THE JAPANESE ARMOURED CRUISERS "KASUGA" AND "NISSHIN."

CONSTRUCTED BY MESSRS. GIO. ANSALDO AND CO., SHIPBUILDERS, AND ENGINEERS, SESTRI PONENTE, ITALY.

(*For Description, see Page* 504.)

Fig. 1.

LONGITUDINAL VIEW.

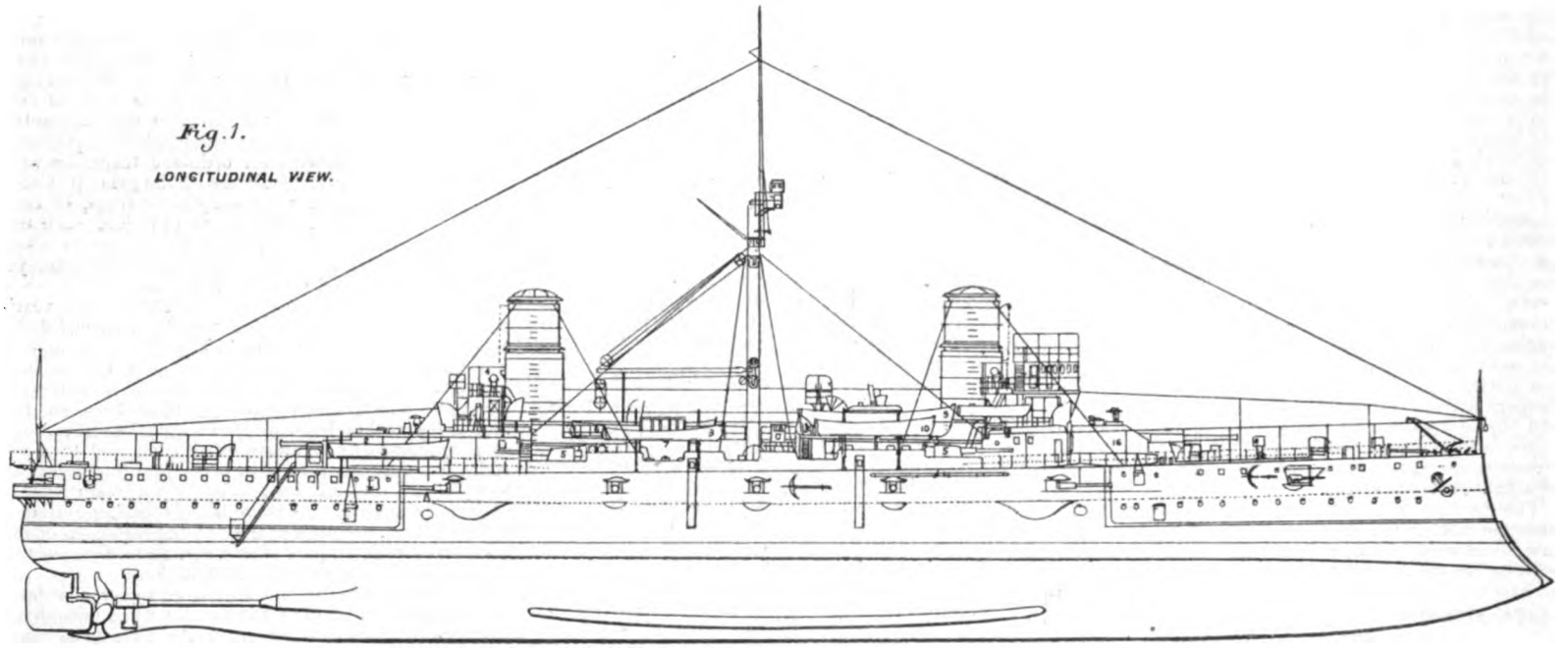


Fig. 2. PLAN OF UPPER DECK ACCOMMODATION.

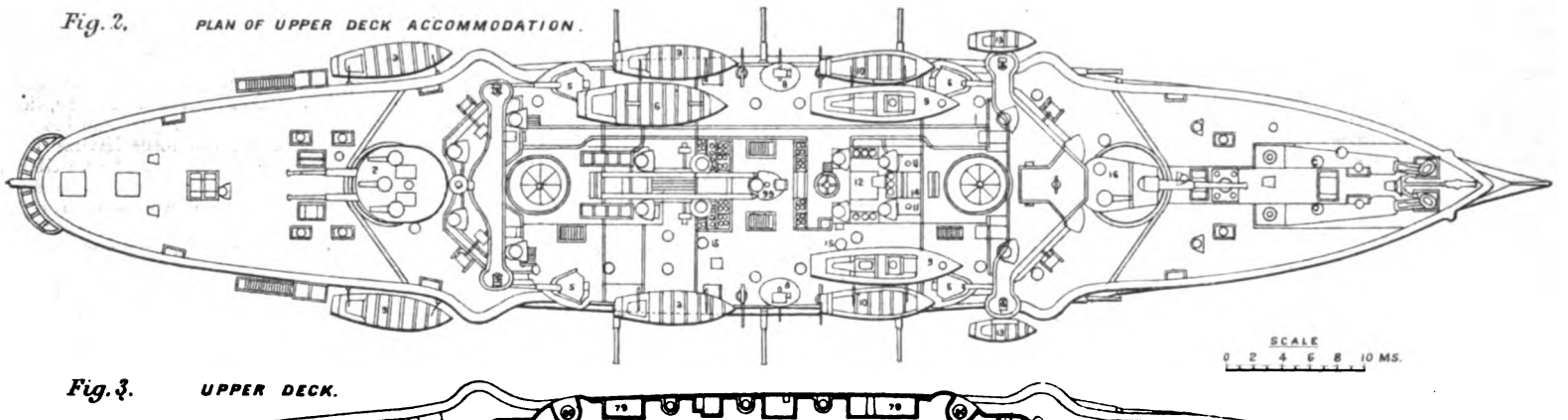


Fig. 3. UPPER DECK.

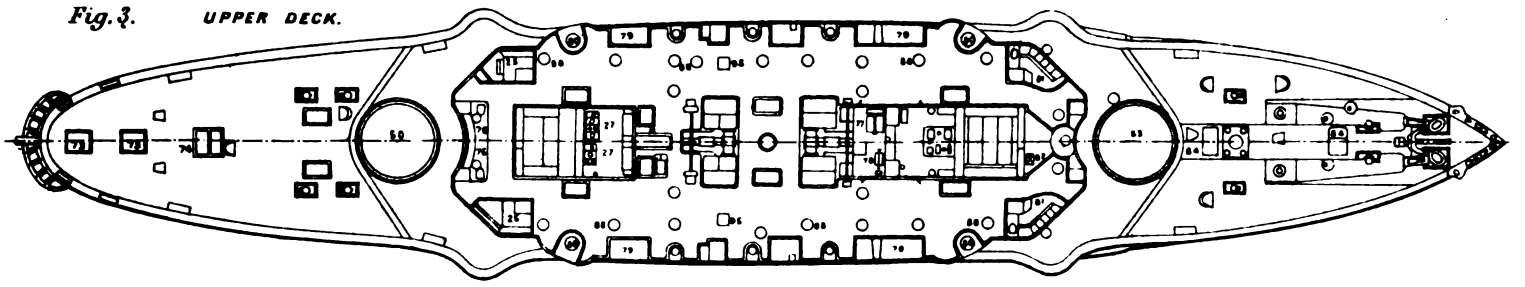


Fig. 4. MAIN DECK.

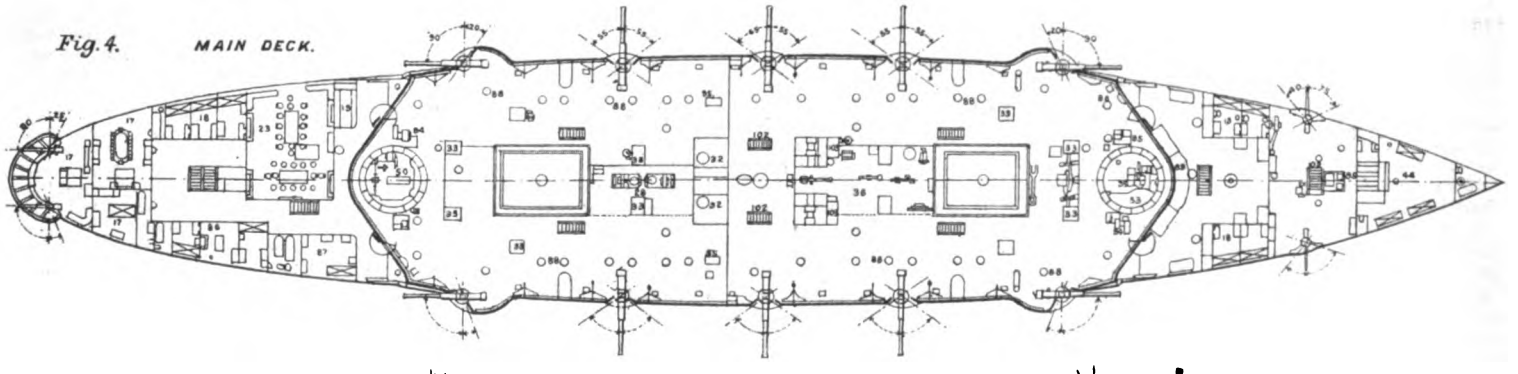
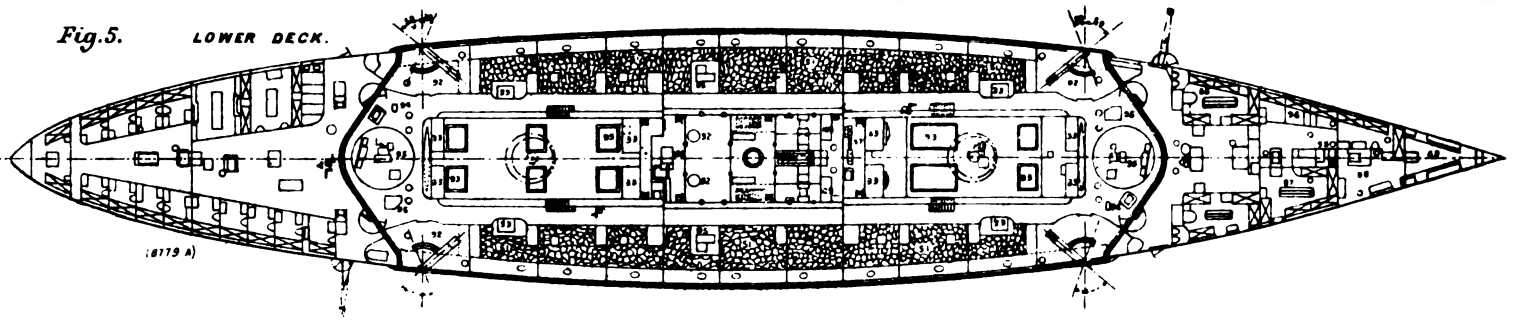


Fig. 5. LOWER DECK.



(8179 A)

THE JAPANESE ARMOURED CRUISERS "KASUGA" AND "NISSHIN."

CONSTRUCTED BY MESSRS. GIO. ANSALDO AND CO., SHIPBUILDERS AND ENGINEERS, SESTRI PONENTE, ITALY.

(*For Description, see* Page 504.)

Fig. 6. LONGITUDINAL SECTION.

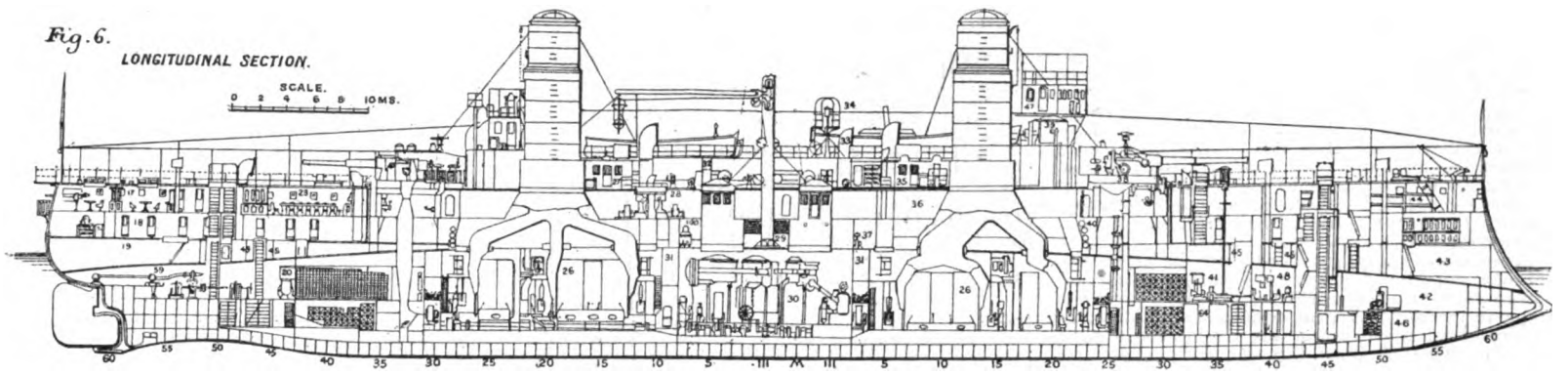


Fig. 7. AFT VIEW.

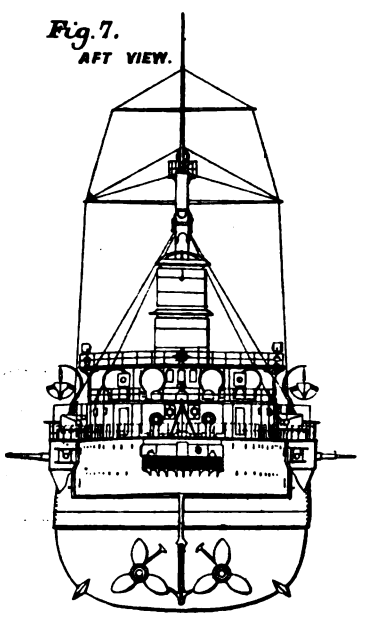


Fig. 8. MIDSHIP SECTION.

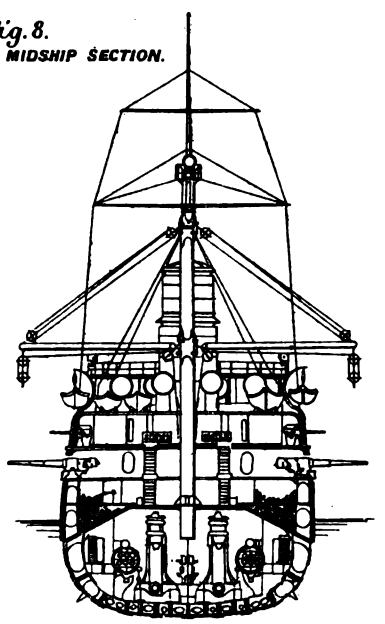


Fig. 9. BOW VIEW.

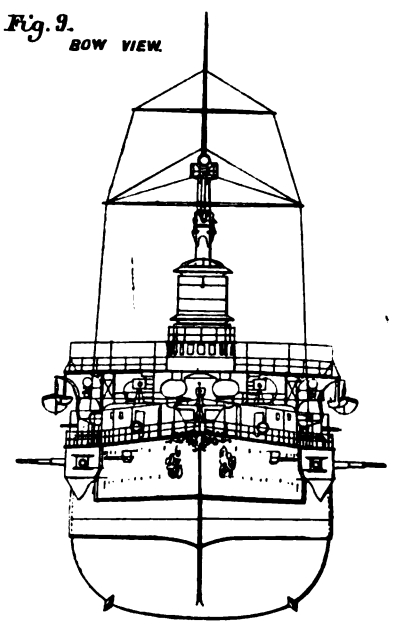


Fig. 10. PROTECTIVE DECK.

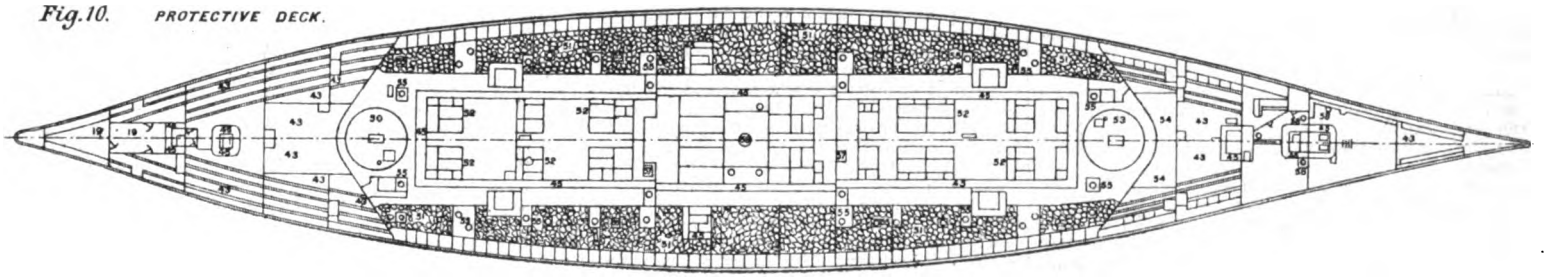


Fig. 11. PLAN OF HOLD (SUPERIOR)

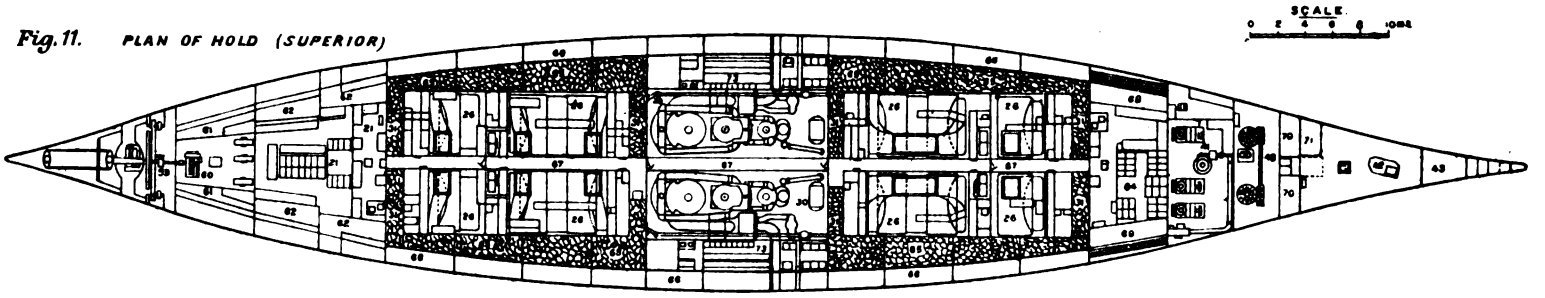
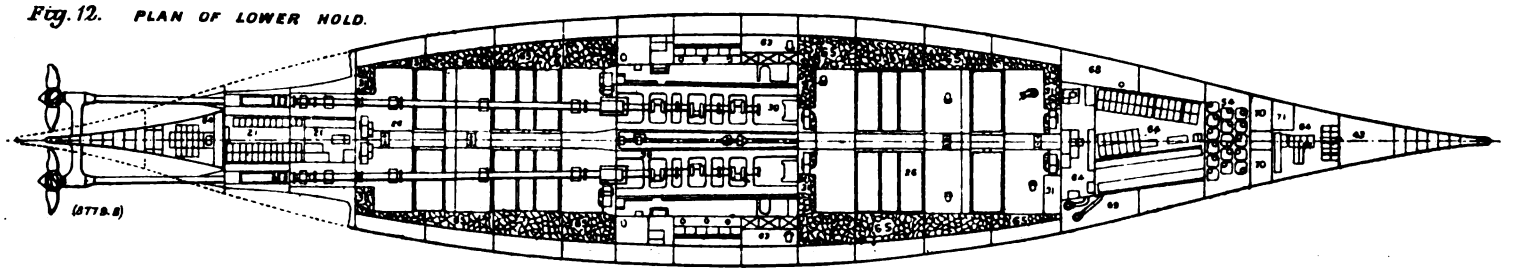


Fig. 12. PLAN OF LOWER HOLD.



THE JAPANESE CRUISERS "KASUGA" AND "NISSHIN."

*The Armoured Cruisers "Kasuga" and "Nisshin," of the Imperial Japanese Navy.**

By Colonel N. SOLIANI.

I HAVE written this paper on the armoured cruisers Kasuga and Nisshin, of the Imperial Japanese Navy, in accordance with the kind suggestion of Sir W. H. White and approval of the Council of the Institution, who—notwithstanding that these ships have already been described, and that their type is by no means new, both having been described in technical papers—thought that a complete record of them would be of some interest. Their authority and their benevolence dissipated my diffidence in the matter, and it only remained for me to try and do my task as best I could. I am not sure of having succeeded, but have endeavoured as much as possible to give the authentic and correct facts, whatever their value may be.

The cruisers Kasuga and Nisshin are the last of a series of sister-ships (ten in number), stretching over a period of about eleven years, from 1893 to 1904. They had a prototype in the earlier Italian cruisers Carlo Alberto and Vittor Pisani, which, except that the armament was less powerful, were of practically the same design. As a main armament, the Carlo Alberto and Vittor Pisani had twelve 6-in. guns, while the Garibaldi (the first of the list of the Kasuga and Nisshin type) had two 10-in. guns and ten 6-in. guns. But, as a compensation, the former ships had a long forecastle, which made them more suitable to ocean steaming and long commission on distant stations.

The genesis of the Carlo Alberto and Vittor Pisani was, in fact, the design of a protected cruiser of about 4000 tons, intended for long cruises abroad. This protected cruiser had the same main features—viz., speed, armament, and structural design—as they had. Admiral Saint Bon, then Minister of Marine, to whom the design prepared under his predecessor was submitted, thought it then unwise for Italy to spend money on warships having no side armour. A sketch submitted to him, and showing the desired armour protection, was approved, and resulted in the construction of the cruisers Carlo Alberto and Vittor Pisani from the complete design of Naval Constructor Colonel (now Lieut.-General) Edoardo Masdea. He was also the designer of the cruiser Garibaldi, the first on the list.

The fact of a ship design being repeated over and over again during a long period adds perhaps to the interest it may deserve; and this may also be enhanced by the circumstance that seven out of ten ships of the list passed, before being complete, to nations other than those for which they were intended and built, including the Kasuga and Nisshin, which, commenced and practically completed for the Argentine Government, have taken an active and useful part in the present war in the Far East under the flag of the Japanese Navy.

It is well known that the transfer to the Japanese Government of the Kasuga and Nisshin, which, under the names of Rivadavia and Moreno, were built for the Argentine Government, was mainly due to the same circumstances as caused the battleships Triumph and Swiftsure to pass from the Chilian to the British Navy. In the case of the remaining five ships which were commenced for the Italian Government, four were transferred to the Argentine Navy, and one—the Cristobal Colon—to the Spanish Navy. The transfer was possible because the shipbuilders had, by contract, sufficient time allowed for delivery to enable them to sell the ships that had been commenced, and to build others for the Italian Navy within the contract time, with all desired improvements and changes.

I say improvements and changes intentionally, because, although they were all intended as improvements, it is doubtful whether all of them were such in effect. For example, while the two first ships—the Giuseppe Garibaldi and the Varese—which passed to the Argentine Navy as Garibaldi and San Martin, had cylindrical boilers, the following ships had boilers of the Belleville and the Niclausse water-tube types; while cylindrical boilers were again used in the Kasuga and Nisshin.

Real improvements were, however, made, such as increase and better arrangement of armament;† better development of the electric plant, which, especially on the Kasuga and Nisshin, is, comparatively speaking, large and perfected in all details.

The first five ships all had the following dimensions:—

Length between perpendiculars	328.10 ft.
Breadth (moulded)	59.75 ,,
Mean draught	23.25 ,,
Displacement	6340 m.-tons
Corresponding supply of coal	600 ,,
Speed	20 knots

The Giuseppe Garibaldi, the Varese, and the Ferruccio had an increase of six frame spaces, equal to 4.86 metres, in the middle part, which permitted a better arrangement and subdivision of boilers and increased coal capacity. The power of the propelling engines was increased from 13,000 to 13,508 indicated horse-power, to insure, as for the preceding ships, the desired speed of 20 knots.

In order of date, the ten ships, with their principal characteristics, stand as given in the annexed table.

The cruisers Kasuga and Nisshin were contracted for to be exactly the same as the Giuseppe Garibaldi, built and delivered to the Italian Government, with the exception that the boilers were to be of the ordinary cylindrical type.

Of course, such a change, although small in appearance, entailed, apart from increased weight, many alterations in structural details, which were afterwards augmented by successive improvements and additions desired by the Argentine Commission, to which I shall refer later on, but there was no alteration in the main structural features of the ships from those of their predecessors.

The principal points which are not peculiar to the Kasuga and Nisshin, but are common to the whole series of ships, are the following:—

(*a*) Armament;
(*b*) Protection;
(*c*) Structural arrangement;
(*d*) Speed;
(*e*) Coal endurance.

(*a*) In regard to the armament, which will be dealt with more in detail hereafter, it will suffice now to call attention to its importance, as shown above, in relation to the size of the ships and to their other features entailing weight; and it is convenient to say here that the armament of all these ships was made and supplied by the firm of Sir W. G. Armstrong, Whitworth, and Co., Limited, through their works at Pozzuoli, in Italy.

The protection has lost some of its original value, although it may be said to be up to date even now. When it was planned the leading idea was to have a complete outside armour protection thoroughly efficient against shells, and an internal deck of sufficient strength to protect all the vital parts below against shell explosion, should any happen to occur inside the armoured walls. Six inches was the general thickness chosen for the side armour; and I think it may be fairly admitted that, fourteen years ago, when the design of the prototype cruisers Carlo Alberto and Vittor Pisani was prepared, such armour was all that could be desired. The outside protection, although not covering the ship all over, was complete in a relative sense, as the side armour not only belted the ship completely at the water line, but above the belt it enclosed the whole armament, and other vital parts in a central citadel which, from the belt, went right up to the upper deck; while the upper deck itself on the top of the citadel, and the lower deck on the top of the belt, were also protected, so as to completely box in the defended parts. It is, perhaps, proper to add that the armour deck beneath the lower deck had the turtle-back form then common to all protected cruisers, the deck meeting the sides of the ship underneath the lower edge of the side armour. Such an arrangement was a natural consequence of the functions assigned to the side armour, and to the armour-deck itself, as above explained.

The armoured citadel, while enclosing the bases of the two turrets, afforded complete protection to the armament of 6-in. guns on the battery deck. It is well to note that the boxing of the guns inside the battery, although not carried out in such a thorough and efficient way as on the Japanese armour-clad Mikasa, was even then initiated, and its advantages understood, as the whole battery was subdivided into four compartments by means of a transverse bulkhead and a central longitudinal bulkhead, built up in connection with the funnel casings, to localise damage should a shell explode inside the battery.

The side armour, not being very heavy, was, for simplicity of construction, not recessed with its lower edge on a shelf, but was simply attached with its backing to the flush side of the ship. The side armour and its backing therefore projected outside the plating, thus increasing the width of the ship at the water-line. A strong angle-iron underneath the lower edge of the armour united it with the ship's side, and gave it some support. The stepping-out of the armour is a convenient point of support for shoring when docking. As will be seen from the engravings on pages 502, 503, and 505, the ships are three-decked—viz., in addition to the armour-deck, they have a lower deck, which in the central part of the ship combines with the armour-deck; a main deck and a flush upper deck.* The ships may be said to be symmetrical fore and aft; the propelling engines occupy the central part, and the boilers are in two equal groups, one forward and one abaft the engines, while the armament is also equally distributed forward and aft. The ships have one mast only, placed in the middle of the length. The location of the propelling engines in the middle, while not free from inconvenience, as it entails a greater length and weight of shafting, and a higher position of the after boilers, which are necessarily fitted above the shaft tunnels, has some important advantages. First, it affords a real duplication of the steaming power, one group of boilers being entirely separated from the other group, with no connection whatever, so that any damage affecting one of them, whether in the boilers or in the steam and feed-pipes, cannot in any way affect the other group.

Greater facility of supervision and direction is obtained by the engineer in charge over the whole machinery, as, without leaving the engine-rooms, he can keep personally in touch with, and attend to either of the groups of boilers, as may be necessary. A shorter length of all pipings in connection with the engine-room, and a more symmetrical and easy arrangement of the same, also result from this plan. And last, but not least, the central position of the engines is beneficial in reducing vibration in the ship due to the longitudinal couple of the inertia forces of the moving parts, which need not be so well balanced. In fact, especially on the Kasuga and Nisshin, vibrations were scarcely felt at any speed; while quite appreciable vibrations were set up by the single-cylinder dynamos forward when running alone, the ship being in harbour.

The central position of the engines, with corresponding symmetrical disposition of armament, dictated to a great extent the structural arrangement of the ships, which is, however, on the whole, the same as is usual in ships of their size and class. Attention, however, may be called to a central tunnel running along the middle line of the ship, close underneath the armour deck, and between and above boilers and engines. The idea of such a tunnel was taken from English warships built or building at the time, which had a similar central passage. But while in the British ships the side bulkheads of the tunnel went right down to the inner bottom and formed magazines below, in the Italian ships, failing the necessary space below, they were contented with the tunnel above, which, as in the English ships, was intended as a thoroughfare for easy communication between the various machinery compartments, for easy and accessible passage of electric wires, speaking-tubes, telegraphs, for the manœuvring of the main drainage valves, &c., and for eventual conveyance of ammunition from end to end, should necessity occur. This last utilisation was, however, subsequently discarded, the tunnel being shut at the ends, with no communication with the ammunition compartments. The tunnel was supported in the engine-

TABLE GIVING PARTICULARS OF ITALIAN ARMOURED CRUISERS.

Original Name.	Final Name.	Builder.	Date of Launch.	Type of Boilers.	Displacement. Metric Tons.	I.H.-P. Specified Metrical.	Armaments.
Giuseppe Garibaldi	Garibaldi	Ansaldo	1895	Cylindrical	6840	13,000	Two 10-in., ten 6-in., six 4.7-in., 22 minor guns four above-water torpedo-tubes.
Varese	San Martin	Orlando	1896	Do.	6882	13,000	Two 10-in., ten 6-in., six 4.7-in., 24 minor guns, four above-water torpedo-tubes.
Giuseppe Garibaldi	Cristobal Colon	Ansaldo	1896	Niclausse	6840	13,000	Two 10-in., ten 6-in., six 4.7 in., 22 minor guns, four above-water torpedo tubes.
Varese	General Belgrano	Orlando	1897	Belleville	6900	13,000	Two 10-in. fourteen 6-in., 24 minor guns, four above-water torpedo tubes.
Giuseppe Garibaldi	Lueyrredon	Ansaldo	1898	Ditto	6840	13,000	Two 10-in., ten 6-in., six 4.7-in., 22 minor guns, four above-water torpedo tubes.
Ditto	Giuseppe Garibaldi	Ditto	1899	Niclauss	7400	13,500	One 10-in., two 8 in., fourteen 6 in., 20 minor guns, four above-water torpedo tubes.
Varese	Varese	Orlando	1899	Belleville	7400	13,350	One 10-in., two 8-in., fourteen 6-in., twenty minor guns, four above-water torpedo tubes.
Ferruccio	Ferruccio	Royal Dockyard of Venice	1902	Niclausse	7400	13,500	One 10-in., two 8-in., fourteen 6-in., twenty minor guns, four above-water torpedo tubes.
Rivadavia	Kasuga	Ansaldo	1902	Cylindrical	7710	13,500	One 10 in., two 8-in., fourteen 6-in., twenty minor guns, four above-water torpedo tubes.
Moreno	Nisshin	Ditto	1903	Do.	7745	13,500	Four 8-in., fourteen 6-in., twenty minor guns, four above-water torpedo tubes.

In all ships the main armament of 10 in. guns and 8-in guns is carried in two revolving turrets, one forward and one aft.

* Paper read before the Institution of Naval Architects, April 12, 1905.

† For example, the four 6-in. guns, two forward and two aft, at the ends of main deck battery, while originally arranged for broadside fire like the remaining central guns of the battery, were altered to right ahead and right astern fire respectively.

* The following references relate to the illustrations, Figs. 1 to 12, on pages 502 and 503:—

1. Hatches to the admiral's rooms. 2. Casemate for 8-in. guns. 3. Boats—9 metres long. 4. 60-centimetre search-lights. 5. 6-in. guns. 6. Boat—11 metres long. 7. Fresh-meat store. 8. 6-pounder guns. 9. White steam-boats. 10. Life-boats—8.50 metres long. 11. Salt-water tanks. 12. Flag-room. 13. Boats—5.20 metres long. 14. Skylight on galley. 15. Rope-winches. 16. Casemate for 10-in. gun. 17. Admiral's saloon. 18. Officers' cabins. 19. Officers' pantry. 20. Fans. 21. Aft magazine. 22. Passage to store-rooms. 23. Officers' mess-room. 24. 8-in. guns. 25. Clerk's office. 26. Boiler-rooms. 27. Officers' galley. 28. Main-deck dynamos. 29. Firemen's bath. 30. Engine-room. 31. Athwartship bunkers. 32. Engine-room air-extractor. 33. Boiler-room ventilator. 34. Standard compass platform. 35. Crew's galley. 36. Workshop. 37. Donkey. 38. 10-in. gun. 39. Conning-tower. 40. Torpedo-room. 41. Lower dynamo-room. 42. Ice-making machine. 43. Store-room. 44. Sick bay. 45. Cofferdams. 46. Peak. 47. Nautical-room. 48. Steam-windlass. 50. 8-in. guns' support. 51. Spare bunkers. 52. Armour-deck crates. 53. 10-in. guns' support. 54. Fresh-water tanks. 55. Coal-boxes. 56. Mast. 57. Passage to Central tunnel. 58. Chain-tubes. 59. Steering-gear room. 60. Steering-engine room. 61. Engineers' store-room. 62. Gunners' store-rooms. 63. Oil-tanks. 64. Fore magazine. 65. Bunkers. 66. Longitudinal side tunnels. 67. Central tunnel. 68. Boatswain's store-room. 69. Steersman's store-room. 70. Anchor-chain lockers. 71. Stream anchor-chain locker. 73. Skylight on the admiral's rooms. 74. Ladders to the admiral's rooms. 75. Ladders to the officers' rooms. 76. Smoking-room. 77. Oven. 78. Kneading-machine. 79. Hammock berthings. 80. 6-in. guns' pedestal. 81. Crew's w.c. 82. Forge and anvil. 83. Conning-tower support. 84. Ladders to main deck. 85. Engineers' mess-room. 86. Commander's sitting-room. 87. Commander's bed-room. 88. Coal-scuttles. 89. Crew's bag shelves. 90. Cadets' mess-room. 91. First engineer's cabin. 92. Casemate for torpedo-tubes. 93. Boiler casings. 94. Chain-elevators. 95. Alternative elevators. 96. Warrant officers' berths. 97. Warrant officers' mess-room. 98. Store distribution room. 99. 75-centimetre search-light. 100. Thyrion pump. 102. Ladders to lower deck. 103. Engine-room ventilators.

rooms by the central longitudinal bulkhead which separates the two engines, and by pillars in the boiler-rooms, in two rows along the central longitudinal passage between the boilers.

In addition to the usual cofferdams around the hatchways of the protective deck, a cofferdam about 30 in. wide was built at the side of the ship from the protective deck to the main deck, to allow leakages to be stopped at the sides, and the slopes of the armour deck to be cleared of water, should damage occur to the armour belt.

(*d*) The specified speed of 20 knots was realised in nearly all the ships, including the Kasuga and Nisshin, as will be shown further on. This was a good speed fourteen years ago for such armoured ships.

(*e*) The coal endurance also, as reckoned by the 1000 tons of coal (increased in the Garibaldi and Kasuga and Nisshin to 1190 tons) the ships could carry, was fairly good, and quite ample for ships intended for Mediterranean service.

The Kasuga and Nisshin were contracted for on December 23, 1901, to be built in twelve months; but before one of them, the Kasuga, was launched (under the name of Rivadavia), the time of delivery, for reasons not depending upon the shipbuilders, was protracted. However, I confidently think that the ships could have been completed near the original contract time, all the necessary materials, like guns and armour, which affect so much the despatch of shipbuilding, having been supplied in good time by the makers. In this respect the shipbuilders were much assisted by the Italian Government, who helped them in many ways.

The keel of the Rivadavia (now Kasuga) was laid on March 10, 1902, and the ship was launched on October 22. The keel of the Moreno (now Nisshin) was laid on March 29, and the ship was launched on February 9, 1903.

Before the end of 1902 all the machinery for both ships was completed and ready to go on board. As previously stated, both ships were to be a repetition of the Giuseppe Garibaldi, built by the same firm of Messrs. Gio. Ansaldo and Co. for the Italian Government, with the exception only of the boilers, which were to be cylindrical, in lieu of the Niclausse water-tube type.

The cylindrical boilers being heavier, in order to simplify matters with regard to speed, it was agreed in the contract that the specified speed of 20 knots of the Giuseppe Garibaldi was to be obtained under precisely the same conditions of draught as in the trials of the latter. The conditions of air-pressure in the stokeholds were, of course, modified to suit the different types of boilers: ½ in. of air-pressure was allowed for natural draught, and not over 1.6 in. of forced-draught trials.

General Dimensions and Data.

Length over all		111.730 metres
,, at water-line		108.860 ,,
,, between perpendiculars		104.860 ,,
Moulded breadth		18.200 ,,
Breadth outside armour		18.710 ,,
Moulded depth		12.190 ,,
Draught on trials	forward	6.600 ,,
	mean	7.100 ,,
	aft	7.600 ,,
Displacement on trial		7.400 met. tons
Indicated horse-power		14,800 met. H.-P.
Speed		20 knots
Total coal capacity		1,190 met. tons
Rudder area		16.98 sq. metres

Armour.—All detailed figures will be found on page 506 (Figs. 13 to 19). The armour-plates were supplied by the steel works of Terni.

Structure, Scantlings, and Materials.—Structure and scantlings are shown on the drawing of the midship section (Figs. 20 and 21, page 506). The hull is built of mild Siemens-Martin steel, no special steel being used anywhere. Wood was limited to upper-deck planking, which is of teak, and to cabins and saloon furniture. No lining was fitted in the magazines. Shelves in magazines and shell-rooms were all metallic.

Displacement Weights.—Particulars of weights of hull and of displacement weights are given in the Appendix.

Armament.—The armament was to be exactly like that of the Italian cruiser Giuseppe Garibaldi. Subsequently, however, in the Nisshin the forward turret, with one 10-in. gun, was, for convenience of time, replaced by a turret having two 8 in. guns—the same as aft. The military tops of the Giuseppe Garibaldi were suppressed, and two machine guns were transferred to upper structures; the armament of the two ships is therefore as follows:—

	"Kasuga."	"Nisshin."
10-in. guns	1	—
8 in. guns	2	4
6-in. guns on main deck	10	10
6-in. guns on upper deck	4	4
3-in. guns on superstructure	6	6
3-in. guns at ends of main deck	4	4
1.8-in. guns on superstructure	6	6
Machine-guns	2	2
Torpedo-tubes (above water at sides)	4	4

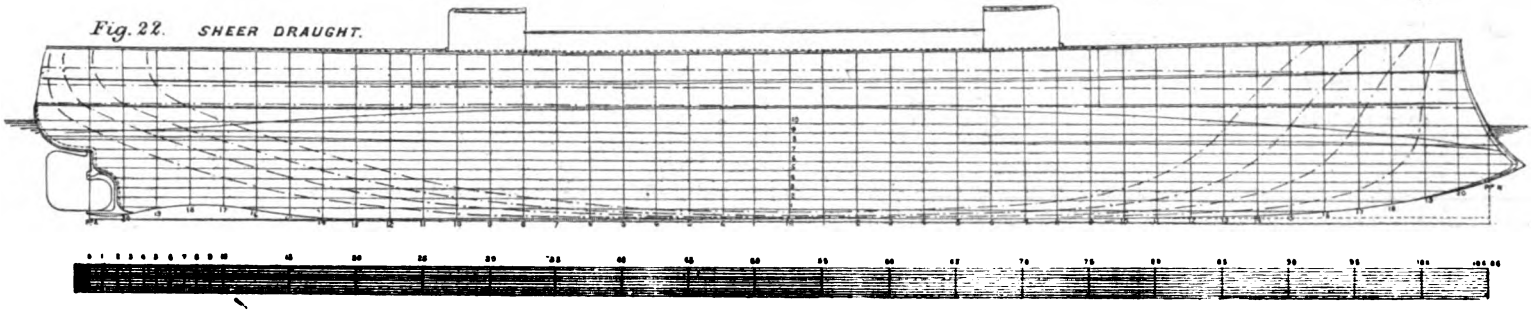
The height of the guns above the water-line on trial draught is as follows:—

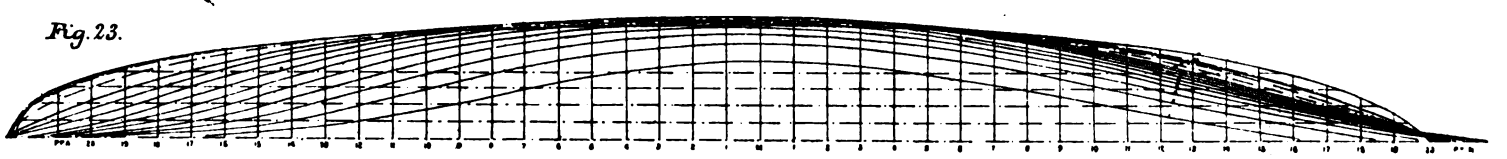
	Metres.
For the 10-in. guns	7.60
,, 8 in. guns	7.10
,, 6-in. guns on upper deck	6.40
,, 6-in. guns on main deck	4.0

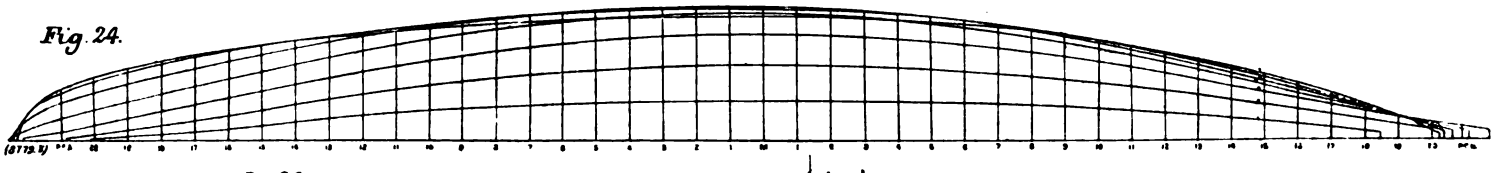
All guns have a wide range of fire, both horizontally and vertically, as follows:—

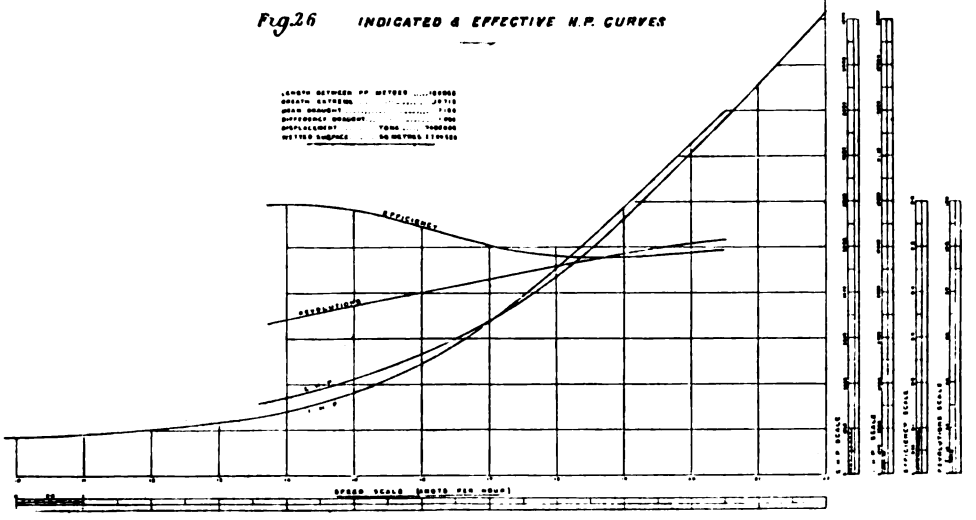
	Horizontal Range from Athwartship.		Vertical Range.	
	Forward.	Aft.	Elevat'on.	Depression.
	deg.	deg.	deg.	deg.
10 in. gun	90	45	35	5
8 ,, guns, forward	90	45	25	5
8 ,, ,, aft	45	90	25	5
6 ,, ,, upper deck, forward	90	20	20	7
6-in. guns, upper deck, aft	20	90	20	7
6-in. guns, main deck, forward	90	20	15	7
6-in. guns, main deck, centre	60	60	15	7
6-in. guns, main deck, aft	20	90	15	7

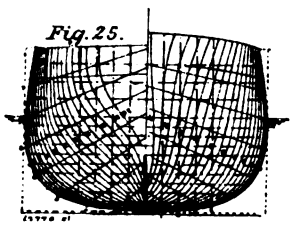
Details of armament, which is all of Elswick type, and built by the Elswick firm in Italy, at Pozzuoli.











The ammunition was supplied by the Ordnance Works of St. Chamond, in France. The turret guns, as will be seen from the drawings, have, as usual, a direct supply of ammunition from the ammunition-rooms below by means of a hoist independent of the revolving turret structure. The 6-in. ammunition is raised from the magazines to the main deck by means of two continuous single-chain hoists (Figs. 27 and 28, page 507), one at each end of the main-deck battery, whence the ammunition is carried on beam rails to the 6-in. guns of the battery, and to the hand-scuttles of the 6-in. upper-deck guns. Minor ammunition is raised from magazines to the main deck, and from the main deck to the upper deck by hoists of the alternative type. The working of turrets and hoists is by electric motors and gear, built by the Stabilimento Elettrotecnico di Savigliano, Piemonte, who also designed and made the chain hoists mentioned above. During the steam trials at sea, the gun trials were also made with good results as regards the guns, turrets, and the ship structure. The guns and turrets were tried precisely in the same way as was done by the Italian Navy for the Giuseppe Garibaldi, viz.:—

Gun Trials.	Elevation. degrees	From Athwartship. degrees
10-in. gun in forward casemate (four rounds)	10	0
	25	90 forward
	10	10 ,,
	35	30 aft
(Weight of projectile, 204 kilogrammes.)		
8-in. guns in after casemate (one round)	8	70 forward
Ditto ditto (one round)	Total depression	0
Ditto (two rounds simultaneous)	3	0
Ditto ditto (one round)	3	80 aft
(Weight of projectile, 104 kilogrammes)		
Every 6-in. gun (one round)	0	0
	Total elevation	60 forward
	Total depression	60 aft
(Weight of projectile, 45 kilogrammes.)		
Every small-calibre gun (one round)	0	0
	Total elevation	Extreme forward
	Total depression	Extreme aft

THE JAPANESE ARMOURED CRUISERS "KASUGA" AND "NISSHIN."

CONSTRUCTED BY MESSRS. GIO. ANSALDO AND CO., SHIPBUILDERS AND ENGINEERS, SESTRI PONENTE, ITALY.

(*For Description, see Page* 504.)

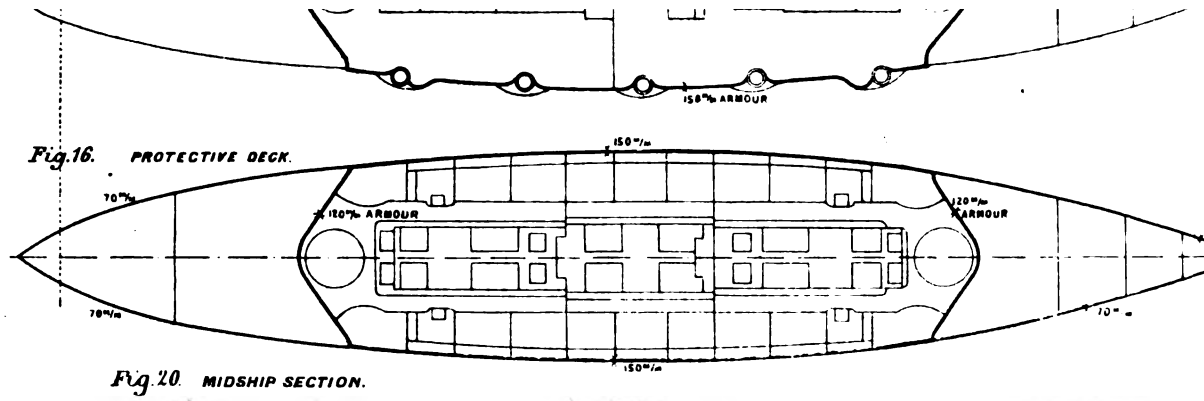


Fig. 16. PROTECTIVE DECK.

PROTECTION.

	Kasuga	Nisshin
	mm.	mm.
Armour belt ..	150–70	150–70
,, side above belt ..	150	150
Armour bulkheads	120	120
,, barbette, 10-in. gun ..	150	—
Armour barbettes, 8-in. guns ..	100	100
Armour conning tower	150	150
Protective deck ..	37–22	37–22
Upper deck above citadel	40	40
Lower deck outside citadel	20	20

Fig. 20. MIDSHIP SECTION.

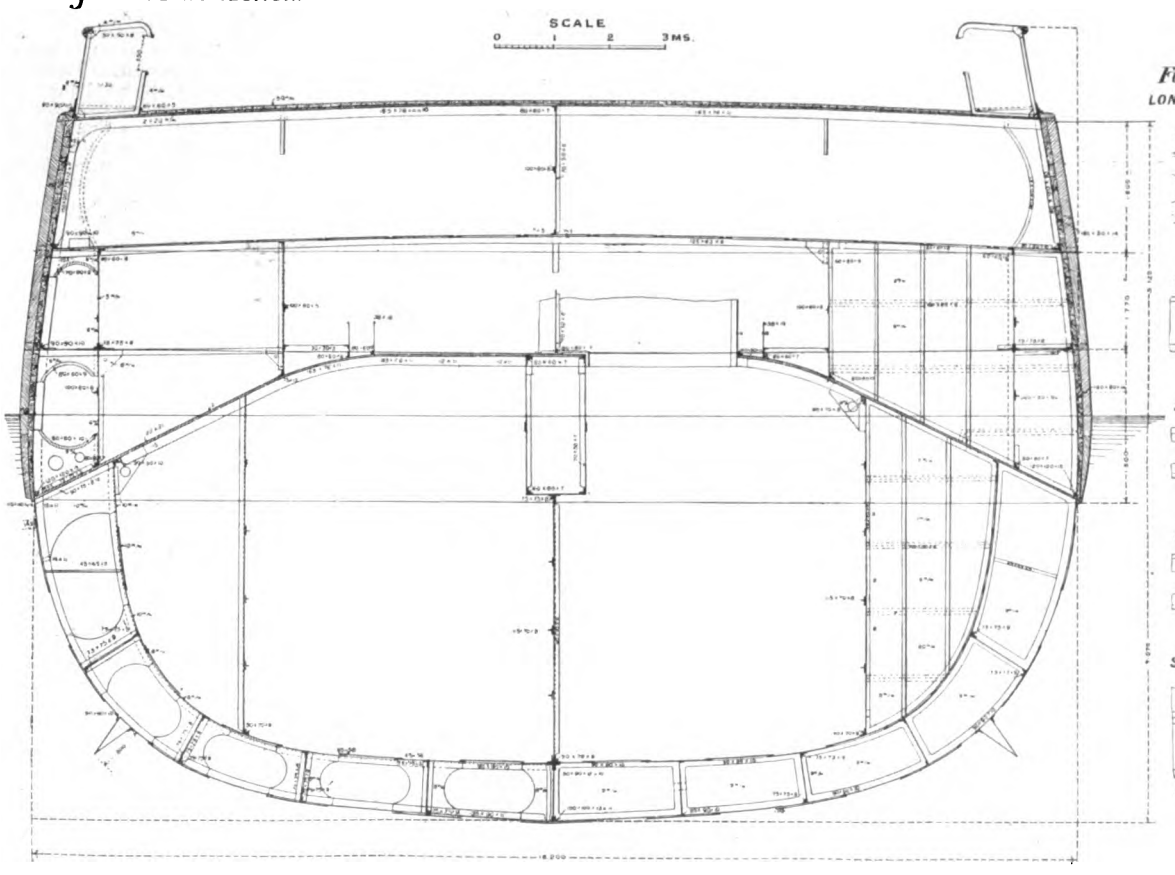
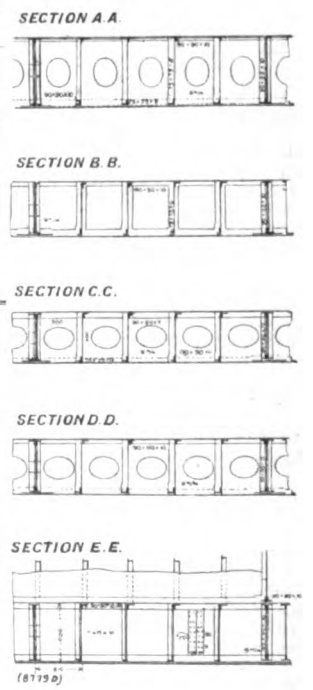
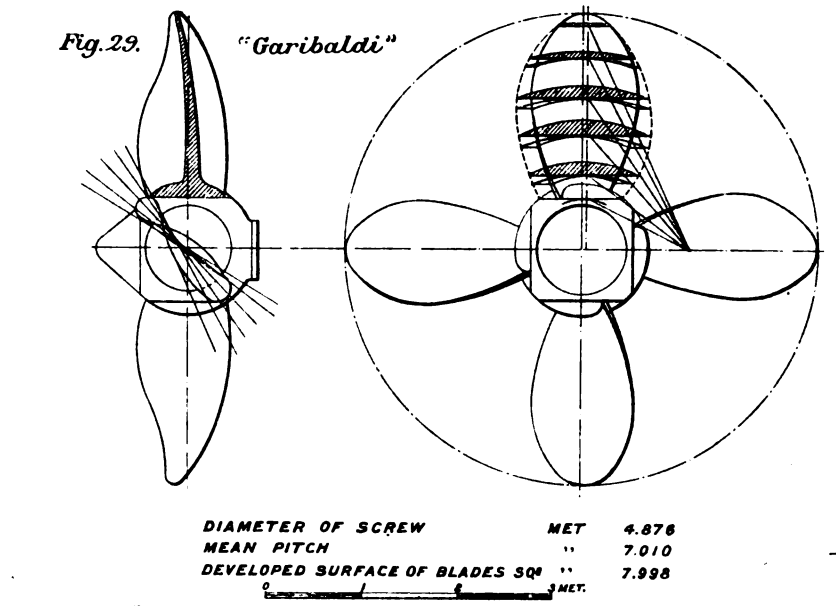


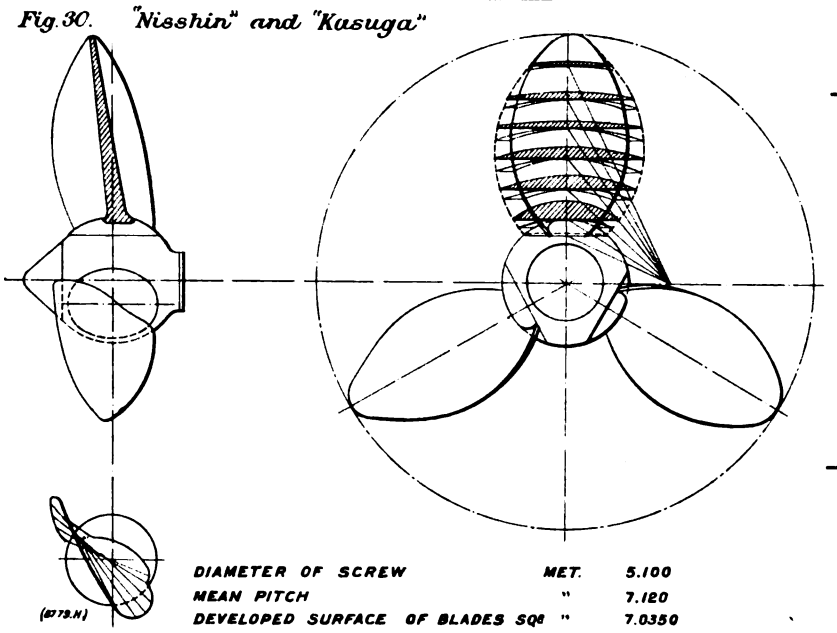
Fig. 21.
LONGITUDINAL SECTIONS.



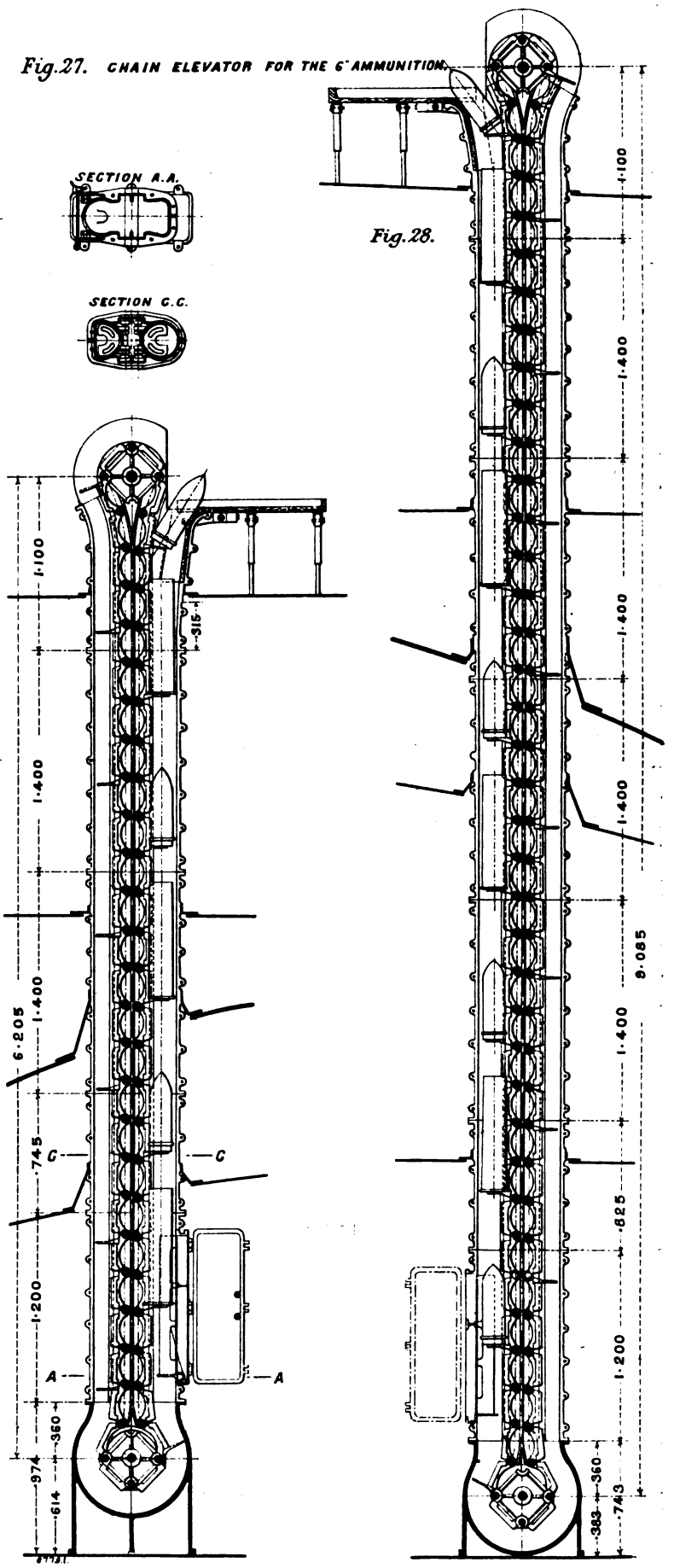
THE JAPANESE ARMOURED CRUISERS "KASUGA" AND "NISSHIN."

CONSTRUCTED BY MESSRS. GIO. ANSALDO AND CO., SHIPBUILDERS AND ENGINEERS, SESTRI PONENTE, ITALY.





FIGS. 29 AND 30. THE PROPELLERS OF THE "GARIBALDI" AND "NISSHIN."



FIGS. 27 AND 28. THE AMMUNITION-HOIST.

Propelling Machinery.—I shall not dwell much upon the propelling machinery, descriptions of which have been given by many technical papers (see *Engineer*, November 4, 1904; ENGINEERING, January 22, 1904; *Marine Engineering*, March, 1904; *Marine Engineer*, September, 1904, &c.). The following particulars will, I think, be sufficient:—

The propelling machinery consists of two twin sets of vertical triple-expansion three-cylinder engines, located side by side in the central part of the ship, in two adjacent independent compartments separated by a central longitudinal bulkhead. Steam is supplied by eight cylindrical boilers in two groups of four boilers each, one abaft and one forward of the engine-room. Each group of boilers consists of two double-ended and two single-ended boilers in two separate compartments, the double-enders being in the large compartment near the engine-room. Each group has one funnel.

Forced draught is obtained by means of twelve steam fans, two in each stokehold, under the closed ash-pit system, the fans being fitted as low down as possible to ensure good ventilation of the stokehold. Care has been taken to balance as well as possible the reciprocating parts of the propelling engines, but no special contrivance was employed.

The dimensions and figures relating to engines and boilers are as follows:—

Sets of engines	2 No.
Cylinders, diameter of high-pressure	1.010 metres
,, ,, medium pressure	1.600 ,,
Cylinders, diameter of low-pressure	2.360 ,,
Stroke	1.170 ,,
Power at forced draught	14,800 I.H.-P.
Revolutions per minute at full power	106
Speed (at forced draught)	20 knots
Condensers, cooling surface (total)	1,360 sq. m.
Diameter of boilers (mean)	4.280 metres
Length of shell of four double enders	5.710 ,,
,, ,, single enders	2.970 ,,
Number of furnaces (total)	36
Diameter of furnaces (mean)	1.104 metres
Working pressure	165 lb.
Total grate surface	82.62 sq. m.
Total heating surface	2262.90 ,,
Diameter of funnels (inside)	3.05 metres
Height of forward funnel above fire-grates	22.62 ,,
Height of aft tunnel above fire grates	21.50 ,,

Steam Trials (Fig. 26).—The steam trials were carried out along the Eastern Riviera, near Rapallo, on the official measured base (6035 metres long) from Punta Chiappe to Portofino, in a depth of about 300 ft. of water. The line of posts at each end is normal to the base line. Therefore, any deviation of the ship from the right course tends to augment the length of the run. The direction of the base line is given in nautical figures on the official Base Map. The compasses of the ships being duly adjusted before initiating the official trips, the ships were steered on the proper course by compass. The posts, compass observations, steering, calculations, and all details of the trials were left to the direction, and in the hands of, the Official Commission of the Argentine Navy, presided over by Captain Domecq Maria Garcia. Both ships went on the official trials at sea after one mooring trial and one preliminary trial at sea, and with clean bottom just out of dock. The contract conditions of trials were simply a repetition of those set out by the Royal Italian Navy for the Giuseppe Garibaldi, and the same results

were to be obtained. The trial conditions of the Giuseppe Garibaldi did not contemplate speed (the ship's design being from the Italian Naval Construction Department), but only development of steam power, and were as follow:—

One natural draught trial of six hours' duration, in which the engines were to develop a mean power of 8600 indicated horse-power.

One forced draught trial of 1½ hour's duration, in which the mean power developed was to be not less than 13,500 indicated horse-power.

In the natural draught trial the coal consumption per indicated horse-power per hour was not to exceed 0.900 kilogrammes (about 2 lb.).

The steam trials of the Garibaldi were made along the Eastern Riviera, and the results obtained on the Portofino base line were as follows:—

Date of Trial.	Duration of Trial.	Draught. Forward.	Aft.	Mean.	Displacement in Metrical Tons.	Sea.	Wind.	Mean Air Pressure in Boiler-Room	Steam in Boilers. Mean Pressure	Vacuum in Condenser. Mean	Revolutions.	Indicated Horse-Power. Starboard.	Port.	Total.	Speed in Knots
	hrs.	m.	m.	m.						in.					
Aug. 17, 1900 ..	6	6.84	7.81	7.07	7354	Calm	Light N.O.	0	176.5	26.5	82.2	4961	4983	9,944	16 16*
Sept. 7, 1900 ..	1¼	6.86	7.27	7.06	7339	Light	,, S.E.	14	204.5	25 6	106	7035	7076	14,111	19.66†

* Ship's bottom not clean.

† Ship's bottom 20 days in water after cleaning.

The coal consumption on the natural draught trial was 0.895 kiligrammes per indicated horse-power per hour.

In both trials no great importance was given to speed observations, the trials being essentially power trials, and the real speed having to be ascertained later by progressive trials when the ship was in the hands of the Italian Navy. However, such being the results, equal speed under the same conditions was to be obtained with the Kasuga and Nisshin; and, as the speed of the Giuseppe Garibaldi was not entirely satisfactory, it was thought advisable to change the screw-propellers in the former ships from four blades to three blades of a somewhat different form, deduced from a screw-propeller design of the Italian Naval Construction Department, tried by model experiments in the Spezia-Froude tank. The details of the screw-propellers in both cases are shown in Figs. 29 and 30, page 507.

I may say, by the way, that speed was improved by the new propellers, and that vibrations, which were small in the Giuseppe Garibaldi, became scarcely perceptible in the Kasuga and Nisshin.

It will be noted that during the natural-draught trials of the Giuseppe Garibaldi the air-pressure in the stokeholds was nil, the Niclausse water-tube type of boilers, with ample grate surface and small resistance to passage of gases, requiring no assisted draught. In the case of the Japanese cruisers, to compensate for the smaller grate area, and for the greater resistance to the passage of combustion-gases through the tubes and flues, an air-pressure of ½ in. was admitted for the natural-draught trials, as is customary in the British Navy for cylindrical boilers.

According to contract, the air-pressure in stokeholds during forced-draught trials was not to exceed 40 millimetres of water, as said above. The results of the steam trials of both ships Kasuga and Nisshin are collected in the annexed table:—

Date of Trial.	Duration of Trial.	Draught. Forward.	Aft.	Mean.	Displacement in Metrical Tons.	Sea.	Wind.	Mean Air Pressure in Boiler-Room.	Steam in Boilers. Mean Pressure	Vacuum in Condensers. Mean	Revolutions.	Indicated Horse-Power. Starboard.	Port.	Total.	Speed in Knots.
	hrs.	m.	m.	m.						in.					
STEAM TRIALS OF CRUISER "KASUGA."															
July 22, 1903 ..	6	6.61	7.47	7.07	7360	Calm	Light	6	165	27½	93	5210	4964	10,174	18.46
Sept. 29, 1903 ..	1½	6.75	7.45	7.10	7400	,,	,,	29	165	26	106	7450	7491	14,944	20.05
STEAM TRIALS OF CRUISER "NISSHIN."															
Oct. 26, 1903 ..	6	6.63	7.48	7.06	7347	Calm	Light	9.5	165	28.2	94.3	5340	5348	10,688	18.74
Nov. 6, 1903 ..	1½	6.76	7.47	7.11	7413	,,	,,	35	165	28	106.5	7439	7457	14,896	20.15

Broadly speaking, the power developed by the engines in both ships compares well with that developed by the Giuseppe Garibaldi's engines. The speed appears better in the Japanese cruisers, owing partly to the higher efficiency of the screw-propellers, partly to the ship's bottom being perfectly clean, which was not the case with the Garibaldi; and, finally, to the speed observations on the Kasuga and Nisshin trials having been more accurate.

On November 6, 1903, progressive trials were made at sea with the Nisshin, the results of which are graphically shown in Fig. 26 (page 506), where the indicated horse-power curve is traced in relation to that of the effective horse-power curve of the Giuseppe Garibaldi, as obtained from model experiments in the Froude tank of the Royal Dockyard at Spezia. The efficiency of propulsion is also shown, and from it I inferred that some improvement in speed might have been obtained with a new set of propellers of same type and form, but having a somewhat larger blade area. Such an increase of blade area would also have been in accordance with Mr. Normand's views, as framed in his formula:—

$$n\, r^{\frac{3}{4}}\, \Delta^2 = j \cdot \frac{F}{V^3}$$

in which

n = number of screw propellers.
r = ratio of blade area to disc area.
Δ = diameter of screw propellers.
j = coefficient which ought to be not less than 0.60.
F = indicated horse-power.
V = speed in knots.

But to change the propellers would have taken up much time; and as the speed obtained was fully satisfactory, the idea was abandoned.

Electric Plant.—The electric power station which, in the Giuseppe Garibaldi consisted of four continuous-current dynamos, having a total power of 120 kilowatts, has been increased by 25 per cent. by the addition of one similar dynamo. The five dynamos were located, three in the dynamo-room below the armour deck, and two on the main deck inside the armoured citadel. These two dynamos were intended for general use, and also as a reserve for the main station. The dynamos of the continuous-current, four-poles, shunt type, were made by the Ansaldo firm, and worked at 110 volts and 300 amperes. The steam-engines, of the compound tandem type, were supplied by Messrs. F. Tosi and Co., of Legnano. The power plant, in addition to supplying current for the electric lighting of the ship, consisting of nearly 500 lamps, and five searchlights—four of 24 in. and one of 30 in.—also supplies current to many electric motors—viz., main artillery motors, ammunition elevators, ventilating fans, ash elevators, refrigerating machine, workshop, &c. All the wires, the principal of which are solid bars, are enclosed in metallic water-tight casings, or protected by Bergman's tubes. The searchlights were supplied by the Officiana Galileo, of Firenze. Many useful electrical devices were also fitted on board, such as loud-speaking telephones, as an addition to the speaking tubes, and various electric tell-tales and indicators—like Molinari's revolution indicator, and a very ingenious general order transmitter, invented by the Chief Engineer of the Argentine Commission, Captain Barbara. The electric plant was thoroughly tested by the official Commission with very satisfactory results.

Watertight Doors.—The watertight doors for communication between the machinery compartments are all high up in the central tunnel, and are of the sluice type, with rack and pinion. No other communication is needed. However, for convenience in ordinary service, two more watertight doors were fitted below in the main bulkheads, separating the single from the double-ended boiler compartments, and in way of the central passage between boilers. The two doors are of the hinged rack-and-pinion type invented by Major Quarleri, naval architect in the Royal Italian Navy, which, by the single working of the pinion-shaft, are not only swung round, but locked and unlocked also. All other important doors in the hold are of the slide-rack and pinion type. On the decks above all doors are hinged.

Ventilation.—The general ventilation of the ship is secured by numerous electric fans, and is on the vertical independent system, each compartment having an inlet and exhaust of its own, so that there is no need of impairing the efficiency of water-tight bulkheads by ventilating pipes passing through them. Moreover, inlet and exhaust having straighter leads, the efficiency of ventilation is better secured. The system is extended to the ventilation of magazines, the temperature of which was accurately tested after the end of the forced-draught trials, with very satisfactory results. The temperatures observed were as follows:—

Temperatures ascertained on Board the "Kasuga" during the Forced-Draught Trials on July 22, 1903.

	At 10 o'clock. Deg. Cent.	At 17 o'clock. Deg. Cent.
Under shade on deck	23.5	24.0
Lower magazine, aft	26.0	26.0
Upper magazine, aft	28.0	31.0
Lower magazine, forward ..	30.0	29.5
Upper magazine, shell-room ..	36.0	34.0
,, ,, powder room	33.0	33.0
Side magazine, starboard ..	29.0	31.5
,, ,, port	30.0	32.0

APPENDIX.

*Displacement Weights of "Kasuga" and "Nisshin."**

Hull.	Weights in Metric Tons. Detail.	Total.
Stem and stern-post	20.366	
Shaft brackets	14.670	
Helm frame	10.790	
Castings to hull	12.965	
Stanchions and pillars	6.608	
Horizontal keel plates	23.740	
Vertical keel and longitudinals ..	60 415	
Transverse frames	196 332	
Beams of protective deck	34.332	
,, lower deck	20.245	
,, main deck	24.807	
,, upper deck	41.077	
Bulkheads in hold .. longitudinal	91.718	
Bulkheads in hold .. transverse	98.732	
Bulkheads between armour deck and lower deck .. longitudinal	76.224	
Bulkheads between armour deck and lower deck .. transverse	55.386	
Bulkheads between lower deck and main deck .. longitudinal	18.714	
Bulkheads between lower deck and main deck .. transverse	11.445	
Bulkheads between main deck and upper deck .. longitudinal	9.015	
Bulkheads between main deck and upper deck .. transverse	14.282	
Bulkheads of armoured traverses	38.174	
,, cabins	25.322	
Plating, outside	463.454	
,, inside	85.114	
,, armour deck	277.611	
,, lower deck	86.499	
,, main deck	98.314	
,, upper deck	302 559	
,, platforms and beams ..	56.014	
Armour gratings on armoured decks	70.892	
Bearers of propelling engines ..	58.511	
,, boilers	23.690	
Structures on upper deck .. .	91.906	
Gun supports	56.922	
Chain tubes and passages	6.828	
Water-tube passages through double bottoms	4.965	
Ventilators	48.190	
Sundries	2.186	
Rivets	186.602	
Cement	57.964	
Paint	25.254	
Wood planking, upper deck ..	95.933	
Bolts	2.120	
Caulking	4.822	
		3,014.420
Accessories of Hull.		
Ventilating fans	6.631	
Pumps and piping	46.684	
Steering gears complete	27.892	
Windlass, winches, bits, bollards, &c.	74.240	
Machine-tools and their motors, electric	5.781	
Refrigerating machine and fittings	2.100	
Distilling condensers, cooking ranges, and pipes	16.225	
Baths, w.c., scuppers, &c. ..	10.156	
Steam-pipes for auxiliary machinery to hull	6.326	
Steam heaters	1.409	
Wood linings in cabins and store-rooms	12.494	
Furniture	23.413	
Ladders and railings	12.942	
Skylights	5.916	
Linoleum and fittings	10.848	
Tapestry, carpets	3.215	
Water-tight doors	21.120	
Sidelights	6.285	
Scuttles and metallic covers ..	39.903	
Shelves, &c., inside magazines and shell-rooms	30.159	
Flooding arrangements of magazines and shell-rooms	6.026	
		874.755
Armour.		
Armour	1,194.559	
Armour bolts	48.915	
Wood backing	92.340	
,, ,, bolts	2.038	
,, ,, caulking	4.748	
,, ,, paint and felt ..	1.206	
		1,343.806
Propelling Machinery.		
Screw propellers and shafting ..	125.000	
Propelling engines and auxiliaries in engine-room, empty	400.000	
Boilers, empty, complete, piping, fans, funnels, and auxiliaries in boiler-room	521.000	
Water in boilers, condensers, and pipes	176.000	
Spare parts, ladders, platforms, tools	70.000	
		1,292.000
Military Armament.†		
Guns, their revolving platforms, mountings, mechanisms, and elevators	455.762	
Electric motors and their basements	4.565	
Accessories, rails	4.815	
Ammunition	200.214	
Rifles	1.248	
Torpedo tubes	7.751	
Pumps, their electric motors and accessories	6.716	
Torpedoes (not included)	—	
		631.071

* The weights given are the mean of the two ships.

† This is the weight of the military armament of the Kasuga. The corresponding weight of the Nisshin is 42 tons heavier.

Electric Plant.

Power station—viz., dynamos, their basements and accessories	41.879	
Electric lamps and wires	14.770	
Searchlights	1.048	
Motors of ventilating fans	3.522	
,, machine-shop, refrigerating machine, &c.	1.630	
Accessories	2.715	
		65.564

Naval Outfit.

Mast (metallic)	15.316	
Top mast, spars, derricks, booms	11.161	
Rigging	8.374	
Awnings and tarpaulings	6.046	
Awning stanchions and railings	11.388	
Anchors and chains	72.612	
Hawsers, ropes, &c.	11.554	
Boats	36.254	
	172.705	
Boats' davits and fittings	11.045	
Voice pipes, thermometrical tubes, indicators	3.451	
Nautical instruments	1.433	
Candle lamps	2.880	
Fittings in store-rooms	2 385	
Tanks, barrels, casks, &c.	16.331	
Warrant officers' outfits	16.070	
Tables, racks, &c., for crew	10.161	
		233 461

Equipment.

Officers, men, and their goods	50.000	
Crockery, mess services, cooking utensils	7.680	
Provisions	30.000	
Fresh water	24.000	
Consumable stores	20.000	
Coal	590.000	
		721.680
Normal load, total		7729.766

Stability.—The stability conditions of the two ships are as follows:

Vessel Empty.

(Without coal, ammunition, provisions, fresh water, water in boilers and consumable stores.)

	"Kasuga."	"Nisshin."
Mean draught	6.470 m.	6.502 m.
Displacement	6639.[000] tons	6731.[000] tons
Height of centre of buoyancy above base line	3.826 m.	3.840 m.
Height of metacentre above base line	8.200 ,,	8.207 ,,
Height of centre of gravity above base line	7.833 ,	7.855 ,,
Metacentric height (G.M.)	0.367 ,,	0.352 ,,

Normal Load.

Mean draught	7.230 m.	7.348 m.
Displacement	7729.[000] tons	7771.[000] tons
Height of centre of buoyancy above base line	4.263 m.	4.275 m.
Height of metacentre above base line	8.037 ,,	8.047 ,,
Height of centre of gravity above base line	7.314 ,,	7.310 ,,
Metacentric height (G.M.)	0.723 ,,	0.707 ,,

Full Load.

Mean draught	7.820 m.	7.850 m.
Displacement	8729.[000] tons	8518.[000] tons
Height of centre of buoyancy above base line	4.575 m.	4.589 m.
Height of metacentre above base line	8.037 ,,	8.047 ,,
Height of centre of gravity above base line	7.314 ,,	7.340 ,,
Metacentric height (G.M.)	0.723 ,,	0.707 ,,

CONTRACTS.—A contract for the erection of a large viaduct over the river at Khushalgah, in Northern India, has been placed by the Indian Office with the Tees-side Bridge and Engineering Company, of Middlesbrough. The bridge is to be of the double-deck type, carrying a railway on the top and a roadway below, and it will have a 471 ft. cantilever span, with an anchor span of 300 ft. Early delivery was an important element in the placing of the contract, and the Cleveland firm will ship the main portions of the structure from the Tees before the close of this year.—The Electrical Company, Limited, 121 to 125, Charing Cross-road, W.C., have secured the contract for lighting the Sandon Huskisson Docks, Liverpool. They have also obtained the order for the electrification, power, and lighting of the Penhriw Colliery, and have recently supplied a high-tension electric pumping plant, with high-lift centrifugal pumps, to Messrs. Bolckow, Vaughan, and Co., Limited, for their Hildon Lodge pit.—Orders have recently been placed with the Chain-Belt Engineering Company, of Derby, for four sets of electrically-driven car-haulage gears, two heavy pan-conveyors for handling iron-ore briquettes, and twelve inclined spiral conveyors to deal with iron-ore concentrates for the new works of the Dunderland Iron-Ore Company, Limited, of Norway.—The firm Comitato Trazione Ellettrica (Dr. G. Finzi), Milan, has secured the contract for the construction of the high-tension single-phase electric elevated railroad which is to connect the two localities of the forthcoming Milan-Simplon Exhibition (Parco to Piazza d'Armi). On this line, which is to be 1500 yards long, four trains will run, each carrying 260 passengers, and made up of four cars equipped on the multiple single-phase Finzi system. The cars will have both mechanical and electrical braking. The machinery is to be built in the Gadda-Brioschi and Finzi Works, Milan.—The Great Western Railway have ordered from the Kennicott Water-Softener Company, 29, Great St. Helens, E.C., a water-softener capable of dealing with 30,000 gallons of water per hour, and to be placed on the railway line at Severn Tunnel Junction.

NOTES FROM THE NORTH.

GLASGOW, Tuesday.

Glasgow Pig-Iron Market.—Last Thursday the pig-iron market was fairly active, and a good business was put through. The morning's cables from America, giving the production and consumption of pig iron in the States during March, were of a strong character, and this had a firming tendency on the market. Cleveland warrants opened firm at 49s. 4d. cash, and 49s. 7½d. one month; business was also done in the forenoon at 49s. 4½d. cash, and 49s. 5½d. eleven days, and 49s. 3½d. three months. The afternoon market was more firm, and Cleveland warrants changed hands up to 49s. 9d. cash and 49s. 10½d. one month, and closed at 49s. 8½d. cash and 49s. 11d. one month sellers. Hematite iron was quoted at 58s. 4½d. one month, and Standard foundry iron at 48s. 5d. cash. Including options, the turnover was about 30,000 tons. On Friday the market was again very active, and at times considerable excitement prevailed. Fully 40,000 tons were put through, the dealings being confined to Cleveland warrants. The tone was strong and irregular. Cash warrants opened at 50s., jumped to 50s. 3½d., but receded smoothly to 49s. 11½d., at which price the forenoon session closed. One month iron also opened at 50s., jumped to 50s. 6½d., and receded to 50s. 1½d. In addition 2000 tons was done at 49s. 9d. three months. In the afternoon the prices of Cleveland warrants held firm at 50s. 1½d. cash, 50s. 3d. to 50s. 4½d. one month, and 49s. 8½d. three months. The market was much quieter, but fully 10,000 tons changed hands. On Monday the market opened with a strong tone, and the dealings in Cleveland warrants amounted to 26,000 tons. Prices were a little irregular. Cash iron was particularly strong, and opened at 50s. 7½d., advanced 1½d., and then eased off to 50s. 8d., which was sellers' closing price. Forward iron was firm at 50s. 10d. at the opening, but declined to 50s. 7d., and closed at 50s. 7½d. buyers. At the afternoon session the upward movement continued, and the turnover was 16,000 tons. Cleveland warrants were done up to 50s. 9d. cash and 50s. 10d. one month, the closing quotations being 50s. 8½d. cash buyers and 50s. 9½d. one month buyers, sellers' prices being a penny more in each. Dealings also took place in three months' warrants at 49s. 6d., which was 1s. 3d. below the cash price. To-day (Tuesday) the market was quieter and the tone easier. Cleveland warrants changed hands at 50s. 8d. cash and 50s. 7½d. one month. Dealings also took place at 50s. 8d. to 50s. 9½d. thirteen days; the turnover was 10,000 tons. About 1500 tons was done at 49s. 6d. three months, with sellers at 49s. at the close, and 1000 tons of Standard foundry iron was dealt in at 48s. 4½d. for May 23. At the afternoon session prices of Cleveland warrants were a shade firmer, but the turnover was again small. Altogether 10,000 tons changed hands, and this total was made as follows:—4000 tons of Cleveland warrants at 50s. 9½d. to 50s. 9d. cash and one month, 2000 tons at 49s. 1½d. three months, and other 2000 tons at 49s. three months, and 2000 tons at 49s. 6d. two months. The prices of to-day for makers' No. 1 iron are as follow:—Clyde, 58s.; Gartsherrie, Summerlee, and Calder, 58s. 6d.; Langloan, 64s. 6d.; Coltness, 65s. (all shipped at Glasgow); Glengarnock (shipped at Ardrossan), 58s.; Shotts (shipped at Leith), 59s.; and Carron (shipped at Grangemouth), 59s.

Scotch Coal.—The shipments of Scotch coal for last week were 224,754 tons, which was an increase on the preceding week, but a decrease on the corresponding week of last year, when the total export was 232,750 tons. These figures are fairly satisfactory, as the total shipments for the year to date show an increase of 301,405 tons when compared with the same period of 1904. The figures for the two great estuaries—the Clyde and the Forth—and the Fife ports of Burntisland, Methil, &c.—are:—

—	Last Week.	Same Week, 1904.	Totals for 1905.	Totals for Corresponding Period 1904.
	tons	tons	tons	tons
Clyde	87,907	90,248	1,282,572	1,232,801
Forth	64,044	62,036	830,265	758,463
Fife ports	72,803	80,466	1,056,669	816,837

Sulphate of Ammonia.—The sulphate market continues quiet, and during the past week prices have given way at most of the ports to a small extent. Requirements of Continental consumers appear to be covered to a large extent by purchases already made, and the chief buyers are dealers who have to cover speculative sales. There is, however, some Colonial and Spanish demand, and this may be expected to be good for the next month or so. Sales were made last week at 12*l.* 15s. to 13*l.* per ton; 12*l.* 15s. is still quoted at Leith.

INDIAN COAL-MINING.—The production of coal in British India in 1903 was valued at 1,299,716*l.*, as compared with a corresponding value of 957,162*l.* in 1898. The average annual value for the six years ending with 1903 inclusive was 1,225,677*l.*

GERMAN STEAM NAVIGATION.—The German West African Line realised last year a rough profit of 79,479*l.*, which was applied to writing down the cost of the fleet, &c., with the exception of 122*l.*, which was carried forward. The council of administration attributes the unfavourable results of last year's working to the depression prevailing in business in South and West Africa. The establishment of railway communication is expected, however, to increase the traffic between German West Africa and Europe.

MISCELLANEA.

A SERIES of comparative tests made in January last at the Babbington Coal Company's No. 3 colliery, Tibshelf, Derbyshire, with a hand-fired boiler and a boiler fitted with the Bennis mechanical stoker and self-cleaning compressed-air furnace, using five very low qualities of fuel, such as smudge and black shale chippings, show the economical efficiency of the Bennis stoker and furnace. In fact, the hand-fired boiler could not burn the lowest grade, while the mechanical-fired boiler evaporated 7.07 lb. of water per pound of shale-chippings, from and at 212 deg. Fahr.

For some time past the electrical engineers in the Post-Office service have entertained the opinion that the increasing responsibility of their position, and the great developments in every branch of telegraph and telephone engineering, justified the formation of a new organisation, which would enable them, by the exchange of views in matters of interest, to keep abreast of the rapid progress being made in various directions, and to remain in touch with their colleagues over the whole of the British Isles. A conference on the subject was held on the 8th inst., in the course of which it was resolved unanimously to form a definite organisation, to be known as "The Society of Post-Office Engineers." The statutes are in course of preparation.

As the result of ten years experiments on the durability of paints at the terminal station of the Pennsylvania Railroad, at Jersey City, it was found that no paint tried could be relied on to protect a clean steel surface for more than about eight months. The conditions here are extremely severe, and for many years the cost of renewing the paint has amounted to 1000*l.* per annum. Finally, a system has been introduced of protecting the steel surfaces with painted paper, which is stated by the railway company to give excellent results. The metal is cleaned in the ordinary way, and is then coated with a single coat of a very sticky substance. Paraffined paper is next pasted over this, and finally painted any colour which may be desired. Holes are cut in the paper for the rivet-heads to pass through, and these heads are then covered with caps of paraffined paper. It is stated that, as the work can all be done at one setting of the scaffolding, the cost is but little more than two coats of litharge in boiled linseed oil, applied direct to the metal, and the result appears to be permanent, whilst painted bars scale off in the conditions of the test in a few months.

The Colony of New South Wales has, as everyone knows, magnificent coal-fields, and it also possesses excellent deposits of iron ore, much of which assays about 60 per cent. of metallic iron, with an exceedingly small content of phosphorus and sulphur. In spite of these advantages, however, nothing has yet been done to develop the manufacture in the colony of steel or wrought iron. With a view to making a start in the utilisation of the great natural resources above referred to, the colony is now calling for tenders for the establishment of blast-furnaces, steel works, and rolling-mills in the colony; the inducement offered being a promise to take from the works for a period of seven years all the metal needed by any Government department, the Commissioners of Railways, or the Sydney Harbour Trust, at a schedule of prices to be fixed in the agreement between the works and the Government of the colony. The average annual amount of these requirements does not, however, appear to be stated in the papers sent us by the Agent-General for the Colony, though it is presumable that intending tenderers will be able to obtain this and further information on application. All tenders must be deposited at the office of the Secretary for Public Works before September 1 next.

Wolfgang A. Müller's project for an electric railway up the Zugspitze involves several interesting novelties. The Zugspitze is an Alpine peak, 2920 metres (10,000 ft.) in height, situated right in the south-west corner of Bavaria, not far from Ammergau, and the journey would practically be started from Munich, the third city of the German Empire with half a million inhabitants. The new line would branch off from Partenkirchen, on the München-Starnberg-Murnau Railway. The first 12.4 kilometres are planned as a street railway past the Eibsel, a favourite resort, and with a maximum gradient of 8.8 per cent., from 700 to 1200 metres above sea-level. The remaining 1720 metres difference in height are to be overcome by a rack railway 4 kilometres in length, with a gradient of, first 36, and then 50 per cent.; this section is to have two stations and three tunnels. As a trolley line would be impossible to keep in repair on such inclines, Müller has adopted a third rail; and he further calculates that direct currents of 750 volts and a battery would be more convenient and suitable than triphase currents—monophase currents are not considered—because the energy, generated by the motors on the way down, could be utilised with direct currents while practically no energy was regained on the Jungfrau with triphase currents, the currents being absorbed by resistances. When the track-rails are placed on the same level, the mass of rock to be blasted away on a slope will, as a rule, in cross-section resemble a right-angled triangle. It is proposed to reduce the amount of rock excavation by placing the rails on different levels. The cars for fifty-six passengers will weigh, empty, 11.5 tons, and be driven by one 220-horse-power shunt motor wound for 3330 revolutions. Two turbo-dynamos of 100 kilowatts, one turbo-dynamo of 75 kilowatts, and a battery of 200 kilowatts, are projected for the power-stations.

BRAZILIAN COAL.—The Brazilian Minister of Industry, Railways, and Public Works has been authorised to expend 12,500*l.* on surveys and explorations in connection with the development of the coal-fields of Brazil.