Apl. 1910

The general description and some of the actual technical data of two large trans-pacific liners "Tenyo Maru" and "Chiyo Maru"

for which I was primary responsible for the design of Ship department, but not on those of Decorative work, Engine department and Electrical department. For the general description the pamphlet which was written and compiled by me for the Works for distribution amongst the friends and engineering papers is made use of, but the parts dealing on the subjects for which I was not responsible are crossed out for the distinction.

BUILT
BY

MITSU BISHI DOCKYARD AND ENGINE WORKS, NAGASAKI.

(AUGUST 1908.)

NEW TURBINE-DRIVEN TRIPLE SCREW PACIFIC LINER "TENYO MARU"

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The completion of the new Pacific liner "Tenyo Maru," first of the three sister ships for Messrs The Toyo Kisen Kaisha (Oriental Steamship Company of Japan) is undoubtedly an event of first importance in the Shipbuilding and Engineering industry on the Pacific Coast, as the vessel is not only the largest ship yet built in the East, but is the first Steamer in the Pacific waters fitted with Turbines, and the Mitsu-Bishi Dockyard & Engine Works who designed, built, engined and entirely equipped the vessel are to be congratulated on the results of the work.

In this ship we have practically the highest development of Shipbuilding and Engineering Work, also supreme examples of Eastern decorative work, unsurpassed in the World of Art.

Design.

It was in the middle of July 1905, that the orders for two new Pacific liners were placed with the Mitsu-Bishi Works to the Owners' design. The former submitted an alternative design, proposing to adopt their own design on the ground that the vessel would be lighter by 200 tons in hull structure, also to adopt the Turbine System instead of reciprocating engines, and both their proposals met with the approval of the Owners. The latter proposal showed not only courage on the part of The Mitsu-Bishi Works who are patent-holders of Parsons' Turbine in the East, but confidence in the invention of the Hon. Charles Parsons by Messrs Toyo Kisen Kaisha. It is true that steam turbine machinery had been fitted on a number of steamers in Europe, but they were of comparatively small displacement, or those larger ships with Turbines were not yet sufficiently tested to ensure the realisation of best results, and in this early stage of Turbine Machinery, its adoption to the new Pacific Steamers is entirely due to kneen foresight of Messrs the Toyo Kisen Kaisha, as Mr. H. Maruta, the General Manager of the Mitsu-Bishi Works expressed it at the luncheon at the launching of the vessel on 14th. Sept. 1907, viz, "we all could not help esteeming and admiring the foresight, enterprise, and courage which characterised the owners decision in adopting the Turbines in the new Pacific liners," the success of which has since proved to be fully justified by the results obtained in Europe.

The Decorative designs of public rooms, were entirely put in the hand of Prof. Tsukamoto of Imperial University, Tokyo, appointed by the Owners.

Dimensions.

The Principal dimensions of the vessel are;

Length between perpendiculars	550′- 0″
,, over all	570′- 9″
Breadth moulded	63′- 0″
Depth moulded	38′- 6″
Loaded draft	31′- 8″
Displacement at this draft	21650
Depth from keel to roof of wheel house	84′- 0″
Depth from keel to top of Masts	167′- 0″
Depth from keel to top of funnels	129′- 0″
Gross Register tonnage	13454 tons.
1st. Clase Passengers	261
2nd. Class Passengers	47
3rd. Class Passengers	816
Officers, Engineers & Crew	250

Construction of the Hull.

The first keel plate of the Tenyo Maru was laid down on Nov. 17. 1905, and she was launched on Sept. 14. 1907. She proceeded on her Official trials on Feb. 19. 1908, so that she was completed in 28 months. Had she been fitted with ordinary reciprocating engines, the time would have been much shorter, but owing to the installment of new plant etc. in the Dockyard in connection with Turbine Machinery, it took longer to complete the vessel than it would otherwise have done. Any delay however that there has been, is more than compensated for by the satisfactory nature of the details in design and construction of the vessel.

Seven thousand five hundred tons of steel were required in the construction of the vessel. In many cases the plates have quadruple riveting.

The flat plate keel is fitted with slab keel 2½″ thick, scarfed, thus a flush surface is obtained for the entire length of the vessel. This is a great convenience in connection with dry-docking of the vessel.

The flat plate keel is 48″ broad and 20/21″ in thickness, and the centre girder plate is 53″ deep and 13/20″ in thickness and is secured by angles 5″ x 5″ x 13/20″ to flat plate keel and 4″ x 4″ x 12/20″ to the inner bottom plating. This construction is continued for the whole length of the ship,

although thickness of plates and bars is reduced at the forward and after ends.

The Inner bottom of the ship is of a width at the central part of 50 ft. tapering towards the bow and stern to take the form of the ship. This structure is built up of floor plates at right angles to the centre girder, of a depth 53″ and extending nearly to the turn of the bilge. Fitted intercostally with these, there are on each side of the centre girder three longitudinals, secured by angles and forming with the plating, the double bottom structure of the ship. This double bottom is used for carrying water ballast and oil fuel, and to give access to all parts and incidentally to lighten the structure, holes have been formed in both the floor plates and intercostal girders. The fourth girder from the centre lining known as the margin plate is continuous fore and aft.

The side framing above the double bottom is of Channel Section 9″ deep for the greater part of the length of the vessel. The spacing of the framing in the centre part of the ship is 30″ and at the bow and stern where heavy angles take the place of the channels, it is diminished to 27″. These angles have reverse angle bars near the edge of the transverse flange. Each fourth frame in the machinery and boiler compartments and each sixth frame in aft hold, are of web section, built up of plates over ½″ in thickness and 24″ to 30″ deep with strong angles on the inner edge, and reel riveted to the shell of the ship. The web frames extend vertically to the upper deck, these frames were built in the framing yard and were fitted there, with all connections hydraulic riveted and subsequently moved to the building berth. The Main framing thus described, extends to the shelter deck. The deck above this, forming the promenade deck for passengers with central deck houses for cabins, and public rooms, is supported by heavy tee standards 6″ deep and 5 ft. apart, the boat deck above the Promenade deck is supported by 2½″ round iron stanchions also 5 ft. apart.

The shell plating is for the most part $\frac{16''\text{-}15''}{20}$ in thickness and generally of 5 ft. width of strake, it is lap-butted and almost entirely quadruple riveted.

The three topside strakes of the plating of the hull which are of 22/20″ 20/20″ 20/20″ respectively and reduced at the ends are double strapped and quadrupleriveted, and the next two strakes which are of 18/20″ in thickness, reduced at the ends are butt-lapped and quadruple riveted. The butts of the keel plates are double strapped and treble riveted,

Wherever possible hydraulic riveting was resorted to, and before the rivets were put in, the plates and angles were forced and held together by hydraulic power, so that the temporary bolts and nuts would bring the surfaces as closely together as possible before riveting. In this way there was absolutely no possibility of yielding when the rivets were put in.

The work done by hydraulic power includes the landing and doubling of Shelter deck sheer strake, a strack below and shelter deck stringer plates bars, keel plates and slab keel plates.

The rivets in the shell and tank top plating vary from ¾″ to 1⅛″ in diameter spaced on an average 3½ to 4 diameters apart. In the bulkheads the sizes generally are ¾″ in diameter, spaced 4½ to 7 diameters apart, deck rivets are ¾″ spaced generally 4 to 4½ diameters apart.

The inner bottom plating ranges from 5 ft. 9 in. to 6 ft. in breadth of strake, and ½″ in thickness reduced toward bow and stern. It is, however, thicker in the boiler and machinery spaces where further strength is imparted to the structure by a greater number of longitudinals, built intercostally with the floor plates. This inner plating is lapped and treble riveted at the butts and joggled and bouble riveted at the edges.

There are twelve bulkheads, of which four being Oil tight for Oil fuel bunkers built of 8/20″ to 7/20″ plating with 7″ angle stiffeners extending to Lower deck and spaced 30″ apart, These are connected by large brackets to tank top plating and to lower deck. The horizontal stiffeners are 9½″ Bulb angles spaced 48″ apart. Above the lower deck i. e. the tween deck bulkheads, the stiffeners are 5½″ angles. The Oil tight bulkheads are built of 10/20″ to 8/20″ plating with 9½″ Bulb angle vertical stiffeners, spaced 30″ apart, and 9½″ Bulb angle horizontal stiffeners spaced 48″ apart. The bulkhead at aft end of Machinery space or bulkhead to the shaft tunnel, one between Machinery and aft boiler room, and one between aft and fore boiler rooms are fitted with watertight doors of "Long-Arm" system. In the aft holds the lower deck flat is lowered down to form the tunnels for the Propeller shafts having Longitudinal bulkhead near the centre line, and also one against the side of the ship on each side, forming fresh water tanks.

The Deck beams are of deep channels throughout and are connected to the framing by knee-brackets and are supported vartically and tied together by Solid circular pillars and double channel bar pillars, the latter being used for wide spaced arrangement.

The Deck plating is 11/20″ to 8/20″ in thickness, but is heavier, where required, principally in the stringers or outside starkes of the deck plating which are 20/20″ to 11/20″ reduced at the ends with extensive doubling in the main structural decks. The laps are joggled and single riveted. The butts are also joggled and treble riveted generally.

At the corners of the hatchways, engine and boiler casing openings there are heavy plate doublings. The coaming of hatchways, which are also of heavy plating, also add to the strength of the structure in their vicinity. To replace the ordinary deck beams removed in engine and boiler openings, there are specially strong beams built up of heavy plates and angles. In the boiler space opening they are 14″ deep and connected and stiffened by heavy angles. In engine space there are introduced five extra heavy girders 45″ deep, arranged both as to position and spacing to permit of turbines being raised from the seats.

As the lower decks of the ship are complete only in the holds, the longitudinal strength in the engine and boiler spaces which occupy the greater part of the middle of the ship, is maintained by girders and stringers.

Engine seating is of fore and aft box girders worked on top of the inner bottom, which is constructed throughout with same lines of longitudinals and inner floor worked at the same height forward and aft. Upon these girders, supports for the turbines were immediately bolted. As the reciprocating stresses are eliminated, and the propeller thrust is almost steam balanced, the structure on the whole is much lighter than what it would have been for reciprocating Machinery.

The stem of the hull is of forged steel with cast steel

fore foot, so as to bring all the ends of plating easily home. The stern post and brackets are of cast steel. The centre propeller shaft passes through an aperture as in a single screw ship, and the stern post after arching up to give satisfactory clearance over the tips of the blades, is carried down abaft the propeller, very nearly to the level of the centre shaft for the purpose of giving sufficient length of bearing for the rudder post. Higher up, the post is considerably swelled out, in order to satisfactorily house the steering gear, which is placed beneath the water line to prepare for the service as an auxiliary cruiser.

In designing the shape of the post, every care was taken to ensure clean entrances in order to reduce friction and eddy making to the lowest possible extent. At a time it was criticised that the post is unnecessarily heavy in structure, but the following two points will suffice as an explanation. (1) While the designing was in progress, the gigantic American Steamer "Minnesota" which is fitted with a similar kind of stern post, although she is fitted with reciproctaing engines and of much lower speed, was brought to the Works for repairs, with a crack at the arch of the post, which circumstance induced the designer to make more allowance in scantling than otherwise would have been. (2) For the transportation of long distance (Great Britain to this country) it was necessary to design the post in several pieces, and to allow sufficient bearing surfaces for bolting together, it was apparently heavier than if it had been in one piece.

The Rudder is also of cast steel in two parts, connected together by horizontal flanges, and as will be seen, revolves on two pintles which together with the gland at the head form the whole support against sideway pressure when manoeuvering.

A singular design of making a slot in the stern post over the rudder, is introduced so as to make the rudder apparently continuous with the stern post; yet sufficient clearance to lift the rudder when unshipping. The rudder is wholly below the water line and its area is 218 square feet.

All the above steel castings are supplied by The Steel Co. of Scotland.

Passenger Accommodation.

The Tenyo Maru has six decks, the topmost viz, the boat deck being about 33 ft. above the load water line. Although it carries the large number of life boats with which the vessel is equipped the greater part of the after deck is available as a promenade for first class passengers. At fore end there is an accommodation for Officers, and, at aft end a commondious smoking room and lounge are fitted.

The next deck is known as the promenade deck, and it equals in length the boat deck. This deck is also arranged as a promenade, and a full idea of its area afforded is given by the plan. At the forward end of the deck house on it, are a Drawing room, a Reading room and four suites of rooms; each consisting of a sitting room, bed room and a bath and toilet room, also four large family rooms. On the midship part, there are four large state rooms specially well fitted, and at the after ends there are nine ordinary state rooms. The windows in the public rooms on this deck and those on Boat and Shelter decks, are Messrs J. Stone & Co's Vertical Motion ventilating square deck house windows. The Cabins and those of similar nature on the deck below, are fitted with Messrs J. Stone & Co's pivoted side scuttles with air inlet and outlet ventilating arrangement.

Each of the sitting rooms in the suites is finished in different woods or styles. A pair of folding berths and a sofa are fitted to each room; the former is so designed, that when folded up, it assumes the appearance of a portion of the wall, having the berth bottom panelled same as the wall, and the wall recessed to receive the berth, a writing desk and dressing table are also supplied. The rooms are upholstered in coloured tapestry, which, with the different shades in carpets to match, gives a very fine appearance. The Bed rooms are in correspondingly good taste and Messrs Hoskins & Son's "Neptune" Silver bedsteads are fitted. The cabins on this deck are all finished in oak.

On the next deck known as the Shelter deck, are located the Dining Saloon for 1st. Class passengers, Smoking room for Intermediate passengers, also Hospital. There are also on this deck 39 first class state rooms. This deck marks the top of the moulded structure of the ship and therefore extends the full length of the vessel. But on no deck is the first class passenger accommodation within 139 ft. of the bow or 158 ft. of the stern, while even the second class passenger rooms are 125 ft. from the stern. The importance of this point is associated with the fact, that there is less disturbance to the Saloon passengers, either from propeller action which is, however, minimised on account of Turbines, or from the action of the sea which is perhaps an insurmountable difficulty even with the greatest of ships. The special feature of the Hospital is the introduction of Messrs Hoskins and Son's patent Equilibrium berths. Three of these are fitted in the hospital.

The Upper deck, which is the first deck within the moulded structure of the ship, has 22 cabins for 1st. class passengers with an auxiliary saloon, also a nursery for children. The Intermediate class accommodation is abaft the 1st. class quarters. There are 16 cabins with a commodious saloon. At fore end there is an accommodation for the crew, and aft end for Chinese Steerage passengers.

The main deck is entirely given over to the steerage passengers, forward for Japanese and aft for Chinese. On this deck 666 emigrants can be accommodated. The berths are Messrs Hoskins & Son's patent galvanized iron berths with sack bottoms.

Several photographs of typical public rooms in the ship are shown here.

A special feature in the ship is the bath room and lavatory accommodation. Toilet apartments are arranged on all decks convenient to the state rooms. There are in all 22 bath rooms and 25 closets for 1st. class cabin passengers. The bath tubs are all of white porcelain. The Sanitary appliances are supplied from Messrs Shanks & Co. Ltd. Scotland and Messrs J. L. Mott Iron Works. New York, U.S.A.

The Lounge is a new feature in Pacific Liners. Time was when ladies so seriously objected to the Smoking, that men were banished to a separate compartment for this pleasure, but now in all public places it has been found conducive to popularity to have an apartment, where men need not be deprived of the society of ladies, even while smoking, and on the boat deck in this new Pacific liner, there

is arranged such a lounge. This lounge is finished in dark coloured Mahogany. The upper panels being carved work with large panels of silk goblin-fabric, representing "Rice fields" relieved by electric blue silk panels with classic design, and lower of smaller size, which combines well with the general design of the wood work. The upholstery is silk damask of electric blue to match the relief, and the floor is covered with a rich carpet with rugs scattered throughout the room, which has various nook provided with chairs and tables, the room is certainly to be admired and appreciated. It is lighted from above by a stained glass skyright.

The 1st. class Smoking room is located at the aft end of the boat deck. The Smoking room is finished in stained oak with panels of elaborate fret design of Peacocks, relieved by two large silk panels with "Kasuga" design (Kasuga Shrine court yard with tame deer) in new mode of goblin-fablic with leather insertion. The floor is covered with India rubber tiles. The effect is undoubtedly unique, and represents a marked contrast to the designs usually adopted in the smoking rooms of modern ships. The upholstering is of simple colour (pale yellowish green) and of buffalo leather. A feature is the delightful arm chair which are easily moveable, so that passengers can draw them up to the artistic fire place which is of beaten bronze. Here after a good dinner and with an interesting book, the peaceful passengers may have unalloyed repose. This room is also lighted on the top by a stained glass skylight. The ventilation of this room by means of fans is very effective.

The first class Drawing room and Reading room are adjacent to each other on the deck below, directly communicating with the main companion way. The only objection, perhaps, in this combination is that passengers going to the drawing room must pass through the reading room, or in some sense writing room, but on board ship, few people are inclined for heavy reading or disposed to write, for this they do more frequently in their own cabins, so that the reading room will, practically, form part of the drawing room. The drawing room is finished in white-maple and bird's-eye maple relieved by silk panels of gold and scarlet with crysanthemum designs. The contrast of colour between the scarlet of the unholstery and white polished surface of maple is striking. The furniture is also of white and Bird's-eye maple, and the upholstery is of silk tapestry of scarlet colour with Japanese artistic designs. Curtains are of goblin-fabric with similar designs in various mixture of colours, yet in harmony with other parts of the room. A Steinway & Son's grand piano occupies a central position in the drawing room. In this room, indeed, beautiful and costly examples of Japanese silk fabric are extravagantly introduced. A pair of door curtains cost considerably over one hundred pounds.

The reading room is treated in exactly the same way as the drawing room.

The first class dining saloon on the shelter deck is 50 ft. broad and about 60 ft. long. There are accommodation for 207 passengers to dine at once. In addition to 3 long central tables, there are arranged a large number of small side tables. The revolving seats have no arms and are, therefore, wider and more comfortable. The Saloon is finished in polished white oak with panellings of bold design. The upholstering is of dark green silk, and the floor is laid in parquetry. The sideboard at the end of the saloon is a very beutiful piece of cabinet making. At the forward end there is a Steinway & Son's upright piano for use in connection with concerts. The Saloon is lighted and ventilated over-head by a large Dome skylight with trunkway. The Dome is glazed with stained glass of flying wild duck design. Inside the trunkway is decorated by large panels of gold goblin-fabric; one representing "Minamoto-no-Yoshi-iye," (Ancient warrior) and the other "Murasaki-Shikibu" (Ancient poetess) crowned with pale blue silk flat with flying plover design. It will not be fair to the designer to pass over the introduction of flying wild ducks in the dome and ancient warrior in panel unnoticed. It is based on the well known military tactical incident of the warrior, who had foreseen the ambuscade of the enemy amongst the bushes by the scattered mode of flying wild ducks, which in general assume one regular line when flying.

The Saloon Entrance or main companion is finished in white oak, Balustrades of grand stairs are of bronze. On top of the stair way there is a large Oil Painting by Mr. Wada Eisaku, representing the court-ladies in the act of plucking the young fir trees; one of the ancient court ceremonies. The floor is laid with India rubber tiles.

There is also an auxiliary saloon to accommodate 19 1st. class passengers, the room is finished in white mahogany with dado and upholstered in copper coloured silk velvet. Here a private or family party could enjoy a quiet meal, entirely isolated from the general public. The Nursery is finished in white, a special feature of this room is that of an upholstered dado, thus the toddling children may be less subjected to injury.

The second class dining saloon is 17 ft. by 40 ft. and can seat 41 passengers. The room is finished in white and upholstered in copper coloured velvet. The Smoking room is finished in colonial pine and upholstered in dark green morocco.

All silk-fabrics are by Messrs Kawashima and Iida, well known silk weavers of Kyoto.

There is one kitchen for the first and second class passengers with separate pantries adjacent to the respective dining saloon, also one for Japanese, and one for Chinese. Many mechanical and electrical contrivances have been introduced by Messrs Henry Wilson & Co. Limited, Liverpool, who supplied practically all the appliances including patent roaster, steam stock pots, steam cooking boiler, grills, bain maries, island ranges, steam ovens, bread and pantry ovens, rotary dough mixture etc. The roaster has three revolving spits, two for joints, and one for game, which are rotated by gearing driven by electric motor. In pantries there are carving table and hot press, bain marie, milk, coffee and hot water apparatus, electric dish washing machine, egg boilers etc.

The ventilation of the ship has had the most careful attention and is connected with the heating appliances by means of Thermo-tank system which will be referred to later, in connection with the electric equipment.

The ship is fitted with most improved Laundry appliances, which are entirely supplied by the Empire Laundry Machinery Co. Boston U. S. A., including Cambridge

washer, extractor and mangles, all electrically driven, steam jacketted starch kettles, electric ironers, etc.

The Clayton apparatus is also fitted in the ship for fire extinguishing, disinfecting and ventilating the holds, bunkers, and double bottoms.

The ship's boats are all fitted with Welin's quadrant davits, by which means, any boat could be easily got out in spite of a considerable list which the ship may have at any time, and some of the boats are fitted with shifting chocks, permitting the boat to be chocked either fully inboard or along the extreme edge of the deck, thereby providing more promenading space on the boat deck.

Cargo and Navigating Appliances.

For dealing with the 6000 odd tons of cargo carried, fourteen derricks are fitted on the vessel, besides there are two derricks each capable of lifting 25 tons. In connection with these there are 14 powerful Steam winches.

The refrigerating installation is of Messrs Hall & Co's combined and interchangeable type, including air cooler and water cooler, etc. The plant is capable of reducing the temperature of the insulated chambers from 70 deg. Fahr. to 20 deg. Fahr. in 15 hours.

The installation of anchor gear in a vessel, is one of the utmost importance and through a long succession of years, Messrs Clarke Chapman & Co. Ltd. have accumulated such experience that their gear is with confidence fitted in the vessel. In the Tenyo Maru there are two cable holders for working the anchor cables which are 2 7/8" in diameter. Aft of the windlass are two capstans for warping, one on the port and the other on the starboard side. These are driven by the horizontal engine placed on middle line of the ship. The engine having two cylinders each 11" dia. and 12" stroke, fitted with link motion reversing gear and steam stop valve, and fitted with single and double purchase gearing, and with clutch gear, so that either or both capstans can be worked at once. Two Capstans are also fitted on the deck aft, similar to those in the fore part of the ship.

The steering gear is by Messrs Brown Brothers Ltd. Edinburgh. There are two sets of steering gear, one located on the upper deck, and the other on the lower deck well under the water line. The rudder itself weighs 27.5 tons, so that the gear is very heavy. The lower gear is designed to put the rudder over in 20 seconds, the upper gear in 30 seconds. The connection of the upper gear, is made by bolting a short fast tiller on the rudder head, to the bottom of the flat tiller carrying the steering engine, and the gear engaging in the quardrant.

The Ship's Telegraphs are all supplied by Messrs Chudburn & Sons, Liverpool, including Reply Engine Room Telegraphs, Steering and Docking Telegraph and Admiralty pattern tell-tales indicating "ahead" and "astern" of the Machinery.

Launching of the Ship.

The Tenyo Maru being the largest ship yet built by the Mitsu-Bishi Works, much care and forethought had been expended on the design and construction of the launching ways. Her weight on this occasion was 7923 tons including the launching ways.

There were nine bilge blocks on each side. The keel was laid with a declivity of 7/16" per foot and the standing ways 6/16" to 12/16" per foot. The camber was 31" in the whole length of 602 ft. The standing ways extended from 29 ft. abaft of the fore perpendicular to 79 ft. abaft of the aft perpendicular. The sliding ways had a bearing length from the fore end of the cradle to the heel aft of 470 ft. 8 in. and as the width was 4 ft. the total area of bearing surface was 3652 square feet, which gave a pressure per square foot of 2.17 tons when the total weight, including the cradle, was taken into consideration. There was, however, at the moment the stern floated a much greater pressure at the forward cradle; which affected not only the fore cradle and the ways, but the floors and tank girder construction. An examination, however, showed that everything had been of sufficient strength to withstand the great thrust, which was calculated to be 1820 tons decreasing to 450 tons as the bow left the ways. The greatest draught aft before lifting was about 28 ft while the maximum moment against tipping was calculated at 382,000 foot-tons.

The ways were placed at 23 ft. centres. They were constructed of Oregon pine. The average length of the timbers forming the ways about 45 ft. built up of 4 logs, and the butts were scarfed, and bolted together by five 1" bolts. Average length of the sliding ways was also 45 ft.

On account of the fine bow, a strong shelf plate of steel was supported by knee brackets, in order to form a batting surface or a bearing for the vertical members of the poppets.

On the standing ways there was laid first a coating of tallow and wax then second a coating of tallow and seed oil, then soft soap in blobs about 6 in. apart. On the sliding ways there was laid, before they were turned in on the top of the permanent ways, a thin coating of tallow and wax and that of tallow and seed oil, with soft soap in blobs. The total quantity of tallow thus used was about 3.6 tons, and of soft soap .5 tons.

Every possible care was taken in the process of releasing the ship and many distinct and pre-arranged electric bell signals with reply system were adopted in carrying out the instructions.

There were two dog shores, but in order to avoid any possible danger which might occur by hanging such a big ship on the dog shores alone, keel blocks under the forward part of the ship, about fifty in number had sand bags put in between the wood blocks instead of being buit up entirely of wood, and were left in place till the last moment. The sand bags were ripped open, just after the dog shores had been knocked down by the falling weights, and the sand allowed to escape. Pressure on the blocks was thus rapidly released, and the total weight brought on the launching ways.

There were hydraulic rams of 200 tons pressure abutting on the head of each of the sliding ways to start the vessel if necessary, but they were not brought into use.

The time occupied in the first 20 ft. of travel was 10.85 seconds, while for the 602 ft. the total length of the standing ways the time was 51 seconds. The maximum speed was 19.76 ft. per second equal to 11.7 knots, and the maximum

acceleration was 98 ft. per second.

The draft forward was 10 ft. 4⅛ in. and aft 16 ft. 0¾ in. with a mean of 13 ft. 2 7/16 in. the total weight being 7593 tons; which excludes the 330 tons due to the launching cradle.

Naming of the Ship.

The honours of the launch were performed by Mrs. Asano; the wife of the President of the Toyo Kisen Kaisha; who named the vessel the "Tenyo Maru." It is interesting to note that "Ten" means "Heavens" and "Yo" "Ocean," the latter is the second character of the Owner's name "Toyo" and are introduced to the Company's Ship as "nia" in "Maureta-nia," and "Lucitania" in Cunard Ships, whilst the former is the first character in Chinese classic vocabulary called "Thousand letters" containig one thousand characters, and the next ship was named "Chiyo Maru," "Chi" meaning "Earth" is the second character.

We sincerely hope that Messrs the Toyo Kisen Kaisha may long flourish to own the vessels to complete the letters in this vocabulary.

Propelling Machinery.

Turning now to a description of the machinery it may be said at the outset, that the Mitsu-Bishi Co. when they obtained the right for manufacturing the Parsons' Steam Turbine in Japan, realised that it was absolutely necessary to impart a thorough practical knowledge to their staff as to the method of manufacture and the actual running under sea conditions of the turbines. They despatched Messrs. Esaky, Chief Draftsman of Engineering Dept. and Araki, the foreman fitter both of them, Engineers of long and varied experience to the Parsons' Works. After a year's stay at the Turbine Shop they returned in time to instruct the foremen and men of the Works, thoroughly to prepare for the fitting out the Turbines of the Tenyo Maru.

The turbines were constructed at the Parsons' Works and shipped out for the vessel.

As the stern photograph of the Tenyo Maru shows, there are three shafts; the high pressure turbine being on the centre shaft, and one combined low pressure and astern turbine on each of the two wing shafts. The turbines take steam at an initial pressure of 180 lbs.

The low pressure shafts are at 12 ft. 6 in. centres on each side of the middle line of the ship. All the shafts are parallel with the middle line of the ship, whereas they are at a slight angle to the level of the keel. The intermediate shafts are of Messrs Armstrong, Whitworth & Co's fluid compressed ingot steel, whilst the propeller shafts are of Messrs Richardson & Son's lockfast iron, and about 20 % heavier than the rule requirements.

The rotor drums of Turbines are of forged weldless steel, the high pressure drum is 76″ in diameter with blades over 130,000 in number while the low pressure drum is 106″ in diameter, with blades over 300,000, and the astern drum is 87″ in diameter, with blades over 160,000. Perhaps a better idea can be formed of the magnitude of the work, when it is stated that the total weight of the high pressure turbine complete is over 67 tons, and of the low pressure and astern turbine over 126 tons.

The over-all length of the turbine rotors including the bearing, is in the case of the high pressure turbine over 24 ft. and of the low pressure and astern turbine over 33 ft. The turbine casings are of cast iron. The bottom portions of the steam and exhaust ends are cast in one with bearing stools.

The governing gear is fitted to each of the turbines and is so arranged, that any increase beyond the required revolutions in any of the turbines, shuts off the steam supply from the turbines until the revolutions fall to the normal speed, also an emergency governor is provided to entirely stop the turbines, should any serious increase in the revolutions take place.

The gland for the shaft passing through the end of the turbine is rendered steam tight by Parsons' latest improved method.

Boilers.

There are thirteen single ended boilers, arranged in two separate boiler rooms, they are designed to work under Howden's system of forced draught, and arranged to burn oil fuel.

There are four large fans, two in each boiler room, each driven by an independent engine. They are supplied by Messrs J. Howdon & Co.

The oil burning arrangements are of Lassoe's low pressure system, and in connection there are four special blowers of Green's vertical pattern, each driven by an independent steam engine for atomizing oil fuels, so arranged that these four blowers take hot air from the hot air duct of Howden's system through a common trunk, and to discharge into a common pipe, by which means the hot air under a pressure is distributed to oil burners and stomized. The furnaces are by Morisons. The funnels are two in number, elliptical in shape, and rise to a height of 120 ft. above the furnace bars.

Condensers and Pumps.

There are two main condensers, two independent twin air pumps and two Parsons' augumentor condensers. Each main condenser deals with each Low pressure turbine. The air pumps are of Weir's high vacuum system, and merchant service design, having cast iron tops and bases with gun-metal barrels, gun-metal buckets, bronze rods and special valves.

Two sets of Centrifugal circulataing pumps are of Mitsu Bishi Make, each having suction and discharge branches, and driven by open engines. There are two surface feed heaters fitted to Parsons' usual design. The shell of the heater is mild steel, tubes and tube plates of brass. The main feed pumps are supplied by Messrs Weir; consisting of two pairs of double acting pumps. Each pair of these pumps is capable of supplying the boilers when the turbines are working at their full power, and the pumpes working at 10 strokes per minute, so connected that either pumps may deal with turbines, these pumps have complete gun-metal water ends, gun-metal buckets, manganese bronze rods, steel piston rods and bronze valves in gun-metal seats. Two Weir direct acting

oil circulating pumps have also been furnished, their duty being to circulate oil through the turbine bearings, a constant and important duty, necessitating pumps of great reliability, one for ordinary working purpose, the other for the standby purpose.

There is also one Weir's pump for water circulation of oil cooling tank.

Two Weir's patent evaporators of merchant service pattern, are fitted each capable of producing 50 tons of fresh water per day.

A separate surface condensing plant, consisting of condenser of Morison's contraflo type, circulating pump, Morison's patent grease extractor is also provided for the auxiliary machinery for use in the port.

Electric Installation.

In a ship of this class carrying so many passengers, the electric installation is naturally an important feature in the equipment of the vessel, and an outline description of the appliances adopted will be of some interest.

The generating plant located on the main deck in the engine room, includes two generating sets, each giving an out-put of 75 kilowatts when running at 430 revolutions per minute.

The large main switchboard has 20 circuits,—11 for the lighting of the ship, 5 for Thermo-tanks, 1 for ventilating fans, 1 for work-shop machinery, 1 for galley machinery and 1 for the search light projector.

The lighting installation is arranged on the double wire system. The mains of each circuit are led from the switchboard to a submain board, which again supplies three, four or six way distributing boxes, each in their turn feeding four to eight way to small porcelain extension boxes, whence branch wires are connected up to the lamps, not more than four lamps are taken from each feeder. There are in all about 1,200 lights of Tantalum system.

The mains of each circuit are led from the switchboard to a double pole fuse junction box with feeders thence to each motor.

The Thermo-tank and ventilating fans form an interesting feature of themselves. The fifteen thermo-tanks are fitted on the weather deck. They are designed for a three fold purpose. Each Thermo-tank can supply through sheet iron trunks fresh air to the compartments, either cold or steam heated at any desired temperature, on the other hand the Thermo-tanks can exhaust the foul air from the compartment. All these operations are performed by a series of lever valves fitted in each thermo-tank. The Thermo-tanks are capable of maintaining the temperature of the room at 65 deg. Fahr. when the superincumbent atmosphere is 32 deg. Fahr. The Thermo-tanks are supplied by Messrs Steward and Co.

The Engine room is ventilated by four ventilators, each fitted with an 18″ electric fan. As regards the ventilation of the saloons, state rooms and cabins, etc., there are 117–10″ Portwayne bracket fans:—98 for state rooms ond 19 for Officers. There are also 5–12″ trunnion bracket fans to galleys and opium room. The Dining Saloon is ventilated by means of 8 overhead fans, each of 40″ in diameter; the Smoking room by 1 ventilator, fitted with 18″ fan and 5–10″ trunnion bracket fans. The Lounge by four of 10″ the auxiliary saloon by two of 12″ and intermediate saloon by three of 12″ fans, all of trunnion bracket pattern.

The laundry is provided with Cambridge washer, extractor, and mangle all electrically driven, also with electric ironers.

The Clayton apparatus is also operated by means of electricity.

As regards the telephone service, there is on the Navigation bridge a telephone, communicating with the engine room, the look out at the forecastle, the docking bridge aft and steering engine room, all of pillar type. The telephones are of the loud speaking marine pattern and are supplied by Messers Alfred Graham & Co. London. In addition to the above there are intercommunication telephones fitted in the cabins of captain, chief engineer and purser, also between three stations in the 1st. class accommodation (one each in the promenade, shelter and upper decks) and saloon pantry.

The navigation lights, telegraphs and principal compasses are also electrically lighted.

There are 30 portable lamps for hold and bunker use, also 8 cargo reflectors, each 4–50 candle power lamps.

The search light projector is of 16,000 candle power.

The Navigation lights have a signal indicator placed in the chart room.

In connection with the water-tight doors of "Long-Arm" system which are actuated by means of Electricity, there are in the chart room controllers and an indicator board, showing every door, and as the doors close, the circuits in connection with each are cut in, and the lamps corresponding to each door are lighted up to show that the operation has been carried out.

The Wireless telegraphy of Telefunken system has been fitted making the ship's equipment quite up-to-date.

Trials.

The trials of the Tenyo Maru which occupied nearly three weeks involved seven series of trips; first three the preliminary and progressive trials, (10. 13. & 15. Feb. 1908) next the Official trial (19. Feb. 1908) and last three the coal consumption trials (22. 25 & 27. Feb. 1908) the Performance of the Ship being exceptionally successful from beginning to end.

The steaming tests naturally excited very considerable attention among marine constructors, and were attended by representatives of several important interests on every occasion.

The Official trial consisted of six runs over the measured 3.458 knot government course at full speed. The full speed guaranteed by the contract was 19 knots, but on this trial, 20.62 knots was obtained which was more than satisfactory. The results of the six runs are as follows.

Speed in kts.

1st. run	20.50						
	) 20.49						
2nd. run	20.48	) 20.56					
	) 20.63		) 20.59				
3rd. run	20.78	) 20.61		) 20.61			
	) 20.59		) 20.62		) 20.62		
4th. run	20.39	) 20.62		) 20.62			
	) 20.65		) 20.61				
5th. run	20.91	) 20.60					
	) 20.55						
6th. run	20.18						

On several occasions ahead and astern trials were made, and it was found that the time occupied to bring the vessel to a dead stop by putting the machinery to full astern from full ahead was 3 min. 30 sec. and to full ahead from full astern 3 min. 30½ seconds.

The satisfactory results of the Tenyo's trials were not only of great importance to the marine engineering, but must have been of a most pleasing nature to the Mitsu-Bishi Dockyard & Engine Works. The Mitsu-Bishi Works are now busy with the "Chiyo Maru"'s internal fittings. She is the second ship and will proceed on her steaming trials in a month or so.

In conclusion it will not be amiss to add here that the Mitsu-Bishi Dockyard & Engine Works has been lately epuipped with an Experimental tank complete with apparatus and machinery of a most improved design, supplied by the well known firm of Messrs Kelso & Son of Glasgow, and doubtless some modifications or improvements will be made on the third ship from the Experimental data obtained by the Tank.

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Launching Data of two Ships.

	"Tenyo Maru"	"Chiyo Maru"
Date of Launch	Sept.14-07.	Dec. 7-07.
Length L.W.L.	549'- 4½"	549'- 4½"
Beam extreme	63'-3 4/20"	63'-3 4/20"
Depth keel to Main deck at side	29'- 6"	29'- 6"
Temperature of Air	88° F	53° F
" " Sea	80° F	64° F
Length of Standing ways	602'- 0"	599'-10"
Wide " " "	3'-10½"	3'-10½"
Length of standing ways beyond stern post	79'- 9"	79'- 0"
Wide " " " where fore poppet presses	3'-10½"	3'-10½"
Distance apart of standing ways Fore	23'- 0"	
Aft	23'- 7½"	
Length of sliding ways	470'- 8"	470'- 8"
Wide " " "	4'- 0"	4'- 0"
Area " " "	3652□'	3652□'
Inclination of Keel	7/16"per ft.	7/16"per ft.
" " Standing way	6/16"per ft.72'-3" 7-11/16 @ 90'-0" 12/16"for 79'-9"	5/16"per ft.23'-6" 6-11/16 @ 90'-0" 12/16"for 36'-4"
Camber of standing way	2'-7½"	2'-7½"
Length Fore poppet base	40'- 5"	40'- 5"
Width " " "	3'-10½"	3'-10½"
Area " " " (both sides)	314.28□'	314.28□'
Distance of fore poppet end abaft stem	38'- 9"	38'- 3"
Launching Weight, Hull & fittings Machinery	7384 T.	7080 T.
Miscellaneous dunnage Shoring etc.	150 T.	150 T.
Ballast	75 T.	145 T.
Cradle	330 T.	330 T.
Total	7,940 T.	7,705 T.
Weight per square foot of sliding way	2.174 T.	2.110 T.
Centre of gravity abaft ℄	13.27'	11.65'
" " " above base	27.48'	27.00'

	"Tenyo Maru"	"Chiyo Maru"
Transverse Metacentre above base	31.29'	31.70'
Metacentric height	3.81'	4.70'
Max. Moment against tipping	382,000 ft.tons.	388,000 ft.tons.
Moment of Weight about fore poppet	2015,800 ft.tons.	1938,000 ft.tons.
Depth of Water at end of ways	7'-11"	8'- 6"
Draught forward	9'- 9"	10'- 0"
aft	16'- 8"	15'-10"
mean	13'- 2½"	12'-11"
Total trim	6'-11"	5'-10"
Displacement Corresponding	7610 T.	7375 T.
Distance the ship runs before heel touches water	59'- 0"	36'- 0"
" " " " when tipping begins	402'- 0"	385'- 0"
C.G.of ship beyond end of way when tipping begins	64'- 0"	48'- 0"
Draft in stern post before lifting	28'- 0"	27'- 0"
Time from starting to instant the stern touches water	18.15 sec.	21.40 sec.
Total time of leaving ways	49.70 sec.	58.40 sec.
Pressure upon fore poppet at lifting point	1820 T.	1840 T.
" " " " " way ends	450 T.	475 T.
Max velocity	11.7 knots.	12.6 knots.
Time from starting to Max. velocity	40 sec.	53.5 sec.
Distance travelled to " "	413 ft.	490 ft.
Max. Acceleration	.98 ft.per sec. per sec.	1.01 ft./sec./sec.
Time from starting to Max. Acceleration	23.9 ft.	34.9 ft.
Velocity on leaving ways	19.2 ft./sec.	21 ft./sec.
Mean Co-eft. of friction	.039	.032

The launching speed was measured by means of a strong cord attached to the end of the sliding way. The cord reeled on a large drum having contact pieces fitted for recording every half revolution and connected to Prof.Bile's Electrical Speed Recorder. By this mean the speed were fairly accurately measured. Also fixed sights were used for checking.

Measurement of Deflection, Stress etc. on the vessels in launching.

Transit, Stromeyer's Indicator etc. were used to measure the deflection, stress etc. of the ship during the progress of launching.

A transit was used for the Shelter deck for measuring the deflection.

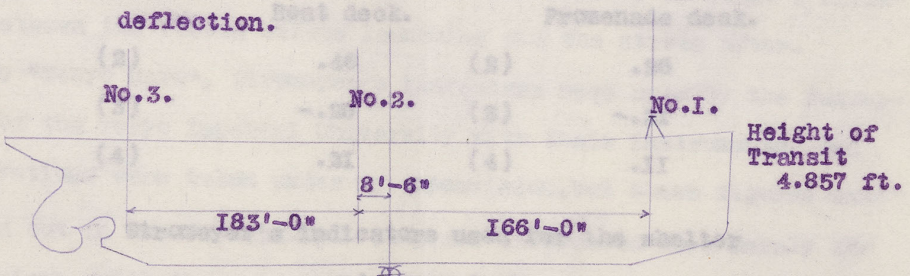
The boat and promenade decks having expansion joints, the movements at these decks are measurable quantities without any special instrument and a simple method was adopted for the purpose.

Stromeyer's indicators were placed on the shelter and upper decks.

The followings are the results obtained from these observations.

"Tenyo Maru"

Transit on the Shelter deck for measuring the deflection.



Results.

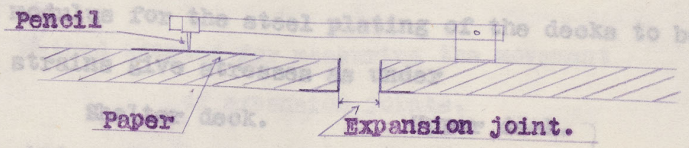
	Reading before the launch	at Max. hogging Reading	Difference	at rest (afloat) Reading	Difference
No.I (Transit)	4.857'	4.857'	0	4.857'	0
No.2 (Staff)	6.790'	6.5I2'	.278'	6.73I'	.059'
No.3 (Staff)	4.857'	4.857'	0	4.857'	0

The deflection at 349 ft. span.

Before launch	0	at No.2 station (nearly amidships)
at Max. hog.	.278'	"
at rest	.059'	"

Method adopted for measuring the movement of expansion joints on boat and promenade decks.

Apparatus used.



Records were taken at the following instances.

(I) Immediately before the ship moves.

(2) Max. movement in one direction.

(3) Max. " " other "

(4) Immediately after the launch, Ship at rest in water.

Extensions were

	Boat deck.		Promenade deck.
(2)	.46	(2)	.26
(3)	-.28	(3)	-.2I
(4)	.2I	(4)	.II

Stromeyer's indicators used for the shelter and upper decks.

The Stromeyer's indicators were placed on the shelter deck and upper decks in the same vertical plane as the expansion joints.

Four observations were made in every case.

(0) First before the ship commenced to move.

(I) During the launch with a maximum extension of deck.

(2) During the launch with a maximum compression of deck.

(3) Immediately after the launch, the ship floating.

On the upper deck the base over which the strain was measured was 6I II/I6 inches, and on the shelter deck 6I 7/I6 inches. The extensions on these bases were

	Shelter deck.	Upper deck.
(I)	.02I5	.0067
(2)	-.0I38	-.0003
(3)	.0III	.0030

Taking Young's modulus for the steel plating of the decks to be 30000000 lbs. the above strains give stresses as under

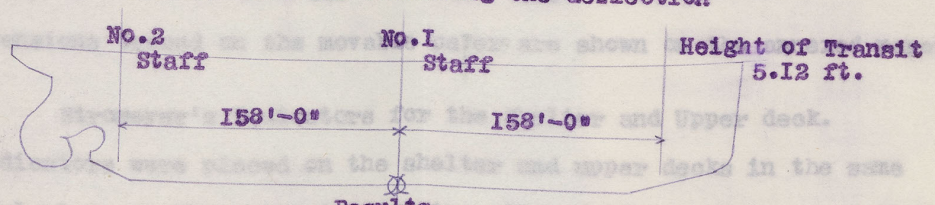
	Shelter deck.	Upper deck.
(I)	4.67 tons per sq.inch	I.46 tons per sq.inch
(2)	-3.00 "	- .07 ※ "
(3)	2.42 "	.65 "

Thus the max.tension obtained was .467 tons which was rapidity followed by max.compressive stress of 3 tons. The third figure of 2.42 tons represented apparently a subpermanent stress on the steel material of shelter deck when the ship is safely in the water or at least a difference between the stress before launching and the stress after.

※ In the "Tenyo Maru", Stromeyer's Indicators were used by the suggestion of the Tokyo Imperial University with their instruments, and observations were taken under my supervision, but these figures were worked out in the University. They are introduced here merely for comparison with those of the "Chiyo Maru".

"Chiyo Maru"

Transit on the shelter deck for measuring the deflection



Results.

	Before the launch		at max. hogg.		at max. sagg.		at rest afloat.	
	Reading	Diff.	Reading	Diff.	Reading	Diff.	Reading	Diff.
Transit	5.I2'	0	5.I2'	0	5.I2'	0	5.I2'	0
No.I Staff	6.72'	0	6.59'	.I3	6.8I'	.09	6.72'	0
No.2 "	5.I2'	0	5.I2'	0	5.I2'	0	5.I2'	0

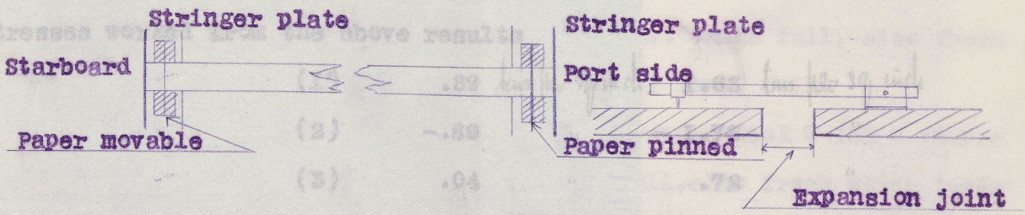
The deflection at the 316 ft. span.

	Travel of ship.	Deflection.
at max.hogg.	339'- 0"	.13
at max.sagg.	446'- 0"	-.09

Method adopted for measuring the movement of expansion joints.

Promenade Deck and Boat Deck.

Apparatus adopted in this case was



Paper on the starboard side was made movable so that it may slide athwartships along the wooden guide. The port side paper was simply pinned down and the observations were made at the same instances as in case of the "Tenyo Maru"

Extensions measured on the fixed paper were

	Prom. deck	Boat deck.
Max. ten	.26"	.35
	-.33	-.42
	.09	.09

Extensions traced on the movable papers are shown on the annexed papers.

Stromeyer's indicators for the Shelter and Upper deck.

The indicators were placed on the shelter and upper decks in the same vertical plane as the extension joints. Observations were made at the same instances as in case of the "Tenyo Maru".

Bases over which strain over which strains were measured:- 6I 7/I6 inches for shelter deck and 6I II/I6 inches for upper deck.

Extensions were

	Shelter deck.	Upper deck.
(I)	.004I	.0075
(2)	-.004I	-.008I
(3)	.0002	.0033

Taking Young's modulus 30000000 lbs. as in the case of "Tenyo Maru"

Stresses worked from the above results

(I)	.89 tons per sq inch.	I.63 tons per sq. inch
(2)	-.89 "	- I.76 "
(3)	.04 "	.72 "

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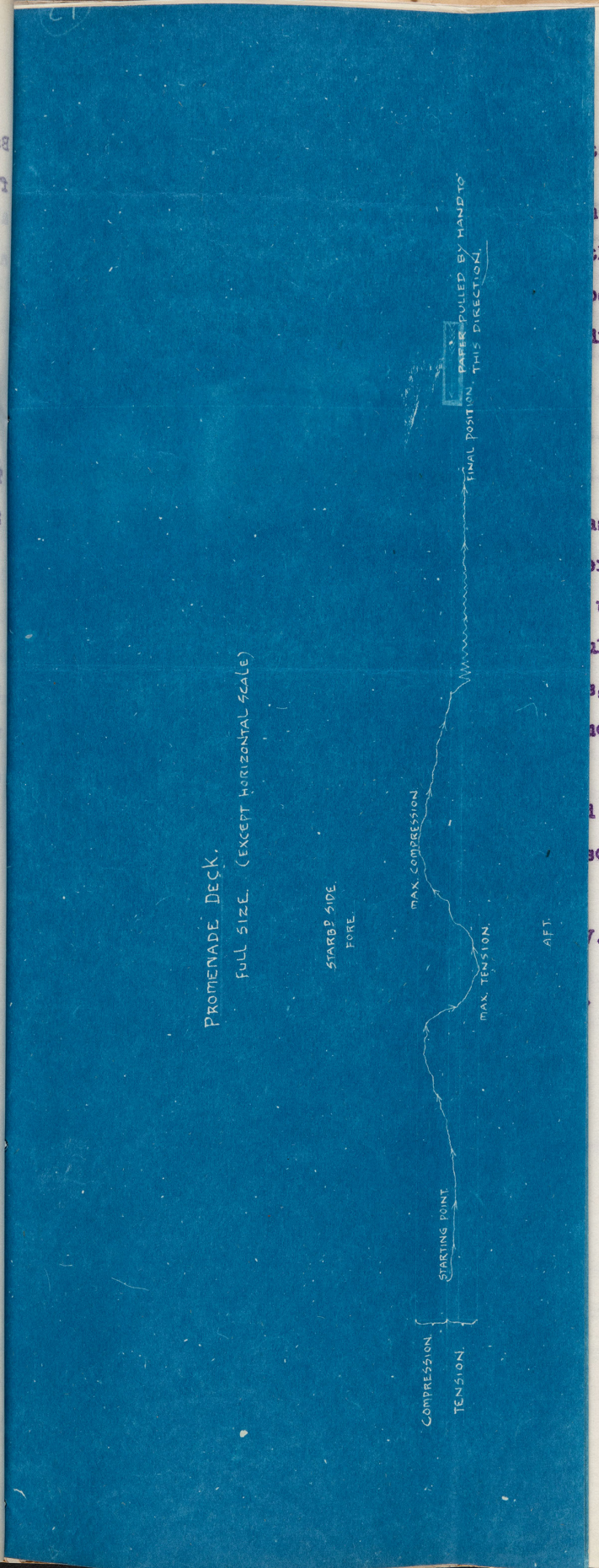

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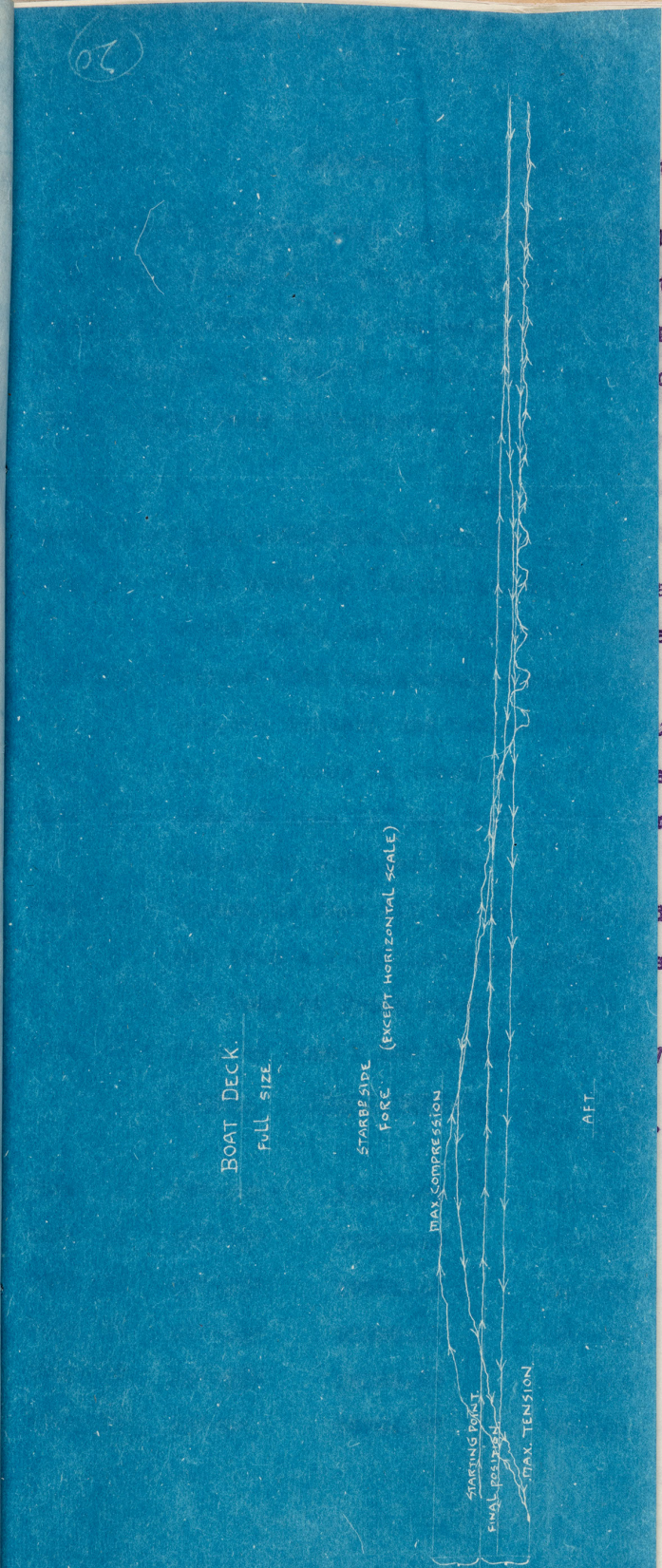
...7.

Metacentre above base line.	G M
27.640	-.955
26.460	2.209
26.80	2.179
27.15	2.39
26.435	-.377
26.46	-.324



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26.80	2.179
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26.435	-.377
26.46	-.324

Inclining Experiment and Stability.

Inclining experiments were carried out for both steamers after the completion. For "Tenyo Maru" 10.34 ton-weights and three pendulums were used whilst for "Chiyo Maru" 7 ton-weights and two pendulums were used and the followings are the results worked out for the different cases of the vessels from these experimental data.

"Tenyo Maru"

Case I - Light condition and boiler empty.

Case II - With steam up, and oil bunkers, ballast tanks full, also fresh water tanks and stores,(@200 c.ft.per tons) full.

Case III - Loaded with homogeneous cargo up to upper deck @ 125 c.ft.per ton, oil bunkers and ballast tanks full, also fresh water tanks full and coal in tween decks 50 tons, and ready for sea.

Case IV - Same as Case III but loaded with homogeneous cargo up to upper deck @ 80 c.ft.per ton.

Case V - Loaded as Case III but oil fuels and coal entirely consumed, and No.5 & 7 ballast tanks empty, also a half the store and 200 tons of fresh water consumed.

Case VI - Same as Case V but loaded as Case IV.

	Draft.	Displacement.	G.G.above base line.	Metacentre above base line.	G M
Case I	17'-10½"	10957.75	28.143	27.640	-.955
Case II	25'-7⅜"	16845.23	24.251	26.460	2.209
Case III	29'-2⅝"	19692.51	24.621	26.80	2.179
Case IV	31'-2⅛"	21258.15	24.780	27.15	2.39
Case V	23'-5¾"	15189.03	26.812	26.435	-.377
Case VI	25'-6"	16754.67	26.784	26.46	-.324

"Chiyo Maru"

	Draft.	Displacement.	C.G. above base line.	Metacentre above base line.	G M
I	18'-3¼"	11261.57	28.673	27.479	-1.194
II	25'-10¼"	17027.46	24.429	26.500	2.071
III	29'-6½"	19947.65	24.802	26.875	2.073
IV	31'-6⅝"	21555.85	24.946	27.250	2.304
V	23'-10½"	15483.16	27.019	26.485	- .534
VI	25'-11½"	17091.40	26.998	26.500	- .498

—:0:—

Trials.

As for trials, although the responsibility for the ship's line and the required horse power is due to the ship designer, the honour of satisfactory results obtained in the trials is more due to the Engine designer, therefore the details of trials will not be given here, but only main results of full speed trials.

Official Trials.

"Tenyo Maru"

Measured 3 mile course.

Displacement	I4I45 tons.
Draft mean	22'- I½"
@ area	I306
Block Coeft.	.656
@ "	.952
Mean of means 6 runs	20.6I
Max. speed obtained	20.9I

"Chiyo Maru"

Measured 3 mile course.

Displacement	I4020 tons.
Draft mean	2I'-I0½"
@ area	I294.63
Block Coeft.	.655
@ "	.952
Mean of means 6 runs	20.62

—:0:—

The stopping trials were made on the "Tenyo Maru" and average time taken to bring the vessel to dead stop by putting the machinery full speed ahead of three turbines to full speed astern with two wing turbines, the centre turbine being stopped, was 2¾ minutes.

—:0:—

Weight of Ships.

On completion the actual weight of ships were as follows:-

	"Tenyo Maru"	"Chiyo Maru"
Weight of Steel & Wood	7991.08	7957.87
" " Cement	325.25	284.05
" " Outfit	638.68	634.86
Total	8955.01 tons.	8876.78 tons.

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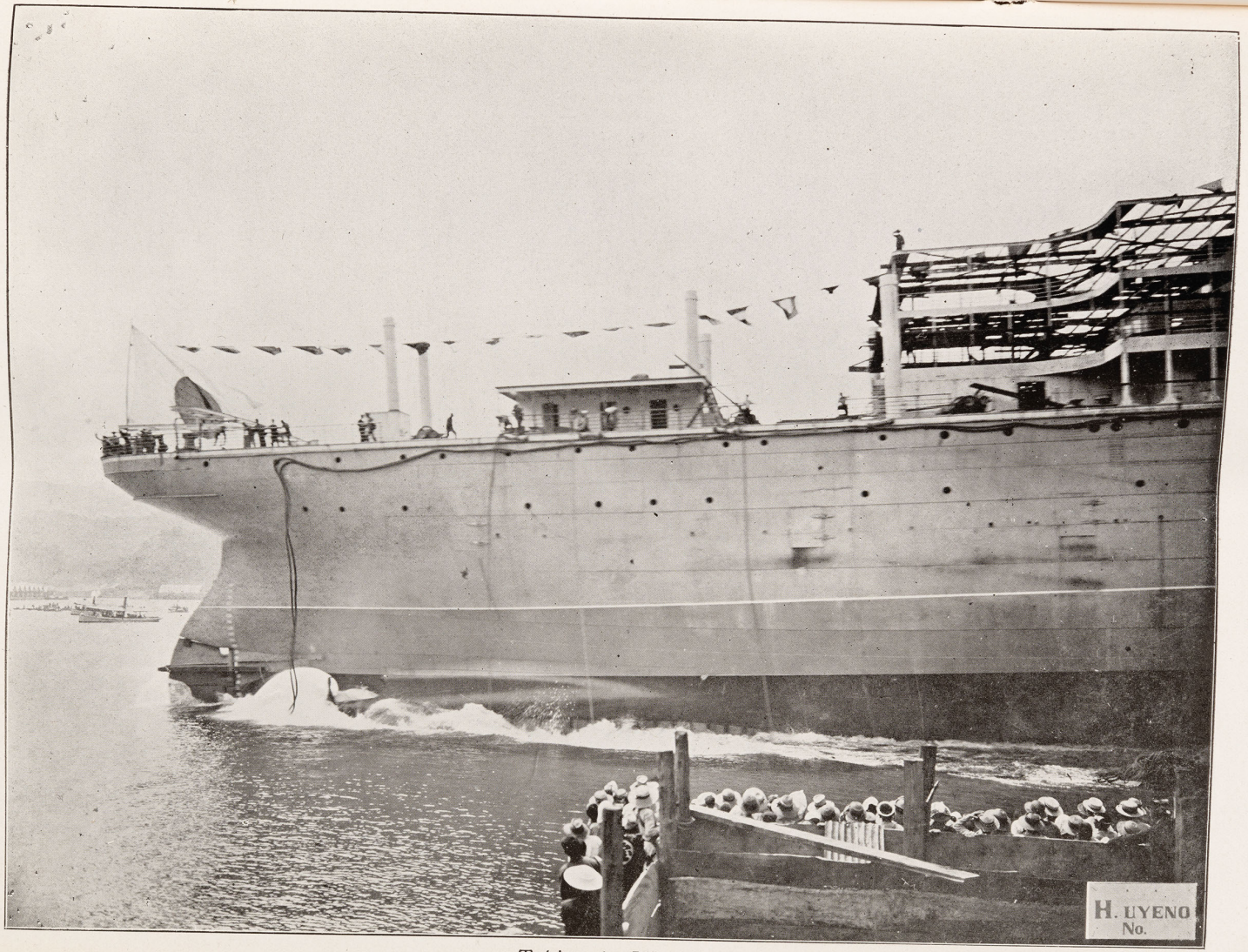
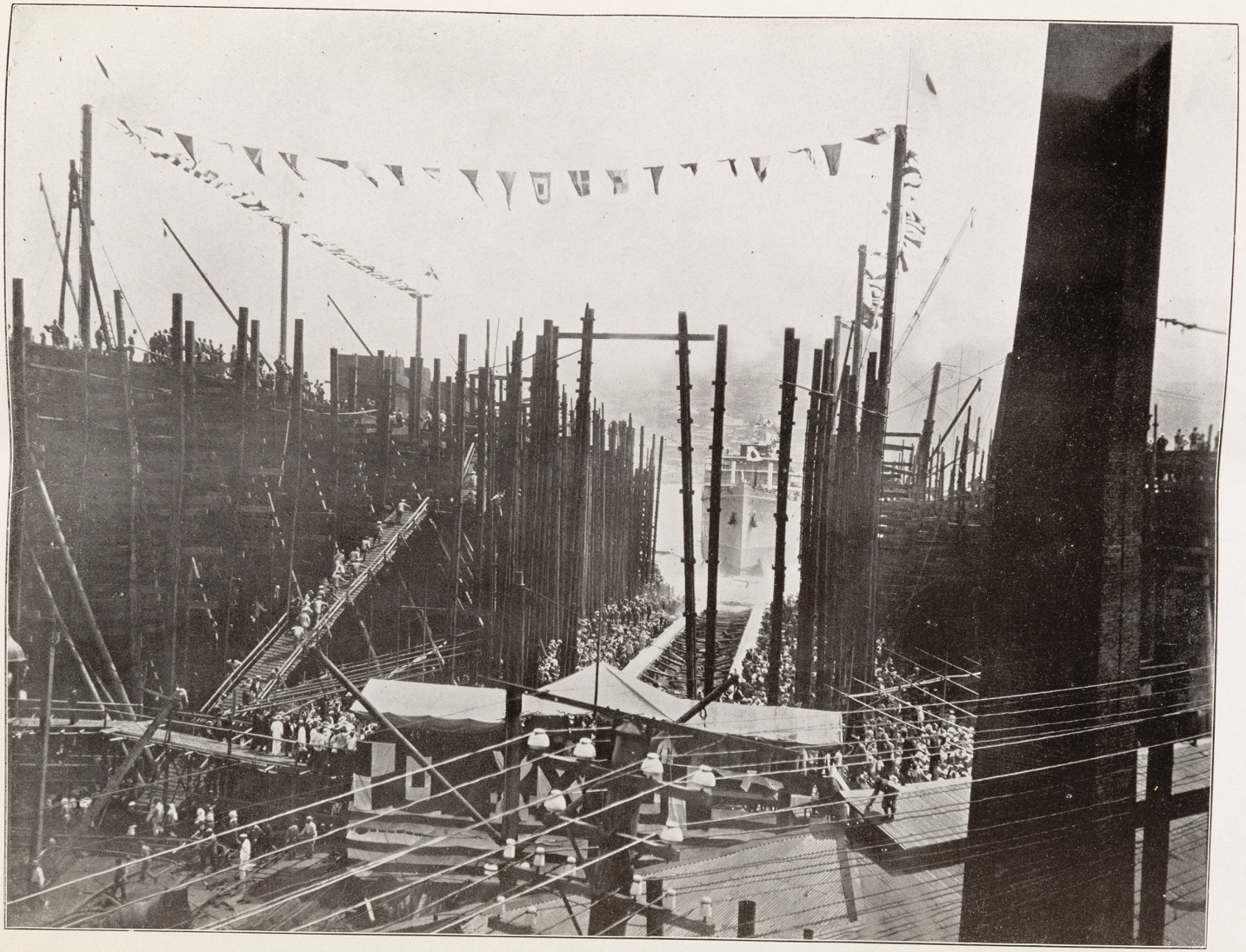
On the Launching Ways, (Stern View).

On the Launching Ways, (Stern Side View).



Taking the Water.

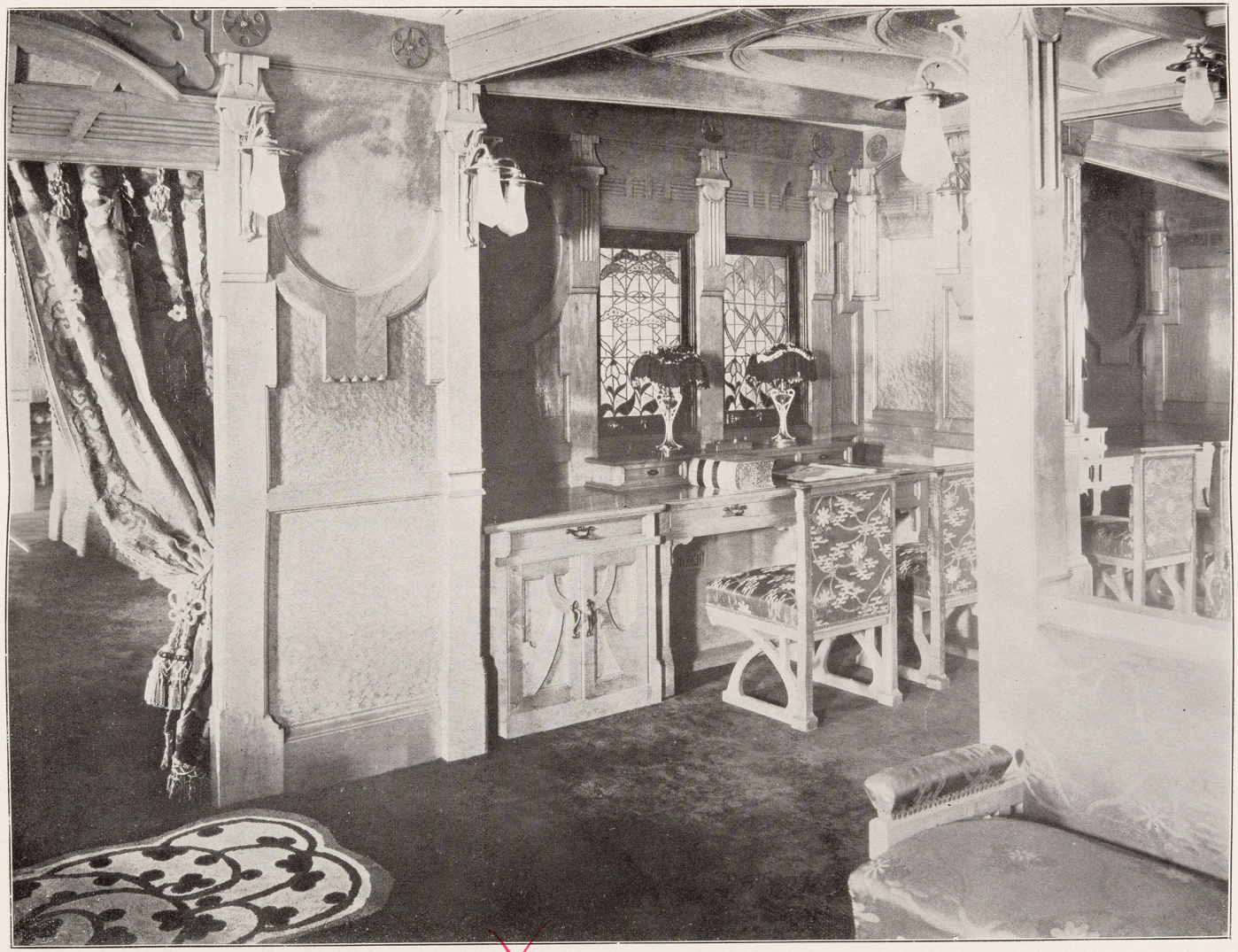


Left the Ways.

Afloat.

Reading Room.

Main Companion, Door to Reading Room.



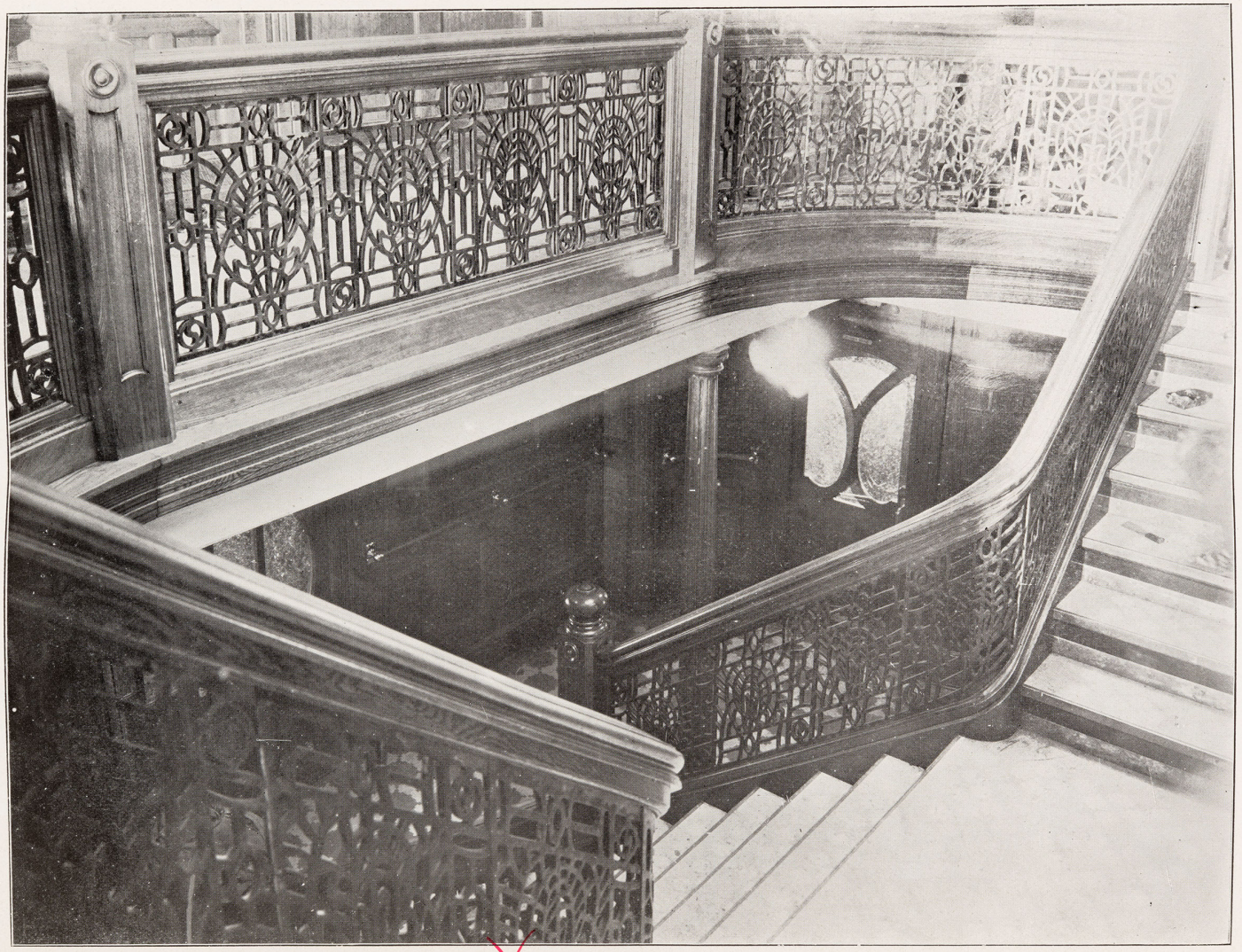
Reading Room.

Drawing Room.

Drawing Room.

Main Companion, with Oil-Painting by Mr. Eisaku Wada.

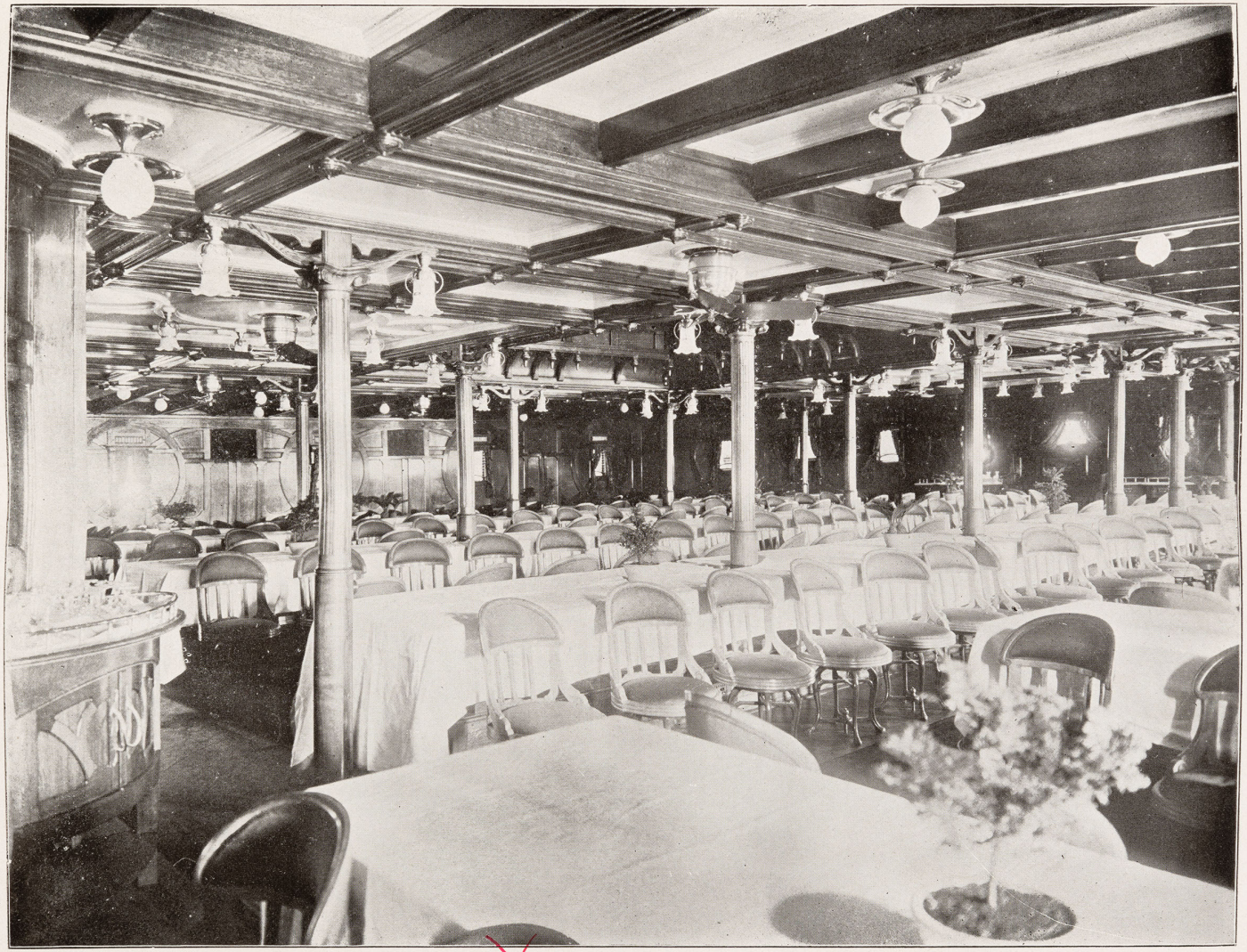
Oil-Painting by Mr. Eisaku Wada.



Grand-Stairway.

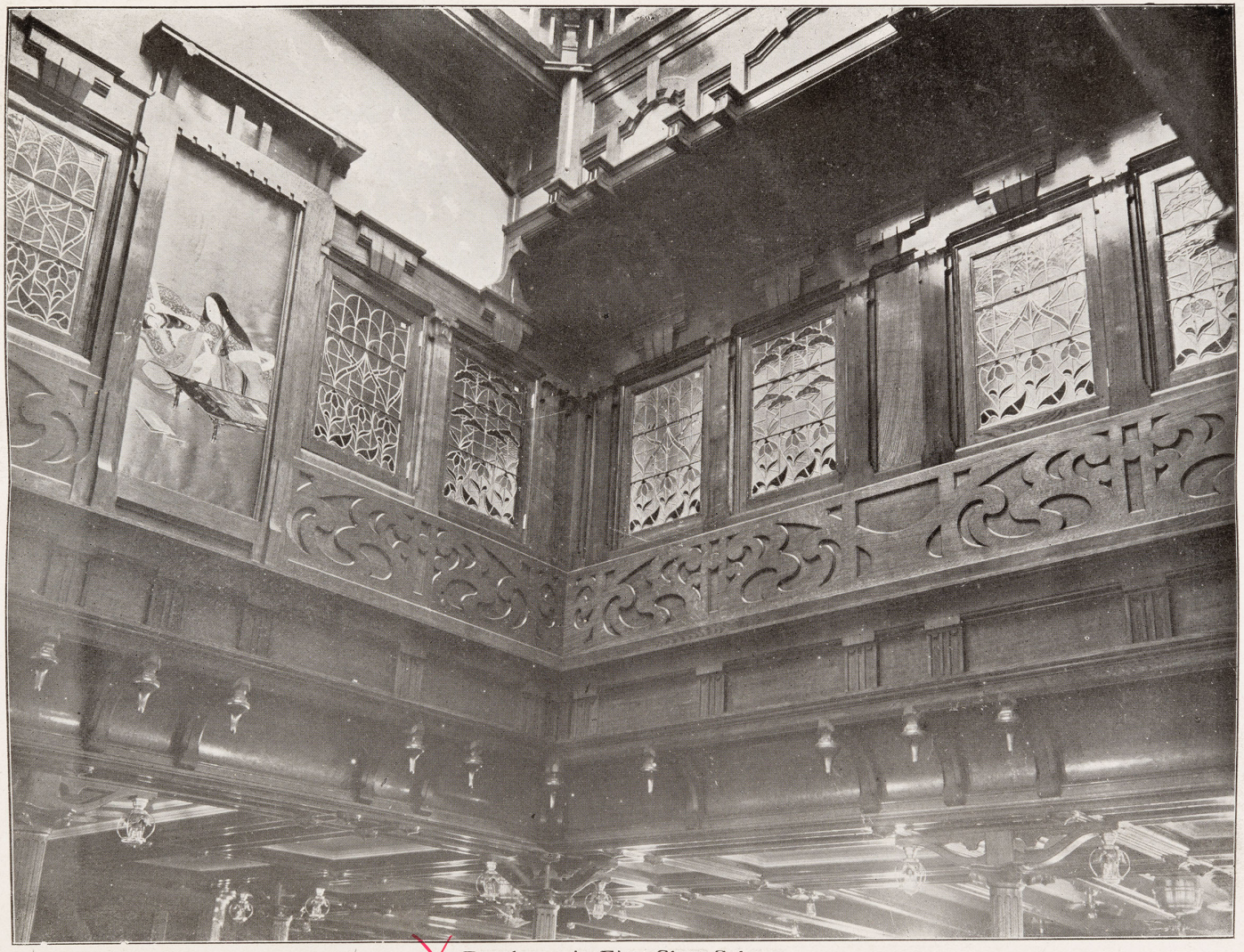
Door to First Class Saloon.

First Class Saloon.

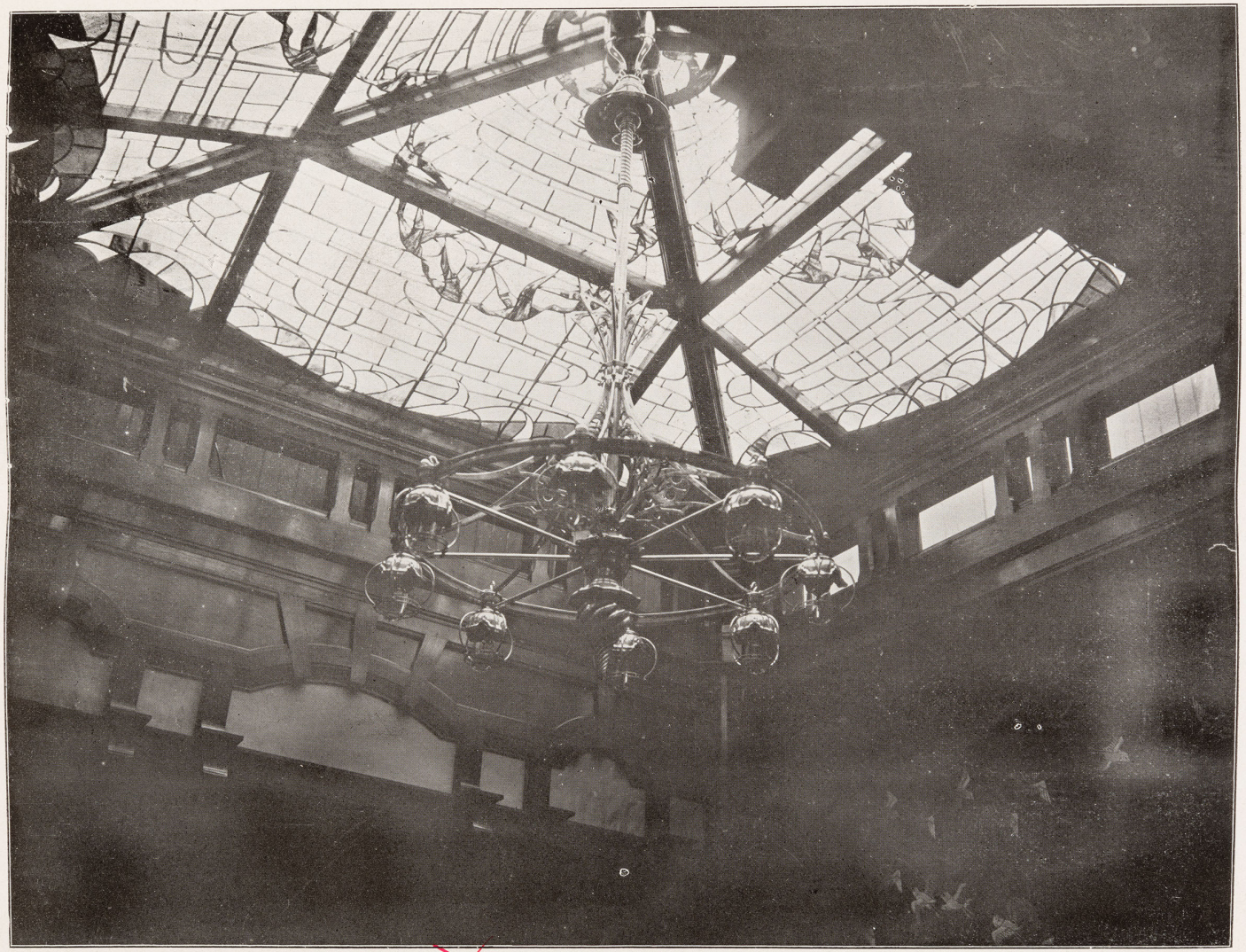


First Class Saloon.

Trunkway in First Class Saloon.



Trunkway in First Class Saloon.

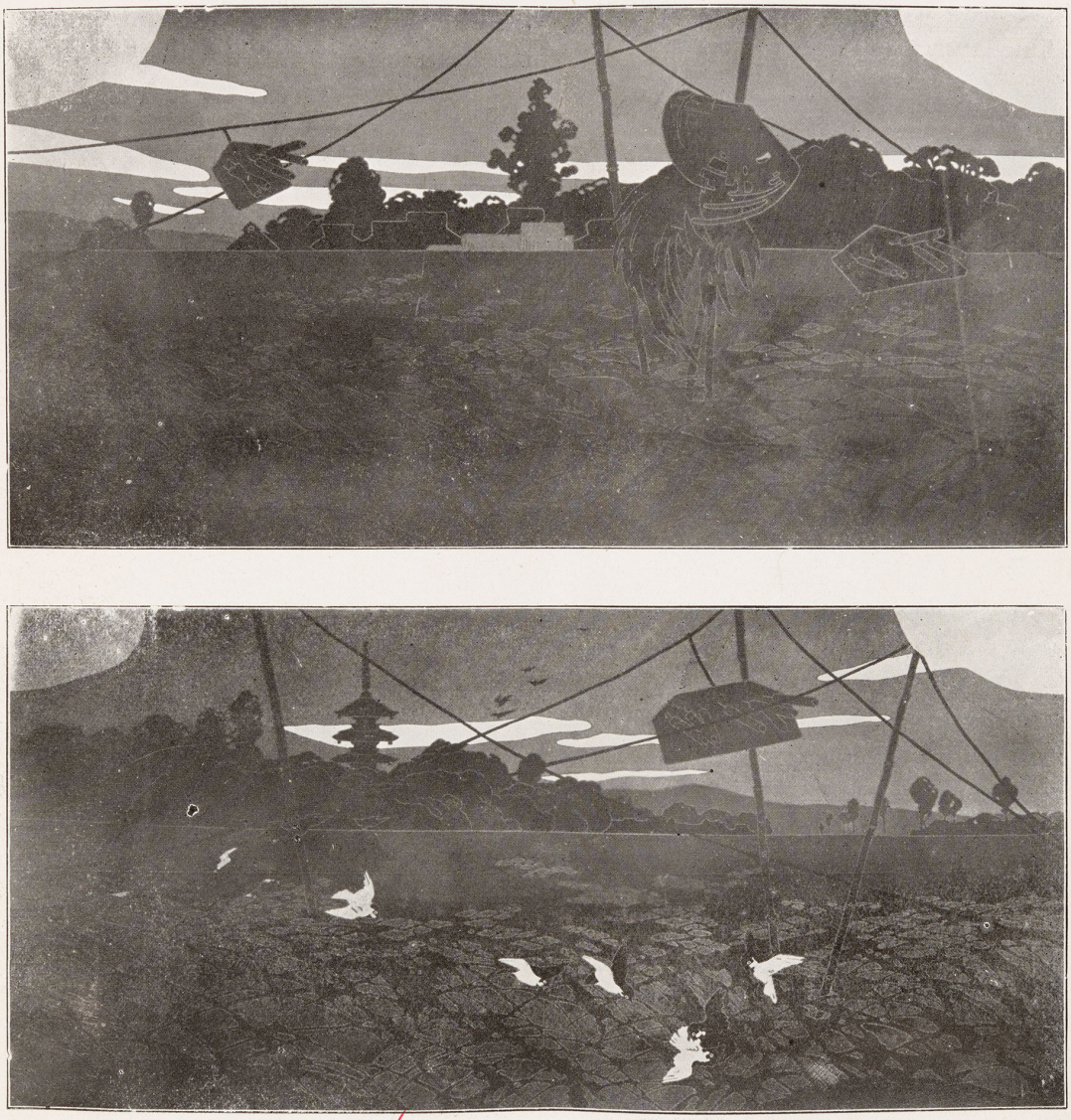


Dome in First Class Saloon.

Goblin Fabrics in Trunkway.

Lounge.

Lounge.



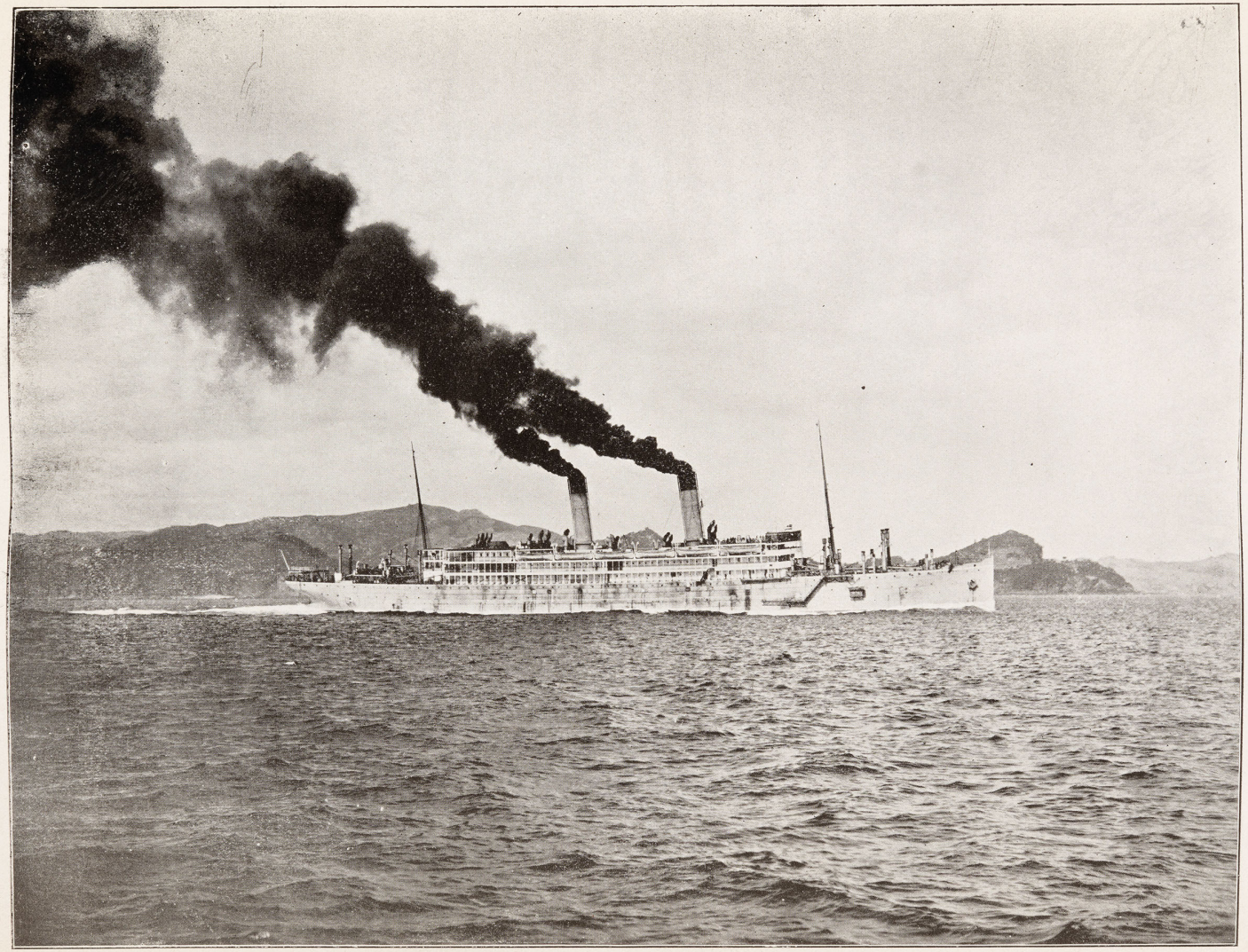
Goblin Fabrics in Lounge.

Smoking Room.

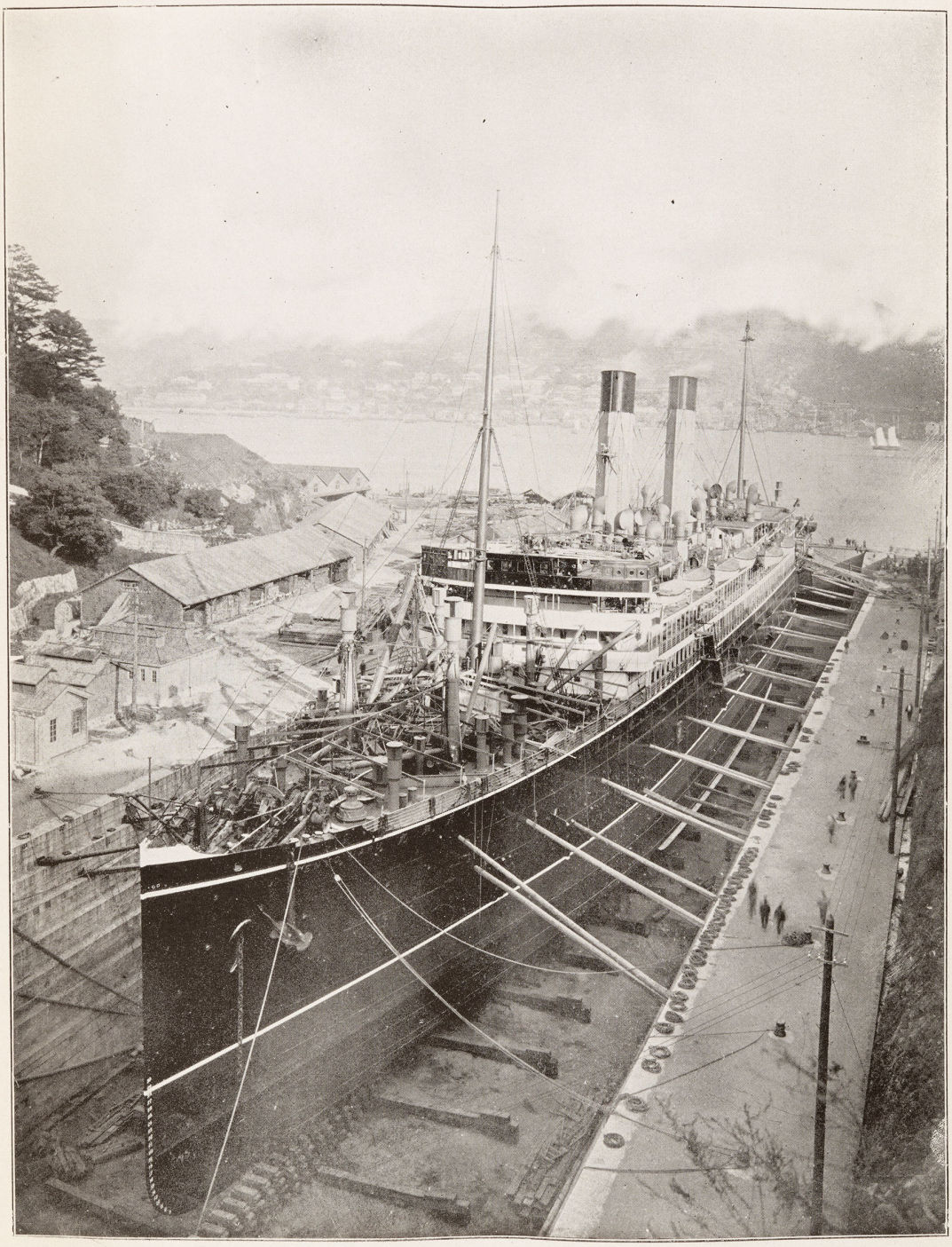
Smoking Room.

Goblin Fabrics in Smoking Room.

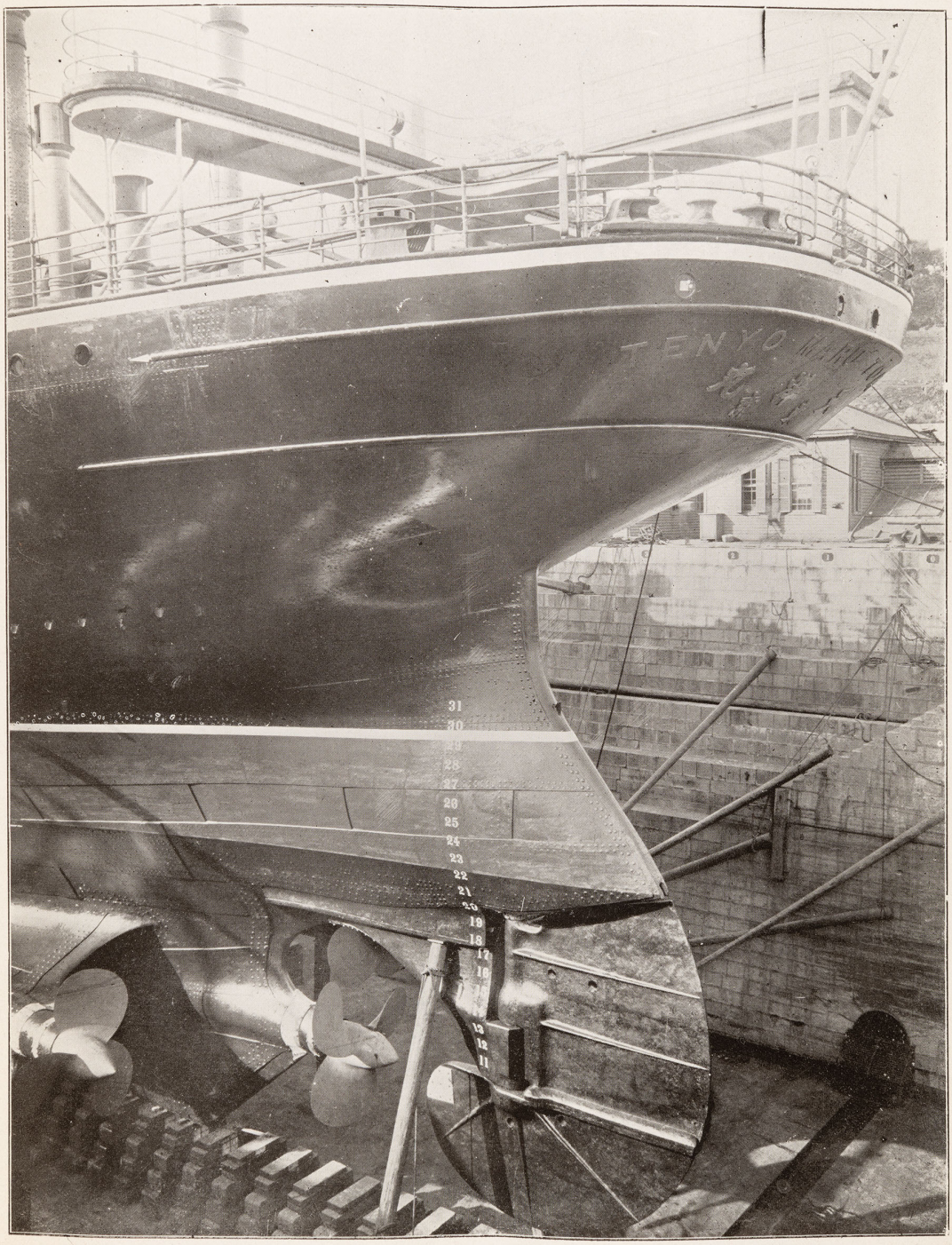
Captain's Room.



Running Her Full Speed Trial.

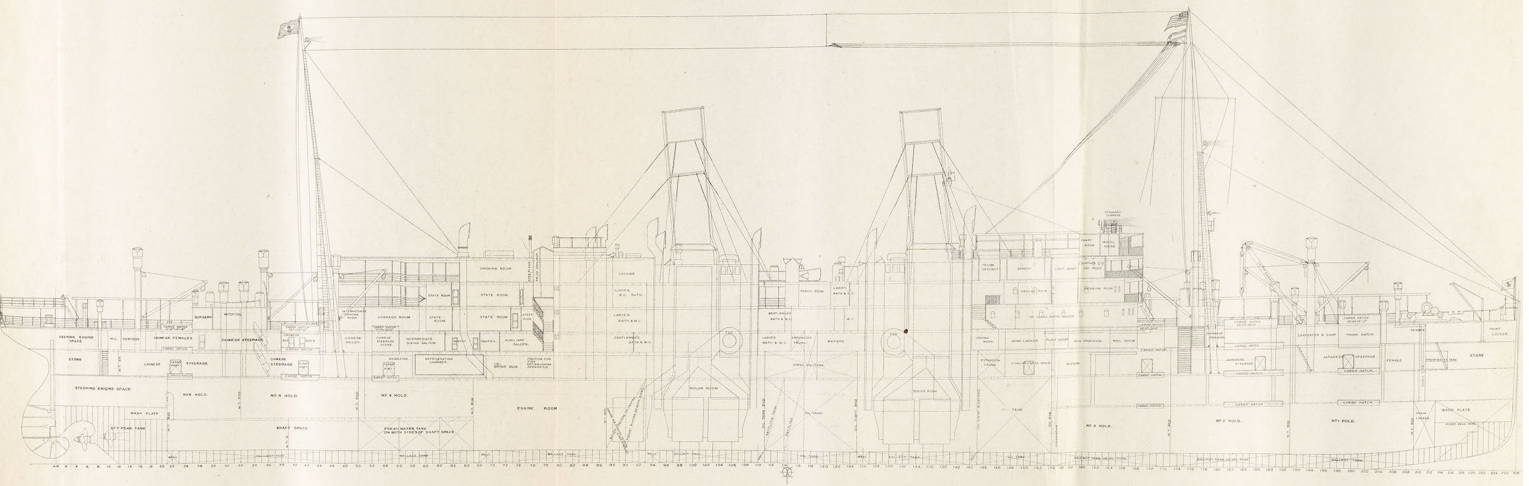


In No. 3 Dry-Dock.



In No. 3 Dry-Dock, (Stern View).

Completed.


STEERING ENGINE SPACE
STORE
CHINESE STEERAGE
JAPANESE STEERAGE
FEMALE
STEWARDESS
STORE
SMOKING ROOM
STATE ROOM
LOUNGE
LADIES' W.C. BATH.
LADIES' BATH & W.C.
GENTLEMENS' BATH & W.C.
SALOON
WATERS
MEN'S BATH & W.C.
LADIES' BATH & W.C.
FAMILY ROOM
W.C.
ENGINE ROOM
BOILER ROOM
No 6 HOLD.
No 5 HOLD.
No 4 HOLD.
No 3 HOLD.
No 2 HOLD.
No 1 HOLD.
AFT PEAK TANK
FORE PEAK TANK
SHAFT SPACE
WASH PLATE
BATH. PLATE

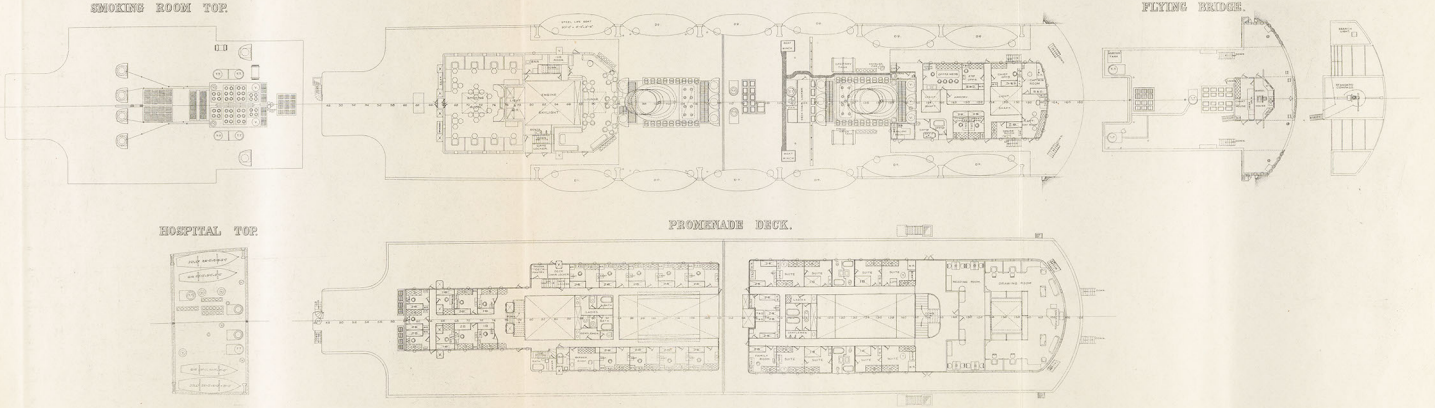
BOAT DECK.

SMOKING ROOM TOP.

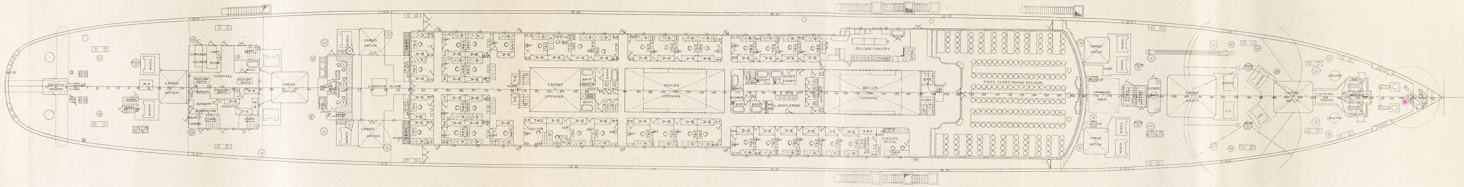
FLYING BRIDGE.

HOSPITAL TOP.

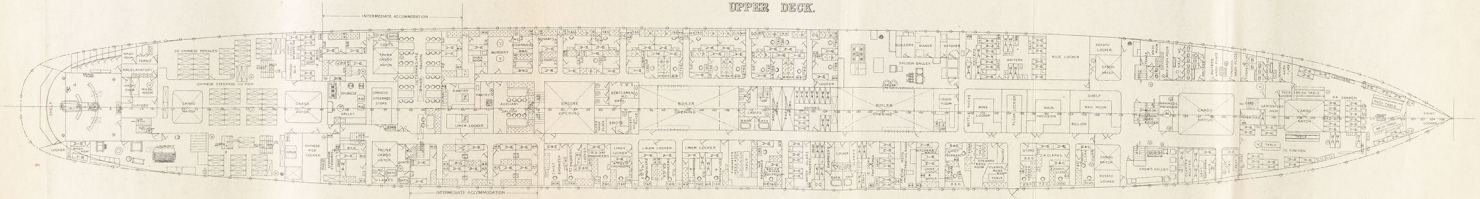
PROMENADE DECK.



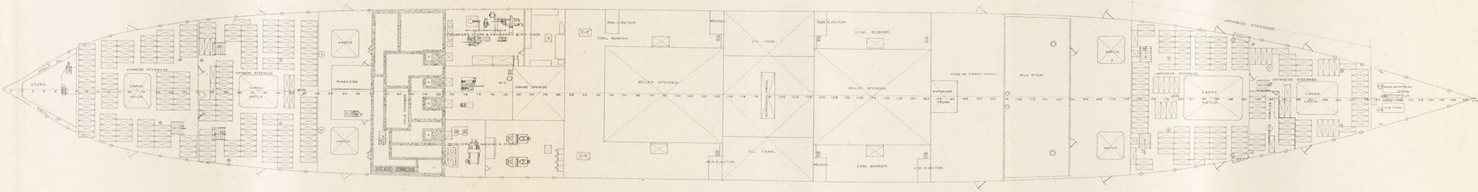
SHELTER DECK.



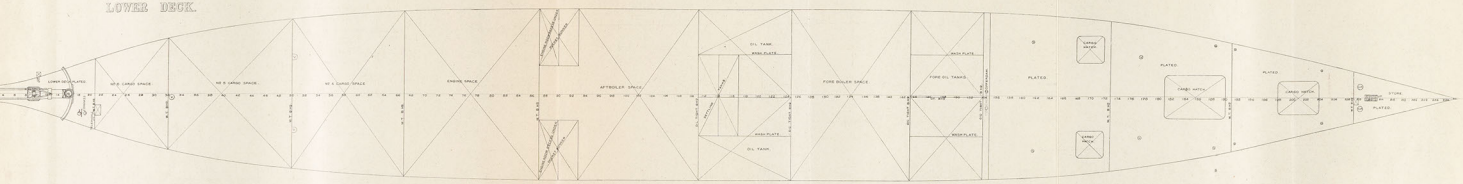
UPPER DECK.



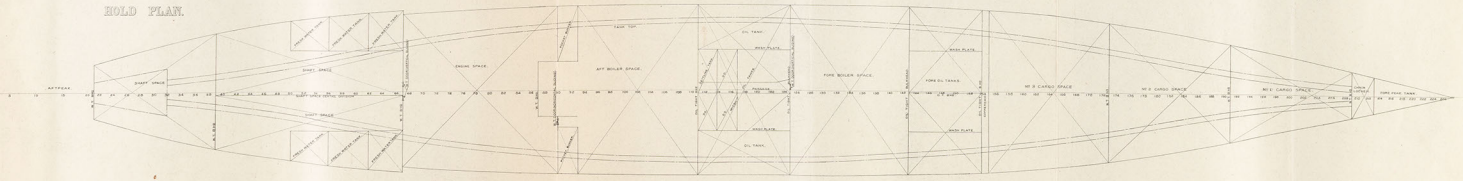
MAIN DECK PLAN.

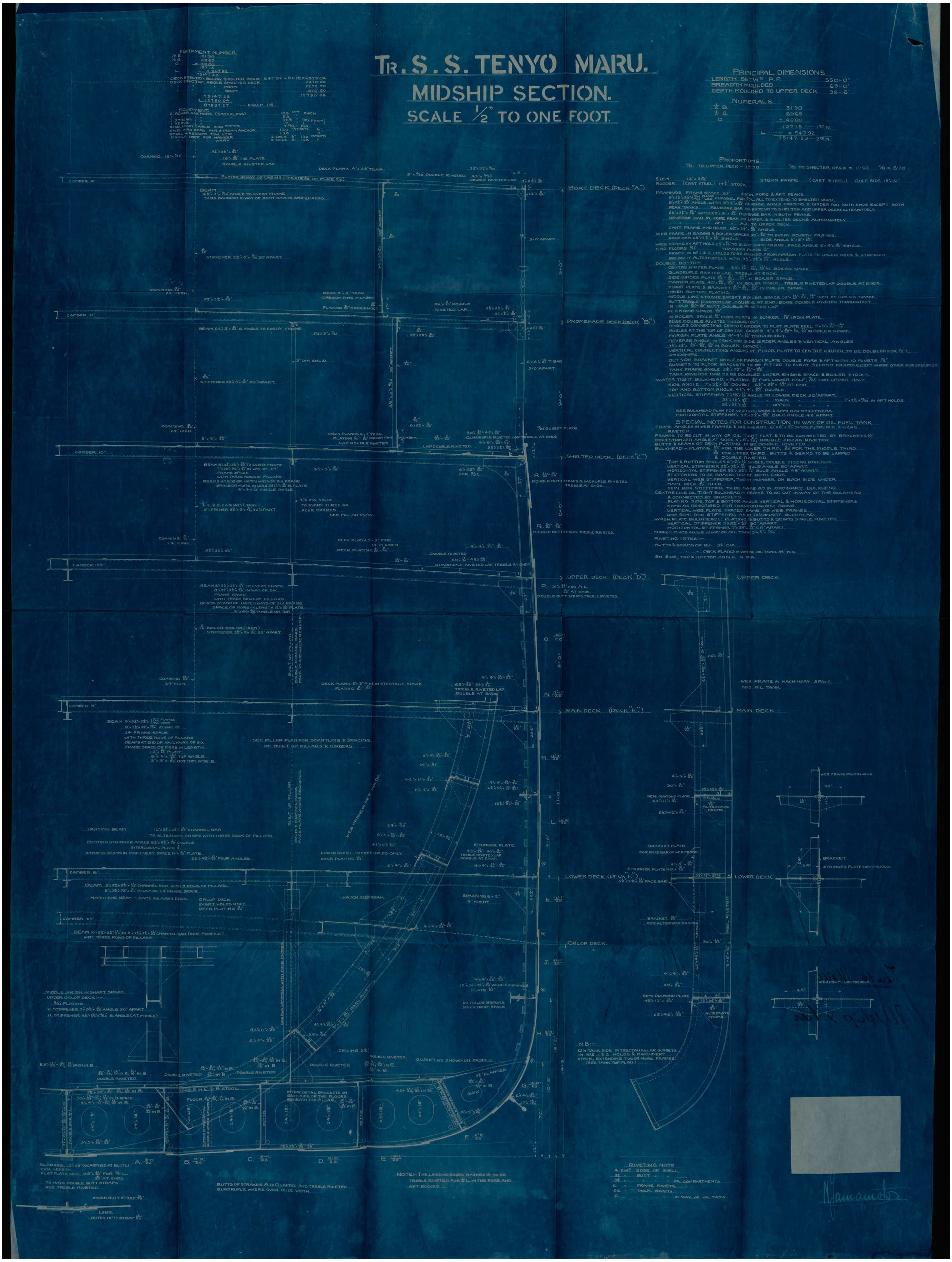


LOWER DECK.



HOLD PLAN.





Tr. S. S. TENYO MARU.
MIDSHIP SECTION.
SCALE 1/2" TO ONE FOOT.
PRINCIPAL DIMENSIONS.
LENGTH BETWn. P.P. 550-0"
BREADTH MOULDED 63-0"
DEPTH MOULDED TO UPPER DECK 38-6"
NUMERALS.
EQUIPMENT NUMBER.
PROPORTIONS.
BOAT DECK. (DECK "A")
PROMENADE DECK. (DECK "B")
SHELTER DECK. (DECK "C")
UPPER DECK. (DECK "D")
MAIN DECK. (DECK "E")
LOWER DECK.
ORLOP DECK.
UPPER DECK.
MAIN DECK.
LOWER DECK.
WEB FRAME IN MACHINERY SPACE AND OIL TANK.
SPECIAL NOTES FOR CONSTRUCTION IN WAY OF OIL FUEL TANK.
RIVETING NOTE
SEE PILLAR PLAN FOR SCANTLING & SPACING OF BUILT UP PILLARS & GIRDERS.

Midship Section of the vessel.

Apl. 1910

The general description and some of the actual technical data of two large trans-pacifi[illegible]d "Chiyo Maru"

for which I wa[illegible]r the design of Ship depart-ment, but not on t[illegible] Engine department and Elec-trical department. [illegible]ption the pamphlet which was written and compil[illegible]or distribution amongst the friends and engine[illegible] of, but the parts dealing on the subjects for w[illegible]le are crossed out for the distinction.

B[illegible]

B[illegible]

M[illegible]HI

DO[illegible]AND

ENGINE WORKS, NAGASAKI.

(AUGUST 1908.)