ceiled throughout with ⅝-inch narrow, tongued-and-grooved, quartered, white oak, with beveled edges, made in removable panels secured to furring strips with round-headed brass screws. Doors (outside) and casings, and window frames and casings, will be of teak; the sills of all doors will be covered with heavy sheet brass.

56. BRIDGE.

A bridge will be constructed by extending the beams of the forward deck house on each side as shown on plans, and covering them with 7.5-pound tie plates, planking, and canvas, the same as top of deck house. This bridge will be well supported at ends by angle-iron stanchions 3 by 3 inches of 8.3 pounds secured to bridge and to sheer plating in a substantial manner, and well braced. A covered chart board of standard pattern, with celluloid top, and with galvanized-iron brackets to attach to the railing of the bridge, will be provided and located as directed. A standard galvanized-iron signal locker will be furnished and placed on the bridge where and as directed. Boxes for binocular glasses will be furnished and located on bridge where directed.

57. HATCHES AND SKYLIGHTS ON SPAR DECK.

The hatches and skylights on spar deck will be in number and size as shown on plans.

The coamings to companion and skylight hatches on this deck, except to engine-room skylight, which will be of 14-pound plates, 18 inches high above top of deck beams, and to galley skylight, will be formed of 12.5-pound plates. They will be 15 inches in height above top of deck beams, the corners well rounded, and the butts of coaming plates neatly strapped on inside. They will be secured to deck beams, plating, etc., by angle bars 3½ by 2½ inches of 7.2 pounds, riveted water-tight to coamings, and will have on inside upper edges angle bars 2½ by 2½ inches of 5 pounds, projecting ½ inch above top of coamings, to which they will be calked water-tight.

The forward hatch will have a cast-steel frame flush with top of deck plank and riveted to deck beams and plating, and fitted with a galvanized steel or galvanized cast-steel plate cover secured with dogs and made perfectly water-tight by being pressed down upon a pure, soft-rubber gasket. Two fixed lights of size as specified for skylights will be fitted in this cover. Ash gratings will be fitted in the hatch below the water-tight cover and so arranged that they may be removed

the crew's hatches, and two single doors to be fitted on the midship hatch, all to have wrought-iron, double-strap hinges (with brass pins), solid bronze locks, handles, hooks, sliding bolts, etc., of substantial ship pattern, as approved, and finished all over; the sliding tops will be fitted with brass slides; the guides will be of brass also.

Circular fixed lights 10 inches in diameter, with composition frames and clear glass ¾-inch thick, as approved, will be fitted in sides of hatches, two in each hatch.

Skylights will be fitted over cabin, wardroom, galley, firemen's wash room, blower room, and engine room, as shown on plans, and will be made of steel throughout, except the fittings, which will be as specified.

The sides and tops of skylights will be formed of 7.5-pound plating connected by 2½ by 2½-inch 5-pound angle bars. Openings will be cut in the tops to which steel shutters will be fitted; around these openings angle bars 3½ by 2½ inches of 6.1 pounds will be worked. On the bottoms angle bars 2½ by 2½ inches of 5 pounds will be fitted and riveted to inside of skylights, bolted to top angle of coamings, and made water-tight. Angle-bar stiffeners, 2½ by 2½ inches of 5 pounds, will be securely riveted to tops and sides as directed. A ridge bar of T-iron 4 by 3 inches of 9.3 pounds will be fitted in center, and a half-round 1¼ inches by ⅝-inch, as shown on plans.

Shutters of 7.5-pound plating, turned down all around the edges, will cover the openings in tops; wrought-iron strap hinges, with brass pins will be fitted to these shutters, which will be made water-tight by being pressed down on pure, soft-rubber gaskets by suitable wrought-iron dogs with composition bolts and nuts. In each shutter, 12-inch circular fixed lights, in number as indicated on plans, will be fitted, the frames to be of brass, of substantial pattern, and the glass ¾-inch thick, clear, and free from defects; the whole to be flush with top of shutter.

Composition screw lifting gears, as approved, and to be operated from below, will be fitted to each shutter. Wrought-iron ringbolts, galvanized, will be fitted to these skylights and to the booby hatches for removing them when necessary.

Approved heavy portable guards will be fitted over cabin skylight to protect it from chafe of towing hawser.

58. HATCHES ON MAIN DECK.

Hatches of the size shown on plans will be located on main deck where indicated. The coamings will be of 12.5-pound plates, 15 inches high above top of main-deck beams, and secured to tie plates, beams, etc., by 3½ by 2½ inch 7.2-pound angle bars, riveted water-tight to coaming plates. They will have outside, on upper edges, 1½ by ¾ inch half-rounds, and on inside, 2¾ inches below top, angle bars 1½ by 1½ inches of 3.4 pounds to receive the ash gratings which will be fitted to the hatches.

Portable guard rails, formed of wrought-iron stanchions, galvanized, and 1-inch galvanized-iron pipe, will be fitted to the hatches, the stan-

chions to step in galvanized cast-iron sockets and to have balls on top to hold the rails in place; all as approved.

Where beams are cut, fore-and-afters will be worked as specified in Article No. 57.

59. HATCHES ON BERTH DECK.

The hatches on forward berth deck will be of sizes and located as shown on plans, provided with wood covers flush with the tops and fitted with brass sunken handles, gratings, and locks or other approved fastenings, as may be directed; the wood covers will be in sections, where required, for easy handling. Their coamings will be of yellow pine not less than 5½ inches wide by 3½ inches thick at the edge of the hatch angles, which will be worked all around the hatch openings. These coamings will be tapered down at the outer edge to the thickness of the deck planking and will be well bolted to the deck framing to resist calking. Portable guard rails, as specified for hatches on main deck, will be fitted.

The hatches to ammunition rooms will be made water-tight, a wood hatch cover to be fitted over the water-tight cover forward and made flush with the deck planking. Wood coamings will be fitted as above.

Where beams are cut, fore-and-afters will be worked as specified in Article No. 57.

60. GUTTER WATERWAYS.

Gutter waterways will be as shown on plans and constructed as specified in Articles Nos. 31 and 32.

61. SCUPPERS.

There are to be on each side of the spar deck five scuppers, each 4 by 3 inches in the clear. They will be made of ¼-inch lead or ⅜-inch cast iron, in the discretion of the contractor, and will extend from the gutterways to and through the plating just above the water line. They will be flanged to connect to waterways and to cast-iron scupper flap-valves on outside plating, fitted with clean-out plugs, suitably strapped, protected where directed with casings of wood, and provided with lip pieces on outside of skin plating.

Similar scuppers, not exceeding seven, leading, where possible, into spar-deck scuppers, will be fitted from the main-deck waterways. Four 2-inch galvanized-iron pipe scuppers will be fitted, as approved, to drain engine-room passages and main deck forward of bulkhead at frame No. 56.

Galvanized-iron pipe scuppers 1½ inches diameter and leading to the deck below will be placed at each after corner of the tops of the deck houses and the pilot house, and at the outboard ends of the bridge where directed. The upper ends of these scuppers will be of lead and flanged to top of deck planking.

Small scuppers or drains of galvanized-iron pipe, of size as approved in each case, will be fitted from bath rooms, shower baths, wash rooms, water-closets, galley, cold-storage rooms, and room for refrigerating

machine, and from beds of windlass and windlass, capstan (gypsy), and steering engines.

All upper openings for scuppers and drains will be fitted with brass castings and gratings secured with brass screws.

62. ASH AND SLOP CHUTES.

There will be an ash and slop chute fitted on each side of main deck where shown on plans. Each pipe will be of cast iron not less than $\frac{7}{8}$ inch thick, made in two parts and flanged to connect together by bolts and nuts; it will be 12 inches in diameter in the clear at top, 13 inches in the clear at lower end, and well secured to stringer and to outside plating, which will be reenforced. The hoppers will be built of plates and angles and fitted with hinged water-tight covers, as approved. These chutes will be thoroughly supported and connected by bracket plates to adjacent parts of the ship. A lip piece will be worked on outside of skin plating to throw the ashes clear of the side. A flushing pipe with valve will be fitted for each chute and connected to the salt-water sanitary system, as approved by the Engineer in Chief.

63. COALING TRUNKS.

Coaling trunks in location, number, and dimensions, as shown on plans, will be built to extend from spar deck to coal bunkers. They will be formed of 10.2-pound plates and $2\frac{1}{2}$ by $2\frac{1}{2}$ inches of 5-pound angle bars and made water tight throughout. The openings to these trunks on spar deck will be fitted with galvanized cast-iron standard 18-inch coal scuttles, except the one amidships, which will have coamings 15 inches high fitted with a water-tight hinged plate cover.

64. COALING SCUTTLES.

Coaling scuttles of standard design will be fitted on main and spar decks in number and location as shown on plans. They will be 18 inches in diameter in the clear, fitted with solid covers of galvanized cast iron, secured in place by central screws, and made water-tight by being pressed down upon pure soft-rubber gaskets. The solid covers will be arranged so that they can be opened from either above or below. A galvanized cast-iron grating will be fitted below each solid cover; it will be so constructed that it may be raised and retained flush with the deck planking when the solid cover is removed.

Iron rungs to serve as ladders will be fitted to all bulkheads in coal bunkers which are near enough to scuttles to admit of passage through them.

65. HAWSE PIPES.

The hawse pipes will be of cast steel, two in number, and located where shown on plans; the castings will be well rounded on inner and outer ends where the chains pass over them, and not less than $1\frac{1}{2}$ inches thick in the thinnest part, the outer ends to have large flanges. These pipes will be designed to stow the stockless anchors to be furnished the

vessel, and the diameter of the opening in each must be sufficiently large to take the anchor selected. A sliding cover of 12.5-pound plating will be fitted to the inboard end of each pipe and scored for the chain.

66. CHAIN PIPES.

Wrought-iron chain pipes, as approved, will be fitted in the decks where shown on the plans and secured in a substantial manner to the plating, etc. The pipes will be 10 inches in diameter in the clear, $\frac{3}{8}$ inch thick, connected at top to a well-rounded flange and at bottom to a bell-shaped end of cast iron; an approved iron cover will be fitted at top of each, and lashing holes will be cut in each where directed.

67. MAST STEPS AND RINGS.

The mast steps will be of cast iron, about $1\frac{1}{4}$ inches thick by $5\frac{1}{2}$ inches deep, suitably ribbed and flanged, or of angle rings, in the discretion of the contractor, shaped to receive the mast heels, and well secured to the deck plating; each will have a rib through the center to keep the mast from turning. The deck under steps will be reenforced as shown on plans.

The mast rings or partners on the main and spar decks will be formed of angle bulbs 6 by 3 inches of 12.5 pounds, worked $2\frac{1}{4}$ inches clear of mast all around, and of sufficient taper to allow proper wedging of the masts. Doubling plates will be worked on spar and main decks of same thickness as deck plating; fore-and-aft beams will be worked in wake of masts. The margins will be as specified under "Deck Planking" (Article No. 68).

A wood coaming of yellow pine will be worked around mainmast on top of after deck house, and will be kept well clear of mast to prevent strain on the house.

Mast coats of canvas will be fitted at all partners and fastened in an approved manner.

68. DECK PLANKING.

The planking of the several decks will be of the specified thickness in the thinnest part when finished, and will be well fitted to the plating, beams, etc., the edges to be planed fair before the plank is laid and to have a proper seam for calking. It will be worked in lengths of from 20 to 30 feet, and be secured by $\frac{5}{8}$-inch galvanized-iron bolts and nuts on all decks. A grommet of wicking, well soaked in white lead, will be placed under the head of each bolt, which must be set down solidly, and a yellow pine plug driven into the hole over each bolthead; these plugs must be sunk in white lead and fit snugly, the grain to run in the same direction as that of the planking. Decking fitted over plating will be thickly coated on underside with red lead. Where there is no plating the butts of the deck plank will be underlaid with plates of 10.2 pounds, of the same width as the planks, sufficiently long to properly stow the butt fastenings, and riveted to the beams. The underside of planking of spar and main

decks, and of deck houses, pilot house, emergency cabin, and bridge, where there is no plating, will be beaded.

The whole of the decks, also the tops of deck houses, pilot house, emergency cabin, and bridge, will be planed fair, but this work will be deferred as long as possible (except on those decks that are to be covered with canvas) in order to have the decks in fine condition when the vessel is delivered to the Government. Planking will be protected during the building of the vessel by a thick covering of turpentine and sawdust, which will be renewed as often as necessary. The underside of exposed planking will be coated with oil during the building of the vessel.

All deck planking will be in the yard of the contractor and properly housed within two months after the signing of the contract for building the vessel.

The planking of all decks will be of yellow pine, as specified under the heading "Lumber," and will be 3 inches wide by 3 inches thick in the thinnest part when finished; this thickness will be increased and leveled up where required in the wake of the gypsy, towing bitts, and gun foundations, and where subject to the chafe of the chain cables. All margin pieces on the spar deck will be of selected East India teak, those of other decks will be of the same quality and kind of lumber, and sawed and laid in the same manner, as the deck planking.

The decks will be calked with not less than one thread of cotton and two threads of oakum well laid down in the seams, leaving them $\frac{3}{4}$ inch deep after calking; immediately after the first calking, however, the seams of the exposed decks will be well painted, and those of all decks filled with wooden strips to exclude dirt; the wooden strips will be removed, the final thread of oakum put in, and the seams payed with an approved marine glue, just before the acceptance of the vessel. All calking and paying must be done when the decks and seams are dry. If leaks develop in the seams of any deck before the acceptance of the vessel, such deck will be recalked, in whole or in part, in a satisfactory manner, by, and at the expense of, the contractor.

The planking on top of deck houses, pilot house, emergency cabin, and bridge will be of tongued-and-grooved white pine, $1\frac{1}{4}$ inches thick by 3 inches wide, and secured to carlings with tenpenny galvanized-iron nails, punched and puttied. It will be given two good coats of best oil paint and covered with tarred paper and cotton canvas—No. 1 canvas on forward deck house and bridge, and No. 2 canvas elsewhere—which will be fastened with 10-ounce copper tacks and finished with three good coats of best oil paint. A quarter-round fastened with galvanized-iron nails, punched and puttied, is to be fitted on top of the canvas at margin strakes, wood coamings, collars, etc., and covered with flashings of canvas protected by water battens.

69. WINDLASS BEDS.

These will be formed of 12.5-pound plates on top and bottom of main and spar deck beams, to which they will be securely connected by suitable angles, the spaces between the plates to be filled in solid with yellow pine in as large pieces as possible. On top of this plating will be fitted decking, as specified for spar deck, the shape and size of the windlass and engine beds, respectively; it will be calked, well painted, and covered with 5-pound sheet lead, before the windlass is placed. Around these beds will be worked angle bars 3 by 3 inches of 7.2 pounds to form water courses about 10 inches wide. The fastenings of windlass will pass through all and set up on underside of lower plates.

70. WINDLASS.

A vertical steam capstan windlass, of type to be approved, will be located where shown on plans and fitted complete with steam engine, wild cats, capstans, etc. The engine will be 8 by 8-inch vertical, secured on top of main deck, and provided with reversing gear; it will have capacity for handling a 2,600-pound anchor at a speed of at least 4 fathoms of chain per minute. The working steam pressure will be 100 pounds per square inch, but the engine must be able to withstand the full boiler pressure. The wild cats, on spar deck, will be provided with suitable locking gears and friction brakes of ample capacity, and made to take 1½-inch stud-link chain.

The worm driving gears will be of bronze, the teeth of the worm and gears to be cut; the bearings for windlass shafts will be lined with white metal composition; the cross-heads, connecting-rod bearings, stuffing boxes, etc., will be fitted with brasses. All fittings and accessories necessary for the complete installation of the windlass will be supplied and fitted.

Portable chain troughs of 2-inch white oak will be fitted from the windlass to the chain stoppers.

71. TOWING BITTS.

A pair of towing bitts, of shape shown on plans, and of approved dimensions, will be located on the spar deck aft. These bitts will be of cast steel, well ribbed inside and outside, and securely fastened with 1¼-inch diameter steel bolts set up from below with nuts over washers and grommets. The heads of bitts will be 14 inches in diameter, and all will be perfectly smooth on outside. Foundations of plates and angles will be built in connection with the spar-deck beams and plating for these bitts, and yellow-pine filling worked between the plates to completely fill the spaces; all as approved.

72. CAPSTAN (GYPSY).

A steam and hand power capstan of approved type, the plans of which are to be submitted, will be located on the port side of the spar deck abreast of the towing bitts, the head to be about 15 inches

in diameter over the whelps, the base, or shaft support, to be in height to suit the cavil on the bitts, and securely bolted to the deck and to the foundation worked under same; the engine will be a double 5-inch cylinder, with 8-inch stroke, fitted on the after berth deck where shown on plans.

The worm is to be of bronze, with cut teeth, and both worm and thrust block will work in a bath of oil so incased as to prevent the leakage of oil onto the deck. All bearings are to have composition bushings, and all parts are to be made interchangeable. A reversing gear is to be fitted, the lever of which will control the throttle, to operate from the spar deck.

73. MOORING BITTS, CHOCKS, AND CLEATS.

Mooring bitts.—Three pairs of double-headed mooring bitts on each side will be furnished and located where shown on plans, or where directed. These bitts will have heads 11 inches in diameter and 22 inches high, and will be secured with eight 1-inch diameter steel bolts, set up with nuts fitted with washers and grommets. Under the forward and after bitts 12.5-pound plates will be worked on underside of deck beams and clipped to same, the spaces between plates and deck to be filled in solid with yellow pine in large pieces; the bolts of these bitts will set up on underside of these foundations.

All bitts will be made of cast steel, the heads to be perfectly smooth on outside, cored out on inside, and stiffened with webs ¾ inch thick, the bases to be fitted with bosses or ribs let into the wood bedpieces to prevent twisting. Teak bedpieces 1 inch thicker than the deck planking, and 1½ inches clear of bases all around, will be worked under these bitts.

Cast-steel chocks of strong proportions will be located where shown on plans and securely fastened; the one on each bow will be of the closed pattern, with 16-inch opening, and will be worked through bulwark plating and flanged to same and to deck planking. Six chocks of the open pattern, with openings 16 inches in the clear, will be fitted on each side and flanged to sheer strake and to deck planking. Two quarter-chocks and one stern chock, all of the two-roller pattern, and of size as approved, will be furnished and flanged to sheer strake and to deck planking.

The bow and side chocks will be babbitted; the quarter and stern chocks will have composition rollers working on steel pins and so arranged that pins and rollers may be kept lubricated and be easily removed; all as approved.

Mooring cleats in number and location as shown on plans or as directed will be fitted. They will be of cast steel 3 feet 6 inches in length, and each will be secured with six 1-inch diameter through steel bolts set up from below with nuts fitted with grommets and washers. These cleats will be well rounded and smoothed. Bedpieces will be fitted under them as described for mooring bitts.

74. GUN FOUNDATIONS.

Four 6-pounder rapid-fire guns will be mounted on the spar deck, two forward and two aft, the mounts to be furnished by the Government, the bolts by the contractor. Under these guns 12.5-pound plating will be worked on top and bottom of spar-deck beams and the bottom plates securely fastened to same by angles 2½ by 2½ inches of 5.9 pounds; the space between these plates to be filled in solid with yellow pine in large pieces. The deck planking at these places, and to about 1½ inches clear of the base of cage mount all around, will be of extra thickness, leveled with water line, and rounded down to thickness of deck plank. Stanchions will be fitted as directed.

The main deck will be strengthened, where indicated on plans, for mounting four 4-inch rapid-fire guns—two on each side—by working under the beams 12.5-pound plating, and securely fastening it thereto by 2½ by 2½ inch 5.9-pound angle bars, the space between these plates and the main-deck plating to be filled in solidly with yellow pine in as large pieces as can be worked. The deck will be stanchioned as directed.

Four rail mounts for a line-throwing gun will be furnished and fitted on the spar-deck rail, two on each side of the vessel, one forward and one aft, and located where directed. The rail will be strengthened as approved in wake of these mounts.

75. AIR PORTS AND CIRCULAR FIXED LIGHTS.

Air ports and circular fixed lights will be in number and location as shown on plans, or as directed; the frames and fittings, except of the rectangular air ports below mentioned, will be of composition, of substantial pattern, and finished where directed, and the glass of best quality, and clear, except in particular places to be designated.

All air ports, except as below mentioned, will hinge up and be fitted with three dogs each, and with toggle-bolts, chains, etc., complete, the details to be in accordance with standard plans to be furnished by the Government. They will also be fitted with rims on outside for shedding water. Where ceiling is worked, casings will be fitted where directed. All air ports will be provided with suitable drains. The air ports in the hull of the vessel will be fitted to receive interchangeable dead-lights or battle shutters of cast iron, galvanized, secured as directed; such shutters or dead-lights will be furnished for all air ports on the berth deck from the after end of the engine space forward to the stem; stowage will be provided for the shutters when not in use; the air port in the prison will be protected as specified under "Prison." The air ports in the hull proper will have glasses 12 inches in diameter in the clear, while those in the deck houses will be 15 inches in diameter in the clear; the thickness of the glass will be not less than 1 inch.

The *circular fixed lights* will conform to the standard plans of the Government. When fitted in doors and bulkheads, the glass shall be 1 inch thick and of the same diameter as air ports in the vicinity.

Those fitted in shutters of skylights shall be 12 inches, and those in booby hatches 10 inches, in diameter in the clear, the glasses to be ¾ inch thick.

There will be two large air ports in each side of the vessel, above the main deck, of size and location as indicated. The frames of the vessel will be cut for these ports, and stiffening bars of same size as frames will be worked around the openings and clipped to the frames. The shutter for each port will be in upper and lower halves, of the same weight plating as the adjacent plating of shell, well stiffened, fitted with pure, soft-rubber gaskets, dogs, etc., for making them water-tight, and with chains, eyebolts, etc., for properly handling and securing them.

76. DECK LIGHTS.

Circular glass deck lights will be put into the spar deck where shown on plans. The frames will be of composition of substantial pattern and fastened to the deck planking with brass bolts. The glass, fitted flush with the top of casting, will be not less than 1¼ inch thick by 10 inches in diameter, clear of casting, which will be well bedded in rubber or red lead and all made water-tight. In places where there is no plating, plating of 10.2 pounds will be fitted under these deck lights, suitable openings being cut for them, and riveted to the beams.

77. BULWARK STANCHIONS.

Stanchions for bow chocks will be fitted as provided in Article No. 35.

78. AWNING STANCHIONS.

Awning stanchions will be of extra heavy wrought-iron pipe, 2 inches inside diameter, with solid ends, and in number and location as approved. They will ship through approved composition bearings fastened to rail and step into galvanized cast-iron sockets riveted to sheer plating of spar deck. Their heads will be fitted with open guides for the ridgeropes. Those forward of the bridge will have suitable galvanized eyes for the ridgeropes for housing awnings.

The composition bearings for stanchions on bridge and on top of forward deck house will be fitted to the guard rails, the sockets to the covering board. The stanchions will be provided with suitable galvanized iron eyes for weather-cloth ridgeropes.

Where sockets are secured to wood, brass through bolts and nuts must be used. Galvanized wrought-iron jack rods and eyes will be fitted around tops of deck houses, pilot house and emergency cabin, stack, and elsewhere as directed, for securing the awnings.

All necessary sockets, composition bearings, eyebolts, cleats, ridge bars, ridgeropes, spreaders, and other miscellaneous fittings for the complete installation of the awnings will be supplied and fitted.

The awning stanchions will be galvanized after completion.

lower block to be fitted with an approved automatic releasing hook. Each thumb cleat will have a hole near its upper end for a lanyard, which will be fitted for lashing the strongback.

Hardened-steel disks will be fitted in the socket castings for heels of davits to rest upon. Suitable Lewis bolts, cleats, eyebolts, ringbolts, gripes, and other fittings for securing boats and for lead of boat falls from the davits to windlass and after capstan (gypsy) will be provided and fitted.

The quadrant davits for power and sailing launches will be fitted with chocks, gears, falls, etc., complete, the chocks to be of height as approved and the falls to be of fiber-clad wire rope of best quality.

All manila falls are to be of the quality of manila hemp known as "F. E. B.," or "Superior good current."

Additional strengthening, similar to that for 6-pounder gun foundations, will be fitted under the quadrant davits.

82. ANCHOR DAVIT.

One anchor davit of about 5½ inches greatest diameter, with an outreach of about 5 feet 6 inches, or sufficient for the head to plumb well outboard when the davit is swung athwartships, and of the design indicated, will be furnished and located where shown on plans. It will be built of mild-steel billets and fitted with the necessary cleats, and with eyes for catfalls and guys.

A composition-bushed cast-iron bearing will be fitted to the breasthook. A cast-iron socket with hardened-steel disk for heel of davit will be fitted to spar deck and securely bolted to the framing and plating of the vessel. Guys and falls will be furnished and fitted, and a galvanized-iron pad eye for the guys secured on the bow chock on each side, as directed.

83. SPRING CHAIN STOPPERS.

Two spring-steel chain stoppers of approved pattern will be furnished, located where shown on plans, and well secured to the deck plating, etc., which shall be worked double for the purpose. In fitting wood chocks under these stoppers care will be taken as to height, etc., that a fair lead for the chain be secured.

84. RINGBOLTS IN DECK.

Forward of the windlass, near wake of the chain cables, ringbolts, of 1⅛-inch iron, with rings about 4 inches in diameter, will be fitted on each side and through-fastened, with nuts and washers on under side of deck, in a substantial manner. Four similar ringbolts, with collars and plates above and nuts and washers below, will be fitted on each side of spar deck and secured through plank-sheer, deck stringer, etc. They will be located where directed.

85. STEERING-ENGINE FOUNDATION.

The foundation for the steering engine will be located on the after berth deck where shown on plans. On top of the deck plating, and

under the steering engine, yellow pine 4 inches thick, with raised coamings, will be worked; this will be covered all over with 5-pound sheet lead, soldered and made oil-tight. Angles and stanchions, as approved, will be worked to make this foundation rigid. Galvanized-iron drain-pipes 1½ inches in diameter will be fitted and led to bilge. Galvanized iron grab rods will be located where directed.

86. ASH EJECTOR.

An opening will be cut in the hull to accommodate the ash ejector, which will be located as described in machinery specifications.

87. MASTS AND SPARS.

The masts will be of Oregon pine, each in one length from heel to truck, and of the following dimensions:

Foremast:	
From heel to truck	88 feet 6 inches.
Pole	7 feet.
Diameter at spar-deck partners	18 inches.
Rake of mast, about	4°.
Mainmast:	
From heel to truck	90 feet.
Pole	7 feet.
Diameter at spar-deck partners	18 inches.
Rake of mast, about	5°.

The masts will be fitted with the necessary bands for rigging, etc., as approved; the mainmast will be fitted with an iron guide or track with composition hanks for the mainsail. The shroud bands shall have lugs forged on them to receive the bolts for shrouds. All ironwork must be galvanized. An 8-inch lignum-vitæ ball truck, gilded, with brass sheaves for signal halyards, will be fitted to each masthead. The mainmast, where exposed in living quarters, will be lagged with strips of quartered oak. The foremast will be fitted with a signal yard and the necessary brackets and fittings for installing the night-signal apparatus. The signal yard will be of spruce of approved dimensions, and fitted with lifts, footropes, bands, etc., complete, and with the necessary fittings for the operation of signals—three sets of halyards on each side. Each mast will be provided with the necessary fittings for the wireless telegraph system.

A platform for a 24-inch searchlight will be built on foremast, as shown on plans, and well secured to same, the plating to be of 10.2-pound material, and the angles 3 by 2½ inches of 5.6 pounds; a galvanized-iron guard rail will be installed around the platform as specified in Article No. 79, and a galvanized-iron ladder fitted to lead to the platform: all as approved.

88. STANDING RIGGING.

The standing rigging will be of the best quality of galvanized charcoal-iron wire rope of the following sizes: Shrouds, 2½ inches in circum-

ference, three being fitted on each side of each mast; fore and main stays, 3 inches; topmast stays, 1¾ inches; backstays, 2 inches. All standing rigging will be fitted single, shackled to solid eyes on masthead bands, and set up through round brass turnbuckles with jam nuts and shackles. The turnbuckles for the shrouds and backstays will be securely attached to chain plates well riveted to sheer strake, those for head stays to a galvanized wrought-iron eye plate secured to deck stringer, and those for the mainstay and maintopmast stay to a similar plate on engine room skylight and well bracketed to same. An additional backstay of 2-inch wire will be fitted from the mainmast head to the stern for the crowfoot halyards; this backstay will set up to a pad eye where shown on plan, or where directed.

Two jackstays of galvanized-iron wire rope will be fitted forward of foremast for oil masthead-light guides. They will set up with galvanized turnbuckles on the searchlight platform. Galvanized-iron pin rails and pins as approved will be fitted to the shrouds. Galvanized-wire Jacob's ladders with galvanized-iron pipe ratlines will be fitted on each side of each mast; these ladders will be served their entire length and set up with galvanized-iron turnbuckles.

The shrouds and backstays will be wormed, parceled, and served their entire length, and the stays to 2 feet beyond the splices. The eyes of all rigging will be double served. Galvanized-iron hanks will be fitted on fore and main stays.

All plates, eyes, eyebolts, shackles, etc., necessary for securing the rigging to the hull and spars will be fitted, all iron fittings to be galvanized.

89. SPIDER BAND.

A substantial galvanized wrought-iron spider band made in two pieces and hinged, the hinges to have brass pins, will be fitted to the foremast, the band to be tapped out for the bosses, which will be screwed in and riveted. Galvanized-iron belaying pins will be furnished and fitted.

90. BOAT STRONGBACKS.

Strongbacks of Nova Scotia spruce, about 7½ inches greatest diameter, and of length proportional to the spread of davits, will be fitted to four pairs of davits. They will be padded for a length of 2 feet at center with oakum neatly covered with canvas.

91. SWINGING BOOMS.

Two swinging booms of Nova Scotia spruce, each about 26 feet long by 7½ inches in diameter, with flat treadpiece on top, will be fitted, one on each side abreast of fore rigging and secured to hull with gooseneck attachments. They will be fitted with Jacob's ladders, pendants, topping lifts, guys, eyebolts, etc., as approved, the Jacob's ladders to be fiber-clad wire rope with hickory rungs, the pendants of fiber-clad wire rope, the topping lifts of flexible fiber-clad wire

rope, with manila purchase, and the guys of manila rope. All eyebolts, goose-neck attachments, etc., will be galvanized.

92. ENSIGN AND JACK STAFFS.

These will be of Nova Scotia spruce of approved dimensions and provided with all necessary ironwork and other fittings for their support, and for belaying halyards, the fittings to be galvanized. A lignum-vitæ or gum-wood ball, gilded, with brass sheaves for halyards, will be fitted to each staff.

93. RIDGEPOLES, RIDGEROPES, ETC.

Ridgepoles and spreaders with bands, goose necks, and stanchions as approved will be supplied and fitted on spar deck, forward deck house, and bridge where required for awnings. The ridgeropes will be of 1½-inch galvanized-iron wire rope, passing through heads of awning stanchions and fitted with sister hooks, thimbles, and lanyards. Galvanized wrought-iron jack rods and eyes will be fitted around deck houses, pilot house and emergency cabin, stack, and elsewhere as required for securing the awnings.

94. RUNNING RIGGING.

The running rigging, except as otherwise specified, will be of the grade of manila hemp known as "F. E. B.," or "Superior good current," 3-strand, except for the fish-fall and the deck tackle, which shall be of 4-strand, of the required sizes and lengths, and completely fitted to the satisfaction of the inspecting officer. The three sails—fore and main staysails and mainsail—will be furnished by the Government.

The falls for power and sailing launches and runners for swinging boom topping lifts will be of the best quality of fiber-clad wire hoisting rope. A full set of ensign and signal halyards of "Silver Lake" cotton cordage will be furnished for masts, staffs, and signal yard. Man ropes for gangways will be of white cotton.

95. BLOCKS, TACKLES, BOLTS, ETC.

Blocks and tackles in sufficient number and of proper sizes for efficiently handling sails, boats, anchors, chains, awnings, signals, booms, ladders, etc., will be furnished and fitted as directed. In addition to the foregoing, there will be furnished one 12-inch deck tackle, three watch tackles (10, 8, and 8 inches), three 9-inch hatch tackles, two 8-inch mast girtlines, four smokestack girtlines, two clotheslines and girtlines, and four snatch blocks (24, 16, 12, and 12 inches). All tackles and whips will be rove full, the length and sizes of falls and sizes of blocks to be as approved. All blocks, except as otherwise directed, will be of ash and have galvanized-iron inside straps, sheaves, hooks or shackles or jaws; all sheaves to be fitted with the most approved Tobin bronze roller bushings, except sheaves for snatch blocks and blocks for anchor purchase and deck tackle, which shall have

metalline bushings. All snatch blocks will be fitted with self-locking bails. All blocks larger than 6 inches and having wood shells will be double cross-bolted and have wide mortises and extra heavy straps, hooks, etc. The blocks for the runners of swinging boom topping lifts, smokestack girtlines, signal halyards (on yard), and masthead lantern (oil), will have galvanized-iron shells. A list of blocks, falls, etc., will be submitted for approval.

All eyebolts, pad eyes, ringbolts, Lewis bolts, cleats, and similar fittings necessary for the proper attachment, working, belaying, and handling and lashing of all parts and appliances will be furnished and fitted to the satisfaction of the inspecting officer. The Lewis bolts will be of composition, the other fittings of galvanized iron.

96. SIDE LADDERS.

A side ladder will be fitted on each side of vessel at the gangway; the platforms, ladders, landings, and buffers will be of clear white ash, the ladders hinged to landings and platforms, and the platforms to sheer strake, in such manner that they may be triced up and stowed flat against the side, the necessary iron supports to be provided. The platforms and landings will be fitted with substantial composition corner pieces and the ladders with composition fittings. Brass guard rails, stanchions, and eyes for manropes will be fitted; there will be provided, also, for each ladder a davit and a bail and chain sling, all in accordance with standard plans to be furnished by the Government.

All ironwork, including the davits, will be galvanized and all composition finished.

97. LADDERS TO HATCHWAYS, ETC.

Ladders will be fitted throughout the vessels where required to provide ready access to, or escape from, every compartment not specially provided with other arrangements for this purpose, and in engine rooms and fireroom to reach the various platforms, passages, and parts of machinery. In engine rooms and fireroom the ladders will be of iron and in number, location, and make to the satisfaction of the Engineer in Chief, United States Revenue-Cutter Service. Light iron ladders, about 12 inches wide, with plate-iron sides, will be fitted in fore and main holds, and bolted to lugs secured to decks or bulkheads. Similar ladders will be fitted to searchlight platform, to top of pilot house, and to top of after deck house. Wrought-iron rungs will be fitted to bulkheads in coal bunkers, fresh-water tanks, and trimming tanks, as directed. Ladders to storerooms will be of ash, with composition hooks and toe pieces. The ladders to the top of the forward deck house, from spar deck to main deck, and from main deck to berth deck will be of clear white ash of substantial make, and secured with composition hooks and toe pieces; treads will be covered with 5-pound sheet lead, with cast-brass nose pieces secured with brass screws; composition eyes for manropes will be fitted for all

inclined ladders excepting to forward deck house, which will have galvanized-iron hand rails and stanchions.

Wherever required for convenience or safety in the vicinity of ladders, galvanized wrought-iron grab rods will be fitted.

98. VENTILATORS.

There will be one ventilator to crew space, two to engine room, two to fireroom, and one to the after berth deck. The ventilators to engine room and to fireroom will be built in accordance with the machinery specifications; the others will be 15 inches outside diameter, and below the spar deck will be built of No. 11 B.W.G. steel, with single riveted laps and seams, and galvanized. Their cowls will be of No. 12 B.W.G. galvanized iron, made portable; the base rings of cowls will be of cast iron, galvanized, finished on working parts and fitted with locking screws to hold cowls in any desired direction. A galvanized-iron casting to receive cowl base, with a galvanized cast-iron cover made water-tight by being pressed down on pure, soft-rubber gaskets will be fitted to each on spar deck.

Three galvanized-iron deck rings and covers, similar to those specified for coaling scuttles, will be fitted on each side of spar deck where indicated on plans, and provided with portable cowls, the cowls to be of No. 14 B.W.G. galvanized iron, 15 inches diameter, to extend about 5 feet above the deck and to have base rings of cast iron, galvanized, beveled so that cowl will stand plumb, with pure, soft-rubber gaskets, and arranged to set up water-tight in the deck rings, each being secured by a bolt passing through the grating, with a spider nut underneath; the ring on bottom of cowl will be of cast iron, galvanized, and will be fitted with composition screws to clamp the cowl in any desired direction. A similar cowl, of the required dimensions, will be fitted to the hawser pipe. Proper stowage will be provided for the covers when not in use.

99. VENTILATION OF COAL BUNKERS.

Two galvanized-iron pipes, each 4 inches in diameter, will be led from each coal bunker to the space between inner and outer stacks for ventilation; wire netting will be fitted in a satisfactory manner over each opening.

100. MECHANICAL VENTILATION.

The executive officer's office, engineer's office, office of the ship's writer, dispensary, sick bay, wireless-telegraph room, warrant officers' quarters and staterooms, petty officers' staterooms on berth deck, galley, and crew space on berth deck will be ventilated mechanically by a system so arranged that it may be worked either on the plenum or on the exhaust system.

Blowers and cowls of approved kind, number, and capacity for this system will be furnished and installed where directed.

The ducts will be made of galvanized iron, varying in weight from No. 14 to No. 20 B. W. G., according to size of duct, led as approved, and made air-tight.

In all rooms or compartments ventilated a brass louver valve will be fitted to each opening and arranged to be operated by hand; all as approved.

101. SOUNDING TUBES AND AIR ESCAPES.

Sounding tubes of 1½-inch galvanized wrought-iron pipe will be fitted to all water-tight compartments, trimming tanks, and fresh-water tanks as directed, care being taken to protect the bottoms against injury from the sounding rods by fitting a screw plug in the bottom of each sounding tube; the upper end of each tube will be covered with a brass screw cap properly marked. An air escape of 1¼-inch galvanized wrought-iron pipe will be fitted to each of these tanks and compartments and led well above the water line.

102. FIGURES FOR DRAFT OF WATER.

The figures will be 6 inches in height, cut in and center punched on each side of stem and sternpost; they are to be carefully laid off to indicate each foot of draft from about 6 feet to 16 feet above the bottom of keel. These figures are to be cut before the vessel is launched.

103. RUNNING-LIGHT FIXTURES.

Fittings and screens will be made, located as directed, and secured, for the reception of oil and electric running lights. The brackets for masthead, towing, and range lights will be of galvanized iron.

104. WATCH BELL.

A clear-sounding bell of bronze of not less than 150 pounds weight, with the vessel's name and date engraved thereon, will be provided, fitted with brass hangings, and secured where shown on plans, or where directed.

105. HOSE RACKS AND BUCKET RACKS.

Metal hose racks, or saddles, for a complete outfit of hose—one rack in the vicinity of each fire plug—will be fitted; each rack will have capacity for one 50-foot length of standard fire hose of approved size, the bottom of hose when stowed to be not less than 9 inches above the deck. Clips of galvanized iron for stowage of hose nozzle and spanner will be fitted close to each rack.

Bucket racks of white pine will be fitted where shown on plans and supplied with 24 extra-heavy galvanized-iron buckets.

106. NAME OF VESSEL.

The name of the vessel in block letters 6 inches in height and ½ inch thick will be placed on the stern, in accordance with the Regulations of the Service, and securely fastened in place with brass screws; the letters will be of composition and gilded.

107. LIGHTNING CONDUCTORS.

There will be provided at each mast one lightning conductor of $\frac{3}{8}$-inch copper-wire rope, fitted complete with tip, fair-leads, etc.; it will be secured at truck and pole and led down the topmast backstay; the lower end will be attached in an approved manner to the shell plating.

108. LIFE BUOYS.

Two Franklin life buoys will be furnished and located, one on each outboard end of bridge, where shown on plans, and fitted complete with guards, guides, pulls, launching gear, etc., as directed; the metal fittings will be galvanized.

109. LEADSMAN'S GRATINGS.

On each side of the vessel, forward of the bridge, where shown on plans, there will be a portable leadsman's grating, fitted with the necessary hinges, supports, stanchions, and guard ropes. The gratings will be of clear white ash and the fittings of wrought iron, galvanized, except pins of hinges, which will be of composition; all as approved.

110. CABIN.

The captain's quarters on the main deck will be located and arranged as shown on plans. All bulkheads will be of steel as provided in Article No. 42.

Where the ship's side is exposed to view, in cabin proper, metal ceiling will be worked on the framing line in removable sections; this ceiling will be of 2.5-pound plating, galvanized, secured to the frames with $\frac{3}{8}$-inch brass button-headed screws; before being secured into place, the outboard side of the ceiling will be given two heavy coats of cork paint. Such light angle stiffening and framing as may be necessary to properly install the ceiling and to make a neat fit and finish at air ports and other openings will be fitted.

In the cabin proper there will be furnished and secured in place, where shown on plans, an extension table, a chiffonier, a buffet, two extension transom seats, a desk, and a bookcase, all of which will be made of quartered white oak. This compartment, except overhead, will be grained natural, quartered oak to match the furniture; the doors will be of quartered white oak.

The table will be 3 feet 8 inches square when closed and 8 feet long when extended. It will have carved legs, spare leaves, removable storm racks, and substantial fastenings to the deck, as approved.

The chiffonier will be about 4 feet in height, fitted with drawers, and have a spindle rail around top.

The buffet will be fitted with French plate mirror, drawers, lockers, pillars, spindle rail around top, and removable storm rack, the latter to be cut for silverware and water bottles as directed.

The transom seats will be arranged to pull out and form berths, with brass fittings, as approved, to keep them open or shut as desired, and with drawers underneath; each berth will have a lee board, secured with

brass fittings; the seats will be 20 inches wide clear of the back cushion when closed and 30 inches wide when extended; the seats, ends, and backs will be upholstered in the best dark green, pebbled leather and tufted and filled with best No. 1 S. A. horsehair drawings; four pillows, 22 inches square, and made to match the upholstering of the seats, will be furnished; stowage for the lee boards and extension mattresses will be provided back of the drawers.

The desk will be roll-top, 50 inches long, 30 inches deep, and 45 inches high, with drawers, pigeonholes, automatic locking device, and an attached movable stand for a typewriter.

The bookcase will have adjustable shelves with removable battens and hinged, leaded-glass doors; a drawer will be fitted at bottom.

All furniture will be built and finished in the best manner.

111. CABIN STATEROOMS.

In each stateroom there will be furnished and secured in place where shown on plans a berth, a bureau, and a clothes locker, all of quartered white oak; the berth fronts will be made of spindle work and hinged to turn down, drawers and a boot locker to be fitted under each berth; the bureau will be fitted with drawers, and will have on top a beveled French plate mirror of suitable size, mounted in a polished quartered-oak frame, and a spindle rail around the top; all as approved; the clothes locker will have doors, shelves, coat hooks, etc., as directed. Coat hooks will be placed in each room where directed; hooks for sword and for revolver will be put in the starboard stateroom. A folding seat will be installed. The door to bathroom will be of clear white pine, painted.

These rooms will be sheathed on the framing line, where exposed, with 2.5-pound galvanized plates secured in removable sections in the same manner as the ceiling in the cabin. Cork slabs 1¼ inches thick will be bolted to the back of the plating to cover the total surface between the frames or stiffeners. Insulating strips of asbestos paper or an equivalent will be fitted on the inside surface of the frames, between them and the steel ceiling. The outboard side of the ceiling will be thoroughly cork painted before the cork slabs are bolted into place. Care will be taken to neatly fit this nonconducting sheathing around obstructions, openings, and fittings, and all of it will be worked as nearly as possible air-tight. The rooms will be finished white, or as may be necessary for the preservation of the sheathing and to harmonize with other work in the rooms. The sides of vessel inside of clothes lockers will be ceiled on the framing line with white pine in removable sections; the ceiling will be painted.

112. CABIN BATH ROOMS.

There will be two bath rooms, located and arranged as shown on plans. In each room will be fitted a tub, a lavatory, a water-closet, and a mirror about 22 inches square (in the clear) of beveled French plate glass in a quartered white oak frame. Suitable towel racks of heavy glass rod with nickel-plated fastenings will be located at tubs and at lava-

tories; grab rods of polished oak with nickel-plated standards will be secured at tubs and at water-closets. Under each mirror will be fitted a shelf, with rail, for toilet and shaving articles, as directed. At each lavatory there will be secured a soap dish, a brush cup, and holders for tumblers, all of heavy brass, nickel plated; at each water-closet there will be a heavy nickel-plated paper holder. A stationary slatted hardwood seat will be built where indicated. The floor of each room will be covered with vitreous tiling, with border, as heretofore provided. No ceiling will be worked in these rooms. Linen lockers and a wine locker of white pine will be fitted as directed where indicated on plans. Coat and hat hooks will be installed. (Article 161.)

113. CABIN PASSAGE AND STAIRWAY.

The location and general dimension of these are shown on the plans.

The partition between the stairway and the wardroom will be of metal and constructed in accordance with the specifications for "Bulkheads," Article No. 42.

The stairs, with their balusters and rails, and the doors leading to the cabin, to the wardroom passage, and to the pantry will be of quartered white oak. The treads will be covered with ½-inch perforated rubber, and have cast-brass nose pieces secured with brass screws, the nose pieces to project to top of rubber treads; sheet brass toe pieces will be suitably secured to the risers. A perforated rubber mat ½ inch thick, to match the treads, and having the ship's name in the center, will be fitted to cover the landing at the foot of the stairs. The sills of the doors will be covered with heavy sheet brass.

114. WARDROOM.

The wardroom will be on the main deck forward of the cabin and arranged as shown on plans. The bulkheads forming this compartment, and those separating staterooms, will be constructed as provided under "Bulkheads," Article No. 42, and finished flush and smooth.

In the wardroom country, as indicated on plans, there will be furnished and secured in place an extension table, a buffet, a bookcase, and two transom seats, all of quartered white oak. The table will be 3 feet 8 inches wide and 12 feet long when extended, secured as approved and fitted with removable storm racks. The buffet, bookcase, and transom seats will be as described for cabin, except that only the fore-and-aft transom seat shall be fitted to haul out to form a berth, and of sizes as indicated on plans. The space under the stairway will be fitted with hooks and white pine shelves as directed for a wardroom locker, the door, made of clear, white pine to be in the forward end. The door in port bulkhead will be of hard wood, painted; that in the forward bulkhead will be of steel.

A water-cooler stand properly supported will be fitted where directed.

Stowage will be provided for a safe, which will be furnished by the Government.

Each stateroom will be fitted with a berth with front hinged to turn down, with drawers and boot locker below the berth, the berth to be

28 inches from top of deck plank to bottom board; with small book-shelves at foot and head of berth, and with a clothes locker, a secretary-bureau, and a folding seat. All of this furniture will be of quartered white oak. The secretary-bureau will have around its top a spindle rail. The clothes locker will have a shelf and the necessary hooks. In each stateroom coat and hat hooks, hooks for sword and revolver, and a suitable shelf for shaving and toilet articles will be placed where directed. Each stateroom will also be furnished with a lavatory, a towel rack, a soap dish and holder, a tooth-brush cup and holder, a comb and brush holder, a glass holder, and a beveled French plate mirror of suitable size in a quartered white oak frame. The towel racks and the holders will be of heavy brass, nickel-plated.

Portable platforms will be fitted in bottoms of lockers under berths. The sides of the clothes lockers fitted against the side of the ship will be made in removable sections that the metal back of them may be got at for cleaning and painting.

The spaces between beams over fore-and-aft bulkheads will be fitted with grill work of expanded metal, galvanized, with $\frac{3}{4}$ by $1\frac{1}{2}$ inch diamond mesh. The door sills will be covered with sheet brass suitably secured.

Ceiling will be fitted on the framing line on the exposed portions of the ship's side in the staterooms; it will be constructed and secured in the same manner as specified for the ceiling in cabin staterooms.

Doors to staterooms will be of clear white pine, finished white, with metal grill work, similar to that above specified, in upper panels.

115. WARDROOM BATH ROOM.

The bath room will be fitted with a bath tub, a lavatory, a French plate-glass mirror (beveled), about 22 inches square in the clear, in a quartered white oak frame, a nickel-plated comb and brush and glass holder, nickel-plated towel racks, and nickel-plated soap dishes, one of them to have a sponge rack. There will be a polished hard-wood grab rod, with nickel-plated standards over the tub, and a portable seat for the tub. The entrance door will be of hard wood, suitably painted. Vitreous tiling, with border of approved design, will be laid in the room.

A scupper to drain overboard will be fitted.

This room will not be ceiled; it will be finished white. (Article 161.)

116. WARDROOM WATER-CLOSET.

This will be fitted with a water-closet as specified under "Plumbing Fixtures," and with a heavy, nickel-plated paper holder. A short, polished hard-wood grab rod with nickel-plated standards will be installed. Vitreous tiling, with border of approved design, will be laid in the room. The compartment will be finished white; no ceiling will be worked in it. It will be scuppered as provided for wardroom bath room or arranged to drain into the scupper of that room. A hard-wood door will be installed.

117. CABIN AND WARDROOM PANTRIES.

These pantries will be of size and located where shown on plans and will be fitted with dressers, shelves, lockers, drawers, racks for crockery and glassware, hooks, and sinks, all complete for the purpose intended and as approved. The sinks will be fitted to drain overboard. The shelving, dressers, etc., will be of clear white ash finished in hard-oil finish and rubbed down, except the dressers carrying sinks, which will be covered with cold-rolled copper, as directed.

Ceiling will not be fitted in these rooms.

The inside of pantries, except the bright woodwork, will be finished in white.

A stand or bracket for a water cooler will be fitted in cabin pantry.

Hard-wood doors will be fitted to these pantries; they will be finished to harmonize with other work in the vicinity.

118. EXECUTIVE OFFICER'S OFFICE.

This will be located where shown on plans and furnished with a desk, bookshelves, and keyboards, all of quartered white oak and as approved. The desk will be a cloth-covered, flat-top double desk of dimensions shown on plans, with recess in center and drawers on one side and partitions for ship's books, with door in front on the other side; one large drawer for blanks will be fitted in center under top, the drawers and lockers to have locks. The bookshelves will be arranged over desk as approved and will be fitted with lip pieces and removable battens. The keyboards will be of approved size, with numbered brass hooks to accommodate all the keys of the vessel, and fitted with doors with suitable brass locks. The interior of office will be finished in white. A steel door will be fitted to the room. The side of the vessel will not be ceiled.

119. ENGINEER'S OFFICE.

This office will be located where shown on plans and fitted with desk, shelves, etc., of quartered white oak, to the satisfaction of the Engineer in Chief, United States Revenue-Cutter Service. This room will not be ceiled. It will be finished in white. The entrance door will be of hard wood, painted, with expanded metal grill work, galvanized, in upper panels.

120. SHIP'S WRITER'S OFFICE.

This will be fitted with a typewriter desk of the drop-cabinet style, and with shelves, drawers, and lockers for stationery, books, and blanks; all of quartered white oak and as approved. A sliding window will be fitted in bulkhead for communication with the executive officer's office. The door to this room will be in all respects similar to that to the engineer's office. This room will be finished white, but will not be ceiled.

121. ARMORY.

The armory will be located on the main deck, and will be fitted with racks and hooks, as approved, for stowing all the rifles, revolvers, cutlasses, and belts intended for the vessels, and with drawers and lockers for cleaning gear, accessory boxes, knapsacks, etc. The woodwork will be of quartered white oak. A hard-wood door, similar to that specified for the engineer's office, will be fitted to the compartment. The room will be finished white, and will not be ceiled; the side of the vessel in the room will be cork painted.

122. DISPENSARY.

The dispensary will be of the dimensions shown on plans, and fitted with sink, desk, dresser, lockers, racks for bottles, and French plate mirror, with beveled edges, about 16 inches square in the clear, all complete for the purpose intended and as approved. The sink will be as specified under "Plumbing Fixtures," and will have towel rack, glass holder, soap dish, etc., of heavy nickel-plated brass. The desk will be a single, roll-top desk of dimensions shown on plans, with drawers on one side and pigeonholes, etc., as approved. Desk, dresser, lockers, frame of mirror, and racks will be of quartered white oak. The entrance door, from passage, will be similar to that to the engineer's office. This room will not be ceiled; it will be finished white.

123. SICK BAY.

The sick bay will be of the dimensions shown on plans, and fitted with two hinged, galvanized-iron gas-pipe berths, with wire mattress, catches, chains, etc., complete, and as approved. This room will not be ceiled, but removable battens of white pine, 4 by 1½ inches, spaced 3 inches apart, will be secured to furring strips on inboard bulkhead. A folding hard-wood seat will be installed where shown on plans. The entrance door will be of steel; there will be a painted hard-wood door between this room and the dispensary.

The room will be finished white.

124. CLOTHING ROOM.

This room will be fitted with shelves, lockers, and drawers, of white pine, faced with clear white ash, finished natural, arranged as approved for the stowage of clothing and small stores. It will not be ceiled. Removable hard-wood battens with galvanized-iron sockets will be fitted in front of shelves, and also where necessary to prevent articles from getting against the metal work. The entrance door will be of hard wood as specified for engineer's office. The side of the vessel in the room will be cork painted. Hooks will be placed where directed.

125. FIREMEN'S WASH ROOM.

This will be fitted with a shower inclosure, and with wash basins, as indicated on plans. The plating on the floor will be covered with vitreous tiling. Drains will be fitted as approved. The divisional

bulkheads in this compartment will be of 7.5-pound plating, worked vertically, and without coaming plates, but stiffened as necessary. The shower inclosure will be fitted with a Type A, navy standard, combined heater and shower head, and grab rod. The wash basins will be enamel-iron sectional lavatories, as described for crew's wash room.

The shower head and lavatories will be supplied through the heater with salt water only. A faucet for bucket use will be provided and connected to the discharge from the heater. A folding hard-wood seat will be installed in the dressing room. Coat and hat hooks will be furnished in number as directed. Metal soap dishes will be fitted in bath inclosure and over lavatories. A galvanized-iron pipe towel rack will be fitted where directed. A French plate bevel-edge mirror, about 24 by 20 inches in the clear, in quartered white-oak frame about 2 inches wide, will be furnished, and secured in place.

The compartment on the port side of the wash room will be arranged to the satisfaction of the Engineer in Chief, United States Revenue-Cutter Service, as a blower room. The door to this compartment and the one to the wash room will be of steel.

A skylight will be fitted over these rooms, as specified in Article No. 57.

126. FIREMEN'S LOCKERS.

There will be fifteen of these lockers, of standard design, each 15 by 15 by 15 inches, made of galvanized sheet steel and fitted with brass lock and brass number-plate. They will be located where shown on plans.

127. GALLEY.

The galley will be of size shown on plans. Under the beams overhead in this compartment No. 14 galvanized sheet iron, with ½-inch sheet asbestos sheathing, will be worked as a protection to the deck.

Vitreous tiling, with border of approved design, will be laid. The galley range will be secured on this tiling, suitable fastenings of galvanized iron being riveted to the plating for this purpose. The range will be 8 feet long, of steel of the best quality, and of extra-heavy weight and thickness, the details of construction to be strictly in accordance with the United States Navy specifications. It will have two fire boxes and two ovens, and be furnished with two of each of the following fire tools: Slice bar, flue scraper, cover lifter, raker, and shovel. The following spare parts will also be furnished: 2 fire panels, 2 oven panels, 4 sets each of rings, covers, and fire brick, and two sets of grates. It will have also a large copper boiler, fitted with brass filling and drain pipes and faucet, as directed. The smoke pipe where it passes through this boiler will be of copper. Above the boiler a double plate shelf, forming warming ovens, will be fitted. The smoke pipe will be led into and to the top of the main stack; it will be made of No. 11 galvanized iron, fitted with dampers, and with arrangements for cleaning. A galvanized steel folding mat to be fitted.

The doors opening into gangways will be fitted in halves. The shelving, drawers, lockers, etc., will be of galvanized steel plates with galvanized expanded steel doors to lockers, all as approved.

Two all-brass hand lift-pumps of approved make will be fitted and connected, one with the sea and the other with the fresh-water tanks; they will have revolving stands and detachable bolted bases; their strokes will be 6¾ inches, cylinders 2¾ inches, and suction pipes 1½ inches inside diameter. All supply pipes will be of ample size, those for salt water to be of brass, and those for fresh water of galvanized iron. The sinks and dish drains will be as specified under "Sinks." Heavy brass cup hooks will be fitted where directed.

A bunker with capacity for 2 tons of hard coal for use of galley will be built in main bunker on port side, as shown on plans; it will be formed of 8-pound plating, bounded by angles 2½ by 2½ inches of 5.9 pounds and stiffened on bottom and sides with angles 3 by 2½ inches of 5.6 pounds, spaced 2 feet between centers. A water-tight scuttle to this bunker will be fitted on main deck, as shown on plans, and iron ladder rungs on bulkhead for access.

A metal coal bin, as approved, and located where directed, will be installed.

A portable baker, 3 feet wide, of heavy, refined sheet steel, with extra heavy castings, and trimmings ground and polished, will be furnished, and installed where shown on plans, the smoke pipe to lead into that of the galley range.

The galley will be scuppered (two scuppers) to drain overboard.

128. BAKERY.

A bakery of the dimensions shown on plans will be located on the starboard side, forward of the galley, and provided with troughs and shelves for mixing and raising bread, as approved. The troughs will be fitted with hinged covers 1¾ inches thick, with composition hinges and fastenings. The troughs and covers will be of clear white ash, the shelving of galvanized steel. Shelves of similar material will also be fitted, as directed, for the stowage of galley utensils. This room will be tiled to match the galley. The bulkheads will not be ceiled. The door between the bakery and the galley will be of grill work.

129. SERVANTS' LOCKER.

This locker will be located where shown on plans, and fitted with a chest of six drawers, each 24 inches wide by 8 inches deep, for the clothing of officers' servants. Partitions will be fitted between the drawers, making each separate from the others. On the top of this chest of drawers six lockers, each 10 inches high, will be built and fitted with doors. The drawers and lockers will be of clear white ash, finished in hard oil and rubbed down; the doors will be fitted with locks, and the drawers with locks and drawer pulls, all of brass or solid bronze. Coat and hat hooks of brass will be placed where directed. This room will not be ceiled, nor will decking be worked in it, but ash gratings will be fitted to cover the clear floor space. The door will be of clear white ash, having galvanized expanded metal grill work in upper panels.

130. CABIN, WARDROOM, AND WARRANT AND PETTY OFFICERS' STOREROOMS ON MAIN DECK.

These storerooms will be fitted with shelves, lockers, and hooks, complete, and as approved. Galvanized-iron sockets and portable battens will be fitted in front of shelving in these and in all other storerooms. All woodwork will be of clear white ash, finished in hard-oil finish and rubbed down. The steel bulkheads will not be ceiled. Ash doors will be fitted to these rooms, as specified in Article No. 129. No decking will be worked in the rooms, but ash gratings will be fitted on the flats.

131. ENTRANCE TO WARRANT OFFICERS' QUARTERS.

The entrance to warrant officers' quarters will be located where shown on plans. The stairs will be fitted with galvanized-iron hand rails, as approved; the treads and risers will be of ash. The treads will be protected by 4-pound sheet lead, and by brass nosings; brass toe pieces will be fitted on risers. A locker with shelves will be built under the stairs. The door will be of clear white ash, with solid panels.

132. COLD-STORAGE ROOM.

A cold-storage room will be constructed; its interior shall be divided into four compartments by heavy, galvanized, expanded metal grill work, or by perforated steel plates, as directed. It will be of approved make, of the dimensions shown on plans, and built in place. It will be ceiled on sides, top, and bottom with 1-inch well-seasoned spruce, secured to furring strips on stiffeners and beams. There will be a 1-inch air space. The nonconductor will be sheet cork, 2 inches thick, worked on inside of outer ceiling and covered with inner ceiling of spruce lined with waterproof paper and No. 20 B. W. G. sheet zinc. The bottoms of the compartments will be lined with 4-pound lead. All linings will be soldered and made water-tight. The deck plating will be carefully cemented before the ceiling is fitted. The compartments will be provided with removable gratings of white ash, as directed. Meat hooks will be secured in each.

A brass drain, with S-trap, will be fitted in each after corner, joined and led overboard. Each compartment will have two air-tight doors, each furnished with extra-heavy brass hinges, dogs, handles, hasps, and padlock, the latter to be attached to a heavy brass chain; the doors will be faced with steel of the same thickness as the bulkhead. All as approved.

133. PETTY OFFICERS' STATEROOMS.

There will be five of these rooms—two in the forward deck house, two on the starboard side of the main deck forward, and one in the starboard after corner of the crew space on berth deck. These rooms, together with the number of berths to be installed in each, are shown on the plans.

The berths will be of galvanized-iron pipe, and so constructed that that they may be readily removed and replaced. A bottom of No. 1 cotton canvas will be fitted in each berth and secured with lashings, and a spare bottom will be furnished for each. Drawers with fronts and tops of galvanized steel will be fitted under each lower berth. All as approved.

Each stateroom, except the forward one on the main deck, will be fitted with a lavatory, ewer, towel racks, soap dishes and holders, glass holders, and a French plate glass mirror (beveled, about 14 by 16 inches in the clear, in a 2-inch quartered sycamore frame), all as described under "Plumbing Fixtures," and each room will have the necessary shelves and coat and hat hooks. The waste from the lavatories will drain into receivers, or overboard, as provided under "Plumbing Fixtures." There will be a clothes locker in each room; it will have a shelf near the top, and coat and hat hooks will be placed in it as directed.

Those staterooms extending to the ship's side will be ceiled on the framing line as described for the wardroom staterooms; those in the forward deck house will be ceiled as described under "Forward Deck House."

The spaces between the beams over fore-and-aft bulkheads of the staterooms on the main and berth decks will be fitted with grill work of galvanized expanded metal, and similar grill work will be fitted in the upper panels of the ash door to each of these rooms. The staterooms in the forward deck house will be ventilated as provided in Article No. 53. Decking will be worked in these rooms.

134. LAMP ROOM.

The lamp room will be arranged for the stowage and care of running lights, lamps, lanterns, etc., and fitted with galvanized-iron shelves, waste locker, drawers, cleaning table, etc., in accordance with the standard type plan, which will be furnished the contractor. Galvanized iron tanks to hold 60 gallons of kerosene, 10 gallons of binnacle oil, and 20 gallons of lard oil, will be furnished and installed in this compartment; the tanks will be fitted with brass lock cocks and name plates, galvanized-iron drip pans, etc., complete. The 60-gallon tank will be fitted with a galvanized-iron filling pipe to spar deck, with a composition screw deck plate, with name, on that deck, and with a suitable vent. No ceiling or decking will be worked in this room, but the plating must be calked oil tight. A galvanized steel folding mat of approved type will be fitted to cover the clear deck space.

Plating of 7.5 pounds will be worked on spar deck over this room.

The door will be of steel.

135. CARPENTER'S LOCKER.

This will be located where shown on plans. It will be fitted with shelves, drawers, lockers, hooks, and racks complete for the purpose and as directed. No ceiling will be worked in this room, but an ash grating will be fitted on the deck. The woodwork will be of white

ash, smoothed, finished, and varnished. The door will be as specified in Article No. 129.

136. CARPENTER'S WORKBENCH.

A carpenter's workbench will be located in the gangway where shown on plans, and will be fitted with vise, drawers, and fittings complete for the purpose intended. The bench will be of white ash, 2 inches thick.

137. BOATSWAIN'S LOCKER.

This locker will be located where shown on plans. It will be fitted with shelves, drawers, and lockers of white ash, and with hooks, as directed. No ceiling or decking will be worked in this room. The woodwork will be smoothed, finished, and varnished, as directed. The door will be as specified in Article No. 129.

138. PAINT LOCKER.

The paint locker will be fitted with shelving of 5-pound steel plates, galvanized, flanged for nose pieces, and fitted with removable metal battens; there will be provided one drawer 8 inches deep and 4 feet long (with partition) under shelves, a jack rod with S hooks for paint pots, and four tanks, each of 75-gallons' capacity, for boiled oil, raw oil, turpentine, and storm oil. The tanks will be made of No. 11 United States standard gauge galvanized iron, and fitted with 1-inch brass lock cocks, filling pipes, air vents, hand-holes, and drip pans, and must be well secured in place. The capacity of each tank and the name of the oil for which it is intended will be marked on a composition plate secured to outside of tank, the name of the oil to be marked, also, on the composition deck plate to filling pipe on spar deck. No ceiling or decking will be worked in this room.

The door will be of steel.

139. SAND LOCKER.

A portable sand locker, of 7.5-pound plating and 2½ by 2½ inches of 5-pound angle bars, of size indicated on plans, will be furnished; the top will be fitted with a hinged cover, arranged to fasten closed or open, and the bottom with a sliding shutter. The locker will be kept sufficiently above the deck planking to allow of draining into a bucket. It will be securely fastened in the place indicated by galvanized-iron straps and clips.

140. OILSKIN LOCKER.

This locker will be located where shown on plans, and fitted with numbered brass hooks for 50 men. Neither ceiling nor decking will be worked in this room. The door will be of ash, and constructed as specified in Article No. 129.

141. ROOM FOR SCRUB-DECK GEAR.

This will be located where shown on plans and fitted with shelves, lockers, and hooks for the stowage of deck-cleaning gear. Shelving and lockers will be of white pine. No ceiling or decking will be worked in this room. The door will be of ash, and constructed as specified in Article No. 129.

142. CREW'S WASH ROOM.

This will be located where shown on plans, and fitted with lavatories, soap dishes, towel rack, and clothes hooks. The lavatories will be as specified under "Plumbing Fixtures." The towel rack will be a ¾-inch galvanized-iron pipe extending the length of the basins. Three French plate, bevel-edge mirrors, about 15 by 12 inches in the clear, with quartered white-oak frames 2 inches wide, will be fitted over basins. The door will be of ash with its upper panels slatted. No ceiling will be worked in this room; the deck plating will be cemented and tiled. Drains as necessary will be fitted.

Two combined heaters and shower baths, Type A, will be fitted in inclosures in this wash room and connected to the salt-water flushing system. These inclosures will have coaming plates 10 inches high, of 10. 2-pound plating, with 3½ by 2½ inches of 7.2-pound angle bars to deck, and will be made thoroughly water-tight and fitted with drains. The partition plates will be of 5-pound plating, connected to stiffeners on bulkhead and extending to under side of spar-deck beams; the edges and the corners will be stiffened by galvanized split pipe 1 inch. The doors to these inclosures will be of hardwood of slatted type, as approved.

Two faucets for bucket use will be provided in this room and connected to the discharges from the shower heaters.

143. CREW'S WATER-CLOSET.

This will be fitted with water-closet, paper holders, and urinal, as specified under "Plumbing Fixtures." A grab rod of ¾-inch galvanized-iron pipe, with flanges for securing same to bulkhead, will be fitted over urinal. Neither ceiling nor wood decking will be worked in the room; vitreous tiling will be laid on the deck plating. Drains will be fitted as approved.

The door will be of ash, with upper panels slatted.

144. WARRANT OFFICERS' WATER-CLOSET.

This will be fitted with a water-closet as described under "Plumbing Fixtures," and with coat hooks and paper holder. A grab rod of ¾-inch galvanized iron pipe will be fitted where and as directed. Vitreous tiling will be laid in the room, which will be satisfactorily scuppered. The door will be of ash, with upper panels slatted.

No ceiling will be worked in this inclosure.

145. WARRANT OFFICERS' SHOWER INCLOSURE.

This will be fitted with a combined heater and shower bath, Type A, navy standard, connected to the salt-water flushing system. It will have a water-tight coaming in front of 10. 2-pound plate 10 inches high, connected to deck as described for shower inclosures in crew's wash room. The dressing room (entrance to shower inclosure) will be provided with a folding seat of hard wood, and with coat hooks, and will be separated from the shower inclosure proper by a latticed swinging door of hardwood. A grab rod will be placed in shower inclosure.

No ceiling or decking will be worked in the room, but the floor will be tiled and scuppered, and an ash grating fitted in the dressing room.

The door to this compartment will be of ash, with upper panels slatted.

146. SCUTTLE BUTT.

A sanitary scuttle butt of the general type used in the United States Navy will be furnished and fitted where shown on plan; it will be made of No. 11 B. W. G. galvanized steel plate properly stiffened, the bottom to be flanged to the side, an angle ring to be worked around the upper edge, to which a top of 7. 5-pound plating, properly stiffened and having a rubber gasket will be bolted or otherwise connected as approved to make the same water-tight. This scuttle butt will be so supported that it may be lowered clear of the cooling coil for the purpose of cleaning and without disturbing the coil. It shall be fitted complete with the necessary supply, overflow, air, and drain pipes, all of which will be of galvanized iron; the drain pipe will be led to the feed and filter tank in the engine room and made water-tight where it passes through bulkheads and decks. A heavy cast-iron, brass-lined lift and force hand pump will be fitted on the main deck alongside of the scuttle butt and connected to the fresh-water tanks; it will be arranged to discharge into the scuttle butt, and also through the nozzle of the pump, valves being placed in the discharge for this purpose; the pump will be as approved. The scuttle butt, a plan of which showing the general type will be furnished by the Government, will be of approximately 70 gallons capacity; the detail working plan, including the supports, will be furnished by the contractor for approval. The supports will be galvanized.

147. WARRANT OFFICERS' QUARTERS, OR STEERAGE.

Quarters for warrant officers will be located on after part of forward berth deck and arranged as shown on plans.

All bulkheads in these quarters will be of metal of the same weight, and fitted in the same manner, as those forming wardroom staterooms.

Sliding doors of clear white pine, the upper panels of which will be formed of ¼-inch flat iron grill work, galvanized, secured in channel-bar frames, will be fitted to staterooms.

Each stateroom will be fitted with one berth, with drawers under, as approved. Each will also be fitted with a clothes locker having a boot locker underneath, rack for glass and toilet articles, French plate mir-

ror, lavatory, ewer, waste tank, soap dish and holder, metal towel rack, clothes hooks, shelves, etc., as directed. The mirror will be of the same size and style and framed in the same manner as those in wardroom staterooms, except that the wood is to be of quartered sycamore; the soap dish and holder and the towel rack will be of heavy brass, nickel plated. A suitable shelf for shaving and toilet articles will be fitted under the mirror.

Ceiling as specified for wardroom staterooms will be worked on the framing line, above the berths.

The mess room or steerage country will be furnished with a table, a chiffonier, a dish rack, and a dresser, the latter to be fitted with drawers and lockers as approved. The table will be of the extension type, of clear white ash, of substantial make, 3 feet 6 inches square when closed and 9 feet long when extended, the extension leaves to be furnished. The berth fronts, clothes lockers, chiffonier, dish rack, dresser, and glass and toilet rack will be of quartered sycamore, varnished and rubbed down. All hardware will be of brass or solid bronze.

The door leading to the crew space will be of white pine, with solid panels.

148. CREW SPACE.

This will be located on the forward berth deck and arranged as shown on plans. Forward of the petty officers' stateroom and the issuing room it will be ceiled on the framing line with yellow-pine battens 1¼ by 3 inches, spaced 3 inches apart, beveled on edges and secured to reverse bars by galvanized-iron bolts and nuts as approved; the battens must be painted on all sides before being secured in place.

There will be furnished and fitted in this space 48 galvanized-iron pipe-berths, folding, in tiers of three, located and arranged as shown on plans. Each berth is to be fitted with two bottoms of No. 1 cotton canvas as provided for staterooms of petty officers. Under each lower berth at the sides of the vessel a seat of clear white ash will be fitted; three drawers of galvanized steel will be fitted under each of these berths, each drawer to have lock and pulls of brass. In addition to the above, galvanized-steel lockers, or drawers, with brass locks and pulls, for 18 men, will be built where shown on plans and as approved.

149. TABLES AND BENCHES FOR CREW.

Swinging tables, and benches, of ash, finished in hard oil, will be furnished for a crew of 65 men. The tables will be hinged lengthwise in the center, secured when open with slip bolts, and have lanyards and eyebolts for swinging; the fittings will be of composition and the lanyards of flexible galvanized-iron wire rope. Legs of the benches will be hinged, and secured when open with galvanized-iron braces. Galvanized-iron hinged supports will be fitted between the deck beams for stowing these tables and benches. Hinged serving tables of 1½-inch white ash will be fitted where shown on plans. Hammock hooks for swinging the tables will be located in the beams where directed.

150. ISSUING ROOM.

An issuing room will be located where shown on plans and fitted with shelves, lockers, and hooks, and with issuing cans or receptacles for sugar, coffee, rice, peas, and beans. The cans will be of No. 22 galvanized iron of substantial make, with rolled and soldered joints and close-fitting galvanized-iron covers, and with a sliding valve in bottom of each; each will have a brass name plate. The shelves and lockers will be of clear white ash, finished in hard oil. Portable battens working in galvanized-iron clips will be fitted in front of shelves; the cans will be secured by metal straps. The details and arrangement of cans and lockers will be in accordance with standard plans. All hardware will be of brass. Ceiling similar to that provided for the crew space—portable battens—and similarly secured will be worked on the framing line.

The door to this room will be similar to that provided for the petty officers' stateroom on the berth deck. The bulkheads will be of metal.

151. CREW'S STOREROOM.

The crew's storeroom will be located where shown on plans and fitted with lockers, shelves, and hooks; each shelf will have a portable batten, as in the issuing room. The woodwork will be of seasoned white ash, finished in hard oil.

The door will be as specified for that of the petty officers' stateroom on the berth deck. The bulkheads will be of metal.

152. DITTY-BOXES.

Ditty-boxes, or lockers, 48 in number, of galvanized steel, will be furnished and located where shown on plans. Each will have a Yale lock, a number-plate, and hinges, all of brass.

153. MESS-GEAR LOCKER.

The forward compartment on the berth deck will be fitted with shelves, lockers, racks, and hooks for the mess gear. The sides of the vessel will be thoroughly cork-painted, and portable battens, similar to those provided for the crew space, will be worked on the framing line. The shelves (with their nose pieces and battens), faces of racks, and fronts of lockers shall be of clear white ash finished in hard oil; the other woodwork, except the ceiling, will be of clear white pine. No decking will be laid in the compartment. The door will be of steel and made to close water-tight.

154. CABIN AND WARDROOM STOREROOMS.

These will be located on after berth deck where shown on plans and will be fitted with shelves, bins, and hooks, complete for the purpose intended, and as directed, the shelving to be of seasoned white ash, oiled. Portable battens working in galvanized-iron clips, and nosings, will be fitted in front of shelves. The side of the vessel in the rooms

will be thoroughly covered with cork paint. Removable yellow-pine battens 4 by 1½ inches, spaced 3 inches apart, will be worked over the steel work and secured to clips on frames and stiffeners.

The doors will be as specified for engineer's office.

155. PRISON.

The prison will be located where shown on plans. The door will be of steel. Three brass louver valves will be fitted in door and inboard bulkhead for ventilation, as directed; these valves and the air port will be protected by strong, fine, brass mesh. Galvanized-iron ring-bolts will be fitted where directed. The side of the vessel will be cork-painted. A heavy prison lock, as approved, will be fitted to the door in a substantial manner, the lock to be attached to a suitable galvanized-iron chain.

The deck plating will be covered by gratings of clear white ash, made in sections.

156. TRUNK ROOM.

This will be located abaft the prison. The side of the vessel in this room will be cork-painted. Portable yellow-pine battens 4 by 1½ inches, spaced 3 inches apart, will be worked on the framing line and secured to clips on frames. Shelving and battens of yellow pine for the stowage of trunks will be fitted as directed; slatted gratings will be fitted on the deck under the lower shelves. The door will be as specified for engineer's office.

157. HAWSER ROOM.

The space in the after end of the after berth deck will be fitted up, as approved, with shelves for the stowage of hawsers and lines. Portable slatted gratings of yellow pine, painted with rug-red navy deck paint, will be fitted on the flat of this room. The sides of the vessel will be thoroughly covered with cork paint and fitted with battens on the framing line as specified in Article No. 156. Similar battens will be fitted on the bulkhead.

A steel-plate deck pipe will lead from this room to the spar deck, where it will be fitted with a galvanized cast-iron deck ring and water-tight cover. The upper and lower ends of this pipe will be furnished with an approved method for preventing the chafe of hawsers, and the upper end shall be arranged to take a cowl of galvanized iron which will project about 5 feet above the deck; the cowl will be so constructed that it may be secured water-tight to the pipe, permit of being turned and clamped in any direction, and stand perpendicular. Stowage shall be provided for this cowl and for the cover when not in use.

The door will be of steel and made to close water-tight.

158. FORE AND MAIN HOLDS.

These holds will be provided with platforms, shelves, lumber irons of galvanized iron, and galvanized-iron rails for blocks, as approved. The platforms in main hold will be approximately 5 feet 6 inches above

top of floors amidships and will extend throughout the length of the hold on both sides of main hatch; they will be formed of 4 by 3 inch 8.5-pound angle bars bracketed to frames and well stanchioned and covered with 6 by 2 inch yellow-pine slats about 2 inches apart, secured in place with galvanized-iron carriage bolts and nuts. The platforms in forehold will extend fore and aft on each side of the hatch and will be constructed in a manner similar to the platforms in the main hold; above and below these platforms shelves with nosings and portable battens in front and with partial partitions will be fitted as approved; two athwartship shelves with nosings, battens, and partial partitions will be fitted on the after bulkhead. A locker for lamp chimneys, electric lamps, etc., will be constructed in the forehold.

The sides of the vessel above the turn of the bilges in these holds will be thoroughly cork-painted.

All piping along the bottoms of the holds will be protected with stout boxing made in removable sections.

Portable iron ladders will be fitted for access to the holds, and galvanized-iron hand grips will be provided in convenient places on the deck above.

The ceiling in holds and in all storerooms below the berth deck, where not otherwise specially described, will be yellow-pine battens 1½ inches thick by 4 inches wide and spaced sufficiently far apart to admit of cleaning and painting the frames and plating behind them; it will be secured to the reverse bars with ½-inch galvanized-iron carriage bolts and nuts. Battens will also be placed on bulkheads to holds and storerooms as may be directed and secured with clips. In the holds on top of the floors, and extending to the turn of the bilge, ceiling of 1¼-inch tongued and grooved yellow pine, doubled and made in portable sections, will be fitted; each section of this ceiling will have two battens secured on underside with galvanized-iron carriage bolts and nuts, and will be fitted with sunken handles.

All ceiling, battens, furring strips, etc., must be thoroughly painted on all sides.

159. GRATINGS, MATS, AND SAFETY TREADS.

Portable white-ash gratings will be fitted on bridge and in pilot house, prison, carpenter's locker, entrance to warrant officers' shower inclosure, to all hatches on forward main and berth decks, to the hatch to the after berth deck, and in front of entrances to booby hatches on spar deck. In hawser room, bread room, sail room, and trunk room portable gratings of yellow pine of the slat type will be fitted. All gratings will be made in the best manner, as approved, and those for rooms and for the bridge will cover the working floor space of each, respectively.

Galvanized-steel folding mats of approved make will be fitted in galley, machine shop, and lamp room. These mats shall cover the entire working floor space of these rooms.

Leadman's gratings will be fitted. (See Article No. 109.)

Mason's brass safety treads will be fitted on spar deck outside all doorways, outside of doorways (not to exceed 14) on main deck, and at tops and bottoms of ladders, and also at the bottoms of ladders on berth deck, the length and width of the safety treads to be as approved.

Brass corrugated gratings will be placed at gangways, as specified in Article No. 80.

160. HAMMOCK HOOKS.

Hammock hooks of wrought iron, galvanized, and made in accordance with standard plans, for slinging about 50 hammocks, will be fitted to beams under spar deck and numbered as directed; six sets of hooks of similar design, but of brass, for cots, will be placed in cabin, wardroom, and steerage, two sets in each compartment.

161. PLUMBING FIXTURES.

All plumbing fixtures shall be of the highest grade. A full descriptive list, giving cuts showing all fixtures and fittings, with manufacturer's name and catalogue number of each article, will be submitted for approval. When "Navy Standard" articles are specified, they are to conform to United States Navy specifications for plumbing fixtures, dated 1905.

Bath tubs.—Three iron, porcelain-lined, under-roll rim bath tubs, 5 feet long and 2 feet 6 inches wide over the rims, will be furnished and located in cabin and wardroom bath rooms, efficiently secured and fitted with all necessary fixtures, pipes, drains, traps, cocks, plugs, portable seats, soap trays, sponge racks, etc. A "Navy Standard, Type A" heater with tubular shower will be attached and connected to each tub, with all necessary valves, cocks, curtain, and fixtures, etc. The water supply will be from the fresh and salt water service and connected through the heaters.

A tubular heater, navy standard, connected with the fresh-water supply, will be fitted to sink in the dispensary.

Four combined heaters and showers, as above described, but without curtains, and connected with the salt-water supply only, will be fitted in the wash rooms of warrant officers, firemen, and crew.

Water-closets.—The water-closets for cabin and wardroom will be of siphon-jet type of extra heavy vitro-adamant, fitted with heavy copper, time-flush tanks, made water-tight, incased in quartered white oak, and have valves in supply pipes. "Sanitor" seats and covers of polished quartered white-oak finish, reenforced, and heavy, broad, nickel-plated brass hinges, and fitted with stops to hold covers and seats when raised, will be furnished.

The water-closet for warrant officers will be a heavily enameled, cast-iron, flushing rim hopper, with polished quartered white-oak finish "Sanitor" seat, reenforced, having heavy, broad, nickel-plated brass hinges, and fitted with stop to hold seat when raised. The flushing will be continuous, and a valve will be fitted in the supply pipe.

All the above closets will be fitted with heavy, galvanized-iron floor plates, well bedded in red and white lead, and all joints well red-leaded to assure absolute tightness.

The water-closet for crew will be a heavily-enameled, wash-out range, with three protable, reenforced "Sanitor" seats, ash finish, galvanized-iron partitions, and heavy, galvanized-iron supporting brackets. The flushing arrangement will consist of a 1½-inch brass pipe, perforated on underside and running all around the top of the range under the covers, and connected to flushing pipes at each end. A brass cock will be fitted in each branch of the flushing pipe, and so arranged that it can be opened or closed with a key wrench only. The discharge pipe will be located at after end.

All of the above-mentioned closets will be flushed from the salt-water sanitary system with brass piping led from the pump in engine room, as approved.

Urinal.—The urinal for crew will be a heavily-enameled, lipped urinal, with high back, fitted with a perforated brass flushing pipe extending its entire length, connected to the salt-water sanitary system, and having a key-socket brass cock.

Lavatories.—The lavatories in cabin and wardroom bath rooms will be heavy, all porcelain (vitreous-glazed), with integral back and apron, and supported on enameled-iron brackets. They will be connected to the fresh-water pressure system, and fitted with heavy, nickel-plated, self-closing faucets, chains, stays, rubber stoppers, supply and waste pipes and traps, nickel plated where exposed, and arranged to drain overboard.

The lavatories for wardroom staterooms will be of cast iron, heavily porcelain-enameled, with integral back, apron, and sides, suitable for the locations as shown, and each fitted with nickel-plated soap dish, chain and stay, and rubber stopper. Waste pipes will be of galvanized iron, with brass traps, and arranged to drain overboard. Ewers will be of "navy standard" with monogram of letters "U.S.R.C.S." in blue, as approved, and fitted with heavy brass nickel-plated rings of same standard.

Warrant officers' and petty officers' staterooms will be fitted with cast-iron, heavily porcelain-enameled lavatories, with integral back, apron, and sides, to suit locations shown, each fitted with nickel-plated soap dish, chain and stay, and rubber stopper. Waste from lavatories in rooms below the main deck will be led into galvanized-iron receivers of about 14 quarts capacity each, with handles, and supported in galvanized-iron frames; the lavatories in the other rooms will be arranged to drain overboard. Ewers will be of "navy standard," as specified for wardroom.

The lavatories for firemen's and crew's wash rooms will be of the sectional type of cast iron, heavily porcelain-enameled, each with back, oval basin 14 by 11 inches, nickel-plated, heavy, brass, self-closing faucet, chain and stay, and soap cup, rubber stopper, galvanized-iron brackets, brass trap, and galvanized-iron waste pipe led overboard. They will be connected to the salt-water pressure system. There will be in each of these rooms, also, a brass self-closing faucet

connected to the fresh-water pressure system and located conveniently for drawing water into buckets, a locked valve to be located in the branch pipe outside of each wash room.

The lavatory in engine room will be located where directed and will be similar to those described for warrant officers, excepting that the supply will be connected to the fresh-water pressure system and will be fitted with a brass, nickel-plated, self-closing faucet.

The lavatory for emergency cabin will be as described in Article No. 55.

Toilet accessories.—Paper holders, metal towel racks, tumbler holders, toothbrush holders, soap-dish holders, sponge holders, comb and brush racks, etc., will be of heavy brass, nickel-plated; soap dishes and brush cups will be of porcelain, with the Service monogram, "U.S.R. C.S.," in blue.

Toilet and glass racks for warrant officers' and petty officers' staterooms will be of quartered sycamore.

Sinks.—Sinks will be 30 by 20 by 12 inches deep in galley, and in cabin and wardroom pantries, and 20 by 16 by 12 inches deep in dispensary, of cast iron, enameled inside and fitted with brass faucets (nickel-plated in dispensary) and strainers, enameled-iron dish drains, galvanized-iron piping, approved traps, etc., complete. Salt water will be led to all sinks excepting that in the dispensary, which will be connected with the fresh-water pressure system through a "navy standard" heater; steam for heating the water will he led into each sink. Two sinks will be fitted in galley, and one each in cabin and wardroom pantries and in dispensary.

Hand pumps.—Two brass-lined hand-lift pumps of approved make will be fitted in galley and connected, one with the sea and the other with the forward fresh-water tanks. They will have revolving stands and detachable bolted bases; their strokes will be $6\frac{3}{4}$ inches, cylinders $2\frac{3}{4}$ inches, and suction pipes $1\frac{1}{2}$ inches, inside diameter. All water-supply pipes will be of galvanized iron of ample size. There will be a hand lift and force pump near the scuttle butt, as described under "Scuttle Butt."

Brass fittings, such as traps, standing wastes, valves, faucets, cocks, and similar fittings will be of heavy pattern; brass piping and fittings will be in every case equal in thickness to standard iron pipe sizes of the same cross-sectional area of opening. Faucets are to be of polished brass with rabbit ears or star handles of the self-closing type, and with plain bibbs or screw ends for hose as required. Shanks in all cases will be threaded to suit iron pipe sizes. Faucets for bucket use in wash rooms shall have threaded ends for attachment of hose.

162. PIPING AND DRAINS.

Exposed fresh-water supply pipes to cabin and wardroom bath tubs and lavatories will be of brass, nickel-plated; all other fresh-water supply pipes will be of wrought iron, galvanized.

All salt-water supply pipes to baths, showers, basins, sinks, water-closets, urinals, and pumps, and all discharge pipes from the same,

except from water-closets, shall be of heavy, seamless-drawn, brass piping.

Discharge pipes from water-closets shall be of cast iron $\frac{5}{8}$ inch in thickness, or of lead $\frac{1}{4}$ inch in thickness, in the discretion of the contractor; those for cabin, wardroom, and warrant officers' water-closets will be of diameter at top to correspond with the discharge openings at bases of bowls, and 2 inches larger at outboard ends, the diameter increasing uniformly from top to bottom; those from crew's water-closets will be 4 inches in diameter at top and increase uniformly to 6 inches at bottom. All discharge pipes will be led as directly as possible, and discharge just above the water line. An approved cast-iron flap valve, with brass pin, will be fitted to the outboard end of each of these discharge pipes, and each pipe will be fitted at the bend with a plug for cleaning out the same. An air pipe will be fitted to the discharge of each individual water-closet and led as directed.

All floor drains, and drains from windlass, etc., will be of heavy galvanized iron piping.

Traps will be fitted to the drains from all sinks, lavatories, bath tubs, etc.

Provision will be made for draining all pipes, pumps, and tanks.

All drains from bath tubs and lavatories (except lavatories in staterooms on berth deck), sinks, closets, etc., will be led overboard through the side of the vessel, just above load-water line.

Where openings are cut in the side of the vessel for discharge pipes, drains, slop chutes, etc., wrought-iron reenforcing rings will be riveted to the hull plating, and wrought-iron lips, flush-riveted, will be worked around the underside of each opening to throw the discharge clear of the ship's side.

All piping will be led close to bulkheads and to the side of the vessel, and kept as much out of the way as possible. Brass unions will be fitted where directed to permit of the piping being taken down and cleaned when required.

Piping passing through water-tight bulkheads will be fitted with composition stuffing boxes of approved type.

All water-service pipes will be covered with asbestos sectional pipe covering where necessary to prevent condensation.

The sizes of pipe connections will be about as follows:

Supply.—Bath tubs and shower baths, $\frac{3}{4}$ inch; lavatories, $\frac{3}{4}$ inch, reduced to $\frac{1}{2}$ inch at connections to faucets; sinks, $\frac{1}{2}$ inch; individual water-closets, $1\frac{1}{2}$ inches; crew's water-closets, $1\frac{1}{2}$ inches; urinal, $1\frac{1}{4}$ inches.

Waste.—Bath tubs, 2 inches; water-closets (see paragraph 3 of this article); individual lavatories, $1\frac{1}{2}$ inches; crew's lavatories, 2 inches; sinks, $1\frac{1}{2}$ inches; urinal, $1\frac{1}{2}$ inches. Where two or more discharges run into one pipe the diameter of that pipe shall be increased to $2\frac{1}{2}$ inches, or more, as necessary.

163. FRESH-WATER SERVICE.

The pump for this service will be as described in the machinery specifications, and will be secured on a suitable foundation of plates and angles. From it a system of pipes will be led to the lavatories in cabin and wardroom bath rooms and engine room, to cabin and wardroom bath tubs and showers, to firemen's wash room, to crew's wash room, to sink in dispensary, and to the boiler over range in galley.

The suction from fresh-water tanks will be 2 inches in diameter, and the main discharge pipe 1¼ inches, all of heavy galvanized iron pipe.

164. STEERING ARRANGEMENTS.

The steam steering engine will be subject to the approval of the Engineer in Chief. It will be of compact and approved design and capable of putting the rudder hard over from port to starboard, or vice versa, with a working steam pressure of 100 pounds per square inch, in twenty seconds when the vessel is moving ahead at full speed. It must have sufficient strength, however, to withstand operation under full boiler pressure.

A quadrant, built up of wrought-steel shapes, and made so as to be taken apart at any time for repairs, will be worked on the rudder stock under the main-deck beams, as shown on plans. It will be connected to the steam steering engine by steel-wire ropes and chains, as approved. These connections will be protected by 2-inch galvanized iron pipes, fitted in one length between bulkheads, and so secured as to be easily and quickly removed, and with brass sheave fair-leaders. A 1-inch section will be taken out of the tops of these pipes, and a hole, as directed, drilled through the under side in each compartment. The connections must be kept well off the shells of blocks and fair upon their sheaves by special fair-leaders. All sheaves will be as large as practicable, and so arranged that they may be easily overhauled and oiled.

A composition steering stand of approved design, with steering wheel of hard wood, brass-mounted, and fitted to operate the steam steering engine by means of an approved telemotor with copper pipe connections, will be fitted in pilot house.

The steering gear will be adjusted for a maximum rudder angle of 37°, care being taken in the design that when the rudder is hard over against the stops at 40° no damage will result by the bringing up of the parts. The gear throughout must be of most approved type and capable of withstanding the stresses incident to the turning tests before mentioned.

Indicators will be fitted to show when the helm is hard over.

A spare tiller of wrought-iron of suitable size, and fitted to ship over the rudder stock through an opening made in the spar deck over the same for the purpose, will be furnished; when the tiller is not in use, the opening will be closed water-tight by a composition deck plate and ring. The tiller will be provided with suitable relieving tackles, with leads to steam capstan. Stowage for the tiller when not in use will be arranged.

165. ANCHORS AND CHAINS.

Two cast-steel bower anchors of the stockless type, as approved, each to weigh 2,600 pounds, and two 1½-inch stud-link chain cables of 120 fathoms each, will be furnished. There will also be furnished one stocked anchor of 600 pounds and one of 300 pounds, exclusive of weight of stock in each case, to be stowed where directed and properly secured. The anchors and chains will be tested before an officer detailed for the purpose, the former in accordance with United States Navy specifications of June 1, 1899, and the latter in accordance with the rules of the American Bureau of Shipping. Each shot of chain must be tested as a whole, and after testing must pass inspection. The chains must not be tarred, but will be painted as directed. They must fit the wild-cats perfectly. Each cable will be fitted with two swivels, a shackle at every 15 fathoms, and an anchor shackle at each end; the swivels will be placed at 4 fathoms and 45 fathoms from the anchor in each cable, the shot next the anchor to be cut for the purpose. Two spare chain shackles, one spare swivel, one spare anchor shackle, and eight galvanized-iron chain hooks will also be furnished. All will be as approved.

166. SPEAKING TUBES.

Separate and direct speaking tubes will be run from the pilot house to the captain's stateroom, cabin desk, engine room, wireless-telegraph room, galley, and executive officer's room; from the engine room to the senior engineer officer's stateroom and fireroom; from the spar deck to the windlass engine, and from the wireless-telegraph room to the captain's stateroom and the emergency cabin. The tubes will be of seamless-drawn brass, 1¼ inches inside diameter, and not less than No. 20 B. G. W., with approved mouthpieces, whistles, stopcocks, etc., on ends. The mouthpieces shall be connected to short flexible tubes where required. All mouthpieces and pipes will be plainly marked on brass plates. The tubes will be suitably incased where necessary.

167. MECHANICAL TELEGRAPHS AND BELL PULLS.

A repeating mechanical telegraph of approved make will be fitted on each end of bridge and in pilot house, and connected to a repeater in engine room. The telegraph in engine room will be located where directed by the Engineer in Chief, United States Revenue-Cutter Service. The dials of bridge and pilot-house telegraphs shall be of porcelain, electrically lighted, and of engine-room telegraph of polished brass, all suitably engraved and marked to indicate slow, half, three-quarters, and full speed ahead and astern, the engraving to be enameled black on "Ahead" and "Stop" divisions and red on the "Back" divisions, the telegraphs to be so located that pointers and repeating levers will point forward for "Ahead" and aft for "Back." All connections must be as approved, and all wires protected.

Bell pulls will be fitted on each end of bridge, in pilot house, and on spar deck aft; they will be of heavy pattern, and connected to gong and jingle in engine room. Bell pulls will also be fitted from spar deck to a gong at windlass engine.

Whistle pulls of material and style as approved will be fitted in pilot house and on each end of bridge.

All wires will be of heavy bronze, with composition chain and brass sheaves at turns, and run in brass tubing. All will be fitted and located as approved.

A return sound tube of brass will be fitted from the engine room to pilot house.

168. ELECTRIC CALL-BELL SYSTEM.

Annunciators will be installed and connected up as follows:

One in galley, connected up with pilot house, cabin, cabin pantry, wardroom, wardroom pantry, and steerage; one in cabin pantry, connected up with cabin, cabin staterooms, cabin bath rooms, emergency cabin, and galley, and one in wardroom pantry, connected up with wardroom, wardroom staterooms, wardroom bath room, wardroom toilet, executive officer's office, chief engineer's office, and galley. These annunciators will be of standard marine type equal to the best made, and as selected.

A 4-inch quartermaster's bell, with brass skeleton frame, will be provided and secured to underside of bridge and connected up with captain's stateroom, cabin, wardroom, wardroom companion, and executive officer's office.

Push buttons and pear drops of approved pattern as selected will be furnished, located, and connected up where directed; each will be suitably marked.

The battery for this system will consist of cells of type and pattern as selected, and in number as necessary for efficient service.

The wires will be of navy standard, not less than No. 16 gauge, and run in cables in galvanized-iron pipe conduits, as directed.

169. GENERAL-ALARM SYSTEM.

A general-alarm system will be installed in the best manner and as approved.

The battery will consist of cells of type and pattern as selected, and in such number as may be necessary to sound a loud alarm. The gongs will be vibrating, 10 inches, water-tight, and operated by push buttons. The wires will be navy standard, not less than No. 16 gauge, and run in galvanized-iron pipe conduits, as directed. A gong will be located in each of the following places: Cabin, wardroom, engine room, on main deck forward, and in crew space on berth deck, and will be operated from pilot house, cabin, wardroom, wardroom companion, and steerage, the push buttons to be protected by pivoting caps, each to have a brass name-plate, and each to operate all gongs.

170. MISCELLANEOUS.

Shelves.—All shelves shall have nosings and removable battens, the latter to work in galvanized iron clips where directed.

Primers.—Shelves and lock straps for the stowage of not to exceed 20 dry gun-cotton primers shall be provided and located where directed.

Lumber irons.—Galvanized-iron lumber irons, as approved, not to exceed 8 sets, shall be fitted to beams where directed.

Pad eyes and eyebolts.—Pad eyes and eyebolts will be placed in the gangways and forward on the main deck as required.

[See pages 75–83 for complete specifications for wiring and fixtures of electric-lighting plant, signaling apparatus, and searchlights.]

SPECIFICATIONS

FOR WIRING AND FIXTURES

OF AN

ELECTRIC-LIGHTING PLANT

WITH

SIGNALING APPARATUS AND
SEARCHLIGHTS

FOR

REVENUE CUTTER No. 22

AND

REVENUE CUTTER No. 23.

SPECIFICATIONS FOR WIRING AND FIXTURES OF ELECTRIC-LIGHTING PLANTS, WITH SIGNALING APPARATUS AND SEARCHLIGHTS, FOR REVENUE CUTTERS NOS. 22 AND 23.

SECTION A. ELECTRIC LIGHTS, GENERAL INSTALLATION.

The following will be furnished:

Electric fixtures, with the necessary incandescent lamps; one 18-inch searchlight with spare parts; one 24-inch searchlight, with spare parts; one night-signaling apparatus, with keyboard and spare parts; one masthead light; two side lights; one anchor light; one stern light; one range light; one towing light; binnacle lights; hand portable lights; two cargo clusters, with reflectors, complete; and magazine lights for ammunition and ordnance storerooms. Also the necessary switches, fuses, etc., as may be required for the efficient installation, operation, and control of the various circuits, as hereinafter described, together with the necessary wire, wiring appliances and accessories, conduit tubes and fittings, fixtures, lamps, spare parts, and stores usually furnished for the proper manipulation, test, and repair of an electric plant of the navy standard type.

The contractor will submit a drawing, showing the general arrangement and location of all the various parts of the electrical installation herein specified, to the Superintendent of Construction and Repair, for his approval, before work is commenced on the same. It is to be understood that the work of installation of the electric-lighting plant will be carried on simultaneously with the work of construction of the vessel, and without interfering with the same in any way, to the end that, when the vessel shall be completed, the electric-lighting plant will be completed also and ready for operation.

SECTION B. WIRING.

All wires used in the various circuits will be of soft annealed pure copper, evenly tinned, having a conductivity of not less than 98 per cent of pure copper for single strands and of not less than 95 per cent for finished stranded cables, when compared with pure copper of an equal cross section in circular mils.

All wires will be thoroughly insulated, as follows:

For single lighting conductors.—First. A layer of Para rubber, not less than $\frac{1}{64}$ inch in thickness, rolled on. Second. A layer of vulcanized

rubber. Third. A layer of cotton tape. Fourth. A close braid of No. 20 two-ply cotton thread, braided with three ends for all conductors under 60,000 circular mils, and of No. 16 three-ply cotton thread, braided with four ends for all conductors over 60,000 circular mils.

For twin conductors.—First. A layer of Para rubber, not less than $\frac{1}{64}$ inch in thickness, rolled on. Second. A layer of vulcanized rubber. Third. A layer of cotton tape.

Two such conductors shall be laid together, the interstices being filled with jute and covered with two layers of close braid, each braid to be of No. 20 two-ply cotton thread, braided with three ends.

SECTION C. WIRING SYSTEM.

The wiring of the vessel will be on the two-wire feeder system, run in approved galvanized metallic conduits throughout, and for masthead light, side lights, gangway lights, stern light, towing light, and range light, to receptacles for attachment of cargo clusters or hand portables, and shall be made water-tight.

SECTION D. SIZES OF WIRES.

The cross section of wires shall be so calculated that in no case will the current in the feeders, mains, or branches exceed 1 ampere per 1,000 circular mils. The maximum load for any feeder shall never exceed 75 amperes.

No single-wire conductors shall be used, except No. 14 Brown & Sharpe gauge; when greater conducting area is required the conductor shall be stranded in a series of 7, 19, 37, 61, 97, or 127 wires, the strand consisting of one central wire, the remainder being laid around it concentrically, each layer to be twisted in the opposite direction from the preceding, and all single wires forming the strand must be of the diameter given in the American wire-gauge table as adopted by the American Institute of Electrical Engineers. The feeders for the searchlight will be of 19 strands of No. 18 Brown & Sharpe gauge wire, having a cross-sectional area of 30,856 circular mils. The cable for the night-signaling apparatus will be special, as specified under the paragraph on "Night-Signaling Apparatus."

The size of wire used in all the feeders, mains, and branches shall be calculated in accordance with the preceding rules.

SECTION E. FUSES.

Any reduction in the size of a feeder will be fused unless the fuse which protects the larger-sized wire is small enough to hold the normal current in the smaller wire down to 1 ampere per 1,000 circular mils cross section. There shall be no soldered or other joints in the feeders or mains except those made in standard wiring appliances, such as junction boxes, etc. Whenever mains are led off from feeders it shall be done through junction boxes, fitted with double-pole fuses. The distribution boxes shall be of an approved water-tight pattern, fitted with a slate panel and double-pole quick-break switches, with inclosed fuses, each branch being arranged so as to fuse independently;

all outlets from branches to lights shall be fused. In each stateroom three outlets—two for lights and one for fan—will be installed on the same branch circuit. All fuses shall be of an approved inclosed type; for branches they shall be rated for 3 amperes and to blow at 6 amperes; for feeders and mains they shall be rated at 1 ampere per 1,000 circular mils of cross section of conductor and shall blow at the rate of 1 ampere per 500 circular mils cross section of conductor.

Twenty-five spare fuses of each size used in the feeders, mains, and branches will be furnished, neatly boxed and marked, as directed.

SECTION F. SOLDERING ENDS OF STRANDED CONDUCTORS.

When stranded conductors are clamped under binding screws the strands of wire shall be soldered together, and where directed suitable lugs or terminals will be sweated on. The ends of the dynamo cables and the switchboard ends of all feeders will be sweated in suitable lugs.

SECTION G. STRIPPING WIRE ENDS FOR CONNECTIONS.

When conductors are connected up to fixtures or wiring appliances, the outer tape and braid will be removed, exposing the vulcanized rubber underneath to within $\frac{1}{8}$ inch of the outside of the gland. Special care shall be taken not to cut into or otherwise injure the vulcanized rubber. When the tape and braid are removed for connecting up movable fixtures, the braid ends shall be protected from fraying by whipping the ends of the braid and varnishing.

SECTION H. CONDUITS.

All wires for the feeders, mains, and branches, as above specified, will be installed in approved galvanized metallic conduits, allowing $\frac{1}{4}$ inch clearance to draw the wires in and out. The main generator cables from the dynamos to the switchboards will be run in accordance with engineer's specifications; the cables from the telephotos stand to the lead up the mast will be protected from injury by a flexible lead conduit; the various connections to hand portables, cargo clusters, etc., will be of heavy marine waterproof cable.

All conduits shall be run as directed, and especial care shall be taken when running the same, locating junction boxes, distribution boxes, switches, etc., to see that all are accessible.

Thorough water-tightness will be observed for all the conduit work throughout the vessel, especially for all leads into wiring appliances and fixtures; where a conduit passes through bulkheads or decks, lock nuts with packing shall be used to secure the conduit and make water-tight fits. "Running threads" with half couplings, to act as lock nuts against the full coupling, may be used in lieu of unions when it will facilitate the work of installation, provided the ends that butt together make a good, tight fit.

SECTION J. WIRES IN CONDUITS.

Both positive and negative legs of the same circuit will be led in the same conduit for all conductors below 60,088 circular mils cross section. If any be over 60,088 circular mils cross section, each must be led in a separate conduit, and these two conduits shall be kept as close together as possible throughout the entire length of the run.

No conduits that carry feeders or mains shall be led into locations subject to excessive heat, nor into the coal bunkers, unless especially authorized.

The conduits will be run through the spar-deck beams, and through the beams in living spaces, and elsewhere will be secured to the metal of the ship by stout galvanized metal straps and brass machine screws, spaced at such intervals as will firmly secure them in place.

It is intended that each conduit shall support the wiring appliances which it taps, and to facilitate the installation of these appliances they may be assembled (when possible) with the conduit before putting the latter in place.

SECTION K. WIRING APPLIANCES IN GENERAL.

In general, all the wiring appliances used in the installation of the electric plant will conform to navy standard in all respects. They are junction boxes, switches, distribution boxes, receptacles, combination switches and receptacles, water-tight boxes for attachment of hand portables, side lights, cargo cluster, etc., and consist in general of a composition box, a sheet-brass cover, a sheet-rubber gasket for making the box water-tight, and an interior fitting mounted on a porcelain base. The boxes are to be secured to decks, bulkheads, etc., by means of brass screws sunk in screw wells, or else supported by the run of the conduit, as directed. Boxes and covers shall be drilled to jigs and be interchangeable.

The junction boxes will be of approved sizes and pattern, fitted with covers and gaskets. The interior fittings will be mounted on vitrified-porcelain insulating blocks, and all current-carrying parts of opposite polarity will be separated from each other and from any metal by at least $\frac{1}{8}$ inch.

All switches used in the feeders, mains, and branches at the points of distribution to the minor circuits, lamps, etc., will be of an approved double-pole, quick-break type, mounted on bases of vitrified-porcelain, and inclosed in water-tight switch boxes with approved covers.

Where distribution boxes are used, they will be of approved size and design. They will be fitted with slate fuse-board panels, carrying the bus bars; each branch will be controlled by a double-pole, quick-break switch and protected by inclosed fuses, each arranged to fuse independently of the others. Small brass plates with black-enameled lettering will be mounted as directed to designate the various branches.

The receptacles for the lamps will be of an approved pattern, mounted on porcelain bases, and fitted with snap switch for controlling the lamp. The sockets will be designed to take "Edison" base lamps, as hereinafter specified.

Each water-tight box for attaching the various hand portables, running lights, cargo cluster, etc., will be fitted with cover and gasket and will contain the switch for controlling the light and the attaching-plug socket, both mounted on a vitrified-porcelain base. The boxes will be tapped for the conduit connections, and care shall be taken that all are made water-tight.

SECTION L. ELECTRIC FIXTURES.

Fixtures for 165 lights, exclusive of portables, cargo clusters, magazine lights, and running lights, will be furnished and located where directed. These fixtures will be of navy standard types and material, suitable for the spaces where located, fitted with steam-tight globes where directed, each lamp controlled by an independent switch and subject to the approval of the Superintendent of Construction and Repair.

The electroliers to be fitted in the cabin and wardroom will be of United States Revenue-Cutter Service standard design, having 6 lamps each, made of extra heavy brass castings, with all parts brazed, and fitted with art glass held in place by flanges, but so arranged that new glass may be inserted when necessary. There will be a diffusing plate under the lamps. The lights shall be controlled by a switch through the center of the diffusing plate so arranged that it will operate two of the lights at the same time, thus permitting 2, 4, or 6 lamps to be lighted, and to extinguish all at once. Each electrolier will be steadied by 4 extra heavy brass chain guys. All metal work will have gun-metal finish. Samples of the art glass will be submitted for approval.

The fixtures for the ammunition and ordnance storerooms will be United States Navy standard magazine fixtures, with lamps.

SECTION M. INCANDESCENT LAMPS.

The incandescent lamps, except as otherwise specially provided, will be 16-candlepower for 110 volts, which shall be obtained by an expenditure of not more than 60 watts of energy per lamp. The lamps will have clear, standard pattern bulbs and "Edison" bases and shall all be interchangeable. They shall have a guaranteed life of at least 600 hours.

The lamps for the masthead light, side lights, towing light, range light, stern light, gangway lights, anchor light, cargo clusters, and hand portables shall be 32-candlepower, "Edison" base. The telephotos lamps shall be of the standard pattern as furnished for night-signaling sets.

The lamps for the binnacles and for the mechanical telegraphs will be of 5-candlepower.

A lamp shall be mounted on each receptacle, and in addition there will be furnished, of the same pattern and type as those used in the installation, one hundred 16-candlepower lamps, fifty 32-candlepower lamps, one complete set of telephotos lamps, ten lamps for telephotos

keyboard, and ten lamps each for binnacles and mechanical telegraphs, all to be carefully packed, boxed, and marked as directed.

SECTION N. SEARCHLIGHTS.

There will be two searchlights, one 24-inch and one 18-inch, the former to be installed forward and the latter aft, located and connected up where directed. Except in size and power, as noted, the searchlights shall be similar in all respects, therefore the following specifications will cover both.

The searchlight or projector shall be of the latest and most improved navy type, consisting of a fixed pedestal or base surmounted by a turntable carrying the drum; the base shall contain the electrical connections and be so arranged that it can be bolted securely to the platform. The turntable shall be so designed that it can be revolved freely and indefinitely in either direction or clamped rigid when so desired. The drum shall be trunnioned on two arms bolted to the turntable, so as to have a free movement in a vertical plane of not less than 40° above and 30° below the horizontal and designed so that it may be operated freely by hand from its place of location or clamped rigid when so desired. The drum shall contain the lamp and a 24-inch parabolic reflecting mirror. The drum shall be well ventilated and balanced and fitted with peep sights for observing the arc and with hand-holes to give access to the lamp.

The lamp shall be of the horizontal carbon type and designed for both hand and automatic feed. The feeding of the carbons must be effected by positive mechanical action and not by springs or gravitation. It must burn quietly on a 125-volt circuit in series with a regulating rheostat and shall be capable of burning about six hours without renewing the carbons. The voltage will be about 48 and the amperage about 50 when producing the best arc, in the case of the 24-inch light, and 45 and 35, respectively, for the 18-inch light.

The mirror shall be of the best quality of glass, parabolic, free from flaws and holes, having its surface ground to exact dimensions, perfectly smooth, and highly polished. Its back shall be silvered in the most durable manner, the silvering to be unaffected by heat. It shall be mounted in a separate frame lined with nonconducting material. The lamp shall be so adjusted as to keep the arc at the focus of the reflector.

The front of the drum shall be provided with a glass door, composed of strips of clear plate glass, the door to be arranged so that it can be put into place on the drum easily and quickly.

All parts of the projector shall be finished in dead-black color throughout, except the working parts, which shall be left bright.

The projector shall project a beam of light of sufficient intensity to render plainly discernible on a clear, dark night a light-colored object 10 by 20 feet in size at a distance of not less than 5,500 yards (4,000 yards for the 18-inch reflector).

There shall be furnished with the projector one tool box with wrenches, mounted sight glasses, extra set of peep sights, dust brushes, chamois skin, spare springs for all magnets, contact spring and screw,

and a pair of carbon-holder clamps with screws and washers; also one spare set of glass strips for front door, complete and neatly boxed, and 100 positive and 100 negative carbons packed in round tin boxes and marked.

SECTION O. NIGHT SIGNALING APPARATUS OR TELEPHOTOS.

The electric night-signaling apparatus will consist in general of a keyboard, cable connections, and four double signal lanterns, secured on a ladder suspended from an outrigger located on the foremast as directed.

The ladder will be made of galvanized-iron wire rope with galvanized-iron distance pieces or rungs from which the lanterns will be suspended. The lower end of the ladder will be secured as directed, and fitted with a turn-buckle near securing end, all as approved.

The lanterns will be spaced 6 feet apart. Each lantern will be made in halves, one half having a white, the other half a red Fresnel lens, and fitted with two navy standard key sockets for 32-candlepower lamps. The cables for supplying the lamps will be brought in through water-tight stuffing boxes.

The keyboard will be of the standard navy type, mounted on a suitable pedestal, and located on the bridge as directed. The keyboard will be waterproof in all respects and provided with means for easily connecting the circuits to the lamps, so as to make all the various combinations required in one motion, as by pressing down a button, the release to be automatic when the hand is removed from the operating lever. It will be fitted with the female half of a coupling, by means of which the cable can be readily connected to the keyboard, the male half of the coupling being connected to the cable, and means shall be provided to prevent the male coupling being wrongly inserted.

Each conductor will be made up of 19 strands of No. 25 Brown & Sharpe gauge wire.

The insulation shall be as follows: A layer of Para rubber, $\frac{1}{64}$ inch thick, rolled on. A layer of vulcanized rubber, to a diameter of 0.257 inch. A layer of $\frac{1}{32}$-inch-thick cotton tape, lapped one-half width. A close braid of No. 30 three-ply linen gilling thread, braided with two ends, the diameter over braid to be $\frac{3}{8}$ inch.

Sixteen conductors, so constructed, shall be laid up in the finished cable, as follows:

The heart of the cable shall consist of a continuous length of 9-thread, tarred, well-stretched hemp rope, the upper end of the heart to extend beyond the end of the cable conductors, and to be finished with a neat, strong eye splice 3 inches in length.

Around the heart shall be laid all of the unit conductors, parallel to the heart, and served with marline as approved.

The condutors shall be branched out for the lamps in pairs, using adjacent conductors, the reduction caused by branching to be made a neat taper by filling in with dead wire or jute; branching shall be

first done from the outside layer of the cable, and spaced for 6-foot distance between the lamp centers, unless otherwise directed.

The outer layer of conductors will be securely hitched with marline hitches, 1 inch apart, using a 6-ply flat twine of about $\frac{1}{8}$ inch in width, the hitching to be for the entire length of cable.

The lower (keyboard) end of the cable will be fitted with the standard navy coupling, as before specified.

There will be furnished, as spare parts, one complete set of lamps for the lanterns and ten lamps for the keyboard, all to be carefully packed, boxed, and marked; also ten gaskets for the lanterns.

SECTION P. RUNNING LIGHTS, PORTABLE LAMPS, AND CARGO CLUSTERS.

The masthead, towing, range, and side lights shall be navy standard battleship lights.

There will be furnished 8 portable navy standard, water-tight, incandescent lamps and holders, with twin conductor cables and attaching plugs complete, connected and ready for use; the lamps will be of 32-candlepower. The cables for six of the lamps will be 30 feet long, and for two, 50 feet long. Suitable water-tight boxes, not exceeding twenty-five in number, for the attachment of these hand portables will be located where directed in the engine and fire rooms, and on the spar, main, and berth decks.

There will be furnished two navy standard cargo clusters with standards, reflectors, and cables, complete, connected up and ready for use. There will be six 32-candlepower lamps for each reflector. Each cable will be 50 feet long, and fitted with attaching plugs, etc., complete. Suitable water-tight boxes, not exceeding six in number, for the attachment of the cargo clusters, will be located where directed.

SECTION Q. TEST OF PLANT.

When the work of installation shall be completed, during the continuous four hours' test under full voltage, all lights in circuit, and the searchlights, telephotos, blower motors, and portables, as desired, the satisfactory condition of the entire installation must be demonstrated, and any defects which may develop must be made good by, and at the expense of, the contractor before acceptance.

SPECIFICATIONS

FOR

TRIPLE-EXPANSION SINGLE-SCREW PROPELLING ENGINE,

WITH

BOILERS AND AUXILIARY MACHINERY.

(84)

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SPECIFICATIONS FOR TRIPLE-EXPANSION SINGLE-SCREW PROPELLING ENGINE WITH BOILERS AND AUXILIARY MACHINERY.

List of plans accompanying these specifications.

General arrangement of the machinery and boilers in the vessel.
General arrangement of the engine.
General arrangement of the shafting.
Valve diagrams.

1. GENERAL DESCRIPTION.

The main engine will be of the vertical, inverted cylinder, direct-acting, triple-expansion type, having one high-pressure cylinder 20 inches in diameter, one intermediate-pressure cylinder 32½ inches in diameter, and one low-pressure cylinder 54 inches in diameter, the stroke of all pistons being 36 inches. The high-pressure cylinder will be forward, the low-pressure cylinder aft, and the indicated horsepower of the main engine will be about 2,000 when making the maximum number of revolutions per minute. The main valves will be of the piston type for all cylinders, being worked by Stephenson link motion with double-bar links, and each main piston will have one piston rod with a crosshead working on a bar guide. The bedplate will be of cast iron supported on a wrought-steel foundation built up from the frames of the vessel, and the framing of the engine will consist of three wrought-steel front columns and three cast-iron housings at the back which will be bolted to facings on the main and auxiliary condensers, the condensers forming part of the framing. The crank shaft will be of the built-up type, and the crank, thrust, intermediate, and propeller shafts, the piston rods, connecting rods, and working parts generally will be forged of mild open-hearth steel. The propeller will be right handed, with four blades, of "Monel Metal," and of the built-up type.

The main condenser will have a cooling surface of about 2,726 square feet, measured on the outside of the tubes; the main circulating pump will be independent and of the centrifugal type; there will be one attached, vertical, single-acting air pump, and two attached bilge pumps, worked by beams and links from the crosshead of the intermediate-pressure engine.

There will be two water-tube boilers of an approved marine type, constructed for a working pressure of 200 pounds per square inch, hav-

ing a total grate surface of about 181 square feet and a total heating surface of about 6,270 square feet, placed in a separate water-tight compartment and arranged as shown on the drawings. There will be one main feed pump of the vertical, duplex, outside center-packed plunger type located in the engine room, and, in addition thereto, general service, bilge, distiller circulating and sanitary, evaporator feed, fresh water, and such other pumps as are hereinafter specified.

There will be two electric generating sets, a turbine-driven forced-draft fan or blower, an evaporating and distilling plant, and such other auxiliary or supplementary machinery, tools, instruments, and apparatus that may be necessary to complete the systems in every detail, as described in the following specifications or shown on the accompanying drawings.

2. CHANGES IN PLANS AND SPECIFICATIONS.

The contractor will make no changes in the plans and specifications without the approval of the Treasury Department. In case it is thought to be advisable to make changes, the contractor will make application by letter to the Engineer in Chief, United States Revenue-Cutter Service, through the inspector of labor and material for the construction of the steam machinery, stating the nature and object of the proposed changes, accompanied by complete plans and specifications of the work involved, together with a statement of his estimate of the amount of increase or decrease in cost, and the inspector of labor and material for the construction of the steam machinery will likewise submit his recommendations as to the proposed changes and his estimate as to the cost of the same.

3. OMISSIONS.

The misplacement, addition, or omission of any word, letter, or punctuation mark will in no way change the true spirit, intent, and meaning of these specifications.

Any part of the machinery, or any article pertaining thereto, which is not specifically mentioned in these requirements or specifications, or shown on the drawings, but which is necessary for the proper completion of the machinery, will be provided by the contractor the same as if it had been mentioned in the requirements or specifications or shown on the drawings.

4. DRAWINGS.

All drawings necessary for the prosecution of the work will be prepared by and at the expense of the contractor, and will be subject to the approval of the Engineer in Chief, United States Revenue-Cutter Service, before the material is ordered or the work covered by the same is commenced, and to that end the contractor will submit to the Engineer in Chief, through the inspector of labor and material for the construction of the steam machinery, three blueprints of each draw-

ing for his examination and approval. One copy will be retained for the files of the office of the Engineer in Chief, and two copies will be returned to the inspector, who will retain one copy for his files, and transmit the third copy to the contractor. A copy of each drawing accompanying orders for steel castings or forgings will also be submitted when the material is ordered.

The drawings will be made to scale, and will be of a uniform size, not exceeding 24 inches by 42 inches, or multiples of the same, and there will be a white space left in the lower right-hand corner of each for the stamps of the Engineer in Chief and the inspecting officer.

Figured dimensions will be shown for all parts, and if a correction or change is made in any part of a finished drawing, the correct dimension will be written underlined, or with the word "marked" written after it. In the drawings furnished, figured dimensions, where given, will be followed, and not scale dimensions, unless otherwise directed.

Materials will be plainly indicated by lettering or by hatching in accordance with a standard schedule· all drawings will state the class of material to be used, and in the case of mixtures the proportions of the constituent parts, all of which will be subject to the approval of the Engineer in Chief.

All discrepancies discovered in the drawings or in the specifications, or between the drawings and the specifications, will be referred to the Engineer in Chief through the inspector of labor and material, and when submitting a drawing to the Engineer in Chief involving changes in the specifications, the contractor's letter of transmittal will call attention to the same.

After the work of construction of the steam machinery is completed the contractor will furnish the Engineer in Chief with three complete sets of blueprints taken from corrected tracings, all of which must be on linen-backed paper.

5. MATERIAL AND WORKMANSHIP.

All material used in the construction of the boilers, main engine, auxiliaries, and steam machinery in general, including all pipes, valves, fittings, clothing and lagging, electric generating sets, and all parts of the installation coming under the cognizance of the Engineer in Chief, United States Revenue-Cutter Service, must be of the best quality, and all workmanship must be first-class in every particular and executed in a workmanlike and substantial manner. Any portion of the work that may be found defective, whether partially or entirely completed, must be removed when so directed by the inspector of labor and material for the construction of the steam machinery, and satisfactorily replaced by new work without extra compensation.

6. TESTS AND INSPECTION OF MATERIAL.

All material used in the construction of the engine, boilers, auxiliaries, and other work coming under the cognizance of the Engineer in Chief, United States Revenue-Cutter Service, will be tested and in-

spected in accordance with the "Specifications for inspection of material," as hereinafter prescribed in paragraph 112.

All references in these specifications to the quality of material to be used refer to the quality as called for by the above-mentioned "Specifications for inspection of material."

The work of construction of the boilers, machinery, and appurtenances shall be at all times open to inspection by officers appointed for such purposes by the Treasury Department. Every facility will be afforded such inspectors for the prosecution of their work. All handing of material necessary for purposes of inspection will be done at the expense of the contractor, and all test specimens necessary for the determination of the strength of material used will be prepared and tested at the expense of the contractor.

7. OFFICE OF THE INSPECTOR OF LABOR AND MATERIAL FOR THE CONSTRUCTION OF THE STEAM MACHINERY.

The contractor must furnish a suitable office for the use of the inspector of labor and material for the construction of the steam machinery, which office must be properly lighted, heated, and ventilated, kept clean, and furnished with a roll-top or other satisfactory desk, a letter-copy press, two chairs, a washstand, towels, a water filter and cooler which will be kept filled, a wardrobe or closet with clothes hooks, and a suitable drawing table of satisfactory size, supported upon trestles and supplied with a cover.

8. RECORD OF WEIGHTS.

No record will be kept of the weights of the machinery, but the contractor must be careful to see that the specified thicknesses of material are adhered to so far as practicable.

9. CARE OF MACHINERY.

The contractor will be responsible for the care of all parts of the machinery installation paid for by the Government under the provisions of the contract as to partial payments.

10. FOUNDATIONS AND BEDPLATE.

The foundations for the main engine and thrust bearing will be as described by the superintendent of construction and repair, United States Revenue-Cutter Service, in the hull specifications. The engine bedplate will be made in two sections of the best quality cast iron, and will consist of six U-shaped girders, as shown on the drawings; they will be properly finished and faced for the crank-shaft brasses and caps, and for the flanges of the front columns and the condensers. The two sections will be bolted together and secured to the engine foundation by 1¼-inch body-bound bolts, forged of Class B steel, setting up on the lower flanges and fitted in reamed holes in the bedplate and foundation, and the condensers will be secured to the bedplate by 1⅛-inch body-bound bolts, forged of Class B steel, and fitted in reamed holes.

A forged-steel horseshoe, planed to template, will be fitted around each holding-down bolt in order to secure the proper alignment of the bedplate. These horseshoes will each be about 3½ inches long by 1½ inches wide, and the thickness of each will vary to conform to the necessary adjustment to put the bedplate in accurate alignment. After the bedplate has been permanently adjusted in this manner, the spaces between the horseshoes will be filled with hardwood packing about 1 inch in thickness. When finally secured, all shafting must be accurately in line with the vessel at load draft and ordinary stowage.

11. CRANK-SHAFT BEARINGS.

There will be six bearings for the crank shaft, each bearing being 10¾ inches in diameter and 12½ inches long, and consisting of a bottom brass, two composition distance pieces fitted over dowel pins, brass liners, and a cap. The cap will be made of cast iron and the other parts of composition; the cap and the lower brass will be lined with approved white metal, fitted in dovetailed recesses, accurately fitted to the journals of the crank shaft, and properly channeled for the distribution of oil. The bottom brasses will be cored out and fitted for water circulation in an approved manner. Each cap will be secured by two 2¾-inch Class B forged-steel collar bolts, fitted as shown on the drawings, and approved provisions will be made to prevent the nuts from backing off and the bolts from turning. The caps and brasses will be drilled and tapped for eyebolts, as directed, for convenience in handling, and there will be an oil box, fitted with a hinged cover, cast on the top of each cap.

After the engine is secured in the vessel, the bearings will all be trued to the shaft and any defects made good by scraping. Suitable brass pins will be let into the main bearing housings, and trammels and shaft gauges will be provided for use when future adjustments are made to the crank shaft.

12. CRANK SHAFT.

The crank shaft will be in one section and of the built-up type, forged of "Class B" steel, with three cranks and a coupling disk, and finished all over as shown on the drawings. The cranks will be set 120° apart, the high-pressure leading, then the intermediate, and the low in regular sequence. The length of the crank shaft will be 18 feet 6 inches over all, the radius of the cranks will be 18 inches, and the coupling disk will be 3¼ inches thick and 21¾ inches in diameter. The main journals will be 10¾ inches in diameter and 12½ inches long, and the crank pins will be 10½ inches in diameter and 12 inches long. There will be a hole 2½ inches in diameter drilled through each crank pin, and counterbored at each end of the pin so that the head and nut of a bolt would fit into the recesses in the event that it ever became necessary to effect repairs to a broken crank pin. The crank webs will be 7½ inches thick, 20 inches wide at the crank-pin end, and 21½ inches wide at the shaft. Each crank web will be keyed to the crank pin and to the shaft with one key, with the exception of the after low-pressure

crank web, where two keys will be used at the shaft. All keys will be forged of Class B steel, and will be fitted and secured in an approved manner.

All journals will be smoothly and accurately turned; the crank pins must be accurately parallel to the main journals, and when finished all must be tested and the accuracy proved.

The crank shaft will be coupled to the thrust shaft by the coupling disk above mentioned, which will be secured to a similar coupling disk on the forward end of the thrust shaft by six bolts, $2\frac{5}{8}$ inches in diameter, forged of Class B steel, and finished to fit the holes in the coupling disks, which will be drilled and reamed, each bolt being secured in place by a casehardened wrought-iron nut and a split pin.

13. TURNING GEAR.

There will be an approved turning gear, fitted as shown on the drawings, for the purpose of turning the main engine by hand. This gear will consist of a cast-iron worm wheel with cut teeth, securely keyed to the coupling disks between the crank shaft and the thrust shaft, and meshing with a bronze worm having cut thread and operated by a ratchet wrench, the arrangement being such that the gear may be readily connected or thrown out as desired.

There will be marks on the crank shaft where directed to indicate the position of the engine centers and the propeller blades, and suitable brackets or a rack will be provided for stowing the ratchet wrench when it is not in use.

14. MAIN AND AUXILIARY CONDENSERS.

The main condenser will be of rectangular section, cylindrical at the top. It will be of cast iron throughout and will have a general thickness of $1\frac{1}{8}$ inches. The dimensions will be about as follows: The shell will be about 10 feet $5\frac{3}{4}$ inches long between the tube sheets, 2 feet $3\frac{1}{2}$ inches wide, and 5 feet 7 inches high, inside measurements, and it will be ribbed as shown. It will be made in one piece and will have flanges for securing it to the engine bedplate and to the auxiliary condenser, as before specified, and there will be facings for the housings for supporting the intermediate and the low-pressure cylinders. There will be the following openings on the condenser, each with properly faced flanges, viz, one for the main exhaust pipe, 15 inches by 19 inches, as shown on the drawings, one for the exhaust from the turbine-driven auxiliaries, one for the air-pump suction, one for the general-service pump suction, and such others as may be necessary. There will be three hand-hole plates; two 5 inches by 11 inches on the outboard side of the condenser, as near the bottom as practicable, so as to clear the lower tubes, and one 8 by 11 inches on the top of the condenser.

The tube sheets will be made of rolled bronze $\frac{7}{8}$ inch in thickness, with smoothly finished holes for the tubes, tapped and fitted with screw glands of composition for packing the tubes. These glands will be beaded at the outer end to prevent the tubes from crawling, and they

will be slotted to admit a tool for screwing them up. Dry corset lacing will be used to pack the tubes.

The tube sheets will be secured to the flanges of the condenser shell by rolled bronze stud bolts, $\frac{7}{8}$ inch in diameter, which will also be used for securing the circulating water chests. Ten of these bolts in each tube sheet will be collar bolts for holding the tube sheets in place when the water chests are removed.

There will be 1,587 seamless-drawn condenser tubes, made of the following composition—60 per cent copper and 40 per cent zinc. These tubes will be $\frac{5}{8}$ inch outside diameter, No. 18 United States standard gauge in thickness, and 10 feet 7½ inches long, spaced $1\frac{5}{16}$ inch center to center. All tubes will be heavily tinned, both inside and outside. The cooling surface will be about 2,726 square feet, measured on the outside of the tubes. There will be one supporting plate for the tubes, made of rolled bronze, $\frac{1}{2}$ inch in thickness, and properly secured in the condenser where directed, and a baffle plate of $\frac{7}{16}$ inch steel, perforated with 1¼-inch holes, spaced 3 inches center to center, will be fitted in an approved manner so as to deflect the steam over all the tubes.

The chest for the entrance and the exit of the circulating water will be made of cast iron with a division plate in the middle. The inlet and the outlet nozzles will each be 10 inches in diameter, and there will also be a flanged opening on the inlet chest for the connection to the main engine water service. The water chest at the other end of the condenser will be made as shown on the drawings, and fitted with a plate valve operated by an outside lever, and there will be flanged openings fitted with valves, as approved, so as to provide for the circulating water connections to the auxiliary condenser.

The condenser heads will be of cast iron, $\frac{7}{8}$ inch in thickness, and they will be secured to the water chests by the $\frac{7}{8}$-inch rolled-bronze stud bolts before mentioned. Each head will be fitted with two hand-hole plates, 8 inches in diameter, located as shown, and each hand-hole plate will be secured by six ¾-inch rolled-bronze stud bolts. Provision will be made for handling the chest covers by means of eyebolts and a track for travelers overhead.

A flanged soda cock will be fitted to a boss on the condenser and connected to a 2-gallon copper tank provided with a hinged cover. There will be a 1-inch boiling-out connection at the lower part of the condenser, and steam for this purpose will be taken from the auxiliary steam pipe through approved valves and pipes. An approved 1¼-inch spring-loaded safety valve will be mounted on a suitable boss on the top of the condenser shell, and this valve will be set to blow at 15 pounds pressure per square inch. An approved ¾-inch connection fitted with a flanged valve will be provided and connected to the fresh-water system for "make-up" feed purposes.

Air cocks, drain cocks, and valves will be provided for both sides of the condenser as may be required.

An approved composition ejector, suitable for a ¾-inch steam connection will be provided and connected up by means of suitable valves,

pipes, and fittings, so that the water in the condenser and air pump channelway may be removed and discharged to the feed-and-filter tank before the main engine is turned. Steam for this ejector will be taken from the auxiliary steam pipe, and the valve for controlling the operation of the ejector will be arranged so as to be handled from a location at or near the working platform.

Zinc slabs will be placed in the condenser to prevent the deterioration of the shell. Two galvanized-steel baskets will be provided for this purpose, and they will be located where directed and secured in an approved manner. Each basket will hold about 25 pounds of clear rolled zinc. Zinc slabs will also be secured to each hand-hole plate of each water end of the condenser by means of rolled-bronze studs, and these zinc slabs will be held off by suitable thimbles so as to project into the water space.

Before the condenser leaves the shop it must be filled with water, subjected to a test pressure of 15 pounds per square inch, and made perfectly tight under these conditions.

The auxiliary condenser will be practically a duplication of the main condenser as to shape and construction, only it will be shorter. It will be made in one piece and will have flanges for securing it to the engine bedplate and the main condenser, as before specified, and there will be a facing for the housing for supporting the high-pressure cylinder. The dimensions will be about as follows: The shell will be about 3 feet 5¼ inches long between the tube sheets, 2 feet 3½ inches wide, and 5 feet 7 inches high, inside measurements, and it will be ribbed as shown. It will be provided with flanged openings for the auxiliary exhaust, the exhaust from the turbine-driven auxiliaries, and for the suction connection to the main feed pump and to the small ejector hereinafter specified. Hand-hole plates will be fitted to the shell and to the heads in an approved manner.

There will be 1,484 seamless-drawn condenser tubes, 3 feet 7½ inches long, and the material used for the tubes and tube sheets will be the same as specified for the main condenser.

The water chests for the circulating water will be arranged so that the water will pass four times through the tubes instead of but twice as in the case of the main condenser, and there will be flanged openings on the after water chest for the connection of the circulating water pipes to the forward water chest of the main condenser as before described. In other words the main circulating pump is to be used as the circulator for both the main and the auxiliary condenser, the cooling water being circulated through the main condenser direct, or by-passed to the auxiliary condenser as desired, through these pipe connections, by means of the plate valves in the forward water chest of the main condenser. Provisions will be made for handling the chest covers by means of eyebolts and a track for travelers overhead.

The auxiliary condenser will be connected by approved valves, fittings, and copper pipes to the suction manifold at the main feed pump, and from the main feed pump an approved copper-pipe connection will lead to the feed-and-filter tank, so that the water may be taken from the auxiliary condenser, discharged to the feed-and-filter tank, and

taken from thence by the main injector and fed to the boilers. In addition to this connection for clearing the auxiliary condenser, there will be an approved ejector suitable for a ¾-inch steam pipe, which will be arranged so as to take water from the auxiliary condenser and discharge into the feed and filter tank. Steam for this ejector will be taken from the auxiliary steam pipe, and it will be properly secured in a convenient location near the auxiliary condenser.

The auxiliary condenser will be properly fitted with air and drain cocks and valves, a soda tank, and boiling-out connections, a safety-valve similar to the one provided for the main condenser, a ¾-inch connection to the fresh-water system for "make-up" feed, an approved water-gauge glass, and zinc protection for both sides.

Before the condenser leaves the shop it must be filled with water, subjected to a test pressure of 15 pounds per square inch, and made perfectly tight under these conditions.

15. FRONT COLUMNS AND HOUSINGS.

Each cylinder will be supported at the front by a finished column, forged of Class B steel, 6 inches in diameter, and at the back by a cast-iron housing, fitted for the attachment of the bar crosshead guide, as shown on the drawings. The housing for the high-pressure cylinder will be bolted to a facing on the top of the auxiliary condenser, and the housings for the intermediate-pressure and the low-pressure cylinder will be bolted to facings on the top of the main condenser. The bolts for securing the cylinders to the columns and housings and for securing the columns to the bedplate and the housings to the facings on the condensers will be body-bound bolts fitted in reamed holes, forged of Class B steel, 2 inches in diameter for the front columns and 1¼ inches in diameter for the housings.

16. CYLINDER CASTINGS AND LINERS.

The high-pressure cylinder will be 20 inches in diameter and will have one single-ported piston valve; the intermediate-pressure cylinder will be 32½ inches in diameter and will have one single-ported piston valve; the low-pressure cylinder will be 54 inches in diameter and will have two single-ported piston valves; and the length of stroke of all pistons will be 36 inches.

The cylinders will consist of castings of the best quality close-grained cast iron, with working liners for the cylinders and valve chests. The cylinder castings will include the valve chests, steam ports and passages, the lower heads, and the various brackets to which the cylinder supports will be attached; all as shown on the drawings. The steam and the exhaust ports and passages will be smoothly cored to the dimensions shown on the drawings, and the walls of the same will be strongly stayed by ribs and bolts.

The flanges for securing the cylinders to each other will be so faced that when bolted together the distance between the centers of the high-pressure and the intermediate-pressure cylinder will be 5 feet 6 inches, and the distance between the centers of the intermediate-pressure and

the low-pressure cylinder will be 7 feet, the cylinder axes being all in one plane and accurately parallel. The cylinders will be bolted together by 1¼-inch body-bound bolts, forged of Class B steel, fitted in reamed holes. The castings, liners, and stuffing-boxes will be held in a vertical position when being bored to their respective diameters, and no deviation will be made from this requirement. The cylinder barrels will be 1¼ inches in thickness, and the lower heads will be cast with the barrels, and will be ribbed and faced as shown on the drawings. There will be facings on the bottoms, drilled and tapped for the attachment of eyebolts.

The cylinder liners will be made of close-grained cast iron, as hard as can be properly worked, turned and faced to fit the cylinder castings. Each liner will have a bearing about 4 inches wide at the middle of its length and at each end, as shown on the drawings. The liners will be flanged at the bottom and secured to the castings by round-headed, countersunk, steel tap bolts, spaced about 4½ inches between centers for the high-pressure cylinder, 4½ inches for the intermediate-pressure cylinder, and 5½ inches for the low-pressure cylinder. The bolt holes in the liners will be counterbored to receive the heads of the bolts. At the top there will be fitted a stuffing-box with a wrought steel gland, to allow for expansion and to make the joint tight between the liner and the cylinder casting. The space left around the liners for all three cylinders will be arranged so that it may be used as a steam jacket, as hereinafter specified, and all ribs will be cored out so as to allow a free circulation of the jacket steam and a free drainage of the water of condensation.

The liners, after being secured in place in the cylinder castings, will be smoothly and accurately bored to the diameters of 20 inches, 32½ inches, and 54 inches, for the high-pressure, intermediate-pressure, and low-pressure cylinders, respectively, and to a thickness of 1⅛ inches, the boring to be done with the cylinders in a vertical position. The liners will be counterbored at both ends, leaving the working bore 3 feet 4½ inches long for the high-pressure cylinder, and 3 feet 3⅜ inches long for the intermediate-pressure and the low-pressure cylinder, so that the high-pressure piston and the intermediate-pressure and low-pressure piston rings will override ⅛ inch at the top and come even at the bottom.

The unfinished parts of the inside of all the cylinders will be thoroughly pickled to remove all the scale.

17. CYLINDER COVERS.

The cylinder covers will be made of the best quality cast iron, with single walls, well stiffened by ribs. They will be so shaped as to provide cylinder ports and will leave as little clearance as possible.

Each cover will be faced to fit its cylinder and will be secured to it by 1⅛-inch, Class B, steel studs, fitted with finished case-hardened wrought-iron nuts.

The cylinder covers will be finished on the outside and on the edges of the flanges, neatly finished corrugated plates of cast iron will be fitted

to the tops of the covers, and they will all be drilled and tapped for jack bolts and eyebolts, as directed. The thickness of the cover flanges will be $1\frac{3}{8}$ inches, and the thickness of the bodies and ribs will be as shown on the drawings.

18. CYLINDER CLEARANCES.

Care must be taken that the volumetric clearances in the cylinders are made no larger than absolutely necessary.

The linear clearance between the pistons and the cylinder heads when the pistons are at the ends of their stroke, will be $\frac{3}{8}$ inch at the top and $\frac{1}{2}$ inch at the bottom. Marks will be made on the crosshead guides showing the striking points of the pistons, and the position of the pistons when the clearances are finally measured after all parts of the engine have been properly adjusted.

19. THROTTLE VALVE, RECEIVER PIPES, AND MAIN EXHAUST PIPE.

The throttle valve will be made of cast iron, composition mounted, of the double-poppet type, and properly designed for the main steam pipe, which will be 7 inches in diameter. It will be operated by means of arms and rods connected to the throttle valve lever at the working platform in an approved manner. Facings will be cast on the body of the throttle valve in order to provide connections for the live steam to the intermediate-pressure and the low-pressure receivers, for the connection from the auxiliary steam pipe, and for the throttle valve drain valve.

There will be two receiver pipes leading from the high-pressure to the intermediate-pressure valve chest, and two receiver pipes leading from the intermediate-pressure to the low-pressure valve chest. These receiver pipes will be made of copper, $6\frac{1}{2}$ inches in diameter for the intermediate-pressure connections and $9\frac{1}{2}$ inches in diameter for the low-pressure connections, and they will be arranged as shown on the drawings.

From the port side of the low-pressure valve chest a rectangular cast iron pipe will connect to the main condenser as the main exhaust pipe. This pipe will be 15 inches by 19 inches in section, and will be provided with a flanged opening, 12 inches in diameter, fitted with a blank flange, so as to provide for an atmospheric exhaust connection. An approved section of galvanized-iron pipe, 12 inches in diameter and No. 12 United States standard gauge in thickness, fitted with a flange for attachment to the opening on the main exhaust pipe, will be furnished, together with the necessary bolts for making up the joint, and the pipe will be properly stowed and secured where directed in the vessel. Facings will be provided on the main exhaust pipe, as shown, for the auxiliary exhaust connections.

20. LIVE STEAM CONNECTIONS TO THE RECEIVERS AND JACKET STEAM.

There will be a 2-inch copper pipe led from a facing on the body of the throttle valve, as before specified, with 2-inch branches for the live-steam connections to the intermediate-pressure and low-pressure receiver. There will be a stop valve at the connection to the throttle valve and at each receiver, the latter to be conveniently operated from the working platform by means of extension rods and hand-wheels.

The space left around the liners for the cylinders will be arranged so that it may be used as a steam jacket, as before specified, and steam for the jackets will be taken from the auxiliary steam pipe through a 2-inch valve and pipe, which will have 1½-inch branches leading to the high-pressure, the intermediate-pressure, and the low-pressure jacket. Each branch steam pipe will be fitted with a 1½-inch adjustable-spring reducing valve and a 1½-inch adjustable spring-loaded safety valve on the jacket side of the reducing valve, both valves to be of an approved design, and there will be a stop valve in each branch close to the jacket. The reducing valves and the safety valves will be set alike for the high-pressure, the intermediate-pressure, and the low-pressure jackets; the valves for the high-pressure jacket steam being adjusted for 150 pounds pressure per square inch, those for the intermediate-pressure jacket steam for 90 pounds pressure per square inch, and those for the low-pressure jacket steam for 30 pounds pressure per square inch. A 1-inch drain will lead from the lowest part of each jacket to an approved automatic trap fitted with blow-through and by-pass valves and pipes, thence to the lower part of the feed-and-filter tank, with a branch leading to the bilge. There will be a stop valve in each drainpipe at the connection to the jacket, and the drainage system of each jacket will be entirely independent as far as the discharge from its respective trap, from which point the drains may be in common. An approved 4½-inch dial pressure gauge in a polished brass case will be properly connected to the reduced-pressure side of each jacket steam connection, and these gauges will be mounted where directed on the engine so as to be plainly seen from the working platform.

21. CYLINDER DRAIN COCKS AND RELIEF VALVES.

Each cylinder will be fitted with a 1-inch drain cock of approved design, placed so as to thoroughly drain the cylinder. These drain cocks will be perfectly tight, without undue friction, and each will be operated by a separate lever at the working platform. All of the drain cocks will discharge into a pipe leading to the main condenser, with a branch leading to the bilge, and an approved stop valve will be fitted at the main condenser and also at the branch to the bilge.

There will be an adjustable, outside-spring, relief valve of approved design 2½ inches in diameter fitted to each end of each cylinder. The casings will be of cast iron; the valve disks will be of composition; the valve seats will be of nickel; the valve stems will be of rolled

bronze, and the springs will be square in section and of the first quality spring steel. The valve fittings will be so constructed that the valves may be overhauled without slacking the springs, and the springs will have approved means of adjustment and be so proportioned as to allow the valves to open to their full extent without shutting the coils or unduly increasing the load. The springs will bear on shoulders on the stems which in turn will fit loosely in sockets recessed in the backs of the valves, the valves being guided by loosely fitting wings or other approved means. The stems will be so fitted that the valves can be opened by the application of a lever, and to this end the casings will have suitable fulcrums, and three levers will be furnished.

The valves will be set at 215, 90, and 30 pounds gauge pressure, respectively, for the high-pressure, the intermediate-pressure, and the low-pressure cylinder, and will be tested to insure the fulfillment of these requirements.

22. INDICATOR CONNECTIONS, REDUCING GEAR, INDICATORS, AND PLANIMETER.

An indicator connection will be made to each end of each cylinder of the engine, as near as possible to the bore of the cylinder and so as to be easily accessible. Each indicator on the cylinders of the engine when in place will be connected to both ends of the cylinder to which it is attached by means of a three-way cock. There will be a valve at each end of the indicator-pipe connections close up to the cylinder, and all pipes, valves, and fittings used will be of finished brass.

The reducing gear for operating the indicators will be of an approved design, and must be so arranged that the indicator drums will have an accurate motion coincident with that of the corresponding pistons, and such as to give a length of card of not less than 3½ inches.

Three indicators of an approved design with exposed springs and of the small-drum type will be furnished by the contractor. Eight springs will be furnished with the set of indicators, the springs to be of the following scales: 10, 20, 30, 40, 60, 80, 100, and 150 pounds; boxwood scales, graduated to correspond to the scales of the springs, will also be furnished; and each indicator will be provided with a neatly finished hard-wood case for protecting the same from injury when not in use and for holding the springs, scales, indicator cards, and instruments furnished with the indicators for adjusting the same.

A planimeter, or averaging device, of an approved design, fitted in a neat leather-covered case, will be furnished with the indicators.

23. METALLIC PACKING.

Metallic packing of approved design will be fitted to the stuffing boxes of all piston rods and valve stems of the main and auxiliary engines and to the steam end stuffing boxes of all pumps.

For piston rods and valve stems over 1¾ inches in diameter the packing must be in at least two independent sections, and for piston rods and valve stems between ¾ inch and 1¾ inches in diameter, inclusive, the packing will be in two independent sections where possible.

The piston-rod and valve-stem stuffing boxes will be made of composition and fitted with metallic packing of approved design, as before specified. They will be provided with efficient means of lubrication, and, if required, a secondary stuffing box for soft packing will be fitted in the gland of each stuffing box.

24. PISTONS.

The high-pressure piston will be made of the best quality cast iron and will be of the solid type, and the intermediate-pressure and the low-pressure pistons will be made of cast steel, "Class B," and each will be fitted with one combined bull ring and follower, made of cast iron, and two snap packing rings, one of which will be below the combined bull ring and follower and the other of which will be carried by the combined bull ring and follower, all as shown on the drawings.

The combined bull rings and followers will be held in place by Class B forged steel studs; 1 inch in diameter where tapped into the body of the pistons and $\frac{7}{8}$ inch in diameter where they pass through the combined bull rings and followers and for the nuts to secure all in place. The nuts will be of wrought iron, finished and casehardened, and each nut will be secured by a brass split pin through the stud over the nut.

The packing rings will be made of the best quality hard close-grained cast iron, and will be cut obliquely. They will be $1\frac{1}{8}$ inches thick and will have a bearing surface $\frac{7}{8}$ inch in width for the intermediate-pressure piston, and $1\frac{3}{8}$ inches thick with a bearing surface $\frac{7}{8}$ inch in width for the low-pressure piston.

The combined bull rings and followers and the packing rings will be finished all over, the pistons wherever required, and all will be drilled and tapped for eyebolts, as directed.

25. PISTON RODS, CROSSHEADS, SLIPPERS, AND GUIDES.

The piston rods will be forged of Class B steel, $4\frac{1}{2}$ inches in diameter, and they will be solid, turned, accurately ground and polished. They will be fitted to the crossheads and to the pistons as shown on the drawings, and they will be secured at each end by a finished wrought-iron nut, with a split pin through the end of the rod beyond the nut.

The crossheads will be forged of Class B steel, and the crosshead pins will be $5\frac{3}{4}$ inches in diameter and 6 inches long on each side of the crosshead. The crosshead pins will be flattened $\frac{3}{8}$ inch on each side, and these flats will stop $\frac{1}{2}$ inch from the ends of the crosshead pins so as to prevent the escape of the lubricating oil.

The crosshead slippers will be made of bronze, shaped as shown on the drawings and bolted to the crossheads. They will be faced with approved white metal, fitted as directed, on both the "go-ahead" and "backing" sides, the sliding surface being $12\frac{1}{4}$ inches by 16 inches for each side.

The crosshead guides will be of the bar type, made of the best quality hard close-grained cast iron. They will be hollow, fitted for water circulation, and will be secured, as shown, to the housings. The

bearing surfaces will be grooved, as approved, and brass oil boxes will be provided at the lower ends for supplying oil to the guides through dragglers on the slippers.

26. CONNECTING RODS, CROSSHEAD AND CRANK-PIN BRASSES.

The connecting rods, with their caps and bolts, will be forged of Class B steel, and they will be finished all over. They will be 87 inches long between centers, turned to $4\frac{3}{4}$ inches in diameter at the neck of the crosshead end and to $5\frac{1}{4}$ inches in diameter at the neck of the crank end. The crosshead end will be forked to span the crosshead, and the fork will be faced off to a uniform thickness of $2\frac{1}{2}$ inches and will be squared and fitted for the crosshead brasses. The crank end will be increased in thickness to $3\frac{1}{4}$ inches, and will be faced, squared, and fitted for the crank-pin brasses.

The crosshead brasses will be accurately fitted with tongue and groove to the connecting-rod ends, and they will have finished holes for the cap bolts, which will be made of Class B steel, $2\frac{1}{4}$ inches in diameter, and each bolt will have a collar nut and a set screw for securing all in place. The brasses will be accurately fitted to the crosshead pins, properly channeled for the distribution of oil, and faced with sufficient clearance between the crosshead and the brasses to prevent nipping when heated. Composition distance pieces, secured by dowels screwed into the brasses, and brass liners will be fitted as directed, so as to be removable without withdrawing the bolts.

The crank-pin brasses will be accurately fitted with tongue and groove to the connecting-rod ends, and they will have finished holes for the bolts, which will be made of Class B steel, $2\frac{3}{4}$ inches in diameter; each bolt will have a collar nut, a set screw for locking the nut, a set screw for holding the bolt in place while backing off the nut, and will be drilled and tapped for an eyebolt, as directed. The brasses will be lined with approved white metal fitted in dovetailed recesses, accurately fitted to the crank pins, properly channeled for the distribution of oil, and faced with sufficient clearance between the crank webs to prevent nipping when heated. Composition distance pieces, secured by dowels screwed into the brasses, and brass liners will be fitted as directed, so as to be removable without withdrawing the bolts.

27. VALVE CHESTS, LINERS, COVERS, AND DRAINS.

The valve chest of the high-pressure cylinder and the valve chest of the intermediate-pressure cylinder will each be fitted for one piston valve, and the valve chests of the low-pressure cylinder will be fitted for two piston valves. There will be openings for inserting the valves and the working liners, and the valve chests will be accurately bored for fitting the same.

There will be a working liner at each end of each valve chest, these working liners to be made of the best quality, close-grained cast iron, as hard as can be properly worked. They will be accurately turned and faced to fit the castings, and accurately bored for the valves. The

inside diameter will be 12 inches for the high-pressure valve chest, 17 inches for the intermediate-pressure valve chest, and 17 inches for each of the two low-pressure valve chests, the thickness of all liners being $1\frac{1}{8}$ inches. They will be forced into place, making all joints perfectly tight, and they will be secured by screws tapped half into the castings. The steam ports will have alternating right and left diagonal bridges of such a section as will permit the easy passage of the steam.

Before the insertion of the working liners the steam and the exhaust passages will be thoroughly cleaned and pickled, care being taken that the edges of all the ports are finished to uniform outline, and that the ports and passages are nowhere contracted to less than the areas shown on the drawings.

The upper valve-chest covers will be made of the best quality cast iron, with the balance-piston cylinders cast on them, as shown. All flanges will be turned and faced to fit the flanges on the valve chests, and they will be secured by 1-inch Class B steel studs. The covers will be fitted with plates, cast with corrugations on the top, and neatly finished to match the cast-iron plates for the tops of the cylinder covers.

The bottom covers for the valve chests will be made of the best quality cast iron, and will have the valve-stem stuffing boxes cast on them, and there will be facings, as shown, for the attachment of the valve-stem guides and the drain valves.

The valve-chest covers will all be drilled and tapped for jack bolts and eyebolts, as directed.

The valve chests will each be fitted with an approved $\frac{3}{4}$-inch drain valve, to be operated from the working platform by means of an extension rod and handwheel. The drain valves will all discharge into a pipe leading to the main condenser, with a branch leading to the bilge, in the same manner as specified for the cylinder drain cocks. The valve-chest main drainpipe and the cylinder main drainpipe will both connect into one opening on the main condenser.

28. VALVES.

The valves will all be of the piston type, there being one 12 inches in diameter for the high-pressure valve chest, one 17 inches in diameter for the intermediate-pressure valve chest, and two 17 inches in diameter for the low-pressure valve chests; and they will be of such a length as to give the steam and exhaust laps required.

They will be of the built-up type, with a cast-iron piston at each end connected by a wrought-steel distance piece, and they will be fitted with packing rings and followers, finished as shown on the drawings.

Each valve will rest against a collar on the valve stem near the upper end, and will be kept in place by a collar nut, lock nut, and split pin through the end of the valve stem over the lock nut.

29. VALVE STEMS AND GUIDES.

The valve stems will be forged of Class B steel, turned, accurately ground, and polished where they pass through the guides and stuffing boxes, and they will be fitted with balance pistons as shown on the drawings. They will be $2\frac{5}{8}$ inches in diameter where they pass through the guides, and $2\frac{3}{8}$ inches in diameter where they pass through the stuffing boxes.

The high-pressure and the intermediate-pressure valve stems will take direct hold of the link block, and the low-pressure valve stems will be connected by a yoke, made of Class B, cast steel, and which will take direct hold of the link block, as shown on the drawings.

The valve-stem guides will consist of Class B, cast-steel brackets, bolted to facings on the lower side of the bottom valve-chest covers, and they will be fitted with approved brasses and forged-steel caps.

30. VALVE GEAR, LINKS, LINK BLOCKS, AND SUSPENSION RODS.

The valve gear will be of the Stephenson type with double-bar links, and all valves will be worked direct. The valve gear will be so adjusted that the mean cut-off in full gear for both ends of each cylinder will be about 0.72 stroke, and the point of cut-off will be variable by means of slotted reverse arms.

The links will be forged of Class B steel, and will be of the double-bar pattern and finished all over. The pins for the eccentric rods and for the suspension rods will be forged of Class B steel, accurately turned and ground, and will be forced into place and riveted over. The pins for the eccentric rods will be 20 inches between centers, and each pair of link bars will be secured together by through bolts of Class B steel, passing through thimbles, and fitted with finished forged-steel nuts, properly secured by means of split pins.

The link blocks will be forged of Class B steel, and will be finished all over. They will have at each side a pair of jaws to span the corresponding bar of the link, and the jaws will be fitted with composition gibs, finished to the curvature of the link bars, and provided with approved means of adjustment.

Each link will be suspended at the middle from the corresponding reverse arm of the reverse shaft by suspension rods, forged of Class B steel, finished all over, and the ends of these suspension rods will be fitted with brasses and caps, and provided with approved means of adjustment.

The valve gear will be adjusted so that the distribution of the steam will be as shown on the valve diagrams, and when all parts of the valve gear are finally secured in place the valve stems will be marked and suitable trams furnished for use when future adjustments are to be made to the valves or gear.

31. ECCENTRICS, STRAPS, AND RODS.

The high-pressure, the intermediate-pressure, and the low-pressure eccentrics will be made in two parts, of the best quality cast iron, and the two parts will be neatly fitted together with tongue and groove and secured by two 1⅜-inch Class B forged-steel bolts, as shown on the drawings. The eccentrics will be bored out to a snug fit on the seatings, and they will be accurately turned to an eccentricity of 3½ inches, and will be rabbeted at each side for the flanges of the eccentric straps. The eccentrics will be 4¼ inches wide, including the rabbets. The seatings will be on the crank shaft, and each eccentric will be securely keyed in place.

The eccentric straps will be made of cast steel, Class B, and they will have flanges to fit the rabbets on the eccentrics, and lugs for the clamping bolts and for the eccentric rods. The two parts of each strap will be held together by two 1⅜-inch Class B steel bolts, with finished heads, nuts, lock nuts, and split pins. Each strap will be lined with approved white metal, fitted into dovetailed recesses, accurately fitted to the faces of the eccentrics, and properly channeled for the distribution of oil. Composition distance pieces, secured by dowels screwed into the lugs, and brass liners will be fitted, as directed, so as to be removable without withdrawing the bolts.

The eccentric rods will be forged of Class B steel and will be finished all over. Each rod will have a T head for securing it to the eccentric strap by two 1⅜-inch collar stud bolts, forged of Class B steel, and fitted with nuts, lock nuts, and split pins. The upper end of each eccentric rod will be forked to span the link, fitted with brasses accurately fitted to the eccentric-rod pins on the link bars, and provided with approved means of adjustment. The distance from the center of the eccentrics to the centers of the link pins will be 6 feet 8 inches.

32. REVERSING GEAR, REVERSE SHAFT, AND BEARINGS.

The reversing gear for the engine will consist of a steam cylinder 9 inches in diameter and 16 inches stroke secured to the side of the main exhaust pipe, as shown on the drawings. The piston rod of the reversing engine will act through the medium of a forged-steel crosshead and a connecting rod on an arm fixed on the reverse shaft. The valve of the steam cylinder will be a slide valve of cast iron, working in a cast-iron valve chest, and it will be operated by means of a floating lever, the primary motion being derived from a hand lever at the working platform and the secondary motion from a pin on the reverse shaft, all parts being so adjusted that the reverse shaft will follow the motion of the hand lever and be firmly held when stopped. The piston rod, connecting rod, and the working parts in general of the reversing gear will be forged of Class B steel.

There will be one reverse shaft forged of Class B steel and fitted with Class B cast-steel arms for the reversing engine and for each link. Each reversing arm will be slotted and fitted with a Class B forged-

steel block, to which the suspension rods for the links will be attached. Each block will be adjustable in the slot by means of a screw and wrench, and will be provided with a suitable index. The slot in the reversing arms will be so designed that the links may always be thrown into full backing gear, irrespective of the position of the block in the slot, and the length of the slots will be such that the cut-off may be varied from 0.5 stroke to 0.72 stroke. The arms will be neatly fitted and properly secured to the reverse shaft by means of keys.

The bearings for the reverse shaft will be secured to the housings, as shown on the drawings, and they will consist of cast-iron brackets and caps, fitted with adjustable brasses, accurately fitted to the journals of the reverse shaft; the caps will be secured by means of stud bolts, nuts, and lock nuts, and an approved lubricating device will be provided for each bearing.

33. WORKING PLATFORM AND HANDLING GEAR.

The height of the engine-room floors and gratings will be as shown on the drawings, and the lower engine-room floor will be conveniently arranged to serve as a working platform. The counter, clock, gauges, telegraph dial, gong, jingle bell, and other engine-room fittings will be placed in approved locations, so as to be in full view from the handling gear. The speaking-tube mouthpieces and the telegraph lever will be near the handling gear, so as to be easily accessible.

There will be at the working platform the following handling gear for the engine, viz: One throttle-valve lever, one reversing lever, three cylinder drain-cock levers, three valve-chest drain-valve handwheels, one bleeder-valve handwheel, two handwheels for the live steam to the receivers, one throttle-valve handwheel for the steam to the reversing engine, and two handles or handwheels for the drains to the reversing engine.

The throttle-valve lever and the reversing lever will work on double quadrants, the other levers will work on single quadrants, and all levers will be clamped by finished composition star wheels. The throttle-valve lever and the reversing lever will be arranged so as to throw in the same direction when the engine is going ahead, and all of the levers and handwheels will be neatly finished and plainly marked so as to indicate their use.

34. ENGINE-ROOM TELEGRAPH, GONG AND JINGLE BELL, AND SPEAKING TUBES.

A mechanical repeating telegraph, as described by the Superintendent of Construction and Repair, United States Revenue-Cutter Service, in the hull specifications, will be fitted in the engine room where directed by the inspector of labor and material for the construction of the steam machinery, with its dial at the working platform and connected to the mechanical telegraphs on the bridge and in the pilot house.

An approved double-hammer engine gong, without tripping gear, 15 inches in diameter, made of polished bell composition and of clear.

tone, will be fitted in the engine room where directed, and properly connected by heavy brass wires, with chains leading over grooved pulleys at all angles, to suitable brass bell pulls that will be provided on the bridge and in the pilot house as directed by the inspector of labor and material for the construction of the hull. There will also be a 5-inch jingle bell, made of polished bell composition and of clear tone, fitted near the gong and connected in a similar manner to brass bell pulls on the bridge and in the pilot house.

Speaking tubes will be fitted for communication between the bridge and pilot house and engine room, between the engine room and fire room, between the senior engineer officer's stateroom and the engine room, and between the senior engineer officer's stateroom and the fire room, as described by the Superintendent of Construction and Repair, United States Revenue-Cutter Service, in the hull specifications. The mouthpieces for the engine-room and fireroom speaking tubes will be of heavy cast composition, neatly finished, and so located as to be easily accessible.

35. STEAM AND VACUUM GAUGES, GAUGE PLATE, REVOLUTION COUNTER, AND CLOCKS.

There will be the following gauges, in polished brass cases, with 8½-inch dials, suitably engraved with the name of the vessel and to show to what part the gauge is connected, mounted on a polished brass gauge plate, which will be secured to an approved framework that will set it off from one of the engine-room bulkheads so that all connections to the gauges may be made at the back of the gauge plate, the gauge cocks being located just below the lower edge of the plate. The gauges will all be of an approved pattern, with seamless tubes, and will be so adjusted that the needle will stand vertical when indicating the working pressure in the part to which the gauge is connected, which point will be marked with red enamel.

One gauge connected to the forward boiler.
One gauge connected to the after boiler.
One gauge connected to the high-pressure valve chest.
One compound gauge connected to the intermediate-pressure valve chest.
One compound gauge connected to the low-pressure valve chest.
One vacuum gauge connected to the main condenser.
One compound vacuum gauge connected to the auxiliary condenser.

Each gauge will have an independent brass-pipe connection to the part to which it is attached, and all gauges indicating steam pressure must have siphons placed below them containing sufficient water to fill the gauge spring when under pressure and to prevent the steam from entering, and so fitted that the water will not be drawn out when the pressure is off the gauge.

In addition to the above-mentioned gauges which are to be mounted on the engine-room gauge plate, there will be approved gauges for the boilers, located in the fireroom; gauges on the branches from the auxiliary steam pipes on the reduced-pressure side of each reducing valve;

gauges on the steam jackets for the main engine cylinders; compound gauges on the evaporator and the feed-water heater; and gauges on the discharge side of all the pumps. These gauges will all be inclosed in polished brass cases, of approved size, and the dials will be engraved with the name of the vessel and of the part to which the gauge is connected.

There will be one revolution counter of the continuous-rotary type, worked by a positive motion, and to register from 1 to 1,000,000, mounted on the engine-room gauge plate. The revolution counter will be of an approved pattern, and will be inclosed in a polished brass case, having an 8½-inch dial, similar to the cases for the gauges, the dial being engraved with the name of the vessel, and the gearing for connection to the main engine shaft will be arranged as approved, and properly secured and protected.

There will be one approved eight-day clock, fitted with a second-hand and inclosed in a polished brass case, having an 8½-inch dial, similar to the cases for the gauges, the dial being engraved with the name of the vessel, mounted on the engine-room gauge plate, and in addition to this engine-room clock there will be a similar clock, inclosed in a polished brass case, having an 8½-inch dial, similar to the fireroom gauges, the dial being engraved with the name of the vessel, mounted in a steel-plate protecting case having a hinged front fitted with heavy plate glass, secured to one of the bulkheads in the fireroom in an approved location.

36. LUBRICATION.

All working parts of the machinery will be provided with approved and efficient means of lubrication. In general, all the oil for the moving parts of the engine will be supplied, as far as possible, from cast-brass oil boxes secured to fixed parts of the engine at convenient points, and having connections for distributing the oil to the various bearing surfaces. Each connection will have an adjusting valve and a sight feed properly protected by a glass tube, and in addition thereto a wick feed will be provided which will supply oil to the same connection. The distributing oil pipes will be of brass, tinned on the inside, and they will lead to wipers on the moving parts or to tubes in the bearings and guides, and the oil boxes will be plainly marked opposite each pipe with the name of the part to which it leads. The oil pipes will be properly led and secured by brass clips, and unions will be fitted to each so that they may be readily taken down, cleaned, and replaced.

There will be one such oil box on each cylinder, from which pipes will lead to the crank pin, crosshead pins, crosshead guide, valve-gear connections, and the valve-stem guide for that engine. The crank pins will be oiled by cups carried on the connecting rods, taking oil from wick drips on the ends of the oil pipes overhead, the oil being carried to the crank-pins by brass pipes secured to the connecting rods, and separate pipes, with deep oil cups, will be fitted for oiling by hand. The crosshead pins will be oiled by cups fitted to the caps, taking oil

from wick drips on the ends of the oil pipes overhead. The crosshead guides will have oil supplied to both sides, and brass oil boxes will be fitted under each guide, and dragglers, secured to the slippers, will distribute the oil over the bearing surfaces. The upper end of each eccentric rod will carry oil cups, deep enough to prevent the waste of oil, and in addition to these cups each eccentric strap will have a deep oil cup, fed by a drip pipe, and so arranged that the eccentric will be lubricated at all times. Each link-block pin will be oiled by two wiper oil cups, and each pair of link-block gibs by one wiper oil cup, all taking oil from pipes overhead.

Cast-brass oil boxes, fitted with sight and wick feeds, and similar in all respects to those above described, will be placed in accessible positions, and about 5 feet above the center line of the crank shaft, so that they may be used for supplying oil for the lubrication of the crank-shaft bearings and the eccentrics. Each main bearing will have two oil tubes, and the oil pipes will be so led and the oil holes so drilled as to introduce the oil at both sides of the bearing near the ends and as near the division between the cap and the lower brass as it is possible. Each main bearing cap will have an approved oil box, with hinged cover, cast on it as before specified.

Oil will be supplied to all of these oil boxes from a 10-gallon copper distributing oil tank that will be located in the engine-room space, as high up as possible. This tank will be well tinned on the inside and fitted with a glass gauge, an air cock, and a filling pipe connected to an approved oil pump that will be mounted in the lower engine room, and arranged so as to take oil from the oil-storage tanks and deliver it to this distributing oil tank. The tank will be connected to all of the cast-brass oil boxes for the engine lubrication by ½-inch brass pipes, tinned on the inside, and fitted with valves so that the flow of oil to each oil box may be controlled at the box.

All the working parts of the main engine, the auxiliaries, and the pumps will have approved oiling devices, and such as will permit of oiling without slowing, and all oiling will be done by means of one oil box wherever practicable. All oil cups, except those cast on the bearings, and all of their fittings will be of cast brass, sheet brass, or copper, with brazed seams for the two last-named materials; all fixed oil boxes will have hinged covers, with stops to prevent their being opened too far, and all oil cups on moving parts will have removable covers.

Brass or copper drip pans, with brazed seams and proper provisions for draining, will be fitted to each crank pit and under each pair of eccentrics, and all other moving parts or fixed bearings will have approved drip pans wherever required.

An approved graphite cup will be fitted to each valve chest of the main engine, the auxiliary engines, and the pumps.

37. WATER SERVICE.

A 2½-inch water-service pipe will be led from a valve on the inlet chest of the salt-water side of the main condenser, with a 2-inch pipe

for the main engine, and a 1-inch branch to the shaft alley, and smaller branches leading to the different parts of the engine and shafting as follows:

One ½-inch pipe, with swivel joint, for each crank-shaft bearing.
One ¾-inch pipe to each main bearing bottom brass.
Two ¾-inch perforated pipes to each crank pin.
Two ½-inch pipes to each crosshead.
One ¾-inch pipe to each crosshead guide.
One ½-inch pipe to each pair of eccentrics.
One ½-inch pipe to each horseshoe of the thrust bearing, and the coil.
One ½-inch pipe to each spring bearing.
One ¾-inch pipe to the stern-tube stuffing box.

All of the water-service pipes, together with the valves and fittings, will be of heavy composition, and each branch will have a separate valve, and will terminate, as directed, in a pivoted nozzle or a permanent connection to the part to be cooled.

In addition to the supply connection from the inlet chest of the salt-water side of the main condenser, as above described, there will be a 2½-inch connection from the distiller-circulating and sanitary pump, as hereinafter specified.

38. THRUST AND SPRING BEARINGS.

The thrust bearing will consist of a cast-iron pedestal, which will be securely bolted to the foundation by 1¼-inch, body-bound, Class B, forged-steel bolts, fitted in reamed holes. The thrust will be taken by nine cast-iron horseshoe rings, lined with approved white metal fitted in dovetailed recesses, accurately fitted to the collars of the thrust shaft, and properly channeled for the distribution of oil, and which will be mounted upon two rolled bronze rods, 2 inches in diameter, on which they will be kept from endwise motion by composition nuts, acting also as distance pieces between the thrust rings. The bronze rods, and with them the nuts, will be arranged so as to permit of endwise adjustment, the rods passing through bosses on the pedestal and being threaded and fitted with composition adjusting nuts. The bosses will be provided with removable caps, and the horseshoes will be held down by vertical bolts passing through the ends of the horseshoes and bearing against a flange on the pedestal.

The weight of the thrust shaft will be taken by two cast-iron bearings which will be secured to facings on the pedestal by 1¼-inch, body-bound, Class B, forged-steel bolts, fitted in reamed holes. These bearings will be provided with bottom brasses, lined with approved white metal fitted in dovetailed recesses, accurately fitted to the journals of the thrust shaft, and properly channeled for the distribution of oil; the caps, which will be made of cast iron, will be recessed away from the shaft, and each cap will have an approved oil box, fitted with a hinged cover, cast on the top. The pedestal will form an oil trough, through which will pass a seamless-drawn copper pipe, so as to provide for the circulation of cooling water, and each horseshoe will be cored out and fitted for water circulation in an approved manner.

The escape of oil at the ends of the pedestal will be prevented by suitable composition stuffing boxes and glands, and a sheet brass cover, provided with a hinged brass door for its entire length so as to afford access to the horseshoes, will be fitted over the thrust bearing and between the horseshoes in such a manner that oil will not be thrown out of the thrust bearing when the engine is in operation.

There will be two spring bearings for the intermediate shaft, which bearings will be made of cast iron, and securely bolted to their respective foundations by $1\frac{1}{4}$-inch, body-bound, Class B, forged-steel bolts, fitted in reamed holes. The lower part, or the bearing proper, will be lined with approved white metal fitted in dovetailed recesses, accurately fitted to the journals of the intermediate shaft, and properly channeled for the distribution of oil, and the caps, which will be made of cast iron, will be recessed away from the shaft, and each cap will have an approved oil box, fitted with a hinged cover, cast on the top.

39. STERN TUBE, BEARINGS, AND STUFFING BOX.

The stern tube will be made of cast iron in one section, $1\frac{1}{4}$ inches in thickness, and it will have two internal flanges, $1\frac{1}{2}$ inches in width, one forward of the after bearing and one aft of the forward bearing, which will be bored to an internal diameter of about $14\frac{1}{4}$ inches and properly faced. The after end of the stern tube will be bored to a diameter of $16\frac{3}{4}$ inches and the forward end to a diameter of $16\frac{15}{16}$ inches. The after end where it passes through the sternpost eye will be turned to a diameter of 20 inches, and there will be an external flange, 21 inches outside diameter and 3 inches in width, which will be recessed $\frac{1}{4}$ inch into the inboard side of the sternpost. The after end beyond the sternpost will be threaded, 4 threads to the inch, and a cast-steel ring nut, 27 inches in diameter and 4 inches thick, will be fitted for securing all in place. This ring nut will be made with a flange at the after side which will extend out in the manner shown on the drawings so as to form a fair-water casing for the hub of the propeller.

There will be two bearings fitted to the stern tube for supporting the propeller shaft, the forward bearing being 28 inches long and the after bearing 50 inches long, the bearings consisting of lignum-vitæ blocks set in composition casings, which will be $\frac{1}{2}$ inch thick from the bottom of the dovetails to the outside of the casing and 1 inch thick elsewhere, the dovetails in the casings being about 2 inches in width. The lignum-vitæ blocks will be well oil soaked and fitted in the casings in such a manner that the wear will come on the end of the grain, and they will be held in the dovetailed grooves by suitable flanges. The orward bearing will be bored to a diameter of $13\frac{15}{32}$ inches and the after bearing to a diameter of $13\frac{9}{32}$ inches, so as to fit $\frac{1}{32}$ inch loose on the propeller shaft, and the after casing will be flanged and bolted to the ring nut on the after end of the stern tube by eight $\frac{7}{8}$-inch rolled bronze tap bolts, one of which will pass through the ring nut and screw into the sternpost in order to lock the ring nut in place.

An approved composition stuffing box, having a packing space 9 inches deep for 1-inch square flax packing, will be fitted and secured at the inboard end of the stern tube; the gland will be of composition and will be secured by six rolled bronze studs, 1 inch in diameter, fitted with rolled bronze nuts and lock nuts.

A 1-inch composition drain cock will be provided and properly connected by brass pipe to the after part of the stuffing box, outboard of the packing, and a brass pipe connection leading to the bilge will be fitted as may be directed.

40. THRUST, INTERMEDIATE, AND PROPELLER SHAFTS.

The thrust shaft will be forged of Class B steel, in one section, 11 inches in diameter, and about 10 feet 6 inches long over all, and it will have nine thrust collars, $1\frac{5}{8}$ inches thick and 19 inches in diameter, with spaces between them of $4\frac{1}{4}$ inches. There will be a coupling disk, $3\frac{1}{4}$ inches thick and $21\frac{3}{4}$ inches in diameter, forged on each end of the thrust shaft, and the coupling disks will each have six $2\frac{5}{8}$-inch holes, drilled and reamed, for the bolts for securing the thrust shaft to the crank shaft and to the intermediate shaft, which bolts will be forged of Class B steel, properly fitted to the holes in the coupling disks and secured by case-hardened wrought-iron nuts and split pins.

The intermediate shaft will be forged of Class B steel, in one section, $10\frac{3}{4}$ inches in diameter, and about 19 feet 8 inches long, over all, and a coupling disk $3\frac{1}{4}$ inches thick and $21\frac{3}{4}$ inches in diameter will be forged on each end. The coupling disks will each have six $2\frac{5}{8}$-inch holes, drilled and reamed, for the bolts for securing the intermediate shaft to the thrust shaft and to the propeller shaft, which bolts will be forged of Class B steel, properly fitted to the holes in the coupling disks and secured by case-hardened wrought-iron nuts and split pins.

The propeller shaft will be forged of Class B steel, in one section, $11\frac{3}{4}$ inches in diameter and about 20 feet 3 inches long, over all, the exact length to be taken from the work. At the forward and after bearings it will be covered with composition casings, $1\frac{3}{16}$ inch thick for the forward bearing and $\frac{3}{4}$ inch thick for the after bearing, shrunk on the shaft and secured from turning by four $\frac{1}{2}$-inch countersunk head-rolled bronze screws. Between these bearings the shaft will be incased in a seamless-drawn brass tube, $\frac{1}{8}$-inch in thickness, let into recesses in the forward and after casings, the joints being well soldered. The after end of the casing at the after end of the propeller shaft will enter the propeller hub $\frac{3}{4}$ inch, and the forward end of the forward casing will extend about 6 inches forward of the gland of the stern tube stuffing box. There will be a coupling disk, $3\frac{1}{4}$ inches thick and $21\frac{3}{4}$ inches in diameter, forged on the forward end of the propeller shaft, and it will have six $2\frac{5}{8}$-inch holes, drilled and reamed, for the bolts for securing the propeller shaft to the intermediate shaft, which bolts will be forged of Class B steel, properly fitted to the holes in the coupling disks, and secured by case-hardened wrought-iron nuts and split pins. The after end of the propeller shaft will be tapered, threaded, and fitted for securing the propeller in place.

The shafts will be finished all over, the journals carefully trued, and all will be adjusted so as to be in accurate alignment with the vessel at load draft and ordinary stowage.

41. PROPELLER.

There will be one right-handed propeller, with four blades, and of the built-up type, 12 feet 3 inches in diameter, and with a pitch and helicoidal area as directed. The blades will be of Monel metal, and the hub of manganese bronze, and each blade will be firmly secured to the hub by manganese bronze studs and nuts properly locked in place. The centers of the blades at the periphery will be about 12 inches aft of the center of the hub, and the flanges of the blades will be turned to fit the recesses in the hub, and after being secured in place the edges must be made fair. The propeller blades and the hub must be cast as smooth as possible, and all will be finished to a smooth surface. The hub will be bored to fit the taper on the end of the propeller shaft, to which it will be secured by a feather key, and held in place by a Class B forged-steel nut, screwed on the shaft and locked in place and covered by a composition cap, bolted to the after end of the hub and made water-tight. The composition casing on the after end of the propeller shaft will enter ¾ inch into the hub of the propeller, and the joint will be made water-tight.

A cast-iron template made to accurately correspond to the taper on the end of the propeller shaft and to fit the hole in the hub of the propeller will be furnished for use in case it becomes necessary to fit a new propeller.

Suitable eyebolts will be attached to the hull, where directed, for the purpose of rigging gear for lifting the propeller when removing it in dry dock.

[See proposal for alternate bids on propeller; manganese bronze and cast steel.]

42. BOLTS AND NUTS.

All bolts and nuts less than 2 inches in diameter will conform to the United States standard unless otherwise specified, and the threads in all cases will be in accordance with this requirement. All finished bolts, except as may be otherwise directed, will be kept from turning by dowels, set screws, or other approved device, and the nuts of all bolts on moving parts and on the main journals, the shaft bearings, and elsewhere as directed, will be fitted with approved keepers, and the bolts will extend beyond the nuts, without threads, and will be drilled and fitted with split pins.

43. FLOOR PLATES AND GRATINGS.

The engine room, the fireroom, the shaft tunnel, and the passages will be floored with steel plates at least ⅜ inch in thickness, and having neatly matched corrugations on the top, running fore and aft. The floor plates will be of convenient size for handling, and will rest on ledges

and bearers of angle or T bars; they will be secured by standard ½-inch countersunk-head brass bolts, the heads being slotted to admit a screw-driver; and in places where the floor plates are subject to heavy shocks they must be well supported and stiffened by doubling plates underneath. Care must be taken to fit the floor plates around the boilers, the engine bedplate, the auxiliary machinery, and the pumps, so that dirt and ashes will not fall into the bilges; drain holes and hand-holes fitted with neat plates will be cut where required; and neat margin angles and ash guards will be fitted and secured along the outer edges of all floor plates as may be directed.

Gratings built up of ⅝-inch square steel bars spaced 2½ inches center to center will be provided for access to all parts of the main engine and the auxiliary machinery in the engine room, and to the boilers in the fireroom, as shown on the drawings, or as may be directed, and where gratings, if fitted, would come over moving parts of the machinery, neat corrugated plates, similar to those used for the floor plates, will be provided.

44. LADDERS AND HAND-RAILS.

Ladders will be fitted wherever necessary to afford access to the engine room and the fireroom from deck, and to reach the various gratings, passages, and parts of machinery. The engine-room ladders will be 23 inches wide in the clear, and will be made with steel plate sides and light steel safety treads having lead-filled corrugated tops with continuous grooves, and there will be a strip of safety treads, not less than 12 inches in width, at the top and bottom landings of each ladder. The fireroom ladders from the deck to the gratings and to the small gratings will have steel plate sides and square double-bar steel treads; the ladders from the gratings to the fireroom floor plates will be made of square steel bars bent over and riveted to the bulkheads. All ladders, except those on the fireroom bulkheads, will be fitted so as to be easily removed and replaced, and they will be jointed and hinged, with the necessary fittings and gear, where they have to be moved when closing hatches, or elsewhere as may be directed.

Hand-rails made of seamless-drawn steel, polished all over, and supported by finished forged steel stanchions, will be fitted to all platforms, gratings, and ladders, and along the passages and on the bulkheads as may be directed. The stanchions will be perpendicular to the platforms, gratings, and ladders, and will be secured by pads or nuts on the lower ends, so as to be easily removed and replaced.

45. FIREROOM AND PASSAGES.

The fireroom and passages, gratings, and ladders will be arranged as shown on the drawings, and approved means will be provided for closing the fireroom space air-tight when using the forced-draft system that will be installed as hereinafter specified.

Racks and clips will be fitted wherever required for holding the fire tools, steam tube cleaners, ash hose, and wrenches used in the fireroom

and for stowing the ash-pit doors, coal and ash buckets and other gear connected with the boilers.

46. MAIN BOILERS.

There will be two boilers of an approved marine water-tube type, designed for 200 pounds working pressure, having straight tubes not less than 4 inches in diameter and both located in the same water-tight compartment, as shown on the drawings.

The general dimensions of the boilers will be about as follows:

Length over casing at bottom	10 feet $\frac{7}{8}$ inch.
Width over casing	14 feet 6 inches.
Height to center of drum	13 feet $2\frac{5}{8}$ inches.
Total grate surface, both boilers	181 square feet.
Length of tubes	9 feet.
Total heating surface, both boilers (about)	6,270 square feet.

All details of the boilers must be subject to the approval of the Engineer in Chief, United States Revenue-Cutter Service, and all material and workmanship must be first class in every particular and as required by the "Specifications for inspection of material."

All parts of the boilers subjected to pressure will be of wrought steel, and there will be no screwed joints in contact with the fire. Welded or flanged plates will be of open-hearth steel, Class B, and all other plates will be of open-hearth steel, Class A. The steam and water drums will be 42 inches inside diameter, and the drumheads will be hydraulic-forged in a single heat, and the edges will be machined off true. The longitudinal seams of the drum shells will be butted and strapped, both inside and outside, the butt straps being formed under hydraulic pressure to the curvature of the drum. All rivet holes will be drilled with the plates in position, and after the holes are drilled the plates will be separated, the burrs removed, and the plates reassembled, metal to metal, with parallel turned bolts fitting the holes preparatory to riveting. All rivets will be standard and made from open-hearth steel, Class B, rivet rods, except those for the longitudinal joint for the drum, which will be made from open-hearth steel, Class A, rivet rods. All riveting will be done by hydraulic pressure wherever possible, and where hydraulic riveting can not be used the rivet holes will be coned and conical rivets driven in place. No snap riveting will be used on any part of the boilers except the casings, and all seams will be properly calked.

The tubes will be straight, not less than 4 inches in diameter and 9 feet long, and will be cold-drawn seamless steel tubes, the best that can be obtained on the market.

There will be 11-inch by 15-inch manholes flanged in the drumheads and reinforced by a ring of sufficient width to make, with the edge of the plate, a seat 1 inch in width for the manhole plate gasket. The plates, studs, dogs, and nuts will be of wrought steel, and the plates will be faced and turned to a true form to fit the manhole openings. Steel

plate templates of the proper size of the manhole plate gaskets will be furnished, and all plates, dogs, nuts, and templates will be plainly marked to show to what holes they belong.

The fronts of the boilers will be of the wrought-steel plate pattern, each containing four furnace doors formed of $\frac{1}{2}$-inch steel plate and properly fitted to the flanged door frames formed of the same material. Each furnace door will have a cast-iron liner for protection from the heat of the fire, a slicing door, a latch for holding the door either open or closed, and supporting hinges so fitted that any sagging may be taken up.

There will be steel plate ash-pit doors with handles for portability, suitable means for fastening when in place and for stowing when not in use, and portable lazy bars with hooks for supporting when in use and for stowing when not in use, will be fitted to both furnace and ash-pit doors.

The dead plates will be of cast iron and so fitted that they may be easily removed and replaced. The grate-bar bearers will be of forged steel, supported in an approved manner; and the grate bars will be of cast iron of approved pattern, interchangeable, and so fitted as to be readily removed and replaced without hauling fires.

The boiler casings will be air-tight and made of galvanized steel, not less than No. 16 United States standard gauge in thickness, stiffened in an approved manner and lined with magnesia at least 2 inches in thickness with asbestos board $\frac{1}{4}$ inch thick inside of the magnesia lining. Wherever the casings are not adequately protected from the impact of the flames by the tubes fire brick of special form, not less than 2 inches thick, will be fitted inside of the asbestos board and the magnesia lining. The casings will be made in sections, fitted so as to be easily removed and replaced, and there will be doors and such other openings in the casings as are necessary for the proper care, examination, and cleaning of the boilers, and so that all parts will be readily accessible.

The uptakes will be made of two thicknesses of steel plate built on angle, channel, or Z bars, so as to leave at all points a clear area of at least one-seventh of the grate area, and there will be a 3-inch air space between the uptakes and the outer casings. The uptakes will be supported by channel beams, as shown on the drawings, and will be secured to the boiler casings, the construction being such that the uptakes and the uptake casings will be free to expand, each independently of the other. The uptakes will be of No. 8 United States standard gauge plate, and the casings of not less than No. 11 United States standard gauge plate, and they will be connected together so as to form one common opening for the smoke pipe. An approved balanced damper will be provided for each uptake and arranged so as to be operated from the fireroom floor. A division plate will be fitted in the uptakes, as shown on the drawings, and means will be provided for access to the inside of the uptakes for examination and cleaning.

The boilers will be secured in the vessel on suitable foundations, as described by the Superintendent of Construction and Repair, United States Revenue-Cutter Service, in the hull specifications, and they will

be well chocked and braced in all directions and so as to be secure against possible displacement.

Ash guards will be fitted around the boilers and in the fireroom passages. They will be made in sections and so as to be readily removed and replaced for the purpose of cleaning under and around the boilers. If it is necessary, in order to make that part of the vessel under the boilers accessible for examination, cleaning, and painting, the ash pans will be made in sections and removable, the fronts of the boiler casings being made in sections and bolted together so as to be readily removed and replaced.

47. SMOKE PIPE.

There will be one smoke pipe common to both boilers, consisting of the smoke pipe proper, which will be built of No. 7 United States standard gauge plate, 5 feet 9 inches inside diameter, and the outer casing, which will be built of No. 12 United States standard gauge plate, 6 feet 9 inches inside diameter, so that there will be a 6-inch air space between the smoke pipe proper and the casing. The smoke pipe will be about 51 feet high above the grates, and the weight of the smoke pipe will be taken by channel beams worked across the top of the boiler hatch, as shown on the drawings.

The inside of the smoke pipe proper and the outside of the casing will be flush riveted, and the smoke pipe proper and the casing will each be stiffened by four angle or T bars extending the full length, and the stiffeners and the butt straps will be within the air space, the stiffeners on the smoke pipe proper alternating with the stiffeners on the casing, and all being arranged to serve as distance pieces. The stiffening angles opposite the guy shackles will also be fitted to serve as distance pieces, and these and all other fittings will be so arranged as to leave the smoke pipe proper and the casing free to expand, each independently of the other.

The smoke pipe proper will be finished at the top by an angle bar and a cape, which will extend down to within 3 inches of the top of the casing, thus leaving a sufficient area for the escape of the heated air, and the casing will be finished at the top by a half-round bar, all as shown on the drawings.

Stay shackles will be secured to the cape for slinging painters, and there will be six ½-inch eyebolts on the upper side, near the outer rim, for securing a canvas cover.

The smoke pipe will be stayed by guys and turn-buckles, each guy shackle being secured to a triangular palm or flange fitted to the casing with three ⅝-inch bolts which will pass through the palm, the casing and an inside guy band or stiffening ring, about 6 inches wide and ¼ inch thick, which will be fitted and secured to the inside of the casing at the point of attachment of the guy palms.

The lead of the smoke pipe guys will be as arranged by the inspector of labor and material for the construction of the steam machinery and the inspector of labor and material for the construction of the hull, and the turn-buckle at the lower end of each guy will be secured to an approved fitting on the hull structure.

There will be a ladder on the outside of the casing on the forward side extending to the top. This ladder will be made of round bar steel, bent to form rungs and properly secured by riveting to the casing.

The outside of the smoke pipe proper and the inside of the casing will be given two coats of paint before securing them together.

48. WHISTLE AND SIREN.

There will be an approved polished brass whistle with a bell about 7½ inches in diameter and 30 inches long, and a polished brass siren of approved pattern and size, located on the forward side of the smoke pipe at a suitable height above the bridge deck. The valves for operating the whistle and the siren will be of the compound pattern, as approved, and wire connections will be properly led to whistle and siren pulls that will be located on the bridge and in the pilot house as directed by the inspector of labor and material for the construction of the hull. There will be a separate whistle steam stop valve on each boiler, and from these valves a 2-inch copper pipe will be led, uniting into one 2-inch copper pipe that will be connected to a 2-inch extra heavy seamless-drawn brass pipe that will be led up inside the smoke pipe, as shown on the drawings, in order to furnish steam for the whistle and the siren. All pipes will be led in such a manner as to avoid all pockets, so that the pipes will drain back to the boilers, and they will be properly braced and secured.

49. BOILER ATTACHMENTS.

Each boiler will have the following attachments of approved design, viz: One twin spring safety valve, one steam gauge, two glass water gauges, four gauge cocks, one sentinel valve, one main steam stop valve, one auxiliary steam stop valve, one whistle steam stop valve, one dry pipe, one main feed check and stop valve with internal distributing nozzle, one auxiliary feed check and stop valve with internal distributing nozzle, one surface blow valve with internal pipe and scum pan, one or more bottom blow valves, a connection for drawing off water for testing, an air cock, and zinc protectors, with baskets for catching pieces of disintegrated zinc.

All the external fittings on the boilers will be of composition, unless otherwise specified, and will be flanged and through bolted, or attached in other approved manner, and all cocks, valves, and pipes, unless fitted on pads, will have spigots or nipples passing through the boiler plate. All the internal pipes will be of steel, and they will be expanded in the boiler plate to fit the nipples on their respective valves, or they will be connected by flanges and through bolts in an approved manner, and all will be properly led, braced, and secured.

50. BOILER SAFETY-VALVES AND ESCAPE PIPE.

There will be an approved twin spring safety valve located on each boiler as shown on the drawings, consisting of a base and casing of cast iron, and fitted with two valves, each valve being 3¼ inches in diameter and made of composition. The valve seats will be of solid nickel,

screwed into the top of the base, and the valve stems will be of rolled bronze. The springs will be of the best quality spring steel, square in section, and of such a length as to allow the valves to lift one-eighth of their diameters when set so that the valves will blow at 200 pounds pressure per square inch. They will have spherical bearings at the ends, or they will be connected to the compression plates in such a manner as to insure a proper distribution of the pressure, and they will be inclosed in casings, so arranged that the steam will not come in contact with them, and so fitted that the valves can be removed without slacking the springs. The valve stems will fit loosely in the valves, to bottom below the level of the seats, and they will be secured so that the valves may be turned by a wrench or crossbar on top of the stem, and the valves will be guided by wings below and in an approved manner above. Each valve will have a projecting lip and an adjustable ring for increasing the pressure on the valve when lifted, or some other approved device for attaining the same result. An approved mechanism will be fitted to each safety valve for lifting the valves by hand from the fireroom floor, and the lifting gear will be properly fitted with composition bushings at each joint, so as to work freely; it will be so arranged that the valves will be lifted successively. Gags will be provided with each safety-valve so that the valves may be held seated when testing the boilers.

The outlet nozzle will be in the base casting, so that the joint at the escape pipe will not have to be broken when adjusting the valves, and there will be a brass drainpipe connection from each safety valve, properly fitted below the valve seats, led to a tank, made of galvanized steel plate, located as shown on the drawings, and provided with a valve and pipe for drawing off the water.

There will be an approved 7-inch copper escape pipe located abaft the smoke pipe, extending to the top, and finished and secured in a neat manner. The escape pipe will have 5-inch branches leading from the safety valves on the boilers, and the auxiliary exhaust pipe will also be connected to the escape pipe, as hereinafter specified.

51. BOILER STEAM GAUGES.

There will be one approved steam gauge for each boiler, located and secured in a conspicuous position on one of the fireroom bulkheads, and so as to be easily read from the fireroom floor. The gauges will have 8½-inch dials, graduated to 400 pounds, inclosed in polished brass cases, and will be so adjusted that the needle will stand vertical when indicating the working pressure of 200 pounds, which point will be plainly marked with red enamel.

Each gauge will be properly connected to its boiler by heavy brass pipes, fitted with the necessary siphon, drain cock, and valve at the boiler, which will be made with a guarded valve stem and a detachable key or wrench for opening and closing the same. Each valve will be provided with openings for the connection of the pipes leading to the boiler pressure gauges in the engine room and fireroom, and for the attachment of a standard test gauge, the latter opening being fitted with a heavy brass plug.

52. BOILER WATER GAUGES.

There will be two approved glass water gauges, one of the ordinary and one of the reflex type, and both fitted with automatic self-closing valves, fitted to each boiler as shown on the drawings. The glasses will be about 12 inches long for the exposed portion; they will be surrounded by brass wire-mesh shields and protected by guards, and the reflex gauges must be so designed that they will fit the ordinary gauge-glass mountings, in order that the two kinds may be interchangeable. All parts of the gauge-glass mountings will be of composition, and the shut-off cocks will have a clear area of at least $\frac{1}{2}$ inch diameter; they will be packed cocks provided with approved means for operating them from the fireroom floor. The blow-out connections will be fitted with brass valves and pipes leading to the bilge, brass unions being fitted, where required, in order that the pipes may be readily taken down and replaced.

53. BOILER GAUGE COCKS.

There will be four composition gauge cocks of an approved pattern fitted on each boiler, and provided with suitable means of operation from the fireroom floor. Each gauge cock will be independently attached to the boiler, and the valve chamber will have two seats, the inner one formed in the casting and the other movable, screwed into the casting and provided with a handle. The valve will have two faces, and will be closed by screwing down the movable seat, and opened by the pressure in the boiler when the outside seat is slackened off. There will be a guide stem on each side of the valve, the valve and stem being turned from one piece of rolled bronze, circular in section where it passes through the movable seat, triangular in section at the inner end, and square in section at the outer end, projecting $\frac{3}{4}$ inch beyond the movable seat, in order that a wrench may be fitted to the same. The opening of the valve will be at least $\frac{3}{8}$ inch in diameter, and the discharge from the chamber will be at least $\frac{1}{4}$ inch in diameter; a brass or copper drip pan, with a brass pipe connection leading to the bilge, will be fitted under each set of gauge cocks.

54. BOILER SENTINEL VALVES.

Each boiler will be fitted with a sentinel valve of approved design made of composition, $\frac{1}{2}$ square inch in area, and set to blow at 210 pounds pressure per square inch.

55. MAIN, AUXILIARY, AND WHISTLE STEAM STOP VALVES.

There will be a 6-inch, cast-iron, brass-mounted stop valve for the main steam connection; a 4-inch, cast-iron, brass-mounted stop valve for the auxiliary steam connection; and a 2-inch composition stop valve for the whistle steam connection, located and secured on each boiler as shown on the drawings. The valves will all be of approved design, arranged so as to close against the boiler pressure, and the handwheels

of the main and the auxiliary steam stop valves will be fitted with extension rods so that these valves may be opened or closed from a location outside of the fireroom space.

56. BOILER DRY PIPES.

There will be an approved dry pipe fitted to the steam drum of each boiler, extending for nearly the full length, and made of steel, perforated on the upper side with longitudinal slits or holes of such a number and size that the sum of their areas will equal the area of the main steam pipe. The dry pipes will be properly secured in the drums, and the ends will be connected to the main and to the auxiliary steam stop valves.

57. MAIN AND AUXILIARY FEED CHECK AND STOP VALVES.

There will be one main feed check valve and one auxiliary feed check valve located on each boiler, as shown on the drawings, with a stop valve between each check valve and the boiler. These feed check and stop valves will be made of composition, of approved design, 2 inches in diameter, and the bodies of the check valves will be so arranged that the outlet nozzle will be at least ½ inch above the valve seat. The check valves will be assisted in closing by spiral springs, made of phosphor-bronze, and the handwheels will be fitted with suitable gear for regulating the feed from the fireroom floor. The discharge openings from the main and the auxiliary feed stop valves into the drums will be fitted with internal nozzles of approved design, arranged with scattering hoods or plates of such a form that the air that may enter the boilers entrained in the feed water will be separated at the discharge nozzles, and escape with the steam through the dry pipes.

58. BLOW VALVES AND PIPES, AND PUMPING-OUT CONNECTIONS.

There will be a 1½-inch surface blow valve and one or more 1½-inch bottom blow valves on each boiler, located as shown on the drawings. These blow valves will be made of composition, of approved design, and will be arranged to close against the boiler pressure. The surface blow valves will each be provided with an internal pipe and scum pan, properly secured in the boiler drum. There will be 1½-inch copper pipes led from the surface blow valves, and connecting to the bottom blow valves, from which 1½-inch copper pipes will be led to 2-inch composition sea valves, of approved design, that will be secured to the hull plating in the fireroom compartment, and so located as to be easily accessible. There will be a flanged opening on one of these sea valves, with a flanged composition valve fitted to the same, for the connection to the hose for wetting down ashes.

There will be approved 2-inch copper pipe connections, fitted with valves, as required, to make the system entirely independent, between

the blow pipes and the fresh-water suction manifold at the general service pump, in order that the boilers may be pumped out when so desired.

59. BOILER AIR COCKS.

A ½-inch composition air cock, of approved design, will be provided and properly secured at the highest point of each boiler.

60. VALVES FOR DRAWING OFF WATER FOR TESTING AND TESTING OUTFIT.

There will be a ½-inch valve, made of composition, and of approved design, fitted to each boiler, where directed, and properly connected up with ¼-inch brass pipe and valve, for the purpose of drawing off water for testing.

A testing outfit, including all chemicals, graduates, burettes, test tubes, and bottles required to make an accurate determination of the chlorine present in any sample of the boiler water by means of a quantitative analysis by the volumetric method, will be furnished.

This testing outfit will comprise:

One burette of 10 cubic centimeters capacity, graduated to $\frac{1}{10}$ cubic centimeter, and fitted with a glass stopcock.
Three 6-inch test tubes.
Three 5-inch test tubes.
Six glass droppers.
500 cubic centimeters standard solution of silver nitrate, 4.738 grams in 1,000 grams of distilled water.
125 cubic centimeters standard solution of silver nitrate.
50 cubic centimeters 10 per cent solution pure potassium chromate.
50 cubic centimeters methyl orange.
50 cubic centimeters 25 per cent solution of phenolphthalein in alcohol.
50 cubic centimeters 5 per cent solution nitric acid.
50 cubic centimeters 5 per cent sodium carbonate.
Four glass-stoppered bottles, each of 50 cubic centimeters capacity.
Four test-tubes brushes.
Three sealed tubes of blue litmus paper strips.
Three sealed tubes of red litmus paper strips.

The testing outfit will be fitted in a neat wooden locker, made with a hinged door provided with a lock and a catch for holding the door wide open when so desired, which will be secured to a convenient bulkhead in the engineer's office. The locker will have shelves and racks for holding the reagent bottles, spare bottles, test tubes, glass droppers, tubes of litmus paper, and tube brushes, and the burette will be clamped to a wooden frame which will be fitted to the locker so as to be swung out when in use or swung back into the locker when not in use, and means will be provided for securing this swinging frame in either position as may be desired.

61. ZINC BOILER PROTECTION.

Zincs for the protection of the boilers will be fitted, as is customary in water-tube boilers, and these zincs will be arranged in baskets, perforated on the sides but not on the bottom, and properly secured in the boiler drums.

62. FIRE TOOLS, ASH AND COAL BUCKETS, WHEELBARROW, ASH HOSE, AND STEAM TUBE CLEANERS.

A complete set of fire tools including one long and one medium length slicing bar, one long and one medium length fire hoe, one long and one medium length ash hoe, one pricker bar, and one devil's claw, will be furnished for each boiler, and racks will be fitted in the fireroom, in convenient locations, for holding the fire tools when not in use.

There will be two ash buckets and two coal buckets furnished for use in the fireroom; the bodies of the buckets being made of No. 14 United States standard gauge steel plate, and the bottoms of No. 11 United States standard gauge steel plate which will rest on a steel stiffening ring, $\frac{1}{4}$ inch thick and $1\frac{1}{4}$ inches deep, riveted to the body of the bucket and further secured by steel plate clips, and there will be a similar stiffening ring fitted around the top of each bucket and riveted to the body. The coal buckets will each have two bent handles, made of $\frac{1}{2}$-inch round steel, riveted to the inside of the bucket and flared out so as to give a good grip when the bucket is full of coal, and the ash buckets will be balanced dump buckets, of the proper diameter to hoist through the fireroom ventilators; each will be fitted with a swinging bail made of 1-inch round steel, firmly secured to the body of the bucket, with stiffening rings around the rivets both inside and outside.

A wheelbarrow, made of steel plate, and fitted with one wheel and two legs at the handle end, and of suitable dimensions to use in the passages alongside the boilers, will be furnished for use in handling coal from the forward and after bunkers.

Two sections of ash hose, fitted up complete with nozzles and couplings for attachment to the pipe connection from a valve on one of the sea valves for the boiler blows, will be furnished, and a rack will be fitted in the fireroom, in a convenient location, for stowing the ash hose when not in use.

Two steam tube cleaners of an approved design, each fitted with a steam hose connection of sufficient length to reach all the tubes in both boilers, will be furnished, and racks will be fitted in the fireroom, in a convenient location, for stowing the hose and tube cleaners when not in use. Steam for the tube cleaners will be taken from the auxiliary steam pipe, through an approved valve and pipe connection, fitted with a coupling for the attachment of the steam hose.

63. VENTILATORS AND ASH HOISTS.

There will be two 21-inch ventilators in the engine room and two 27-inch ventilators in the fireroom, located and arranged as shown on the drawings. They will be made of No. 10 United States standard gauge steel plate, and will be butted, single-strapped, flush riveted, and fitted with angle-bar stiffeners. The cowls will be movable, properly supported, and fitted with base rings made of cast iron, heavily galvanized, machined on the working parts, but left unfinished on the outside, and approved gear will be provided for turning them by hand from below decks.

Suitable openings, having doors fitted with heavy composition hinges and latches and hooks for holding them open or closed, will be provided in the fireroom ventilators for hoisting ashes out of the fireroom, and eyebolts will be secured in the ventilators, and double-purchase ash whips furnished, so that the ash buckets, before specified, may be easily handled and emptied overboard through ash chutes that will be fitted as approved by the Superintendent of Construction and Repair, United States Revenue-Cutter Service. The lower ends of these ventilators will also be provided with hinged doors, setting up on rubber gaskets, and arranged so that the fireroom may be closed air-tight when using the forced-draft system.

64. ASH EJECTOR.

There will be one hydropneumatic ash ejector of approved design located in the fireroom as shown on the drawings, and properly secured to a substantial support. It will have a 3½-inch copper-pipe connection from the discharge manifold of the general service pump, valves and cocks being fitted where required so as to regulate the water supply, and the overboard discharge pipe will be of cast iron, having an internal diameter of at least 6 inches. This discharge pipe will be made extra heavy, and will be provided at the bends with renewable cast-iron blocks, held in place by a cover secured by bolts and nuts, and one spare set of blocks will be furnished for each bend so fitted in the pipe.

65. FORCED-DRAFT FAN OR BLOWER.

There will be furnished, secured in place, and connected up as directed, one approved forced-draft fan or blower of the multiple-bladed type, driven by a steam turbine of approved design, both to be mounted on a common bedplate, and located in a separate compartment on the main deck as shown on the drawings. The forced-draft fan or blower will take air direct without the intervention of ducts, and will discharge through a short duct to the fireroom compartment, the forced draft being of the closed-fireroom system. The fan or blower must be of such dimensions as to be capable of supplying with ease sufficient air to maintain the maximum rate of combustion in the furnaces of the boilers, and the turbine will be designed to operate condensing or noncondensing with steam at boiler pressure, and an additional nozzle will be fitted for use with lower steam pressures. The shaft bearings will be accessible while the turbine is in motion, and

they will be lined with approved white metal fitted in composition boxes, easily removable, and the bearings, together with their lubricating devices, must be thoroughly protected from dust. The fan or blower casing must be made so that all moving parts and bearings can be examined and adjusted without cutting out rivets, and one spare set of shaft bearings complete, one spare rotor for the turbine, and one spare shaft for the turbine, will be furnished. Steam for the turbine will be taken from the auxiliary steam pipe through approved valves, fittings, and copper pipes, and the exhaust will be to the main and auxiliary condensers through a full-size direct-exhaust connection, and also to the atmosphere through the escape pipe, valves being provided in these exhaust pipes where required to make the systems independent and complete in every detail.

66. GENERAL REQUIREMENTS FOR PUMPS.

Complete detail drawings of all pumps will be submitted for approval and the material of all parts will be plainly stated on these drawings.

The water cylinders, together with their valve chests, except for the independent bilge pump, the distiller circulating and sanitary pump, and the evaporator feed pump, will be made of cast iron, fitted with composition liners, at least $\frac{1}{4}$ inch in thickness, extending from head to head and properly secured in place. The water pistons, plungers, and fittings will be made of composition; the pump rods will be made of rolled bronze; and all working parts except the steam pistons and valves will be made of steel. All pins for the valve-gear connections will be hardened and ground, and all stuffing boxes, followers, and glands will be made of composition, and those for the piston rods and valve stems for the steam ends will be fitted with approved metallic packing. All pumps, including the attached air pump, will be fitted with composition valves and seats for the water ends, the valve springs being made of phosphor-bronze, and the discharge side of each pump will be fitted with a relief valve, of approved pattern, having an outside spring of phosphor-bronze. Air chambers of approved pattern and material will be provided for the suction and discharge sides of all the pumps, except the attached air pump, which will be fitted with a 10-inch copper standpipe on the discharge side as hereinafter specified; drain valves, piped to the bilge, will be fitted to the steam cylinders of all pumps, and pet cocks will be fitted to the water ends where required, all valves, cocks, fittings, and pipes used in making these drain connections being of brass, and properly led, braced, and secured with unions so as to be readily disconnected and replaced. An approved pressure gauge, having a $4\frac{1}{2}$-inch dial, and inclosed in a polished brass case, will be properly connected by means of a brass valve and brass pipe to the discharge side of each pump; the dials of these gauges will be engraved with the name of the vessel and the pump to which each gauge connects, and each will be mounted in a convenient location near its pump.

The pumps will be so placed that the pistons and the valves may be readily examined at any time, or the piston rods drawn, and the water cylinders of the pumps will be so arranged that the pistons and the

plungers may be easily packed without disturbing the framing of the pump or the pipe connections. The covers of the water cylinders will be flanged, and in all the pumps fitted with water pistons the openings left when the covers are removed will be large enough to draw the pistons. Jack bolts and eyebolts will be fitted to the pumps where required, and all parts will be arranged for convenient examination and adjustment. An approved graphite cup will be fitted to the steam-valve chest or chests on each pump, and efficient means of lubrication will be provided for all parts.

All pumps will be provided with the necessary valves, pipes, and suction and discharge manifolds that are required to make each system complete in every detail, and all connections must be shown on the pipe plans and be made to the satisfaction of the Engineer in Chief, United States Revenue-Cutter Service.

67. PUMPS AND PUMP CONNECTIONS.

There will be the following pumps of approved design, located as shown on the drawings, or as may be directed:

No.	Pumps.	Kind.	Size (inches).	Suction pipes from—		Discharge pipes to—		Location.
					In.		*In.*	
1	Circulating	Vertical, centrifugal	26″ runner, 6″ x 8″ engine.	Sea	10	Main condenser	10	Engine room.
1	Air	Attached, worked by beams from I. P. crosshead.	22″ diameter, 16″ stroke.	Bilges	6	Overboard	10	Engine room.
				Main condenser	....	Feed and filter tank.	6	On main engine.
1	Main feed	Vertical, double-acting, duplex, outside, center-packed, plunger.	8″ x 5″ x 10″	Feed and filter tank.	4	Main feed pipe	3	Engine room.
				F. W. side of auxiliary condenser.	2	Feed and filter tank.	2	Engine room.
				Sea	7			
				Bilges, direct	6			
				Bilges	3½	Fire main	5	
				Fresh water tanks	2	Overboard	5	
1	General service.	Vertical, double-acting, duplex.	14″ x 8½″ x 12″	Trimming tanks	2	Auxiliary feed pipe	3	
				Boilers	2	Feed and filter tank.	3	Do.
				F. W. side main condenser.	3½	S. W. side main condenser.	5	
				Feed and filter tank.	3½	Ash ejector	3½	
2	Bilge	Attached, worked by beams from I. P. crosshead.	3½″ diameter, 16″ stroke.	Engine-room bilges	2½	Overboard through one 3½-inch pipe.	2½	On main engine.
1	do	Vertical, double-acting, simplex.	8″ x 10″ x 12″	Bilge, direct	5	Overboard	4	Engine room.
				Bilges	3½			
1	Distiller circulating and sanitary.	do	do	Sea	4	Distiller condenser and overboard.	2½	
						Sanitary system	2½	Do.
						Water service	2½	
						Fire main	3	
1	Evaporator feed.	do	3½″ x 2½″ x 4″	Sea	1			
				Outboard discharge from main condenser.	1	Evaporator	¾	Do.
1	Fresh water	do	4½″ x 4″ x 6″	Fresh-water tanks and trimming tanks.	1¼	F. W. tanks on deck.	1	Do.
						Feed-measuring tank	1	
1	Hand deck	Double-acting	5-inch	Sea	2½	Hose connection	2½	On deck, where directed.
				Bilges	2½			

68. CIRCULATING PUMP.

There will be one approved circulating pump of the centrifugal type, with a casing of cast iron, and a runner or impeller 26 inches in diameter, made of composition, finished on the outside and perfectly balanced. The shaft will be an extension of the engine shaft, fitted with a heavy composition casing, and the bearing will consist of lignum-vitæ blocks secured in a composition sleeve made in halves, the blocks being set so that the wear will come on the end of the grain. Suitable provisions will be made to prevent the sleeve from turning, and a composition stuffing box with a gland made in halves will be fitted. There will be an air cock at the top of the casing and a drain cock at the bottom.

The runner or impeller will be driven by a vertical engine, having a cylinder 6 inches in diameter by 8 inches stroke, mounted on a common bedplate with the centrifugal pump, which will be properly secured to a substantial foundation, and located in the engine room as shown on the drawings. The engine will be of the open type, having the cylinder supported by a cast-iron housing at the back and a finished steel column at the front; the crank shaft, piston rod, connecting rod, and valve stem will be forged of Class B steel, and the eccentric strap and the stuffing boxes will be made of composition. Efficient means of lubrication will be provided for all parts, and an approved graphite cup will be fitted to the valve chest.

Steam for the engine will be taken from the auxiliary steam pipe through approved valves, fittings, and copper pipes, and the exhaust will be to the auxiliary exhaust pipe through similar connections, valves being fitted at the engine in both the steam and exhaust pipes, and the steam or throttle valve being arranged so as to be operated from a location at or near the working platform.

The inlet nozzle on the pump will be 10 inches in diameter, and it will be connected to the main sea valve by a seamless-drawn copper pipe, 10 inches in diameter and $\frac{1}{4}$ inch thick, and there will be a copper pipe 6 inches in diameter, fitted with a cast-iron, composition mounted, stop, check, lift valve of approved design, for the bilge injection connection. The discharge nozzle on the pump will be 10 inches in diameter, and it will be connected to the inlet nozzle on the salt-water side of the main condenser by a seamless-drawn copper pipe, 10 inches in diameter, and the overboard discharge from the main condenser will be through a seamless-drawn copper pipe, 10 inches in diameter, which will be connected to an approved outboard delivery valve on the side of the vessel. There will be suitable 4-inch copper pipes, fitted with gate valves of approved design, between the main and the auxiliary condenser as before specified and as shown on the drawings, so that the circulating pump may furnish the cooling water for both condensers.

The general service pump will have an approved copper pipe connection to the salt-water side of the main condenser, so that the pump may be used as a circulating pump, if required, and valves will be fitted in this pipe where necessary in order to make the system entirely independent.

69. AIR PUMP.

There will be one approved vertical, single-acting air pump, 22 inches in diameter and 16 inches stroke, worked by beams and links from the intermediate-pressure engine crosshead, as shown on the drawings, and secured to facings on the back of the main condenser.

The air pump barrel will be made of cast iron, fitted with a heavy composition liner, and it will be secured to the suction channel way from the main condenser and will have faced flanges and brackets for securing it to the facings on the main condenser as before specified. There will be a flange for the foot-valve seating and the upper part will form a seating for the delivery-valve seat. The foot-valve seat will be secured in the pump as shown on the drawings, the joint being scraped to a true surface, and the delivery-valve seat will be held in place by six springs on studs secured to the air-pump cover. The piston will be of composition, and will have a bearing surface $5\frac{3}{4}$ inches wide, fitted with a packing space $3\frac{1}{2}$ inches wide for $\frac{5}{8}$-inch packing. The upper surface will be fitted for five metallic disk valves, each 6 inches in diameter, and the valve guards will be firmly secured in place in such a manner that, when desired, they may be readily removed. The cover will be made in halves, so arranged that the valves may be easily examined, and jack bolts and eyebolts will be fitted where required, so as to facilitate the work of opening the air pump.

The beams will be built up of double plates of Class B steel, $\frac{5}{8}$-inch in thickness, the pins at the crosshead end being $2\frac{3}{4}$ inches in diameter and $3\frac{1}{2}$ inches long, and the pins at the pump end being $3\frac{3}{4}$ inches in diameter and $3\frac{1}{2}$ inches long. The rock shaft will be 5 inches in diameter, and the rock shaft and the pins will be forged of Class B steel, and finished all over. The bearings for the rock shaft will be of composition, with cast-iron caps, and these bearings, as well as the brasses for the beam links, will be provided with approved means of adjustment, and fitted for the efficient lubrication of all parts.

The air pump suction will be directly from the bottom of the main condenser, through the channel way shown on the drawings, and the discharge will be through a seamless-drawn copper pipe, 6 inches in diameter, to the feed-and-filter tank. An approved standpipe, made of 10-inch seamless-drawn copper pipe, will be fitted to the discharge nozzle, so as to provide for the steady and satisfactory operation of the pump, and the air pump, together with the main condenser, must be capable of maintaining a vacuum of within 4 inches of the atmospheric barometer with the propelling engine and the auxiliaries working at full power.

In addition to this attached air pump, the general service pump will be independently connected to the main condenser through approved valves, fittings, and copper pipes, so that it may be used as an auxiliary air pump to clear the main condenser when desired, and there will be a small ejector provided, as before specified, for removing the water from the main condenser and the air-pump channelway before the main engine is turned; the discharge from the general service pump and from

the small ejector will be to the feed-and-filter tank through approved connections.

The main feed pump will be connected by approved valves, fittings, and copper pipes so that it may be used to take the water from the auxiliary condenser and discharge to the feed-and-filter tank, and there will be a small ejector, as before specified, for clearing the auxiliary condenser and which will also discharge to the feed and filter tank through approved connections.

70. MAIN FEED PUMP.

The main feed pump will be a vertical, duplex, outside center-packed plunger pump of approved design, with steam cylinders 8 inches in diameter, water plungers 5 inches in diameter, and a stroke of 10 inches; and it will be located in the engine room as shown on the drawings and properly secured to a substantial support. The water end of the pump will be of cast iron, fitted with solid composition plungers working through outside center-packed stuffing boxes packed with fibrous packing set down by means of adjustable composition glands, and all parts so arranged as to permit of the ready renewal of the packing.

The water valves will be of composition, and will work on composition valve seats firmly secured in the main castings; the valve bolts and the springs will be of phosphor-bronze, and the arrangement of the valve bolts will be such as to prevent the valves from getting adrift. The piston rods and the valve stems will be of steel, and all moving parts will be provided with efficient means of lubrication; an approved graphite cup will be fitted to each steam valve chest.

An air chamber will be provided for both the suction and the discharge sides; the steam cylinders will be fitted with cushioning valves; and all parts will be arranged for the steady and satisfactory operation of the pump. An approved 4½-inch dial pressure gauge, fitted in a polished brass case, will be connected to the discharge side, and properly secured in a convenient location. The steam cylinders and valve chests will be tested under a pressure of 300 pounds per square inch, and the water cylinders and valve chests under a pressure of 400 pounds per square inch, and all proved to be tight and satisfactory under these conditions.

Steam for the pump will be taken from the auxiliary steam pipe through approved valves, fittings, and copper pipes, and the exhaust will be to the auxiliary exhaust pipe through similar connections, valves being fitted at the pump in both the steam and exhaust pipes. An approved chronometer valve will also be provided in the steam connection, which valve will be actuated by a copper float in the feed-and-filter tank, arranged so as to regulate the speed of the pump and to stop the pump when the tank is practically empty.

The pump will be connected up by approved valves, fittings, manifolds, and copper pipes so as to take water from the feed-and-filter tank and the fresh-water side of the auxiliary condenser, and discharge to the main feed pipe through or around the feed-water heater, and also to the feed-and-filter tank.

71. GENERAL SERVICE PUMP.

The general service pump will be a vertical, duplex, piston pump of approved design, with steam cylinders 14 inches in diameter, water cylinders 8½ inches in diameter, and a stroke of 12 inches, and it will be located in the engine room as shown on the drawings, and properly secured to a substantial support. The water ends will be of cast iron, fitted with heavy composition liners extending from head to head and properly secured in place, the water pistons will be of composition, and the water valves will be of composition and will work on composition valve seats firmly secured in the main castings; the valve bolts and the springs will be of phosphor-bronze, and the arrangement of the valve bolts will be such as to prevent the valves from getting adrift. The steam end piston rods will be of steel, the water end piston rods of rolled bronze, and the valve stems of steel, and all moving parts will be provided with efficient means of lubrication; an approved graphite cup will be fitted to each steam valve chest.

An air chamber will be provided for both the suction and the discharge sides, and the steam cylinders will be fitted with cushioning valves, all parts being so arranged as to provide for the steady and satisfactory operation of the pump. An approved 4½-inch dial pressure gauge, fitted in a polished brass case, will be connected to the discharge side and properly secured in a convenient location. The steam cylinders and valve chests will be tested under a pressure of 300 pounds per square inch, and the water cylinders and valve chests under a pressure of 400 pounds per square inch, and all proved to be tight and satisfactory under these conditions.

Steam for the pump will be taken from the auxiliary steam pipe through approved valves, fittings, and copper pipes, and the exhaust will be to the auxiliary exhaust pipe through similar connections, valves being fitted at the pump in both the steam and exhaust pipes.

The pump will be connected up by approved valves, fittings, manifolds, strainers, and copper pipes so as to take water from the sea, the bilges, the fresh-water tanks, and the trimming tanks, the boilers, the fresh-water side of the main condenser, and the feed-and-filter tank, and discharge to the fire main, to overboard, to the auxiliary feed pipe, to the feed-and-filter tank, to the salt-water side of the main condenser, and to the ash ejector. There will be two suction manifolds for this pump; one for the pipes from the fresh-water connections, and one for the pipes from the salt-water and bilge connections, and there will be an approved stop valve between the two manifolds, so that when pumping fresh water the sea and bilges may be completely shut off, and vice versa.

72. BILGE PUMPS.

There will be two approved vertical, single-acting plunger bilge pumps on the main engine, one located on each side of the air pump and worked by the same beams and links from the intermediate-pressure engine crosshead. These bilge pumps will be made of cast iron and fitted with composition plungers 3½ inches in diameter and 16

inches stroke, and they will be faced and secured to the air pump casting, as shown on the drawings. The valves will be of composition and will work on composition valve seats firmly secured in the castings, all being arranged so as to be readily accessible for examination, and an air chamber will be fitted to the discharge side of each pump.

The pumps will be connected up by approved valves, fittings, manifold, strainers, and copper pipes with extra heavy galvanized wrought-iron pipes at the ends where they enter the bilge suction boxes, so as to take water from the engine-room compartment and discharge overboard through one common pipe connecting to a valve on the side of the vessel.

The independent bilge pump will be a vertical, simplex pump of approved design, with a steam cylinder 8 inches in diameter, a water cylinder 10 inches in diameter, and a stroke of 12 inches, and it will be located in the engine room, as shown on the drawings, and properly secured to a substantial support. The water end of the pump will be of composition, and the water valves will be of composition and will work on composition valve seats firmly secured in the main casting; the valve-bolts and the springs will be of phosphor-bronze, and the arrangement of the valve bolts will be such as to prevent the valves from getting adrift. The piston rod will be of rolled bronze and the valve stem of steel, and all moving parts will be provided with efficient means of lubrication; an approved graphite cup will be fitted to the steam valve chest.

An air chamber will be provided for both the suction and the discharge sides, and all parts will be arranged for the steady and satisfactory operation of the pump. An approved 4½-inch dial pressure gauge, fitted in a polished brass case, will be connected to the discharge side and properly secured in a convenient location.

Steam for the pump will be taken from the auxiliary steam pipe through approved valves, fittings, and copper pipes, and the exhaust will be to the auxiliary exhaust pipe through similar connections, valves being fitted at the pump in both the steam and exhaust pipes.

The pump will be connected up by approved valves, fittings, manifolds, strainers, and copper pipes with extra heavy galvanized wrought-iron pipes at the ends where they enter the bilge suction boxes, so as to take water from the various compartments of the vessel and discharge overboard through an approved valve on the side of the ship.

73. DISTILLER CIRCULATING AND SANITARY PUMP.

The distiller circulating and sanitary pump will be a vertical, simplex pump of approved design, with a steam cylinder 8 inches in diameter, a water cylinder 10 inches in diameter, and a stroke of 12 inches, and it will be located in the engine room, as shown on the drawings and properly secured to a substantial support. The water end of the pump will be of composition, and the water valves will be of composition and will work on composition valve seats firmly secured in the main casting; the valve bolts and the springs will be of phosphor-bronze, and the arrangement of the valve bolts will be such as

to prevent the valves from getting adrift. The piston rod will be of rolled bronze and the valve stem of steel, and all moving parts will be provided with efficient means of lubrication; an approved graphite cup will be fitted to the steam valve chest.

An air chamber will be provided for both the suction and the discharge sides, and all parts will be arranged for the steady and satisfactory operation of the pump. An approved 4½-inch dial pressure gauge, fitted in a polished brass case, will be connected to the discharge side and properly secured in a convenient location.

Steam for the pump will be taken from the auxiliary steam pipe through approved valves, fittings, and copper pipes, and the exhaust will be to the auxiliary exhaust pipe through similar connections, valves being fitted at the pump in both steam and exhaust pipes.

The pump will be connected up by approved valves, fittings, manifolds, and copper pipes, so as to take water from the sea and discharge to the distiller condenser and overboard, to the supply pipe for the water service on the main engine, and to the fire main, and through extra heavy, lead-lined galvanized wrought-iron pipes to the sanitary system, all pipes connected with the sanitary system in the machinery space being made of this material.

74. EVAPORATOR FEED PUMP.

The evaporator feed pump will be a vertical, simplex pump of approved design, with a steam cylinder 3½ inches in diameter, a water cylinder 2½ inches in diameter, and a stroke of 4 inches, and it will be located in the engine room as shown on the drawings and properly secured to a substantial support. The water end of the pump will be of composition, and the water valves will be of composition and will work on composition valve seats firmly secured in the main casting. The valve bolts and the springs will be of phosphor-bronze, and the arrangement of the valve bolts will be such as to prevent the valves from getting adrift. The piston rod will be of rolled bronze and the valve stem of steel, and all moving parts will be provided with efficient means of lubrication; an approved graphite cup will be fitted to the steam valve chest.

An air chamber will be provided for both the suction and the discharge sides, and all parts will be arranged for the steady and satisfactory operation of the pump. An approved 4½-inch dial pressure gauge, fitted in a polished brass case, will be connected to the discharge side and properly secured in a convenient location.

Steam for the pump will be taken from the auxiliary steam pipe through approved valves, fittings, and copper pipes, and the exhaust will be to the auxiliary exhaust pipe through similar connections, valves being fitted at the pump in both the steam and exhaust pipes.

The pump will be connected up by approved valves, fittings, and copper and brass pipes, so as to take water from a small sea valve on the body of one of the large sea valves in the engine room and also from the outboard discharge from the main condenser and discharge to the evaporator.

75. FRESH-WATER PUMP.

The fresh-water pump will be a vertical, simplex pump of approved design, with a steam cylinder 4½ inches in diameter, a water cylinder 4 inches in diameter, and a stroke of 6 inches, and it will be located in the engine room as shown on the drawings and properly secured to a substantial support. The water end of the pump will be of cast iron, fitted with a heavy composition liner, extending from head to head, and properly secured in place. The water valves will be of composition and will work on composition valve seats firmly secured in the main casting; the valve bolts and the springs will be of phosphor-bronze, and the arrangement of the valve bolts will be such as to prevent the valves from getting adrift. The piston rod will be made of rolled bronze and the valve stem of steel, and all moving parts will be provided with efficient means of lubrication; an approved graphite cup will be fitted to the steam valve chest.

An air chamber will be provided for both the suction and the discharge sides, and all parts will be arranged for the steady and satisfactory operation of the pump. An approved 4½-inch dial pressure gauge, fitted in a polished brass case, will be connected to the discharge side and properly secured in a convenient location.

Steam for the pump will be taken from the auxiliary steam pipe through approved valves, fittings, and copper pipes, and the exhaust will be to the auxiliary exhaust pipe through similar connections, valves being fitted at the pump in both the steam and exhaust pipes.

The pump will be connected up by approved valves, fittings, manifolds, and copper and brass pipes, so as to take water from the fresh-water tanks and the trimming tanks and discharge to the fresh-water tanks described in the hull specifications, and also to the feed-measuring tank in the engine room, as hereinafter specified.

76. HAND DECK PUMP.

There will be one 5-inch double-acting hand deck pump, of approved design, located and secured where directed by the inspector of labor and material for the construction of the hull. This pump will have cast-iron cylinders fitted with heavy composition liners, extending from head to head, and properly secured in place, and the pump will be connected up by approved valves, fittings, manifolds, and copper pipes to the sea and the bilges of the vessel, so that it may be used as a fire and bilge pump. The suctions from the sea and from the various compartments of the vessel will be entirely independent of the several other sea and bilge connections to the engine-room pumps and bilge ejector, and the discharge nozzles on the pump will be arranged for the attachment of a 2½-inch hose. All of the gear for operating the pump, such as the brakes or levers, will be of an approved pattern and will be marked and stowed in racks near the pump.

77. BOILER INJECTOR.

There will be one injector of approved design, located in the engine room where directed, and connected up by approved valves, fittings, manifold, and copper pipes, so as to take water from the feed-and-filter tank and the feed-measuring tank and discharge to the auxiliary feed pipe for the boilers. This injector will have a 2-inch steam connection taken from the auxiliary steam pipe, a 2-inch suction connection, a 2-inch discharge connection, and a 1½-inch overflow connection which will be properly connected by a brass or copper pipe so fitted that any water passing down the same may be seen. The tubes will be proportioned so as to deliver against a pressure 30 per cent above the steam pressure, and a valve will be fitted for independently regulating the steam to the lifting nozzle.

78. BILGE EJECTOR.

There will be one cast-iron, brass-mounted bilge ejector of approved design, located in the engine room where directed, and properly connected up by means of approved valves, fittings, strainers, and copper pipes, so as to take water from the engine-room compartment and discharge overboard through a valve on the side of the vessel. This ejector will be of a capacity requiring a 1½-inch steam connection, which will be taken from the auxiliary steam pipe through approved valves, fittings, and copper pipes. The suction connection will be through a 3-inch copper pipe with an extra heavy galvanized wrought-iron pipe at the end where it enters the bilge suction box, and the discharge overboard will be through a 3-inch copper pipe connection to the discharge valve on the side of the vessel, as above specified.

79. PORTABLE EJECTOR FOR WRECKING PURPOSES.

There will be one cast-iron, brass-mounted ejector of approved design, furnished for wrecking purposes, which will be of about 15,000 gallons capacity per hour, and of a size requiring a 2-inch steam connection, a 4-inch suction connection, and a 3½-inch discharge connection.

A 2-inch copper pipe will be led from a fitting in the auxiliary steam pipe to a convenient location on deck, near the engine-room hatch, to furnish steam for this ejector, and valves will be provided at each end of this pipe, as approved, the valve on deck being arranged for the attachment of a 2-inch armored steam hose.

Eighty feet of 2-inch armored steam hose, in 20-foot lengths, with couplings complete, for attachment to the steam connection on deck and to the steam opening on the ejector, will be furnished, together with 30 feet of 4-inch galvanized wrought-iron pipe in 10-foot lengths, with flanged couplings and strainer complete, for the suction connection, and 20 feet of 3½-inch canvas hose, with couplings complete, for the discharge from the ejector, all of which gear will be properly protected and stowed in the vessel, where directed by the inspector of labor and material, for the construction of the steam machinery.

80. FEED-AND-FILTER TANK.

There will be one combined feed-and-filter tank located in the engine room as shown on the drawings, and properly secured to a substantial foundation. It will have a capacity of about 350 gallons, and will be built up of $\frac{1}{4}$-inch steel plates with a flanged bottom of $\frac{3}{8}$-inch steel plate, and it will be stayed internally in an approved manner. A portion of the tank will be fitted as a filter, and will have three divisions filled with loofas, and arranged so that the water from the main and auxiliary condensers, as delivered by the air pump, the main feed pump, the general service pump, and the small ejectors will enter at the top and then be filtered successively through the divisions from the top of each, and all will be designed so that the filtering material may be readily renewed when required.

The tank will have manholes with hinged and bolted covers; a glass water gauge with suitable guards, shut-off cocks, and drain cock; and a copper float for actuating the chronometer valve in the steam connection to the main feed pump, as before specified. There will be at least 100 pounds of clear rolled zinc plates, fitted in baskets having perforated sides and solid bottoms, secured in the feed-and-filter tank where directed.

The tank will have the following pipe connections: Discharge pipes from the air pump, the main feed pump, the general service pump, and the small ejectors; an overflow pipe leading to the bilge and so arranged that any water passing down it may be seen; suction pipes for the main feed pump and the general service pump, properly fitted with approved valves; drain pipes from the steam traps which will enter the tank well below the ordinary water level; and a vapor pipe 2 inches in diameter made of copper, and fitted with an approved check and stop valve secured as high up as possible on the side of the vessel.

81. FEED-MEASURING TANK.

There will be one feed-measuring tank located in the engine room as shown on the drawings, and properly secured to a substantial foundation. It will have a capacity of about 300 gallons, and will be built up of $\frac{1}{4}$-inch steel plates, and it will be stayed internally in an approved manner. The tank will have a manhole with bolted cover; a glass water gauge extending the full height of the tank, fitted with shut-off cocks and drain cocks, and provided with a fixed graduated scale reading to 10 gallons; an approved relief valve; an approved check valve opening inward; and it will be properly connected by approved valves, fittings, and copper and brass pipes, so that it may be filled by the fresh-water pump as before specified, and be emptied to the main and auxiliary condensers through the "make-up" feed connections, and the main injector will be connected, as elsewhere specified, so as to take water from the feed-measuring tank and discharge to the auxiliary feed pipe for the boilers.

82. FEED-WATER HEATER.

There will be a feed-water heater of approved design, of ample capacity to properly heat the feed water, and provided with all the necessary fittings, complete, located in the engine room, as shown on the drawings, and properly secured to a substantial foundation. The heating agent will be the auxiliary exhaust steam, and there will be a pipe, the full size of the auxiliary exhaust pipe, connecting it with the heater, with a stop valve at the heater. The pressure in the auxiliary exhaust line and the heater will be regulated by a spring-loaded back-pressure or relief valve placed at the auxiliary exhaust connection to the main condenser.

The heater will be fitted with the necessary safety valve, compound pressure gauge, water-gauge glass, air and drain cocks and valves, and nozzles for the various pipe connections. An opening closed with a suitable plate or door will also be provided in the shell for access to the coils and the interior of the heater. The location of the heater will be such that it will be accessible for examination and so that it will drain by gravity directly into the feed-and-filter tank through an approved trap provided with a by-pass connection.

The discharge from the main feed pump will be properly connected by approved valves, fittings, and copper pipes so that the feed water may be passed through or by-pass the heater, as desired, and thence to the main feed pipe for the boilers.

83. SYSTEMS OF PIPING.

There will be the following systems of piping, together with such others as may be necessary to complete the machinery installation in accordance with the plans and specifications, viz:

Main steam and exhaust piping; auxiliary steam and exhaust piping, with branches to all the auxiliary steam machinery in the vessel; live-steam piping to the intermediate-pressure and the low-pressure receivers and the jackets on the main engine cylinders; bleeder piping; dynamo engine, turbo-generator, and forced-draft fan turbine steam and exhaust piping; circulating-water piping for the main and auxiliary condensers; air-pump piping; main feed suction and discharge piping; auxiliary feed suction and discharge piping; injector and ejector suction and discharge piping; fresh-water suction and discharge piping; bilge suction and discharge piping; sea suction and discharge piping; fire-main piping; sanitary system piping; steam-heating system piping; boiler blows and internal piping; water-service piping; evaporator and distiller piping; tank piping; and vapor, escape, whistle and siren, indicator, and drain piping.

Each system will be complete in itself, and all piping, together with the valves, fittings, and connections, will be shown on the working drawings and the pipe plans.

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84. GENERAL REQUIREMENTS FOR PIPES, VALVES, FITTINGS, MANIFOLDS, STRAINERS, AND ZINC BOXES.

The design, material, and dimensions of all pipes, flanges, valves, fittings, manifolds, strainers, and zinc boxes will be as approved by the Engineer-in-Chief, United States Revenue-Cutter Service, and they will all be shown on the working drawings and the pipe plans, and properly numbered, listed, and described so as to be readily identified and located.

All pipes will be so led and the flanges so placed that they will be readily accessible for remaking joints when necessary, and all pipes will be well supported and properly secured, as directed by the inspector of labor and material, for the construction of the steam machinery.

Pipes will be led in such a manner that no angles or tees of decks or bulkheads will have to be cut, and removable plates will be fitted on the bulkheads where necessary to allow the flange bolts to be properly set up. Where pipes pass through decks and bulkheads they will be fitted with standard deck and bulkhead stuffing-boxes as approved by the Superintendent of Construction and Repair, United States Revenue-Cutter Service, and all pipes led through the coal bunkers will be kept away from the openings of the coal chutes and properly protected by galvanized steel-plate casings, made in sections and easily removable for repairs. Care must be taken to see that all copper and brass pipes are led sufficiently high to keep them out of the bilge water under ordinary circumstances, and they must be well painted and protected wherever necessary by galvanized steel-plate casings similar to those described for protecting the pipes through the coal bunkers.

All steel pipes will be fitted with standard forged-steel flanges, the pipe being expanded into the same or secured in other approved manner, and all copper pipes will have standard composition flanges, brazed on, the pipe being expanded or turned over into a recess in the face of the flange. All valves and fittings for use in the steel pipes will be of heavy cast iron or cast steel, and for use in the copper and brass pipes they will be of composition unless otherwise specified or directed. All joints between the flanges of steam, feed, and blow pipes will be made with corrugated copper gaskets of approved pattern, and all other joints will be made with gaskets of sheet packing, as may be directed by the inspector of labor and material, for the construction of the steam machinery. Standard mild-steel bolts and nuts, fitted with washers where required, will be used to secure the flanges together, except for those in the pipes along and below the floor plates, where standard bolts and nuts of rolled bronze will be fitted.

The size of a valve where given in these specifications refers to the diameter of the equivalent clear opening, and all valves and their fittings of 2½ inches in diameter and less will be made of composition, while those larger than 2½ inches in diameter, except as may be otherwise specified, will be made of heavy cast iron and composition mounted. All valve stems, studs, and nuts will be made of rolled bronze, the valve stems being threaded so as to turn right handed to close, and all valves 1 inch in diameter and less may have inside

thread and screwed ends, while all valves over 1 inch in diameter must have bolted covers, outside thread, and flanged ends.

The handwheels must be at least twice as great in diameter as their valves, and they will be made of composition, finished all over when located in the upper engine room, and elsewhere thay may be made of cast iron. All valves will be standard globe, angle, or cross valves, of approved design, and no gate valves will be fitted except in the circulating-water connections between the main and the auxiliary condenser, as shown on the drawings. All valves underneath the floor plates will have their handles or handwheels located in convenient positions, and neat, removable plates will be fitted to the floor plates so as to afford access to the same.

All valves will be fitted so as to be easily ground in, and grinding-in guides and handles will be provided for each size of valve, as directed by the inspector of labor and material for the construction of the steam machinery.

There will be approved suction and discharge manifolds, made of cast iron and composition mounted, provided at each pump as required, and all suction and discharge valves, whether in manifold or single valves, will be, unless otherwise directed, stop, check, lift valves of approved design, with outside thread and so arranged that they may be kept off their seats when desired.

All sea suction valves will have approved composition strainers over their openings on the outside of the vessel, and all pipes from the drainage systems of the vessel to the pumps, including the main circulating pump and the bilge ejector, will be fitted with approved galvanized steel plate strainer boxes at the open ends of the pipes, and approved galvanized steel plate strainers of the basket type fitted in galvanized cast-iron boxes with removable covers above the floor plates in convenient locations.

All copper suction and discharge pipes designed to convey salt water will be fitted at intervals of from 10 to 15 feet with cast composition "zinc" boxes, with flanges matching flanges on the pipes, and care must be taken to locate these boxes on horizontal sections of the pipes, and in the sea suction pipes the "zinc" boxes will be placed as close to the sea valves as possible, inboard of the valves. Each pump-discharge pipe designed to convey salt water will have a "zinc" box as near the pump as is practicable, after which they will be spaced as specified. The design of the "zinc" boxes will be such as to leave the pipe unobstructed and the box will have the general form of the body of a gate valve, there being a bonnet and a faced opening for inserting the zinc, which will be U-shaped, bent from a rolled slab one-half inch thick.

85. MATERIAL AND THICKNESS OF PIPES.

All pipes except the main steam pipes, the main exhaust pipe, the heating system pipes, the lower ends of the bilge suction pipes, the fire main and connections, and the sanitary system pipes in the machinery space will be made of seamless drawn copper or brass, as approved by

the Engineer in Chief, United States Revenue-Cutter Service. The main steam pipes will be made of seamless drawn steel, the main exhaust pipe will be made of cast iron, the heating-system pipes will be made of extra-heavy galvanized wrought iron, the lower ends of the bilge suction pipes will be made of extra-heavy galvanized wrought iron, the fire main and connections will be made of extra-heavy lead-lined galvanized wrought iron, and the sanitary-system pipes in the machinery space will be made of extra-heavy lead-lined galvanized wrought iron, all as hereinafter specified.

The thickness of steel and copper pipes will be found by the following formulæ, while that of the brass and wrought-iron pipes will be the standard commercial grade.

Where P=pressure above the atmosphere in pounds per square inch.
D=inside diameter of the pipe in inches.
T=thickness of the pipe in inches.

For steel pipes—

$$T=\frac{P \times D}{10{,}000}+\frac{1}{8} \text{ inch.}$$

For copper pipes—

$$T=\frac{P \times D}{8{,}000}+\frac{1}{16} \text{ inch.}$$

For steam, bleeder, and blow pipes—
P=200 (boiler pressure).
For feed discharge pipes—
P=400 (twice the boiler pressure).
For feed suction pipes and copper water-service connections—
P=150.
For other water pipes without pressure—
P=50.
For exhaust pipes $4\frac{1}{2}$ inches in diameter and less—
P=20.
For exhaust pipes above $4\frac{1}{2}$ inches in diameter—
P=50.

For pipes not included in the above list the thickness will be as approved by the Engineer in Chief, United States Revenue-Cutter Service.

No bend will be allowed in steel pipes the radius of which is less than 36 inches for 6-inch pipes and 41 inches for 7-inch pipes, and no bend will be allowed in copper pipes the radius of which is less than one and one-half times the inside diameter of the pipe, and all pipes in which there are bends will be made one gauge thicker than given by the formulæ.

All pipes will be tested by water pressure before being connected in place, and after installation they will be tested as hereinafter specified.

86. MAIN STEAM, RECEIVER, AND EXHAUST PIPES.

From the 6-inch main steam stop valve on each boiler a 6-inch seamless drawn-steel pipe will be led, connecting into one seamless drawn-

steel pipe, 7 inches in diameter, which will lead directly to the throttle valve on the main engine, as shown on the drawings, and which will form the main steam line. The fittings used in this main steam line will be made of cast steel, and all pipes will be properly led, braced, and secured. An approved copper pipe, 3 inches in diameter, and fitted with stop valves as required, will be led from the auxiliary steam pipe to the throttle valve on the main engine, the connection on the body of the throttle valve being between the disks of the valve, so that when the throttle valve is closed the main steam pipe will be closed, but it will still be possible to operate the main engine through this independent steam connection from the auxiliary steam pipe.

The receiver pipes from the high-pressure to the intermediate-pressure valve chest and from the intermediate-pressure to the low-pressure valve chest will be made of copper; the main exhaust pipe will be made of cast iron and provided with a flanged opening for an atmospheric exhaust connection, all as heretofore specified.

87. AUXILIARY STEAM AND EXHAUST PIPES.

From the 4-inch auxiliary steam stop valve on each boiler a 4-inch copper pipe will be led, connecting into one copper pipe, 4 inches in diameter, as shown on the drawings, and which will form the auxiliary steam line. Stop valves will be placed in these pipes where directed, and branches fitted with valves and approved reducing valves will be taken off where required through suitable composition fittings or castings, so as to provide steam connections to the various auxiliaries and steam systems throughout the vessel. Wherever a reducing valve is fitted in one of the auxiliary steam branches an approved 4½-inch dial pressure gauge inclosed in a polished brass case will be connected to the reduced pressure side of the pipe and properly secured in a convenient location. An approved copper pipe, 3 inches in diameter and fitted with stop valves as required, will be led from the auxiliary steam pipe to the throttle valve on the main engine, in order to provide an independent steam connection, as before specified.

An auxiliary exhaust pipe, made of copper and 4½ inches in diameter, will be fitted as shown on the drawings, and properly connected to the various auxiliaries so that the auxiliary exhaust steam may be directed to the main condenser, to the auxiliary condenser, to the feed-water heater, and to the atmosphere through the escape pipe, as may be desired, and approved valves and fittings will be provided in these auxiliary exhaust connections so as to make the systems complete in every detail. Full-size direct exhaust connections will be provided for the turbine-driven auxiliaries to both the main and auxiliary condensers and to the atmosphere.

Each auxiliary engine, turbine, and pump will have stop valves in both the steam and exhaust pipes as close to the engine, turbine, or pump as is convenient and practicable, and all pipes will be properly led, braced, and secured, care being taken to so arrange the various connections that no pockets can occur.

88. BLEEDER PIPE.

A 2½-inch copper pipe will be led from a fitting in the auxiliary steam pipe to the main condenser to serve as a bleeder connection, and it will be provided with a stop valve at the branch from the auxiliary steam pipe and a stop valve at the main condenser, the former to be so arranged that it may be conveniently operated from the working platform.

89. MAIN FEED SUCTION AND DISCHARGE PIPES.

There will be a 4-inch copper pipe led from the bottom of the feed-and-filter tank to the suction manifold at the main feed pump, and there will also be a 2-inch copper pipe connection to the fresh-water side of the auxiliary condenser, as before specified, valves being provided in these pipes where necessary to make the systems independent and complete in every detail.

From the discharge side of the main feed pump the main feed pipe, of copper, 3 inches in diameter, will be led so as to discharge through or by-pass the feed water heater and thence to the fireroom space, where the pipe will branch into two 2-inch copper feed pipes leading to the main feed check valve on each boiler. There will be a valve in the pipe at the main feed pump and valves at the feed-water heater and between each check valve and its respective boiler so as to regulate the feed water as may be desired.

There will also be a 2-inch copper pipe led from the discharge side of the main feed pump to the feed-and-filter tank so as to provide for the discharge of the water from the fresh-water side of the auxiliary condenser, valves being fitted in this pipe at the pump and at the feed-and-filter tank, as required, so as to make an entirely independent connection.

90. AUXILIARY FEED SUCTION AND DISCHARGE PIPES.

There will be a 3½-inch copper pipe led from the bottom of the feed-and-filter tank to the fresh-water suction manifold at the general-service pump, and there will also be a 2-inch copper pipe connection to this same manifold from the fresh-water tanks and the trimming tanks, a 2-inch copper pipe connection from the boiler blow pipes, as before specified, and a 3½-inch copper pipe connection from the fresh-water side of the main condenser, valves being provided in these pipes where necessary to make the systems independent and complete in every detail.

From the discharge side of the general-service pump, the auxiliary feed pipe, of copper, 3 inches in diameter, will be led to the fireroom space, where it will branch into two 2-inch copper feed pipes leading to the auxiliary feed check valve on each boiler. There will be a valve in the pipe at the general-service pump and a valve between each check valve and its respective boiler, so as to regulate the feed water as may be desired.

There will also be a 3-inch copper pipe led from the discharge side of the general-service pump to the feed-and-filter tank, so as to provide

for the discharge of the water from the fresh-water side of the main condenser, valves being fitted in this pipe at the pump and at the feed-and-filter tank, as required, so as to make an entirely independent connection.

The boiler injector will be properly connected up by valves, fittings, and copper pipes, so as to take water from the feed-and-filter tank and the feed measuring tank and discharge to the auxiliary feed pipe.

91. FRESH-WATER SUCTION AND DISCHARGE PIPES.

There will be a 2-inch copper or brass pipe, as approved, connecting all the fresh-water tanks in the vessel, except the feed-and-filter tank and the feed measuring tank, and valves and fittings will be provided in the branches to the several tanks so that each tank may be filled independently of the others or water taken from each tank independently of the others, as may be desired. The main filling pipe to the fresh-water tanks will be $2\frac{1}{2}$ inches in diameter and located in the fireroom compartment, as shown on the drawings, and in addition to this main filling pipe there will be a separate $2\frac{1}{2}$-inch filling pipe for each tank, except the fresh-water tank in the fireroom compartment, which pipes will be led up to deck plates, as directed by the inspector of labor and material for the construction of the hull.

There will be a 2-inch copper or brass suction pipe connection from this fresh-water pipe to the fresh water suction manifold at the general-service pump, and a $1\frac{1}{4}$-inch copper or brass suction pipe connection to the suction side of the fresh-water pump, the discharges from the general-service pump being through a 3-inch copper pipe to the auxiliary feed pipe and through a 3-inch copper pipe to the feed-and-filter tank, while the discharges from the fresh-water pump will be through a 1-inch brass or copper pipe to the fresh-water tanks on deck, as described in the hull specifications, and through a 1-inch brass or copper pipe to the feed measuring tank, located in the engine room, as before specified.

92. SEA VALVES, SEA SUCTION AND DISCHARGE PIPES.

There will be one 10-inch composition sea valve of approved design located in the engine room, as shown on the drawings, and properly connected by a 10-inch seamless-drawn copper pipe, $\frac{1}{4}$ inch thick, to the inlet nozzle of the circulating pump, and from the discharge nozzle of the pump a 10-inch seamless-drawn copper pipe will be led to the inlet nozzle on the salt-water side of the main condenser. There will be 4-inch copper-pipe connections, fitted with gate valves, between the salt-water sides of the main and auxiliary condensers, and from the discharge outlet on the main condenser a 10-inch seamless-drawn copper pipe will be led to a 10-inch, cast-iron, composition mounted, outboard delivery valve of approved design that will be secured on the side of the vessel, as shown on the drawings. The valve will be faced with rubber, and the stem will be weighted so as

to be automatic in its action, and suitable provisions will be made so that the valve may be secured either open or closed, as may be desired.

There will be one 7-inch composition sea valve of approved design, located in the engine room as shown on the drawings, and properly connected by a 7-inch copper pipe to the salt-water suction manifold of the general service pump, and from the discharge manifold of the general service pump there will be a 5-inch copper pipe connection to the fire main, a 5-inch copper pipe connection to an overboard discharge valve on the side of the vessel, a 5-inch copper pipe connection to the salt-water side of the main condenser, and a 3½-inch copper pipe connection to the ash ejector; valves being provided in all of these various connections so as to make each system independent and complete in every detail.

There will be one 4-inch composition sea valve of approved design, located in the engine room as shown on the drawings, and properly connected by a 4-inch copper pipe to the suction side of the distiller circulating and sanitary pump, and from the discharge manifold of the distiller circulating and sanitary pump there will be a 2½-inch copper pipe connection to the distiller condenser and thence overboard through a valve on the side of the vessel, a 2½-inch copper pipe connection to the supply pipe for the water service on the main engine, a 3-inch copper pipe connection to the fire main, and a 2½-inch extra heavy, lead-lined, galvanized wrought-iron pipe connection to the sanitary system, all pipes connected with the sanitary system in the machinery space being made of this material, as before specified; valves being provided in all of these various connections, so as to make each system independent and complete in every detail.

There will be a flanged opening cast on the body of the 4-inch composition sea valve for the distiller circulating and sanitary pump, and this opening will be fitted with a 1-inch composition valve of approved design, for the sea connection to the evaporator feed pump, to which it will be connected by a 1-inch brass pipe; there will also be a 1-inch brass-pipe connection to the evaporator pump from the outboard discharge from the main condenser, and from the discharge side of the evaporator feed pump a ¾-inch brass pipe connection, fitted with a check and stop valve, will be led to the evaporator.

There will be one 2½-inch composition sea valve, of approved design, located in the engine room, as shown on the drawings, and properly connected by a 2½-inch copper pipe to the suction manifold of the hand deck pump, and the discharge nozzles of the hand deck pump will be threaded for the attachment of 2½-inch hose.

There will be two 2-inch composition sea valves, of approved design, located in the fireroom compartment, as shown on the drawings, for the sea connections for the boiler blows, and there will be a flanged opening cast on the body of one of these valves, fitted with a 1-inch composition valve of approved design, and from this valve a 1-inch brass pipe connection, fitted with a valve for the attachment of the hose for wetting down ashes, will be led and secured in a convenient location in the fireroom.

Steel strengthening rings will be riveted inside of the hull plating around the openings of all valves secured to the hull of the vessel, and all sea valves will be screw stop valves, secured by rolled bronze studs or bolts to flanges or facings on composition sea chests, which will be bolted to the strengthening rings by rolled bronze studs, care being taken not to drill the holes entirely through the rings.

All sea valves, with the exception of the boiler blow valves, will have composition strainers over their openings on the outside of the vessel, and these strainers will have $\frac{3}{8}$-inch holes with a collective area equal to twice the area of their respective valve opening, and the strainers must be properly secured to the sea chests by rolled bronze studs and nuts and must not be fastened to the plates of the vessel.

Zinc protection will be fitted in each opening in the hull for the sea valves, and these zinc rings or strips must be secured in such a manner as to be readily renewed when required.

93. BILGE SUCTION AND DISCHARGE PIPES.

There will be 2½-inch copper pipes leading from a 3½-inch suction pipe for the engine-room bilges to the suction sides of the attached bilge pumps on the main engine, and from the discharge sides of these attached bilge pumps, 2½-inch copper pipes will be led, uniting into one 3½-inch copper pipe which will discharge the water overboard through an approved valve on the side of the vessel.

There will be a 5-inch copper pipe led from the engine-room bilge to the suction manifold at the independent bilge pump, as a direct bilge suction, and there will also be 3½-inch copper pipes led to this same manifold from the various compartments of the vessel, and from the discharge side of the independent bilge pump a 4-inch copper pipe will be led so as to discharge the water overboard through an approved valve on the side of the vessel.

There will be a 6-inch copper pipe led from the engine-room bilge to the salt-water suction manifold at the general-service pump, as a direct bilge suction, and there will also be 3½-inch copper pipes led to this same manifold from the various compartments of the vessels and from the discharge manifold at the general-service pump a 5-inch copper pipe will be led so as to discharge the water overboard through an approved valve on the side of the vessel.

There will be a 6-inch copper-pipe connection to the engine-room bilge from the circulating pump, the discharge being overboard through the pipes for the circulating water, as before specified; the bilge ejector will be connected by a 3-inch copper pipe so as to take water from the engine-room bilges and discharge overboard through a 3-inch copper pipe led to an approved valve on the side of the vessel; and the hand deck pump will be independently connected to the bilges, as before described, the discharge from the hand deck pump being through the nozzles threaded for the attachment of 2½-inch hose.

All pipes from the drainage systems of the vessel to the pumps, including the circulating pump and the bilge ejector, will be fitted with extra heavy galvanized wrought-iron pipes at the ends where they enter the

bilge suction boxes which will be made of galvanized steel plates and arranged so as to be easily cleaned when required. In addition to the strainer boxes at the open ends of the pipes, as above described, there will be an approved galvanized steel plate strainer of the basket type fitted in a galvanized cast iron box with removable cover provided in each bilge suction connection, and these basket strainer boxes will be located above the floor plates so as to be easily accessible for cleaning, and valves and fittings will be provided in all of these various bilge connections, where required, in order to make the systems independent and complete in every detail.

94. FIRE MAIN AND CONNECTIONS.

An approved 5-inch extra heavy, lead-lined, galvanized wrought-iron pipe will be led through the vessel as the fire main, and it will be provided with branches and fire plugs for the attachment of 2½-inch hose. There will be seven of these fire plugs, located where directed by the inspector of labor and material for the construction of the steam machinery, and they will be made of heavy composition, of approved design, and fitted with caps, secured by chains, for the protection of the threads for the hose connections.

There will be a 5-inch copper pipe connection to the fire main from the discharge manifold of the general service pump, and a 3-inch copper pipe connection from the discharge manifold of the distiller circulating and sanitary pump; while the hand deck pump will be connected up by 2½-inch copper pipes so as to take water from the sea and discharge through nozzles threaded for the attachment of 2½-inch hose, all as before specified.

Three hundred and fifty feet of standard 2½-inch cotton, rubber-lined fire hose, in 50-foot lengths, with couplings, complete, will be furnished, together with 150 feet of standard wire-wound 1½-inch rubber wash-deck hose, in 50-foot lengths, with couplings, complete, and approved hose racks or reels will be provided for stowing the fire hose and the wash-deck hose, and mounted in locations where directed by the inspector of labor and material for the construction of the hull.

Three 2½-inch and three 1½-inch rubber hose nozzles, three complete sets of male and female couplings, and three complete sets of reducers or adapters for 2½-inch and 1½-inch hose will be furnished, together with six hose spanners, suitable for use with the hose couplings and reducers provided in accordance with these requirements.

Plans showing the leads of the fire main, together with the connections from the pumps and the branches to the fire plugs, will be submitted to the Engineer in Chief, United States Revenue-Cutter Service, for his approval before work is commenced on the construction of the same.

95. STEAM HEATING SYSTEM.

There will be steam radiators of approved pattern, made of heavy wrought-iron pipes with cast iron bases, having about 30 square feet of heating surface for every thousand cubic feet of space to be heated,

located in the cabin, the wardroom, the pilot house, the steerage, the crew's quarters, the offices, the toilet rooms, the bathrooms, and such other places in the vessel as may be directed. The woodwork behind the radiators will be protected by heavy asbestos boards, fitted between neatly finished zinc screens, which will be secured in an approved manner, and when tested and finally secured in place all the radiators and the protecting screens will be painted or bronzed as may be directed by the inspector of labor and material for the construction of the steam machinery.

All of the heating system connections will be of extra heavy galvanized wrought-iron pipes of suitable size, steam being taken from the auxiliary steam pipe through approved valves, fittings, reducing valves, and manifolds, with a 4½-inch dial pressure gauge, fitted in a polished brass case, connected to each branch connection from the auxiliary steam pipe to the manifolds on the reduced pressure side, and each steam circuit from the manifolds to the radiators will be plainly marked.

There will be two steam traps of approved design, located in the engine room where directed, and properly connected up so as to drain the various circuits of the heating system. These traps will be provided with by-pass connections and arranged so as to discharge to the feed-and-filter tank and the auxiliary condenser, with a branch connection led outboard as directed, and each drain circuit from the radiators to the traps will be plainly marked.

All pipes to the radiators and the drains to the traps will be properly led and secured so that there will be no pockets where water can collect; where the pipes pass through the decks or bulkheads composition thimbles and stuffing boxes will be fitted; guarded valves, of approved design, will be fitted for the steam and drain connections to each radiator, and heavy composition drip cups will be provided under each valve.

The radiators will each be tested to 200 pounds pressure per square inch at the place of manufacture and proved to be tight before they are secured in place, and after the heating system is installed all parts will be tested as hereinafter specified.

Plans showing the pattern, size, and location of radiators, the various pipe connections, the valves, reducing valves, manifolds, and traps will be submitted to the Engineer in Chief, United States Revenue-Cutter Service, for his approval before work is commenced on the construction of the same.

96. EVAPORATING AND DISTILLING PLANT.

There will be an evaporating and distilling plant of approved design and of the capacity required to produce about 2,300 gallons of fresh water per twenty-four hours located in the engine room as shown on the drawings, properly secured to substantial foundations and connected up complete in every detail with all the necessary valves, fittings, and copper, brass, and galvanized wrought-iron pipes required for efficient operation.

The evaporator will be provided with the necessary steam, vapor, feed, and blow connections, safety valve, spring-loaded valve, compound pressure gauge in a polished brass case, glass water gauge, salinometer pot and connections, including a brass salinometer and a salinometer thermometer, and zinc protection for the shell. Openings or manholes closed with suitable plates or doors will be provided in the shell for access to the coils and the interior of the evaporator. The shell, the coils, and the distiller condenser will be tested at the place of manufacture under a pressure of 50 pounds per square inch for the shell, 200 pounds per square inch for the coils, and 50 pounds per square inch for the distiller condenser, and proved tight before being secured in place, and after installation all parts will be tested as hereinafter specified. Steam for the evaporator will be taken from the auxiliary steam pipe through approved valves, reducing valve, fittings, and copper pipes, and the coils will drain through an approved steam trap, fitted with a by-pass connection and arranged so as to discharge to the feed-and-filter tank and the auxiliary condenser. The vapor pipe will lead from an adjustable spring-loaded valve of approved design secured on the shell of the evaporator to the distiller condenser with a branch connection to the auxiliary exhaust pipe, and the distiller circulating pump and the distiller circulating water connections will be arranged as before described.

The distiller condenser will be located as high up as possible, and it will be provided with the necessary circulating and distilled water connections, approved air valves, aerating device, and spigot cock for testing the distilled water, which will be led through heavy galvanized wrought-iron pipes, fitted with valves where required, to the fresh-water tanks.

Plans showing the general arrangement of the evaporating and distilling plant, the details of the evaporator and the distiller condenser, the valves, reducing valve, spring-loaded valve, trap, and all pipe connections will be submitted to the Engineer in Chief, United States Revenue-Cutter Service, for his approval before work is commenced on the construction of the same.

97. DRAIN PIPES AND TRAPS.

All places where condensed steam can accumulate will be provided with drain valves and cocks of ample size connected by copper or brass pipes to steam traps of approved design, unless otherwise specified, and which traps will be fitted with by-pass connections and arranged so as to discharge to the feed-and-filter tank, the auxiliary condenser, or the bilges. All drain valves and cocks will be of composition and will be secured, wherever possible, directly on the part they are to drain, and the cylinders of the auxiliary machinery and the pumps and the lowest part of all water pipes will be provided with drain valves or cocks, fitted with brass pipes where required.

The drains of the various parts of the machinery will be as follows:

Parts drained.	Drained through—	Drain to—
Cylinders and valve chests, main engine.	No trap; unite into common pipe.	F. W. side of main condenser; bilges.
Cylinders, auxiliary machinery, and pumps.	No trap; drain pipes fitted as required.	Bilges.
Jackets on main engine cylinders.	Approved automatic float traps fitted with by-pass.	Feed-and-filter tank; bilges.
Feed-water heater	Approved automatic float trap fitted with by-pass.	Feed-and-filter tank.
Evaporator coils	do	Feed-and-filter tank; F. W. side of auxiliary condenser.
Heating system	Approved automatic float traps fitted with by-pass.	Do.

98. OIL, WASTE, AND TALLOW TANKS.

There will be oil tanks having a total capacity of about 400 gallons, divided as directed, made of galvanized steel plate not less than $\frac{1}{8}$ inch in thickness, and of approved dimensions, fitted in the engine room in convenient locations, and in addition to these oil-storage tanks three 10-gallon copper oil tanks, one of which will be connected to the main engine oiling service as before specified, will be provided.

The large oil-storage tanks will be fitted with manhole and hand-hole plates, filling pipes leading from the deck, vents, pipe and lock-cock connections for drawing off oil, drip pans, and gauge glasses having fixed graduated scales, and the engine oil-storage tanks will have suitable connections to a rotary oil pump of approved design, which will be arranged so as to take oil from these tanks and force it to the distributing oil tank in the engine-room hatch and to one of the small copper oil tanks.

The copper oil tanks will be well tinned on the inside and will have filling connections, screwed plate covers, vents, lock-cock connections for drawing off oil, drip pans, and gauge glasses having fixed graduated scales; all of the oil tanks, both large and small, will have their capacity in gallons plainly marked on the outside.

A galvanized steel plate waste tank of suitable dimensions to contain about 200 pounds of waste and having a hinged cover secured by a padlock will be fitted in the engine room or storeroom, as may be directed; and a small galvanized steel plate tank of suitable dimensions to hold about 50 pounds of tallow will also be provided.

99. GLASS WATER AND OIL GAUGES.

Glass gauges of approved pattern will be mounted on the boilers, the feed-and-fitter tank, the feed-measuring tank, the feed-water heater, the evaporator, the traps, and the oil tanks, and all glass gauges will be provided with shut-off valves at both ends, those under steam pressure

being fitted with an automatic self-closing device. Drains and blow-through valves or cocks will be fitted on each gauge glass mounting, the glasses will all be protected by suitable guards, and the gauges on the feed-measuring tank and the oil tanks will be fitted with fixed graduated scales reading to 10 gallons on the feed-measuring tank and to 5 gallons on the oil tanks.

100. THERMOMETERS.

All thermometers will be certified 9-inch scale case, of approved pattern, with heavy V-shaped bronze case and plate-glass front, and fitted with separable socket and either straight or angle stem to suit the location where connected. The thermometer tubes will be nitrogen gas filled and fitted with expansion chambers, all sockets will be interchangeable, and the armored bulb chambers of the thermometers will be ground so as to make absolute metal to metal contact with the sockets. All the sockets will be made with standard taper, and variations in the socket and bulb chambers must not exceed $\frac{1}{1000}$ inch at the respective point of calibration.

The location of the thermometers will be as follows, viz:

	Graduated.
One on the main injection pipe	0–150°
One on the main outboard delivery pipe	0–150°
One on the feed and filter tank	0–220°
One on the main feed pipe beyond the feed-water heater	0–250°
One ordinary, copper case, for air temperature in the fireroom	0–150°
One ordinary, copper case, for air temperature in the engine room	0–150°

101. LABELS ON GEAR AND INSTRUMENTS.

All valves, except such as may be otherwise directed by the inspector of labor and material for the construction of the steam machinery, will have brass plates marked to show their uses, or they will have the same plainly and neatly stamped on their handwheels, together with an arrow showing the direction of rotation for opening and for closing, and all cocks will be similarly marked as to their uses and to show whether they are open or closed. All hand levers or their quadrants will be marked, and the gauges, counter, and clocks will be engraved with the name of the vessel and the gauges marked to show to what part they are connected. A brass plate with neat lettering will be secured near each speaking-tube mouthpiece to show to what part of the vessel it communicates; each oil pipe leading from the oil boxes on the main engine will be marked with the name of the part to which it supplies oil; and the heating system steam and drain circuits will be properly designated.

102. ELECTRIC GENERATING SETS AND SWITCHBOARD.

The main generating set will be a 20-kilowatt, 110-volt, single cylinder engine, direct-connected marine type generating set of approved design, and it will be located in the engine room as shown on the drawings, and properly secured to a substantial oak seating that will be laid down on a steel foundation built up of plates and angles from the frames of the vessel.

The engine will be designed to operate condensing with steam at 80 pounds gauge pressure which will be taken from the auxiliary steam pipe through approved valves, reducing valve, fittings, and copper pipes, and the exhaust will be to the auxiliary exhaust pipe through similar connections, valves being fitted at the engine in both steam and exhaust pipes. The drains will be fitted with valves and brass pipes leading to the bilge; efficient means of lubrication will be provided for all moving parts, and an approved graphite cup will be fitted to the valve chest.

All of the necessary tools and wrenches used for overhauling and adjustment, including an approved device for truing the commutator when worn, and four spare sets of carbon brushes will be furnished with the generating set and mounted in racks near the same or packed, boxed, marked, and stowed where directed in the vessel.

The auxiliary generating set will be a 7½ or 8 kilowatt, 110-volt, turbo-generator of approved design, and it will be located in the engine room as shown on the drawings and properly secured to a substantial oak seating that will be laid down on a steel foundation as specified for the main generating set.

The turbine will be designed to operate condensing with steam at boiler pressure and an additional nozzle will be provided for use with lower steam pressures. Steam for the turbine will be taken from the auxiliary steam pipe through approved valves, fittings, and copper pipes, and the exhaust will be to the main and auxiliary condensers through a full size direct exhaust connection and also to the atmosphere through the escape pipe, as shown on the drawings. Efficient means of lubrication will be provided for all moving parts, and the drains and cooling water connections will be properly fitted with valves and brass pipes, the discharge connections leading to the bilge.

All of the necessary tools and wrenches used for overhauling and adjustment, including an approved device for truing the commutator when worn; one spare rotor, shaft, and bearings, and four spare sets of carbon brushes will be furnished with the turbo-generator and mounted in racks near the same, or packed, boxed, marked, and stowed where directed in the vessel.

Polished steel hand-rails firmly supported by finished forged steel stanchions will be fitted around both the main and the auxiliary generating sets in an approved manner.

The switchboard will be of the double-panel design, as approved, made of blue slate with black enamel front and about 1½ inches in thickness, and it will be secured and set off by an angle framework so as to give access to all connections which will be made at the back.

All the necessary instruments and switches for controlling and distributing the current generated by the two generating sets will be fitted on the switchboard; all exposed nuts, boltheads, and mountings will be polished; and brass plates, with neat lettering filled in with black enamel, will be secured on the front of the switchboard so as to designate the use of each instrument and switch.

On the panel for the main generating set there will be installed:

1 voltmeter, 0–150, circular type.
1 ammeter, 0–300, circular type.
1 lamp ground detector.
2 lamps for lighting the switchboard panel.
1 main switch, double-pole, quick-break.
1 main circuit breaker.
1 rheostat for main generator field.
2 rheostats for searchlight circuits.
2 circuit breakers for searchlight circuits.
10 double-pole, quick-break switches for controlling the various circuits; all to be fitted with approved inclosed fuses.

On the panel for the auxiliary generating set there will be installed:

1 voltmeter, 0–150, circular type.
1 ammeter, 0–150, circular type.
1 lamp ground detector.
1 lamp for lighting the switchboard panel.
1 main switch, double-pole, quick-break.
1 main circuit breaker.
1 rheostat for auxiliary generator field.
2 double-pole, quick-break switches for controlling the two circuits hereinafter specified; all to be fitted with approved inclosed fuses.

Both of the generating sets will be properly connected to their respective panels of the switchboard by cables led in heavy armored conduits. The current from the main generating set will be distributed by the several switches as required by the hull specifications, and the current from the auxiliary generating set will be distributed by the two switches above mentioned; one for the motor-generator for the wireless apparatus, and the other for a connection to the main generator bus bars. An approved equalizer will be fitted in this last named circuit, so that if at any time the two generating sets have to be run in parallel the load will be properly distributed.

In other words, the intent of these specifications is to provide the two generating sets and the necessary instruments, switches, wiring, conduits, and connections and to complete the installation in such a manner that either or both of the generating sets may be used to light the vessel, operate the searchlights, the telephotos, and the motor-generator for the wireless apparatus. The 20-kilowatt set being generally used for the lighting of the vessel, and the operation of the searchlights, telephotos, and the electric fans, and the turbo-generator for the operation of the motor-generator for the wireless apparatus and

for a few lights and the operation of electric fans during the daytime or when the main generating set is temporarily not in operation.

Plans showing the general design and arrangement of the generating sets and switchboard, together with the connections, will be submitted to the Engineer in Chief, United States Revenue-Cutter Service, for his approval before work is commenced on the construction of the same.

103. STEERING ENGINE AND WINDLASS ENGINE.

The steering engine and windlass engine will be as described by the Superintendent of Construction and Repair, United States Revenue-Cutter Service, in the hull specifications, and steam for these deck auxiliaries will be taken from the auxiliary steam pipe through approved valves, reducing valves, fittings, and copper pipes, and the exhaust from these engines will be to the auxiliary exhaust pipe through similar connections.

104. LIFTING GEAR.

Efficient lifting gear, consisting of traveler bars and trolleys, turnbuckles, differential falls, deck-beam clamps, shackles, hooks, and eyebolts, as may be directed, will be fitted and supplied as required for lifting the various parts of the machinery for overhauling and examination. Holes will be tapped in all the principal movable parts of the machinery for this purpose, and eyebolts furnished and fitted to the same, as may be required by the inspector of labor and material for the construction of the steam machinery.

105. SPARE PARTS.

The following spare parts will be furnished and fitted, ready for use, and whenever duplicate pieces are furnished for two or more pieces of machinery of the same size they shall be made strictly interchangeable. All finished parts not of brass, except as may be otherwise directed, will be painted with three coats of white lead and oil and properly lashed in tarred canvas, with the name of the piece plainly marked on the same. Brass pieces will be marked or stamped and packed away as directed, and all of the spare parts will be stowed in racks and boxes to the satisfaction of the inspector of labor and material for the construction of the steam machinery.

One-half set of follower bolts and nuts for each steam piston of the main engine so fitted;
One spring packing ring for each steam piston of the main engine so fitted;
One bottom brass for the crank-shaft bearings;
One set of crank-pin brasses;
One set of crosshead-pin brasses;
One complete set of brasses for the valve gear of one cylinder;
One bolt for the crank-pin brasses;
One bolt for the crosshead-pin brasses;
One bolt for the main journals;

One bolt for the eccentric straps;
One-half set of coupling bolts for the shafting;
One complete set of water valves, valve bolts, and springs for each pump;
One-half set of follower bolts and nuts for the steam piston or pistons of each pump so fitted;
One-half set of follower bolts and nuts for the water piston or pistons of each pump so fitted;
One complete set of fibrous packing for the water piston or pistons of each pump so fitted;
Ten boiler tubes of each size used in the boilers;
Forty hand-hole plates, with dogs, bolts, and nuts, complete, for use in the boiler headers;
One-half set of safety-valve springs for each boiler;
One complete set of grate bars for each boiler;
One complete set of grate bar bearer bars for each boiler;
One complete set of door-frame liners for each boiler;
One complete set of furnace-door liners for each boiler;
Three patterns of each size grate bar used in the boilers;
One pattern of each dead plate used in the boilers;
One pattern of each door-frame liner used in the boilers;
One pattern of each furnace-door liner used in the boilers;
One set of steel templates, $\frac{1}{16}$ inch in thickness, for all manhole and hand-hole plates used in the boilers, and each template to be plainly marked as to its location;
One spare hose and nozzle for each steam tube cleaner;
Twenty-five condenser tubes for each condenser;
Fifty condenser tube glands for each condenser;
One-half set of coils for the feed-water heater;
One-half set of coils for the evaporator;
One-half set of coils for the distiller condenser;
One spare rotor, shaft, and bearings for the turbine of the turbo-generator;
One spare rotor, shaft, and bearings for the turbine of the forced-draft fan;
Four complete sets of carbon brushes for each generating set;
One complete set of blocks for the ash-ejector discharge pipe;
One set of zinc rings for each opening in the hull of the vessel so fitted;
One complete set of patterns for the zinc rings for the openings in the hull of the vessel.
One cast-iron template of the bore of the propeller hub.

106. TOOLS.

The following tools will be furnished for use in the engine room and the fireroom, all to be of the best quality of their respective grades and satisfactory to the inspector of labor and material for the construction of the steam machinery.

One complete set of finished, drop-forged steel, open-end wrenches with casehardened jaws, to fit all the nuts and bolts in the engine-room compartment, including duplicates of all wrenches found to be necessary in erecting and installing the machinery.

One complete set of drop-forged steel, open-end wrenches, similar to the above set, only rough finished, to fit all the nuts and bolts in the engine-room compartment, including duplicates of all wrenches found to be necessary in erecting and installing the machinery.

One complete set of rough-finished, drop-forged steel, open-end wrenches, to fit all the nuts and bolts in the fireroom compartment, including duplicates of all wrenches found to be necessary in erecting and installing the boilers.

Light skeleton wrenches will be furnished in addition to the above wrenches for use on the crank pin and crosshead pin connections and the main journal cap bolts; all wrenches for nuts of bolts 2 inches in diameter and larger will be box wrenches where such can be used; socket wrenches and special wrenches will be furnished where required and all wrenches will be mounted in neatly fitted wrench boards or angle racks, and each wrench will be plainly marked with the name of the part for which it is primarily intended to be used.

Duplicate sets of all tools used in assembling the boilers, including two tube expanders, which will each have a spare set of rolls and three driving pins.

Fixed trammels for putting the engines on centers and for setting the main valves without removing the covers, the crank webs and the valve stems being properly marked for this purpose, and a set of trammels and gauges for aligning the crank shaft; all trammels and gauges being properly marked and fitted in neat wooden cases.

One valve-reseating machine with tools and cutters, complete, for use on valves from $\frac{1}{4}$ inch diameter up to valves 6 inches in diameter.

One portable electric two-speed hand or breast drill, wound for 110 volts, with a capacity from 0 to $\frac{1}{2}$-inch drills, wired up ready for use, together with a complete mounted set of drills from $\frac{1}{16}$ inch to $\frac{1}{2}$ inch, by sixty-fourths, suitable for use with the same.

107. MACHINE TOOLS.

The following machine tools of approved make and type will be furnished, installed where directed in the machinery space upon substantial foundations, and properly connected up ready for use. They are to be of the best quality and workmanship, each fitted with independent motor drive, and starting and controlling rheostats of approved type will be furnished and connected in the wiring circuits, which will be taken off a switch on the main switchboard panel, and led through conduits to the machine-shop space and to the several machine tools.

One 14-inch engine lathe with an 8-foot bed, with gears to cut threads from $1\frac{1}{2}$ to 40 per inch, and provided with compound rest and taper attachment. A large and a small face plate, a large and a small independent chuck, a large and a small geared scroll chuck, all having

reversible jaws, and a large and a small drill chuck, all fitted to the lathe spindle, will be furnished, together with a complete set of lathe tools of the separate cutter and holder type, as may be selected by the inspector of labor and material for the construction of the steam machinery.

One 20-inch drill press, with wheel, lever, and automatic self-feed and quick lever return, together with a set of drill collets, two mounted drill chucks, and a complete set of drills from $\frac{1}{8}$ inch to $1\frac{1}{4}$ inches, by thirty-seconds.

One wet and dry tool grinder having wheels 8 inches and 10 inches in diameter, mounted upon a standard base fitted with tables and tool rests, water tank, and pump, complete.

108. TESTS OF BOILERS, MACHINERY, AUXILIARY MACHINERY, AND PIPING.

All parts to be tested will be so placed as to be accessible for examination by the inspector of labor and material for the construction of the steam machinery during the tests; no clothing or lagging will be on the cylinders, valve chests, boilers, pipes, feed-water heater, evaporator, or any part to be tested, during the tests; and all tests will be made by and at the expense of the contractor. Steam will not be raised in the boilers until after the water tests of the boilers when in place on board the vessel, unless it be desired for drying or testing joints, for which purposes the pressure must not exceed 10 pounds per square inch, but after the water tests have been satisfactorily completed, steam may be raised in the boilers whenever necessary to test the various steam connections and the operation of all parts of the main and auxiliary machinery and the pumps.

The following parts will be tested before being placed on board the vessel:

Parts to be tested.	Test pressure per square inch above the atmosphere.	Test.
High-pressure cylinder and valve chest	300 pounds	Water pressure.
Intermediate-pressure cylinder, valve chest, and receiver pipes.	130 pounds	Do.
Low-pressure cylinder, valve chests, and receiver pipes.	90 pounds	Do.
Low-pressure valve chests, exhaust side	30 pounds	Do.
Main exhaust pipe	15 pounds	Do.
Main and auxiliary condensers	do	Do.
Main feed-pump water cylinders, valve boxes, air chamber, valves, fittings, and main feed pipes.	400 pounds	Do.
General service pump water cylinders, valve boxes, air chamber, valves, fittings, and auxiliary feed pipes.	do	Do.
Steam pipes and valves, auxiliary engines, pumps, and all parts, fittings, and connections subject to boiler pressure.	300 pounds	Do.
Exhaust pipes, valves, fittings, and connections	100 pounds	Do.
Circulating water pipes	50 pounds	Do.
Fire main and connections	300 pounds	Do.
All other water pipes, both suction and discharge.	100 pounds	Do.
Feed-water heater, shell	50 pounds	Do.
Feed-water heater, coils, valves, fittings, and main feed-water connections.	400 pounds	Do.
Evaporator shell	50 pounds	Do.
Evaporator coils	200 pounds	Do.
Distiller condenser	50 pounds	Do.

The following parts will be tested after being placed on board the vessel:

Parts to be tested.	Test pressure per square inch above the atmosphere.	Test.
Main boilers	400 pounds	By the application of heat to fresh water in the boilers, the boilers being full.
Main boilers and the pipe connections, the main engine, the auxiliary machinery, and the pumps.	200 pounds	By steam, and all leaks to be made tight before the parts are clothed and lagged.
Main and auxiliary feed systems, as a whole, from and including the pressure parts of the pumps up to the valves on the boilers.	400 pounds	Water pressure.
Fire-main system as a whole	200 pounds	Do.
Heating system as a whole	do	Do.
All parts after being finally secured in place	Working pressures.	Under working conditions.

109. CLOTHING AND LAGGING.

Clothing and lagging will be fitted on the boilers, the machinery, the auxiliary machinery, the pumps, and the pipes, as follows, after they have been installed on the vessel and tested in place; it will be made removable wherever required, and secured so as to be easily repaired and replaced. The magnesia used for clothing and pipe covering will be composed of 85 per cent carbonate of magnesia and 15 per cent asbestos fiber; the galvanized sheet steel on the boiler drums will be secured by bands of the same material and galvanized screws and bolts; the Russia-iron lagging will be secured by polished brass bands and round-head brass screws; and the canvas covering on the pipes will be sewed in place and properly painted as may be directed.

Parts clothed and lagged.	Covering.	Lagging.
Drums of boilers	Magnesia	Galvanized sheet steel.
Cylinders and valve chests of main engine; main steam, receiver, and exhaust pipes.	do	Russia iron.
Upper and lower cylinder heads and valve-chest covers.	do	Finished cast-iron false covers.
Steam cylinders and valve chests of auxiliary machinery.	do	Russia iron.
Steam cylinders of pumps	do	Do.
All steam and exhaust pipes and main feed pipes	do	Canvas, sewed on and painted.
Feed-water heater	do	Russia iron.
Evaporator	do	Do.
Heating-system pipes, both steam and drain	do	Canvas, sewed on and painted.

110. PAINTING.

All parts of the boiler casings, the uptakes, the engine work not finished, the auxiliary machinery, and the pumps, will be painted on the outside with two coats of brown zinc and oil, and when finally secured in place will be given two coats of paint of approved colors as selected by the inspector of labor and material for the construction of the steam machinery. The outside of the smoke pipe proper and the inside of the casing will be given two coats of paint before securing them together, and when finally secured in place the outside of the casing will be given two coats of paint as directed; all pipes, including those covered with canvas and those in the bilges, will be given two priming coats, and when all parts have been completed and satisfactorily tested, they will be given two coats of paint and marked in accordance with the following schedule:

Pipe system.	To be painted.
Steam-supply pipes	White, with black bands near the flanges.
Steam-exhaust pipes	White, with red bands near the flanges.
Feed and fresh water suction pipes	Gray, with black bands near the flanges.
Feed and fresh water delivery pipes	Gray, with red bands near the flanges.
Salt-water suction pipes	Green, with black bands near the flanges.
Salt-water delivery pipes	Green, with red bands near the flanges.
Bilge suction and delivery pipes	Pink.
Fire main and connections	Red.

All parts of the engine room, the fireroom, the shaft tunnel, the storeroom, the passages, and the bulkheads will be given two priming coats, and when all work has been completed and satisfactorily tested they will be given two coats of paint of an approved color.

Care must be taken when painting the various parts that paint is not smeared around on the finished work, and when the painting is

finally completed all paint spots must be cleaned off; the floors, platforms, and gratings cleaned and oiled; and all parts of the entire installation left in a thoroughly clean and satisfactory condition.

111. TRIALS OF MACHINERY AND TRIAL TRIPS.

All trials will be made by and at the expense of the contractor, and to the satisfaction of the officer or officers appointed by the Secretary of the Treasury to witness the trials and inspect the machinery installation of the vessel.

The machinery is to be operated at the dock until it can be run for four consecutive hours at full power without heating of the journals or necessity for any adjustments, which will constitute the official dock trial, after which the underway trial trips will be made. There will be two underway trial trips, the first to be a full-power trial for four consecutive hours, working off at 200 pounds pressure all the steam that the boilers will make under forced draft, and the second to be a full-power trial for two consecutive hours, working off at 200 pounds pressure all the steam that the boilers will make under natural draft. The coal used during these trials will be a free-steaming coal of the best quality as selected by the inspector of labor and material for the construction of the steam machinery, and ample time will be allowed between the forced and natural draft trials to clean the fires and get all parts in condition to develop the maximum horsepower under natural draft.

The contractor will assign a force of observers for duty at the dock and underway trials in connection with the recording of data for the reports of the trials, and these observers are to be under the direction of the officer or officers appointed by the Secretary of the Treasury to witness the trials, to the end that all readings and indicator cards may be noted and recorded on a log sheet in a satisfactory manner. Indicator cards will be taken at least every half hour during the dock and underway trials to determine the total horsepower developed and whether the valves are properly adjusted and the work equally divided between the cylinders, every effort being made to secure accurate data as to the performance of the steam machinery.

After the underway trials are satisfactorily completed, the cylinders and valve chests of the main engine, pumps, and auxiliaries will be opened and all parts examined; the crosshead pins, the crank pins, the main journals, and the various connections of the main engine will be stripped and examined; the evaporating and distilling plant, the heating system, the fire main, the ejector for wrecking purposes, and the various pump connections will be tested; the boilers cleaned, opened, and examined; and all parts of the machinery installation shown to be in first-class condition. When this work is completed to the satisfaction of the officer or officers appointed by the Secretary of the Treasury to witness the trials and inspect the machinery installation of the vessel, all parts will be cleaned and painted, and the finished work oiled and left in proper order for acceptance by the Government.

SPECIFICATIONS

FOR

INSPECTION OF MATERIAL.

FOR USE IN THE

CONSTRUCTION OF MACHINERY AND HULL WORK, COMING UNDER THE COGNIZANCE OF THE ENGINEER IN CHIEF, U. S. REVENUE-CUTTER SERVICE.

61724—10——23

SPECIFICATIONS FOR INSPECTION OF MATERIAL.

GENERAL INSTRUCTIONS FOR TESTS AND INSPECTION OF ALL MATERIALS (HULL AND MACHINERY).

General instructions: All material for which tests are herein prescribed must be inspected and tested at the place of manufacture by an engineer officer of the Revenue-Cutter Service, and must be passed by him, subject to the restrictions herein mentioned.

All castings, stem, sternpost, and rudder frame will be tested and inspected under the direction of the Engineer in Chief, Revenue-Cutter Service, and each article when passed by the engineer inspector will be stamped with the inspector's official stamp.

The acceptance of material under the tests herein prescribed will not relieve the contractors from the necessity of making good any material that fails in working or which may be rejected on account of bad workmanship at the shipyard or works, notwithstanding the fact that it has been accepted for tensile strength, elongation, and weight.

The inspector shall see that each object is clearly stamped with, first, the maker's name; second, the official stamp of the inspector, and, third, for all boiler plates, the lowest tensile strength. The official stamp must not be placed on any material until it has been passed ready for shipment.

Every facility shall be extended to the inspectors for testing and examining the material in course of manufacture at the mills. All handling of material and other work necessary for the testing and inspection of material shall be done by, or at the expense of, the contractors.

Test pieces shall not be cut off until the plate or object shall have passed the surface inspection. After the piece has been cut off it shall not receive any treatment except machining to size. Test pieces or coupons for determining the tensile strength and elongation shall be cut from the longitudinal edges of the plates, and test pieces for the quenching and bending tests shall be cut from the transverse edges of the plates.

The tensile-test pieces for boiler plates shall have a length of at least 15 inches. Tensile-test pieces must have an area of cross section not less than 0.5 square inch for plates less than $\frac{5}{8}$ inch thick, and for plates thicker than $\frac{5}{8}$ inch the area of cross section shall not exceed 1 square inch.

Where test pieces are taken from the ends of forgings, the prolongations from which the specimens are taken must not have been forged less in diameter than the smallest part of the forging.

In the case of the propeller shaft the prolongation for test specimens must have the general diameter of the shaft itself and not that of the reduced diameter at the after end.

Each ingot from which important steel forgings are to be made shall have a piece cut off of its upper end (as cast) equal in weight to not less than 15 per cent of its total weight.

Ingots for forgings shall be at least one-third greater in width, thickness, or diameter than the greatest corresponding dimensions of the forgings into which they are to be made. All ingots for forgings must be bottom cast.

Each tensile-test piece shall be subjected to a stress in a testing machine running at a speed not exceeding 6 inches per minute, until the piece is ruptured.

Such additional tests may be required by the inspectors as they deem necessary to detect lack of uniformity in the material.

ORDERS FOR MATERIAL.

Contractors will furnish the Engineer in Chief of the Revenue-Cutter Service with duplicate copies of their orders to manufacturers for all material requiring inspection. Contractors will also furnish the Engineer in Chief, Revenue-Cutter Service, blueprints, in duplicate, of forgings, etc., requiring inspection. Manufacturers will furnish the inspectors with invoices giving marks, dimensions, and weights of each shipment of material.

HULL PLATING AND SHAPES.

1. All material for hull plates and shapes will conform to the following requirements:

Ultimate strength 60,000 to 70,000 pounds per square inch.

Elastic limit. Not less than one-half ultimate strength.

Percentage of elongation (in a length of 8 inches, except as modified by Rule 12 of Manufacturers' Standard Specifications for "medium" steel) 1,400,000 divided by the ultimate strength.

Bending test, 180°, to a diameter equal to thickness of piece tested, without fracture on outside of bent portion.

The limitations as to weight to be as prescribed in Rule 13 of the Standard Specifications, revised February 6, 1903.

It is understood that the Government will not inspect this material at the place of manufacture, but that any material that fails during its incorporation into the vessel must be rejected and replaced by good material. Copies of all orders for hull plates and shapes, together with copies of test reports from the mills, must be furnished.

HULL RIVETS.

Hull rivets shall be of a standard make and of the best quality of material, as approved.

INSPECTION OF IRON FORGINGS—HULL AND MACHINERY.

These will be of the best quality of wrought iron, accurately and smoothly forged, all welds being practically perfect and without signs of overheating or bad scarfing. They will be practically without flaws or defects of any kind, and will conform strictly to the required dimensions.

BOILER PLATE.[a]

Number of gauge.	Approximate thickness in fractions of an inch.	Approximate thickness in decimal parts of an inch.	Weight per square foot in pounds avoirdupois.
000	3–8	.375	15
00	11–32	.34375	13.75
0	5–16	.3125	12.50
1	9–32	.28125	11.25
2	17–64	.265625	10.625
3	1–4	.25	10
4	15–64	.234375	9.375
5	7–32	.21875	8.75
6	13–64	.203125	8.125
7	3–16	.1875	7.5
8	11–64	.171875	6.875
9	5–32	.15625	6.25
10	9–64	.140625	5.625
11	1–8	.125	5
12	7–64	.109375	4.375
13	3–32	.09375	3.75
14	5–64	.078125	3.125

[a] When steel plates are ordered to gauge, the United States Standard Gauge for sheet and plate iron and steel, adopted by act of Congress and approved March 3, 1893, will be used. An extract from the act (Public, 137) is given in the following table:

1. The physical and chemical characteristies of steel boiler plate are to be in accordance with the following table:

Class.	Material.	Minimum tensile strength.	Maximum tensile strength.	Minimum elastic limit.	Elongation.	Maximum amount of—		Cold bend about an inner diameter.
						P.	S.	
		Lbs. per sq. in.	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Per ct. in 8 inches.*			
Class A..	Open-hearth steel.	60,000	68,000	32,000	25	.04	.035	Equal to thickness of plate through 180°.
Class B..	Open-hearth steel.	52,000	60,000	26,000	27	.04	.035	Flat back through 180°.
Class C[a].	Open-hearth or Bessemer steel.	To be in accordance with the "Standard Specifications of the Association of American Steel Manufacturers for Structural Steel," revised July, 1896.						

[a] Class C plates, shapes, etc., will be inspected at the building yard and not at the place of manufacture, except upon special request of the contractor. No physical or chemical tests will be made unless from the appearance of the plates giving evidence of overheating, cold rolling, etc., or for other reasons the inspector has doubts as to their fitness for the purpose for which they are intended.

2. *Kind of material.*—Steel for boiler plates of all grades (except Class C) shall be made by the open-hearth process, and shall contain not more than four one-hundredths of 1 per cent of phosphorus and not more than thirty-five one-thousandths of 1 per cent of sulphur.

3. *Surface and other defects.*—Plates must be practically free from all slag, foreign substances, brittleness, laminations, hard spots, sand or scale marks, scabs, snakes, or other injurious defects.

4. *Test pieces.*—One longitudinal tensile test piece and one transverse bending test piece shall be cut from each plate as rolled, in such places as may be designated by the inspector. The cold-bending test pieces may have their corners rounded to a curve the radius of which is equal to one-fourth the thickness of the plate.

5. *Shearing.*—Boiler plates shall not be sheared closer to finished dimensions than once the thickness of the plate along each end and one-half the thickness of the plate along each side. This allowance shall be made by the contractor on his order, and the manufacturer shall shear to the ordered dimensions.

6. *Weight and gauge.*—The variations in weight and gauge shall not exceed the limits set by the Standard Specifications of the Association of American Steel Manufacturers, which are as follows:

Variation when ordered to gauge.—For all plates ordered to gauge there will be permitted an average excess of weight over that corre-

sponding to the dimensions on the order equal in amount to that specified in the following table, provided no plate shall be rejected for light gauge measuring 0.01 inch or less below the ordered thickness:

Table of allowances for overweight for rectangular plates when ordered to gauge.

[The weight of 1 cubic inch of rolled steel is assumed to be 0.2833 pound.]

PLATES ¼ INCH AND OVER IN THICKNESS.

Thickness of plate.	Width of plate.		
	Up to 75 inches.	75 inches to 100 inches.	Over 100 inches.
	Per cent.	*Per cent.*	*Per cent.*
¼ inch	10	14	18
5/16 inch	8	12	16
⅜ inch	7	10	13
7/16 inch	6	8	10
½ inch	5	7	9
9/16 inch	4½	6½	8½
⅝ inch	4	6	8
Over ⅝ inch	3½	5	6½

PLATES UNDER ¼ INCH IN THICKNESS.

Thickness of plate.	Width of plate.	
	Up to 50 inches.	50 inches and above.
	Per cent.	*Per cent.*
⅛ up to 5/32 inch	10	15
5/32 up to 7/16 inch	8½	12½
7/16 up to ¼ inch	7	10

Variation when ordered to weight.—Plates 12½ pounds or heavier, when ordered to weight, shall not average more variation than 2½ per cent either above or below theoretical weight.

Plates from 10 to 12½ pounds, when ordered to weight, shall not average a greater variation than the following:

Up to 75 inches wide, 2½ per cent either above or below the theoretical weight.

Seventy-five inches and over, 5 per cent either above or below the theoretical weight.

BOILER PLATES AND SHAPES (CLASS C).

7. Under this head will be included all material of that kind which is not essential to the structural strength of boilers and engines, such as:

Ash dumps.
Ash pans.
Ash-pit doors.
Boiler casing, for water-tube boilers.
Coal and ash buckets.
Fireroom air screens.
Furnace doors.
Ladders.
Oil tanks.
Platforms and gratings.
Smoke pipes and covers.
Tallow and other tanks.
Uptake and uptake doors.
Feed and filter tanks.

Note 1.—Floor plates are to be hard, free from surface defects, and to conform to the dimensions ordered.

Note 2.—Grate bars are to be free from injurious defects and to conform to the dimensions ordered.

No chemical or physical tests will be required of either of these last two items.

RODS FOR BOLTS, STAYS, BRACES, AND RIVETS.

1. The physical and chemical characteristics of rods for bolts, stays, braces, and rivets are to be in accordance with the following table:

Class.	Material.	Minimum tensile strength.	Maximum tensile strength.	Minimum elastic limit.	Elongation.	Maximum amount of—		Cold and quench bends about an inner diameter.
						P.	S.	
		Lbs. per sq. in.	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Per ct. in 8 inches.*			
Class A..	Open-hearth carbon steel.	60,000	68,000	32,000	25	.04	.04	Equal to thickness of test piece.
Class B..	Open-hearth carbon steel.	52,000	60,000	26,000	27	.04	.04	Equal to ½ thickness of test piece.

If the contractor desires and so states on his orders, the department will direct that the inspection of the rods be made at the place of manufacture of the bolts, stays, or rivets instead of at the place where the rods are rolled.

2. *Kind of material.*—The steel shall be made by the open-hearth process, shall contain not more than four one-hundredths of 1 per cent of phosphorus, not more than four one-hundredths of 1 per cent of sulphur.

3. *Surface and other defects.*—The rods must be true to form, practically free from seams, hard spots, brittleness, injurious sand or scale marks, and injurious defects generally.

4. *Test pieces.*—One tensile and one bending test piece shall be selected from each lot of 1,000 pounds of material or fraction thereof. All of the test pieces shall be taken from rods finished in the rolls, and when practicable but one piece will be cut from each rod selected for test. Should any test piece be found too large in diameter for the testing machine, the piece may be prepared for test in the manner prescribed for forgings. The tensile tests for rounds $\frac{5}{8}$ inch in diameter and less shall be made on the largest sizes available and the elongation measured on a length equal to eight times the diameter.

5. *Bending tests.*—The cold and quench test pieces of Class A rods shall stand bending through an angle of 180° around a curve the inner diameter of which is equal to the diameter of the rod. The cold and quench bends of Class B rods shall stand bending through an angle of 180° around a curve the inner diameter of which is equal to one-half the diameter of the rod. The quench-test piece shall be heated to a dark cherry red in daylight and plunged into fresh clean water at a temperature between 80° and 90° F. No bending test will be satisfactory if any cracks are to be seen on the outside of the bent portion.

FINISHED BOLTS, STAYS, BRACES, AND RIVETS, CLASSES A AND B.

After the rods to be made up into bolts, stays, braces, and rivets have been tested as previously described, the finished articles shall be tested by lots of 1,000 pounds or fraction thereof, one piece being taken to represent the lot.

Bolts and stays.—When the bolts or stays are of sufficient length in the plain part to admit of being bent cold, they must stand bending double to a curve of which the inner radius is equal to the radius of the bolt or stay without fracture.

When bolts or stays are not of sufficient length in the plain part to admit of being bent cold, the threaded part must stand bending cold without fracture as follows:

	Degrees.
If of $\frac{1}{2}$ inch diameter or less	35
If above $\frac{1}{2}$ inch diameter and under 1 inch	30
If 1 inch diameter or over	25

Where the bending tests can not be applied, the two following hammer tests must be substituted:

(*a*) The test piece to stand flattening out cold to a thickness equal to one-half its original diameter without showing cracks.

(*b*) The test piece to stand flattening out, while heated to a cherry-red heat, to a thickness equal to one-third its original diameter without showing cracks.

Surface inspection.—(1) All bolts, stays, and braces shall be practically free from surface defects.

(2) All bolts are to be headed hot, and the heads made in accordance with the United States standard proportions unless otherwise specified. The head must be concentric with the body of the bolt.

(3) The thread must be of the United States standard unless otherwise specified, and must be clean and sharp. The threads of Classes A and B bolts may be either chased or cut with a die, but the threads of body-bound bolts must be chased and must extend far enough down so that when the nut is screwed home there will be not more than one and one-half threads under it. The plain part of body-bound bolts must be turned in a lathe to fit accurately in the bolt hole.

Rivets.—Samples from each lot are to stand the following tests without fracture, test (*a*) being applied to one lot and (*b*) to a second, etc.:

(*a*) Bend double cold to a curve of which the inner diameter is equal to the diameter of the rivet.

(*b*) Bend double hot through an angle of 180° flat back.

(*c*) The head to be flattened when hot without cracking at the edges until its diameter is two and one-half times the diameter of the shank.

(*d*) The shanks of sample rivets to be nicked on one side and bent cold to show the quality of the material.

Surface inspection.—Rivets shall be true to form, concentric, and free from injurious scale, fins, seams, and all other injurious defects. If the material is found to be very uniform and none of the tests made of a series of lots fails, the inspector may discontinue the tests after he has made enough to satisfy himself that the whole of the material on the order is satisfactory.

Note.—In measuring the diameter of rivets the inspector will allow for the trade custom of making rivets with an actual diameter slightly (about $\frac{1}{16}$ of an inch) less than the nominal diameter.

BOILER TUBES.

GENERAL REQUIREMENTS COVERING ALL BOILER TUBES.

1. *Surface inspection and gauging.*—Tubes must be practically free from all surface defects, and in no part more than one-half a gauge below the specified thickness. The defects to be particularly avoided in seamless tubes are tears, snakes, checks, slivers, injurious scratches and rings, laps, pits, and sinks; in lap-welded tubes they are defective welds, cracks, blisters, scale pits, and sand marks. If the tube ends are swaged down, swelled, upset, or reinforced, they will be subjected to a second inspection to see that no damage has been done by this process.

2. *Weight.*—A tolerance of 5 per cent over and 3 per cent under the calculated weight will be allowed for individual tubes, assuming that 1 cubic inch of iron weighs 0.280 pound and 1 cubic inch of steel 0.283 pound. Ordinarily tubes will be weighed in lots as follows:

Tubes under 2 inches outside diameter to be weighed in lots of not over 30.

Tubes 2 inches outside diameter to 2½ inches to be weighed in lots of not over 20.

Tubes 2½ inches up to 3 inches to be weighed in lots of not over 10.

Tubes over 3 inches outside diameter to be weighed in lots of 10.

If, however, the inspector or the contractor so desires, every tube of any size may be weighed separately, and accepted or rejected on its merits.

3. All seamless cold-drawn steel tubes shall be annealed as a final process in retorts or an approved furnace in which the flame does not strike the tubes. One or more of the stamped test pieces will be placed in the center of each retort or middle of each furnace charge. The charge of each retort or furnace will be numbered. The test pieces will be given the same number as the charge with which they are annealed, so that if it is found after testing that any lot is not soft enough it may be reannealed.

4. Tubes which are found satisfactory with respect to their surface, weight, and gauge will be divided into lots of 100, and two tubes from each lot will be subjected to the following tests:

(*a*) A piece 3 inches long cut from the first tube must stand being flattened cold by hammering until the sides are brought parallel with a curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws, the bend at one side being in the weld, if any.

(*b*) The end of the second tube must stand being expanded cold to one and one-sixth times its original diameter by driving into it a pin having a taper of 1½ inches to a foot, without showing cracks or flaws. Instead of test (*b*), at the option of the contractor, an equivalent substitute test may be made as follows: Turn a flange all around the end of the tube and of a width equal to 12½ per cent of the diameter of the tube, all the work to be done cold. If only one of the tubes so tested fails, that tube will be rejected and the inspector will select two other tubes from the same lot and subject both to the same test as the one that failed, and both of these tubes must be found satisfactory in order that the lot may be passed. The failure to pass satisfactorily either of the tests marked (*a*) and (*b*) will reject the lot which they represent.

(*c*) Each tube shall be subjected to an internal hydrostatic pressure of 1,000 pounds per square inch without showing signs of weakness or defects.

5. The failure of 10 per cent of the lots of tubes to pass the specified inspection and tests will render the whole order liable to rejection.

6. The manufacturers shall furnish for the department's records a copy of their analysis of the material used for tubes.

7. Each tube shall be stenciled with the name of the vessel for which it is intended, the word "steel," the maker's name, and, when necessary, the location mark.

8. After the inspection is completed and before shipment, all tubes must be coated inside and outside with boiled linseed oil or other

approved preservative to protect them from rust until such time as they are to be put into the boilers, when said coating will be removed.

STEEL CASTINGS (HULL AND MACHINERY).

The physical and chemical characteristics of steel castings are to be in accordance with the following table:

Class.	Material.	Treatment.	Minimum tensile strength.	Maximum tensile strength.	Minimum elastic limit.	Elongation.	Maximum amount of— P.	Cold bend about an inner diameter of 1 inch.
			Lbs. per sq. in.	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Per cent in 2 in.*		
Class A..	Any approved process.	Annealed	75,000	85,000	35,000	15	0.06	Through 90°.
Class B..	...do.....	...do.....	60,000	70,000	30,000	18	.06	Through 120°.
Class C [a].	...do.....	.....	.....	.....	.....	.....	.....	.....

[a] Class C castings will ordinarily be subject to surface inspection only, at the building yard. They will not be tested unless there are reasons to doubt that they are of a quality suitable for the purpose for which they are intended. Tests, if required, shall be made at the expense of the contractor, and may be made at the building yard. The inspector will select a sufficient number of the castings and have them crushed, bent, or broken, and note their behavior and the appearance of the fracture.

2. *Kind of material.*—Steel for castings may be made by the crucible, open-hearth, Bessemer, Tropenas, or any other process approved by the Engineer in Chief. The material must be of uniform quality throughout. In case of doubt on this point the inspector will have drillings for complete analysis taken from the surface and from the center of the thickest parts. In all cases analyses may be made for phosphorus, and no casting shall contain more than six one-hundredths of 1 per cent.

3. *Treatment.*—All castings, except those of Class C, shall be annealed, unless otherwise directed. If castings are subjected to any special treatment, the inspector will make such additional tests as he may deem necessary to see that the treatment has left the material of uniform character throughout. In case the results obtained by the first tests do not conform to the specifications, the manufacturer may re-treat the castings and submit additional pieces for test.

4. *Surface and other defects.*—All castings shall be thoroughly cleaned before they are presented for inspection. They shall be sound, free from brittleness, injurious roughness, sponginess, pitting, porosity, shrinkage and other cracks, cavities, foreign substances, and all other injurious defects. Particular search shall be made at the points where the heads or risers join the castings, as unsoundness at such points is likely to extend into the castings.

IRON CASTINGS.

(For cylinders, valve chests, and liners, and other important parts.)

1. The inspection must conform to the General Instructions for the Inspection of Material.
2. The castings must be in accordance with the machinery specifications.
3. The grade and quality of the metal will be specified on the order.
4. The castings must be free from blowholes, porous places, shrinkage, cracks, or other defects.
5. If the inspector has doubts of the quality of the material in any casting, he may make tests at the expense of the contractor. The minimum tensile strength of the material shall be 20,000 pounds per square inch, the length of the test piece being not less than 2 inches. The transverse breaking load for a bar 1 inch square, loaded at the middle and resting on supports 1 foot apart, shall be not less than 2,000 pounds.
6. The scale shall be removed from the unfinished parts of the insides of all cylinder covers and valve-chest covers and from their liners either by pickling or other approved process as may be required by the machinery specifications.

IRON CASTINGS, CLASS C.

Iron castings for minor parts, such as furnace fittings, etc., will be subject to inspection only at the building yards to see if they are in all respects suitable for the purposes for which they are intended.

COMPOSITION CASTINGS.

1. The inspection must conform to the "General instructions for the inspection of material."
2. The castings must be in accordance with the machinery specifications.
3. The grade and quality of the metal will be specified on the order.
4. The castings must be free from blowholes, porous places, shrinkage cracks, or other defects.
5. The various compositions will be as follows:

	Copper.	Tin.	Zinc.
For all journal boxes and guide gibs, where not otherwise specified, by weight.....parts..	6	1	½
Naval brass.....per cent..	62	1	37
Brazing metal and flanges for copper pipes.....do....	85	.....	15
Condenser tubes.....do....	60	.....	40
Composition not otherwise specified.....do....	88	10	2

FORGINGS.

1. The physical and chemical characteristics are to be in accordance with the following table:

Class.	Material.	Treatment.	Minimum tensile strength.	Maximum tensile strength.	Minimum elastic limit.	Elongation.	Maximum amount of—		Cold bend about an inner diameter of—
							P.	S.	
			Lbs. per sq. in.	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Per cent in 2 in.*			
Class A...	.....	.....	.....	.....	.....	.....	.....	.....	.....
Class B...	Open-hearth carbon steel.	Annealed.	60,000	70,000	30,000	30	.06	.04	Half inch through 180°.
Class C[a].	Open-hearth or Bessemer.	.....	45,000	.....	.....	20	.....	.....	One inch through 180°.

[a] Class C forgings will not be tested unless there is reason to doubt that they are of a quality suitable for the purpose for which intended. Tests, if required, shall be made at the expense of the contractor, and may be made at the building yard.

2. *Kind of material.*—Steel for forgings of all grades, except Class C, shall be made by the open-hearth process; shall contain not more than six one-hundredths of 1 per cent phosphorus and not more than four one-hundredths of 1 per cent of sulphur.

3. *Treatment.*—All forgings, except those of Class C, shall be annealed as a final process unless otherwise directed. Forgings, such as crank shafts, thrust shafts, etc., may, previously to oil-tempering, be machined in a manner best calculated to insure that the oil-tempering effect reaches the desired portions. In this case the inspector will decide upon the location of the test pieces if they can not be taken in the manner herein described.

4. *Surface and other defects.*—All forgings shall be free from slag, cracks, blowholes, hard spots, sand, foreign substances, and all other defects affecting their value.

COPPER PIPES.

1. The inspection must conform to the "General Instructions for the Inspection of Material under the cognizance of the Engineer in Chief."

2. The pipe must be made of Lake copper, and a chemical analysis must show that the metal is 99.5 per cent pure copper. One analysis may be taken from each lot of 2,000 pounds or less.

3. The pipe must be free from indentations, cracks, flaws, or other surface defects, inside and outside, perfectly round, of the specified

diameter and thickness in all parts. All pipes shall be seamless drawn.

4. Each pipe must withstand an internal hydraulic pressure which will subject the metal to a stress of 6,000 pounds per square inch, the test pressure being calculated by the following formula for thin hollow cylinders, but in no case will a test pressure of over 1,000 pounds per square inch be required:

$$p = \frac{2ts}{d}, \text{ in which}$$

p=Safe internal pressure;
d=Inside diameter in inches;
s=Safe tensile strength of material=6,000 pounds per square inch;
t=Thickness of pipe in inches.

Every pipe must be perfectly tight under pressure and show no signs of bulging, cracks, flaws, porous places, or other defects.

5. A strip 1½ inches wide will be taken from each lot of 500 pounds or less of pipe and must stand the following tests:

(*a*) If less than ½ inch thick, it must stand bending flat back cold after being annealed.

(*b*) If ½ inch or over, it must bend back after being annealed until the ends are parallel and the inner radius of the bend is equal to the thickness of the piece.

STEEL STEAM PIPES (SEAMLESS).

1. *Material.*—(*a*) The seamless pipes must be made from solid billets or disks of perfectly homogeneous steel, and cold drawn or hot rolled, as specified in the order.

2. *Surface inspection.*—The pipe must be free inside and outside from all surface defects which would materially weaken it or form starting points of corrosion. The defects to be especially avoided are the same as those mentioned under the head of defects in boiler tubes. The pipe must be perfectly round and vary not more than 1 per cent above or below the gauge diameter.

3. *Hydraulic test.*—Every pipe must be subjected to an internal water pressure of 1,000 pounds per square inch, without showing signs of bulges, cracks, or other defects.

4. *Other tests.*—Pipe 4 inches outside diameter and less will be tested in lots, and in the same manner as prescribed for steel boiler tubes.

Pipes over 4 inches outside diameter may be tested in lots of 5, two pipes being selected from each lot and care taken that the pipes selected for tests have had the same treatment as the remainder of the lot, *i. e.*, that they must not be annealed or softened by slow cooling unless the others have been treated in the same way. If the inspector has any doubts that the pipes have not all received the same treatment he will test each pipe singly.

(*a*) Two test pieces will be cut circumferentially (when it is practicable to get a strip of the requisite length) from the ends of two differ-

ent pipes, straightened when hot, and machined to shape and to a width of 1½ inches. For thickness up to and including $\frac{5}{16}$ inch, the length between the measuring points will be sixteen times the thickness. For thickness greater than $\frac{5}{16}$ inch, the length between measuring points will be 8 inches. The tests must show a minimum tensile strength of 48,000 pounds per square inch, and an elongation of at least 12 per cent in 8 inches.

(*b*) Two test pieces of a width equal to three times the thickness of the metal in the pipe cut circumferentially from the ends of the other test pipes shall stand bending cold to an inner diameter equal to thrice the thickness of the metal without showing cracks on the outside of the bend.

5. The failure to pass these tests in a satisfactory manner will reject the lot unless the manufacturer desires to test each pipe separately, in which case a tensile test shall be taken from one end and a bending test from the other, and the pipe accepted or rejected accordingly.

6. If the ends of the pipes are flanged, swaged down, swelled, upset, or reenforced, they will be inspected after this work is done to see that no damage has been done by this process.

7. All cold-drawn pipes must be annealed in retorts or in an improved furnace in which the flame does not strike them.

8. Each pipe will be stenciled with the name of the maker and name of the vessel for which it is intended, and its location mark when necessary.

9. The inspector's identification stamp and the United States Revenue-Cutter stamp will be put on the cases in which the pipes are shipped.

STEEL FLANGES FOR STEEL PIPE.

The flanges are to be forged from the solid (not welded) and are to be screwed, riveted, or welded on as required by the order.

The steel of which flanges are made shall stand the following tests: The test piece to be taken from the billet or plate from which the flange is forged, and to be reduced to shape with the least amount of hammering possible. One tensile test piece and one bend shall be taken from the entire lot.

The test shall show that the metal has a tensile strength of at least 56,000 pounds per square inch, and an elongation of at least 30 per cent in 2 inches. The bending test piece 1½ inches wide shall stand bending double (until the ends are parallel) without fracture (on the outside of the bend) to a curve of which the inner radius is one and one-half times the thickness of the test piece.

SEAMLESS TUBES FOR CONDENSER.

1. Condenser tubes shall be made of the following composition: 60 per cent copper and 40 per cent zinc, in the manufacture of which new materials only have been used; they must be true to form and of equal thickness throughout; they must withstand an internal hydrostatic pressure of 500 pounds per square inch and be capable of being

flattened and bent back on themselves, hot or cold, without fracture. The hydrostatic test will be made on each tube of the whole lot. The bending tests will be made before the tubes are tinned.

2. *Surface inspection.*—All tubes must be seamless, true to form, of an equal thickness throughout, of workmanlike finish, free from injurious cracks and seams, and stiff enough to lie straight when resting on supports 6 feet apart.

3. *Tinning and annealing.*—All tubes of 60 per cent copper and 40 per cent zinc must, after final drawing, be annealed, acid-cleaned, dipped in molten tin, and then immediately wiped with hempen tow inside and out to insure their being smooth on both surfaces.

4. *Diameter and gauge.*—All condenser tubes will be of $\frac{5}{8}$-inch outside diameter and of No. 18 United States standard gauge, unless otherwise specified.

5. *Test specimens.*—The inspector shall select at random from the tubes, before tinning, a number of tubes equal to 1 per cent of the entire order, for tests. These test tubes will be exclusive of the number required on the order and will be furnished at the contractor's expense.

6. *Weight.*—All of the tubes are to be weighed in lots of 50 each, so that the average weight of each tube and of the entire order may be determined.

MANGANESE-BRONZE AND "MONEL METAL" CASTINGS.

[For propellers.]

1. The inspection must conform to the General Instructions for material coming under the cognizance of the Engineer in Chief.

2. The castings must be made in accordance with the drawings and specifications, sound, clean, free from blowholes, porous places, cracks, or any other defects which will materially affect their strength or appearance or which indicate an inferior quality of metal.

3. In the case of screw propellers coupons will be cast attached to the hub and to each blade; the coupons will be cast in a horizontal position, and those on the blades will be attached at half the distance from the root to the periphery. The coupons will be cast 2 inches in diameter and turned down to a diameter of 1 inch between measuring points, which points will be 2 inches apart. The coupons are to have no treatment other than machining to reduce them to the proper diameter.

4. Coupons shall not be detached from castings until they are stamped by the inspector.

5. The test pieces shall show an ultimate tensile strength of not less than 60,000 pounds per square inch, an elastic limit of not less than 30,000 pounds per square inch, and an elongation of not less than 20 per cent in 2 inches.

6. The color of the fractured section of the test pieces and the grain of the metal must be uniform throughout.

7. No test piece shall be less than $\frac{1}{2}$ inch in diameter nor less than 2 inches between measuring points.

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