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SPECIFICATIONS

FOR

TRIPLE-EXPANSION SINGLE-SCREW PROPELLING ENGINE,

WITH

BOILERS AND AUXILIARY MACHINERY,

FOR A

REVENUE CUTTER,

TO BE KNOWN AS

"No. 3, R. C. S."

(FOR THE PACIFIC COAST),

OF

ABOUT 1,280 TONS CRUISING DISPLACEMENT,

To make a speed of 16 knots per hour when developing about 2,000 horsepower.

OFFICE OF THE
ENGINEER IN CHIEF U. S. REVENUE-CUTTER SERVICE,
TREASURY DEPARTMENT.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1895.

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FOR

T riple-Expansio Single-Screw Machinery.

U. S. REVENUE CUTTER NO. 3, FOR THE PACIFIC COAST.

SPECIFICATIONS

FOR

TRIPLE-EXPANSION SINGLE-SCREW PROPELLING ENGINE,

WITH BOILERS AND AUXILIARY MACHINERY.

1. GENERAL DESCRIPTION.

The main engine will be of the vertical, inverted-cylinder, direct-acting, triple-expansion type, having one high-pressure cylinder 25 inches, one intermediate cylinder 37½ inches, and one low-pressure cylinder 56¼ inches in diameter, the stroke of all pistons being 30 inches. The collective indicated horsepower of propelling, air-pump, and circulating-pump engines will be 2,000 when the main engine is making about 160 revolutions per minute. The high-pressure cylinder will be forward and the low-pressure cylinder aft. The main valves will be of the piston type for the high-pressure cylinder and of the double-ported slide type for the intermediate and low-pressure cylinders; all will be worked by Stephenson link motions, with double-bar links. Each main piston will have one piston rod, with a crosshead working on a slipper guide. The framing of the engine will consist of three wrought-steel front columns, and short cast-iron columns at the

back resting on the main condenser, which will form a part of the framing. The engine bedplate will be of cast iron, supported on a wrought-steel foundation built up from the frames of the vessel. The crank, line, and propeller shafts will be forged of mild open-hearth steel, and will be solid. The piston rods, connecting rods, and working parts generally will be forged of mild open-hearth steel.

The main condenser will have a cooling surface of about 3,000 square feet, measured on the outside of the tubes, the water passing through the tubes. There will be one independent, vertical, single-acting, twin air pump, worked by two steam cylinders. The main circulating pump will be independent and of the centrifugal type. The propeller will be right-handed and of manganese bronze, with detachable blades.

There will be four single-ended steel boilers of the horizontal return-fire tube type, all constructed for a working pressure of 160 pounds per square inch. The boilers will be placed in a separate water-tight compartment and have one fire room, as shown on the drawings. Each boiler will have two corrugated furnaces of 3 feet 6 inches internal diameter. The total heating surface will be about 5,200 square feet, measured on the outer surfaces of the tubes, and the total grate surface about 168. The boilers will be 11 feet 6 inches outside diameter and 10 feet long over all. There will be a main boiler feed pump of the vertical duplex type located in the fire room. There will be, in addition, auxiliary feed, bilge, fire, and other pumps, located as shown.

There will be one double smokestack, located as shown. The forced draft will be of the closed fire-room system, and will consist of two blowers, which will discharge into the fire room. Means will be provided for slicing the fires when under forced draft without opening the furnace doors. There will also be provision for regulating the supply of air to each furnace. There will be one hydro-pneumatic ash ejector, furnished complete, ready for use, of an approved design. There will be an approved steam reversing gear, electric-light plant, distilling and evaporating apparatus complete, and such other auxiliary or supple-

mentary machinery, tools, instruments, or apparatus, necessary to make the system complete in every detail, as are described in the following specifications or shown in the accompanying drawings.

2. FOUNDATIONS FOR MAIN ENGINE AND THRUST BEARING.

The foundation for the main engine will be built up from and form a part of the framing of the vessel. The foundation for the thrust bearing will be similar to, and form a continuation of, the engine foundation. Both will be stiffened in a fore and aft direction by intercostals, spaced as shown on the drawing. The top of both foundations will be formed of a $\frac{3}{4}$-inch steel plate. The engine bedplate will be secured to the foundation by body-bound holding-down bolts $1\frac{1}{8}$ inches in diameter and spaced $10\frac{1}{2}$ inches between centers. The holes in foundation and bedplate will be reamed for these bolts. Around each holding-down bolt will be fitted a forged-steel wedge-shaped horseshoe, which will be planed to template and then fitted to secure the proper alignment of the bedplate. After the bedplate has been permanently adjusted in this manner, the spaces between the foundation plate, bedplate, and the horseshoes will be filled in by an approved, thoroughly seasoned, hardwood packing about 1 inch in thickness. Before the wood packing is permanently driven in place it will be coated with a thin red-lead paint. The steel horseshoes will be about $3\frac{1}{2}$ inches long, $1\frac{1}{2}$ inches wide, and the thickness of each will vary to conform to the necessary adjustment to put the bedplate in alignment. When finally secured, all shafting must be accurately in line with the vessel at load draft and ordinary stowage. All parts of the machinery and boilers will be secured in an approved manner.

3. BEDPLATE.

The bedplate will be in one casting, and will be made of the best quality of cast iron. It will consist of six U-shaped girders, as shown. The upper part of bedplate and lower flanges will be connected to the webs and stiffened by ribs, as shown. They will be properly finished

and faced for crank-shaft brasses and caps, and for the flanges of the supporting frames and columns. The bed-plate will be secured to engine keelsons by $1\frac{1}{8}$-inch body-bound forged-steel bolts, setting up on the lower flange. Each girder will have a vertical flange to fit the flanges and facings on the condenser, and will be bolted to the condenser by $1\frac{1}{8}$-inch body-bound steel bolts, spaced about $5\frac{3}{4}$ inches between centers. A steel key will be recessed halfway in each flange and securely fitted to each girder.

4. CYLINDER COLUMNS.

Each cylinder will be supported at the back on a cast-iron column, which forms part of the condenser, and at the front by a forged-steel column, as shown. The forged-steel column will be about 8 feet $4\frac{1}{2}$ inches long, 6 inches in diameter, with flanges for feet 14 inches in diameter by $2\frac{1}{2}$ inches thick. The cast-iron column will be fitted for the slipper guides and will have a separate water back, cored out 8x2 inches for water circulation. The slipper guides will be bolted to the columns with body-bound bolts and accurately faced for the slippers.

5. CYLINDERS.

They will consist of casings of best quality of hard, close-grained cast iron, with working linings for the cylinders and high-pressure valve chests. The cylinder casings will include the valve chests, steam ports and passages, the lower heads, and the various brackets to which the cylinder supports will be attached. The steam and exhaust ports will be smoothly cored to the dimensions shown in drawings, the walls of the passages being strongly stayed by ribs.

The flanges for securing the cylinders to each other will be so faced that when bolted together the centers of the cylinders will be 5 feet $6\frac{1}{2}$ inches between H. P. and I. P. cylinders and 4 feet 9 inches between I. P. and L. P. cylinders, with the cylinder axes all in one plane and parallel. The cylinder casings will be bolted together and to their supporting columns by body-bound bolts. The casings, liners, and stuffing boxes shall be held in a vertical position when bored to their respective diameters.

6. HIGH-PRESSURE CYLINDER CASING.

The barrel will be $1\frac{1}{4}$ inches thick. The lower head will be cast with the barrel, ribbed and faced as shown on drawing. There will be one single-ported piston valve. The casing will be faced and bored as shown, for the reception of the working cylinder linings and for the valve-chest lining. The brackets at the bottom for attachment of the supporting frames and columns will be well ribbed and faced. The walls of the steam passages will be properly stayed. There will be facings, flanged and ribbed where necessary, for the attachment of the cylinder and valve-chest covers, steam pipes, valve-stem bracket, piston-rod stuffing box, relief valves, drain cocks, indicator pipes, drainpipes, and oil cups. The internal part of the cylinder will be pickled to remove the scale.

7. INTERMEDIATE-PRESSURE CYLINDER CASING.

The head will be cast with a single wall; the barrel will be $1\frac{1}{4}$ inches thick. A double-ported slide valve will be fitted and there will be faced brackets for supporting frames. There will also be facings for attaching the exhaust pipe, valve-stem bracket, receiver safety valve, receiver live-steam pipe, relief valves, jacket steam and drain pipes, piston-rod, and valve-stem stuffing boxes, also for indicator pipes, oil cups, and drain cocks. The internal part of the cylinder will be pickled to remove the scale.

8. LOW-PRESSURE CYLINDER CASING.

The head will be cast with a single wall; the barrel will be $1\frac{1}{4}$ inches thick. It will have a double-ported slide valve. There will be faced brackets for the supporting frames and facings for attaching the steam and exhaust pipes, valve-stem bracket, receiver safety valves, receiver live-steam pipes, jacket steam and drain pipes, relief valves, piston rod and valve-stem stuffing boxes, indicator pipes, oil cups, and drain cocks. The internal part of the cylinder will be pickled to remove the scale.

9. CYLINDER LININGS.

They will be close-grained cast iron, as hard as can be properly worked with tools of Mushet's steel, turned and

faced to fit the cylinder casings. Each lining will have a bearing at about the middle of its length and at each end. The linings at the bottom will be flanged and secured to the casings by round-headed, countersunk, steel tap bolts, spaced about $4\frac{1}{2}$ inches between centers for the H. P. cylinder, $4\frac{1}{2}$ inches for I. P. cylinder, and $5\frac{1}{2}$ inches for the L. P. cylinder. The bolt holes in the linings will be counterbored to receive the heads of the bolts. At the top there will be fitted a stuffiing box with a composition gland, to allow for the expansion and to make the joint tight between the liner and cylinder casing.

The linings, after being secured in place in the casings, will be smoothly and accurately bored to the diameters of 25, $37\frac{1}{2}$, and $56\frac{1}{4}$ inches for the high, intermediate, and low pressure cylinders, respectively, and to a thickness of $1\frac{1}{8}$ inches, the boring to be done with the cylinders in a vertical position. The linings will be counterbored at both ends, leaving the working bores 2 feet 7 inches long. The unfinished parts of the linings will be pickled to remove scale.

10. CYLINDER COVERS.

They will be made of cast iron, well stiffened by ribs. Annular recesses will be cored for the heads of the piston follower bolts, and the covers will be so formed as to leave as little clearance as practicable. Each cover will be turned and faced to fit its cylinder casing, and will be finished on outside of flanges.

The cover of the high-pressure cylinder will be secured to the cylinder casing by twenty-two, the cover of the intermediate-pressure by thirty, and the cover of the low-pressure by forty $1\frac{1}{8}$-inch steel studs with finished, case-hardened nuts.

Holes will be drilled and tapped for jack bolts and eye-bolts. The thickness of all three covers will be $1\frac{1}{8}$ inches.

11. CYLINDER COVER CASINGS.

They will be made of highly finished cast iron, the thickness and design will be as shown on drawing, and they will be secured to lugs on the cylinder covers by the eyebolts.

12. CYLINDER CLEARANCES.

The clearance between the upper cylinder heads and pistons will be $\frac{3}{8}$ inch, and between the lower cylinder heads and pistons $\frac{1}{2}$ inch.

Care will be taken that the clearances in the cylinders are made as specified. After the engines are set up in place and connected, the volume of clearance at each end of each cylinder will be carefully measured, and the result plainly marked on some conspicuous part of the cylinder casing. Marks will also be made on the crosshead guides showing the position of the pistons when the clearances were measured.

13. STEAM JACKETS.

The intermediate-pressure and low-pressure cylinders will be steam jacketed on the sides.

The space left around the working linings for steam jackets will be $\frac{3}{4}$ inch in width. All ribs must be cored out so as to allow a free circulation of the jacket steam and a free drainage of the water of condensation.

Steam for the jackets will be taken from the main steam pipe in the engine room by a 2-inch pipe. From this pipe a $1\frac{1}{2}$-inch branch will lead to the intermediate-pressure jacket. This branch will have a $1\frac{1}{2}$-inch adjustable-spring reducing valve, adapted to pressures of from 20 to 80 pounds above atmosphere.

Another $1\frac{1}{2}$-inch branch will lead to the low-pressure jacket. This branch will have a $1\frac{1}{2}$-inch adjustable-spring reducing valve, adapted to pressures of from 0 to 30 pounds above atmosphere.

Each branch steam pipe will have a stop valve close to the jacket.

There will be on each jacket steam pipe, on the jacket side of the reducing valve, a $1\frac{1}{2}$-inch adjustable-spring safety valve, adapted to the same pressures as the reducing valves.

A 1-inch drain will lead from the lowest part of each jacket to an approved automatic trap with blow-through and by-pass pipes and valves, thence to the lower part of the feed tank, with a branch to the bilge. Each drainpipe

will have a stop valve close to its jacket. The drainage system of the jacket of each cylinder will be entirely independent as far as the trap discharge, from which point the drains may be in common. All pipes in the jacket drain system will have union joints so as to be easily overhauled.

14. VALVE CHESTS.

The valve chest of the high-pressure cylinder will be fitted for one piston valve. There will be openings at each end for inserting and removing the valves and working linings; the chests will be accurately bored and faced for the reception of the working linings.

Before the insertion of the linings the steam and exhaust passages must be thoroughly cleaned out and pickled, and care taken that the passages are nowhere contracted to less than the specified areas.

Each intermediate-pressure and each low-pressure valve chest will have a $2\frac{3}{4}$-inch adjustable-spring safety valve of approved pattern. They will be loaded to 80 and 30 pounds, respectively, for the intermediate and low pressure chests.

All valve chests will also be fitted with approved composition drain cocks or valves that may be operated from the working platform, the H. P. and I. P. valves to discharge through pipes into the bilge and feed tanks, with the necessary valves for directing the water to either, and the L. P. valve into the condenser.

15. VALVE-CHEST LININGS.

There will be a working lining at each end for the piston valve. They will be close-grained cast iron, as hard as can be properly worked with tools of Mushet's steel, accurately turned and faced to fit the casings, and accurately bored to an internal diameter of 16 inches, leaving the wall $\frac{7}{8}$ inch thick.

They will be forced into place, making all joints perfectly tight, and secured by screws tapped half into the linings and half into the casings.

The steam ports will have alternating right and left diagonal bridges, of such a section as to permit of the

easy passage of steam, taking up not more than one-fourth of the port area.

The edges of all ports will be finished to a uniform outline.

16. VALVE-CHEST COVERS.

They will be made of cast iron, and will be well ribbed, as shown. They will be finished all over on the outside, except the recesses between the ribs, which will be covered with black-walnut lagging to conform to cylinders.

All flanges will be machined and faced to fit the openings in valve chests and finished on the outside and edges. The lower cover of the H. P. valve-chest will be faced and bored to receive the valve-stem stuffing box.

All valve-chest covers will be secured in place by a sufficient number of steel studs with finished, case-hardened nuts.

The cylinders for the balance pistons for the valves will be bolted to the upper covers of the valve chests, and will be bored to diameters of $5\frac{1}{2}$ and 9 inches, respectively, for the intermediate and low pressure valves. These balance cylinders will be connected to the condenser by brass pipes.

The L. P. valve-chest cover will be drilled and tapped for jack bolts and eyebolts, and provision will be made for handling it by overhead track, eyebolts, or other approved means.

Lugs will be fitted in the H. P. steam chest to prevent the rings from overriding the seats when valves are disconnected. There will be approved provision for proper oiling of the valve stems.

17. PISTON VALVE.

The high-pressure piston valve will be single ported, of cast iron, made with packing rings.

The followers of the valves will be of cast iron, secured in place by steel stud bolts with wrought-iron nuts and brass split pins. The follower bolts will pass through lugs on the inside of the valve shell and have their heads so formed and fitted as to prevent turning, or they may be stud bolts squared where they pass through the follower, with square holes in the follower to correspond.

The packing rings will be of hard cast iron, turned larger than the bore of valve seat, cut obliquely, and fitted in an approved manner.

The two parts of the valve will be separated, when in place on their valve stem, by a steel distance piece, which will be of such length as to make the steam and exhaust laps as follows for H. P. valve:

Steam lap: Top, $1\frac{35}{64}$ inches; bottom, $1\frac{7}{16}$ inches.

Exhaust lap: Top, minus $\frac{21}{32}$ inch; bottom, minus $\frac{15}{32}$ inch.

18. INTERMEDIATE AND LOW PRESSURE SLIDE VALVES.

The intermediate slide valve will be double ported and will be made of cast iron. The face of the valve will be finished to a true plane. All the edges will be finished. The weight of the valve will be balanced, as shown in drawing.

The steam lap will be: Top, $1\frac{35}{64}$ inches; bottom, $1\frac{7}{16}$ inches.

The exhaust lap will be: Top, minus $\frac{9}{64}$ inch; bottom, plus $\frac{1}{16}$ inch.

The low-pressure slide valve will be double ported and will be made of cast iron. The face of the valve will be finished to a true plane. All the edges will be finished. The weight of the valve will be balanced, as shown in drawing.

The steam lap will be: Top, $1\frac{3}{4}$ inches; bottom, $1\frac{9}{16}$ inches.

The exhaust lap will be: Top, plus $\frac{13}{32}$ inch; bottom, plus $\frac{13}{16}$ inch.

19. VALVE STEMS.

They will be of forged steel, and all the stems will take direct hold of the link blocks. The high-pressure valve stem will be 2 inches diameter at the stuffing box and reduced to $1\frac{1}{2}$ inches where it passes through the valve. The upper end of the valve stem will be fitted to the valve by means of double nuts and split pin; at the bottom of the valve the stem will taper and fit into a heavy steel washer, as shown. The intermediate and low pressure

valve stems will be fitted in the same manner as high-pressure, with the exception that the upper ends of stems will extend so as to connect with the balance piston at top, as shown. The diameter of the intermediate and low pressure valve stems will be $2\frac{1}{2}$ inches at the stuffing boxes and $2\frac{1}{8}$ inches where they pass through the valves. All the valve stems, where they pass through the valve-stem guides, will be made $3\frac{1}{4}$ inches square, as shown.

20. PISTONS.

They will be made of cast steel, and will be conical. The followers will be made of cast iron, of such size and sections as shown in drawings, secured in place by $1\frac{1}{8}$-inch bolts, spaced in an approved manner.

The follower bolts will be steel studs, screwed into the pistons; the bodies of the studs to be square, passing through square holes in the followers. The follower-bolt nuts will be of wrought iron, finished and casehardened, each nut to be secured in place by a brass split pin of ample size.

Each piston will have two packing rings, each $\frac{5}{8}$ inch wide and $\frac{3}{4}$ inch thick, of hard cast iron, cut obliquely and tongued. The Department will furnish a drawing showing the manner of making these rings.

The packing rings will be set out by steel springs of approved pattern, all set to an equal and proper tension. There will be sufficient clearance between the piston and cylinder to allow for difference of expansion.

Each packing spring must be so secured in the piston as to be firmly held in place and easily inserted and removed. The springs must be of best spring steel, of approved design, and properly tempered.

Each piston must be carefully gauged, and care taken that the clearance between the piston and cylinder head and cover is as called for in these specifications.

21. PISTON RODS.

The piston rods will be of forged steel, 5 inches diameter, excepting at ends, where they will be 4 inches diameter over threads. They will be turned to fit the pistons with

collars, as shown, and fitted each with a steel nut at piston end, secured by a screw-stop pin. The parallel parts will be smoothly and accurately turned. Each piston rod will have, at its seating in the piston, a collar of 6 inches diameter and 1 inch thick, well filleted, and recessed in the piston as shown.

At the crosshead end each piston rod will be turned to fit the crosshead and will be provided with a steel nut secured by a set screw.

22. CROSSHEADS.

The crossheads will be of forged steel.

The body of the crossheads will be secured to the piston rod and will be shaped for the reception of the wrist-pin brasses, caps, and the slipper guide. The wrist-pin journals will be $5\frac{7}{8}$ inches diameter and 6 inches long.

The slipper will be bolted to the side of crosshead by four $1\frac{1}{4}$-inch bolts, and the wearing face of the slippers will be grooved for the reception of the white-metal strips. The slippers will be made of wrought steel, shaped as shown, and will be lined with approved antifriction metal on the "go-ahead" sides. It will have a bearing surface of 13x16 inches on the ahead size.

23. CONNECTING RODS.

The connecting rods, with their caps and bolts, will be of forged steel, finished all over. They will be 75 inches long between centers, turned 5 inches diameter at small ends, and $6\frac{1}{2}$ inches at the large ends. The crosshead end of each rod will be forked to span the crosshead pins. The crank-pin end of each connecting rod will be increased in width to $21\frac{1}{2}$x11 inches and $3\frac{1}{2}$ inches in thickness, faced on each side and squared on the end for the brasses.

A circular recess will be bored in the end of the connecting rod for the reception of steadying boss on the back of the brass.

The crank-pin end will be provided with brasses and steel cap.

The bolts will be of steel, $3\frac{1}{4}$ inches in diameter, and will have recessed nuts, washers, and set screws. The heads of the bolts will be fitted with stop pins.

The cap bolts will be provided with set screws for holding their weight when backing off the nuts, and in the upper end of the bolts there will be a tapped hole for screwing in an eyebolt for handling.

The bolts will pass through the brasses, the whole bolt being covered by the brass.

Composition distance pieces will be fitted between the brasses so as to be removable without taking out the bolts.

Each cap will have two eyebolts for handling.

24. CRANK-PIN BRASSES.

They will be accurately fitted to the connecting-rod ends and secured by the cap bolts as before specified. They will be fitted with approved white metal in strips, accurately fitted to the crank pins, and properly channeled for distribution of oil. They will be faced, with sufficient clearance between crank webs to prevent nipping when heated. The brasses will be bored 10½ inches in diameter and will be 13½ inches long.

Distance pieces of composition will be fitted between all brasses. They will be removable without taking out the cap bolts, and channeled so as to be easily reduced when taking up lost motion.

25. CROSSHEAD BRASSES.

The crosshead brasses will be about ⅞ inch thick at the crown, and they will fit the two pin bearings accurately. They will be provided with composition distance pieces. The two caps will be of steel and will each be held by two 2½-inch steel bolts fitted with stop pins, nuts, and set screws.

26. CROSSHEAD GUIDES.

The guides to take the thrust of the crosshead will be of cast iron. They will be bolted to the facing on the back frames. The space back of the guides will be cored to form a water passage, as shown on the drawing, for circulation of water to keep the guides cool. The guides will be smoothly and accurately finished, and will be fitted

in place to proper alignment. Backing guides of cast iron will be firmly bolted in place by through, body-bound bolts. Brass oil boxes will be screwed to lower end of each guide.

27. PISTON-ROD STUFFING BOXES.

They will be made of composition and fitted with approved metallic packing, with efficient means of lubrication. The packing to be in all respects equal to the best in the market, and subject to the approval of the engineer in chief, United States Revenue-Cutter Service.

28. VALVE-STEM STUFFING BOXES.

They will be made of composition and fitted with approved metallic packing, with an approved and efficient means of lubrication; this packing to be in all respects equal to the best in the market, and subject to the approval of the engineer in chief, United States Revenue-Cutter Service.

29. CYLINDER RELIEF VALVES.

There will be an adjustable-spring relief valve $2\frac{3}{4}$ inches diameter on each end of the high-pressure, intermediate-pressure, and low-pressure cylinders. The valves and their casings will be of composition. Pipes with easily broken joints will lead from the relief-valve casings to the bilge.

These valves will have nickel seats or their equivalent, and the valve fittings will be so constructed that the valves can be easily overhauled without slacking the springs and so that steam will not come into contact with the springs. The springs will have approved means of adjustment, and will be long enough to allow the valves to open to their full extent without unduly increasing the load. The valves will be guided by loosely fitting wings. The springs will bear on shoulders on spindles, which fit loosely in sockets recessed in the backs of the valves. These spindles will be so fitted that the valves can be moved by the application of a lever. The valves will be fitted with casings and drainpipes, which will prevent people being scalded by hot water from the cylinders. Suitable fulcrums will be

on casings for the application of levers for working the valves, one lever to be furnished.

The spring casing of each valve will be fitted with a suitable lock; all locks to have interchangeable keys.

30. CYLINDER DRAIN COCKS.

The high-pressure, intermediate, and low pressure cylinders will each be fitted with one 1½ inch asbestos-packed drain cock, placed so as to drain the cylinders thoroughly. The cocks must be perfectly tight, without undue friction. The drain cocks of each cylinder will be worked by a separate lever at the working platform. All the drain cocks will discharge into a pipe leading to the bilge. Small drain cocks will be fitted to the lowest parts of drain pipes.

31. ENGINE THROTTLE VALVE.

The engine will have a 9-inch throttle valve bolted to the high-pressure cylinder steam connection, as shown. It will consist of a single poppet valve, balanced at lower end by a piston and located next the engine, working with a handwheel and lever. A design for this valve will be furnished by the Department. The valve and its casing will be of composition. The throttle valve will have an approved locking gear, worked from the platform, which will hold the valve wide open when desired.

32. VALVE GEAR.

It will be of the Stephenson type, with double-bar links. 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 0.7 stroke.

33. ECCENTRICS.

They will be of cast iron, each in two parts for the I. P. and L. P. cylinders and solid for the H. P. cylinder.

The two parts of each eccentric will be neatly fitted together and secured by two forged-steel bolts. They will be bored out to a snug fit on the seatings and turned accurately on the outside to an eccentricity of 3⅛ inches

for the high and the intermediate and $3\frac{3}{4}$ inches for the low pressure. The seating for the eccentrics will be on the shafting for the H. P. and L. P. and on the coupling for the I. P. The eccentrics will be recessed at each side for the flanges of the eccentric straps. Each backing eccentric will be securely keyed on the shaft and each "go-ahead" eccentric will be secured to the corresponding backing eccentric by through bolts in slotted holes, the holes to be filled up after the eccentrics are set.

The eccentrics will have $3\frac{1}{4}$ inches face, including rabbet, for the low and intermediate pressure and 3 inches for the high pressure.

34. ECCENTRIC STRAPS.

They will be of composition, finished all over, made with flanges to fit the recesses of eccentrics, and with lugs for the clamping bolts and for the eccentric rods. The two parts of each strap will be held together by two forged-steel bolts with finished heads, lock nuts, and split pins, and fitted with channeled brass distance pieces. Each strap will be lined with white metal fitted into dovetailed recesses and hammered in place. They will be accurately and smoothly bored to fit the eccentrics on faces and properly channeled for oil.

35. ECCENTRIC RODS.

They will be of forged steel, finished all over. Each rod will have a T head secured to its eccentric strap by two forged-steel stud bolts with nuts locked in place.

The upper end of each rod will be forked to span the link, and fitted with adjustable brasses, as shown.

The two brasses in the forks of each rod must be fitted accurately in line with each other and smoothly bored to fit the link pins. The distance from centers of eccentrics to centers of link pins will be for the H. P. and I. P. 5 feet $6\frac{5}{8}$ inches. The low-pressure rods will be 5 feet 6 inches.

The high, intermediate, and low pressure eccentric rods will be open.

36. MAIN LINKS.

They will be of the double-bar pattern, of forged steel, finished all over. They will have the pins for eccentric rods forged on and finished to 20 inches between centers. Extensions of the pins at the ahead-motion end of each link will form the pins for suspension rods. Each pair of bars will be secured together by through bolts of forged steel and thimbles fitted with forged-steel nuts well secured with split pins.

37. LINK BLOCKS.

They will be of forged steel, finished all over. They will consist each of a link block, terminating at each end in a pair of jaws to span the corresponding bar of the link. The jaws will be fitted with composition gibs finished to the curves of the links. Each gib will be secured to the link block by set screws free in the link block, but tapped into the gib, as shown. The Department will furnish a design for taking up the wear in these blocks.

38. SUSPENSION LINKS.

Each Stephenson link will be suspended from the corresponding arm of the reversing shaft by forged-steel suspension links. The ends of these links will be fitted with brasses, bored accurately to fit suspension pins on main links and pins on reversing shaft, and to be adjustable by straps, gibs, and keys.

39. VALVE-STEM GUIDES AND REVERSE-SHAFT BRACKETS.

There will be facings on the bottom of cylinders for bolting the valve-stem guides and reverse-shaft brackets. These brackets will support the reverse shaft and will also form the guides for the valve stems. The valve-stem guides will be fitted with adjustable brasses, with caps and steel bolts as shown.

40. REVERSING GEAR.

The reversing gear will consist of a steam cylinder and a hydraulic controlling cylinder placed nearly vertical and acting directly on an arm fixed on the reversing shaft. It

will be placed near the intermediate-pressure cylinder column. The steam piston rod will be secured to a steel crosshead connecting to the arm on the reversing shaft. The piston rod will pass through the controlling cylinder with uniform diameter.

The steam cylinder will have a slide valve, which will be worked by a hand lever on a notched quadrant at the working platform, in conjunction with an eccentric on the reverse shaft and levers, as shown.

There will be a by-pass valve on the hydraulic cylinder worked by a connection to the steam valve. The arrangement will be such that the reversing piston shall follow the motion of the hand lever and be firmly held when stopped.

There will be a stopcock in the by-pass pipe of the hydraulic cylinder, and a pump for reversing by hand will be connected to the hydraulic cylinder with its lever convenient to the working platform. The by-pass pipes will be connected to the valve box of the hand pump in such a way as to leave the hand arrangement always in gear.

The reversing engine will be secured to the bedplate by seven 1-inch body-bound steel bolts and otherwise as approved. The steam-piston will be of cast-iron and fitted with an approved form of snap packing ring of cast iron $1\frac{3}{4}$ inches wide and $\frac{7}{16}$ inch thick. The steam cylinder will be 12 inches in diameter and with $12\frac{1}{2}$-inch stroke of piston. The hydraulic cylinder will be packed by two cup leathers, a mold for which will be furnished to the vessel. Drainpipes, as approved, will be fitted to the steam cylinder, and all connections will be made to make the reversing gear complete.

41. REVERSING SHAFT.

There will be one forged-steel reversing shaft for the engine. The reversing shaft will be about 17 feet $\frac{1}{2}$ inch long and 5 inches in diameter. It will be finished all over and turned for four journals, each 6 inches long and 5 inches diameter.

There will be fitted to the reversing shaft five steel arms in all, two for the reversing engine and one for each link. The shaft will be supported by adjustable bearings. Each

reversing arm for the links will be made with a slot fitted with a cast-steel block, to which the suspension rods will be attached. Each block will be adjustable in the slot of its arm by a square-cut thread, with approved locking device, and will be fitted with a suitable index. The slots in these arms will be so arranged that the links may always be thrown into full backward 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 about 0.5 to 0.75 of the stroke. All arms will be finished, neatly fitted, and keyed to the shaft.

42. REVERSING SHAFT BEARINGS.

Each bearing will have a composition bottom brass and will be fitted with a composition cap, secured in place by steel bolts and lock nuts and split pins. The caps and bottom brasses will be accurately bored and fitted to the journals of the shaft.

43. STUFFING BOXES.

All iron boxes will be bushed with composition. Metallic packing of approved make will be fitted in stuffing boxes of all piston rods and valve stems of main engine and of all auxiliary engines.

44. EXHAUST PIPES.

Leading from the exhaust side of the high-pressure valve chest there will be a passage cast with the cylinder, one on each side, as shown on the drawings. From the intermediate-pressure cylinder there will lead a copper pipe $14\frac{1}{2}$ inches in diameter, with a composition bend at I. P. cylinder, to connect to the low-pressure valve chest. A 19-inch copper exhaust pipe will connect the low-pressure valve chest and the condenser. Approved slip joints will be fitted in pipes where shown and in such other sections of pipes as may be deemed necessary.

45. WORKING LEVERS AND GEAR.

There will be at the working platform the following hand gear for the engine, viz: One reversing lever, one lever for reversing hand pump, three cylinder drain cock levers,

throttle-valve lever and hand wheel, bleeder-valve handwheel, two by-pass valve handwheels, reversing engine drain-cock levers, and reversing engine stop-valve handwheel. The reversing and throttle valve levers will work on a double quadrant, and will have spring latches of "locomotive" pattern; all others, arcs and set screws with handwheel. All levers and handwheels will be marked to show their uses.

46. WORKING PLATFORM.

The height of the upper engine room floor will be as shown on drawing, and will be conveniently arranged to serve as a working platform. The counters, clock, gauges, telegraph dial, gong, jingle bell, and other engine room fittings will be so placed as to be in full view while working the engine. Speaking tube mouthpieces and telegraph levers will be conveniently placed.

47. CRANK-SHAFT BEARINGS.

The bearings for the crank shaft will be in two parts, the upper part and cap being a steel casting lined with white metal fitted into dovetail recesses and hammered in place. The lower part of the bearing will be of composition, as shown, fitted as the cap, with white metal, and turned to fit a steel chock in which it rests. This chock will be secured to bedplate by four $\frac{7}{8}$-inch steel bolts. The bottom brass will have provision made for circulating water through it, and will be fitted with ample oil channels. Each cap will have an oval hand-hole for the purpose of feeling the journals. The hand-hole will have a box-shaped cover for holding tallow, the bottom being perforated and extending to within a quarter of an inch of the journal.

The caps will be secured by two steel through bolts, fitted as shown, each bolt $2\frac{3}{4}$ inches in diameter and having approved provision made against the nuts backing off.

The bolts will be screwed into square nuts, placed as shown.

After the engine is secured in the vessel the bearings will be bored out to perfect alignment, if required. They

will also be trued on their shafts and any defects made good by scraping to a proper bearing.

The bearing will be so fitted that the only bearing of the journal will be on the white-metal surface.

The bottom brasses will be so fitted that they can be removed without taking out the shafts.

48. JOURNAL BOXES.

All journals or moving parts of iron or steel will run, unless otherwise specified, in composition boxes. These boxes will be lined with antifriction metal which shall be equal to "Parson's white metal."

49. MANDRELS FOR WHITE-METAL BEARINGS.

Hollow cast-iron mandrels will be furnished for forming the white-metal linings of crank-pin, crank-shaft, and line-shaft bearings. All these will be smoothly and accurately turned to size, marked, and packed so as to be perfectly protected.

50. SHAFTS.

All the crank, intermediate, thrust, and propeller shafts will be forged of mild open-hearth steel. Each length will be forged solid in one piece, and will have couplings forged on. All shafts will be finished all over. They will be supported as shown.

51. CRANK SHAFT.

There will be two sections in crank shaft for the propelling engine. The after section will have two cranks of 15 inches throw, and the forward section one crank. They will have coupling disks forged on as shown. The coupling disks will be 3 inches thick and 21 inches diameter. The length of forward section of shaft will be 5 feet 6 inches and that of the after section 10 feet 3½ inches. There will be two journals on forward section of shafting, one on each side of crank, each 10½ inches in diameter and 13½ inches long. The after section of crank shaft will have four journals, each 10½ inches in diameter and 13½ inches long.

The crank pins will be $10\frac{1}{2}$ inches in diameter and $13\frac{1}{2}$ inches long.

The crank webs will each be 12 inches wide and $6\frac{1}{4}$ inches thick; the webs to be chamfered as shown in the drawings.

Crank pins must be accurately parallel to the main journals. All journals are to be smoothly and accurately turned, and when finished will be tested and their accuracy proved. When the two sections are bolted together the cranks of the engine will be at angles of 120° to each other, the intermediate to follow the high pressure and the low pressure to follow the intermediate.

The two sections of crank shaft will be coupled to each other by six $2\frac{3}{8}$-inch forged-steel bolts; the after crank-shaft coupling will be bolted to the thrust-shaft coupling in the same manner. All holes in each coupling will be drilled and reamed. The bolts will be finished to fit the holes snugly, and each fitted with a wrought-iron nut and split pin.

52. TURNING GEAR.

A worm wheel for turning the shaft, provided with ratchet and lever of approved design, will be fitted where directed.

53. THRUST SHAFT.

It will be $9\frac{3}{4}$ inches in diameter. The shaft will have nine thrust collars $1\frac{3}{4}$ inches wide, with spaces of $3\frac{1}{2}$ inches, the collars to be $15\frac{1}{2}$ inches outside diameter. There will be coupling disks forged on the forward and after ends 3 inches thick and 21 inches diameter. There will be a raised seating on the thrust shaft for the L. P. eccentrics.

The bolt holes in the couplings will be drilled and reamed, and will be fitted and spaced the same as those in the crank-shaft coupling, with the same size and number of bolts.

54. INTERMEDIATE SHAFT.

There will be one section of intermediate shafting for the engine, supported on two spring bearings, built up from the floors. This shaft will be $9\frac{3}{4}$ inches in diameter and about

28 feet long. The couplings will be forged on, and of the same dimensions as those described for the thrust shaft. The coupling bolts for the forward end of shaft will be tapered bolts, $2\frac{1}{2}$ inches diameter at the large end and $2\frac{1}{8}$ inches at the small end. The holes in the couplings, forward end of line and after end of thrust shafts, will be accurately reamed to correspond with the taper bolts. There will be one cast-iron collar, in two pieces, bolted to the line shaft by two $1\frac{1}{8}$-inch steel bolts. The collar will be located on the forward side of the after-spring bearing to prevent the shafting from going outboard when detached. The size of collar will be $3\frac{1}{4}$ inches wide and $16\frac{1}{4}$ inches in diameter; it will also be secured to shaft by two 1-inch steel set screws.

55. PROPELLER SHAFT.

The propeller shaft will be $10\frac{1}{2}$ inches in diameter; the length will be taken from the work. It will be covered with a composition casing, extending from the propeller boss to 6 inches forward of the gland of the stern stuffing box; this casing will be shrunk on shaft in sections 30 inches long, and each will be secured by two $\frac{1}{2}$-inch Muntz metal screws staggered. Each section will be tapered at ends, as directed, and lap each other 1 inch; if found necessary, the joints will be protected by a fillet of soft solder.

The casing will be $\frac{3}{4}$ inch thick in the after bearing and at the joints, $\frac{13}{16}$ inch thick in the forward bearing, and $\frac{1}{2}$ inch thick elsewhere. The after end of the casing will enter the propeller boss $\frac{3}{4}$ inch and will make a water-tight joint.

There will be a composition fair-water casing bolted to the eye of stern post and extending over the propeller hub about $\frac{1}{2}$ inch.

56. THRUST BEARING.

The thrust bearing will consist of a cast-iron pedestal, which will be securely bolted to the main engine foundation plate by sixteen 1-inch steel bolts in reamed holes. The base plate of the thrust bearing will have an extension on the forward end which will be securely bolted to a

flange on the engine bedplate. The thrust will be taken by eight cast-iron horseshoe collars, lined with white metal and mounted on two steel rods 2¼ inches in diameter, upon which they will be kept from endwise motion by composition nuts screwed on the rods, acting as distance pieces between the thrust rings. The steel rods, and with them the nuts, will permit of adjustment endwise, the rods passing through bosses on the pedestal and being threaded and fitted with adjusting nuts. The thrust rings 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 shaft will be taken in composition bearings fore and abaft the thrust rings, adjustable vertically by liners under brasses. The pedestal will form an oil trough (through which will pass a coil for water circulation), the escape of the oil at the ends being prevented by stuffing boxes and glands.

57. SPRING BEARINGS.

They will be of cast iron, with faced flanges secured to the foundation by body-bound forged-steel bolts. The brasses will be fitted so that they may be easily removed and renewed. The bearing surfaces will be accurately bored to 9¾ inches diameter, faced with white metal, dovetailed and hammered in place. The cap will be fitted with an oil and tallow cup and a hand-hole for feeling the bearing. The length of these bearings will be 12 inches. The forward side of the after bearing will have a facing of the same diameter as the collar previously described (under "Intermediate shaft") for preventing the shafting going outboard when detached. The bearings will be supported on approved and suitable foundations, built up of plates and angles from the frames of the ship.

58. FRICTION BAND.

An approved hinged friction band, 5 inches in width and ¾ inch thick, will be fitted to the coupling of propeller and intermediate shafts in the shaft alley. The hinge will be secured to a foundation built up from the frames of the

vessel. The halves of the band will be clamped together by a hinged bolt, and an arrangement will be made for separating the two halves of the band when not in use without disconnecting the clamping bolt. The engineer in chief will furnish a design for this device.

59. STERN TUBE AND BEARINGS.

The propeller shaft will be supported in the stern tube on two bearings, one at each end of the tube. The length of the after bearing will be 4 feet and that of the forward bearing 3 feet. The stern tube will be of cast steel. It will be $1\frac{1}{8}$ inches thick and will be cast with two internal flanges, one forward of the after bearing and one aft of the forward bearing. The internal diameters of these flanges will be about $12\frac{1}{2}$ inches and they will be $1\frac{1}{2}$ inches wide. Each end of the stern tube will be bored to a diameter of $14\frac{1}{2}$ inches and the flanges will be properly faced. The stern tube will be in two sections, flanged and bolted to each other and to bulkhead at frame 95. The after section, where it passes through the sternpost eye, will have an external flange $18\frac{3}{4}$ inches in outside diameter and $1\frac{3}{4}$ inches wide, which will be located at the inboard end of sternpost. The after end of the stern tube will be threaded (4 threads to the inch) and will have fitted to it a steel ring nut 3 inches wide and $21\frac{1}{2}$ inches in diameter. The forward end of the stern tube will be bolted to the bulkhead at frame 88. Where the tube is secured to bulkheads at frames 88 and 95, there will be fitted steel strengthening rings $\frac{3}{4}$ inch thick and 3 inches wide. These rings will be riveted both to the bulkhead and to the flanges of the stern tube. The internal diameter of these rings will be just sufficient to clear the flanges on the stern tube when the latter is being placed in position.

The composition casings for securing the lignum-vitæ staving in place will be $\frac{7}{16}$ inch thick from the bottom of the dovetails to the outside of the casing, and will be $\frac{13}{16}$ inch thick elsewhere. The dovetails in casing will be 2 inches wide. The after casing will be flanged and bolted to the ring nut by eight $\frac{3}{4}$-inch Muntz metal tap bolts, one of which will pass through the ring nut and screw into the sternpost eye in order to lock the ring nut in place.

The lignum-vitæ will be placed in strips in the bearings, so arranged that the bearing surface will be on the end of the grain, and it will be held in the dovetailed grooves of the casing by suitable collars.

The lignum-vitæ, after being well water-soaked, will be bored to a loose fit on the shaft, and will then project $\frac{3}{8}$ inch above the surface of the casing. The forward lignum-vitæ bearing will be bored to a diameter of $12\frac{5}{32}$ inches and the after lignum-vitæ bearing to $12\frac{1}{32}$ inches.

A composition ring will be bolted to the flanges of the after and forward casings for the purpose of preventing the lignum-vitæ staving from working out. This ring will be held in place by countersunk screws of manganese bronze.

The inner lignum-vitæ bearing will be made in two pieces, and so arranged as to be withdrawn by removing the inner stuffing box. The outer bearing casing will be withdrawn outboard.

A composition sleeve, $\frac{1}{2}$ inch thick, finished on the outside and made in halves, will be secured to the sternpost by Muntz metal screws, and will form a fair-water line from sternpost to boss of propeller.

60. STERN-TUBE STUFFING BOX.

At the inboard end of the stern tube a composition stuffing box will be bolted, having a packing space 7 inches deep for 1 inch packing. The gland will be in two parts, with $1\frac{1}{4}$-inch space between them. The gland studs (six in all) will be $\frac{7}{8}$-inch diameter standing bolts of Muntz metal, and will be provided with lock nuts. A $1\frac{1}{4}$-inch drain cock will be fitted on after end of stuffing box, outboard of the packing, with a pipe leading to the bilge.

61. SCREW PROPELLER.

There will be one manganese-bronze right-handed propeller, with four blades. It will have a diameter of 12 feet, and a pitch and helicoidal area as directed. Each blade will be firmly bolted to the boss by tap bolts of rolled manganese or Tobin bronze, secured by lock plates. The flanges of the blades will be turned and faced to fit

the recesses in the boss accurately, and after being secured in place must have the edges made fair. The recesses for the boltheads will be covered by composition plates held by countersunk screws and finished to form a smooth surface fair with the boss. The center of the blades at periphery will be about 1 foot aft of the center of the hub. The boss of the propeller will be accurately bored to fit the taper of the propeller shaft, to which it will be secured by a feather key $2\frac{1}{4}$x$1\frac{3}{8}$ inches. The propeller will be held on the shaft by a steel nut screwed on and locked in place in an approved manner. The propeller boss will be finished at after end by a composition cap, which will cover the nut and will be bolted on water-tight. The composition casing on propeller shaft will enter $\frac{3}{4}$ inch into the propeller boss and will be fitted water-tight. The propeller will be cast as smoothly as possible and have all roughness removed. A hollow cast-iron template, made to accurately fit the hole in propeller boss and keyway, will be furnished and securely boxed. Two spare blades with bolts and nuts complete will be furnished.

62. **CONDENSER.**

The condenser will be of rectangular shape, cylindrical at top and bottom, and of cast iron. The dimensions will be about as follows: The shell will be not less than 1 inch in thickness, about 16 feet 3 inches in length over all, 5 feet 2 inches in height, 2 feet $9\frac{1}{2}$ inches in breadth, and will be ribbed as shown. It will be made in three sections, the joints to be scraped and bolted together with body-bound bolts wherever practicable; elsewhere to be fitted with stud bolts. These sections will form part of the housings for supporting the back of cylinders. There will be the following openings in the condenser, each with properly faced flanges, viz: One for main exhaust pipe, 19 inches in diameter; one 4-inch diameter auxiliary exhaust pipe, for air, circulating, feed pumps, and all auxiliary machinery. There will also be facings for air-pump suction pipe, connections to distilling apparatus, a connection to auxiliary feed pump, and such others as are necessary. There will be four hand-hole plates, three on the outboard side

of the condenser, as near the bottom as practicable so as to clear the lower tubes, and one on top of the condenser, near the forward end of the middle section; the size of hand-holes to be 4x8 inches.

A nozzle for salt-feed spray and soda cock will be attached to exhaust-pipe nozzle. There will be a 1-inch boiling-out nozzle at the lower part of the condenser, placed on air-pump suction pipe. The casings of condenser and heads will be ribbed as shown on drawing.

The condenser tube sheets will be made of composition, $\frac{7}{8}$ inch thick, with smoothly finished holes for tubes, tapped and fitted with screw glands for packing tubes. The glands will be beaded at outer ends to prevent tubes from crawling, and will be slotted to admit a tool for screwing up. Cotton-tape packing will be used. There will be 1,253 seamless drawn Muntz metal tubes, $\frac{5}{8}$ inch outside diameter, No. 18 B. W. G. in thickness, tinned outside and inside. The tubes will be 14 feet 5 inches long between tube sheets, and will be spaced $1\frac{5}{16}$ inch between centers. The cooling surface will be about 3,000 square feet, measured on the outside of the tubes. The tube sheets will be secured to the flanges of the shell by Tobin bronze stud bolts. There will be two supporting plates of composition $\frac{1}{2}$ inch thick, placed where directed.

The chest for entrance and exit of circulating water will be made of cast iron, with a division plate in the middle. The inlet and outlet nozzles will each be 10 inches in diameter of opening.

The condenser heads will each be fitted with two manhole plates 9 inches in diameter, located as shown. Each plate will be secured in place by six $\frac{3}{4}$-inch steel stud bolts. All bolts for securing flanges of pipes and manhole plates will be standing bolts, and will, wherever practicable, be screwed into condenser casing, with heads inside.

The water chest at the other end of condenser will be cast as shown. The heads will be $\frac{7}{8}$ inch thick, and will be secured to water chest by twenty-three $\frac{7}{8}$-inch standing bolts. There will be braces of Tobin bronze connecting the tube sheets, as shown, 1 inch in diameter, and each passing through a stay tube $1\frac{1}{8}$ inches internal diameter and $\frac{1}{4}$ inch thick.

Baffle plates of sheet brass will be fitted as shown, to direct the steam over all the tubes. In front of the main exhaust nozzle, above the tubes, will be an approved deflecting plate.

Pipe and cock will be provided for admitting an alkaline solution into the condenser, this pipe to connect with the salt-feed spray.

Drain pipes will be provided leading to the bilge. Zinc slabs, in such quantity as may be directed, will be placed in the bottom of the condenser, to prevent the deterioration of the shell.

Before the condenser leaves the shop it shall be tested to 20 pounds pressure per square inch and made perfectly tight under these conditions.

There will be suitable flanges on the condenser, as shown, for securing it to the foundation by body-bound bolts.

Provision will be made for handling the chest covers by suitable eyebolts and attaching a track for travelers to beams overhead, or in other approved manner.

63. DISTILLING APPARATUS.

An approved distilling apparatus, placed where shown on the drawing, will consist of an evaporator and a condenser, with all the necessary accessories, having a capacity of at least 4,000 gallons of potable water per twenty-four hours, at a temperature of not more than 90° F. when the cooling water is taken in at a temperature of 60° F.

The evaporator will be made with shell of plate steel, with welded longitudinal seam. The heads will be of plate steel and the spiral elliptical coils of copper, tinned inside and out. It will be felted and lagged with black-walnut staves held in place by brass bands, and will be fitted with a safety valve, steam gauge, glass water gauge, gauge cocks, salinometer pot, and blow valve. It will take steam from the auxiliary steam pipe, and will be fitted with an automatic trap of an approved pattern, and with a drain pipe leading to the feed tank. The shell of the evaporator will be tested to 50 pounds to the square inch, and the coils

and all parts subject to the boiler pressure to 70 pounds per square inch more than the boiler pressure.

The condenser will be made with shell of sheet copper flanges and heads of composition, and coils of copper or brass, thoroughly tinned on both sides. There will be at least nine coils, with one inlet and one outlet valve of composition. A filter of approved design will be fitted to the condenser.

The water from the filter will be led to the bottoms of the supply tanks by suitable pipes and valves. A connection will be provided from the evaporator to the condenser, so that the evaporator can be used to make up losses. The exhaust from the electric light engine will also discharge into this condenser. The pumps for operating the distilling apparatus will be as described under the heading of "Pumps."

All pipes, valves, steam traps, salinometer pot, etc., necessary for the complete and efficient operation of the distilling apparatus will be fitted in place. The evaporator and condenser will be so fitted that their coils can be easily removed for repairs.

64. FEED AND FILTER TANK.

There will be a combined feed and filter tank placed as shown on the drawing, and supported on a suitable framework built up from the frames of the vessel. It will have a capacity of about 500 gallons. It will be made of wrought-iron plates, $\frac{1}{4}$ inch thick, built up of angles, and stayed internally in an approved manner. The tank will have at least 100 cubic inches of rolled zinc plate, suspended from the braces in a wrought-iron basket with a solid bottom and perforated sides. A portion of the tank will be fitted as a filter, into which the water from the air pump will deliver at the top, and provided with approved filtering material so arranged that the water will rise through it, and that the filtering material will be readily accessible. The tank will have a manhole with bolted cover, and will have a glass water gauge with suitable guards, shut-off cocks, and drain cocks.

The tank and filter will have the following pipe connections: A discharge pipe from the air pump; an over-

flow pipe leading to the bilge, but so arranged that any water passing down it may be seen; a suction pipe to feed pumps, with valve in same; drain pipes from steam traps, as elsewhere specified; a vapor pipe 3 inches in diameter, of copper, No. 16 B. W. G., leading to the main escape pipe. The feed-pump suction will be provided with a balance valve operated by a copper float in the feed tank, so arranged that it will allow no air to enter the feed pipe. All trap discharges and drains will enter the tank well below the ordinary water level. A design for this tank will be furnished by the Department.

65. FRESH-WATER SUPPLY TANKS.

There will be two fresh-water supply tanks located where shown, in the lower engine room. They will be firmly secured in place as directed; the combined capacity of the tanks will be about 1,260 gallons. They will be made of wrought-iron plates, $\frac{1}{4}$-inch in thickness, and must be perfectly water-tight before being placed in position. They will be properly braced, connected by pipes to condenser, to main and auxiliary feed pumps, to the injectors, to each other, and connected to the main deck by $2\frac{1}{2}$-inch filling pipes, fitted with brass deck plugs, vent cocks, and with all necessary valves to pipe connections to make the service complete. The tanks will be thinly cemented on bottom.

66. AIR PUMP.

There will be an independent air pump, of approved pattern, equal to the Blake vertical twin-pump system, having two direct-acting vertical steam cylinders, each 9-inch diameter by 12-inch stroke, and two single-acting vertical air pumps, each 20-inch diameter by 12-inch stroke. The steam cylinders will rest upon an entablature of cast iron, the latter to be connected to the air cylinders by heavy tie-rods of wrought iron. To the under side of this entablature will be bolted a cast-iron saddle, provided with proper bearings for the two wrought-iron beams, which latter are attached to the pump rods by suitable links, etc., said links to be provided with suitable arrangement for taking up wear and lost motion.

The main valve for each steam cylinder is to be a plain D slide valve. These valves are to be operated by an auxiliary piston working in a horizontal steam cylinder and operated by a plain D slide valve. The steam pistons of the main steam cylinders and the auxiliary steam cylinder are provided with cast-iron rings set out by adjustable springs. The valve rod of the auxiliary cylinder is to be of steel, provided with adjustable collars for regulating the length of stroke. The main steam cylinders are to be provided with adjustable cushion valves in the ends of each cylinder.

The shaft for the beams is to be of wrought iron, working in babbitted bearings, the piston-rod crosshead to be of steel, piston rods of steam cylinders to be of steel, a sight-feed lubricator of sufficient size to be supplied, and all bearings to have sight-feed oil cups, provided with taper feed.

The air cylinders are to be cast iron, to have composition linings, and to be provided with suitable hand-holes for getting at the bucket and foot valves; the pump buckets to be of composition, packed with adjustable fibrous packing, and the bucket rods to be of composition; both foot and head valves to have composition seats; valve bolts to be of composition and springs of phosphor bronze; the valves to be best quality of medium hard rubber, packed with composition washers. Suitable priming valves will be provided for each air cylinder.

The air pump must not occupy a floor space greater than 56x27 inches nor a height to exceed 99 inches over all.

The air pump will rest upon a suitable and approved foundation, built up of plates and angles from the frames of the vessel. It will be secured to the top plate of the foundation by 1-inch body-bound wrought-iron bolts.

There will be one suction nozzle 13 inches by 5 inches, which will connect both air cylinders to the condenser. This nozzle will bolt directly onto a corresponding nozzle on the condenser. Both air cylinders will discharge through one pipe directly into the feed tank. The steam cylinders will take steam from the auxiliary steam pipe, and also from a branch of the main steam pipe, with a

stop valve having a handwheel at the working platform. They will exhaust through a special pipe into the condenser or into the low-pressure receiver. The air pumps and condenser must maintain a vacuum of within 4 inches of mercury of the atmospheric barometer when the propelling engine is at full speed under forced draft.

67. CIRCULATING PUMP AND CONNECTIONS.

There will be one approved circulating pump of the centrifugal type. The casing will be of cast iron, and the fan or runner will be of composition, smoothly cored, finished on the outside, and perfectly balanced. The shaft will be an extension of the engine shaft, and will be cased in a composition sleeve, shrunk and pinned on. There will be a bearing for the shaft on one side of the casing, consisting of lignum-vitæ on end of grain, secured in a composition sleeve in two parts. There will be suitable provision to prevent this sleeve from turning. There will be suitable composition stuffing boxes, of which the glands will each be in two parts. There will be an air cock at the top of the casing and a drain cock at the bottom. The pump will be driven by a vertical engine 8 inches in diameter and 8 inches stroke. It will be of the open type, having the cylinder supported on a cast-iron column of ample stiffness at the back and a polished steel rod at the front, thus giving a full view of all the working parts while running. The crank shaft, piston rod, connecting rod, and valve stem will be made of steel. The engine will be supplied with throttle valve, lubricators, and automatic devices for oiling crank pin, crosshead pin, and guides. All glands and all running parts coming in contact with the circulating water will be of composition. The engine and pump will have the same bedplate, which will rest upon a suitable foundation, built up of plates and angles from the frames of the ship.

There will be a 10-inch suction nozzle on the pump connecting with the two injection valves and the bilge. There will be a stop valve in the bilge suction pipe, bolting to the casing of the lower main injection valve. The discharge nozzle will be so connected as to discharge either

into the condenser or overboard through the outboard delivery valve. Each of these branches will be 10 inches in diameter and each will have a 10-inch straightway valve located where shown on the drawing. The circulating-pump engine will take steam from either the main or auxiliary steam pipes and exhaust either into the condenser or low-pressure receiver. There will be an arrangement for controlling the throttle valve from the working platform.

68. MAIN FEED PUMP.

There will be one vertical duplex feed pump of the Blake pattern, having 8 inches diameter of steam cylinders, 5 inches diameter of water cylinders, and 12 inches stroke, located in the fire room where shown on the drawing. The suction nozzle will be 3½ inches diameter and the delivery 3 inches in diameter. The water ends of these pumps will be entirely of composition, naval standard, and be provided with water pistons of composition, packed with fibrous packing and set out with adjustable set screws and springs.

The water valves are to be of composition and valve springs of phosphor bronze. The valve seats will be of composition and driven or screwed into the main casting in the most substantial manner. They will be further secured by an arrangement of valve bolts which will not only prevent the valves from getting adrift but which will also hold the valve seats in position, one valve bolt passing through one discharge valve and its seat into the next chamber and holding in position the suction valve and seat immediately under the same; this valve bolt, which secures both suction and discharge valves and their seats, to be easily withdrawn from the outside of casting by simply removing a cap nut and set screw provided for the purpose. The piston rods will be of composition and the valve rods of steel. The steam pistons will be fitted with cast-iron packing rings, set out by adjustable screws and springs. Each steam cylinder will be provided with a cushioning valve at each end. Adjustable collars will be provided on valve rods for adjusting the length of the stroke while the pump is in operation.

The water cylinders will be tested to a pressure of 300 pounds to the square inch and the steam cylinders to a pressure of 250 pounds to the square inch.

An air chamber of suitable size, made of hammered copper, to be attached to the pump, immediately in the rear of the water cylinders, in a central position, out of the way of the valve mechanism and any piping. The upper heads of the water cylinders will be readily removable without interfering with the tie-rods, so that the water pistons can be packed from the top ends of the water cylinders. The outside dimensions of this pump must not exceed 67½ inches in height, 26¼ inches in width, including the wheel handles of the cushioning valves of the steam cylinders; distance from bulkhead to outside of steam cylinder, 20¾ inches; distance from bulkhead to outside of front of water cylinder, 20 inches.

It will be connected to draw from the feed tank and fresh-water tanks, and discharge into the main feed pipe only.

69. AUXILIARY FEED PUMP.

There will be one auxiliary feed pump, similar in all respects to the main feed pump above specified, located in the engine room where shown on the drawing. It will be connected to draw from the sea, feed tank, fresh-water tanks, bilge, or boiler, at will, and deliver into the auxiliary feed pipe, fire main, or overboard through a Kingston valve, each branch to be provided with a suitable screw valve within convenient reach of the pump. In the engine room there will be a hose connection on fire main, furnished with a screw straightway valve.

70. DISTILLER CIRCULATING, FIRE, AND BILGE PUMP.

There will be a vertical duplex pump, having 7½-inch diameter steam cylinders, 5-inch diameter water cylinders, and 8 inches stroke. It will have a 4-inch diameter suction and 3-inch diameter discharge valve. This pump will be of the same general description as the main and auxiliary feed pumps, with the exception that iron water ends will be used. These water cylinders will be lined with composition from head to head. The water pistons, piston

rods, valve seats, etc., will also be of composition. The pump connections will be so arranged that it can draw from either the sea or bilge and discharge into the distiller, fire main, or overboard, at will. Each branch will be provided with a suitable screw straightway valve within convenient reach of the pump.

71. DISTILLER PUMP.

There will be one combined fresh and salt water pump, for the distilling apparatus, of the horizontal type. It will have a $3\frac{1}{2}$-inch diameter steam cylinder, $2\frac{1}{8}$-inch diameter salt-water cylinder, $2\frac{1}{8}$-inch diameter fresh-water cylinder, and a common stroke of 4 inches. The fresh-water cylinder will be entirely of iron, and the salt-water cylinder entirely of composition.

72. BILGE PUMP.

There will be a bilge pump, located where shown in the lower engine room, having a steam cylinder 6 inches in diameter, a water cylinder 8 inches in diameter, and a stroke of 10 inches. The suction nozzle will be 5 inches in diameter and the discharge nozzle 4 inches in diameter. It will be of the horizontal type, with composition mounted cast-iron water cylinder, and provided with composition valve plates. The water cylinder will be made extra thick, to withstand the corrosive effect of bilge water. It will have connections so that it can draw from either the forward or after trimming tanks and the engine-room bilge and discharge overboard; to draw from the sea through a Kingston valve and discharge into either the forward or after trimming tanks.

73. FIRE PUMP.

There will be one vertical duplex fire pump, located on on the port side of engine room, and having steam cylinders 14 inches in diameter, water cylinders $8\frac{1}{2}$ inches in diameter, and a stroke of 12 inches. The bulkhead to which this pump is attached will be secured in a substantial and approved manner. The water cylinders will be of iron, composition mounted, and provided with com-

position water pistons, piston rods, and valve plates. It will draw from the sea or the bilge and discharge into the fire main or overboard.

74. HAND PUMP.

There will be an approved hand pump, located in lower engine room where directed, fitted complete to draw from the sea, and connected with main feed pipe, provided with all necessary pipes, valves, etc. It will have a detachable hand lever, which will be stowed in brackets on the bulkhead.

75. BILGE EJECTOR.

There will be an approved bilge ejector, placed where directed in the lower engine room, for blowing water from the bilge overboard. It will be fitted with necessary pipes and valves, and the lower end of the pipe will be connected to an approved Macomb strainer. It will be of a capacity requiring a $2\frac{1}{2}$-inch steam pipe and a $3\frac{1}{2}$-inch discharge.

76. PUMP PISTON-ROD PACKING.

In all of the pumps above specified the piston rods and valve stems $\frac{3}{4}$ inch in diameter and over will be packed with approved metallic packing, equal in all respects to "Katzenstein's."

77. PUMP CONNECTIONS AND FITTINGS.

All pumps will be supplied with the necessary pipes and valves to make the system complete in every detail, and all connections necessary for their successful operation must be made to the satisfaction of the superintending engineer. All pipes to be of copper or brass, and all valves of composition.

78. LUBRICATION.

To each high, intermediate, and low pressure cylinder there will be fitted one brass, nickel-plated, multiple sight-feed oiler, equal in all respects to the *Michigan*. These oil reservoirs will have a capacity of not less than one gallon each, and will be provided with a filler at their tops.

At both ends of the reservoirs will be fitted heavy plate-glass disks, set with washers into heavy brass rims which will screw into the reservoirs like the object lens of a telescope, thus showing at all times the amount of oil in reservoirs. There will be suitable supports at each end of reservoirs for securing them to cylinders. At the top of the reservoirs there will be fitted an approved number of regulating valves, which will regulate and control independently of each other a corresponding number of sight feeds, located at the bottom of the reservoirs. To each sight feed there will be a union tapped for connecting seamless brass piping to the various points of oil distribution. Piping will lead from sight feeds connected to reservoirs to all moving parts of engine wherever practicable. There will be fitted to main steam pipe of high-pressure cylinder, close to valve chest and also to intermediate valve chest, approved steam sight-feed oil cups, each of 1 quart capacity, with gauge glass. The intermediate-pressure and low-pressure cylinders will each be fitted with a small hand oil pump.

All working parts of machinery will be fitted with efficient lubricators, each with a sufficient oil capacity for four hours' running. Each main crank pin will be oiled by cups carried on the crosshead, taking oil from wicks overhead; the oil to be carried to the crank pins by brass pipes secured to the connecting rod. In addition thereto there will be for each crank pin an approved wick cup arrangement on the side of each rod. These pipes will have union joints where connected to oil cups.

Each main crosshead journal will take oil from an overhead wick cup.

Each crosshead guide will be oiled by dragglers taking oil from a cup at the bottom, and will have an oil cup at the top.

There will be an approved means for oiling piston and valve-stem rods through the metallic packing in the stuffing boxes. These will be in addition to the globe cups fitted. They will be placed sufficiently high to insure the oil running when desired, without regard to the trim of the vessel. The eccentrics will also be provided with effi-

cient means of lubrication. All working parts for which oil cups are not specified will be provided with oiling gear of approved design, such that they can be oiled without slowing.

Moving oil cups, where necessary, will have removable covers. The supply of oil to various parts is to be easily regulated.

There will be steam sight-feed cups on each auxiliary engine. All oil cups and their fittings, except such as are cast on bearings and not otherwise specified, will be finished cast brass or sheet brass or copper, as may be directed, with all seams brazed.

79. OIL DRIPS.

All fixed bearings will have drip cups of sheet brass, properly applied. All moving parts will have drip cups or pans where directed, to be substantially made of sheet brass or copper, with brazed seams. All fixed drip cups will have drainpipes and cocks of at least ½ inch diameter, which can be used while the engines are in operation.

80. MAIN INJECTION VALVES.

There will be two screw main injection valves, of an approved design and not less than 10 inches diameter each, located where shown on the drawing. The hand-wheels of these valves must be easily accessible above the lower engine-room floor plates. The casings will be of cast iron, brass mounted. There will be a ¾-inch steam pipe of galvanized iron connected to both casings below the injection valves. Valves will be put in each end of these steam pipes.

81. BILGE INJECTION VALVE.

Secured to the lower main injection valve there will be a 10-inch bilge injection valve of the same general description as the main injection valves. From this valve a copper pipe, fitted with a Macomb strainer, will lead to the bilge. The lower end of this pipe will be of galvanized iron. An approved arrangement will be provided to prevent the accidental flooding of the engine compartment

if both the main and bilge injection valves should be open at one time.

82. OUTBOARD DELIVERY VALVE.

There will be in the engine compartment, where shown, one 10-inch outboard delivery valve of approved design; it will be secured to the hull at about the load water line. The casing will be of cast iron, brass mounted. A hand-wheel will be fitted for operating this valve, but it will be automatic in its action. The valve stem and valve will be of composition, the latter faced with rubber.

83. SEA VALVES.

There will be an approved cast-iron, brass-mounted sea valve located in the engine room. It will be provided with two nozzles, one for the suction pipe from main bilge pump and the other for the suction pipe of the distiller circulating pump. There will also be an approved sea valve of composition in the boiler compartment, with nozzles for the auxiliary feed-pump and fire-pump suctions.

84. BOTTOM-BLOW SEA VALVES.

There will be two composition bottom-blow sea valves, of approved design, located on the hull of the ship, one on each side of the fire room, just above the fire-room floor plates. The bottom-blow pipes from the starboard boilers will both lead into the starboard sea valve, and a similar arrangement will be made for the port boilers. These valves will be provided with approved sheet-iron shields.

85. MANNER OF SECURING SEA AND INJECTION VALVES TO HULL.

The sea valves will be secured to composition sleeves. These sleeves will have a flange on the outside, by means of which they will be secured to outer skin of ship by countersunk brass screws. The other end of sleeve will have a thread cut on it, and a cupped washer of composition will be firmly held by a composition nut, fitting thread, or other approved arrangement. The valve will be bolted to a flange screwed on threaded end of sleeve.

All suction valves will have composition strainers over their openings, secured to end of sleeve, and the sleeves for suction valves will be conical at outer ends to insure requisite area of openings through strainers. The strainers will have $\frac{5}{8}$-inch holes, with a collective area equal to twice the area of valve openings.

Sea valves for deck pumps will be secured and made similar to those for injection valves.

86. MAIN STEAM PIPE AND BRANCHES.

A 5-inch copper pipe will lead from each main boiler stop valve. The pipes from the forward boilers will unite with those from the after boilers and form 7-inch pipes, one on each side of the ship. These 7-inch pipes will be led aft and then unite, forming the main steam pipe, 9 inches in diameter. This 9-inch pipe will run from the connection with the 7-inch branches to the main engine, passing through the athwart-ship coal bunker in a water-tight box, as shown on the drawing. There will be straightway screw stop valves, entirely of composition and of approved design, located as follows: One 9-inch stop valve in main steam pipe at the junction with the 7-inch branches (there will be a brass deck plate 18 inches in diameter over this valve for the purpose of closing the same from the deck); one 7-inch stop valve in each 7-inch branch at junction with main steam pipe; one stop valve, 5 inches in diameter, in each of the 5-inch branches from the forward boilers, located near the connections with 7-inch branches at after boilers; these two valves will have 5-inch nozzles on the forward side and 7-inch nozzles on the after sides, to connect with the 7-inch branches. The main and branch steam pipes will be curved, as shown on the drawing, to allow for expansion. There will be a 4-inch branch from the main steam pipe to the auxiliary steam pipe in the engine room. There will be a stop valve in this branch, located close up to the main steam pipe. No pockets where water can accumulate and form a water ram will be allowed anywhere in the main steam pipe or its branches.

87. SEPARATOR.

There will be located in the main steam pipe, where shown on the drawing, an approved centrifugal separator. It will be made entirely of composition, and will be fitted with a well-protected glass gauge and an approved automatic steam trap, with drain delivering into feed tank. The glass gauge will be of the automatic-closing pattern.

88. AUXILIARY STEAM PIPE AND BRANCHES.

There will be a 4-inch auxiliary steam pipe, of copper, as shown, connecting to each of the four boilers, extending through the engine and boiler compartments and to the windlass, steering, dynamo, and blower engines, and to all other auxiliary steam machinery. In each branch leading from this pipe there will be a composition stop valve close up to the auxiliary pipe, as well as stop valves, of the same material, on the auxiliary machinery. On each boiler valve box there will be a 4-inch straightway stop valve. There will also be 4-inch stop valves of composition in the pipe as follows: One at the junction of the pipe from the forward boilers with the pipe leading to engine room; one at the junction of pipe from after boilers with the pipe leading to engine room. Over the port forward boiler there will be three stop valves, one on each side of the junction with the pipe to the forward auxiliaries, and one in the pipe to forward auxiliaries. Wherever pockets necessarily occur in any of these pipes or branches the same will be drained and trapped.

89. AUXILIARY EXHAUST PIPE.

There will be an auxiliary exhaust pipe, of copper, of sufficient size for all steam auxiliary machinery. It will have composition valves to direct the exhaust steam into the condenser or into the atmosphere through the escape pipe, at will. In each branch from each auxiliary engine there will be a composition stop valve located close up to the pipe. These branches will be of either copper or brass as directed.

90. BLEEDER PIPE.

There will be a 4-inch branch from the main steam pipe, of copper, led into the main exhaust pipe; it will be fitted with a composition stop valve close up to the main steam pipe, and so arranged that it can be operated from the working platform.

91. INTERMEDIATE AND LOW PRESSURE STEAM PIPES.

Branches of approved size will lead from the main steam pipe to the intermediate and low pressure receivers; each will have a composition stop valve so located that it can be operated from the working platform. These pipes will be of copper.

92. MAIN FEED PIPE.

A seamless drawn-brass pipe of the full size of the pump discharge will lead from the main feed pump and discharge into the main feed pipe only. The branches leading to the boilers will have each a composition straightway valve, with handwheel in a convenient position for regulating the feed. All parts of the pipe will be above the floors, in plain view, and all joints made by flanges screwed on the pipes and bolted together. A suction pipe will lead from the feed tank to the main feed pump.

93. AUXILIARY FEED PIPE.

A pipe will lead from the auxiliary feed pump to the auxiliary feed pipe, having branches to each of the auxiliary check valves on the boilers. All these pipes will be of the same material and fitted the same as the main feed pipe. A branch from the feed-tank suction pipe above specified will lead to the auxiliary feed pump, with a composition non-return valve close to the pump.

94. BOILER PUMPING-OUT PIPES.

Brass pipes of the same size as the bottom blowpipes will connect the bottom blowpipe with the auxiliary feed pump, and have a screw composition stop valve above the floor near the pump in each pipe.

95. ESCAPE PIPE.

There will be a 7-inch copper escape pipe located abaft the smoke pipe, extending to within five feet of the top, finished and secured in an approved manner. This pipe will have branches leading to all the safety valves on the boilers. The auxiliary exhaust pipe will also lead into the escape pipe.

96. DRAINPIPES AND TRAPS.

All places where condensed steam can accumulate will be provided with drainpipes and composition cocks or valves of ample size, and with approved automatic traps, which will discharge into feed tank or condenser or as directed. All traps will have by-pass pipes and valves for convenience of overhauling. The lowest parts of all water and all pump cylinders and channel ways will have drain cocks with pipes where required. The handles of all drain cocks will point downward when closed. All traps will have glass-water gauges of approved automatic-closing pattern.

97. AUXILIARY ENGINE STOP VALVES.

Each auxiliary engine will have composition stop valves in both steam and exhaust pipes as close to cylinders as possible. Exhaust stop valves will be straightway where practicable. All pumps except centrifugal pump, or such others as may be otherwise directed, will have screw check valves of composition in both suction and delivery pipes, close to the pump cylinders, so arranged that they may be kept off their seats when desired.

98. FIRE MAIN.

A 3½-inch copper pipe will extend fore and aft, as directed, with fire plugs of standard size where directed. This pipe will be connected with the discharges of the main fire pump in upper engine room, the auxiliary feed pump, and the distiller circulating pump. A branch from the main will lead to the compartment abaft the engines, and one to each compartment forward. Each of these branches will be fitted with a fire plug, and will be so connected that all of the fire pumps can work on it. There will be fire plugs

in approved positions in the engine room and in the fire room. There will be three fire plugs located where directed in the main deck, and of approved design. Drainpipes will be fitted to drain all parts of the fire main and its branches. A reverse coupling will be supplied, with adapters to suit the various sizes and threads of fire hose commonly in use, for the purpose of filling the boilers with fresh water from hose on shore or from boats alongside.

99. COCKS AND VALVES.

All cocks and valves and their fittings, except as otherwise specified, will be of composition. All handwheels will be of finished brass, except as otherwise specified, and will be at least one and one-half times as great in diameter as their valves. All cocks communicating with vacuum spaces will have bottoms of shell cast in and have packed plugs.

Valves of approved pattern will be supplied wherever necessary to complete the various pipe systems, whether herein specified or not. No conical-faced valve will have a bearing on its seat of more than $\frac{3}{16}$ inch in width. All valve spindles must turn right-handed to close, and have outside threads where practicable. All valve-stem yokes will be of composition and bolted to covers by composition bolts. Cocks and valves may have, where approved, in lieu of wheels or permanent handles, removable box or socket wrenches, marked and stowed in convenient racks. All cocks and valves underneath the floor plates will have their wheels or handles above the floor plates, in easily accessible positions, unless otherwise directed. The sizes of valves as given in these specifications refer to the diameters of the equivalent clear openings.

100. SUCTION PIPE FROM BOTTOM OF CONDENSER.

From the air-pump channel way below the foot valves a $3\frac{1}{2}$-inch copper pipe will lead to the main feed-pump suction pipe, with a screw-down nonreturn valve. A similar pipe will be led to the auxiliary feed pump.

101. PIPES THROUGH WATER-TIGHT BULKHEADS AND DECKS.

They will be made water-tight by stuffing boxes, flanges, or other approved means. Pipes must not be led in such manner that the angles or tees of the bulkheads will have to be cut. Holes through wooden decks where pipes pass through will have brass or copper thimbles, made water-tight, extending at least 3 inches above decks.

102. PIPES THROUGH COAL BUNKERS.

They will be protected by iron casings, made in sections and easily removable for repairs. Pipes must not be led under openings of coal chutes.

103. BILGE STRAINERS.

Each pipe leading from the bilges to the pumps or ejector will be fitted with an approved Macomb strainer above the floors. The strainers will be of copper, well tinned, and must have a diameter of not less than one and one-half times that of the pipe and a depth of not less than twice the diameter of the pipe. There will also be an approved galvanized-iron box strainer at the end of each pipe. Macomb strainers and galvanized-iron box strainers will also be fitted to all bilge suction pipes from deck pumps.

104. THICKNESS OF PIPES.

The thickness of straight copper steam piping, fire service, and blow-off pipes will be found by the following formula, viz: Multiply the diameter in inches by the pressure in pounds per square inch and divide by 8,000; add $\frac{1}{16}$ inch to the quotient, and the result will give the thickness of the pipe. The thickness of feed pipes will be found by the same formula, with the exception that the pressure should be taken as one and one-half times the boiler pressure above the atmosphere. The thickness of all feed suction piping will be $\frac{1}{8}$ inch for pipes less than 3 inches in diameter and $\frac{5}{32}$ inch for pipes of 3 inches in diameter and less than 5 inches in diameter. The thickness of water pipes without pressure will be:

Of 2 and less than 5 inches, $\frac{3}{32}$ inch.

Of 5 and less than 11 inches, $\frac{1}{8}$ inch.

All copper piping will be one gauge, B. W. G., thicker in the bends than in straight parts.

The thickness of all exhaust and other pipes not in the above list, except steam pipes, will be determined by the above rule, using a pressure of 50 pounds.

105. MATERIAL AND FITTING OF PIPES.

All pipes, except the lower ends of bilge suction pipes, will be of copper or seamless drawn brass, unless otherwise specified. The lower parts of bilge suction pipes will be of galvanized iron. All pipes will be suitably supported in an approved manner wherever necessary.

All feed and blow pipes, all bilge suction pipes except the lower parts, and all steam pipes less than 3 inches in diameter will be seamless drawn. All copper pipes over 3 inches in diameter will have composition flanges of an approved design, riveted on and brazed. All under 3 inches will have flanges or approved couplings of composition, brazed on. All feed and blow pipes will have composition flanges. All flanges will be faced and grooved, and joints made with approved material. All composition flanges below the floor plates will be connected by bolts and nuts of naval brass. All flanges will be made in accordance with a standard to be furnished by the engineer in chief. All bends in brazed-copper pipes will be one gauge thicker than straight parts. All copper-pipe T pieces and fittings will be of composition, except where otherwise specified. Expansion joints of approved pattern will be fitted where required. Slip joints, if fitted, will have stop bolts and flanges. All copper pipes in bilge will be well painted and covered with waterproof canvas, and must not rest in contact with any of the iron or steel work of the vessel.

106. ENGINE-ROOM WATER SERVICE.

There will be in the engine room a $2\frac{1}{2}$-inch brass pipe, connected with a sea valve and with a special delivery from the distiller circulating pump, with brass branches to the different parts of the engine, as follows: A $\frac{3}{4}$-inch branch,

connected by a union joint with a pipe screwed into the cap of each crank-shaft bearing, and leading through brasses to top of journal; two ¾-inch pipes to each crank pin; one ¾-inch pipe to each main bearing; two ½-inch pipes to each crosshead; one ¾-inch pipe to each crosshead guide; one ¾-inch pipe to each pair of eccentrics; one 1-inch pipe to the thrust bearing; one ¾-inch pipe to each line-shaft bearing. The above will have detachable sprays, short lengths of hose, or pivoted nozzles, where directed. Each branch will have a separate brass valve.

All the water-service pipes and fittings above the floors will be of brass.

107. STEAM AND VACUUM GAUGES.

There will be the following gauges, in polished brass cases, suitably engraved to show to what they are connected, all to be of approved pattern, with seamless tubes, viz: One to connect with the main steam pipe and graduated to 255 pounds steam pressure; one compound gauge, graduated to 110 pounds steam pressure, to connect with first receiver; one compound gauge, graduated for 40 pounds steam pressure, to connect with the second receiver; one vacuum gauge, to connect with the condenser. All the above will have 8½-inch dials. There will also be four boiler steam gauges, as specified elsewhere, and such other gauges for dynamo-engine steam pipe, heater pipes, etc., as are required.

108. GAUGE PLATE.

There will be in the upper engine room, placed where directed, a suitably engraved nickel-plated brass gauge plate, upon which will be secured the boiler-pressure gauge, first and second receiver gauges, vacuum gauge, revolution counter, and clock. The plate will be set off from the bulkhead about 1½ inches, on hard-wood strips. Pipes to gauges will connect therewith at back of the plate so as not to show in front. The cocks in these pipes will be located just below the gauge board. The engravings will be cut deep and will be filled in with black enamel. The Department will furnish a design for this plate and frame.

109. ENGINE-ROOM TELEGRAPH.

A repeating telegraph of approved pattern will be fitted in the engine room, with its dial at the working platform, and connected to repeaters in the pilot house and on the bridge. The connections are to be made in such manner that the chance of derangement shall be minimized.

110. THERMOMETERS.

There will be the following metallic-dial thermometers, all to be permanent fixtures, the casings and fittings to be of polished brass: One on hot well; one on feed tank; one on main injection pipe; one on outboard delivery pipe.

The hot-well and feed-tank thermometers will be so fitted as to waste no feed water. These will be located where directed.

111. REVOLUTION COUNTER.

It will be of the continuous rotary type, to register from 1 to 1,000,000, worked by positive motion, to be in a polished brass case with 8½-inch dial.

112. ENGINE-ROOM GONGS.

One approved double-hammer engine gong, 15 inches in diameter, will be fitted in the engine room where directed. The connections to be led to the pilot house and such other places as shall be directed by the superintending officer. There will also be a 6-inch gong in the fire room, connected to a bell pull in the engine room at the working platform. An approved sounding tube of brass will be provided leading from the gong in the engine room to the pilot house. There will also be one 5-inch jingle bell, the pulls of which will be led in the same manner as those of the gong. All connections to be made with approved sheaves and flat chains at the angles instead of cranks.

113. SPEAKING TUBES.

They will be made of copper not less than No. 20 B. W. G. and 1 inch inside diameter. They will connect the engine room to the pilot house and to the chief engineer's room. There will also be a speaking tube between the

engine and the fire room, and between the chief engineer's room and the fire room. Each tube will be fitted at each end with a mouthpiece and approved annunciator, the mouthpieces to be connected to short flexible pieces where required. All mouthpieces or pipes will be plainly marked. The tubes will be suitably incased where necessary.

114. CLOCK.

There will be in the engine room, mounted on the gauge plate, one eight-day clock of approved pattern, in a polished case, and 8½-inch dial; it will be fitted with a second hand.

115. ENGINEER'S WORKSHOP.

The engineer's workshop, located on starboard side of lower engine, as shown on drawing, will be fitted with a 4x5 inch vertical engine, of approved design, and supplied with all the necessary piping and valves for its efficient operation. The necessary shafting and hangers, pulleys, etc., for a lathe, shaping machine, and drill press will be furnished and erected in place by the contractors. The lathe, shaping machine, and drill press will be supplied by the Department. There will be an approved vise and vise bench, with drawers underneath, and other approved drawers and lockers, located where directed.

116. ASH EJECTOR.

There will be located in the fire room, where directed, one approved hydropneumatic ash ejector, equal in all respects to the "See" pattern. It will be connected to the auxiliary feed pump, and be provided with all the necessary fittings for its permanent and efficient operation. The discharge pipe will be at least 6 inches internal diameter. Approved ash-hoisting gear will also be fitted in the 27-inch fire-room ventilators. A removable hopper will be located in the bulwarks to connect with approved ash chutes.

117. INDICATOR GEAR.

An indicator connection will be made to each end of each cylinder of main engine, as near as possible to the

bore of the cylinder, and so as to be easily accessible. Each indicator on cylinders of main engine, when in place, will be connected to both ends of the cylinder to which it is attached by means of three-way cocks. The connecting pipes will be 1-inch bore, and will have easy bends. There will be valves in each end of the pipes, close up to the cylinders. The gear for operating the indicators will be of an approved design, and must be so arranged that the indicator barrels will have a coincident motion with that of the pistons, and such as to give a length of card of not less than 4 inches. The steam cylinders of the air and circulating pump engines will have holes tapped for indicator fittings and then plugged. The indicators will be furnished by the Department.

118. REDUCING VALVES.

Composition reducing valves of approved design will be fitted in the steam pipes of auxiliary machinery and the steam pipes to steam heaters wherever directed.

119. LIFTING GEAR.

Efficient lifting gear, consisting of traveling bars and pulleys, deck-beam clamps, turn-buckles, shackles, hooks, eyebolts, etc., will be fitted wherever required for lifting parts of the machinery for overhauling and repairing. Holes will be tapped in the principal movable parts of machinery for this purpose.

120. FIRE AND ENGINE ROOM VENTILATORS.

There will be four ventilators in the fire room, two 27 inches internal diameter and two 21 inches internal diameter, located where shown on the print. They will be made of steel No. 10 B. W. G. thick, butted and single strapped and flush riveted. They will be fitted at bottom with hinged air-tight doors to prevent escape of air when under forced draft. The cowls will be movable, of No. 11 B. W. G. copper, not planished, and at least 56 inches in greatest diameter for the 27-inch ventilators and 44 inches for the 21-inch ventilators. The base rings of cowls will be of composition, finished on working parts, but left unfinished on the outside.

There will be two engine-room ventilators, located where directed, each 18 inches internal diameter. They will be of steel above the deck, and will extend into the engine room about 6 inches; the part in the engine room will be of sheet brass, about No. 12 B. W. G. The cowls will be movable, of No. 12 B. W. G. copper, unplanished, and at least 44 inches in greatest diameter. The base rings of cowls will be of composition, finished on working parts, but left unfinished on the outside.

All the above cowls will be supported on antifriction bearings and fitted with approved gear for turning them from the engine and fire rooms, the gear to be of composition, except the spindles, which will be of wrought iron. Brass handwheels, finished all over, will be fitted to spindles in the engine room, about 6 inches below the deck, and wrought-iron T handles to spindles in fire room. The lower ends of ventilators in engine room will be fitted with brass rings for the attachment of windsails to the lower engine room when necessary.

121. FLOORS AND PLATFORMS.

The engine room, fire room, and connecting passages will be floored with approved wrought-iron plates, $\frac{1}{4}$-inch thick, with neatly matched flat-topped corrugations running fore and aft. The plates will be of convenient size and easily removable. They will rest on proper ledges of angle or T iron, spaced in an approved manner, and will have drain holes where necessary. Platforms of corrugated wrought-iron plates will be provided for getting at all parts of the main and auxiliary engines and boilers. There will be platforms of gratings suspended 6 feet below the main deck between each pair of boilers. These platforms will each be 9 feet long and 5 feet wide.

There will be an opening in the after platform for egress from the passageway between the two after boilers by means of a vertical hinged ladder placed between boilers. There will also be a ladder from this platform to the deck. These platforms, where placed over moving machinery, will be fitted the same as the lower floors. In other places, if directed, they will be made of wrought-iron rods $\frac{5}{8}$ inch square, placed $\frac{3}{4}$ inch apart.

122. LADDERS.

Ladders will be fitted wherever necessary for reaching the engine room and fire room from deck, and for reaching the various platforms, passages, and parts of machinery. The engine-room ladders will be made with plate-iron sides and light cast-iron treads with corrugated tops. The fire-room ladders will be made with plate-iron sides and double square bar treads.

All ladders will be so fitted as to be easily removable where required, and will be jointed and hinges, with necessary fastenings and gear.

123. HAND RAILS.

Hand rails, easily removable where required, will be fitted to all ladders and platforms, around moving parts of machinery, and along bulkheads and passageways. The hand rails will be made of deoxidized bronze or of approved equivalent metal which will not easily tarnish, and will be polished all over. The stanchions will be of polished wrought iron or steel, the lower ends of which will pass through floor plates, with nuts underneath.

124. LABELS ON GEAR AND INSTRUMENTS.

All cocks will have engraved brass plates to show their uses and to indicate whether open or shut. All valves, except such as may be otherwise directed, will have similarly engraved plates to show their uses or have the same plainly engraved on handwheels.

All hand levers or their quadrants will be similarly marked. All steam stop valves will have indices to show to what extent they are opened.

All gauges, thermometers, counters, and speaking-tube annunciators will be suitably engraved to show to what they are connected.

All engravings will be deep and be filled in with black cement.

125. OIL TANKS.

Oil tanks of 500 gallons total capacity, divided as directed, will be fitted and secured in place where directed

on the port side of lower engine room and supported on an approved wrought-iron shelf, with facilities for filling from deck. They will be made of wrought iron not less than $\frac{3}{16}$ inch thick, and will have a glass gauge, a manhole and cover near the top, and a locked cock for drawing oil. In the engine room there will also be fitted two copper oil tanks of 10 gallons capacity each, and in the boiler compartment two of 3 gallons capacity each, all to be provided with lock cocks. All oil tanks to be fitted with drip pans. Each of the large tanks will have a hand pump and pipes for filling the smaller tanks, and be provided with a set of measures. One iron tallow tank and one waste tank will be fitted where directed; they will have hinged covers. All plates of the iron tanks are to be flanged, and will be galvanized before riveting.

126. WHISTLE.

An approved polished brass chime whistle, with bell of about 8 inches diameter, will be placed forward of the smoke pipe, and connected to the auxiliary steam pipe by a pipe having a stop valve at its lower end and a working valve at the upper end. The pipe will be secured to the stack by a brass band made in halves. The whistle pipe will be covered with magnesia covering, and inclosed in a brass casing above the deck. A drainpipe with valve will lead from the lowest point of the whistle connection.

127. HOSE AND HOSE REELS.

Five hundred feet of hose will be supplied, in not over 50-foot lengths, with suitable couplings. The hose will be of the best quality 4-ply rubber engine hose, all $2\frac{1}{2}$ inches diameter, with standard couplings. There will be three flanged male couplings, of composition, located where directed in the deck. The caps will be of finished composition, hung on a chain. Four pairs of spanners will be supplied. Five approved hose nozzles will also be furnished, of finished composition.

Metal hose reels of approved pattern will be fitted where directed. Hose nozzles and spanners will be fitted to beckets near plugs.

128. ENGINE-ROOM DESK.

A black-walnut desk, with roll top, pigeon-holes, and locked drawers, will be fitted in the upper engine room where directed.

129. CLOTHING AND LAGGING.

The main cylinder and valve chests, after being finally secured in place in vessel and tested during a dock trial, will be covered with $1\frac{1}{4}$-inch magnesia sectional covering and neatly lagged with black-walnut staves all over, with polished brass bands and round-headed brass screws. The lagging will be made in removable sections over each cylinder and valve chest, the sections being plainly marked.

All steam and exhaust pipes and all steam valves will be clothed in an approved manner with $1\frac{1}{16}$-inch magnesia sectional covering, covered with canvas and well painted. The main steam and exhaust pipes in engine room and the steam separator will be also covered with black-walnut lagging, held in place by brass bands. The canvas covering of steam pipes will be secured to bulkheads where the pipes pass through them.

The steam cylinders of all auxiliary engines will be clothed and lagged the same as main cylinders.

After the boilers are in place and have been tested and painted they will be covered all over, except where directed, as low as the saddles, with magnesia sectional covering at least 2 inches thick. This clothing will be covered on tops, sides, and on ends, where directed, by galvanized wrought-iron plates about No. 18 B. W. G., flanged not less than 1 inch and bolted with composition bolts; it will also be secured to boiler plates at bottom by angle iron, which will be held in place by $\frac{1}{2}$-inch bolts tapped part way into the boiler plates, and held off from the boiler plates elsewhere by suitable distance pieces.

130. ASH SPRINKLERS.

A valve for wetting down ashes will be fitted in the fire room where directed, and will be supplied with the necessary hose, couplings, and nozzle.

131. STEAM TUBE CLEANER.

A steam tube cleaner of approved pattern will be fitted in the fire room. Steam will be taken from the auxiliary steam pipe, and a sufficient length of steam hose will be provided to easily reach all of the tubes.

132. BOLTS AND NUTS.

All boltheads and nuts less than 2 inches, except in special cases, will conform to the United States standard. Screw threads on bolts and nuts in all cases to conform to the above standard. All finished bolts, except as directed, will be kept from turning by dowels or other suitable devices.

The nuts of all bolts on moving parts and on pillow blocks, and elsewhere as shown, will be fitted with keepers, and the bolts will extend beyond the nuts, without threads, and be fitted with split pins.

133. TOOLS.

The following tools will be furnished in addition to those elsewhere specified:

One set of wrenches complete for the engine and the fire room, to be fitted for all nuts in their respective compartments, plainly marked with sizes, and fitted in iron racks of approved patterns. The wrenches for engine room will be finished and erected in engine room, as directed, on tasty wrench boards backed with metal. The wrenches for nuts of bolts over 2 inches in diameter will be box wrenches, where such can be used. Socket wrenches will be furnished where required. Open-end wrenches will be of steel or wrought iron with case hardened jaws; all others of wrought iron or cast steel.

One pair of taps on rod for boiler-stay tubes, for tapping front and back tube sheets of boilers at one operation. These will be duplicates of those used in originally tapping the sheets, and be so packed as to be perfectly protected from injury.

A fixed trammel for setting the main valves without removing the covers, the valve stems to be properly marked for this purpose.

Fixed trammels or gauges for aligning crank shafts, brass pins being let into pillow blocks and center marked for this purpose.

Two complete sets of fire tools for each of the four boilers, and suitable racks for same.

Four coal and four ash buckets for fire rooms.

All trammels and gauges will have protecting cases. All tools will be conveniently stowed.

134. DUPLICATE PIECES.

The following duplicate pieces, in addition to others specified, will be furnished, fitted, and ready for use, viz: One-half set of follower bolts and nuts for each steam piston; one-half set of springs for each steam piston; 1 bottom brass for each crank-shaft bearing; 2 crown brasses and 2 butt brasses for each crank pin; 1 set of brasses complete for each crosshead journal; 1 complete set of metallic packing for each stuffing box; a spare hose and nozzle for the steam tube cleaner; one-half of a complete set of grate bars and bearers for each furnace, and 1 pattern for each casting; 50 stay tubes for boiler, threaded to fit threads in tube sheets, with ends wrapped in canvas; 50 ordinary boiler tubes, ready for use; 50 condenser tubes, packed in boxes; 100 condenser-tube glands; 1 spare spring for each safety valve and relief valve; 1 spare tinned-copper basket for each Macomb bilge strainer.

Wherever duplicate pieces are furnished for one of two or more pieces of machinery of the same size they will be made strictly interchangeable.

All finished duplicate pieces not of brass, except as otherwise specified, will be painted with three coats of white lead and oil and well lashed in tarred canvas, with the name painted on outside. Brass pieces will be marked or stamped. All pieces will be stowed in an approved manner.

All boiler tubes will be securely stowed in racks or as directed.

135. MATERIALS AND WORKMANSHIP.

All castings must be sound and true to form, and before being painted must be well cleaned of sand and scale and all fins and roughness removed.

No imperfect casting or unsound forging will be used.

All nuts on rough castings will fit facings raised above the surface, except where otherwise directed. All flanges of castings will be faced, and those coupled together will have their edges made fair with each other. The faces of all circular flanges will be grooved.

All bolt holes in permanently fixed parts will be reamed or drilled fair and true in place and the bodies of bolts finished to fit them snugly.

All pipes beneath floor plates will be connected by forged bolts and nuts of rolled manganese or Tobin bronze.

All brasses will fit loosely between collars of shafting.

All brasses or journals will be properly channeled for the distribution of oil.

Metallic packing for stuffing boxes will be such as may be approved.

All small pins of working parts will be well casehardened.

All steel joint pins of valve gear will be hardened and ground to true cylindrical surfaces.

All materials used in the construction of the machinery will be of the best quality. The iron castings will be made of the best pig iron, not scrap, except where otherwise directed.

Composition castings will be made of new materials. The various compositions will be, by weight, as follows:

For all journal boxes and guide gibs, where not otherwise specified: Copper 6, tin 1, and zinc $\frac{1}{4}$ parts.

For composition not otherwise specified: Copper 88, tin 10, and zinc 2 per cent.

Tobin metal will be of the best commercial quality.

Antifriction metal will be of "Parson's white metal."

Ornamental brass fittings will be of good uniform color.

All castings will be increased in thickness around core holes.

Core holes will be tapped and core plugs screwed in and locked, except where bolted covers are used or where it may be directed that the holes be left open.

All steel forgings will be without welds and free from laminations.

All flanges, collars, and offsets will have well-rounded fillets.

All nuts on moving parts of machinery will be locked in place by split pins.

136. FINISH.

All parts of the engine, including the reversing gear, are to be finished. The wrought-iron and brass work and exposed edges of the iron castings in the engine room are to be finished. The ends of all studs and bolts in sight about the engine are to be cut to corresponding lengths and finished. All exposed boltheads and nuts to be hexagonal, and care to be taken to give all parts a neat and finished appearance. Heads of all set screws and the nuts securing the cylinder covers, steam chests, pump bonnets, and stuffing boxes to be finished and casehardened Upper engine room to be finished in approved hard wood. An approved cabinet of drawers, with desk above the same, a marble-top washstand, with a tank and waste pipe, and a cushioned seat, with locker underneath, to be furnished and placed where directed.

137. TESTS OF MACHINERY, CONDENSER TUBES, STEAM PIPES, ETC.

The high-pressure cylinder, jacket, and valve chest will be tested by water pressure to 240 pounds to the square inch; the intermediate-pressure cylinder and connections to 150 pounds, and the low-pressure to 100 pounds. The exhaust side of the low-pressure valve chest will be tested to 30 pounds. The condenser will be tested to 20 pounds.

Condenser tubes shall be made of Muntz metal 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 300 pounds per square inch and be capable of being flattened and bent back on themselves, hot or cold, without fracture.

The steam pipes and valves, the auxiliary engines, and all fittings and connections subjected to the boiler pressure will be tested by water pressure to 250 pounds to the

square inch. The pumps, valve boxes, and air vessels of the feed, fire, and bilge pumps will be tested to 300 pounds per square inch. India-rubber valves, taken at random, must stand a dry heat of 270° F. for one hour and a moist heat test of 320° F. for three hours without injury. The cylinders and condenser will be tested before being placed on board, and must be so placed that all parts may be accessible for examination by the inspector during the tests. All parts will also be tested after being secured on board. No lagging or covering is to be on the cylinders or pipes until after the dock trial and all the joints are proved to be steam and water tight under the maximum pressure.

138. STEAM HEATING APPARATUS.

There are to be steam radiators, of approved pattern, as follows: In cabins, in cabin and wardroom lavatories, in wardroom, in executive officer's office, in engine room, in engineer's workshop, in wardroom pantry, in chart room, in pilot house, in petty officers' quarters, in crew's quarters, on berth deck, and in all rooms and compartments where found necessary. The radiators are to have at least 30 square feet of heating surface for each 1,000 cubic feet of the spaces they are respectively placed in. The radiator in pilot house will consist of 1-inch pipes of brass, arranged around the front to suit the curve of the house. In the crew's quarters on berth deck they will consist of 2-inch galvanized-iron pipes, one above the other, all around locker seats and sides of vessel and across forward bulkhead. Ornamental tops of metal or marble, and the casings of open castings or meshed wire, are to be furnished where directed, and the woodwork behind heaters is to be protected by neatly finished metal screens on furrings, with asbestus between. Brass drip pans will be fitted under pipe joints where directed. All pipes are to be properly secured; where they pass through decks and bulkheads brass thimbles and stuffing boxes are to be used, and asbestos placed around them when desired. The steam pipes to cabin and wardroom are to be led along in the shaft alley and storerooms, and the exhaust steam led and drains fitted as directed. All connections, valves, etc.,

necessary to put the entire heating apparatus in the most perfect order and ready for use, and to the satisfaction of the superintending engineer in every respect, are to be furnished and fitted by the contractor.

Steam for these radiators will be taken from the auxiliary steam pipe where directed, and the connecting pipes will be fitted with reducing valves of approved design. There will be at least six steam traps, equal in all respects to "Dinkel's" No. 3, located on iron shelves where directed. There will also be a suitable tank for the condensed steam to drain in, and an approved automatic feed pump to pump the water back into the boiler, placed where directed. All steam heaters will be tested to the maximum boiler pressure (160 pounds) and found to be tight before being erected in place. A steam gauge with 4½-inch dial will be on each circuit.

139. ELECTRIC-LIGHT PLANT.

Contractors are to furnish and install, in complete working order and in a thorough and workmanlike manner, the following described plant, viz:

140. ENGINE.

There will be one automatic-governing, high-speed, self-contained engine, with direct connection to shaft of dynamo armature, herein referred to. The engine and dynamo must be on the same bedplate. The engine must be equal in construction, finish, and efficiency to any of the following well-known makes, viz, Armington & Simms, Parker-Allen, or Ideal, and must operate practically without noise. The floor space occupied by the engine and dynamo proposed to be furnished must not occupy a greater area than that allowed in plan of vessel accompanying these specifications, leaving sufficient margin for convenient access thereto. All parts must be accessible for examination and repair.

The connection from engine shaft to dynamo shaft must be a solid coupling capable of withstanding the shock of a short-circuited armature without damage.

The engine must be capable of operating the dynamo supplied therewith, at 500 revolutions per minute, to its

full-rated capacity, practically without noise, and be designed to work at an initial pressure of 60 pounds, exhausting into a vacuum of 25 inches, or into the atmosphere. The cylinders and other parts subjected to steam pressure must successfully withstand a water pressure of 250 pounds per square inch. They must be able to bear without injury the removal of the entire load by suddenly breaking the circuit of the dynamo.

The cylinder will be fitted with automatic relief valves in addition to the usual drain cocks, and great care will be taken that the steam pipes are properly drained. The engine steam pipe will be fitted with a reducing valve and steam gauge. Approved packing will be used on piston rod and valve stem.

141. ELECTRIC-LIGHT ENGINE, CONDITIONS FOR—

The engine must govern automatically so as to meet the following conditions: (*a*) variation of speed from one-fourth to full load, not to exceed 2 per cent; (*b*) variation when the exhaust is changed from the atmosphere to a vacuum, not to exceed 5 per cent; (*c*) variation on any change of steam pressure between 40 pounds and 80 pounds, not to exceed 2 per cent.

The engine must be fitted with the most efficient lubricating apparatus, oil guards, and wrenches, and must be capable of continuous running without the use of lubricants in the steam space. The cylinders and valve chest must be covered with suitable nonconducting material and cased with Russia iron.

It must run without undue heating in any of its frictional parts.

142. DYNAMO.

The dynamo will be of the direct-connected, compound-wound, multipolar type, having a capacity of 10 kilowatts. At 500 revolutions per minute it will produce a constant electro-motive force of 80 volts, measured at the poles, the current being 125 amperes. The variation of voltage from maximum load to none shall not exceed 1

volt without alteration of field rheostat, the brushes being on neutral lines.

Field rheostats will be supplied having sufficient range to compensate for the increased resistance of the field coils due to their heating. They will be mounted in an incombustible frame.

The armature shaft will have self-oiling bearings, be well balanced, and run true. A satisfactory arrangement must be made in the armature bearings to prevent the oil from running along the shaft or being spilled, and also to take up the thrust of the armature when the vessel is tossing in a sea way or heeled over. The commutator segments must be of hard copper or bronze, insulated with mica, and must not be less than 1½ inches deep. The brushes, of copper wire or gauze, to be equal to the Fleming patent brush. There will be only two brush holders, positive and negative. The brush-working surface of commutator will be not less than 6 inches wide.

Sparking must not occur when operated at full load, and but a trifling amount when otherwise. Insulation resistance of circuits from each other, of each frame, and of frame from combination bedplate, not to be less than 1 megohm. The windings of the dynamo, both field and armature, must be well protected from mechanical injury, and must be painted with a water-proof, noninflammable covering.

The engine and dynamo will be provided with guards and hand rails, and all necessary tools, including a brush filer, wrenches, etc.

143. ELECTRIC-LIGHT SWITCH BOARD.

The switch board shall be of slate not less than 1 inch thick. It shall be fitted with the necessary circuit-controlling switches (D. P.), all to be "automatic-break," one for each main circuit. There will be supplied one Weston switch-board ammeter, reading to maximum rated output of the generator. There will also be supplied one Weston voltmeter, switch-board type, reading to 125 volts; also one pressure switch and one ground detector, all to be mounted on the switch board.

144. ELECTRIC-LIGHT CONDUCTORS.

The wiring is to be done on the two-wire feeder system. All conductors are to be in accordance with the following specifications: To be of soft annealed copper wire, having 96 per cent conductivity; no single wire larger than No. 14 B. W. G. to be used. Conductors to be stranded when greater conducting area is desired; no single finished conductor smaller than No. 16 B. W. G. to be used. The conducting area to be at the rate of 1 square inch per 1,000 amperes of current, reckoned at the rate of $\frac{5}{100}$ of an ampere per candlepower.

The feeders and mains from switch board are to be run directly to points of distribution.

Points of distribution will be located at most central positions throughout the vessel, at which points cut-out boxes are to be placed, made of wood, lined with metal or asbestos and covered with metal, having also asbestos-lined or glass doors, with lock and key.

The wiring will be so proportioned that the maximum variation of electrical pressure at the lamps in the different parts of the boat under any normal conditions will not exceed 2 per cent and the loss of any circuit shall not exceed 3 per cent from dynamos to lamp outlet at farthest point on circuit, plant running with maximum load.

The current for the lamps is to be taken from the mains through double-pole cut-outs; no branch circuit to carry, when fully loaded, more than 7 amperes of current; no wires to be led through or into coal bunkers except when authorized. Wherever any wire is reduced in size for any purpose a double-pole fusible strip must be placed in water-tight box, each individual light to be protected by single or double pole fuse in porcelain.

Wires to be run in moldings of clear, well-seasoned white pine, except when run over hard-wood surfaces, when it will be of the same material as the latter; moldings to receive a coat of white lead before being put up. When wires are led over beams or over iron bulkheads or decks, a strip of wood backing will be securely put up with brass machine screws and the molding fastened to that. All wires passing through bulkheads will be protected with

hard-rubber tubing, and through water-tight bulkheads led through water-tight metal stuffing tubes, lined with hard rubber.

All joints to be made in a substantial manner, so that no movement of the two ends relative to each other is possible, and so that the cross section of the contact is at least twice the cross section of the conductor. All joints will be well soldered and taped and coated with waterproof and fireproof compound. Resin is the only flux permissible in soldering. Joints are to be avoided in the main leads. Junction or branch blocks to be used, and to be water-tight when necessary. The boxes to be made of bronze or brass and fitted with stuffing boxes on the inside for packing the boxes water-tight. Joints on lead-covered wire are to be covered with lead, soldered, and thoroughly wiped, making lead cover as water-tight as before joint was made.

The search-light circuit shall lead directly from the switch board to the pedestal furnished for the search light, and shall have no other connection with the incandescent circuits. The search-light junction box to be without fuses.

A suitable resistance coil on noncombustible frame shall be supplied and fitted in dynamo room or at the control stand as a dead resistance for the search-light mains. Resistance of same to be so proportioned that the arc lamp of the search light will normally operate at its greatest efficiency.

All junction boxes, switches, and receptacles must be separated from metal surfaces by at least $\frac{3}{4}$ inch of hard wood, and secured by brass screws entering wood at least $\frac{1}{2}$ inch. It is required that at least $\frac{1}{4}$ inch of clear solid wood shall separate all wiring accessories from the metal of the vessel. The conductors of opposite polarity must be separated at least $\frac{3}{16}$ inch from each other and from the metal junction box.

Double-pole switches shall be furnished for each group of four or more lights in addition to those controlling circuits. All fuses and switches to be mounted on incombustible bases of best insulating material.

All safety strips must be inclosed in water-tight boxes. Safety strips shall not be less than 1¼ inches long, and of such cross section that they will carry 50 per cent more current and fuse without riding or elongating excessively at double the current required for all lamps fed by the smaller conductor. All fuses under 10-light capacity to be in glass tubes.

Wiring lamp outlets are to consist of spiral-spring key sockets mounted on porcelain, standard naval type.

All sockets will be of the same dimensions relative to the base of the lamps, so that any lamp of any candle-power will fit any socket. All sockets shall be of substantial construction, and all portions of the shell and key will be thoroughly insulated by porcelain or equally good insulation. No compressed fiber will be used. All fixtures will be protected by individual cut-outs placed in the circuit leading to them, as close as possible to and within 5 feet of the fixture. In officers' staterooms lights are to have individual switches conveniently located near head of berth. All electroliers to be controlled by switch when directed. All switches and fixtures are to be set on circular blocks thick enough to finish off molding thereto. Fixture blocks to have brass terminals, each terminal to have two brass binding screws, one for main and one for fixture wire.

145. INSULATION.

The insulation resistance of the entire system connected in parallel, including the circuits of the dynamos, must measure not less than 250,000 ohms; that of each separate circuit not less than 1 megohm.

All conductors, except certain fixture and portable wire, will be insulated as follows: First, a layer of best quality pure Para rubber. Second, a layer of white rubber containing no sulphur. Third, a layer of vulcanized rubber containing not less than 30 per cent pure best quality rubber. Fourth, a layer of cotton braid.

The first layer to be put on either in the form of tape or squeezed on in a seamless tube, but in either case it must be of uniform thickness, free from impurities, elastic,

tough, and without breaks or holes. The second and third layers will be continuous, free from flaws or holes, and will not crack or open when the conductor is bent at a sharp angle. The fourth layer, being intended as a protection to the insulation against mechanical injury, will be closely braided, made of strong, smooth cotton thread, and will not break when the conductor is sharply bent. After being put on it will be thoroughly saturated with an approved noninflammable and approximately waterproof compound. The thickness of the insulation, excluding the outer layer of cotton, will not be less than $\frac{3}{32}$ nor more than $\frac{1}{8}$ of an inch, and of the outer layer of cotton about $\frac{1}{32}$ of an inch. After twenty-four hours' immersion in sea water the insulation must have a resistance of not less than 1,000 megohms per nautical mile. The physical and electrical characteristics of the insulation will not be affected by considerable changes of temperature up to 200° F. For use in damp places wire to have an outer covering of $\frac{3}{32}$ inch lead.

Silk portable wires to be double conductor, each to be composed of stranded tinned copper wires not less than $\frac{20}{30}$ B. W. G., and will be insulated first with a layer of pure rubber tape, second braid. Two conductors thus insulated will be covered with a braid of heavy machine twist silk and the two conductors stranded together.

Portable wire for deck or fire-room use will be double conductor, each to be composed of stranded wires of tinned copper, equivalent in total area to No. 16 B. W. G., insulated first with vulcanized rubber, containing at least 30 per cent pure rubber, second braid. The two conductors thus insulated will be arranged concentrically or stranded together, using a jute filling. The whole will then be covered with vulcanized or okonite tape, and a covering of hemp braided or woven about $\frac{1}{32}$ inch in thickness, treated with a coating of an approved noninflammable, fairly water-proof compound. The external diameter of the finished cable will not exceed $\frac{7}{16}$ inch.

146. SEARCH LIGHT.

A search light of the latest and most approved type, including pedestal, a combination automatic and hand

lamp, a quantity of spare carbons, and other appurtenances usually furnished, will be erected where shown on drawing. It will be designed for 25 amperes current and will be controlled as directed. It must be subject to approval, and all appurtenances necessary for its proper working must be supplied and installed.

147. LAMPS.

Lamps (16-c. p.) to the number of 340 are to be supplied, 146 of which will be fixtures and 194 spare. All lamps shall be designed for 80 volts. Their efficiency when new shall not be less than $3\frac{8}{10}$ watts per candlepower and shall not vary more than $\frac{2}{10}$ of a watt. All lamps must be strictly interchangeable in all standard sockets, and must be of the best quality and finish, with a guaranty that all lamps supplied shall have an average of 600 hours.

148. SPARE PARTS FOR ELECTRIC-LIGHT PLANT.

There will be one armature fitted complete for dynamo, supplied spare; also one portable lathe center for turning up armature. There will also be supplied such other spare parts for the plant, including carbons for the search light, wire, etc., as will enable it to be used for a period of one year without additions, the amount to be based upon the supposition that the plant shall receive good and intelligent care.

Fixtures.—All fixtures are to be of the best material and workmanship and are to be subject to approval. Water-tight recesses with lenses for coal-bunker lights, with doors communicating from the outside, will be fitted where directed.

149. INSTALLATION OF ELECTRIC-LIGHT PLANT.

The plant is to be installed by the contractors, and they must furnish a suitable person to operate the plant and instruct those in charge thereof aboard the vessel during a test of ten days, during which the satisfactory character of the installation and its conformity to these specifications are to be determined by an officer who will be appointed for such purpose by the Secretary of the Treasury.

It is understood and agreed that the installation and finish of the plant is to be first class; that all details of piping, fittings, and construction necessary to the complete and satisfactory installation of a plant of the character described are to be considered as included in the foregoing specifications, and performed and supplied without additional cost to the Government.

150. INSPECTION AND COMMERCIAL TESTS OF ELECTRIC-LIGHT PLANT.

The plant to be inspected during the course of construction, and when completed will be thoroughly tested at some shore station to obtain accurate data. The efficiency of the plant must be at least 80 per cent (commercial). A commercial test will be made to determine the consumption of water, and this shall be 40 pounds dry steam per I. H. P. at 80 pounds pressure, or 45 pounds dry steam at 40 pounds pressure, with vacuum.

No part of the dynamo field or armature winding shall heat more than 50° F. above the temperature of the surrounding air after the maximum rated output has been produced for a period of four hours, the temperature of the room to be taken at the moment of stopping after the run, by means of a thermometer hung 3 feet from the dynamo, on the side opposite the engine.

The temperature of the field coils to be found by taking the electrical resistance cold and after the run. The temperature of the armature is to be found by placing thermometers on the armature as soon as the dynamo stops, covering it with waste, and taking the highest readings as the temperature of the armature coils.

151. DRAWINGS OF ELECTRIC-LIGHT PLANT.

A set of working drawings of engine and dynamo on tracing cloth and a diagram of the wiring of the vessel will be furnished by the contractor.

152. ARRANGEMENT OF ELECTRIC LIGHTS.

The one 6-cluster light in cabin, the two 4-cluster lights in wardroom, and the two 3-cluster lights in upper engine

room will be attached to ceiling fixtures, finished in silver or bronze as directed, and the lamps will be furnished with shades or globes of glass, ground sufficiently to soften the light, but not to cut it off to any extent.

The lights in pantries, companionways, executive officer's office, water-closets, chart room, and pilot house will be suspended from approved fixed brass brackets, finished in silver or bronze, with approved shades, and will be located where directed. The four in upper engine room and the six in fire room to have a steam-tight globe, as hereinafter described. The cabin, wardroom, and staterooms to be fitted with desk lights. There will be two portable lights for lower engine room and two for fire room. Lamps not otherwise specified will be secured to plain commercial styles of brackets as approved.

The following standard electric-light fixtures will be fitted where necessary:

Desk lights for use in offices and staterooms, and finished in oxidized silver or dark bronze.

Deck lanterns finished in dark bronze, and intended for general use.

Magazine lantern finished in dark bronze, fitted for two lamps and reflectors, to show light on four sides. A seat will be provided for regulation magazine candlestick.

Portable, bulkhead, and steam-tight globe fixtures will be finished in dark bronze.

The above fixtures to be of bronze, except the magazine lantern, which will be made of copper. Wherever required, all fixtures to be supplied with base blocks of wood, conforming to the location of the fixture.

All desk lights, lanterns, and portables, where furnished for vessels, shall be wired and fitted with suitable lengths of portable conductors as may be required. Key sockets are required in desk lights, brackets, and ceiling fixtures, and keyless sockets in all others.

Steam-tight globes to be of clear white flint glass, not more than $\frac{1}{4}$ inch thick and not less than $\frac{1}{6}$ inch thick; outside length, 8 inches; outside diameter, $3\frac{1}{8}$ inches.

153. NUMBER AND LOCATION OF LAMPS.

There will be 16-candlepower lights located as follows, and elsewhere as directed, to the number of 146 (in addition to search light):

2 16-candlepower lamps in (2) cabin bathrooms.
1 16-candlepower lamp in entrance to cabin water-closets.
1 16-candlepower lamp in cabin passageway.
4 16-candlepower lamps in (2) cabin staterooms.
6 16-candlepower lamps (in cluster) in cabin.
1 16-candlepower lamp (portable) at cabin table.
1 16-candlepower lamp in cabin pantry.
1 16-candlepower lamp in captain's office.
1 16-candlepower lamp in captain's companionway.
2 16-candlepower lamps under poop deck.
2 16-candlepower lamps in chart room.
1 16-candlepower lamp in pilot house.
2 16-candlepower lamps in steering-engine room.
1 16-candlepower lamp in wardroom refrigerator.
1 16-candlepower lamp in cabin refrigerator.
3 16-candlepower lamps in galley.
1 16-candlepower lamp in petty officers' water-closets.
1 16-candlepower lamp in crew's water-closets.
6 16-candlepower lamps under forecastle deck.
2 16 candlepower lamps in (2) wardroom bathrooms.
4 16-candlepower lamps in passageway between officers' state rooms.
16 16-candlepower lamps in (8) wardroom staterooms.
8 16-candlepower lamps (2 4-light clusters) in wardroom dining room.
1 16-candlepower lamp in wardroom pantry.
1 16-candlepower lamp in armory.
1 16-candlepower lamp in engineer's log-room.
1 16-candlepower lamp in executive officer's office.
2 16-candlepower lamps in wardroom companionway.
1 16-candlepower lamp in wardroom water-closets.
2 16-candlepower lamps in dynamo room.
4 16-candlepower lamps in (4) petty officers' staterooms.
1 16-candlepower lamp in petty officers' pantry.

10 16-candlepower lamps on forward berth deck.
2 16-candlepower lamps in engineers' store room.
2 16-candlepower lamps in magazine.
4 16-candlepower lamps in storerooms in after hold.
4 16-candlepower lamps in shaft alley.
10 16-candlepower lamps (2 portable) in lower engine room.
6 16-candlepower lamps (in 2 clusters) in upper engine room.
1 16-candlepower lamp at desk in upper engine room.
2 16-candlepower lamps at gauge plate in upper engine room.
1 16-candlepower lamp (portable) in upper engine room.
2 16-candlepower lamps in passageway between fire and engine rooms.
1 16-candlepower lamp in passageway to forward coal bunkers.
6 16-candlepower lamps (2 portable) in lower boiler room.
3 16-candlepower lamps in engineers' work shop (1 portable).
4 16-candlepower lamps in upper boiler room.
6 16-candlepower lamps (built in) for coal bunkers.

154. BOILERS.

There will be four single-ended boilers, of the horizontal return fire-tube type, all to be made of steel. They will be about 11 feet 6 inches outside diameter and about 10 feet long over all. They will have a total heating surface of about 5,200 square feet, and a total grate surface of about 168 square feet. Each boiler will have two corrugated furnaces, 3 feet 6 inches internal diameter.

155. BOILER MATERIAL.

All plates and rivets used in the construction of the boiler will be of open-hearth steel. All material will be tested as hereinafter specified.

156. BOILER SHELLS.

Each boiler shell will be made of one course, and each course will consist of two plates, $1\frac{1}{16}$ inches thick.

157. BOILER HEADS.

Each head of the boilers will be made of two plates, each $\frac{3}{4}$ inch in thickness. The front heads will be flanged outwardly at the furnaces, and all heads will be flanged inwardly at the circumference. The heads will be stiffened by T-bars, as shown on the drawing.

158. BOILER-TUBE SHEETS.

They will be $\frac{3}{4}$ inch thick at the back and at the front. They must be accurately parallel, and all tube holes will be slightly rounded at the edges. The holes for the stay tubes will be tapped together in place. The holes at combustion-chamber ends will be drilled to suit the tube protectors, as specified below.

159. BOILER TUBES.

They will be of charcoal iron, the best that can be obtained on the market, and subject to the approval of the engineer in chief. All tubes will be $2\frac{1}{2}$ inches in external diameter. The ordinary tubes will be No. 10 B. W. G. in thickness, and will be swelled to $2\frac{9}{16}$ inches external diameter at the front end. The back ends will be expanded in the tube sheets, beaded over into a counter-bore, which will be filled with a ring, or they will be protected from the action of the flame in other approved manner. A design for the method of protection of the ends of these tubes will be as shown on the drawing.

The stay tubes will be No. 6 B. W. G. in thickness, and will be reenforced at both ends to an external diameter of $2\frac{5}{8}$ inches, leaving the bore of the tube uniform from end to end. They will then be swelled at the front ends to $2\frac{3}{4}$ inches external diameter. They will be threaded (12 threads per inch) parallel at combustion-chamber ends, and taper at front ends to fit threads in tube sheets. They will be screwed into the tube sheets to a tight joint at the front ends, and will be made tight at the back ends by expanding and beading. All expanding will be done by approved tools. Cast-iron ferrules of $1\frac{3}{4}$ inches internal diameter will be used to protect the ends of stay tubes in

combustion chambers. All tubes will be spaced $3\frac{1}{2}$ inches from center to center vertically and $3\frac{3}{4}$ inches horizontally.

160. COMBUSTION CHAMBERS.

There will be two combustion chambers in each boiler; they will be made of $\frac{1}{2}$-inch plates at top and back, and $\frac{5}{8}$ inch thick at bottom, as shown. The tube sheets will be as before specified. The tops of the combustion chambers will be braced by girders, as shown. The plates will be flanged where necessary, and all parts will be joined by single riveting. The holes for screw stay bolts in plates of combustion chambers and shells will be drilled and tapped together in place.

161. BOILER BRACING.

The bracing will be as shown in drawing. The combustion chambers will be stayed to each other and to the shell of the boiler by screw stays with 12 threads to the inch, screwed into both sheets and fitted with nuts—the nuts to be set up on beveled washers where stays do not come square with the plates. The holes for all screw stays will be tapped in both sheets together in place.

The nuts for the upper through braces will be of forged steel set up on slightly cupped washers, inside and outside, with cement joints. No packing will be used.

The bottom of the combustion chambers will be stiffened by angles.

All screw stays and all screw braces will have raised threads.

All braces will be made without welds, with the exception of the lower wing braces, which will be of wrought iron secured to crow feet at back ends.

162. RIVETED JOINTS.

The longitudinal joints of boiler shells will be butted with 1-inch straps outside and $\frac{3}{4}$-inch inside, and treble riveted, as shown on the drawings. Joints of heads and joints of heads with shells will be double riveted, as shown. Joints in furnaces and combustion chambers will be single riveted. Rivets will be of open-hearth steel, with approved

heads. Edges of all plates in cylindrical shells and of all flat plates, where not flanged, will be planed. Edges of flanges will be faired by chipping or otherwise, as may be approved. Plates in cylindrical shells must not be sheared nearer the finished edge than one-half the thickness of the plate along the circumferential seams and not nearer than one thickness along the longitudinal seams. No plate must average less than the specified thickness along the longitudinal seams. All rivet holes in shell plates will be drilled in place after bending; after the holes have been drilled the plates will be separated and have the burrs around the holes carefully removed. Hydraulic riveting will be used wherever possible, with a pressure of 65 to 75 tons. In parts where hydraulic riveting can not be used the rivet holes will be coned on the driven side $\frac{1}{16}$ inch. Seams will be calked on both sides in an approved manner. All joints will be as shown on the drawing.

163. FURNACES.

Each furnace will be in one piece and corrugated. The thickness and diameter will be as shown on drawing. They must be perfectly circular in cross section at all points. They will be riveted to flanges of front heads and to combustion-chamber plates, as shown. The corrugations of adjacent furnaces will be made to alternate.

164. BOILER MANHOLES AND HAND-HOLES.

There will be manholes in each boiler, placed and of such size as shown in drawing. All manholes will have stiffening rings as shown. The manhole plates will be of cast or mild steel in dished form. Each plate will be secured by two wrought-iron dogs and two $1\frac{1}{4}$-inch studs screwed in the plates (8 threads to the inch), fitted with collars and riveted on the inside. Each plate will have a convenient handle. All plates, dogs, and nuts will be indelibly marked to show to what holes they belong.

165. GRATE BARS AND BEARERS.

The grate bars will be of cast iron and of an approved pattern. They will be so fitted as to be readily removed

and replaced without hauling fires. The bars at sides of furnaces will be made to fit the corrugations. The bars will be made in two lengths, resting on the dead plate in front and on the bridge wall in the rear of each furnace. They will be supported in the middle by an approved frame-work, made to fit in the corrugations. No holes will be drilled in the furnaces for securing furnace fittings. The area of opening between grate bars will be about 40 per cent of the grate area.

166. BRIDGE WALLS.

They will be made of cast iron, extending to the rear of the combustion chambers, and so fitted as to be readily removable. They will be covered on the top with fire brick or other approved refractory material. The area of opening above bridge walls will be about 15 per cent of the grate surface.

167. FURNACE FRONTS.

They will be made with double walls of wrought iron or steel, bolted to a light frame. The space between the two walls will be in communication with the fire room. The inner plate of furnace front will be perforated as may be directed. The dead plates will be made of cast iron and fitted so as to be easily removable. The door openings will be as large as practicable.

168. FURNACE DOORS.

The furnace doors must be protected in an approved manner from the heat of the fire. The perforations in doors and linings will be such as may be directed. Each door will have a small door near its lower edge for slicing fires. There will be two hinges to each door, of wrought iron. The latches will be of wrought iron. There will be approved arrangements for preventing the doors from sagging and for holding them open when firing. The doors will be fitted with circular dampers.

169. ASH-PIT DOORS.

They will be made of $\frac{1}{8}$-inch wrought iron or steel stiffened with angle or channel iron. They will be furnished

with suitable buttons, so as to close the ash pit tightly when the furnace is not in use. Each door will have two wrought-iron beckets to fit hooks on boiler fronts.

170. LAZY BARS.

A lazy bar with the necessary lugs will be fitted in the front of each ash pit. There will also be portable lazy bars for the furnaces.

171. ASH PANS.

Ash pans of ¼-inch wrought iron or steel, reaching from the front of the furnace flue to the bridge wall, will be fitted to all furnaces.

172. UPTAKES.

They will be made of double shells of wrought iron, No. 8 B. W. G., built on channel iron and stiffened with angle irons, and will be bolted to boiler heads and to the smoke-pipe base. Outside of the uptakes will be a jacket inclosing a 3-inch air space. This jacket will be made of No. 12 B. W. G. iron, and will extend from the tops of the uptake doors to the tops of the uptakes. The space between the plates of the uptakes will be filled with an approved incombustible nonconducting material.

173. UPTAKE DOORS.

The uptake doors will be made of double shells of iron of the same thickness as uptakes, and have an air jacket like the uptakes. The space between the shells will be filled with the same nonconducting material as in uptakes. The hinges and latches will be made of cast steel or wrought iron. Each door will have an eyebolt near its top for handling and one near the bottom for convenience in opening.

174. DOUBLE SMOKE PIPE AND GUYS.

The smoke pipe, which is to be double, and cape are to be substantially as shown on plan; the height of pipe to be not less than 54 feet above the grates; the area of the

same to be about 30.6 square feet. The exterior casing will be set off from the interior pipe 3 inches by studs of sufficient strength to support its weight. From 18 inches above the main deck the smoke pipe will take the rake of the masts, and be built of No. 9 B. W. G. steel. The uptakes will connect with the base pipe as shown.

Surrounding the pipe from the junction with the uptakes, and extending to within 5 inches of the top, there will be a casing of No. 11 B. W. G. steel. It will be butted and strapped, flush riveted on the outside, and open top and bottom. It will be stayed to the pipe with socket bolts, and will be finished with a half-round iron at the top. The inside pipe will be finished at the top with an angle iron, and will have a hood of No. 9 B. W. G. steel, finished at bottom with half-round iron projecting 6 inches beyond outside casing, covering the casing, to which will be secured shackles for slinging painters. Stay shackles will be secured to the stack through a wrought-iron ring 3½ inches by ½ inch thick on the inside of the stack. This band will be located 6 feet from the top of the stack. The pipe will be strongly secured by guys and turn-buckles of approved dimensions and pattern. Light steps of ½-inch round iron 10 inches long will be fitted on forward port side of stack, spaced about 16 inches apart, reaching to the top. They will be riveted to outside casing and project out 3 inches from the same. The umbrella will bolt to an angle iron riveted to the smoke pipe at the height shown on the drawing. There will be about 12 inches space between the umbrella and deck, vertically. The umbrella will rest on lugs; the latter will be riveted to the casing and be spaced about 2 feet apart. The opening in umbrella for escape pipe will be about 1 inch larger than the pipe itself, and will have a casing flanged and riveted around it about 2 inches high. The pipe will have a cape secured to it by a band, which will extend 2½ inches over the casing. The whistle pipe will have composition fittings at top and bottom, as shown. A damper will be placed in the smoke pipe where directed, and means for adjusting the same from the fire room will be provided.

175. BOILER SADDLES.

Each boiler will rest in two saddles built up of plates and angles. They will be secured to the angle irons by bolts screwed through the boiler shell, with heads inside. These bolts will fit holes in the angle irons of the front saddle snugly, but pass through enlarged holes in the angles of the back saddles to allow for expansion. Lugs built up of plates and angles will be fitted at each end of each boiler, as shown, to prevent displacement of boilers in case of a collision. Each boiler will be secured, in addition to the above, by four $1\frac{1}{4}$-inch round braces, having palms forged on the ends, which will be bolted to the boiler shells and to the reverse frames of the vessel.

176. BOILER ATTACHMENTS.

Each boiler will have the following attachments, viz: One steam stop valve, one auxiliary stop valve, one dry pipe, one main feed check valve with internal pipe, one auxiliary feed check valve with internal pipe, one surface blow valve with internal pipe and scum pan, one bottom blow valve with internal pipe, two safety valves, located as shown, one steam gauge, located in fire room, one glass water gauge of automatic closing type, four asbestos-packed gauge cocks, one sentinel valve, one salinometer pot, one drain cock, one air cock.

All external fittings will be of composition unless otherwise directed. All fittings will be flanged and through-bolted, with nuts on the inside, as approved. All cocks, valves, and pipes will have spigots or nipples passing through the boiler plates. All internal pipes will be of brass, No. 14 B. W. G., and must touch the plates nowhere except where they connect with their external fittings. The internal feed and blow pipes will be expanded in the holes in boiler shells to fit the nipples on their valves, slightly beaded over in the countersinks in the shell, and they will be supported where necessary in an approved manner. The stems of all valves on boilers are to have outside screw threads.

177. CIRCULATING APPARATUS.

There will be an approved apparatus (equal to Craig's) fitted to each boiler for circulating the water from under the furnaces.

178. ZINC BOILER PROTECTION.

Zinc for the protection of the boilers will be held in baskets suspended from the stays; these baskets will be of wrought iron, perforated on the sides and solid on the bottom. There will be four baskets in each boiler, each containing about 25 pounds of broken rolled zinc. Each strap for supporting the baskets will be filed bright where it comes in contact with the stays, and the outside of the joint will be made water-tight by paint or approved cement.

179. BOILER STOP VALVES.

There will be one 5-inch brass stop valve, with vertical spindle, on each boiler. The valves will be bolted to a composition valve box at the top of each boiler, as shown. These valve boxes will each have a 5-inch nozzle connecting with the boiler, and, in addition to the nozzle for the main stop valve, will each have a nozzle for the 4-inch auxiliary stop valve and two for the safety valves. The same set of bolts will secure both the valve box and the nozzle at the end of the dry pipe.

180. DRY PIPES.

There will be in each boiler, as high as possible and properly supported, a 5-inch brass dry pipe, thoroughly tinned outside and inside, No. 14 B. W. G., extending nearly the whole length of the boiler, perforated on its upper side with transverse slits, as shown. Combined area of slots shall not be less than the area through stop valve. The pipe will be made in one section, one end being closed and the other end fitting into a casting, which latter will bolt through the flange on the valve box. There will be a 1-inch drain hole in the underside, near the closed end; a brass pipe will lead from this hole to about 3 feet below the water level in the boiler.

181. FEED CHECK VALVES.

The main and auxiliary feed check valves will each be $2\frac{1}{2}$ inches in diameter. They will be fixed on the shell at the inboard front end of each boiler, but entirely separate from each other, and will be fitted with internal pipes, the feed pipes leading above the tubes and pointing downward in the water space between the nests of the tubes and between the nests and the shell. The valve cases will be so made that the bottom of the outlet nozzle shall be at least $\frac{1}{2}$ inch above the valve seat. The valves will be assisted in closing by phosphor-bronze spiral springs. These valves will have finished brass bent bar handles in lieu of handwheels.

182. SAFETY VALVES.

Each boiler will have two "Richardson's pop" 3-inch spring safety valves securely bolted to the valve box, as shown on the drawing. The valves will be set for a pressure of 160 pounds and fitted with mechanism for lifting by hand from fire room; the mechanism for each pair of valves to be such that the valves will be lifted in succession. A drainpipe will be attached to each safety-valve casing, below the level of the valve seats, leading to the bilge. Each safety-valve casing will be connected to dry pipe, as shown.

183. SENTINEL VALVES.

Each boiler will have a sentinel valve at the front end $\frac{1}{2}$ square inch in area. It will have a sliding weight on a notched lever graduated to 175 pounds pressure.

184. BOTTOM BLOW VALVES.

There will be a 2-inch bottom blow valve on each boiler, bolted on the shell, near the front. The boiler pressure will be above the valve. An internal pipe will lead from the valve to near the bottom of the boiler. The valve casing, valve, handwheel, and valve stem will be made of composition.

185. SURFACE BLOW VALVES.

There will be a 1½-inch surface blow valve on each boiler, bolted on or near the front. The boiler pressure will be above the valve. An internal pipe will lead from the valve to near the water line in each boiler, and will be fitted with a scum pan. The valve casing, valve, hand-wheel, and valve stem will be made of composition.

186. BLOW PIPES.

A 2-inch pipe will connect the bottom blow valves with a sea valve in the same compartment. These pipes will each have a nozzle for the connection of a pipe for pumping out the boilers, as well as a 1½-inch nozzle for the attachment of pipes from the surface blows. There will be a straightway valve in the blow pipe as near the sea valve as possible. All joints will be flanged joints.

187. BOILER PUMPING-OUT PIPES.

A 2-inch pipe will connect each blow pipe with the auxiliary feed pump, and will have a screw stop valve above the floor, near the pump.

188. STEAM GAUGES.

There will be at the front end of each boiler a spring steam gauge of approved pattern, with seamless tube and 8½-inch dial, graduated to 225 pounds. Each gauge will have an independent connection with the boiler and be fitted with a three-way cock and a coupling for attachment of a test gauge. A standing test gauge in a neat box will be furnished.

189. BOILER WATER GAUGES.

Each boiler will have a glass water gauge of approved automatic-closing pattern. Each gauge will be placed at the side of the boiler and will have 1½-inch pipes leading to top and to near bottom of boiler, with a valve in each, close to boiler. The shut-off and blow-out cocks are each to have at least ½ inch clear opening, and will be packed cocks, with levers and rods for working from fire room. The glasses will be about 16 inches in exposed length, with

the lowest exposed part about 1 inch above the highest heating surface. The glasses will be well protected. A brass index plate, with letters cast in relief, will be fixed close to each gauge glass to show the height of the top of combustion chamber. The blow-out cocks will have drain-pipes leading to bilge, with union joints.

190. GAUGE COCKS.

There will be four asbestos-packed gauge cocks of approved pattern on the front end of the boiler, with rods and levers for working from fire room. Each cock will have an independent attachment to the boiler. They will be spaced about 6 inches vertically, the lowest one being about 4 inches below the highest surface. Each set of cocks will have an approved drip pan of sheet brass, with a pipe leading from the same to the bilge.

191. SALINOMETER POTS.

There will be salinometer pots, fitted with brass hydrometers and thermometers of approved pattern connected to each boiler. They will be placed in the fire room or where directed.

192. BOILER INJECTORS.

There will be two injectors of approved pattern in boiler compartment, equal in all respects to Korting's No. 8, with connections to boilers, tanks, and sea.

193. BOILER DRAIN COCKS.

Each boiler will have a 1-inch drain cock of approved pattern placed near the after end of boiler.

194. BOILER AIR COCKS.

Each boiler will have a $\frac{1}{2}$-inch air cock at its highest part, with a $\frac{1}{2}$-inch copper pipe leading to the bilge.

195. FORCED DRAFT.

The forced draft will be of the air-tight fire-room system, and arrangements will be made to make the fire room as nearly air-tight as possible; air-tight screens will be

fitted so as to make the space under pressure as small as possible.

196. FIRE-ROOM BLOWERS.

There will be two approved fire-room blowers, equal in all respects to the Sturtevant type, located where shown on the drawing, provided with air ducts from the two ventilators, and capable of supplying with ease the air requisite to maintain the maximum rate of combustion. The spindle bearings must be accessible while the blowers are in motion, and must be thoroughly protected from dust.

197. BLOWER ENGINES.

Each blower will be driven by a direct-acting engine equal in all respects to the Sturtevant type and of sufficient power to run the blower at full speed with steam of 100 pounds boiler pressure. The engine valves must be of the slide type. All working parts must be closed in, but easily accessible for overhauling. The lubrication must be automatic and thorough. The throttle valve in the steam pipe of each blowing engine will be arranged to be worked from the fire-room floor, with suitable index to show how much it may be open. The steam pipe for each blower will be connected with the auxiliary steam pipe, and the exhaust pipes with the auxiliary exhaust pipe. The shafts of blower engines will be so fitted that a portable revolution counter can be easily applied without removing any part of the mechanism. An approved air-pressure gauge will be supplied and located where directed.

198. AIR LOCKS.

Suitable air locks must be provided in the passages into the fire room and in the ash-hoist ventilators to prevent the escape of air while the fire rooms are under pressure.

199. GEAR FOR HANDLING COAL.

Approved means, either by cars and tracks or overhead trolleys and buckets, will be provided for transporting coal from bunkers to fire room.

200. TESTS AND INSPECTION OF ALL MATERIALS.

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.

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 by the inspector at the ship-yard or works. All boiler and hull plates must be rolled from slabs.

The inspector shall see that each object or plate is clearly stamped with, first, the maker's name; second, the private stamp of the inspector; and, third, for all boiler and hull plates, the lowest tensile strength. The inspector's stamp must not be placed on any boiler or hull material until it has been weighed and passed ready for shipment.

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; test pieces for the quenching and bending tests shall be cut from the transverse edges of all plates which are to be tested.

The tensile-test pieces for boiler and hull plates shall have a length of at least 14 inches. They shall be 2 inches wide across the shoulders, which shall join by easy fillets a parallel-sided portion having a length of 8 inches. Tensile-test pieces must have an area of cross section not less than 0.5 of a 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.

Each tensile test piece shall be subjected to a stress in a testing machine, running at medium speed, until the piece

is ruptured. Every facility shall be afforded the inspector for testing and examining the material in the course of manufacture.

201. WEIGHTS OF ALL 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, for the purpose of determining the calculated weights.

The actual weight of all hull material will be obtained by the inspector before it is shipped from the mill.

202. INSPECTION OF IRON CASTINGS.

All important iron castings, including cylinders, cylinder linings, condenser, back columns, bedplate, valves, valve liners, etc., must be made of the best quality of cast iron, which shall have received at least one remelting. Castings for wearing surfaces, as cylinder linings, must be of close-grained iron as hard as can be properly worked with tools of Mushet's steel.

203. TESTS FOR IRON CASTINGS.

From each heat of cast iron a tensile-test piece must be poured. This must be machined to size and must show a tensile strength of not less than 18,000 pounds per square inch. If directed, test coupons will be attached to the larger castings. The cross-sectional area of test pieces will not be less than 0.5 of a square inch.

204. TENSILE TESTS FOR SHAFTING, STEEL COLUMNS, AND REVERSE SHAFT.

These will be made of open-hearth steel of the best quality. Each section of crank, thrust, line, and propeller shaft, and each steel engine column, and the reversing shaft shall have a piece cut from its upper end (as the ingot is cast) of sufficient length for a longitudinal tensile-test specimen. These specimens will be taken at a distance from the axis of the forging equal to one-half the radius. They will have a length of 2 inches between measuring points. Each of these tensile specimens must

show a tensile strength of not less than 60,000 pounds per square inch and an elongation of not less than 25 per cent in 8 inches.

205. QUENCHING AND BENDING TESTS FOR SHAFTING, COLUMNS, ETC.

A bar ½ inch square will be taken from each forging, and must stand bending double flat on itself after quenching in water at 82° F. from a dark cherry-red heat in daylight, without showing cracks or flaws.

206. TESTS FOR PISTON AND CONNECTING RODS, VALVE STEMS, AND CROSSHEADS.

These will be of open-hearth steel of the best quality. Each forging for piston and connecting rods, valve stems, and crossheads will be annealed. Each forging, after receiving all treatment, will have a piece cut from its upper end (as the ingot is cast) of sufficient length for a longitudinal-test piece, having a length of 2 inches between measuring points. Where several pieces are made together in one forging, one tensile specimen may be taken from the upper end (as the ingot is cast) to represent the combined forging. Each of these tensile specimens must show a tensile strength of not less than 80,000 pounds and an elongation of not less than 25 per cent in 2 inches.

207. QUENCHING AND BENDING TESTS FOR PISTON AND CONNECTING RODS, VALVE STEMS, AND CROSSHEADS.

One bar ½ inch thick, cut from each forging, must stand bending double when cold to an inner diameter of 1 inch without showing cracks or flaws.

208. TESTS FOR BOILER PLATES.

These must be of open-hearth steel of the best quality. One tensile-test piece and one bending piece shall be cut from each plate as rolled for the boilers. Tensile and elongation test pieces shall be cut from the longitudinal edges, and pieces for the quenching and bending test shall be cut from the transverse edges.

209. TESTS FOR SHELL PLATES.

The test pieces must show a tensile strength of from 60,000 to 68,000 pounds per square inch and an elongation in 8 inches of at least 25 per cent, the elastic limit being at least 31,000 pounds.

210. TESTS FOR FURNACE PLATES, FLANGE PLATES, AND PLATES FOR COMBUSTION CHAMBERS.

The test pieces must show a tensile strength between 52,000 and 60,000 pounds, with an elongation in 8 inches of 28 per centum longitudinally.

211. QUENCHING TEST FOR BOILER PLATES.

One piece shall be cut from the transverse edge of each shell plate, furnace, or flange plate, as finished at the rolls, for the quenching test. These strips shall be cut 2 inches wide and 12 inches long, and may be trimmed to size with machine tools and have sharp edges taken off with a fine file. The piece will then be heated to a cherry red and plunged into water at a temperature of 82° F. Thus prepared, it must be possible to bend the piece so it shall double round a curve of which the diameter is not more than the thickness of the piece tested, without showing cracks or flaws. The ends of the piece must be parallel after bending.

212. SURFACE INSPECTION OF BOILER AND HULL PLATES.

All plates must be smooth and free from laminations, cracks, scabs, snakes, scale marks, pits, or other defects. All flanges must turn without cracking the surface or splitting the edges of the plates.

213. SHEARING OF BOILER PLATES.

Boiler plates shall not be sheared closer to finished dimensions than once the thickness of plate along each end and one-half the thickness of plate along each side. This allowance will be made by the contractor on his order, and the manufacturer will shear to ordered dimensions.

214. WEIGHT AND GAUGE OF BOILER PLATES.

Boiler plates must not be less than the specified thickness on the longitudinal edge; no more than 0.03 inch thicker in the middle of the transverse edges for plates under 60 inches, or 0.04 inch for plates over 60 inches in width.

215. TESTS AND INSPECTION FOR BOILER RIVETS.

These must be of open-hearth steel of the best quality. They must be true to form, free from scale, fins, seams, and all other defects.

216. TENSILE AND ELONGATION TESTS FOR RIVET RODS.

The rivets for use in the longitudinal seams of the boiler shells shall have from 60,000 pounds to 68,000 pounds tensile strength per square inch, with an elongation of not less than 26 per cent in 8 inches; and all others shall have a tensile strength of from 52,000 to 58,000 pounds per square inch, with an elongation of not less than 30 per cent in 8 inches. One tensile and elongation test shall be made from each lot of 1,000 pounds of rivet rods. Full-sized rivet rods may be used for test specimens.

217. PRACTICAL TESTS OF BOILER RIVETS.

From each lot six rivets are to be taken at random and submitted to the following tests: Two rivets to be flattened out cold under the hammer to a thickness of one-third the diameter without showing cracks or flaws.

Two rivets to be flattened out hot under the hammer to a thickness of one-quarter the diameter without showing cracks or flaws, the heat to be the working heat when driven.

Two rivets to be bent cold into the form of a hook with parallel sides without showing cracks or flaws.

218. TESTS FOR BOILER TUBES.

The tubes must be made of the best quality of charcoal iron, and their surfaces must be smooth and free from rust, scale, pits, laminations, bad scores, or imperfect welds

which would decrease their thickness more than ½ gauge B. W. G., otherwise they will be rejected.

Strips ½ inch in width will be cut lengthwise from the tubes. These strips will be heated to a cherry red in daylight and plunged (while at this heat) in water of a temperature of 82° F.; after being so quenched a strip must bend, cold, back upon itself, without crack or flaw.

The end of a tube will be heated to a cherry red in daylight for a distance equal to one and a half times the diameter, and a taper pin, at a blue or dull red heat, driven in. The tube must stretch to one and one-eighth times its original diameter without split or crack. The taper of the pin must not exceed one in eight (1½ inches to the foot), and its surface must be smooth.

Each tube will be subjected to an internal hydrostatic pressure of 500 pounds to the square inch.

These tests to be made by an engineer officer at the place of manufacture, and one tube shall be selected from each lot of 100 or fraction thereof, unless, in his opinion, a larger number must be tested to enable him to form a proper estimate of the whole lot. The surface inspection and the hydrostatic test will, of course, be made on each tube of the whole lot. Failure to pass satisfactorily the above inspections or tests will be cause for the rejection of the whole lot of tubes.

219. FORGINGS FOR RODS, SHAPES, AND BOILER BRACING.

All stay rods and braces must be of open-hearth steel of the best quality, and must be made without welds, with the exception of the two wing braces in each boiler, which will be of the best quality of wrought iron. All material for boiler bracing which receives any forging must be afterwards annealed. Stay rods and bracing must be true to form, free from seams, hard spots, scale marks, and defects generally.

220. TENSILE TESTS FOR RODS, SHAPES, AND BOILER BRACING.

One thousand pounds for boiler braces shall constitute a lot, from which two tensile-test pieces shall be taken, each from a different object.

Bracing coming in contact with the fire must have a tensile strength of from 52,000 to 60,000 pounds per square inch, and an elongation of not less than 26 per cent in 8 inches if rolled, or 32 per cent in 2 inches if forged. Other bracing must have a tensile strength of not less than 65,000 pounds per square inch, and an elongation of not less than 24 per cent in 8 inches if rolled, or 30 per cent in 2 inches if forged.

221. QUENCHING AND BENDING TESTS FOR RODS, SHAPES, AND BOILER BRACING.

One bar ½ inch square, cut from each lot of the bracing coming in contact with the fire, must stand bending double to an inner diameter of 1½ inches after quenching in water at a temperature of 82° F. from a dark red cherry heat in daylight, without showing cracks or flaws. A similar piece cut from each lot of the other bracing must stand cold bending double to an inner diameter of 1½ inches without showing cracks or flaws. Material for screw stay rods will be considered as coming in contact with the fire.

222. INSPECTION OF STEEL CASTINGS.

These must be of steel of the best quality. All steel castings must be annealed unless otherwise directed. All castings must be sound, free from brittleness, injurious roughness, pitting, sponginess, porosity, cracks, cavities, foreign substances, and all other defects affecting their value. Particular search for defects will be made at the points where the risers join the castings, as unsoundness at these points may extend into the castings. Steel castings will be carefully examined while being machined for blowholes and other defects. The Government will reserve the right to make such other tests of steel castings as may be considered necessary.

223. TESTS FOR MANGANESE BRONZE FOR PROPELLER.

Coupons will be cast attached to the hub and to each blade of the propeller. The coupons will be cast in a horizontal position, and those from 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. They must have an average tensile strength of at least 55,000 pounds and an elastic limit of at least 18,000 per inch of original section, and an elongation of 18 per cent in 2 inches.

The coupons will have no other treatment than machining to reduce them to the proper diameter.

224. QUALITY AND INSPECTION OF HULL PLATES AND SHAPES.

All plates and shapes used in the construction of the hull will be of open-hearth steel. Each plate and shape will be legibly stamped with the maker's name and the tensile strength. The surfaces of all plates must be free from flaws, scabs, cracks, snakes, or other imperfections. All shapes must be true to form, free from defective sections, shaded backs, grooved fillets, imperfect edges, etc.; free from slag, foreign substances, brittleness, hard spots, laminations, sand and scale marks, scabs, snakes, etc. Clean-cutting punches must be used to prevent cracking of metal on the convex side.

225. TENSILE TESTS OF HULL PLATING AND SHAPES.

From each 2,500 pounds of plating and shapes as finished at the mill one tensile and elongation test piece and one cold-bending test piece will be selected by the inspector at random. Plates and shapes are to be rolled in the presence of the inspecting officer. The tensile strength shall not be less than 55,000 pounds per square inch, and the elongation in a length of 8 inches must not be less than 25 per cent.

226. TESTS, COLD BENDING, FOR HULL PLATES AND SHAPES.

Samples of the plating for cold-bending test shall be bent over flat on themselves without signs of fracture. Cold-bending samples cut from the shapes shall either be opened out flat when cold or closed down flat on themselves, as the inspector may direct, without showing signs of fracture in either case. If one of the above specimens

fails, an additional piece may be taken, but if this also fails, each of the plates or shapes which compose the 2,500 pounds must pass the cold-bending test or be rejected. The number of pieces under the cold-bending test may be increased if the inspector has reason to suspect overheating or cold rolling. Strips cut from plates for cold-bending tests will be 2 inches wide and 12 inches long, and may be trimmed to size with machine tools and have sharp edges taken off with a file.

227. TEST PIECES, SIZE OF, FOR HULL PLATES AND SHAPES.

Test pieces shall not be taken from any plate or shape which is less than $\frac{3}{10}$ inch in thickness; for such plates or shapes the test pieces must be taken from the heavier plates or shapes which are rolled from the same heat.

228. PLATES AND SHAPES FOUND DEFECTIVE.

Any plate or shape showing signs of fracture during its incorporation into the vessel or after it has been secured in place must be rejected and replaced.

229. WEIGHTS OF MATERIAL.

Plates of $12\frac{1}{2}$ pounds per square foot or under may be accepted if the weights vary between 3 per cent above and 5 per cent below the specified weights.

All other plates may be accepted if the weights vary between the specified weights and 5 per cent below them.

The weights of all shapes may vary between 3 per cent above and 5 per cent above the specified weights.

All plates and shapes to be used in the construction of the vessel must be weighed in the presence of the inspecting officer before shipment from the mill and again before incorporation into the vessel.

230. TENSILE AND ELONGATION TESTS FOR HULL RIVETS

All hull rivets must be made from the best quality of mild open-hearth steel. One thousand pounds of rivets made from bars coming from the same heat will constitute a lot, and two tensile specimens, each from the end of a different rod, will be tested from each lot. These

specimens must show a tensile strength between 50,000 and 58,000 pounds per square inch and an elongation of at least 28 per cent in a length of 8 inches. In case of rivets less than $\frac{5}{8}$ inch in diameter the tensile tests required for each lot may be made on bars from the same heat as the lot to be tested and not more than $\frac{5}{8}$ inch in diameter.

231. PRACTICAL TESTS FOR HULL RIVETS.

From each lot six rivets are to be taken at random and submitted to the following tests:

1. Two rivets to be flattened out cold under the hammer to a thickness of one-half the diameter without showing cracks or flaws.

2. Two rivets to be flattened out hot under the hammer to a thickness of one-third the diameter without showing cracks or flaws, the heat to be the working heat when driven.

3. Two rivets to be bent cold into the form of a hook with parallel sides without showing cracks or flaws.

Rivets must be true to form, free from scale, fins, seams, and all other injurious or unsightly defects.

232. TESTS OF MANGANESE BRONZE FOR STEM, STERN FRAME, RUDDER FRAME, AND FOR ALL MANGANESE BRONZE USED IN HULL.

Coupons will be cast attached to each casting and in a horizontal position. They will be cast 2 inches in diameter and turned down to a diameter of 1 inch between measuring points. They must have a tensile strength of at least 50,000 pounds, an elastic limit of at least 18,000 pounds per inch of original section, and an elongation of not less than 18 per cent in 2 inches.

The coupons will have no other treatment than machining to reduce them to the proper diameter.

233. PAINTING.

After a satisfactory test the boilers will be painted on the outside with two coats of brown zinc and oil, and when placed in position on board the vessel will be painted with two coats of paint of approved color. The shafting, when

in place, will be painted with two coats of red lead and oil and two coats of white paint. The smoke pipe will be thoroughly painted before and after erection on board. The ventilators will be painted similarly to the smoke pipe, except the interiors of the cowls, which will be painted vermilion. The outside of cowls will not be painted. All pipes will be painted in accordance with a schedule to be hereafter furnished. All parts of the engines and accessories will be painted as directed.

234. STOREROOMS.

Two storerooms, one fitted with galvanized-iron locker for waste and with suitable drawers and shelves to receive engineer's stores, the other to receive oil tanks, measures, lanterns, etc., to be erected in such location as the superintending officer may direct.

235. SUPERINTENDING ENGINEER'S OFFICE.

A suitable office with desk will be furnished by the contractor for the use of the superintending engineer.

236. INSPECTION.

The work of construction of boiler and machinery and appurtenances shall be at all times open to inspection by officers appointed for such purpose by the Secretary of the Treasury. Every facility will be afforded such inspectors for the prosecution of their work. All handling of material necessary for the purposes of inspection will be done at the expense of the contractor. Such test specimens, not otherwise specified, as may be necessary for the determination of the strength and quality of materials used in the construction of the hull and steam machinery shall be prepared and tested at the expense of the contractor.

237. TESTING OF BOILERS.

When the boilers are ready for testing they are to be filled entirely full of water, a fire lighted, and the temperature of the water brought to 200° F.; a hydrostatic pressure of 240 pounds per square inch is to be be applied, and all leaks are to be made tight under these conditions.

Temporary gauge cocks, safety valves, and steam gauges are also to be applied to the boilers, and a steam pressure of 140 to 160 pounds maintained on the same by making fires in the furnaces for at least three hours on each of the two different days, so that the boilers will cool off after the first trial. This operation is to be repeated until all joints are made tight. All leaky rivets to be cut out and others driven in their places. These tests will be made before the boilers are put in the vessel, in the presence of the superintending engineer, who will satisfy himself that the boilers are in absolute working order under the requirements of the contract and specifications, after which the boilers may be placed in the vessel and permanently secured in position.

238. TRIAL OF MACHINERY AND TRIAL TRIPS.

Steam will be raised in the boilers whenever required to test the connections and workings of all parts of main and auxiliary engines to determine if they are in first-class working condition. All trials to be made to the satisfaction of the engineer in chief and at the expense of the contractor. The machinery is to be operated at the dock at least twelve hours, and until it can be run continuously at full speed without heated journals, after which a trial trip is to be made until the engines will make a successful run of at least eight consecutive hours, working off at 160 pounds pressure all the steam the boiler will make with clean fires, using free-steaming coal, to be selected by the superintending engineer. Indicator cards will be taken every half hour during both dock and underway trials, to determine whether the valves are properly adjusted and the power is equally divided between the three cylinders. Cards will also be taken during the eight hours trial for determining the powers necessary for different rates of speed.

239. RECORDS OF WEIGHTS.

All machinery, boilers and appurtenances thereof, as fitted, and all spare machinery and tools herein specified will be weighed by the contractor in the presence of the superintending engineer before being placed on board;

and no part of the material will be placed on board without being so weighed to the satisfaction of the superintending engineer. A complete record of the weights will be kept.

240. WORKING DRAWINGS.

All drawings necessary for the prosecution of the work must be prepared by and at the expense of the contractor. Those which are developments of the drawings furnished and of these specifications will be subject to the approval of the engineer in chief before the material is ordered or the work commenced. In the drawings furnished figured dimensions, when given, will be followed, and not scale dimensions, unless otherwise directed. All discrepancies discovered in drawings or between drawings and specifications will be referred to the engineer in chief. Duplicate copies of each working drawing will be furnished to the engineer in chief for his approval before the work shown by the drawing is commenced.

A copy of each drawing accompanying orders for castings or forgings will also be supplied when the work is ordered.

241. DRAWINGS OF COMPLETED MACHINERY.

The contractor will make and furnish the Treasury Department with a complete set of tracings of the boilers, machinery, and appurtenances as actually completed, including plans of same as fitted on board the vessel. These tracings will include every piece of machinery, both in whole and in part, and will be in such detail as would enable the entire machinery to be duplicated without additional drawings. No sheet will contain drawing of more than one part of the machinery, except those intimately connected with each other. The detail drawing of each part of machinery will be furnished within one month after the completion of the part, without waiting for its incorporation into the machine as a whole. Detail drawings will be made to a scale of not less than 1½ inches to a foot. General plans of the machinery in place in the vessel will be made to a scale of ½ inch to the foot. Pipe

plans will be made to a scale of not less than ½ inch to the foot. Detailed drawings will be hatched, where in section, in accordance with a schedule to be furnished, to show the various metals employed. In addition to the above tracings, two complete sets of blue prints will be furnished, one to the engineer in chief and one to the vessel.

242. CLEANING.

All finished parts of engine, auxiliary machinery, and the internal parts of the boiler will be thoroughly cleaned before the contractors turn the vessel over to the Government.

243. GENERAL PROVISIONS.

It is to be distinctly understood that the engine, auxiliaries, boilers, and all parts of the steam machinery are to be completed, connected, and fitted out in every detail, and all piping, valves, and fittings to the engine, auxiliaries, boilers, and all parts of the steam machinery, or between the same, must be furnished and fitted, whether herein specified or not.

244. GENERAL CONDITIONS FOR THE STEAM MACHINERY.

The intent of these specifications for the steam machinery is declared to be that the contractor shall provide, at his own cost, all apparatus, material, and labor necessary to the full construction and completion of the steam machinery, ready for service, whether the same is described in the specifications and shown on the drawings or omitted from one or the other, or from both, or improperly described or shown, or both. The specifications and drawings are to be strictly followed, and not departed from except by direction or authority of the Secretary of the Treasury, or, on minor matters, by the engineer in chief, so far as they relate to the steam machinery, when the same shall be considered as of benefit to the Government, and so long as the general style and character are maintained such changes are to be made by the contractor without extra compensation therefor. Any dispute arising respecting the true

meaning or intention of the specifications and drawings, or omissions or imperfections in them, shall be referred to the engineer in chief, United States Revenue-Cutter Service, whose decision shall be final and conclusive. If the contractor should vary from the specifications or plans, except by direction or authority as before named, the Government shall be at liberty at any time, before or after the completion of the work, to order such improper work to be removed, remade, and replaced, and all work destroyed by the alteration made good at the contractor's expense. All material and workmanship to be first-class and satisfactory to the superintending officers. Before the Government will accept the steam machinery it must be wholly completed, as before mentioned, tested as specified, and all parts cleaned.

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SPECIFICATIONS

FOR

PORTABLE FURNITURE

FOR

SINGLE-SCREW COMPOSITE PROPELLER

FOR

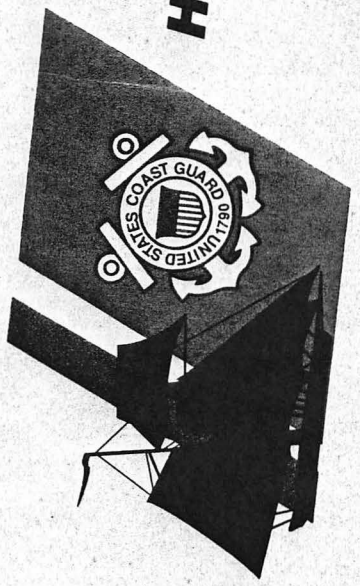
UNITED STATES REVENUE CUTTER SERVICE, 1895.

"No. 3, R. C. S.,"

FOR SERVICE ON THE PACIFIC COAST.

OFFICE DIVISION REVENUE CUTTER SERVICE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1895.



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SPECIFICATIONS

FOR PORTABLE FURNITURE FOR SINGLE SCREW COMPOSITE PROPELLER, NO. 3, R. C. S., AND TO BE CONSIDERED IN CONNECTION WITH AND FORMING PART OF THE SPECIFICATIONS FOR THE HULL, FITTINGS, EQUIPMENT, ETC., FOR SAME.

All furniture to be of such style or finish and kinds of wood as may be directed by the superintending officer, and all hardware to be of brass or bronze, as directed; all doors and drawers to be fitted with locks, and all locks to be furnished with duplicate keys.

The several pieces, number, design, and general dimensions of the furniture to be as follows:

FOR CAPTAIN'S CABIN.

One sideboard, extreme length 5 feet, extreme height about 6 feet 3 inches, and in width or depth 21 inches; the top to be of marble or wood as approved, and in height about 3½ feet, and fitted with tumbler racks and margin rail as required. The mirror in the back and above the sideboard to be of the best plate glass of approved dimensions and appropriately framed and mounted; the shelves and drawers to be in number and dimensions as may be directed.

Two bookcases, each 3 feet long, about 6 feet high by about 15 inches wide or deep; the shelves to be in number as required, and the doors to be paneled in approved manner.

FOR CAPTAIN'S OFFICE.

One writing desk about 3½ feet long by 30 inches wide, and fitted with drawers, pigeonholes, etc., as may be directed.

FOR CAPTAIN'S STATEROOMS.

In each room there will be one bureau 3 feet 4 inches long, 22 inches wide, to a height of 3 feet 9 inches to the top, which will be of marble or wood, as may be directed, and below this there will be five drawers; above and across the top there will be three small drawers 2½ inches deep, and above these a mirror of the best plate glass of approved dimensions, and appropriately framed and mounted; also one wardrobe, in height about 6½ feet by 2½ feet wide and 12 inches deep, with a shelf in the upper part, and the front to be fitted with doors or with rod and curtains as may be directed.

FOR CABIN LAVATORIES.

Each room to be provided with one toilet rack, about 20 inches long, and extreme height about 21 inches by about 6 inches deep, and fitted with shelves, rod, drawers, etc., as directed; also one towel rack of approved design.

FOR WARDROOM.

One sideboard, extreme length 6 feet, extreme height about 6 feet 3 inches, and in width or depth 21 inches; the top to be of marble or wood as approved, and in height about 3½ feet, and fitted with tumbler racks and margin rail as required. The mirror in the back and above the sideboard to be of the best plate glass of approved dimensions and appropriately framed and mounted; the shelves and drawers to be in number and dimensions as may be directed. Eight secretary bureaus, each in length 3 feet 4½ inches, 22½ inches in depth or width, and in height 3 feet to top of writing shelf, which will be in width about 18 inches, and fitted to swing up over the small drawers, etc., above, and down to a horizontal position; below the top there will be three large drawers; above the top, for a height of about 16 inches, to be fitted with drawers and pigeonholes, shelves, etc., arranged as directed and fitted with margin rail around the top of same; above this there will be a plate-glass mirror of approved dimensions appro-

priately framed and mounted; the total height of bureau with mirror to be about 6½ feet; also eight wardrobes similar to those required for the cabin staterooms, and eight toilet racks and eight towel racks of similar design; eight marble-top washstands with bowls, etc., as approved, and each to be supplied with hot and cold water; also waste pipes, etc., complete as directed.

WARDROOM LAVATORIES.

Each room to be provided with one toilet rack, about 20 inches long, and extreme height about 21 inches, by about 6 inches deep, and fitted with shelves, rod, drawers, etc., as directed; also one towel rack of approved design.

FOR EXECUTIVE OFFICER'S OFFICE.

One writing desk, about 30 inches high, of suitable size for the room, and fitted with drawers and lockers as may be required.

FOR ENGINEER'S LOG ROOM.

One writing desk of suitable size and shape for the room, and fitted with drawers and lockers as may be required.

FOR FORWARD OFFICERS' QUARTERS.

Four secretary bureaus, four wardrobes, four toilet racks, four towel racks, and four washstands; all to be made and fitted similar to those for the wardroom, except that they may be made of white ash or maple.

WIRE MATTRESSES.

There will be one galvanized-iron wire mattress for bed, fitted in each stateroom of the captain's cabin, wardroom, and forward officers' quarters; also to the berths on each side in the captain's cabin and wardroom dining room; to be located and of the dimensions as shown on the plans.

The several pieces of furniture as required to be secured where directed on the vessel in a suitable manner.

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INDEX TO SPECIFICATIONS

FOR

Single-Screw Composite Propeller "No. 3, R. C. S.,"

FOR

U. S. REVENUE CUTTER SERVICE.

SPECIFICATIONS FOR HULL

OF

Single-Screw Composite Propeller "No. 3, R. C. S.,"

1895.

FOR SERVICE ON THE PACIFIC COAST.

PRINCIPAL DIMENSIONS.

	Ft.	In.
Length over all	219	
Length between perpendiculars	200	
Breadth of beam molded, 32 feet 6 inches extreme	33	4
Depth of hold from top of flat keelson plate to top of main-deck beams amidships	17	10¼

Displacement to mean draft of 14 feet above bottom of keel, 1,280 tons.

QUALITY OF MATERIAL, TESTS, ETC.

All plates and shapes used in the construction of the hull will be of open-hearth steel. The rivets will be of open-hearth or Clapp-Griffith steel. Each plate will be legibly stamped with the maker's name and the tensile strength. The surfaces must be free from flaws, scabs, cracks, snakes, or other imperfections. Clean-cutting punches will be used to prevent cracking of metal on the convex side.

From each 5,000 pounds of plating as finished at the mill, one tensile and elongation test piece and one cold-bending test piece will be selected by the inspector at random. Plates are to be rolled and weighed in the presence of the inspecting officer. The tensile strength shall not be less than 55,000 pounds per square inch, and the elongation in a length of 8 inches to be not less than 25 per cent.

Samples for cold bending shall be bent flat over on themselves without signs of fracture. If one of these specimens fails, an additional piece may be taken, but if this also fails, each of the plates which compose the 5,000 pounds must pass the cold-bending test or be rejected. The number of pieces under the cold-bending test may be increased if the inspector has reason to suspect overheating or cold rolling.

Test pieces for light plates, 10 pounds or under, shall not be less than $\frac{3}{16}$ inch in thickness, and shall be taken from the same heats from which the heavier plates are rolled.

The angles and other shapes must be free from all defects, and any angle or shape cracked while punching or bending must be rejected.

WEIGHTS OF MATERIAL.

Plates of $12\frac{1}{2}$ pounds per square foot and less may be accepted if the weights vary between 3 per cent above and 5 per cent below the specified weights.

All other plates may be accepted if the weights vary between the specified weights and 5 per cent below them.

Contractors, in their orders to manufacturers, must state the weights per square foot for all plates.

At least 30 per cent of each lot proposed to be used shall be weighed in the presence of the inspecting officer, who shall select the plates to be weighed, and who shall decide as to each lot.

HULL RIVETS.

One ton of rivets made from bars coming from the same heat will constitute a lot, and two tensile specimens, each from the end of a different rod, will be tested from each lot. These specimens must show a tensile strength between 50,000 and 58,000 pounds per square inch, and an elongation of at least 28 per cent in a length of 8 inches. In case of rivets less than $\frac{5}{8}$ inch in diameter the tensile tests required for each lot may be made on bars from the same heat as the lot to be tested, and not more than $\frac{5}{8}$ inch in diameter.

Hammer tests.—From each lot six rivets are to be taken at random and submitted to the following tests:

1. Two rivets to be flattened out cold under the hammer to a thickness of one-half the diameter without showing cracks or flaws.

2. Two rivets to be flattened out hot under the hammer to a thickness of one-third the diameter without showing cracks or flaws, the heat to be the working heat when driven.

3. Two rivets to be bent cold into the form of a hook with parallel sides without showing cracks or flaws.

Rivets must be true to form, free from scale, fins, seams, and all other injurious or unsightly defects.

FLAT KEEL PLATE.

To be of steel 20 pounds per square foot by 36 inches wide amidships, and to extend from stem to sternpost, where it will be made about 1 foot wider on each side of the scarfs of same, and be connected to the plating riveted to these parts to take the hood-end fastenings; to be worked in lengths of about 18 feet, or agreeable to a proper shift of butts with the vertical keel, the butts to be planed and well fitted and calked in careful manner, and to have butt straps on inner side, the straps to be $\frac{1}{16}$ inch thicker than the plates; to be treble-chain-riveted, their width to be sixteen and one-half times the diameter of the rivets, and to be worked on each side of the vertical keel angle bars; the hood-end bolts to be tap-bolted and riveted, as directed, to the stem and sternpost castings.

MAIN WOOD KEEL.

To be of Puget Sound fir as directed, sided 15 inches by 17 inches deep, worked as shown on the cross-section plan, the lower edge of the rabbet for the garboard strakes being 9 inches above the bottom of keel; to be worked with the grain flat ways, and the pieces to be in lengths of about 60 feet or more, as may be practicable, and the several pieces connected together by flat tabled scarfs about 6 feet long, and fastened with yellow-metal

or bronze bolts riveted on rings; to prevent splitting the nibs, a horizontal ½-inch bronze bolt will be driven through each nib and riveted on rings; the ends of this keel to be fitted into recesses formed for same in the stem and sternpost castings; all to be fastened to the flat keel plate by $1\frac{1}{16}$-inch diameter naval-brass or bronze screw bolts as approved and tested for the outside planking; the bolts to be reduced about $\frac{1}{16}$ inch in diameter over the thread ends; the heads being about 1⅝ inches in diameter, to be driven from lower side and through the flat keel plate and angles on vertical keel and well set up with a nut bearing on a thin iron washer with a hemp grommet well saturated in a mixture of red and white lead, and worked under both washer and head of bolt; the heads to be sunk about 1 inch below the surface of keel and filled with Portland cement or as may be directed; the bolts to be staggered with one bolt in every frame space or room between the frames; tap bolts to be worked to the stem and sternpost castings as required; the faying surfaces of the keel plate and wood keel to be well coated with a mixture of red and white lead or some other approved composition before being worked together.

FALSE KEEL.

To be of Puget Sound fir 3 inches thick by 15 inches wide, the grain to be worked flat ways and in lengths of about 12 feet, and fastened to the main keel with 6-inch composition spikes, heads punched about ½ inch, with two spikes in each butt, and the remaining fastenings to be about 2 feet apart near alternate edges; the butts of the false keel to be kept well clear of the lower nibs of the scarfs of the main keel.

After the bolts securing the main keel are all in and plugged, the lower side of this main keel will be sheathed with copper before the false keel is put on.

VERTICAL KEEL.

To be 15 pounds per square foot, and in depth 24 inches generally, and to extend, except where shown

on the plans or herein stated, 4 inches above the floor angles, so as to be connected to two continuous longitudinal angle bars 2¾ by 2¾ inches of 6 pounds per foot, which are to be riveted to it and to the flat keelson plates and reverse bars. These upper longitudinal bars will extend from frame No. 7 aft, as shown on the plans. The continuous longitudinal angle bars on lower edge connecting vertical and flat keel together will be 3 by 3 inches of 7 pounds per foot, and extend to stem and sternpost as shown on the plans, to which they will be connected in substantial manner. Under the engine bedplate and thrust bearing the vertical plates will be increased in depth sufficiently to connect direct with same. Care must be taken, however, to preserve the continuous strength of the keel by tapering the plates down to the ordinary depth of keel as shown on the plans. All vertical keel plates and angle bars to same to be worked in the greatest lengths procurable, all butts to be planed and accurately fitted in the most careful manner, the straps to be treble-riveted, with alternate rivets in the third row omitted, the straps to be double and each $\frac{1}{16}$ inch thicker than half the thickness of the plates, their length to be sixteen and one-half times the diameter of the rivet, and to extend only between the edges of the top and bottom angles of the keel; the plates to have holes cut in them at every frame sufficient only to allow the reverse bars or straps to pass through. Before and abaft the engine space this vertical keel will be lightened by having a hole 8 inches in diameter cut in every room or opening between the frames, except where there are butt straps. *Limber holes 3 inches* in diameter to be cut in the vertical keel plates in every frame space above the lower longitudinal angle bars, as shown on the plans.

STEM.

To be of manganese bronze and formed of two pieces, as may be necessary, the upper piece to be bossed out and shaped for the passage of the bowsprit and wedges to same, also broadened out at the top to make good

connection with the forecastle-deck plating, to which it will be well riveted, also to be rabbeted to receive the ends of the outside plating, and to be scarfed and well riveted above the torpedo port to the lower piece. The lower piece also to be of manganese bronze, the heel part palmed out to make good connection with flat keel plate to which it will be well riveted, the upper end bossed out and shaped for the passage of the torpedo tube, also rabbeted to receive the ends of the outside plating; a tapered flange will be formed on each side about 1 to 1¼ inches thick by 5 to 6 inches wide abaft the rabbet line between the torpedo port and heel, to afford fastening for the outside wood planking, this rabbet to be not less than $3\frac{5}{16}$ inches deep; at the lower end it may be made $3\frac{1}{2}$ inches deep in order that $12\frac{1}{2}$ pounds per square foot steel plating may be riveted to the flanges and frames of the vessel, and to extend to about 6 inches abaft frame No. 3 and down to and be connected to the flat keel plate as turned up for this purpose, to give additional fastenings where desired for the hood ends, and, that this planking in the rabbet, etc., may not be less than 3 inches thick. A recess will be cast in the lower end for the fore end of wood keel to ship into, and the stem below the torpedo port and forward of the flanges and rabbet line may be cored out in approved manner, but there must not be less than $3\frac{1}{2}$ inches solid metal in the front or center line, and about 2 inches at sides and clear of rabbet. Below the torpedo-port opening, the greatest siding of the stem will be 15 inches; between this port and the bowsprit-port opening, to be 3 inches thick by 7 inches wide, and rabbeted to receive the 14 pounds outside plating, etc., as required

All to be shaped as shown on the plans.

A composition or manganese bronze hinged shutter to be fitted back in the recess in the front of the stem over the torpedo port, and provision made for operating the shutter from the inside of the vessel, by means of a rod on each side passing through the casting, as may be directed by the superintendent.

STERN FRAME.

To be of manganese bronze and formed of two pieces, if practicable, the rudderpost to be molded 14 inches and sided at the after edge 8 inches at the top, tapering in thickness down to the heel as required, also tapered on the sides to a thickness of about 2½ inches on the front edge and rounded, sides in thickness 1 inch; to have two lugs formed on it for taking the rudder, the upper lug to be 7 inches deep and the middle lug 6 inches deep; also cored out as required, and with web worked opposite each rudder lug; the upper web to be 1¼ inches thick and the lower one 1⅛ inches thick, the ends of rudderpost to fit into the upper and lower castings, to which they will be well bolted, as directed; the opening or distance between the rudderpost and main post to be not less than 6 feet 3 inches; the lower end or shoe of the main sternpost to be palmed out to make good connection with the flat keel plate, to which it will be well secured, also broadened out in the center under the propeller with a rib worked on each side about 22 inches over all, and formed as shown on the plans for the reception of the rudder and rudderpost, the forward and after edges in the propeller well or opening to be tapered and rounded off neatly so as to not present any obstruction to the passage of the water, a recess to be formed for the after end of wood keel to ship into; at the shaft to be bossed out, bored, and fitted for the shaft tube, etc., as required by the engineers. Above and below the shaft this post is to side 15 inches, and to be provided with tapered flanges as required for the stem, the flanges to extend to the upper after end of the stern frame where the wood planking ends; the transom plate to which the cant frames will be secured will be connected by angle clips to the head of this stern frame as shown on the plans; the rabbet to be of sufficient depth to stow planking of not over 3 inches thick abreast the shaft, and increasing to 3½ inches thick above and below this; 12½ pounds per square foot steel plating to be riveted to the flanges and to extend about

6 inches forward of frame No. 98 to provide for additional fastenings for the hood ends where required, this plating to be connected in substantial manner to the flat keel plate as turned up for this purpose.

If found impracticable to build this stern frame of two pieces, the upper part under the counter may form the third piece, and to be well scarfed to the main post below the water line, also to be fitted with butt straps on the inside of the flanges, etc., all to be made watertight and secured in substantial manner.

RUDDER.

The frame to be of manganese bronze, the least diameter of the head to be 8 inches, to be provided with rudder lock fitted around and under the counter, and sunken eye in head for hoisting; the pintles to be shrunk in the casting, or fitted and fastened in place by keys secured by plate over the ends as may be directed; the upper pintle to be 4½ inches in diameter, the middle and lower 3½ inches in diameter; sleeves will be worked over these pintles as approved, if so directed; a carrier to be fitted above the stuffing box on head of post, for taking the entire weight of the rudder; the rudder frame to be filled in between with white pine, and the covering plates to be of 12½ pounds per square foot manganese bronze, riveted through the frame and tap-bolted, where required; the thickness of the rudder frame at the thinnest part on the back to be not over 2¼ inches. All to be shaped and molded as shown on the plans.

TRANSVERSE FRAMES.

To stand square to the base line, as marked on the plans, and spaced 24 inches between centers, and formed of Z bars 5 by 3 by 3 inches of 12 pounds per foot, the lower ends to be split up to the turn of the bilge, and opened out to form the main and reverse bars of the frame; the main bars to be cut off against the longitudinal angles on top of flat keel plates, and the reverse bars to butt against the vertical keel plate; the reverse

bars on each side before and abaft the machinery space, where required to be connected together by $2\frac{1}{2}$ by $2\frac{1}{2}$ inches of 6 pounds per foot angle straps, about $2\frac{1}{2}$ feet long, passing through the vertical keel, holes being cut in the latter for this purpose. Between the main and reverse bars from frame 36 to frame 72, inclusive, floor plates 12 pounds per square foot, and before and abaft these points 10 pounds per square foot floor plates will be worked to make the floors generally 20 inches deep next the vertical keel plate, to which they will be connected by angles $2\frac{1}{2}$ by $2\frac{1}{2}$ inches of 6 pounds per foot, these floor plates to be lightened with holes as shown on the midship section, except at the transverse watertight bulkheads. In order to avoid any twist in the bars or floor plates and make plain work, also to provide all possible space for the fastenings of the outside planking, the floor plate may be worked in the bosom of the reverse bar and on the back of the main bar, as may be directed by the superintending officer. Within the engine and boiler spaces, angle bars $2\frac{1}{2}$ by $2\frac{1}{2}$ inches of 6 pounds per foot will be worked to form double reverse bars, the lower ends on alternate sides of the vessel to pass through the vertical keel plates about 16 inches, serving as butt straps to the reverse flanges of the Z bars, the upper ends to extend out to about 1 foot above the head of the floors. Under the engine the floors will be increased in depth sufficient to connect direct by means of suitable angles with engine bedplate and thrust bearing, and will be worked in one piece if practicable; if composed of more than one piece, the butts to be strapped and riveted as required for the vertical keel plates; and where saddles are required under the boiler, these floor plates will be made of sufficient depth and shape to form them, and may also be thickened up to 14 pounds per square foot, if so directed. All these deep floors to be scored or punched out for the passage through of the continuous bars on top of the longitudinals and vertical keel, also for flat keelson plates.

All floors of whatever depth, weight, or location, where it is consistent with the strength required, will be lightened by means of holes cut in them, as shown on the plans or as may be directed.

Forward and abaft the machinery space double reverse angle clips $2\frac{1}{2}$ by $2\frac{1}{2}$ inches of 6 pounds per foot, will be worked in wake of the angles on top of longitudinals to give additional fastening. Intermediate frames will be worked under the engine where absolutely necessary, and elsewhere as may be required, to give the local support necessary. At the transverse water-tight bulkheads an angle bar 3 by 3 inches of 6 pounds per foot will be substituted generally for the ordinary frame, to connect the bulkhead to the outside plating, planking, etc. The main transverse bulkheads, as at the forward and after ends of the boiler compartment, and at frames Nos. 16, 21, 24, and 31, and elsewhere as may be directed, will have double angle bars connecting same to the outside plating or planking. A vertical strip, 14 pounds per square foot, will be worked on the outside of the frames at all transverse bulkheads, and to project about 3 to 4 inches on each side of the frame, to provide room for fastening of wood planking, etc. These bars are not to pierce the longitudinals or other fore and aft work.

At the extremities of the vessel the frames, where necessary, may be formed of $2\frac{1}{2}$ by $2\frac{1}{2}$ inches of 5 pounds per foot angle bars and $7\frac{1}{2}$ pounds per square foot bracket plates, substantially connected to the stringers, plating, planking, etc., as required for the other frames.

Limber holes 3 inches in diameter will be cut in all floor plates of the frames except at transverse bulkheads, to allow for flow of water, as shown on the plans.

FLAT KEELSON PLATES.

To be in width 9 inches on each side of the vertical keel, by 15 pounds per square foot; to be tapered at the extremities as may be required, and to extend from frame No. 7 to frame No. 88, and be well riveted to

the longitudinal angles and reverse bars; the plates to be worked in the longest lengths practicable, the butt straps to be on the lower side, double-riveted, and arranged to make a proper shift with those of the vertical and flat keel plates.

MAIN-DECK BEAMS.

To be of angle bulb 6 by 3 inches, of 12⅓ pounds per foot, to have a beam on every frame, all to have a spring of 7½ inches in a length of 32 feet 6 inches; at the extreme ends of the vessel the beams will be reduced in section and formed of angles 5 by 3 inches of 9½ pounds per foot. In the living spaces on the forward and after-berth deck, the ends will be split and turned down 15 inches, with a piece welded in and lightened with holes, and well riveted to the frames. In the engine, boiler, and coal-bunker spaces, also at the after end of the vessel, to be connected to the frames by bracket plates of 10 pounds per square foot. The engine and boiler hatches will be formed of 14 pounds per square foot plates 10 inches deep, thoroughly connected, as approved, by angle bars, etc., to the beams and deck plating.

BERTH-DECK BEAMS.

To be of angle bar 3½ by 3 inches of 6½ pounds per foot, and to have a beam to every frame; to be worked straight, their tops to be 7 feet 4 inches below the tops of main-deck beams at the sides of the vessel, and to be connected to the frames and fore and aft bulkheads by 8½ pounds per square foot bracket plates. The engine hatch will be formed of 14 pounds per square foot plates 7 inches deep, and thoroughly connected, as approved, by angle bars, etc., to the beams, bulkheads, deck plating, etc.

Additional framing will be worked under the dynamo room, also short beams and other framing under the steps of the masts, where required to give the necessary support, as indicated on the plans or as directed.

FORECASTLE AND POOP DECK BEAMS.

To be of angle bar $3\frac{1}{2}$ by 3 inches of $6\frac{1}{2}$ pounds per foot, with a beam to every frame; all to have a spring of $7\frac{1}{2}$ inches in a length of 32 feet 6 inches; the ends to be split and turned down 10 inches, with a piece welded in and securely riveted to the frames. Special framing will be worked at the bow to afford proper support to the forestays, connecting same to the stem casting, as indicated on the plans.

BEAMS TO STOREROOMS AND BELOW BERTH DECK.

To be of angle bar 3 by $2\frac{1}{2}$ inches of 6 pounds per foot, and placed where shown on the plans; worked straight, and to cut off against the fore and aft bulkhead, and connected to the latter and to the frames of the vessel by bracket plates of 8 pounds per square foot.

LONGITUDINALS.

There will be three longitudinals on each side of the vessel, worked to stand square with the outside planking throughout their lengths, and located as shown on the midship section; all to extend as far forward and aft as practicable in order to afford the greatest longitudinal strength; no two longitudinals on the same side will butt on the same frame, and the continuous double angles on the inner edges will be worked in the longest lengths practicable, their butts to be well shifted, suitably strapped, and double-riveted; these angles will be 3 by $2\frac{1}{2}$ inches of 6 pounds per foot. There will be tie plates on the outside of the frames opposite each longitudinal, to which they will be well riveted, as shown on the cross section; the bilge plate takes the place of the third longitudinal tie plate; these tie plates to be 10 inches wide by 14 pounds per square foot, and to extend for the whole length of the longitudinals and one frame space beyond, to be worked in the longest lengths practicable, the butts to be in the middle of the frame space and shifted clear of each other, with straps on the inside $\frac{1}{16}$ inch thicker than the plates and to be double-riveted, the rivets to be flush

on the outside. Where the tie plates sheer up forward and aft, to be connected to the bilge plates by double-riveted butt straps; and where the longitudinals extend forward and abaft the bilge plates, the tie plates will be carried on as before required.

The first and second longitudinals will be 12½ pounds per square foot, the outer 10 pounds per square foot, all formed of intercostal plates, the lower edges flanged to rivet to the outside tie plates, etc., and the upper edges to extend 3 inches above the top of the reverse frames, to which they will be connected by double continuous angles, as shown on the midship section. If the height of engine bedplate renders it desirable to increase the depth of the first longitudinal on each side sufficient to connect direct with the engine bed and thrust bearing throughout the engine space, in order to save weight, it will be done; care must be taken, however, to make continuous the strength of the longitudinal by tapering the plates from height of engine bed down to the ordinary depth of the longitudinal plate through three or more frame spaces. Above the reverse bars these deep plates may be lightened with holes, if consistent with the strength required, also to afford ready access to examine the framing and plating of the vessel. The first longitudinal from the keel on each side will have *two limber holes 2½ inches* in diameter, cut low down, as shown on the midship section, in every frame space or room between two frames. *Limber holes 2 inches* in diameter will be cut in a similar manner in the second longitudinal on each side, and *1½-inch limber holes* will also be cut in the third longitudinal on each side.

MAIN-DECK STRINGERS AND PLATING.

The stringer plates to be in width amidships 42 inches of 17½ pounds per square foot and gradually reduced in weight to 15 pounds at the ends of the vessel by 30 inches in width, and broadened out under the 6-pounder guns, as shown on the plans; to be worked in lengths of about 20 feet, the butts to be double-chain-riveted, with straps on lower side, and all to make good shift

with the butts of the outside plating, to be connected on the upper side to the sheer strake on each side between the poop and forecastle decks by a continuous angle bar 3½ by 3 inches of 9 pounds per foot, worked in the longest lengths practicable, the butts covered by suitably riveted straps. At the after end of the forecastle and the fore end of the poop decks, this angle will be turned in, and if practicable worked continuously on the reverse flanges of the frame bars under the poop and forecastle decks; staple angles 3 by 3 inches of 7 pounds per foot will be worked where directed to connect this stringer and plating to the outside plating under these decks.

All this work to be well calked and made thoroughly water-tight, and under the poop and forecastle decks to be filled in between the frames with white pine or cement, as may be directed, sloping on the top to throw the water onto the deck plank. At the after end of the vessel to be filled in between the stringers with 12½ pounds per square foot plating; and at the bow between the stringers with 15 pounds per square foot plating, as shown on the plans. Plating 10 pounds per square foot will be worked under the steam steering engine and galley inclosure, also under the windlass, wash rooms, water-closets, refrigerators, engineer's workshop, and around the masts as indicated on the plans. To be filled in between the stringers on each side, and the poop and forecastle decks, with 5 pounds per square foot plating, and to be connected to the stringers, tie plates, and to each other by single-riveted edge strips worked on the upper side.

All this work to be well calked and made thoroughly water-tight.

Tie plates 12 inches wide of 10 pounds per foot will be worked on each side of the hatches, etc., as indicated on the plans; to be worked in long lengths, all butts to be double-chain-riveted, with straps on lower side.

BERTH-DECK STRINGERS AND PLATING.

The stringers on the ends of the beams to be 8½ pounds per square foot by 20 inches wide, except where

broadened out to form the bottom of the coal pockets, as shown on the plans; at the bow and stern of the vessel to be filled in between the stringers with 5 pounds per square foot plating. To be connected to the outside plating in the coal bunkers by intercostal angles 2½ by 2½ inches of 5 pounds per foot, also to the reverse flanges of the frames by a continuous angle 2½ by 2½ inches of 5 pounds per foot, worked in long lengths and suitably strapped. Over the trimming tanks and ammunition rooms, 2½ by 2½ inches of 5 pounds per foot staple angles will be worked to connect these stringers to the outside plating; and elsewhere as may be directed, to be filled in between these angles, where directed, with Portland cement, and all to be made thoroughly w ater-tight. The plates to be worked in lengths of about 20 feet, the butts to be double-riveted, with straps on lower side, and arranged to make good shift with the butts of the outside plating. The plating forming the top or roof of the passage between the engine and boilers to be also 8½ pounds per square foot, and connected to the berth-deck beams by angle clips on upper side, 2½ by 2½ inches of 5 pounds per foot, as indicated on the plans.

Tie plates 10 inches wide of 8½ pounds per foot will be worked on each side of the hatches, as indicated on the plans, with straps on lower side; 5 pounds per square foot plating will be worked to hatches, etc., as indicated, and the plating in the dynamo-room and wardroom water-closets and urinals to be 10 pounds per square foot.

The plating under mast steps to be 8½ pounds per square foot.

POOP AND FORECASTLE DECK STRINGERS AND PLATING.

The stringers to be 16 inches wide, except where broadened out over the 6-pounder gun sponsons, by 8½ pounds per square foot, to be worked in lengths of about 18 to 20 feet, with double-riveted butt straps on lower side, and the butts to be well shifted clear of those in the outside plating; to be filled in between the stringers

at the bow and stern with 5 pounds per square foot plates, as shown on the plans. Eight and one-half pounds per square foot plates to be worked under the capstan, bitts, around the masts, anchor davits, and across the midship ends of these decks as required. Five pounds per square foot plates to be worked at hatches, scuttles, and other openings as directed. Tie plates 10 inches wide by 8½ pounds per square foot to be worked on each side of the hatches, etc., as shown on the plans; to be worked in long lengths with double-riveted butt straps on the lower side. The bounding angles connecting the stringers to the outside plating, etc., to be 3 by 2½ inches of 6 pounds per foot; all to be well riveted to the beams, plating, etc.

PLATING TO STOREROOMS, ETC., BELOW BERTH DECK.

To be of 7½ pounds per square foot, connected to the outside tie plates, etc., where practicable, and bulkheads by staple angles 2½ by 2½ inches of 5 pounds per foot, and to the reverse bars of the frames by continuous angles of same size and weight, all to be made water-tight by calking, and filling, where directed, in between the angles with the best Portland cement. A water-tight manhole to be fitted in the floor of each room to give access for cleaning and painting the hull below. Great care will be taken with all these rooms to make them thoroughly water-tight.

BREASTHOOK.

To be formed by a continuation of plating on the beams below the berth deck and forward of frame No. 7, where this plating will be 10 pounds per square foot, lightened with holes, and connected to the frames, plating, etc., by 2½ by 2½ inches of 5 pounds per foot angle bars, as shown on the plans.

TRANSVERSE WATER-TIGHT BULKHEADS.

To be located where shown on the plans, the bottom strake to be 10 pounds per square foot, the middle portion 8½ pounds, and the upper strake 7½ pounds per

square foot, all to be lap-jointed, lap-butted, single-riveted, and stiffened by vertical angle bars 3¼ by 2 inches of 5⅓ pounds per foot, spaced about 2 feet apart, those to the deep bulkheads at the boilers and engine to be 3½ by 2½ inches of 7⅓ pounds per foot. The angles for taking the decks to be double where required, and the bars connecting the bulkheads to the outside plating, planking, and longitudinal bulkheads, etc., will also be worked double, to be 3 by 3 inches of 6 pounds per foot. The bulkheads at the ends of the coal pockets in the fire room will be of 8½ pounds at the bottom and 7½ pounds per square foot plate at the top, all the bulkheads to be carefully calked and made thoroughly water-tight. Additional stiffeners to be worked to these bulkheads wherever required. The stuffing-box bulkhead at frame No. 88 to be not less than 10 pounds per square foot.

COAL BUNKER AND OTHER FORE AND AFT BULKHEADS.

The fore and aft bulkheads forming the coal pockets abreast the boilers to be of the dimensions and shape as shown on the plans, the berth-deck stringers forming the bottom, and to which they will be connected by 3 by 3 inches of 7 pounds per foot angles; the sides to be of 8½ pounds per square foot plating worked flush on the outside, the butt and seam straps to be on the inside of the pockets and double-riveted; to be stiffened by angle bars 3 by 2½ inches of 5 pounds per foot, worked on the inside and placed about 2 feet apart; the upper ends of these angles may be bent to connect with the flat side of the angle-bulb deck beams, and 14 pounds facing plate forming the boiler hatch, to which they will be well riveted.

The fore and aft bulkheads to the coal bunkers and passage abaft the boilers to be located as shown on the plans, the bottom strakes to be 10 pounds per square foot, the middle portion 8½ and the upper 7½ pounds per square foot; all to be lap-jointed and single riveted, the butts to be strapped and double riveted. The lower edges to be connected to the reverse bars of the frames by angle

bars 3 by 3 inches of 7 pounds per foot, worked on the outside of the bunkers, the upper edges connected to the main-deck plating by 2½ by 2½ inches of 5 pounds per foot angles, and to be worked around the beams where required. These bulkheads to be stiffened vertically by angle bars 3 by 2½ inches of 5 pounds per foot, spaced 2 feet apart, 7½ pounds per square foot bracket plates worked to connect the stiffeners to the berth-deck beams, as required; all these bulkheads to be well calked and made thoroughly water-tight. The center longitudinal bulkheads forward, between the ammunition rooms, will be constructed and stiffened similar to the other fore and aft bulkheads, and to be made thoroughly water-tight.

A railway will be constructed in the coal bunkers and passages, as shown on the plans, and provided with two coal cars for the proper transfer of coal.

OUTSIDE PLATING.

To be worked as shown on the cross-section and profile inboard plan. Above the main-deck molding and forming the sides of the forecastle and poop, to be 12½ pounds per square foot. The hammock berthing between the forecastle and poop decks on the outside, and below the upper molding, to be of 10 pounds per square foot; all below the main-deck molding to be of 14 pounds per square foot, all to be worked lap-jointed and single-riveted at the edges and double-riveted at the butts, with straps eleven and one-half times the diameter of the rivets; all butt straps to be of the same quality, but $\frac{1}{16}$ inch thicker than the plates they connect, and to have the fiber in the same direction as that of the plates. The butt straps to the inside strakes to be of the whole breadth of the plates, those to the outside strakes to extend only between the edges of the adjacent inside strakes; the plates to be in lengths of 18 to 20 feet, and all the butts to be as nearly as possible in the middle of the opening between the frames, and there are to be in all cases not less than two plates between butts vertically over each other. All plates ending on the stem

and stern frame to be double-riveted or tap-bolted thereto as directed; 12½ pounds per square foot plating may be worked around the stern if so directed by the superintending officer.

For a length of about 114 feet amidships, i. e., from frame No. 25 to frame No. 82, an additional sheer strake of 14 pounds per square foot will be worked on the inside, as shown on the midship section, double-riveted butt straps to be fitted to both thicknesses of plating, the laps of this sheer strake to be double-riveted.

Solid liners of the same thickness as the adjacent plates are to be fitted between the frames and the outside strakes of the plating; the liners at the water-tight transverse bulkheads are to extend on each side of the frame angles sufficiently to take two additional rows of rivets on each side, the rows not to be in line with the rivets in the edge fastenings of the plating.

All laps, butt straps, and faying surfaces of the plates to be cleaned from rust before being worked.

The edges and butts to be planed and accurately fitted, and all joints to be calked in the most careful manner, metal to metal; no canvas, red lead, or any other substance inserted in the seams, except by permission of the superintending officer.

All holes cut through the plating or planking must be kept well clear of the frames, butts, and laps, and placed between the frames; *reenforcing plates* will be worked to outboard delivery, injection valves, and at other openings in the bottom, etc., wherever required or directed. The whole surface of the outside plating to be thoroughly cleaned of the scale formed in manufacture by immersing each plate in a bath of diluted hydrochloric acid, or by some other approved method. The use of a drift punch will not be permitted.

BILGE STRAKE.

A 14 pounds per square foot bilge strake will be worked on each side where shown on the plans, to be 30 inches wide for a length of about 60 feet amidships, then to taper gradually and sheer up at the ends to 15

inches wide. To be worked in lengths of 18 to 20 feet, the edges and butts planed and fitted with double-riveted butt straps on the inside between the frames; the fore and after ends to be connected in a similar manner to the outside plating; all to be well riveted to the frames of the vessel.

DIAGONAL PLATES.

Diagonal plates will be worked on the outside of the frames where shown on the plans, to be 12 inches wide by 14 pounds per square foot, the upper ends to be connected to the outside plating by double-riveted butt straps where the diagonal straps meet between the frames of the vessel; the lower ends to be connected in a similar manner to the bilge strake.

OUTSIDE PLANKING.

The planking will extend from the keel to a sheer line as shown on the plans, to be in height on the stem 17 feet 3¼ inches, amidships at frame No. 50, 16 feet, and at the stern 19 feet 3½ inches above the bottom of extension of the false keel. All the planking to be of Puget Sound fir, as may be directed, to be worked to lay the grain flat ways on the frames, etc., and all to be in one thickness as shown on the plans; and except the garboard strake to be 5 inches thick on the frames of the vessel, and reduced over tie plates and plating as the thickness of same may require to make fair work; the upper edge of the top strake to be protected by a beveled angle bar 3 by 3 inches of 7 pounds per foot worked from stem to stern, and to be well riveted and calked water-tight to the outside plating. The lower edge of the rabbet on the keel to be 7 inches above the bottom of this main keel, and in depth not less than 3 inches, the garboards to be 7½ inches thick next the keel and 5 inches at the outer edge by 12 inches wide amidships; the planking may be gradually reduced in thickness from 15 to 20 feet abaft the stem and forward of the sternpost down to the ends of the vessel to 3 inches in the rabbet and 3½ inches for the lower strakes.

The plank on the bottom to be about 10 inches wide amidships and on the sides about 9 inches, reducing in width forward and aft as may be necessary to make fair work. The garboard strake butts to be not less than 5 feet clear of the scarfs of the main keel, and those in the garboard on the opposite side The planking to be worked in lengths of 50 to 60 feet, and all to be thoroughly seasoned, and free from sap, knots, wane, rents, and other defects, and worked with the heart side to the frames, etc.; the butts to be in the middle of the space between the frames, and where there is no outside plating, to be underlaid with butt plates of 14 pounds per square foot worked as wide as the plank, and to extend from frame to frame, to which they will be well riveted, the rivets to be flush on the outside, and where the plank may have a tendency to strain off, the butt plates may be increased in thickness as directed. The butts of the planking to be carefully arranged, well shifted, and to have not less than three strakes of plank between butts vertically over each other in the same frame space, and not closer fore and aft than 6 feet; step butting not to be allowed. The planks to be well coated with a mixture of red and white lead as approved, where they come in contact with the steel or other metal surfaces.

The fastenings to be of bronze bolts and nuts, or rolled naval brass, as may be directed, and if formed of brass to be made of 62 parts best selected copper, 37 of Silesian zinc, and one of tin, and to stand a tensile stress of 22 tons per square inch, with an elongation of 10 per cent in a length of 2 inches, and to be capable of being bent cold to an angle of 40 degrees without showing crack or fracture. The bolts to be $\frac{15}{16}$ inch diameter in the shank, reduced to $\frac{7}{8}$ inch over the thread end, the heads to be about $1\frac{9}{16}$ inches diameter, and sunk in below the surface of the plank about $\frac{7}{8}$ inch, compressing the wood about $\frac{1}{8}$ inch when set up on the flanges of the frames or plates, with a nut bearing on a thin iron washer with a hemp grommet well saturated in a mixture of red and white lead, and

worked under both washer and head of bolt; the shank under the head of the bolt, or the head as may be approved, to be so formed as to prevent it turning when the nut is being hove up; the recess over the head to be filled with Portland cement, or plugged in approved manner as may be directed. Where the planks are reduced in thickness and width at the ends of the vessel, the bolts will be reduced to ⅞ inch and ¾ inch, as may be directed.

All planking 9 inches wide and over to be double-fastened; all under 9 inches to be double and single fastened alternately; all butts to be double-fastened; the butts of the wider plank to be treble-fastened at special places where directed by the superintending officer. The bolt holes for the bolt heads to be enlarged with a doweling machine as approved. Bronze tap bolts as directed to be worked where required to the stem and sternpost castings. All this work to be done in the most careful and workmanlike manner.

After the fastenings are all completed and the vessel calked, the whole surface of the planking will be planed off fair and smooth, and well coated with paint or some approved composition as may be directed.

MOLDINGS OUTSIDE.

There will be two continuous solid iron, half-round moldings 3 by 1½ inches, one at the top of the sheer strake and the other near the top of the hammock berthing; similar moldings will be worked to the poop and forecastle decks, as shown on the plans. Particular care will be taken to work these moldings to a fair and true sheer line as marked on the plans, and to be well riveted to the sheer strake and angle bars, as shown on the midship section.

STANCHIONS.

To be of wrought-iron tubes, with heads and heels, except where hereafter mentioned or directed, welded in solid and firmly secured to the beams, etc.

Under the poop and forecastle deck beams, to be about 2¼ inches in diameter by about ⅛ inch thick, placed as near as may be in the center line under the forecastle to support the weights above; those under the poop deck in the cabin to be located next the fore and aft bulkheads, and elsewhere so as not to obstruct the passageways.

Under the main-deck beams, to be about 2½ inches in diameter by $\frac{3}{16}$ inch thick on the forward berth deck, to be placed generally in the center of the vessel, under the windlass, steam-steering engine, and galley, and to be well stanchioned; those on the after berth deck to be located back of the fore and aft bulkheads in the staterooms as far as practicable; great care will be taken in placing these stanchions, also particularly to maintain a continuous line of support as near as may be by stanchions below the berth deck extending to the framing of the vessel. *In the passages between the boilers*, solid stanchions, in order to have them as small as possible, to be about 2¾ inches in diameter, or as may be directed. *In the engine room*, tubular stanchions will be placed where shown on the plans, or where practicable, to support the berth-deck beams, particular care to be taken to well stanchion the forward part of the after berth deck where it extends forward of the bulkheads below. Between the engine room and boiler room, the vertical angles stiffening the sides of the passage may be extended up on each side of this passage to the main-deck beams to form stanchions for this part of the main deck. Special care will be taken to provide ample support under the heels of the fore, main, and mizzen masts, by means of angle bars and stanchions as approved.

Under the dynamo room additional stanchions as may be required will be worked to give the necessary support.

Stanchions below the berth deck forward, also below the forward platform deck, to be placed generally in the center of the vessel, and to be tubular, by about 3 inches in diameter.

The chain lockers to be well stanchioned to give ample support, also arranged to facilitate the cleaning and painting of the vessel whenever required.

All stanchions will be arranged in general, as near as may be, to provide for a continuous line of support, and to facilitate this below the berth deck, **T** shapes 3½ by 3 inches of about 10 pounds per foot may be worked extending over two or more beam spaces, and connected to the beams in substantial manner by angle bars, as approved.

HAMMOCK BERTHING.

To be of the dimensions and shape as shown on the plans, the outside plating or bulwark forming the outside to be 10 pounds per square foot, the top plating to be 8½ pounds per square foot, and the plating on the inner side to be 5 pounds per square foot, all the plating to be worked flush with butt straps on the inside of berthing. Frames formed of angle bars 2 by 2 inches of 3½ pounds per foot, and well riveted to the deck stringer, will be worked 2 feet apart or over every main-deck beam; solid 5 pounds per square foot plates lightened with holes, as approved, will be worked to every fourth frame, or 6 feet apart, except to the gangways, coal and ash chutes, freeing ports, and in vicinity of boat davits, where these plates will be solid 8 pounds per square foot, and larger angles worked if so directed. A continuous 2½ by 2½ inches of 5 pounds per foot angle bar will be worked to connect the bottom edge of inner berthing plate to the deck stringer, all this work to be well calked and made thoroughly water-tight. Continuous angle bars 2 by 2 inches of 3¼ pounds per foot will be worked on the inner side of the berthing, at the wood moldings, as shown on the plans; these moldings to be of Puget Sound fir, 3 by 3 inches, and molded and secured in substantial manner to the angles and plating. Berthing boards or strips, as approved, to be worked on the sides and bottom for the hammocks, etc., to rest on. All necessary eyebolts and other fastenings for hammock cloths and

other purposes are to be provided and fitted, and to be of brass where directed.

GUTTER WAY ON MAIN DECK.

To extend from the after end of the forecastle aft on each side to the poop deck as shown on the plans, the outer angle bar being 2½ by 2½ inches of 5 pounds per foot, and the inner bar 2½ by 2½ inches of 6 pounds per foot, and placed to form a gutter way 10 inches in width, including the angles, as shown on the plans.

These gutters to be flush-riveted, well calked, and made thoroughly water-tight. Wood or iron gratings to be fitted over the gutters where directed.

FREEING PORTS.

To be of the dimensions, number, and location as shown on the plans, and fitted with shutters on the outside, same thickness as the plating, and fitted with brass hinges on the upper side, also provided with fastenings to hold in place, open or shut, on the inside. Two more additional ports will be cut and fitted in a similar manner if directed by the superintending officer.

ENGINE, BOILER, AND SHAFT SUPPORTS.

To be made of steel plates and angles as directed, and of sufficient strength to bear without yielding all strains brought upon them, and care at the same time to be taken that access is secured to all parts of the vessel for cleaning, painting, etc. The 12-pound floor plates may be thickened up to 14 pounds if so directed, to form the boiler saddles, and to be further supported by fore and aft braces as approved.

HOLES IN BULKHEADS FOR ENGINEER'S PIPES.

All holes in water-tight bulkheads, flats, decks, etc., for the passage of steam or other pipes to be cut and made water-tight around the pipes in an approved manner as may be directed.

WATER-TIGHT DOORS AND MANHOLES.

To be fitted in the bulkheads where shown on the plans, the plates of the doors to be of the same weight per square foot as the bulkheads of which they form a part, and care will be taken to have the door frames as light as consistent with the strength required.

The hinged doors to the lower bunkers will each be fitted with a small sliding door in the lower part about 18 by 24 inches, as shown on the plans. The doors in the passage to engine room forming the air lock to be fitted with round, thick, clear glass in their upper parts about 10 inches in diameter. Manholes to be cut where shown on the plans, and as may be directed, and to be fitted with approved water-tight covers, and the frames or coamings to be raised from 2 to 3 inches above the plating.

WATER COURSES.

To be cut in the longitudinals, transverse frames, and elsewhere as may be directed, and to be as low down as practicable.

SCUPPERS (MAIN).

To be in number and location as shown on the plans, or as may be directed. The main pipes to be made of cast steel, diameter in the clear 6 inches, the upper ends to be flanged to connect to the underside of the main-deck stringer, to which they will be riveted, and the lower ends connected in a similar manner to the outside plating about 12 inches above the mean-load water line, as marked on the plans, and above the berth-deck stringer. A flap valve will be worked inside of each pipe near the lower end, also a brass screw plug will be fitted to facilitate cleaning, and a lip piece of composition to be worked on the outside of the planking, to throw the water clear of the side of the vessel. Care will be taken to work the pipes between the frames and as close out to the outside plating as possible; and all the connections to be made thoroughly water-tight. The pipes to be suitably strapped to the

frames or plating of the vessel and protected where necessary by casings of wood, as directed. The scuppers to the poop and forecastle decks to be fitted and in number as may be directed. The scuppers to the manger to be not over 3 inches in diameter and fitted in a similar manner.

ASH CHUTES.

There will be one ash chute on each side, located in the hammock berthing where shown on the plans, or as may be directed, and made of cast iron, to be 12 inches diameter in the clear at the top, and 13 inches in the clear at the lower end, near which it is to be enlarged and fitted with a flap valve and chain to prevent the inrush of water. The pipes to be not less than $\frac{7}{8}$ inch thick and made in two parts, if necessary, and flanged to connect together, by bolts and nuts, the upper part to be riveted to the main-deck stringer plate and provided with a hopper in the hammock berthing, the lower end to be permanently attached to the hull plating, a flushing pipe to be connected to each hopper and fitted as directed, and a composition lip piece to be worked on the outside of the planking to throw the ashes clear of the side of the vessel. The hoppers to be built of plates and angles, and fitted with hinged covers as approved, also shutters as approved to close over the openings. These chutes to be thoroughly supported and connected by suitable brackets, etc., to the deck framing, bulkheads, etc., as required.

FIXED COAL CHUTES.

Fixed coaling chutes, four in number, to be built and located on the forward berth deck, as shown on the plans, to be 18 inches in diameter and worked from the top of coal bunker and plating of the berth deck to the underside of main-deck plating, to be made of 5 pounds per square foot plates and connected to the plating of the decks by angle rings $2\frac{1}{2}$ by $2\frac{1}{2}$ inches of 5 pounds per foot; all to be well calked and thoroughly tested as directed, and made perfectly dust tight.

PORTABLE COALING CHUTES.

Portable coaling chutes to be in number and location as shown on the plans, or as may be directed; to be made of plates about 8 pounds per square foot, the upper end to fit against the plating of the hammock berthing, with flanges worked on the bottom and sides to slip into dovetailed rabbet strips worked on the plating for this purpose; the lower end to be shaped to fit into the coaling scuttle in the deck with a 3 by $2\frac{1}{2}$ inches of 6 pounds per foot angle worked around to fit on top of the deck plank, with a rubber strip secured to the bottom of angle, and not less than four screws fitted around in the angle, as may be directed, to fasten same into the rim of the scuttle, screw-holes to be worked in the latter for this purpose to insure tightness when the screws are hove up. On the outside opening a shutter will be fitted, the sides to be formed of 8 pounds per square foot plates, and to close in the berthing, and fitted with brass hinges and approved fastenings to hold same when closed, also when opened at the proper angle for coaling, forming a partial hopper for this purpose. These coaling chutes to be about 20 inches long by 18 to 24 inches high, and it is intended in building these portable coaling chutes that provision be made for storing them when not in use inside the hammock berthing.

CHAIN LOCKERS.

To be of the dimensions and location where shown on the plans, the bottom and sides to be of 10 pounds per square foot plates, connected together and stiffened vertically by angle bars 3 by $2\frac{1}{2}$ inches of 6 pounds per foot, and by half-round 3 by $1\frac{1}{2}$ inch bar stiffeners worked on the inside as shown on the plans; the bounding angles to be $2\frac{1}{2}$ by $2\frac{1}{2}$ inches of 5 pounds per foot; 3-inch limber holes will be cut in the bottom of each locker, portable iron gratings will also be fitted to the bottoms, and provision made for securing and slipping the cables by shackles or eyebolts as directed. The beams supporting the bottom will be 3 by 2 inches

of 6 pounds per foot, bracketed and stanchioned in a substantial manner, and access provided, as shown on the plans, for examining, cleaning, and painting the vessel under these lockers.

TRIMMING TANKS.

These tanks will be formed by the hull proper and located as shown on the plans, the forward tank extending from the transverse bulkhead at frame No. 7, to the stem, and up to the berth-deck plating; the after tank to extend from frame No. 88 aft and up to the storeroom flat, and berth-deck plating abaft frame No. 95.

These tanks to have the bottom and sides well coated with the best Portland cement or other approved composition so as to cover the planking and metal completely; the tops to be covered with coal tar as directed. To be fitted with sluice valves and all necessary connections for draining to the suction pipes of the pumping system, etc.; also fitted with flooding cocks for filling; all valves and cocks to be worked from the deck above, and approved means provided for indicating whether the valves are open or closed. Each tank to be provided with a water-tight manhole or scuttle to give access for cleaning and painting, etc.

CEMENT.

At the extremities of the vessel in the trimming tanks, and at other places where more than the ordinary bulk of cement is required, to be first given a thin coat of cement, and when this is dry to be filled in with coke, and liquid cement is to be poured on repeatedly till the whole mass is solid and impervious to water.

A thin coating of cement or other approved composition may be worked on the inside of the hull planking and plating in the engine and boiler rooms, shaft alley, and elsewhere as directed, to protect the inaccessible portions of the plating, etc.; and care to be taken to work only sufficient cement to carry the water up to the limber holes as cut low down in the longitudinals, floor plates, etc.; and every effort will be

made to have the weight of cement as small as possible, and great care must be taken to have all plates, angles, planking, etc., thoroughly cleaned before applying the cement.

HATCHES ON BERTH DECK.

The coamings to the hatch to the hold to be formed of angle bulb 7 by 3 inches of 18¼ pounds per foot, welded in one piece with the corners rounded, and of the size shown on the plans, and well riveted to the deck framing and plating; a small angle about 1⅛ by 1⅛ inches of 1½ pounds per foot to be worked around on the inside about 2 inches below the top to form a ledge for the gratings or hatch covers; also fitted with hatch bars and locks or other approved fastenings; the coamings to the hatches to the general storeroom and bread room to be built and fitted in a similar manner. The remaining hatches on this forward berth deck to have coamings of white oak, or other hard wood as directed, not less than 5 inches wide by 3½ inches thick at the edge of hatch, and tapered down at the outer edges to the thickness of the deck plank, and all well bolted to the deck framing and plating to resist calking; to be of the dimensions and location as shown on the plans, all to be provided with wood covers, flush with the tops, and fitted with brass sunken handles; also hatch bars and locks or other approved fastenings as may be directed. The hatches in the after berth deck will be built and secured in a similar manner except that the coamings, covers, etc., will be flush with the top of the deck plank; the fittings and fastenings to be as directed. The engine hatch on this deck to be 14 feet wide by 25 feet 2 inches long in the clear; and after the engine with its moving parts is in place, as many beams on a level with the berth-deck beams as may be practicable and desirable for the support of the engine-room platform grating, will be worked in between the coamings of this engine hatch, and to be so fitted and secured as to be readily taken out when required by the engineers.

HATCHES TO PLATFORM.

To be fitted with water-tight covers in an approved manner as directed by the superintending officer.

HATCHES AND SKYLIGHTS.

The hatches on the main deck forward of the foremast to be of the size and location as shown on the plans and formed of 10 pounds per square foot plates with rounded corners, and secured to the deck framing and plating by angle bars $3\frac{1}{2}$ by $2\frac{1}{2}$ inches of 6 pounds per foot, the plates to be in height 9 inches above the top of the deck plank, and fitted on the outer top edge with $1\frac{1}{2}$-inch half-round bars, and on the inside, about 2 inches below the tops, with $1\frac{1}{4}$ by $1\frac{1}{4}$ inches of 2 pounds per foot angles, to support the gratings; appropriate fittings to be secured to these coamings for the attachment of tarpaulins as directed. The coamings to the after companion hatch, to the forward berth deck, also to the wardroom companion, and to the two wardroom skylights, to be constructed in a similar manner, except that these coamings will be 18 inches in height above the top of the deck plank; the coamings to the boiler, fire-room, and engine hatches, to be in height 30 inches above the top of the deck plank, and built in a similar manner; provision will be made in the boiler and fire-room hatches for metal covers and gratings as required by the engineers. The wardroom skylight on this deck to be sunk below the bottom of the gratings, and built of mahogany or other approved hard wood, as may be directed; to be glazed with thick clear glass, protected by heavy brass rods set in independent frames; all to be properly fitted with brass hinges and brass quadrants to keep in place at required angles when open.

The coamings to the hatches on the forecastle deck to be built and fitted as required for those immediately below them on the main deck.

The dimensions of all hatches and skylights, in the clear, to be as marked on the plans.

The lower part or base of the skylights and companion way on the poop deck to be formed of 10 pounds per square foot plates, and secured to the deck plating, etc., by $3\frac{1}{2}$ by $2\frac{1}{2}$ inches of 6 pounds per foot angle bars as required for the forward hatches, the plates to be 12 inches in height above the deck plank, but with 2 by 2 inches of 4 pounds per foot angles worked around on the outside at the tops to form a ledge for the frames of the skylights and companion to rest on, and to which they will be secured in a substantial manner. The skylight frames to be of mahogany or other hard wood, as directed, and fitted with double-thick clear glass, and to be protected by heavy brass rods set in independent frames. The hinges to be of brass, also to be provided with brass quadrants to keep in place at any required angle when open. The circular skylight aft to be of brass, and fitted with wheel and screw in the center for raising and lowering the top from below; also glazed with thick, clear glass, and protected by heavy brass rods, as directed.

The cabin companion to be of mahogany or other hard wood, substantially secured to the top angles as required for the skylights, to be paneled inside and out, with proper moldings, etc., as may be directed, and fitted with the necessary brass work where required.

The boiler hatch as framed for the passage of the boilers at the main deck to be 16 feet wide by 12 feet fore and aft in the clear, the beam at the forward end being worked to give this length, as shown on the plans, the hatch being formed by 14 pounds per square foot plates 10 inches deep, and secured to the deck beams and plating by angle bars $3\frac{1}{2}$ by $2\frac{1}{2}$ inches of 6 pounds per foot; intermediate framing will be worked in this hatch as shown on the plans, to be taken out when required for the passage of the boilers.

The engine hatch to be 8 feet wide by 19 feet 9 inches long fore and aft in the clear, otherwise to be built as required for the boiler hatch. After the engine is in place, three beams will be worked in this hatch between the coamings, as shown on the plans,

and fitted to remove when required. The skylight frames to this engine hatch to be of mahogany or other hard wood as approved, to be divided into a suitable number of sections, and glazed with thick, clear glass, to be protected by heavy brass rods set in independent frames, all to be properly fitted with brass hinges and brass quadrants to keep in place at required angle when open.

CANOPIES.

The canopy frames to the companion hatches on the forecastle deck and to the after companion to the forward berth deck to be of galvanized-iron gas pipes, and so fitted that they can be easily removed. The canopy to the wardroom companion to be of brass, to be made as light as consistent with the strength required, and so fitted that it may be easily removed.

The canopy to the engine-room hatch to be built and shaped as shown on the plans, to be of heavy brass piping. All fittings for securing the tarpaulin covering to be of brass and fitted complete as directed.

PLANK SHEERS OR WATERWAYS.

On poop and forecastle decks to be of the best selected Puget Sound fir, or other approved wood, in thickness not over 4 inches by 7½ inches wide, or wider as may be directed, to allow for nibs of the deck plank, and coved out on inner edge down to thickness of deck; to be fastened through the stringer plates with ⅝-inch galvanized-iron bolts with nuts on lower side, all worked as required for the deck-plank fastenings.

A chock piece, 5½ inches square and of hard, durable wood that will hold fastenings, to be worked all around the top of the plank sheers of the poop and forecastle decks as shown on the plans, and to be fastened with ¾-inch galvanized-iron bolts with nuts set up on bottom of deck stringers, the fastenings to be worked as required for the deck planks and spaced as may be directed.

DECK PLANK.

The plank of the several decks to be of the specified thickness when completed, and the undersides to be well fitted to the plating and thickly coated with red lead or other approved material; the edges to be planed fair before the plank is laid, and to have a proper seam for calking.

The whole of the material to be of seasoned fine-grained Puget Sound fir, cut to lay "vertical grain," free from knots, sapwood, and other defects. The running plank to be worked in lengths of 50 to 60 feet, and each strake of plank is to be secured by galvanized-iron bolts and nuts, the heads to be plugged and the plugs set in white lead; and in order that the bolts may be properly placed relatively to the edges of the strakes, the holes will be drilled in the plating and beams after the strakes are laid off. Where there is no plating the butts of the deck plank will be underlaid with plates, from 8½ to 10 pounds per square foot, according to location, and sufficiently long to properly stow the butt fastenings only, the plates to be of the same width as the planks and to be riveted to the beams.

The whole of the decks are to be planed fair on the upper side; but this work is to be deferred as long as possible, so as to facilitate delivering the vessel to the Government with the decks in perfect condition.

Poop and forecastle deck planks to be not over 4½ inches wide by 2½ inches thick in the thinnest part, except in wake of the capstan, where it will be made thicker and leveled up as required; to be fastened to the deck plating, beams, etc., with flat-headed screw bolts not less than ½ inch in diameter, and distributed in the planking as directed. A hemp grommet, saturated with red lead, will be placed between the deck plating and the head to make the bolt water-tight in the deck plating.

Main deck, the planks to be not over 6 inches wide or less, as may be directed, by 3 inches thick; the thickness, however, will be increased and leveled up where required in wake of the windlass and where subject to

the chafe of the chain cables and under the 6-pounder guns; to be worked and fastened in all respects as directed for the forecastle deck, except that the bolts will not be less than $\frac{9}{16}$ inch in diameter; to be $\frac{5}{8}$ inch in diameter where the plank is more than 3 inches thick.

Berth-deck planks, both forward and abaft the machinery space, to be in width not over $4\frac{1}{2}$ inches, and not over $2\frac{1}{2}$ inches thick in the thickest part when finished; to be worked and fastened similar to the forecastle deck, the fastenings to be distributed as directed.

WINDLASS BED.

To be formed of plates 10 pounds per square foot on the top and bottom of the beams, and connected by suitable angles; the space between the plates to be filled in solid with Puget Sound fir; the fastenings of windlass to pass through all and set up on lower side of plates.

WINDLASS AND CAPSTAN.

The windlass and capstan to be of an approved pattern; the windlass to be complete with steam engine, etc., and made to take $1\frac{1}{2}$-inch chains, also drumhead to be fitted on each end of shaft as shown on the plan to take hawser when required. The capstan to be supplied with two sets of 6-foot bars.

CHAIN PIPES.

Chain-pipe castings as approved, of cast iron, to be placed in the decks where shown on the plans, and secured in a substantial manner to the plating, etc., to be about $11\frac{1}{2}$ inches diameter in the clear, and fitted with appropriate plate-iron covers with handles as approved.

CHAIN COMPRESSORS.

Will be fitted under the main-deck beams, as approved, to be of wrought iron, and provided with cleats, tackle blocks, etc., complete for use.

BOW STOPPERS.

There will be two bow stoppers, located where shown on the plans, and of an approved pattern, and well secured to the deck plating, etc., which may be here worked double for this purpose, care to be taken as to the height, etc., in fitting the wood chocks under the stoppers, that they will effectually stopper the chain when required; eyebolts to be fixed to the beams for working the levers, etc., as directed.

HAWSE PIPES.

To be of cast iron, one on each side, as shown on the plans, diameter of casting in the clear 11½ inches; to be well rounded both on the inner and outer parts where the chain passes over, and not less than 1⅝ inches thick in the thickest part; the outer lower part of lip to be well thickened and rounded to throw the chain clear of the vessel; angle rings 2¼ by 2¼ inches of 7 pounds per foot to be worked around the outer edge and tap-bolted to the casting; also to be well fastened to the outside plating and deck framing and plating. To be fitted with all necessary plugs, blind and riding bucklers, buckler bars, etc.; also bucklers of approved pattern to be fitted and hinged on the outside. The bucklers and buckler bars to be stowed as directed. A doubling plate of 14 pounds per square foot will be worked on the inside of the hull plating through which the hawse pipes pass, to give additional support to the fastenings.

MANGER.

To be formed by working an angle bulb about 6 by 3 inches across the deck plating at frame No. 6, and to be well secured through this plating and beam below; the deck plank will be omitted forward of this manger.

ANCHOR DAVITS.

There are to be two anchor davits, one on each side, as shown on the plans, to be of the best wrought iron, 6¼ inches in diameter in the thickest part, tapering at the head and heel to 3¾ inches, and to be fitted with

the necessary eyes for cat and fish blocks and guys neatly forged on, also fitted with brass stuffing boxes where they pass through the forecastle deck, at which place reenforcing plates of 10 pounds per square foot will be worked and well riveted to the deck plating; the socket castings on the gun deck for the heel of the davits to be of cast steel or cast iron as directed, and fitted with brass bushing, and steel disk for end of davits to rest on, and thoroughly bolted to the framing and plating of the vessel.

BILLBOARDS AND ANCHOR FITTINGS.

The billboards to be located where shown on the plans and formed of 10 pounds per square foot plates and $2\frac{1}{2}$ by $2\frac{1}{2}$ inches of 5 pounds per foot angle bars, as approved. To be fitted with all necessary trips, cleats, triggers, and eyebolts for securing, stowing, and letting go the anchors, complete as may be directed.

SPONSONS FOR 6-POUNDER GUNS.

To be in size, shape, and location as shown on the plans, and formed by the continuation of the outside plating, which will have a doubling plate worked on the inside for the extent of the sponsons; this doubling plate to be worked to form a rabbet for the shutters to the gun ports. To be connected to the stringer plates of the main, poop, and forecastle decks by angle bars as worked to connect these stringers to the outside plating. To be supported on the outside by bracket plates of 10 pounds per square foot where required, and flanged plates of $12\frac{1}{2}$ pounds per square foot, shaped as required, and riveted to the outside plating under the sponsons. The port openings to be 21 inches high in the clear, and in length, fore and aft, as shown on the plans, to obtain the range of fire indicator. The shutters to be formed of one thickness of plating, hinged on lower side of the port, shaped as required, and to have not over three shutters to each sponson, and all fitted to fasten securely on the inside, and to close water-tight as directed; means to be provided for raising the shutters as approved.

RINGBOLTS IN DECK.

Forward of the windlass in wake of the chain cables there will be two ringbolts on each side formed of 1½-inch iron with rings about 5½ inches in diameter, and to be fastened to the beams and deck plating or framing in a substantial manner as directed.

MOORING AND TOWING BITTS, AND CHOCKS AND PIPES.

There will be two pairs of double-headed bitts located on each side of the poop and forecastle and main decks, as indicated on the plans, to be about 10½ inches in diameter, and made of cast steel or cast iron as approved. All the bitts to have wood bedpieces, as approved, fitted under them, and the fastenings to the bitts to pass through and set up on lower side of the stringer plate. Cast-steel chocks, in number and location as directed, to be secured to the stringer plates, etc., by bolts and nuts in a substantial manner as approved, and to be neatly rounded on the inside for the passage of the hawsers, and rollers to be fitted in such as may be required.

WARPING PIPES.

To be in number and location as shown on the plans or as may be directed, to be made of cast steel or cast iron as approved, and fitted to the plating, etc., and secured in a substantial manner; and to be neatly rounded on the inside for the passage of the hawsers, etc., to be fitted with shutters on the outside, with brass hinges at the top, and provision made for fastening the shutters open or closed.

BOW CHOCK.

A white-oak or other hard-wood chock will be built around the bow, to be in height 21 inches above the top of the deck, and worked parallel with it, as indicated on the plans, to be 6 inches wide at the base and 4½ inches at the top, and secured to the deck stringers by ⅞-inch bolts set up with nuts on lower side of stringer plate. Pin rails and fair-leaders to be worked on the inside as may be directed or shown on the plans.

COAL SCUTTLES.

To be 18 inches diameter in the clear, and in number and location as shown on the plans; to be fitted with solid covers with flush handles, and to be turned off and made to fit practically water-tight; also fitted with iron grating, and both so designed that they can be opened from below as well as above deck at all times, so as to serve as escape scuttles from the bunkers.

Iron rounds to serve as ladders will be worked to all bulkheads which are sufficiently close to the scuttles to admit of passage through same.

DECK LIGHTS,

Circular glass deck lights to be put in the decks where shown on the plan or directed, to give light and air to the rooms below. The frames to be of brass and fitted with brass grating in the top side flush with surface of the deck plank, the bars of the grating to be ¼ inch thick by ⅞ inch deep, and the meshes to be in the clear not less than 1⅛ inches; the frames for the glass to be hinged below the deck to swing down. The glass to be not less than 1¼ inches thick by 10 inches in diameter, clear of casting and well bedded in rubber, and all made thoroughly water-tight. The frame is to be fastened to the deck plank with brass screws. A brass drip cock will be fitted to carry off any water that may collect above the glass. There will be four holes, each ¾ inch in diameter by 1 inch deep, worked in the flanges of the deck plates for the reception of brass castings, which will be made to fit in same and be secured to lower ends of the copper pipes or funnels forming ventilating shafts to the rooms below; these pipes to be properly secured and made to ship and unship easily, and to be furnished and fitted wherever required to give light and air.

WATER TANKS.

There will be four water tanks located at the after end of the hold, to be of the dimensions called for by the plans in order to pass them through the hatches in

the decks above—two to have a capacity of 893 gallons each, and two to have 790 gallons each ; there will also be two water tanks placed at the after end of the engine room, as shown on the plans—one to have a capacity of 755 gallons and the other 496 gallons, making a total of 4,617 gallons of fresh water.

All tanks to be made of 10 pounds per square foot plate iron, and fitted with manholes, proper pipe connections to pumps, etc., as required, and all to be properly stowed and secured in place where shown on the plans.

MAST STEPS AND RINGS, ETC.

The steps to be of cast steel about 1¼ inches thick by 5½ inches deep, to be suitably ribbed and flanged, shaped to receive the mast heels, and well secured to the framing and plating.

The mast rings or partners to be formed on the main deck of 3½ by 2½ inches of 6 pounds per foot angles, worked around on top of the deck plating, and to allow for about 3-inch wedges ; a partner plate of 10 pounds per square foot to be worked at the bottom of these beams, to which it will be secured by suitable angles with 2½ by 2½ inches of 5 pounds per foot angle rings on lower side ; a 14-pound per square foot plate will be worked around on the inside of the upper and lower angles, to which it will be flush-riveted to form a backing for the mast wedges. The mast rings on the forecastle and poop decks to be built in a similar manner, but with a slight reduction in the size of the angles and thickness of plating, as may be directed.

PIN RAILS, ETC.

The pin rails to be fitted abreast of each mast, as shown on the plans, to be formed of mahogany or other approved wood, and fitted with brass chafing plates, belaying pins, bolts, rods, and fittings complete, as directed. The stanchions or braces to the pin rails to be secured to the deck plates, etc., in a thorough manner. The pin rails for the main rigging will be secured in substantial manner to the inner side of the hammock

berthing. The pin rails to the chock on bow of forecastle deck to be located where shown on the plans and fitted as directed.

JACK RODS.

Jack rods will be fitted to the masts, as shown on the plans, those to the main and mizzen mast to be of brass, and to the foremast of galvanized iron; the rods to be in diameter 1¾ inches, and the stay bolts securing same through the deck-plank plates, etc., with nuts on lower side, to be not less than 1¼ inches diameter in the shank. Eyebolts to be worked around the masts, in the decks, etc., where directed.

BOWSPRIT BITTS.

To be formed of 10 pounds per square foot plates and 2 by 2 inches of 3½ pounds per foot angle bars, and made to serve as a ventilator to the berth deck; to be 9 by 14½ inches each, out to out, and worked 9 inches apart to house the heel of the bowsprit, and to be brought together above the bowsprit and connected to the forecastle-deck plating and opening into the ventilator above same, the lower ends to be curved and connected to the athwartship bulkhead below on the berth deck, which will be cut out in the bitt openings to allow for passage of fresh air; sliding shutters, as approved, to be fitted to close over these openings, when desired. The bitts to have angle bars, as approved, worked around them on the main-deck plating, also to be connected in similar manner to the forecastle-deck plating; all this work to be well calked and made thoroughly water-tight; all to be worked where shown on the plans.

LAMP LOCKER.

To be located where shown on the plans, and fitted up with metal shelving, wire lockers, etc., complete, as required. The doors to be of thin steel plate and to be fitted with brass hinges and locks, etc., as may be directed.

FIREMEN'S AND CREWS' WASHROOMS.

To be built and located where shown on the plans, and fitted with bowls, bath tubs, wire lockers, clothes hooks, etc., complete. A lift pump to be provided and fitted in each complete; also connections made for both hot and cold water supply. The deck plating to be cemented and tiled in an approved manner, and fitted with a 1½-inch drainpipe at the floor to carry off waste water, with a lip piece on the outside to throw the water clear of the vessel.

STEAM-STEERING ENGINE INCLOSURE.

To be in size and location as shown on the plans and formed of 7½ pounds per square foot plates, to be connected to the main-deck and forecastle-deck plating by angle bars as directed, and stiffened vertically by 2½ by 2½ inches of 5 pounds per foot angle bars, worked about 2 feet apart; there will be two or more doors of proper size to provide for the passage of the engine, etc., and to be located where necessary, the doors to be fitted with brass locks and hinges, as approved. From two to four round brass-framed side lights will be fitted in the bulkheads where required, the frames to be hinged and fitted with clear glass lights 12 inches diameter, clear opening, the glass to be from ½ to ¾ inch thick.

GALLEY INCLOSURE.

The galley inclosure to be in size and location as shown on the plans, and formed of 1-inch mesh galvanized-iron wire, and fitted with doors as approved; the bounding angle at the base to be 3½ by 2½ inches of about 7 pounds per foot, well riveted to the deck plating; there will be no deck plank worked in this inclosure, but the plating of the galley floor to be given a thick coating of cement, in which a pavement of approved material and design will be worked, and on which the galley or range will be placed and secured, suitable fastenings being riveted to the plating, etc., for this purpose, as directed; the cement to be worked down to allow the water to drain into a scupper pipe of 1½-inch galvanized iron as worked on each side in the

galley room extending down and out between the deck beams through the outside plating with lip piece on underside; to be fitted with water-tight plugs on the inside. The galley or range will be of an approved pattern, with cooking capacity for about 75 persons, and provided with all the necessary and usual cooking utensils, copper boilers with faucets, etc., complete for service, as directed.

This galley inclosure to be fitted with two dressers, tables, two sinks, shelves, racks, lockers, hooks, metal coal box on port side, it being intended to use the forward port coal pocket for galley coal; the drainpipes to the dishwashers to be fitted with plugs, and the pipes to be lead out through the ship's side as directed; there will also be provided a hand pump for drawing fresh water from the tanks, and a hand pump for salt water. All wood fittings to be of white ash; only such attachments of wood as are necessary to secure the fittings will be allowed. The galley smoke pipe will extend up and be secured to the chart-room roof and railing to same, as shown on the plans.

ENGINEERS' WORKSHOP.

No deck plank will be worked in this room, the floor plating to be well coated with cement; the room to be fitted up with racks, shelves, and vise bench, and as directed; the bulkheads forming this room on the main deck to be of wood, and the door to be made to slide inside the room, with appropriate fittings, fastenings, bumpers, etc., as directed.

REFRIGERATORS.

To be ceiled on the sides, also top and bottom, and furred off from the angles and beams of the vessel, and packed in between with such material as may be directed; to be fitted with ice boxes and inner doors of wood made in two halves, hung with brass hinges, and to have brass fastenings, etc.; drainpipes to be fitted as directed. The floor plating in these rooms to be thoroughly cemented before working the ceiling, etc.

PILOT HOUSE, CHART ROOM, AND BRIDGE.

The pilot house and chart room to be of the dimensions and shape as shown on the plans, height in the clear under the beams, 6 feet 6 inches; the coaming plates both at the top and bottom of this house to be of 8½ pounds per square foot; angle around base and against which the deck plank will butt, to be 3 by 2½ inches by 6 pounds per foot; angle around the top outside connecting plates of house to an 8-inch by 5 pounds per square foot stringer as worked around the ends of the beams of the roof, to be 1¾ by 1¾ inches of 3 pounds per foot; the plating in between the coaming plates to be of 5 pounds per square foot run vertically with flush-riveted seam straps on the outside worked in between the coaming plates; the vertical stiffeners or frames to be 2½ by 2 inches of 3½ pounds per foot, spaced generally about 2 feet apart, but so arranged as to not interfere with the windows and doors as shown on the plans; the beams to be of angle bars 2½ by 2 inches of 4⅓ pounds per foot, their ends turned down about 6 inches to form knees on the vertical frames to which they will be riveted; the bounding angles at the outer edge of the top of roof of house to be 1½ by 1½ inches by 3 pounds per foot, a 1½ by ¾ inch half-round molding will be worked all around the house on the outside of this angle, and a galvanized molding as approved will be worked all around as shown on the plans. The margin strake of the planking of the roof to be 2 inches thick by 6 inches wide, to be of Puget Sound fir, and secured to the stringer plates as directed; the planking of the roof to be 1½ inches thick Puget Sound fir of approved width, and well fastened to wood beams of white pine 2¼ inches deep by 1½ inches thick, which will be secured to the flat sides of the angle beams by $\frac{5}{16}$-inch bolts and nuts placed about 15 inches apart.

Scupper pipes.—There will be two on each side, the material and workmanship to be as required; the pipes will be not over 1½ inches diameter in the clear.

The windows and doors to be in number, location, and size as indicated on the plans; all sashes and blinds

to be of cherry, the blinds to be on the inside, the sashes to be glazed with the best plate glass of approved thickness, all to be hung with lead weights on metal chains or cord as approved, the weights to be made to work noiselessly by having grooves in them which will work on hard-wood tongued strips properly secured in the framing; suitable pockets will be formed, also sills, window stops, strips, moldings, etc., complete to the satisfaction of the superintending officer.

Both the pilot house and chart room are to be ceiled or sheathed all around on the inside with tongued and grooved narrow fir, or other wood as directed; furring strips to be worked on the stiffeners for this purpose; panels or sections of sheathing to be worked where required to make examination and repairs back of same and to be secured with brass screws.

The outside doors to be made of wood as directed, and worked to correspond with the outside of the house and fitted with brass hinges and locks, also hooks to hold them open as required.

The bulkhead between pilot house and chart room to be of 1-inch thick beaded, tongued and grooved fir, the sliding door in the same to have brass fitting.

The chart room is to be fitted with a locker seat on the port side about 2 feet wide and 15 inches high, with two or more drawers under it; abreast the end of the desk a locker will be worked, access being had from the top side; the back of the locker seat to be inclined, and the head rail to same and nosing on front edge of seat to be of hard wood as approved; the back to be upholstered with the best leather and hair; a portable leather cushion tufted and filled with hair to be made for the locker seat. A hard-wood, flat-top, cloth-covered desk, as approved, with recess in the center, with drawers on one side and partitions with a door in front on the other side, the desk to be about 64 inches long, 24 inches wide, and 30 inches high, as indicated on the plans, to be constructed; and at a height of about 4 inches above the desk there will be built and hinged a chart board, as large as the available space will permit,

made of 1-inch thick, narrow, well-seasoned fir or pine, appropriately stained on the top and bottom side, the ends to be battened with rim all around and paneled on lower or outside, and to close against a locker built against the bulkhead and fitted with ledge for the charts; all to be neatly finished and strongly constructed, and furnished with all necessary supports, catches, etc., all metal work to be of brass or bronze, as approved.

Pilot house to be fitted up for the reception of the binnacle, also fitted with pigeonholes for flags, shelves, racks, etc., for spy and binocular glasses, speaking trumpet, etc., complete as directed.

Bridge.—A bridge will be constructed by extending the roof of the chart room out on each side for the distance shown on the plans, to be formed by the continuation of the angles and plating, etc., as worked to roof, to be well supported by hollow galvanized-iron stanchions to the forecastle deck, and about 2¼ inches in diameter with solid heads and heels fastened in a substantial manner.

FORCED DRAFT IN FIRE ROOM.

The fire-room hatches above the main deck to be fitted with thin-hinged shutters, also portable shutters where necessary to be fitted, in order that this compartment shall be fairly air-tight to provide for the forced draft.

AIR PORTS.

To be in number and location as shown on the plans, the frames to be of composition, and the glass of good, clear quality, not less than 1 inch thick, and all the ports to be not less than 10 inches diameter in the clear; all to be fitted with rims on the outside for shedding the water, also fitted with drip pipes and brass cocks complete, the lower elbow and section of pipe to be of iron ¾ inch outside diameter. A composition hinged shutter will be also worked on the inside of each air port, with suitable fastenings to same, to afford security in

case the glass in the air port gets broken; this shutter to be fitted to close over the glass port after it is closed and fastened in the port.

VENTILATION PIPES TO SHAFT ALLEY, ETC.

The shaft alley will be ventilated by a galvanized-iron duct 6 inches in diameter, extending from the after end of alley up to and under the berth-deck beams aft and up out at the stern under the poop-deck stringer plate; to be made tight where it passes through water-tight bulkheads. A galvanized-iron ventilator will also be worked where shown on the plans for ventilating the forward berth deck, to be 15 inches in diameter and fitted to connect with the bowsprit bitts.

CEILING IN HOLDS, STOREROOMS, AND COAL BUNKERS.

The ceiling in the holds and storerooms to be generally of Puget Sound fir battens 1⅜ inches thick by from 3 to 4 inches wide, and placed sufficiently far apart to admit of cleaning and painting the frames and plating behind them; to be secured to the reverse flanges of the frames by galvanized-iron screw bolts and nuts, or to furring strips worked to the frames, if so directed. Battens also to be placed upon the athwartship bulkheads of these rooms where directed.

The ceiling to the coal bunkers will be worked in two thicknesses, each 1½ inches thick fir, so laid as to break joints, and to be secured as directed to the reverse bars of the frames and laid tight, the faying surfaces to be well coated with approved paint or composition, and both thicknesses to be calked; this ceiling will extend up to and just above the third longitudinal on each side, where it will be worked out to the outside plating and made tight; above this there will be no ceiling in the coal bunker. A loose flooring of like material to be temporarily secured in the bunkers under each coal scuttle to break the force of the falling coal.

GRATINGS TO AMMUNITION ROOMS, STOREROOMS, HATCHES, ETC.

Portable ash gratings, as approved, to be fitted to the floors of all ammunition and other storerooms below

the berth deck, also in the pilot house, as directed. Ash gratings, as approved, will also be worked to all hatches on main deck forward and forward-berth deck, forecastle deck, and also to such hatches on the after-berth deck as may be directed; hatch bars to support the gratings fitted with approved handles, also locks and bars, or other approved fastenings, etc., to be worked where directed.

WARDROOM.

The fore and aft bulkheads to staterooms to be located where shown on the drawings and constructed of white pine, or other approved wood, and designed without pilasters, but with suitable moldings and caps as approved; the moldings of the panels may be of darker wood if directed. All sections to have stationary blinds in upper part, and panels below; the doors will have fixed blinds in the upper and lower parts.

The bulkheads between the staterooms to be of narrow, tongued-and-grooved, 1-inch thick seasoned pine or fir, and each stateroom will have a berth, the front hinged to turn down, and fitted with drawers and lockers below the berth, and small bookcases at fore end of berth, or elsewhere in the staterooms as may be directed. A small Venetian blind will be arranged in each room to close over the air-port openings on the inside. The space between the beams over the fore and aft bulkheads, and elsewhere as required, to be fitted with bronze-wire mesh for ventilating purposes.

The deck strips to be of yellow pine and secured with brass screws. All drawers, lockers, etc., to be fitted with duplicate keys, and all hardware to be of best quality, locks of brass, knobs and hinges of bronze.

Provision will be made in fitting up the rooms to afford access by removable parts back of berths, lockers, etc., for examining, cleaning, and painting the frames and plating of the vessel. The wardroom dining room to be in length fore and aft in the clear, 12 feet; the bulkheads and other joiner work to be worked to correspond to the wardroom. A locker seat and berths to

be built on each side of the dining room, as indicated on the plans; the fronts worked and molded to correspond to the other joiner work of this room, the berths to be in width 30 inches; and the locker seat 17 inches by 15 inches high; the spaces in the locker seat to be divided into sections, and scuttles worked in the top to each; above the back of the locker seats there will be two tiers of drawers in height and two in length under each berth, top of berth or bottom board, above top of locker seat 28 inches; height of permanent berth front above this, 6 inches. In connection with these fixed berth fronts provided for, portable berth fronts 6 inches high will be supplied and fitted ready for use. Appropriate moldings of hard wood, as approved, to be worked where directed. Cushions of the best mohair plush and curled hair are to be furnished for the locker seats, to be about 3 inches thick and in two lengths on each side.

The bulkheads to the rooms forward of the wardroom dining room to be worked to show the same finish, also the casing to the after end of the engine-room hatch, as worked to the wardroom, etc., and made of the same kind of wood as directed; the hardware also to be of the same material and design. The under side of the deck and metal work overhead, also beams, etc., in the wardroom, staterooms, dining room, and rooms forward of same, to be thoroughly coated with cork paint, or other approved nonconducting composition, as directed.

WARDROOM PANTRY.

To be fitted up with drawers, lockers, bins, racks, shelves, hooks, wash sinks, water tanks, pump, supply and waste pipes, plugs, cocks, etc., complete, as may be directed; all hardware to be of brass, the woodwork of white ash or other hard wood, as approved. Steam table to be fitted and to be in size and location as may be directed.

WARDROOM LAVATORIES.

To be located where shown on the plans; to be fitted with bath tubs porcelain-lined, marble-top washstands,

basins, supply pipes for hot and cold water, waste pipes, water tanks, etc., as directed.

WARDROOM WATER-CLOSETS.

To be of earthenware and of the most approved design; the pipes from the closets to be not less than 3 inches in diameter, of wrought or cast iron, as approved, well stayed and protected, and connected to the outside plating and planking just above the water line in a thorough manner, with a lip piece worked around on the underside. Supply and waste pipes to be fitted complete and led where directed. Brass porcelain-tipped clothes hooks, also a shelf and small locker, to be worked where required. No wood ceiling or sheathing, nor deck plank, will be worked in this room; the beams will be plated with 10 pounds per square foot plating, and then cemented and tiled in an approved manner, as directed. The urinals will be of earthenware of the most approved design, and fitted with all necessary supply and waste pipes, tanks, etc., if directed. These urinals and water-closets to be well ventilated.

ARMORY.

To be located where shown on the plans, the reverse bars of the frames to be sheathed and worked as required for the wardroom; to be fitted up with racks, etc., as approved, to stow all the rifles, cutlasses, and pistols intended for this vessel.

EXECUTIVE OFFICER'S OFFICE.

To be located where shown on the plans, and fitted up with shelves and racks, as directed.

ENGINEER'S LOG ROOM.

To be located where shown on the plans, and fitted up with shelves and racks, as directed.

MEDICINE LOCKER.

Located where shown on the plans, and fitted up with shelves, drawers, racks, etc., as directed.

CABIN, STATEROOMS, ETC.

The cabins, staterooms, and other rooms, bulkheads, skylight casings, lavatories, water-closets, pantry, etc., in connection therewith, to be constructed and finished and painted or polished in same manner as specified for the wardrooms; to be of the dimensions indicated on the plans, and the same care to be taken to provide for removable parts for cleaning and painting the hull of the vessel. Locker seats and berths to be built on each side of the forward or main cabin as indicated on the plans, and to be similar in all respects to those specified for the wardroom. As many brass cot hooks as directed will be put up in the cabin. The after cabin will be fitted with locker seat only, as shown on the plans, and provided with cushions as may be directed, and also fitted with a bookcase where shown. The deck plank will not be omitted in any of these rooms. The bath tubs, washstands, water-closets, and urinals will be of the best and most approved pattern, as required for the wardroom; the baths and washstands to be supplied with both hot and cold water. The closets to the stateroom and lavatory to be fitted up with shelves, drawers, clothes hooks, etc., as may be directed. All doors and drawers to be fitted with brass locks and duplicate keys.

Captain's pantry.—To be fitted up as required for the wardroom pantry, including steam tables, etc.

Captain's office.—To be fitted up with book racks, shelves, lockers, etc., as may be directed; the wood to be as approved.

FORWARD OFFICER'S QUARTERS.

To be in location and size as shown on the plans, and constructed and finished complete as required for the wardroom. The space between the after wood bulkhead and the steel bulkhead to be filled in with asbestus. The dish lockers to be fitted up with shelves, racks, etc., as required; also wash sink, water tank, pipes, tables, drawers, etc., complete as usual for pantry fittings, to be supplied and fitted. The wood casing to

the fixed coal chutes to be worked directly against the metal chutes, with cleats at the top and bottom, so as not to occupy any additional room.

STEERING ARRANGEMENT.

The steam-steering engine to be of an approved pattern, and located where indicated on the plans, to be fitted complete, and such spare parts as may be required to be supplied and stowed where directed.

A quadrant to be worked on the rudder stock under the main-deck beams as shown on the plans, to be built up of wrought steel shapes, or made of composition fitted in two sections so as to be taken apart for repairs at any time; to be connected to the steam-steering engine by wire ropes and rods as directed, and lead under the main-deck beams; all sheaves to be as large as practicable, and where the connections pass through the wardroom, etc., to be protected by 2-inch brass pipes, in one length between bulkheads, and to have 1 inch taken out of the tops, and so secured as to be easily and quickly removed; casings to shafts, rods, etc., to be fitted where directed, and forward of the wardroom, iron pipes may be used as approved. The connections are to be kept well off the shells of blocks and fair upon their sheaves by special fair leaders. All rods, shafts, etc., passing through bulkheads or decks, to be fitted with stuffing boxes of brass, made water-tight; brass journals to be fitted in hangers to shafts, etc., and provided with self-feeding oil cups.

The connections between the steam-steering engine and steering wheel in the pilot house to be formed by shafts about 2½ inches in diameter, beveled gear wheels, drums, etc., as required; all geared wheels to be of composition, with machine-cut teeth, and nicely fitted to avoid noise. A wrought-iron spare tiller to be built of suitable size and fitted to ship over the rudder stock down through the scuttle over same in the main deck for this purpose, and made water-tight; the spare tiller to be stowed and secured in the locker of the after cabin. Steering wheels to be also placed on the main

deck forward of mizzenmast, and fitted to operate the steam-steering engine, also to steer by hand when steam engine is disconnected. These wheels to be built of such kinds of hard wood and brass work as may be directed.

Particular care will be taken to make the entire steering-gear arrangement complete and satisfactory to the superintending officer.

SPEAKING TUBES, ETC.

The speaking tubes to be made of brass, with mouthpieces, whistles, stopcocks, and wire gauze diaphragms to be fitted where required; the pipes to be cased where directed. The mouthpieces and whistles to be of an approved pattern. Separate and direct means of communication will be established between the pilot house and all important places, including engine room, ammunition rooms, cabin, search light, galley, and elsewhere as required.

Mechanical telegraphs will be fitted from the pilot house and bridge to the engine room, all fitted with *bells* or gongs as approved; all wires to be protected.

RUNNING LIGHTS.

Fittings and screens to be made and secured for the reception of these lights and located as directed.

WATCH BELL.

A clear-sounding bell of about 140 pounds in weight, with the vessel's name and date engraved thereon, is to be provided and fitted with brass hangings, or as required, and secured where directed.

SOUNDING TUBES.

A sounding tube to be fitted in each compartment or space where directed, and care to be taken to protect the bottom against injury from the sounding rod by fitting a screw plug in the bottom of each sounding rod.

FIGURES FOR DRAFT OF WATER.

To be 6 inches in height and cut in a legible manner on stem and stern, also to be painted on before the

vessel is launched, and to be carefully laid off and to indicate every foot from about 6 feet to 16 feet above the bottom of the keel.

BOAT DAVITS AND CRADLES.

There will be three pairs of boat davits on each side, located where shown on the plans, or as may be directed, those to the steam cutter and launch to be not less than 4 by 5½ inches, to the rowing cutter 4½ inches, and to the whaleboats 3¾ inches; all to be of hammered wrought iron, tapered and shaped, and of required height, and fitted complete with wrought-iron sleeves, etc., and socket castings on the outside, the heel sockets to be worked below the main-deck molding on the outside; also galvanized-iron chain guys, topping lifts, gripping irons, spans, boat spars, with irons for same, galvanized-iron cleats fastened on davits; also fitted with blocks and friction rollers on steel pins, and manila boat falls from 3½ to 2½ inches of required length, all complete as directed. Care will be taken to work thicker plates and angles opposite the boat davits to give the required support, as specified, for the hammock berthing. The steam cutter, sailing launch, and rowing cutters to be stowed in iron cradles to be fitted and well secured to the hammock berthing, and to be in height so that the lower sides of the keels, when these boats are secured for sea in the cradles, will be 18 inches above the top of the hammock berthing. The cradles to be well covered with leather, as approved, also hinged on the outside and provided with stays and braces of wrought iron, as may be directed. The davits to the boats abreast the poop deck may be long enough to lower these boats on to the deck, over the guard rails, etc., if so directed. All fittings, etc., necessary to handle all the boats properly, to be supplied and fitted in approved manner. A pair of port davits will be built and fitted where directed, for the accommodation of the dingey.

HATCH CRANES.

Wrought-iron hatch cranes, as approved, to be fitted to such hatches as may be directed for the proper handling of stores, ammunition, etc.

COAL AND CARGO DAVITS.

To be two in number and about 2½ to 3 inches in diameter, located where directed, and to be in height sufficient to swing bags of coal or other goods over the top of the hammock berthing; to be fitted to unship and to stow against the berthing, or where directed.

SWINGING BOOMS.

Two swinging booms of spruce, each about 26 feet long by 6½ inches diameter, and fitted with all ironwork necessary for the proper working and stowing of same, to be provided and fitted; to have one on each side opposite the fore rigging, and completely fitted with all blocks, ropes, etc., for working same as directed.

LIFE BUOYS AND GUARDS.

Two life buoys of the Franklin type, located where shown on the plans, to be furnished and fitted complete with all guards, guides, pulls, etc., as required.

SIDE LADDERS, SEA STEPS, ETC.

To be fitted on each side of the vessel at the gangways, where shown on the plans, with platform, ladder, and gratings of white ash; also brass guard rails and stanchions, and eyes for manropes. The lower platform to be attached to the ladder and hinged, and the whole to be arranged to trice up by means of davits on side and bail in foot of ladder; all ironwork to be galvanized. The sea steps to be wrought or cast, as approved, and well riveted to the plating, etc.

GANGWAY BOARDS.

Each to be of mahogany or other hard wood as directed, 3½ inches thick, molded as required, placed 30 inches apart, to form the gangway, etc., fastened to the

bulwark, etc., and carved and fitted in approved manner, and brass plates and eyebolts to be fitted where directed. A 10 pounds per square foot door will be fitted to each gangway, to be provided with brass hinges and fastenings complete as directed.

LADDERS TO HATCHWAYS, ETC.

To the fire room and engine room to be of iron, as directed, the remaining ladders to be of white ash, unless otherwise specified. Eyes to be put in the heels of all ladders for manropes. The ladders to the top of the pilot house to be thoroughly secured. Backs to be fitted to ladders where directed, and all companion ways to be provided with stanchions and grab rods, and the steps, where directed, to be covered with india rubber or brass plates, as may be required.

HAMMOCK HOOKS AND BAG RACKS.

For berthing the crew to be of iron as approved and fitted to the main-deck beams forward, also to the forecastle-deck beams, to be in number as directed. Brass hammock hooks, as directed, will also be worked in the cabin and wardroom.

Galvanized-iron piping about 1 inch in diameter will be worked to the reverse bars of the frames to accommodate the clothes bags of the crew as may be directed.

CEILING ON FORWARD BERTH DECK.

For a height above the berth deck of $3\frac{1}{2}$ feet all around, forward of the officers' quarters, Puget Sound fir ceiling battens beaded on the edges and about $1\frac{1}{4}$ inches thick by 3 to 4 inches wide, and placed not less than 3 inches apart, will be worked and secured to the reverse bars of the frames by bolts and nuts as approved; above these there will be no ceiling, but the surfaces of all metal will be well coated with the best cork paint or some other nonconducting material.

SWINGING TABLES AND BENCHES FOR CREW.

To be made of white ash with galvanized-iron fittings, the legs to be hinged; to be in number sufficient to

accommodate the crew, and fitted to be stowed up between the beams as directed. *Mess chests* to be built as required.

WATER-CLOSETS AND URINALS FOR CREW AND OFFICERS.

To be in number and location as shown on the plans, and all water-closets and urinals to be of earthenware or porcelain-lined iron, and designed with water trap to prevent the return of foul air from the discharging pipe. There will be no valve fitted, except the flushing valves, which will close automatically, and to be made exceptionally strong; all to be fitted with flushing tanks. Each closet pipe in the crew's water-closet to be connected to one main discharge pipe on each side of the vessel, about 4 to 5 inches in diameter, and this pipe to be fitted at end opposite to discharge with a nozzle for hose, and for hand and steam connection for cleansing the discharge pipe. The floor under the urinals to be fitted with 1½-inch drainpipe leading to the outside of the vessel, with drip flange on the lower side. The seats in the crew's water-closets to be of ash, and the bulkheads and doors to be of such wood and construction as may be directed There will be no deck plank worked in the crew's closets; the deck plating will be cemented and tiled in an approved manner.

PAINT LOCKER.

The lower storeroom abaft the forward trimming tank will be fitted up for a paint locker and provided with shelves, etc., as may be directed.

PRISON.

To be located where shown on the plans, the floor to be covered with ash gratings, the upper part of the door to be fitted with iron gratings or holes in the door as directed; also fitted with lock as approved.

BOLTS FOR SECURING GUNS.

To be made and fitted wherever required to secure the guns in a substantial manner.

EYEBOLTS IN BEAMS.

Eye or other bolts to be secured to all beams or other framing where necessary for the purpose of removing casks, packages, etc., and for tricing up chain cables, etc., as directed.

OIL TANKS.

Two tanks of galvanized iron, with brass cocks, with locks and keys as approved, filling pipes, etc., to be made and stowed on each side of the bowsprit above the manger, the filling pipes to be lead through the forecastle deck, and fitted with brass screw plugs. The capacity and kind of oil to be marked on the outside.

HAWSER AND HOSE REELS.

Three reels for hawsers, to be built and fitted where shown on the plans. Hose reels will be built and secured where required to stow the requisite quantity of hose.

ENSIGN STAFFS.

Two ensign staffs, one forward, and one aft, located where shown on the plans or as may be directed, and of approved dimensions, to be provided and fitted with all necessary iron work.

PLATFORM FOR 1-POUNDER GUNS.

The 1-pounder guns and mounts will be secured to the top of the hammock berthing where directed, and platforms will be built of ash gratings at the required height above the deck for working the guns, and to be supported as may be directed; also fitted to swing up against the berthing and secured thereto when required.

GUARD RAILS AND STANCHIONS.

The stanchions and rails to same across the fore end of the poop deck to be of brass, those around the sides of this deck, also to and around the forecastle deck, to be of galvanized iron, fitted with a brass ball well secured on the upper end of each stanchion. All to be in height about 2 feet 10½ inches above the top of wood chocks as

worked around these decks, the heels fitted to appropriate castings let in the top of the chocks and secured with brass screws. Brass stanchions and rails of similar design and height will be worked around the top of the pilot and chart house, and bridge; the sockets to be of approved design, and fastened with brass screws. All rails to be about 1 inch in diameter. On the forecastle, abreast the bower anchors, about $\frac{5}{16}$-inch chain, galvanized, may be used instead of the rails, as may be directed, and fitted in approved manner.

AWNING STANCHIONS.

To be of wrought iron, spaced about 8 to 12 feet apart, according to location, and having due regard to the boats as stowed on the hammock berthing; to be fitted to sockets, etc., to be secured on the outside of the berthing, and the upper ends of stanchions to be not less than 7 feet above the forecastle and poop deck plank; those in between these decks and for the main deck to be of such height as to maintain a fair sheer line for the margin rope to the awnings.

DRAINAGE AND PUMPING ARRANGEMENT.

All suction pipes will be worked on top of the reverse frames, connecting through manifolds, as located in the engine room, to the trimming tanks and all watertight compartments below the berth deck, and in turn will be connected to the pumps of the main engine, and to be in diameter as directed.

To have one $6\frac{1}{2}$-inch and two $5\frac{1}{2}$-inch hand pumps of approved pattern, and fitted complete with copper pipes (except within about 3 feet of the bilge, where they will be of galvanized wrought iron), composition screw-down valves, nonreturn valves, sea cocks, etc., and are to be fitted for extinguishing fire. These pumps will connect to the bilge suction pipes, and connected in such manner that the compartments may be freed from water by either hand or steam pumps or by both.

A fire main to be worked nearly the whole length of the vessel, to be about $3\frac{1}{2}$ inches in diameter amidships and $2\frac{1}{2}$ inches at the ends, and charged with water at a

high pressure from the steam pump; all the pumps to be connected with this main and fitted with all necessary nozzles and hose as directed. All valves in the fire room to be of the Ludlow pattern. Lift pumps, in number as directed, for filling cisterns to water tanks, water-closets, lavatories, deck filter tanks, galley, crew's closets, etc., with all necessary copper and iron pipes, are to be fitted; those for fresh water to be tinned. The roses of all bilge suction and injection pipes to be made of zinc, zincked or enameled iron, or other approved material.

If the pipes are of copper the lower portions, which are likely to be immersed in the bilge water, are to be of zinc or other approved material to prevent galvanic action between the copper and steel. Zinc strainers are to be fitted and secured to all openings, Kingston discharge pipes, and elsewhere as directed. All spare gear to be supplied and stowed where directed.

Pipes for flushing the water-closets and supplying the tanks will be so arranged and of sufficient diameter that a steady stream may be kept running through them while the main engine is in motion, if so directed ; the connections with the pumps to be arranged by the engineers.

The discharge from the lift pumps in the closets will connect with these pipes, that the closets may be flushed when the engine is not in motion, or as may be directed. All gearing for working the pumps to be of the most approved pattern, and to be marked and stowed near their work as directed. Where pipes run through bulkheads to be fitted with stuffing boxes as approved. All necessary eye and other bolts to be fitted where directed. Screw caps as approved to hold against the pump pressure to be fitted wherever required.

LUMBER IRONS.

Lumber irons as approved to be fitted to the beams in the hold and elsewhere as may be directed.

ENGINEERS' STOREROOMS.

Both on and below the berth deck. To be fitted with shelves, lockers, racks, bins, etc., as required by the engineers; and all available spaces in the shaft alley and engine room for stowage of engineers' stores and spare parts, will be utilized for this purpose and fitted up accordingly.

DYNAMO ROOM.

To be located where shown on the plans; batten strips to be worked on the reverse bars of the frames as required for the ceiling to storerooms.

Beds for seating the dynamo and engine will be built where required, and care will be taken to work additional framing below the floor, also stanchions as may be necessary to provide sufficient support and to take the fastenings. White-pine closets and lockers to be built as required. Wire matting or ash gratings to be fitted to the floor of this room as may be directed.

AWNING AND SAIL ROOM.

To be located where shown on the plans, and battens to be worked on the reverse bars of the frames as required for the other storerooms; similar battens, with furring strips under them, to be worked on the forward and after steel bulkheads of this room. Gratings to be worked on the floor; also hard-wood rollers to be fitted at the entrance in hatch as directed.

The whole of the steel surfaces of the room to be well coated with cork-faced paint to prevent condensation before any wood work is secured or put in place.

BREAD ROOM.

To be built in all respects as required for the sail room except rollers; the wood bulkhead to be not less than 1¼ inches thick, and the doors to be fitted with brass hinges, locks, etc., as approved; this wood bulkhead, also the ceiling or lining and floor, to be lined with tin or zinc, if so directed.

AMMUNITION ROOMS AND ORDNANCE STOREROOM.

Located where shown on the plans, and made water-tight, in approved manner as required; the floor plates to be $7\frac{1}{2}$ pounds per square foot and to have water-tight manholes worked in them, to give access below for examining, cleaning, and painting; to have portable ash gratings, as approved, on the floors; and the bulkheads to be fitted with battens as required for the other storeroom; the sides of the vessel to be lined up step-fashion agreeable to the outside depth of the ammunition boxes to be stowed there in order to make square stowage; this work to be of white pine or fir, and so secured that it can be readily removed to examine, clean, and paint the frames and plating of the vessel. The entrances to these after rooms over the shaft alley to be lined or not, as may be determined by the superintending officer. The doors to the ordnance locker over the alley to be fitted with brass lock and hinges as approved.

Cork paint to be applied, as specified for the sail room, before any woodwork is secured or put in place.

The ordnance storeroom to be built and fitted as required for the ammunition rooms. All ladders to be of ash. The light boxes are to be of approved dimensions and to be of steel as directed, the glass to be thick, and of good, clear quality, and protected by brass wire screens, shelves, racks, and hooks to be worked in the storeroom as directed.

Arrangements are to be made and fitted for flooding these rooms direct from the sea by means of pipes and valves, the rods for working same to be operated from the berth deck, and means taken on this deck to indicate whether the valves are open or closed; overflow and drain pipes and valves will also be fitted for freeing these rooms, as may be directed.

Holes as approved are to be drilled in the floor plating of these rooms and fitted with brass screw plugs, with suitable covers as directed, to allow the water which may remain below the gratings to run to the bilge. All metal fittings to be of brass, and the hatch

and door fittings to be as directed. The ammunition room on the port side forward of hold, will be utilized, as may be required for the stowage of sail covers, hoods, tarpaulins, bags, sailmakers' stores, etc., and fitted up accordingly; but this must not interfere with utilizing this room for carrying ammunition at short notice as originally provided for herein. These ammunition rooms to be properly ventilated, and where fresh air is drawn from a cowl or other opening, if necessary, it should have a water-tight sliding shutter fitted to it so as to prevent water from getting into the pipes leading to the ammunition rooms in the event of the sea washing over the top side. The exhaust or outlet pipes for foul air should be led up from the top of rooms and brought into the artificial exhaust ventilation-system pipes. The position of inlets and outlets in these rooms will depend somewhat on the stowage of cases or ammunition boxes, etc., in same, but they must be placed as near as may be at opposite ends of the rooms, the outlets to be in the top near passageway, inlet in bottom at opposite end of rooms. The orifices of all exhaust and supply pipes to these rooms to have strong brass water-tight sliding covers fitted over them, of equal strength to the bulkheads, so as to effectually resist fire from explosion from the outside. These brass covers are to be worked from the passage way or other appropriate place next these rooms by means of rods, and to be fitted with indicators near them to show whether the shutters are open or closed.

All pipes communicating with these rooms are to be so arranged as to prevent anything being passed directly from the upper orifices into these rooms; wire gauze to be also fitted over all orifices as directed.

Where the pipes or cowls, for the supply of fresh air or otherwise, are carried above the top side and exposed, the continuity of the pipe should be broken by the insulator of strong vulcanite or wood tubing, not less than 4 feet long, to be fitted outside the ammunition-room compartments. The pipes along which the lightning may travel are to be connected above the vulcanite break to a steel beam or other continuous metal

conductor by which the electric fluid can pass, without interruption, to the sea. Care will be taken with the speaking tubes leading to these rooms, to break the continuity of these pipes in order that they shall not become conductors of lightning, and also that these rooms be kept fireproof and water-tight.

VENTILATION.

In addition to the numerous air ports, scuttles, ventilators, etc., shown on the plans to induce natural ventilation, every advantage will be taken to amply secure this where practicable by natural means; and in order that any vitiated air that may collect may be exhausted from the engine room, shaft alley, forward and after berth decks, and storerooms, etc., below, one or two blowers of the necessary capacity, and separate entirely from the blowers placed in the fire room by the engineers for forced draft, will be placed on the forward berth deck or elsewhere as may be directed, the pipes to be of metal as approved, of the requisite size, and worked under the berth-deck beams where required, and led to the several rooms as directed. Where the bulkheads are pierced by the ventilation or other pipes, all approved means to be used to prevent the flow of water from one compartment to another, automatic valves being fitted where required for this purpose. Brass louvers are to be fitted in the top sides leading into the openings between the frames, the louvers to have light bars, and covers to slide over same to keep out water. Louvers to be fitted between decks, and under those in the top side above the main deck, to ventilate the living spaces, etc. Efficient means will be taken to prevent the ventilation of the hold spaces into the living spaces by way of these louvers. The air-tight bottom is to be fitted directly under each of these louvers so as to cut off all connection between the living spaces and hold; particular care is required in this work. Ventilating pipes or tubes, both horizontal and vertical, to be fitted and led wherever directed for ventilating the hold, store rooms, etc., and to be complete with all necessary casings, louvers, and cowls.

All cowls, air casings, pipes, trunks, etc., for ventilating the vessel are to be fitted complete, those near the compasses to be of copper, and all to be fitted with wheel gearing so they may be easily turned round to the wind.

In case it shall be determined, in order to save weight and space, to utilize one or more of the blowers intended for forced draft, on account of the few occasions these blowers will be required for such work, for purposes of ventilating the vessel, such changes in pipes, valves, etc., will be made if practicable, to enable the blowers to fulfill either one of the requirements when necessary.

MASTS AND SPARS.

All to be of Puget Sound fir, clear of all defects, and worked to the dimensions here given.

	Ft.	In.
Foremast.		
Height above top of main deck	62	10
Bury	7	8
Total length	70	6
Diameter at the main deck	0	18
Rake of foremast 4½ degrees.		
Mainmast.		
Height above top of main deck	63	10
Bury	8	1
Total length	71	11
Diameter at the main deck	0	18
Rake of mainmast 5 degrees.		
Mizzenmast.		
Height above top of main deck	63	8
Bury	7	10
Total length	71	6
Diameter at the main deck	0	16½
Rake of mizzenmast, 5¾ degrees.		
Topmasts, etc.		
Fore and main topmasts, total length, each	40	0
Mizzen topmast, total length	37	9
Bowsprit (steve 19 degrees), total length 32 feet 9 inches, diameter in bed, 18 inches.		

Topmasts, etc.—Continued.	Ft.	In.
Foreyard (arms 21 inches), total length	54	0
Foregaff (pole 18 inches), total length	29	0
Maingaff (pole 18 inches), total length	28	0
Mizengaff (pole 36 inches), total length	26	0
Swinging booms, (two, each), total length	26	0

All spars to be fitted with patent inside iron-strapped blocks, patent sheaves, patent truss to foreyard, also all bands, straps, eyebolts, rods, etc., complete, and such parts galvanized as ordered. The lower masts and gaffs to be fitted with iron guides or tracks, hanks, etc., for handling gaffs and sails; the slides and jaws for ends of gaffs to be of brass. All metal and other work to be furnished and fitted complete, as may be directed by the superintending officer.

STANDING RIGGING.

All to be of the best quality galvanized charcoal iron wire rope, and connected to the masts, chain plates, etc., also to be of such sizes, types, etc., as may be directed.

The head stays to be set up in approved manner on wrought-iron eye plate as worked to the forecastle-deck stringer.

The shrouds and backstays to be set up as may be approved to the chain plates as riveted to the sheer strake. The shrouds to be parceled and served with marline their entire length, also the backstays as approved. Three feet to be left on all ends.

The forestay, jib stay, fore-topmast stay, to be fitted with galvanized-iron hanks.

Three jackstays of $2\frac{1}{2}$-inch galvanized-iron wire rope are to be fitted to the mast, one on each side of track, on which the brail blocks are to slide; to be fitted as approved. There will be four shrouds on each side to the fore and mainmast, and three on each side to the mizzenmast; also two topmast backstays on each side to these masts, together with spring stays and topmast stays as shown on the plan. The bobstays and other stays to the bowsprit to be of chain or wire rope as

directed; all necessary ironwork, rigging, blocks, and fittings of whatever kind to be supplied and fitted to the entire satisfaction of the superintending officer.

All this work and such other parts as are necessarily connected with this standing rigging to be furnished and fitted complete, and in working order as may be directed by the superintending officer.

RUNNING RIGGING.

To be of the best manila rope of the required sizes and lengths, and completely fitted in all respects to the satisfaction of the superintending officer. If directed, chain with suitable iron blocks will be used for throat and peak halyards; the standing parts of the latter may be worked and fitted on spans if so directed.

LIGHTNING CONDUCTORS.

There will be fitted and secured on each mast one lightning conductor of $\frac{3}{8}$-inch copper wire rope, fitted complete, with tips and leaders scored for rigging and seizing as may be directed, and to be in sufficient lengths to reach 6 feet below the surface of the water.

JACOB'S LADDERS, FITTINGS, ETC.

To be provided and fitted as directed; fittings to decks to be of brass as approved.

SAILS AND AWNINGS, ETC.

All sails and awnings, except where otherwise directed, are to be of the best No. 5 cotton duck, and roped with the best bolt rope; all to be fitted complete, the sails with reefs or bonnets, outhaulers, downhaulers, clew ropes, sheets, brails, gaskets, etc. The material for the square sails on the foremast to be as directed, the awnings to be fitted with hooks, lacings, thimbles, eyelets, tackles, crow's feet, halyards, ridgepoles, stanchions, etc.

The awnings are to be set by ridgeropes of 1½-inch circumference galvanized-iron wire through the heads of the awning stanchions, etc., and other fittings to be worked as directed.

Covers for sails, guns, boats, companion ways, skylights, capstan, etc., also for fronts of hammock berthing with approved fittings, are to be furnished, fitted, painted, etc., as may be directed.

BLOCKS AND BOLTS.

Best galvanized iron inside-strapped blocks of approved size and pattern, bolts (clevis, collar, and plain), etc., in sufficient number for conveniently handling sails, boats, anchors, guns, etc., to be furnished with suitable sized rope for falls, etc., including three snatch blocks, one deck tackle, and three watch tackles, etc., all as may be directed by the superintending officer.

ATTACHMENTS FOR RIGGING.

All plates, eyes, eyebolts, shackles, turn-buckles, etc., necessary for securing the rigging to the hull of the vessel to be made and fitted where required, and additional forgings, plates, and shapes will be worked for this purpose wherever required or directed.

ANCHORS AND CHAINS.

There will be two bower anchors, each to weigh about 2,850 pounds, and two 1½-inch stud-link chains of 120 fathoms each, both fitted with shackles at every 15 fathoms and an approved anchor shackle at each end, and two spare chain shackles and one spare anchor shackle. There will also be furnished one sheet anchor of 2,850 pounds, and one sheet chain, 120 fathoms of 1½-inch wire. The chains are to fit the wildcats perfectly, and are to be tested according to admiralty rule and a certificate of test furnished from the proper authority. There will also be furnished one stream anchor of about 700 pounds, and three kedge anchors of 400, 300, and 200 pounds respectively, and to be stowed where directed. The bower anchors to be fitted with bands and rings for catting and fishing at the same time. Chain hooks as approved will also be furnished and in number as required, together with the other necessary chain tools.

CALKING DECKS, BOTTOM PLANKING, ETC.

The whole of the calking to be done in the most workmanlike manner, as directed, and the greatest care taken to not strain the fastenings; the decks, bottom planking, and roof of pilot and chart house are to be calked agreeable to "Brooks's improved method of calking." Should the final calking be deferred until the vessel is completed, it is to be understood that the decks are to be kept perfectly tight during the work of construction, and the final calking will be done and the deck edge reconciled in workmanlike manner, in order to deliver the vessel to the Government with the decks, etc., in first-class condition.

VARNISHING DECKS.

To be varnished or otherwise coated as may be directed by the superintending officer, to protect them during the progress of the work.

CLEANING DURING CONSTRUCTION, ETC.

All dirt and chips, etc., to be cleaned out daily during construction, and no water is to be allowed to remain in the vessel, and particular care must be taken that all foreign matter is removed, and the parts thoroughly cleaned before the application of any paint or cement.

To be thoroughly cleaned on delivery.

CLEANING, GALVANIZING, ETC., AND PAINTING STEEL AND IRON WORK.

All steel and iron work is to be carefully scraped, scaled, and cleaned before being painted. The tie plates of the longitudinals, bilge plates, diagonal plates, keel plates, outside plating, the floor plates of frames, and other plates, as may be directed, are to be treated as follows for the purpose of removing the black oxide or scale:

The plates before being taken in hand for working are to be immersed for a few hours in a liquid consisting of 19 parts of water and 1 of hydrochloric acid. The plates should be pickled on edge and not laid flat

When the plates are removed from the dilute acid, both surfaces are to be well brushed and washed to remove any scale which may adhere to them, and then bathed with some alkaline solution to neutralize any acid that may remain on the plates, and,be thoroughly washed, by a hose with fresh water, as directed. The plates on removal from the water should be placed on edge to dry.

All fastenings for ceiling or holds, staterooms, etc., to be galvanized.

The outside plating to be coated when directed with not less than three thick coats of an approved composition. At a suitable time before delivering the vessel to the Government to be docked, the outside above the wood planking to be cleaned, and two more coats of an approved antifouling paint applied. The wood planking to be painted or well coated with some approved composition, as may be directed, before the metal sheathing is put on. In addition to the foregoing, the whole of the vessel, both inside and out, and all iron or steel surfaces covered with wood, also the wood planking, are to have one or two coats of the best oil paint, of such color, etc., as the superintending officer may direct.

All iron or steel work in living spaces, storerooms, holds, and ammunition rooms to be painted with cork paint to prevent condensation.

Especial care will be taken that the paint applied to the outside plating before launching is given ample time to harden, and that it adheres firmly to the plating.

PAINTING, GRAINING, AND POLISHING WOODWORK.

All the woodwork, other than hard wood, is to be painted in the best manner, with not less than three coats of the best oil paint, of such color, and with such portions varnished or grained, as may be directed. Cabin, wardrooms, and staterooms, also those on forward berth deck, to be finished as may be directed. The cabin and wardroom skylights to be finished in hard wood or oil, as directed.

The masts and spars, and such other woodwork intended to be kept bright after being cleaned, to be given three or more coats of the best spar varnish or composition, as directed.

METAL SHEATHING ON BOTTOM.

The whole of the bottom up to a line of 2 feet forward, 1 foot amidships, and 18 inches aft, above the mean load line as marked on the plans, to be sheathed with copper as approved, ranging in weight from about 24 to 28 ounces; the thicker metal to be worked on the bow for a distance of about 30 feet from the stem, also for a depth of at least 4 sheets all around the vessel at the water line, and on the bottom and sides of the keel, also aft for a distance of about 10 feet forward of, and to the sternpost and counter. Before the sheathing is put on, the bottom will be well coated with a mixture of turpentine and tallow, or some other approved composition. The copper to be well dressed up to the planking, etc., and the laps hammered down smooth; all this work to be done in a thorough manner as directed.

GENERAL FASTENINGS, QUALITY OF MATERIAL AND WORKMANSHIP.

All rivets are to be of steel and must conform to the requirements as stated in these specifications, those not less than ½ inch in diameter to be made of a conical form under the head.

The breadth of the edge strips, laps, and butt straps, where not specified, and the size, form, and pitch of rivets, and angles of countersink, to be such as to insure perfect water-tightness where required, and as approved by the superintending officer.

The riveting is to be executed in a careful and workmanlike manner, the rivets thoroughly fitting the holes, and the greatest care is to be taken in punching to prevent unfair holes. All such holes are to be reamed out before riveting, and a rivet suitable to the increased size of the hole is to be inserted.

The countersinking is also to be carefully done.

All rivets to be laid up, and all rivet work to be completed in the manner required. Special care must be

taken not to burn the rivets when heating, and, if necessary, rivet furnaces which will avoid burning the rivets must be used.

The superintending officer may require any holes to be drilled and bolts turned for them, or he may substitute bolts for rivets, or make other changes of this kind whenever he may think desirable, without additional charge.

The workmanship throughout to be of the most thorough character, 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.

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

Care will be taken that no unsightly work is allowed.

TESTING FORGED WORK.

All shackles, ring and eye bolts, stopper bolts, eyes, hooks, slips, or triggers, all blocks, anchor davits, chain plates, boat davits, etc., are to be tested by strain as approved. On no account are jump welds to be made in important forgings. If any forgings or other iron or steel work should be sublet by the contractor, the subcontractor shall be informed by the contractor that such forgings, etc., are to be done under the immediate supervision of the superintending officer.

TESTING WATER-TIGHT COMPARTMENTS, TANKS, ETC.

The trimming tanks at the ends of the vessel, also the water tanks and other water-tight compartments to be tested by filling the compartments with water, and any defects discovered to be made good, refilled, and tested until found perfectly water-tight.

TESTING RED LEAD.

The contractor is to provide crucibles, etc., for testing the red lead, and all red lead must be thoroughly tested and proved satisfactory by the superintending officer before being used.

CARVING ON BOW AND STERN.

Carvings in hard wood will be worked and secured on the outside of the bow and stern, the designs to be as approved, and to be painted, and with such parts gilded as may be directed.

GROUNDING.

Care will be taken that the vessel does not at any time take the ground; should this occur before completion, the vessel must be docked, thoroughly examined, and all injury thereto repaired to the satisfaction of the superintending officer and at the expense of the contractor.

SUPERINTENDING OFFICERS' OFFICE.

A suitable office will be furnished by the contractors for the use of the superintending officers, and to be suitably heated when required.

INSPECTION.

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

RECORD OF WEIGHTS.

All parts of the vessel and appurtenances thereof as fitted will be weighed by the contractor in the presence of the superintending officers before being placed on board, and no part of the material will be placed on board without being so weighed to the satisfaction of the superintending officers.

DRAWINGS.

The contractor will make and furnish the Treasury Department a complete set of blue prints of the various plans and details of the hull and fittings before the work on each part is commenced. Within one month after the completion of each part, tracings will also be furnished both in whole and in part, and will be in such detail as would enable the entire hull and appurtenances thereof to be duplicated without additional drawings. Detail drawings will be made to a scale of not less than 1½ inches to the foot. General plans of the vessel will be made to a scale of ⅜ inch to the foot.

GENERAL CONDITIONS.

The intent of these specifications for hull and fittings is declared to be that, with the exception of boats, outfits, provisions, and ship's stores (which will be supplied by the Government), the contractor shall provide at his own cost all apparatus, material, and labor necessary to the completion of the vessel ready for service as a revenue steamer, whether the same are described in the specifications as shown on the drawings or omitted from one or the other, or from both, or improperly described or shown on both.

The specifications and drawings are to be strictly followed, and not departed from except by direction or authority of the Secretary of the Treasury, or on minor matters by the Chief of the Revenue-Cutter Service, so far as they relate to the hull, and the Engineer in Chief as regards the steam machinery when the same shall be considered as of benefit to the Government, and so long as the general style and character of the vessel and its arrangements are maintained such changes are to be made by the contractor without extra compensation therefor, and any dispute arising respecting the true meaning or intention of the specifications and drawings, or omissions or imperfections in them, shall be referred to the Chief of the Revenue-Cutter Service or Engineer in Chief, whose decisions shall be final and conclusive. If the contractor should vary from the specifications or plans, except by direction or authority

as before named, the Government shall be at liberty at any time, before or after the completion of the work, to order such improper work to be removed, remade, and replaced, and all work destroyed by the alteration made good at the contractor's expense.

All material and workmanship to be first class and satisfactory to the superintending officers.

The vessel must be wholly completed, as before specified, and all parts cleaned.