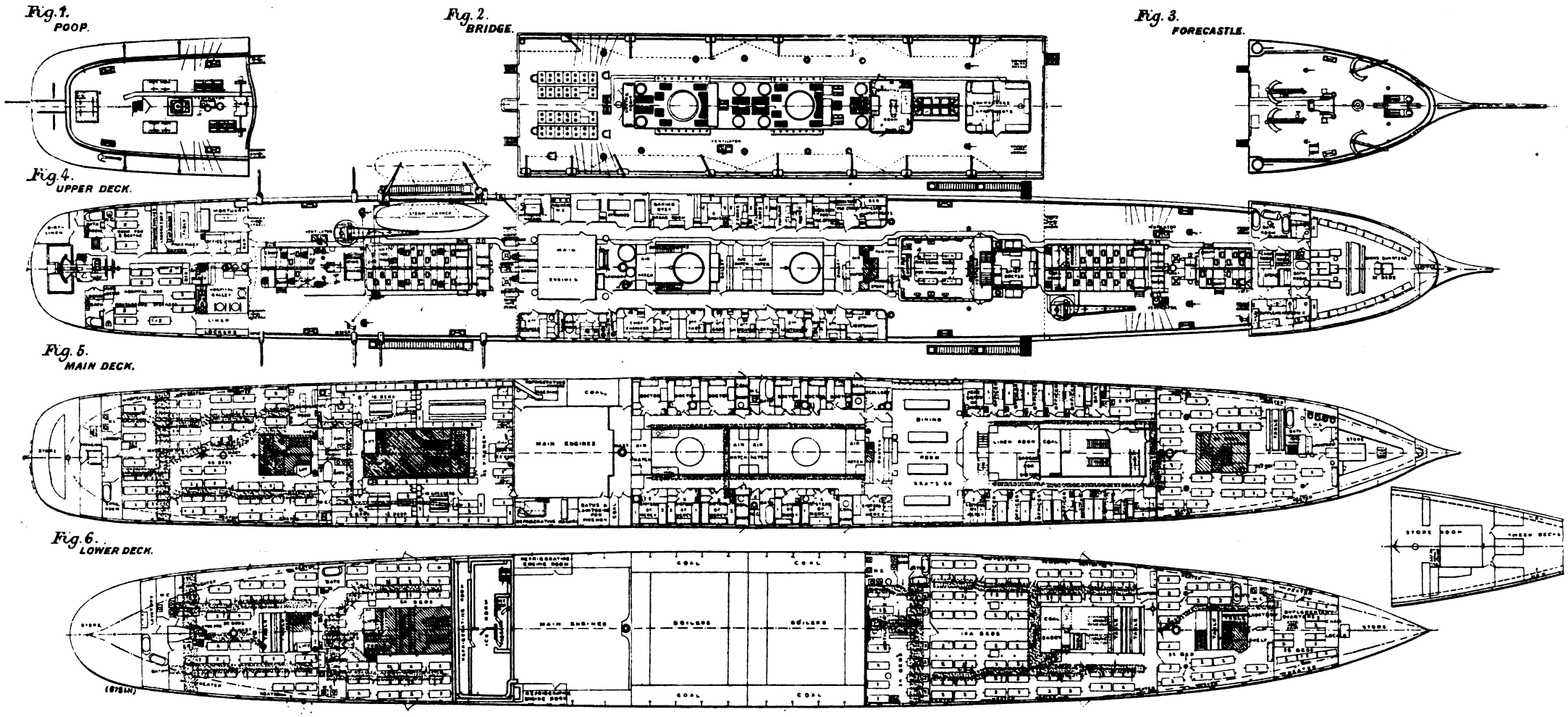
THE RUSSIAN VOLUNTEER T.-S.S. "OREL," AS ARRANGED FOR HOSPITAL WORK.

CONSTRUCTED BY MESSRS. HAWTHORN, LESLIE, AND CO., ENGINEERS AND SHIPBUILDERS, NEWCASTLE-ON-TYNE.

(*For Description, see Page* 554.)



INDUSTRIAL NOTES.

THE most momentous and far-reaching decision ever given in a court of law, respecting labour, was given by the United States Supreme Court last week, when it declared that any laws passed by individual States of the Federal Union limiting the hours of labour were unconstitutional. This decision arose out of a case in which an enactment by the Legislature of the New York State made a working day of ten hours the legal limit of a working day for bakers. This decision will render nugatory over 100 enactments passed by various States, limiting the hours of labour both of skilled and unskilled workmen at the instigation and demand of the labour organisations of the United States. The Supreme Court declares that the limitation of hours of labour by any legislative body interferes with the right of free contract, and cannot be permitted under the Constitution of the United States. This decision is held to be the most important, as affecting the relations of capital and labour, that the Supreme Court has given. Of course, it does not affect children, or those under age, as these are not legally capable of making "free contracts," but it does affect all citizens of full age, and all women who may be in a position to enter into "free contracts." In this country for over six centuries the law intervened in labour contracts by fixing the hours of labour, the rates of wages, and other conditions of employment. Workmen were practically debarred from making "free contracts," and the most severe punishments were dealt out under the Old Combination Laws if they attempted to regulate the conditions of labour. Some of the newer labour leaders in this country would now revert to similar legislation, but to the disadvantage of employers, and to the advantage, or supposed advantage, of labour. Legislation affecting children in factories, &c., will, as we have said, not be affected by the decision of the United States Supreme Court, but adults will have to fall back upon their own labour organisations to reduce working hours.

The Amalgamated Engineers' report for the current month is not very encouraging as regards employment, but an explanation is given to the effect that the number of unemployed is greater than it would otherwise have been in consequence of discharges from Government workshops, due to lack of work and the enforcement of age disability. There is also the shipsmiths' dispute on the North-East Coast, which affects some of the members. The total membership was, at date, 96,608, showing an increase of 270. Of the total, there were on donation benefit 4985; on sick benefit, 2381; on superannuation allowance, 4904. There was a decrease under each head, so that trade is certainly better than it was. There is a general movement among the members on the North-East Coast and on the Clyde for an advance in wages; on the latter river for the inauguration of weekly pay. In this case all branches of the engineering and shipping trades act in concert. The council of the society are taking steps to re-establish the American and Canadian Council, and branches in both countries are being asked to nominate candidates. It was found to be necessary to abolish or suspend such council for administrative reasons, but the difficulties appear to have been got over. The vote for the continuance of 100*l.* per annum to the "John Burns Election Fund" has been carried by a large majority. Out of the seven students who were willing to go into residence at the Ruskin College at Oxford, three have been selected. If one or more of these fail, others on the list will take their place. Notice is given of this year's competition for the Allan and Newton Prize, value about 5*l.* 12*s.* 8*d.* Competitors must be members or the sons of members. The examinations will be in steam, machine construction and drawing, mathematics, theoretical and applied mechanics. The examinations and awards will be the same as given in the Science Directory for competitions for Royal Exhibitions. Those prizes have given a stimulus to the younger men engaged in the engineering branches of trade.

The report of the Boiler-Makers and Iron Shipbuilders does not as yet indicate any material improvement in trade, for the total number on the funds was 8601, as against 8629 in the previous month—a decrease of only 28. The decrease was in the number of un-

employed and on the sick-list, but the total number in receipt of superannuation benefit was larger by 53. There was a net increase of 187 in membership, after allowing for deaths and arrears of contributions. The cost of benefits in the month was 14,157*l.* 6s. 1d., the weekly amounts being about the same as in the month previous.

The report of the Iron-Founders says that "trade does not improve so rapidly as we could wish," but it adds that there is a total decrease on the funds of 152. The expenditure still exceeds the income, but certain general charges, such as salaries and rent of rooms, account mainly for this. Still, the outlook appears to be brighter; there is more work in the market, but the prices are very low, competition being very keen. "In the North of England," the report says, "matters are generally satisfactory, employment being for the most part fairly good." Shipbuilding yards continue busy, several firms being engaged in extending their premises. In Yorkshire, with one or two exceptions, the engineering branches are active; the firms engaged in the manufacture of light engineering tools are very active, as also are the hydraulic, tramway, and electrical branches, while the textile-machine sections are also in demand. The total on the funds was 3597, showing a decrease of 152. The decreases were in respect of donation benefit, sick benefit, and strike pay, but there was an increase of eleven on superannuation allowance. The weekly cost of benefits was 1160*l.* 17s. 8d., or about 1s. 4d. per member per week. The total membership stood at 18,503, showing an increase over a year ago of 153. The balance in hand stood at 84,544*l.* 3s. 3d., showing a decrease of 1023*l.* 10s. 3d. in the month. The trade returns from the branches show improvement, both in the number of places and in the aggregate membership in those places. Still, twenty-seven places, with 5539 members, report trade as "bad," and sixteen, with 2325 members, as "very bad"; but there is no discharging, and only eleven are on short time. There is to be an accident levy of 1s. per member in this year, in four instalments of 3d. per quarter. There is a good deal in the report about labour representation, the union being fortunate enough to have one of its prominent members in the House of Commons. The member reports monthly on the political situation or on general politics, especially in respect of labour, both in and out of the House of Commons.

The report of the Associated Iron-Moulders of Scotland is more favourable than for months past. There was a net gain of 31 in membership, and a decrease of 107 in the number of unemployed. This is regarded as satisfactory for the season of the year, especially as brighter weather is now expected, which will give a further impetus to trade. The income for the month was 1991*l.* 0s. 7d.; the expenditure was 1951*l.* 9s. 9d., showing a net gain of 39*l.* 10s. 10d. It is explained that the increase in funds was small in consequence of payment of salaries, rents, &c., for the quarter. There has been a marked improvement in trade in the marine and jobbing shops, but in the light casting shops it is still quiet, though not depressed. Disputes exist in eight shops in Scotland, all of which are closed to members of the union. A full notice is given of the joint conference of the General Federation of Trade Unions and of the Engineering and Shipbuilding Federation to consider what steps shall be taken to ensure weekly payments of wages on the Clyde—a question which might involve a stoppage of work. A general conference of the various iron-moulders and iron-founders' unions in America and Britain is proposed, whereby a working agreement may be effected by all such unions.

The report of the Associated Blacksmiths is more encouraging than for a long time past. There was an increase of 21 in membership, and a decrease of 33 in the number of unemployed. Only 21 members were signing the vacant-book at date. There was therefore a reduction in the amount paid as unemployed benefit, but an increase in the amount paid to superannuated members. There was a gain in funds of 123*l.* 14s. 7d., the balance in hand being 23,301*l.* 19s. 5d. It is complained that trade is subject to great fluctuations—there is a want of steadiness. It is stated, however, that the stationary engine, locomotive, and electrical engineering branches are fairly good in the districts covered by the society's returns.

The report of the Amalgamated Society of Carpenters and Joiners does not regard the condition of trade as at all satisfactory, notwithstanding the fact that there was a reduction in the number on unemployed benefit of over 1000. It is pointed out that if only one member in each branch found employment, the total would reach 886. Still a reduction of over 1000 in the aggregate is something to be thankful for. There was a total of 70,663 members; of these, 4959 were on unemployed benefit, 1808 on sick benefit, and 1709 on superannuation benefit. A fresh dispute has arisen between the United Brotherhood of Carpenters and Joiners in America and the Amalgamated Society. It is alleged that the Brotherhod, so-called, has failed to comply with the terms of the award when the matter was referred to arbitration. This shows a poor idea of brotherhood. It is stated that trade is nearly as bad in America as in Great Britain. In Canada, also, trade is far from good, and members of the union are warned against the misleading glowing accounts of the prospects for joiners in Toronto and elsewhere. It is said that a very large percentage of members of the unions are out of work, while hundreds of non-union men have been arriving, and are in search of work. Owing to a dispute with a large joinery firm in Norwich, members are cautioned not to fix any work sent from the firm. It is said that the firm refused to receive a deputation or to accede to the terms of the union. In eight other places there are disputes, though not of a serious character. As the financial position of the society is not so good as it ought to be, for the benefits provided, two suggestions have been made: either to increase the contributions, or reduce the benefits. The members have rejected both; therefore the council fall back upon special lines to meet emergencies.

The *Ironworkers' Journal* for April contains a good deal of matter of general interest, but more particularly relating to the iron and steel trades, such as statistics of trade and reports of great firms connected with the production of iron and steel. The Association stands out prominently for Free Trade, and therefore statistics bearing upon that side of the question have prominence. The general secretary of the Association has studied the question on the Continent as a special commissioner, and in America as one of the Moseley Commission, and he is well up in the statistics of British trade. The report of the proceedings of the Midland Wages Board are particularly interesting at the present time, because it gives an account of the negotiations for a revised scale, as a basis for future agreements. The draft scheme was submitted to all the branches of the Operatives' Association, as well as to the employers connected with the Board, and also to the Welsh Committee. Some suggestions were made by the latter, in modification of the proposals submitted, and there is every reason to hope that the Board will be re-constituted on a basis satisfactory to all parties.

The report of the Operative Cotton-Spinners' Association is more satisfactory than for a long time past. The weekly average of members on the funds was only 3.75 per cent., as against 3.84 in the previous month, and 20.95 per cent. a year ago. The total membership was 14,582—a gain of 83 in the month, and of 519 for the past year. The officials dealt with 20 dispute cases; in the previous month, 21; and in the same month of last year, 32. There were 18 claims for compensation sent in to employers; previous month and same month a year ago, 15 in each case. There were also 57 accident cases; month previous, 46; same month last year, 37 The financial gain in the month was 569*l.* 1s. 1d.

The strike of boot and shoe operatives in Northamptonshire had not terminated at the Easter holidays, but it was reported that a number of non-unionists, driven by hunger, had gone in. Meanwhile, the decision of the Secretary of State for War had to some extent reassured the workers that existing local conditions as to wages would be considered in connection with all such contracts. This might pave the way for the reopening of negotiations on the basis of the Fair Wages clause—a clause which ought not to give unscrupulous employers an advantage over those who pay according to the statement list.

Two Bills, regarded as of great importance, have been introduced into Parliament, and read a first time under the ten minutes rule. But this matters very little. After all, a debate on the first reading is of little importance, for the measure itself is not in the hands of those who try to criticise the Bill. It is on the second reading only that a real debate can be effectively made. The Bills in question are the Aliens Bill and the measure dealing with the unemployed. We shall hear more about them anon.

REFUSE-DESTRUCTION AT BRUSSELS.—We have received a report by Mr. Lewis, Alderman of Public Works, of Brussels, describing the installation made by the Horsfall Destructor Company, Limited, of a destructor plant in that city. The plant is situated on the Quai de Willebroeck, near the buildings of the refuse farm, in order to group all the cleansing services. It is capable of incinerating the whole refuse of the city of Brussels, the population of which is 187,000 inhabitants, spread over an area of 2475 acres, with a total area of 620 acres of public streets. The Hamburg plant, also put down by the Horsfall Company, was used as a type by the Belgian authorities in the design of their own installation.

THE RUSSIAN VOLUNTEER FLEET.*

By HERBERT ROWELL.

THE prominence into which the ships of the Russian Volunteer Fleet have been brought during the present war with Russia and Japan seems to make this a suitable time to bring the fleet, and more especially the faster portion of it, to the notice of this Institution.

CONSTITUTION AND OBJECTS OF THE RUSSIAN VOLUNTEER FLEET ASSOCIATION.

The Volunteer Fleet was originally founded as a material expression of the wish of the more wealthy Russians, especially those of Moscow, to assist their Government, then at war with Turkey, by providing vessels which would be of use as transports and auxiliary cruisers, and be self-supporting as liners in times of peace. Encouraged by the heir-apparent who subsequently became Czar Alexander III., committees were formed in all the chief cities, with an administrative committee in Moscow, and their formation was followed by the purchase, in 1877-8, of four vessels belonging to the North German Lloyd Company, which were re-named the Rossia, Petersburg, Moskva, and Nijni-Novgorod, and were used at the conclusion of the Russo-Turkish war to bring troops back to the Russian Black Sea ports. On the conclusion of peace, in the summer of 1878, preparations were made to open a line to the Far East, and these four vessels sailed for their first voyage in the autumn of that year, and during the next ten years six other vessels were purchased.

The early career of the Volunteer Fleet as a trading organisation was not such as to encourage its founders, and there was considerable conflict of opinion as to whether it should be continued as a separate institution or transferred to the Russian Steam Navigation Company. The former course was decided on, and ten years after its foundation the whole organisation was transferred to the control of the Ministry of Marine, a definite policy of building inaugurated, and its constitution and objects clearly defined as being for the maintenance of a cargo, passenger, and postal service between Odessa and the East, and the general development of national commerce, all the operations of the fleet being on a commercial basis.

The funds of the Volunteer Fleet as now constituted consist of:—

1. The assets of the original company.
2. Donations.
3. Profits of commercial operations.
4. Subsidies from the Government.

The vessels of the Volunteer Fleet have to make not less than eighteen trips annually between Odessa or St. Petersburg and Vladivostok, calling nine times out and nine times home at both Port Arthur and Shanghai. A number of compulsory voyages are fixed annually for carrying convicts to the Island of Saghalien, calling at the ports of Alexandrovsk and Korsakovsk. A scheme of sailings with rates for cargo and passengers is drawn up every year by the committee, and approved by the Ministers of Marine, Finance, War, Interior, and Ways and Communications. These rates hold good for the ensuing season, and are subject to a rebate of 20 per cent. to passengers travelling on Government service. A special tariff is arranged for rank-and-file, peasants, emigrants, convicts and their families, who accompany them voluntarily, and also for any Government cargo; 30 cwt. of mails and postal parcels are carried free by each vessel in specially constructed compartments, above which weight freight is paid. Couriers and special messengers travel free, except for the cost of their food.

The fleet takes precedence over all other steamship companies in the carrying of troops, military and naval stores, &c., but has, however, the right to refuse this service if the ship is already appointed for the service of some other Government department, or if the cargo to be despatched by the War or Naval Department is not ready at the time of sailing. The Minister of Marine has the right to hand over the vessels of the Volunteer Fleet temporarily for the use of the Naval or War Departments, on conditions to be agreed between these Ministers and the Imperial Control.

The demand for subsidies is submitted for decision in the usual course to the Council of State, and, if approved, the amount allowed is paid by the Government for a definite period of time, depending on the conditions under and in which the fleet is at the time, and are payable at the beginning of each year, subject to any deductions for the non-fulfilment of the previous year's sailings.

The obligations of the Volunteer Fleet are:—To build or acquire ocean-going steamships corresponding to its aims, and the necessary offices, workshops, quays, warehouses, and other adjuncts for its business.

The ships, offices, and agents of the Volunteer Fleet are free from the Imperial Commercial Tax.

The commanders, officers, engineers, and doctors on the ships of the Volunteer Fleet are taken from the Active Navy List, from amongst the retired naval officers, or from any Russian subjects trained for the naval service. The commanders, as also the heads of offices and agents, are approved by the Minister of Marine on the recommendation of the President of the Committee, who himself appoints the remaining officers. Naval officers receive no remuneration from the Government, but their time on the Volunteer Fleet service counts in regard to their pension, and they may retain their post after the expiration of the time limit for Navy service.

The Committee, to whose administration the Volunteer Fleet is entrusted, meets at least once a week, and is directly subordinate to the Minister of Marine. It con-

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

TABLE I.—PARTICULARS OF VESSELS SPECIALLY DESIGNED AND BUILT FOR THE RUSSIAN VOLUNTEER FLEET ASSOCIATION.

NAME.	BUILDERS.	Length.	Breadth	Depth	Under Deck Tonnage.	Gross Tonnage.	Engines.	Boilers.	Heating Surface	I.H.P.	Speed on Trial.	Number of Crew.	Number of Passengers.	Bunker Capacity.	Cargo Capacity in Cub. Ft.	Water Ballast Capacity.	Dead-weight on 24 Ft. Draught.	Number of Masts.	Number of Funnels
		ft. in.	ft in.	ft in.							knots			tons		tons			
1. VESSELS FOR SPECIAL SERVICE IN THE FAR EAST.																			
Habarovsk	Hawthorn, Leslie, and Co.	250 0	35 10	21 0	819	1523	Twin. 18, 28, 46×30 in. Single.	3 S.E.	5,000	1,750	12½	53	454	190	79,700	380	..	2	1
Diomed	Ditto	91 6	19 6	9 0	90	100	16½, 33 × 22 in. Single	1 S.E.	1,150	..	10	7	..	..	..	..	..	1	1
Siberiak	Ditto	90 0	19 6	9 0	95	97	16½, 33 × 22 in.	1 S.E.	950	..	10	7	..	..	..	..	..	1	1
2. LOW-SPEED VESSELS FOR OVERSEA SERVICE.																			
Yaroslavl	W. Denny & Bros.	385 0	44 9	31 0	3880	4495	20, 33, 50 × 42 in.	4 S.E.	..	2,500	12.84	110	21, & 800 convicts	706	255,530	666	5220	2	1
Tambov	Ditto	385 0	44 9	31 0	3880	4441	20, 33, 50 × 42 in.	4 S.E.	..	2,500	13.24	110	850	706	246,024	666	5270	2	1
Kiev	J. Brown and Co.	419 0	49 6	32 0	4811	5566	21, 34, 52 × 45 in.	3 S.E.	8,113	3,000	13	115	970	843	309,820	907	6030	2	1
Voronej	W. Denny & Bros.	419 0	49 6	32 0	4761	5616	21, 34, 52 × 45 in.	3 S.E.	8,109	3,000	13	115	970	859	305,030	856	6150	2	1
Vladimir	Ditto	419 0	49 6	32 0	4761	5621	21, 34, 52 × 45 in.	3 S.E.	8,109	3,000	13	115	970	869	305,240	856	6126	2	1
Ekaterinoslavl	Hawthorn, Leslie, and Co.	419 0	49 6	32 0	4815	5492	21, 34, 55 × 42 in. Twin-screw.	3 S.E.	8,112	3,000	13	115	1020	900	315,800	918	6320	2	1
Design (Shelter deck)	Ditto	471 0	60 0	34 11½	7100	8000	24, 40, 66×48 in.	5 S.E.	13,400	5,500	13½	129	2390	1500	465,000	1200	7300	2	1
3. HIGH-SPEED VESSELS FOR OVERSEA SERVICE.																			
Orel	Hawthorn, Leslie, and Co.	415 0	47 9½	35 0	4470	4528	Twin. 34, 54, 85 × 51 in.	4 D.E. and 2 S.E.	17,200	10,000	19¼	113	1380	765	218,300	600	4090	3	2
Saratov	Ditto	425 0	49 9½	35 0	3512	5308	34, 54, 85 × 51 in.	5 D.E. and 2 S.E.	18,470	9,500	18¾	129	1515	820	240,900	670	4030	3	2
Petersburg	Ditto	425 0	51 8	34 10	3405	5336	34, 54, 85 × 51 in.	5 D.E. and 2 S.E.	24,050	10,500	19	138	1568	1210	233,000	770	4390	3	2
Kherson	Ditto	455 6	54 0	37 3	5787	6138	30, 57, 92 × 54 in.	24 Belleville	35,350	13,500	19½	164	1600	1440	243,500	850	4410	3	3
Moskva	J. Brown and Co.	470 0	58 0	37 0	6388	7267	36½, 61, 103 × 54 in. Four of each.	30 Belleville	41,605	17,500	20 16	170	1630	1440	270,000	900	4750	3	3
Smolensk	Hawthorn, Leslie, and Co.	470 0	58 0	37 0	4783	7270	26, 44, 75 × 48 in.	24 Belleville	42,560	16,000	20.1	174	1640	1640	266,800	1064	5000	2	3
Design (Shelter deck)	Ditto	470 0	60 0	35 0	4650	7100	26½, 45, 77 × 48 in.	3 S.E. cylindrical and 9 Yarrow large tube	46,500	16,750	20	175	2100	1700	350,000	1100	5400	2	2

sists of a president, who is appointed from among the admirals on the active list, having no other appointment or occupation, by Imperial command, on the recommendation of the Minister of Marine, two members from the Ministry of Marine, one member from the Ministry of Finance, one member from the War Office, and a representative of the Imperial Control, who has not, however, the right of veto. The inspector, or, as he would be termed in England, the general manager, is recognised as a consulting member of the committee. A representative of the Ministry of the Interior, with the right of veto, attends the meetings when matters affecting this department are under consideration.

Reserve and insurance funds are established, the former being obtained by an annual charge on the trading profits equal to 5 per cent. on the first cost of the ships and real estate of the Association, and the latter by a similar charge of 3 per cent. on the present value of the ships. The first charge ceases when the ships are written down to 5 per cent of their total original cost, and the latter when the insurance fund reaches and does not fall below one-third of it.

Provision is made whereby the inspector, committee, and staff benefit by the prosperity of the Association.

The funds, transactions, and accounts are under the supervision and inspection of the Imperial Control, and subject to special rules drawn up by it with the approval of the Minister of Marine.

SHIPS OF THE RUSSIAN VOLUNTEER FLEET ASSOCIATION.

In considering the ships of the Russian Volunteer Fleet, it is only proposed to deal with vessels specially designed for its service, and these may be divided into three classes:—

1. Vessels for special service in the Far East.
2. Low-speed vessels for oversea service.
3. High-speed vessels for oversea service.

I.—VESSELS FOR SPECIAL SERVICE IN THE FAR EAST.

The principal vessel under this heading is the Habarovsk (see Table I., first division), built for the Arctic service as a postal, store, and relief ship, principally in the Sea of Okhotsk. She is a twin-screw vessel, 250 ft. long, 36 ft. beam, and 21 ft. depth, of exceptionally strong construction, to work among ice, and fitted with accommodation for first, second, and third-class passengers. The more exposed parts of the accommodation are insulated, and steam heating and steam cooking apparatus are fitted on an extensive scale. The Siberiak and Diomed are two powerful tugs, constructed internally and externally so as to serve as icebreakers, and fitted with fire and salvage pumps.

II.—LOW-SPEED VESSELS FOR OVERSEA SERVICE.

These vessels, which are shown in Table I., second division, in order of date, are principally distinguished from the third group by the difference in speed and the plainer style of the first-class accommodation, which in their case was fitted in the poop instead of in bridge houses and 'tween decks amidships. They are all twin-screw vessels of about 12 knots speed, having cylindrical boilers and Howden's system of forced draught. Of this group the Yaroslavl calls for particular notice, as she was specially built for the transport of the worst class of convicts from Europe to Saghalien, and for this purpose groups of beds in the different 'tween decks are enclosed in cages, with passages all round between them and the ship's side to serve as sentinel walks, &c. This arrangement makes it possible to control the number of convicts on deck, so that it never becomes larger than the guards deem expedient. Only male convicts are carried in this vessel, any members of their families deciding to go into exile with them being carried in the other vessels. Special means are fitted in the convicts' quarters for dealing with insubordination on a large scale, and dark cells are constructed in each compartment.

The Tambov is of the same dimensions and power as the Yaroslavl, except that she is fitted for carrying troops or emigrants instead of convicts, and has more saloon accommodation. She was built and equipped ready for sea by Messrs. Denny in less than six months, which, in spite of the advantage of duplication, was an excellent performance.

The Vladimir, Voronej, Kieff, and Ekaterinoslavl were four sister vessels, which were built with a view of increasing the earning power of the fleet. Being of lower power and fuller form, their carrying capacity is much larger, and their consumption much lower than the high-speed vessels. They preserve, however, the characteristic appearance of the ships of the Volunteer Fleet. Their dimensions are 453 ft. 6 in. over all, 419 ft. between perpendiculars, 49 ft. 6 in. beam, and 32 ft. depth, moulded. Fitted with twin-screw machinery of about 3000 indicated horse-power, they are able to steam 12 knots with a consumption of 40½ tons per day loaded. The boilers are of the single-ended cylindrical type, working with Howden's system of forced draught. The upper and lower 'tween decks are fitted with portable iron beds for troops or emigrants, and accommodation for officers or first-class passengers is fitted in the poop. The ships' officers and engineers are berthed in the bridge amidships, and the crew and firemen in the forecastle forward. Generally speaking, the arrangements and fittings of these, in other respects, are similar to those of the higher-speed vessels, except that no guns or magazines are arranged for, and that arrangements are made whereby the holds and lower 'tween decks also may be fitted for carrying troops on short voyages in the Black Sea, if necessary, thus increasing their numbers from 1020 to 2660 of all grades.

III.—HIGH-SPEED VESSELS FOR OVERSEA SERVICE.

This group, which is shown in the third division of Table I., on the present page, consists—in order of age—of the Orel, Saratov, Petersburg (now Dnieper), Kherson (now Lena), Moskva (now Angara), and the Smolensk (now Rian), and as it embraces the vessels which have in the highest degree those features which constitute the ideals sought after by those whose aim it was to develop the fleet to its highest degree of usefulness, it will be considered in greater detail. The intention in 1889, when the Orel was ordered, was to build ten vessels of high speed which would fulfil all the requirements of the higher class of troopship and auxiliary cruiser, and yet be able to trade as mail and passenger steamers when not required for that purpose. As might be expected, it was found that these vessels could not be run profitably, and, foreseeing that the opening of the Trans-Siberian Railway would rob the fleet of much of its more profitable passenger and trooping business, the Committee decided that four of the ten ships should be built as intermediates, these vessels being the last four of the previous group.

The Orel was originally a flush-decked vessel of the spar-deck class, but in 1897 she had a poop, bridge, and forecastle added, thus converting her to the type adopted in the later vessels. Her dimensions are 445 ft. over all and 415 ft. between perpendiculars, 48 ft. in breadth, and 35 ft. depth, moulded. She has twin-screw engines, with cylinders 34 in., 54 in., and 85 in. in diameter, with a 51-in. stroke, and four double-ended cylindrical boilers, 18 ft. long by 15 ft. in diameter, worked at 160 lb. pressure, with a heating surface of 17,200 square feet. She has a hold capacity of 99,800 cubic feet, and a total cargo capacity of 218,300 cubic feet. On a draught of 24 ft. she carries 3550 tons deadweight and has a speed of 19 knots. She is fitted throughout for troops, of which she carries 1380 of all grades, and a crew of 113 all told. The saloon accommodation is fitted in the upper 'tween decks amidships. The Orel is now attached to Admiral Rodjestvensky's squadron as a hospital ship, having been converted for this purpose at La Seyne, by the Forges et Chantiers de la Méditerranée, the funds being subscribed in France, partly by the French Red Cross Society. It is claimed that she is the most completely equipped hospital ship that has yet been commissioned, and has specially built operating-rooms, binding and dressing-rooms, surgeries, laboratories, sterilising-room, steam disinfecting-room, Röntgen ray department, &c. (See Figs. 1 to 6, page 553.)

The Kostroma has also been converted for the same purpose, and is attached to Admiral Nebogatov's squadron at Suda Bay.

The Saratov is 461 ft. over all, 425 ft. between perpendiculars, 50 ft. beam, and 35 ft. depth, moulded. She has twin-screw machinery, with cylinders 34 in., 54 in., and 85 in. in diameter, with a stroke of 51 in., and has five double-ended cylindrical boilers, 18 ft. long by 13 ft. 3 in. in diameter, and two single-ended boilers 9 ft. 4 in. long by 13 ft. 3 in. in diameter; all of 160-lb. pressure, with a total heating surface of 18,470 square feet. On a draught of 24 ft. she carries 4030 tons dead-weight, and has a speed of 18½ knots. She carries 1515 troops of all grades, and a crew of 129 all told.

The Petersburg is 461 ft. over all, 425 ft. between perpendiculars, 52 ft. beam, and 35 ft. depth, moulded. She has twin-screw machinery, with cylinders 34 in., 54 in., and 85 in., with a stroke of 51 in., and five double-ended cylindrical boilers, 18 ft. long by 13 ft. 10½ in. in diameter, and two single-ended boilers, 9 ft. 4 in. by 13 ft. 10½ in. in diameter, all working at a pressure of 160 lb., with a total of 24,050 square feet of heating surface. She has a hold capacity of 233,000 cubic feet, and on a draught of 24 ft. she carries 4390 tons dead-weight, and has a speed of 19 knots. She carries 1568 troops of all grades, and a crew of 138 all told.

These three vessels are all fitted with cylindrical boilers, whereas the Kherson, Moskva, and Smolensk are fitted with water-tube boilers of the Belleville type, the last one having economisers.

The Kherson is 492 ft. over all and 455 ft. between perpendiculars by 54 ft. by 37 ft. 3 in. depth, moulded. She has twin-screw machinery with cylinders 36 in., 57 in., and 92 in. in diameter with a 54 in. stroke, and twenty-four Belleville boilers, working at 250 lb. pressure. She has a hold capacity of 112,900 cubic feet, and a total cargo capacity of 243,500 cubic feet. On 24 ft. draught she carries 4415 tons dead-weight, and has a speed of 19½ knots. She carries 1600 troops of all grades, and a crew of 164 all told.

The Moskva is 507 ft. over all and 470 ft. between perpendiculars by 58 ft. by 37 ft. depth, moulded. She has twin-screw machinery with cylinders 36½ in., 61 in., and 103 in. in diameter, with a 54-in. stroke, and thirty Belleville water-tube boilers, with a heating surface of 41,605 square feet, and has a speed of 24.16 knots.

The Smolensk is 537 ft. over all and 470 ft. between perpendiculars by 37 ft. depth, moulded. She is fitted with twin-screw machinery, having cylinders 26 in., 44 in., and 75 in. in diameter, with a 48-in. stroke, four of

THE RUSSIAN VOLUNTEER T.-S.S. "SMOLENSK."

CONSTRUCTED BY MESSRS. HAWTHORN, LESLIE, AND CO., ENGINEERS AND SHIPBUILDERS, NEWCASTLE-ON-TYNE.

(For Description, see Page 554.)

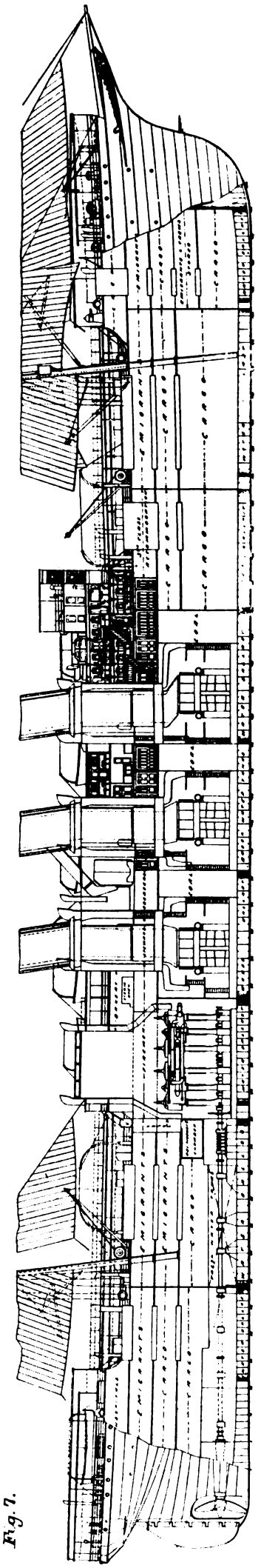


Fig. 7.

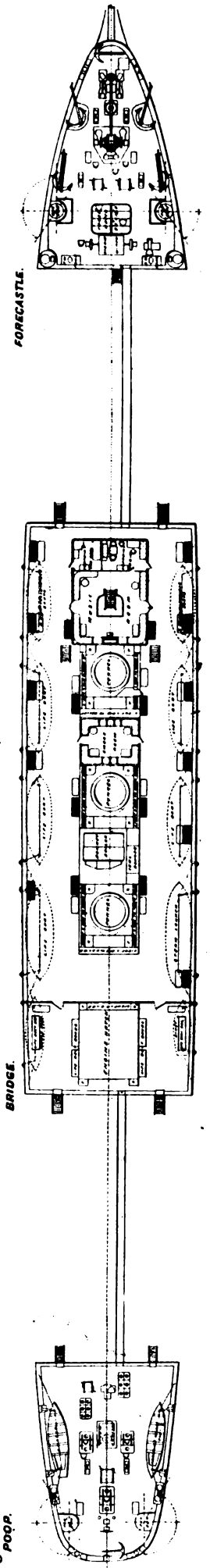


Fig. 8. POOP.

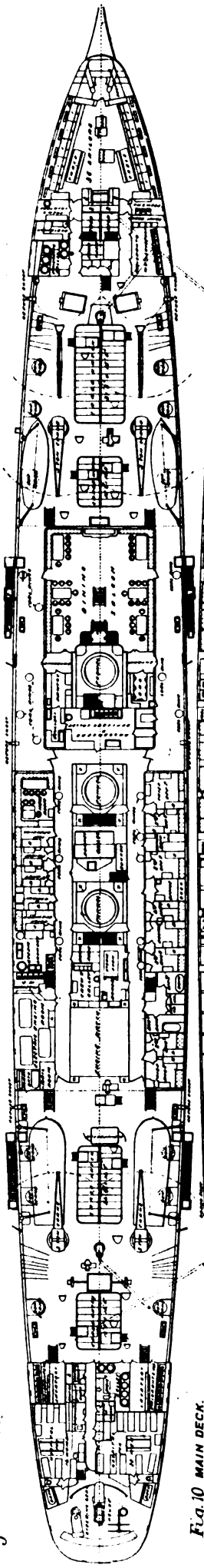


Fig. 9. UPPER DECK.

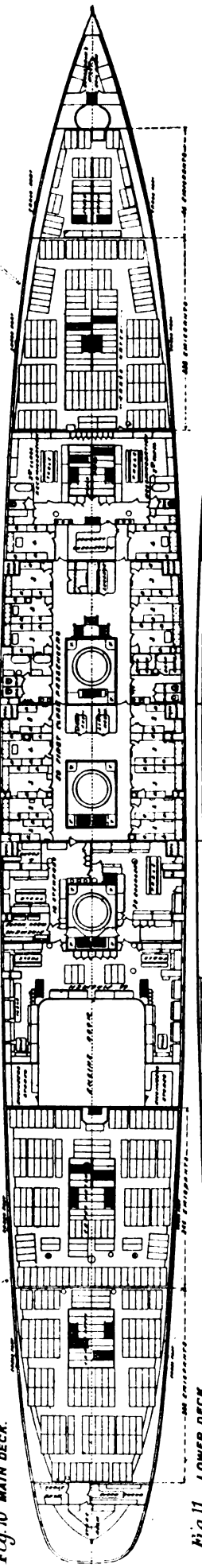


Fig. 10 MAIN DECK.

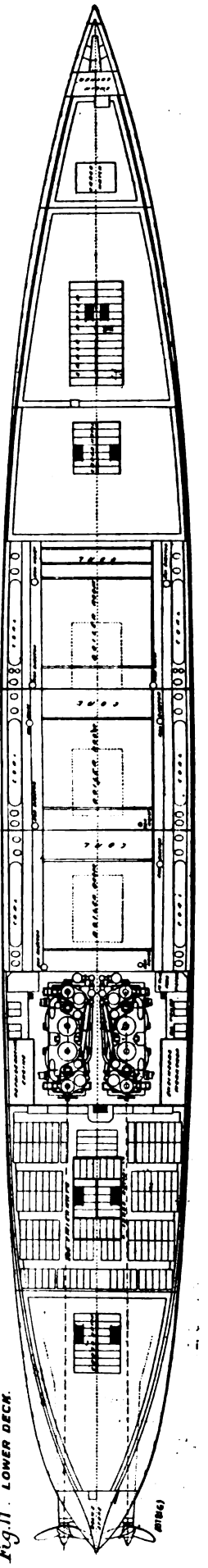


Fig. 11. LOWER DECK.

each size, and twenty-four Belleville boilers with economisers, having a heating surface of 42,560 square feet. She has a hold capacity of 125,500 cubic feet, and a total cargo capacity of 366,800 cubic feet, and on 24-ft. draught she carries 5000 tons dead-weight, and has a speed of 20¼ knots. She carries 1643 troops of all grades, and a crew of 174 all told.

Apart from the points of difference shown in Table I., page 555, or already named, between these six vessels, and that existing in the machinery, which will be referred to later, they are so similar in type that a description of the Smolensk, which is the most recent, may be taken as applying to them all. The Smolensk, the general arrangement and appearance of which is shown in Figs. 7 to 11, page 556, is a two-masted schooner-rigged vessel, with yards on the foremost (which have since been removed), three funnels, and a clipper stem and a short bowsprit. She has a long forecastle, bridge, with a bridge-house at its forward end, and a short poop. The bridge-deck, which extends from side to side over the bridge and bridge-house, is covered all fore-and-aft by a boat-deck, over the forward end of which a large navigating-bridge is constructed. The sleeping accommodation for the first-class passengers is in the upper 'tween decks, abreast of and forward of the machinery-casing. These rooms vary in size up to 15 ft. 6 in. by 10 ft. 6 in., no upper berths being fitted, and the larger rooms are arranged so that the berths may be folded away, in order that they may be utilised as sitting-rooms. The dining-saloon is on the upper deck, and communicates, by a pantry, on each side with the galley, which is situated at a convenient distance abaft it. The music-room stands on the bridge above, with a large opening in its centre, giving light to the dining-saloon below from the skylight overhead. The smoke-room is on the bridge, further aft. The officers and engineers are berthed on the bridge on either side, the crew and petty officers in the forecastle, and the firemen in the 'tween decks, near the machinery-casing. The poop is fitted up with two large hospitals, dispensary, operating-room, and quarters for an assistant and two Sisters of Mercy.

A special feature of the first-class accommodation in some of these vessels is that, when the service on which the vessel is engaged requires it, the forward end of the dining-saloon can be divided off and arranged with four of the largest state-rooms, and the music saloon, with which it communicates by an independent stairway, to form a private and very complete suite of apartments. The saloon accommodation, as a whole, though on a smaller scale, is similar in style to that of the leading Atlantic liners.

Both 'tween decks all fore-and-aft are fitted up for troops or emigrants, a large apartment being set apart for non-commissioned officers or third-class passengers. Apart from the saloon galley which serves the ship's officers and the saloon, there is one galley for the crew amidships and one forward, and one aft capable of cooking with comfort for 50 per cent. more troops than the vessel is fitted up for; and in addition a bakery is provided which can produce 2 tons of bread per day. A steam laundry, with washing, wringing, and ironing plant, and a drying-room, is fitted amidships, as well as a large disinfecting plant. The system of ventilation is by Stewart's thermo-tanks, of which seven are fitted and worked in conjunction with electric fans and air-trunks led to every part of the vessel, the capacity being such that the whole of the air can be replaced by warm fresh air three-and-a-half times an hour in the emigrants' quarters, and five times an hour in the state-rooms and saloons. A refrigerating engine, with freezing and chilling rooms, and an iced-water fountain is fitted. The electric-light plant is in triplicate, each plant being capable of lighting the vessel. The distilling plant has a capacity of 16,000 gallons per day, equal to 8¾ gallons of water for every man on board.

A large high-pressure auxiliary boiler of the cylindrical type is carried on deck in the machinery casing, with connection to the pumps and all auxiliary machinery.

The fresh-water tanks are built between the tunnels, the method of building them between the outside of the tunnels and the shell of the ship, adopted in some of the earlier vessels, having been abandoned.

The boats, which are carried on the boat deck and on the poop as well as in the forward and after wells, include a number of semi-collapsible and steel lifeboats, a powerful steam-towing launch, and 6-ton and 8-ton surf boats for landing troops. Rapid handling of stores is ensured by the use of cranes and Temperley transporters forward and aft. Two steam and one hand steering-gear of very large power are fitted, enabling the vessel to manœuvre with exceptional ease. Sixteen guns are carried, and ammunition hoists are arranged in convenient positions for the portable magazines, which can be dropped into the holds at short notice. The girder and collar system of pillaring is adopted in order to facilitate this, flooding connections are provided for these magazines, and fire-extinguishing pipes are fitted to each compartment in the holds and 'tween decks.

(To be continued.)

THE PALMER RECORD.—In connection with the works of the Palmers Shipbuilding and Iron Company, Limited, there has been issued an occasional journal conducted by the staff, and known as "The Palmer Record." We have received the latest issue of this "Record," which is exceptionally well printed, and includes many beautifully-prepared process blocks, forming a pictorial record of recent events in connection with the works, launches, trial trips, and the completion of the electric power-station. Special note may be made of an interesting article on the development of torpedo-boat destroyers.

FACTORS OF SAFETY IN MARINE DESIGNS.

*Margins and Factors of Safety, and their Influence on Marine Designs.**

By A. E. SEATON.

EVERY structure and machine must be so designed that, when properly constructed, it is capable of safely carrying the load or developing the power for which it was intended for a considerable period; some, in fact, must do so for an indefinitely long time. At the same time, such structures and machines are, as a rule, for good and sufficient reasons, not made stronger or heavier than necessary.

In recent years, in fact, a demand has arisen for something that shall be as light as possible consistent with the necessary strength; in such cases, however, endurance is not generally of prime or even great consequence. Notwithstanding this, every designer of such things, as, indeed, every business man, likes to have a margin on which to "come and go," as well as one which shall not be trenched on under normal conditions. Most rules and formulæ contain, either latent or apparent, some provision for such margins, and one hears, both in the lecture theatre and drawing-office, much talk of "margins of safety" and "factors of safety;" but it is doubtful if these things are as clearly appreciated there, or elsewhere, as is desirable in their full meaning and effects.

One has only to read an ordinary specification of a ship or engine to perceive how nebulous appears to be the knowledge of their authors of the dangers for which factors and margins of safety are supposed to be the insurance; it will also appear that the cures for these ills, whose cause is so often not understood fully, are applied as promiscuously and with the same faith as are patent medicines for bodily ailments. Further, some of them, too, have the old analogy, in their effects, to certain drugs, inasmuch as they produce the disease they are supposed to cure.

The component parts of structures and machines are subject to be stressed in either one or more of the following ways—viz.:—

1. By a steady and constant pull, so that the metal is in tension, or by a steady and constant pressure, so that the metal is in compression.

2. By a pull or pressure repeatedly but gently applied and removed, so as to vary in intensity from 0 to a maximum, and the reverse.

3. By the repeated sudden application of the full load, and its sudden removal at intervals, so that the material is suddenly and intermittently subject to tension or compression.

4. By the repeated gradual application, gradual withdrawal and reversal of the load, so that the material is alternately in tension and compression.

5. By the repeated sudden application and reversal of the load, so that the material is alternately in tension and compression, the changes being sudden and violent from plus to minus.

The margin or factor of safety on each portion must depend for its magnitude on the nature of the load to which it is subjected; the least being required when subject to No. 1, and the greatest to No. 5 conditions. The materials thus employed have physical characteristics with which engineers are nowadays familiar, although the accuracy of the knowledge of them is still partially undetermined, so that the cause of failure, when it does occur, often continues to be more or less of a mystery, or, at all events, of a controversial nature. This is especially so in those cases where structures have been subjected to dynamic forces.

It is admitted that no metal under load should be stressed beyond its elastic limit or yield-point; it used to be considered that, if the load never stressed it to the limit of elasticity, the metal could not give way, and should last for ever. We know now that, under certain circumstances, metals will give way when apparently stressed much below that point; but we also know that to bring on destruction in that way the load must be intermittent; further, we know that if the stress is an alternating one, its magnitude, to produce fracture, may be still less than if intermittent. Modern research, especially that of Professor Arnold, has shown that time also enters very largely into the account when dealing with dynamic forces; that the quicker the application of the load the fewer are the repetitions necessary to ensure fracture; or, the oftener per minute are the repetitions of load, the smaller that load need be to produce fracture. Now, although we know, and have known, most of these things for many years, do we always act upon this knowledge when determining the so-called margins of safety? Are engineers always consistent in fixing the magnitude of such allowances as they make? Let us see what are really the dangers for which provision has to be made. The wrought materials used nowadays can generally be got of fairly uniform quality, and we have the means in the tensile and drop-testing machines of ascertaining that quality, and their general suitability for the purpose for which they are wanted. Any danger due to faulty material should therefore be slight, and little or no margin is required for insurance.

The formulæ and rules on which a design is evolved may be, and sometimes are, subject to doubt; for example, those used for giving the stress on a shaft due to torsion really only give the shear on the outer envelope, or skin, of the shaft, and without allowing for the fact that that skin is firmly attached to, and therefore supported by, the next layer of metal. Such also is the case when calculating the stress on a beam subject to cross-bending. But in the case of a rod suspending a weight, or in that of a short stanchion supporting a load, there can be no scepticism.

With the shaft subject to torsion, it is difficult to determine what is the greatest nominal stress that may be put on the outer layer, so that the shaft may run in safety indefinitely. It must, of course, be such that at any point it is really below the yield point; but how much can only be determined positively by experiment. If the shaft is subject to a steady torque, or one whose torsional variations are slight, probably the nominal stress may safely be as high as 75 per cent. of the yield-point;* while, if the variations are great and violent, it might not be safe with only 40 per cent. Again, if the shaft has on it a fly-wheel or a screw propeller, so that there are rapidly changing alternating stresses due to the bending moment as well as shearing forces due to torsion, perhaps 30 per cent. would not be too little to reckon on. In specifying and designing shafting or beams, is all this always remembered? Certainly no one, not even the Board of Trade, asks for a test of these things as a check on either calculation or material, however intricate and doubtful the formulæ may be.

Now in the case of the rods and stanchions, as also of thin cylinders, such as boiler shells, practically the whole of the section of metal is resisting the load, so that it is stressed uniformly and exactly as given by the calculation.

A good instance, therefore, of case 1 is a boiler shell. Here the load is gently applied, continuously kept on, with slight variations in magnitude, and gently removed; moreover, the intermission interval is long—generally very long; stress, therefore, may surely be high, so much so that, if it were 60 per cent. of the elastic limit, there would be no danger from overstrain of material—that is, a "factor of safety" as low as 3 would be really quite sufficient for the working pressure. A factor of safety of 4, therefore, must be ample. But if a boiler were so designed, and an hydraulic test made of twice the working pressure, the stress on the plates would be uncomfortably near the elastic limit, although still below it nominally by about 20 per cent. of the working pressure.

It may be mentioned in passing that it is somewhat anomalous of the Board of Trade to allow bridges which are subject to sudden intermittent loads to be built with a factor of safety of 4, and deny the same to marine engineers for boilers with the much less trying loads above described, but insist on a minimum of 4½. Likewise, it seems extraordinary that this department should permit a railway company to allow locomotives in crowded stations, and close to the streets in towns, whose boilers have never been tested to more than 50 per cent. above the pressure on the safety-valves, and have never been seen during construction by one of its surveyors, while insisting on such inspection, and on their being tested to twice the working pressure, in the case of the boilers fitted in the same companies' steamships.

It may be urged, however that a constant danger for which provision must be made is faulty workmanship, both in the treatment of the material in making and in the construction of the structure. This was to a considerable extent true in the days of scrap-iron forgings and plates made with a hammer, often barely equal to the work, and worked and rolled with laminations and flaws in every part, and when such plates were manipulated with the punching and shearing machine. To-day, with ingot steel forged in a press and rolled to homogeneity, and manipulated with drilling machines of every sort, the danger is minimised; so that, with the good workmanship which can be insisted on and obtained at such moderate cost, with the good machine-tools of both large and small size now in general use, small provision, if any, is sufficient to meet any danger from these causes, especially for boilers which have been made under the inspection of independent surveyors. This consideration should influence the officials of the Board of Trade and other authorities in determining the factor of safety they demand for boilers made, under inspection, of the best materials and the best workmanship.

Another, but somewhat remote, disturbing cause is what in the electrical world is now called "overload"—that is, the fear that at some time, under peculiar and abnormal circumstances, the load may be considerably in excess of the maximum designed load. No doubt, that was one of the chief reasons for the test pressure of boilers being fixed originally at double the working pressure. In fact, in those early days the working pressure was so low that the margin of safety got in this way was by no means excessive.

It will be admitted, I think, that, with the technical knowledge we now possess, and with the inspected and tested materials we now use, a structure made of wrought materials might be pronounced fit, or otherwise, for its work, so far as strength or safety is concerned, by simple inspection; and in the case of machinery or parts of machinery made of cast materials, almost the same method should do for most of it, seeing that it is common practice to make some allowance for the contingency of a casting having latent defects which may detract somewhat from its strength. This method is, however, not yet relied on, for we still continue to do what in early days was absolutely necessary—viz., to prove the truth of such calculations as were made, as well as the quality of the material and workmanship, by testing boilers, cylinders, &c., by water to some pressure in excess of the maximum to which they are exposed when at work. Is such a process now really necessary and satisfactory; and, if so, how and to what extent should it be applied?

Formerly boilers were built with or without definite

* Paper read before the Institution of Naval Architects, April 14, 1905.

* The resistance to shearing of wrought iron and steel is 80 per cent. of that to tension; with Naval brass and the strong zinc bronzes it is only 56 per cent.

THE RUSSIAN VOLUNTEER FLEET.*

By HERBERT ROWELL.

(Concluded from page 557.)

THE armament consists of 120-millimetre and 75-millimetre rapid-firing guns, and their disposition and angle of fire on two of the vessels is shown in Figs. 12 and 13, below. The number of guns arranged for at the time of building was as follows :—

	120 mm.	75 mm.	47 mm.	37 mm.
Smolensk	8	8		
Moskva	8			
Kherson	7			
Petersburg	7	..	6	8
Saratov	7			

It is understood that the number of guns carried has been largely increased on some of the vessels; for instance, the Kherson now carries eleven 120 millimetre guns.

The ballast-pumps are capable of ejecting 800 tons of water per hour, and 12-in. bilge pipes are fitted; and, in case of emergency, by utilising the full pumping power of the vessel, the amount of water dealt with can be increased to 2500 tons per hour. Ten water-tight bulkheads extend to the upper deck, and the subdivision of the vessel is such that any two compartments may be open to the sea without the vessel necessarily foundering (see Fig. 14, below).

The main boilers are placed in three stokeholds of equal size, the coal-bunkers being arranged at the sides as well as athwartships, so as to afford a certain amount of protection. These stokeholds communicate by water-tight doors, which can be closed instantaneously from the deck, and which are so placed that their sills are 2 ft. 6 in. above the stokehold floor—that is, 5 ft. above the inner bottom. The vessel is built to Lloyd's highest class, with additions, has capacity for 1000 tons of water ballast, and a permanent bunker capacity of 1650 tons.

It will be seen from Table II., page 591, which gives the total distance steamed and total coal consumed by all the ships of the Volunteer Fleet, that the average speed on the voyage of the high-speed vessels is 11 to 13½ knots, corresponding to 1650 to 4050 indicated horse-power, as against 9000 to 16,500 indicated horse-power, which these vessels are capable of developing; and taking the powers corresponding to those speeds, the coal consumed works out at about 3 lb. per indicated horse-power per hour. These results reached a climax in the later boats fitted with Belleville boilers, on which a heavy loss was incurred on each voyage. Twe attempts were made in two of the earlier vessels to increase economy at reduced speeds; in the first instance by fitting a fourth cylinder on the top of the high-pressure cylinder, and in the second by fitting an expansion-valve in the high-pressure piston-valve. Neither was considered to fully meet the requirements of the service, and it was therefore decided to fit in the Smolensk machinery of a type which was first worked out by the late Mr. F. T. Marshall (whose premature death occurred so recently) under the instructions and patents of Mr. Philip Watts and the late Mr. Magnus Sandison, and fitted with highly satisfactory results in a training-ship named the General Baquedano, built at Elswick for the Chilian Navy, with a view of getting the maximum economy at cruising speeds. This arrangement, which formed the subject of a paper read before this Institution by Mr. Sandison, in April, 1900, consists (as will be seen by the accompanying sketch and Fig. 15, on this page) of six cylinders working on each shaft, two being high pressure, two intermediate, and two low pressure, in two sets, but on six cranks, and so arranged that a set of three on either shaft may be disconnected, and the connecting and slide-valve rods slung clear, the whole crank-shaft being driven by the set in operation. This system enables a voyage at half power to be made with the same consumption per indicated horse-power as for full power, without the shaft alignment troubles experienced in the Sardegna and other vessels where the same end was sought to be attained by fitting two separate engines to each shaft with an arrangement for disconnecting the forward set.

The results obtained on the consumption trials were as follows :—

Full Speed.

Power	15,900 indicated horse-power
Speed	20¼ knots
Tons of coal burnt	157 tons
Duration of trial	12 hours
Consumption in pounds per indicated horse-power per hour ..	1.741

Trading Speed.

Power	4055 indicated horse-power
Speed	13½ knots
Tons of coal burnt	30.75
Duration of trial	10 hours
Consumption in pounds per indicated horse-power per hour ..	1.698

This result was borne out on the voyage from the Tyne to Odessa, during which a carefully measured consumption trial was run between Algiers and Constantinople, when the consumption for all purposes worked out at 1.73 lb. per indicated horse-power per hour, with a speed of 14¾ knots.

In practice it is advisable to use each set alternately for the voyage out and home.

It is possible to make the change from half to full power at sea with comparatively small loss of distance or of steaming at a higher speed, owing to the saving in weight of bunkers.

Reference to Table II., page 591, shows that each ton of cargo carried on the round voyage in the Smolensk requires 1.104 tons of fuel for its transport, as against 1.624 tons in a similar vessel with Belleville boilers and ordinary machinery, 0.462 ton in the slower vessels, and 1.045 tons in the fast vessels with cylindrical boilers. It is, perhaps, hardly necessary to point out that, as in trading only half the working parts of the six-cylinder machinery are in use, its life would be prolonged. The weight of the six-cylinder arrangement is practically the same as that of the three-cylinder arrangement, and owing to the valves being arranged on the face of the cylinders the length of the machinery space required is only about two frame spaces more than in the case of a ship with the three-cylinder arrangement; the relative lengths being 42 ft. 9 in. and 38 ft. 9 in.

When running at full power the balance of the engines was found to be practically perfect, and vibration, except immediately over the propellers, completely absent.

The boiler installation, which consists of twenty-four Belleville boilers fitted with economisers, has been found to work most satisfactorily, as was shown by the official report to the Russian Admiralty after the Smolensk's last cruise, which was "65 days at sea—ready to sail to-morrow." That these boilers have proved so much superior to those of the Kherson (now Lena) is due to the Board of Trade having insisted on lap-welded iron tubes in the latter vessel, many of which have given out.

The boilers, which have 42,565 square feet of heating surface and 1333 square feet of grate surface, would, without undue forcing, have enabled the engines to

covered, as will be seen from Fig. 16, page 591, which shows the distance in miles covered by two vessels, one, "B," fitted with the Smolensk type of machinery, and the other, "A," with the ordinary type of machinery, during the first 12 hours of a voyage, assuming that both started at a cruising or trading speed of 14 knots, with one boiler-room out of three under steam, and received orders at the end of the third hour to proceed at full speed.

In making this comparison it is assumed that water-tube boilers are fitted in both vessels, and that the time necessary for getting up steam on the unlighted boilers is three hours. If the vessels had equally started with steam on all boilers, the distance steamed at the end of 12 hours would have been the same, seeing that in that case the six cylinders would obviously have been coupled up before starting. If both vessels had cylindrical boilers, the difference at the end of 12 hours would be 58 knots, as shown by the dotted lines, seeing that although there would be the same falling-off in speed in "A" as in the case of "B" during the four hours engaged in coupling up, the time taken to get up steam would be longer. It will be seen that the vessel "B" at the end of seven hours' steaming has lost 68 knots, and against this she has, apart from the saving in the cost of fuel, a radius of action, at the cruising speed of 13 knots, of 4700 knots per 1000 tons of coal, as against a radius of action of 3150 knots per 1000 tons with the ordinary type of machinery. This represents, allowing for carrying coal in No. 3 hold, a radius of action of 12,600 knots as against 8500. With coaling stations at definite points she would either have the advantage of carrying considerably more dead-weight,

Fig. 12. SKETCH SHOWING SIZE AND POSITION OF GUNS "SMOLENSK"

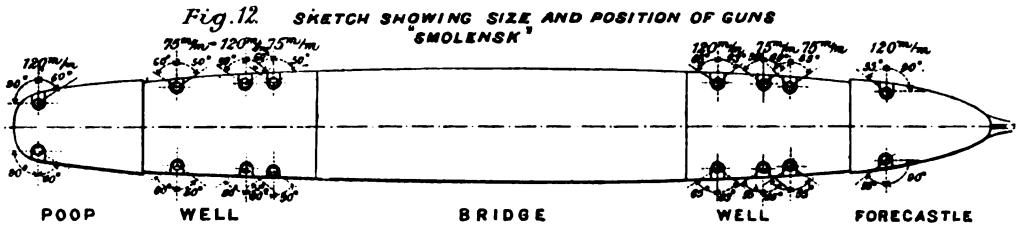


Fig. 13. "KHERSON"

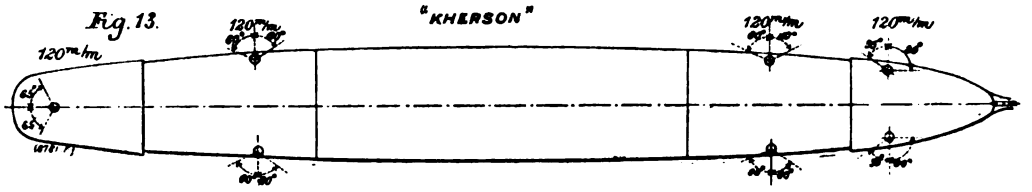


Fig. 14. T. S. S. "SMOLENSK" DIAGRAM SHOWING TRIM WITH DIFFERENT COMPARTMENTS FLOODED.

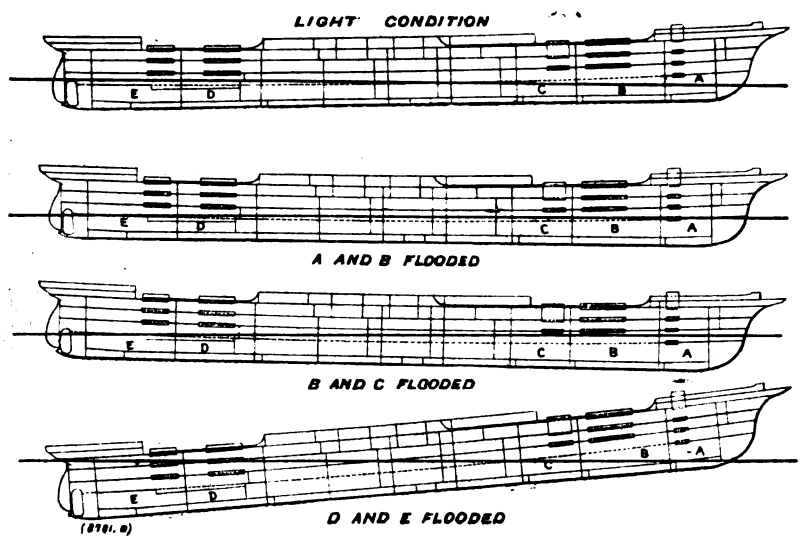
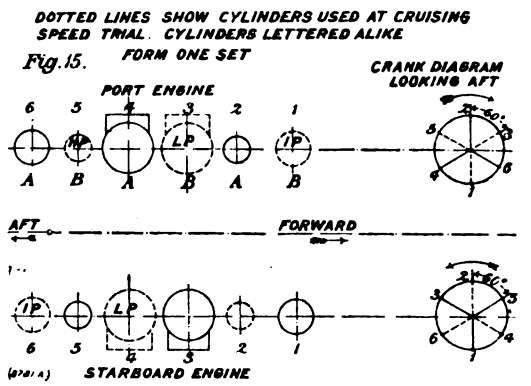


Fig. 15. FORM ONE SET



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

TABLE II.

VESSEL.	BUILDERS.	DATE FIRST VOYAGE BEGAN.	DATE LAST VOYAGE ENDED.	Type of Machinery.	Type of Boilers.	Total Miles Steamed.	Total Hours Under Way.	Mean Speed.	COAL. Lighting Up and Keeping Steam.	COAL. Under Way.	COAL. Per Mile.
									tons	tons	cwt.
1. LOST OR OBSOLETE SHIPS BOUGHT BY THE ORIGINAL RUSSIAN VOLUNTEER FLEET ASSOCIATION MORE THAN TWENTY YEARS AGO.											
Rossia	Caird and Co., Greenock	August 1, 1878	November 13, 1894	Compound	..	509,224	49,193	10.35	4480	78,220	3.072
Petersburg I.	Ditto ditto	,, 1, 1878	March 17, 1893	,,	..	494,625	48,115	10.28	4800	85,160	3.444
Moskva I.	.. ..	,, 1, 1878	July 7, 1882	..	..	101,123	9,694	10.43	1815	19,818	3.920
Moskva II.	J. Elder and Co.	March 14, 1884	September 19, 1895	Compound	..	410,457	38,161	10.75	6070	74,340	3.622
Kostroma I.	Aitken and Mansel	January 28, 1883	May 16, 1887	,,	..	135,272	14,308	9.45	1960	17,780	2.630
Yaroslavl I.	.. ..	September 9, 1880	March 1, 1882	..	..	16,055	1,710	9.38	267	2,113	2.632
Yaroslavl II.	Forges, &c., La Seyne	June 23, 1885	,, 1, 1890	Compound, 3-cylinder	..	95,241	10,109	9.42	1000	10,640	2.234
Nijni-Novgorod I.	Caird and Co.	September 1, 1878	January 1, 1891	Compound	..	320,028	35,588	8.99	4200	38,570	2.410
Vladivostok	Lobnitz and Co.	February 16, 1880	June 4, 1893	,,	..	249,207	31,717	7.85	1620	16,400	1.316
2. SHIPS BOUGHT BY, BUT NOT DESIGNED FOR, THE REORGANISED RUSSIAN VOLUNTEER FLEET.											
Kostroma	Hawthorn, Leslie, and Co.	February 18, 1888	January 1, 1904	Triple	Cylindrical	588,964	55,932	10.53	4170	77,280	2.624
Nijni-Novgorod	Armstrong, Whitworth, and Co.	,, 12, 1891	,, 1, 1904	,,	,,	463,192	50,879	9.10	2980	47,480	2.050
Kazan	Wigham-Richardson and Co.	September 1, 1900	,, 1, 1904	Triple; twin	,,	133,586	11,504	11.61	1160	23,030	3.448
3. SHIPS BUILT AND DESIGNED FOR THE REORGANISED RUSSIAN VOLUNTEER FLEET FOR OVERSEA SERVICE.											
(a) Low Speed.											
Habarovsk	Hawthorn, Leslie, and Co.	February 4, 1895	August 24, 1902	Triple; twin	Cylindrical	143,628	15,819	9.08	2280	15,130	2.106
Yaroslavl	W. Denny and Brothers	January 1, 1893	January 1, 1904	,,	,,	457,137	44,440	10.29	5210	75,990	3.324
Tambov	Ditto ditto	June 12, 1893	,, 1, 1904	,,	,,	430,886	42,782	10.07	4290	68,250	3.168
Vladimir	Ditto ditto	August 19, 1895	,, 1, 1904	,,	,,	340,511	34,357	9.91	3530	60,710	3.576
Voronej	Ditto ditto	April 19, 1896	,, 1, 1904	,,	,,	320,519	31,578	10.15	2890	55,150	3.442
Ekaterinoslavl	Hawthorn, Leslie, and Co.	June 20, 1896	,, 1, 1904	,,	,,	311,596	29,652	10.51	2410	47,940	3.078
Kiev	J. Brown and Co.	May 6, 1896	,, 1, 1904	,,	,,	313,905	29,264	10.73	2550	52,550	3.368
(b) High Speed.											
Orel	Hawthorn, Leslie, and Co.	March 1, 1890	January 1, 1904	,,	,,	409,329	36,335	11.27	7760	78,950	3.858
Saratov	Ditto ditto	December 17, 1891	,, 1, 1904	,,	,,	461,862	39,844	11.59	5760	101,590	4.40
Petersburg	Ditto ditto	June 1, 1894	,, 1, 1904	,,	,,	351,049	29,993	11.70	4560	80,760	4.601
Kherson	Ditto ditto	August 21, 1896	October 1, 1903	,,	Belleville	231,625	19,424	11.92	6370	80,340	6.937
Moskva	J. Brown and Co.	October 5, 1893	September 1, 1903	,,	,,	107,290	9,752	11.00	2270	45,840	8.546
Smolensk	Hawthorn, Leslie, and Co.	January 1, 1902	January 1, 1904	Triple; six-cylinder	,,	4,197	307	13 65	81	1,219	5.809

Fig. 16. DIAGRAM SHOWING RELATIVE POSITIONS UNDER SIMILAR CONDITIONS OF "SMOLENSK" AS BUILT AND IF FITTED WITH THREE CYL^{RS} ENG^{E}. DIFFERENCE BEING DUE TO TYPE OF ENGINES, DOTTED LINES SHOW DIFFERENCE IF BOTH VESSELS HAD CYLINDRICAL BOILERS.

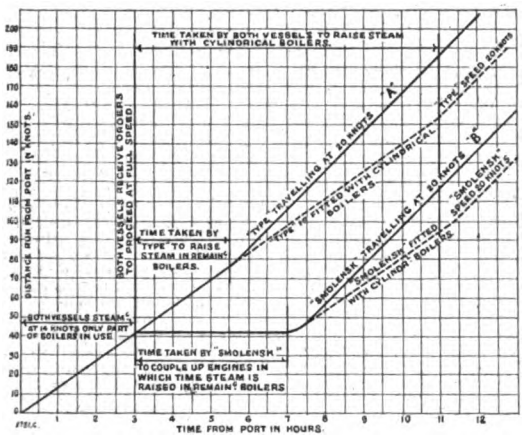
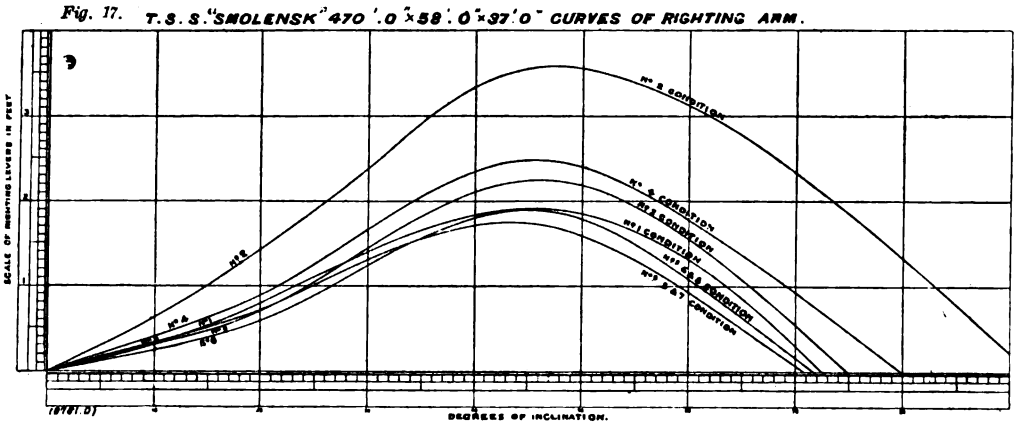
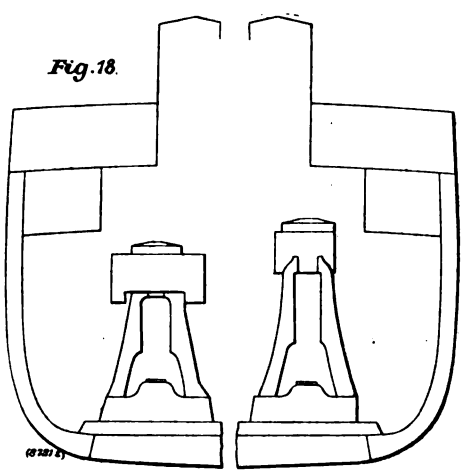


Fig. 17. T.S.S. "SMOLENSK" 470'.0 × 58'.0 × 37'.0" CURVES OF RIGHTING ARM.



COMPARISON OF HEIGHT OF SIX CYL^{RS} & THREE CYL^{RS} ARRANGEMENTS

Fig. 18.



SIX CYLINDER ENGINE. THREE CYLINDER ENGINE

develop 18,000 indicated horse-power at 105 revolutions—equal to 840 ft. piston speed, which, considering the comparative lightness of the reciprocating parts and their perfect balance, would have been maintained without difficulty. This power would, with suitable propellers, have increased the speed about a knot. In this connection it should be borne in mind that the propellers had to be designed so as to ensure obtaining economy of consumption at cruising speed as well as at full power, and that a maximum piston speed of 800 ft. per minute was a condition of the contract.

In view of the fineness necessary to obtain the required speed, the extent of the superstructures and the weight of the deck fittings, considerable care had to be exercised in the design, so as to get a vessel which would have sufficient stability and yet be easy of propulsion. A satisfactory solution was, however, obtained, and the metacentric height of the vessel in her equipped condition, with water in main boilers and bunkers empty, was 1.27 ft., the low centre of gravity of the six-cylinder engines helping this appreciably. Fig. 17, on this page, shows the range and extent of the statical stability of the Smolensk under a sufficient number of conditions to enable the officers navigating her to draw their own deductions as to her safety in any condition of loading. Fig. 18 shows the difference in height of the three-cylinder and the six-cylinder arrangements, which is of considerable importance in vessels designed to act as auxiliary cruisers.

With regard to the speeds of all the vessels, it should be noted that the speed named in each case is not that obtained on a measured-mile trial, but is the average speed attained on a 12 hours' continuous steaming trial in the case of the faster vessels, and of 24 and 48 hours' trials in the case of the slower vessels. The trials took place in the presence of a Commission representing the Russian Admiralty and the Russian Volunteer Fleet, the Naval Attaché of the Russian Embassy in London being also a member; and the observations of speed and consumption, as well as those of draught, fore and aft trim, hold capacity, capacity of ballast tanks, amount of water discharged per hour, and stability, each of which formed the subject of a guarantee, were carried out by a staff of twenty-one inspectors, under whose supervision the hulls and machinery were built, and who were responsible to the Commission. They also tested and proved the satisfactory working of every fitting on board.

To summarise the development of the vessels of the Volunteer Fleet, this association has now in the Smolensk obtained a type of troopship which, under the protection of her own guns, is capable of transporting 3000 tons of stores and munitions of war and 1650 troops 4400 knots in nine days under such conditions of comfort as to land them in good health, without calling at any port on the way, and of landing them, subject to conditions of weather, on any beach, promptly and without assistance. At cruising speed she could do the same thing from Odessa to Vladivostok.

What the future of the Volunteer Fleet will be it is difficult to foretell. During the thirteen years preceding the present war it had, under the able management of General Linden, the present inspector, prospered. Some of the vessels have been lost, and the Kherson* and Moskva were transferred to the Admiralty. The opening of the Siberian Railway having, as already stated, materially encroached on the more lucrative portion of the ocean trade, makes it increasingly difficult to run the vessels, especially those of higher power, as liners. It may fairly be assumed, however, that the same forces that led to its establishment, and the same foresight and ability that have achieved its success, will ensure its continued existence.

As a matter of interest, particulars are given in Table I., page 555 *ante*, of two vessels showing the probable direction of future development of both the high and the low-speed types, in view of the increasing need of economy in working and first cost, the importance of capacity for tea cargoes, and the draught limit of Vladivostok Harbour.

THE INDIA-RUBBER INDUSTRY IN COLOMBIA.—According to the United States Consular Agent at Quibdó, Colombia, in South America, the supremacy of the gold-mining industry of that country is being disputed by the rubber industry, as the cultivated trees are now producing about one ton of rubber per day, and most of the negro farmers are planting trees. Though the individual planting in this way is not extensive, the total is very large. Planting on a large scale is being carried on at a number of places—as Yankolomba, La Maria, Salaqué, Bebará and Tangué. In order to extract the rubber, the bark of the tree is cut lightly with a machete, so as not to pass to the wood, and the cut fills up with gum, which coagulates, and is gathered the following day. By careful growers only a small portion is cut at a time, in order not to weaken the tree, but the operation can be repeated every two or three weeks, as desired. The strips of rubber, called "chaza," are gathered from the gashes and rolled together. They bring about 75 cents per pound on the New York market. In some cases trees as young as three years are bled; but it is better to allow them to grow undisturbed for two years longer.

* The Kherson was illustrated in ENGINEERING on the two-page plates of November 27, December 11, and December 25, 1896.