Marine Engineering and Shipbuilding Abstracts

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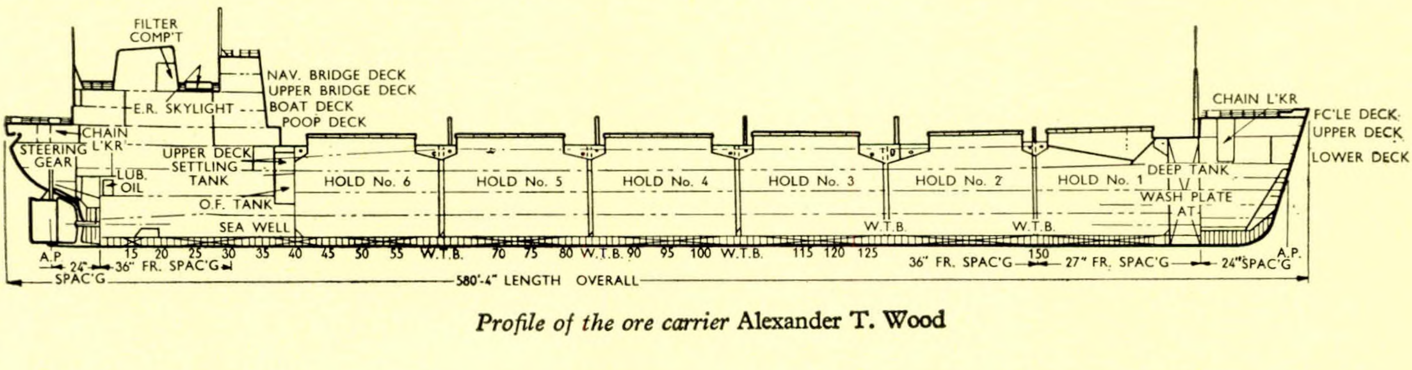
* Patent Specification

Largest Canadian-built Ship

Many interesting features have been incorporated in the design of the *Alexander T. Wood,* an ocean going, dry cargo carrier built for Westriver Ore Transports, Ltd., Montreal, by Canadian Vickers, Ltd. These include the use of alternating current, a controlled pitch propeller and electrically driven, constant tension, mooring winches. The following are the vessel's main particulars: —

Length overall	580ft.
Length, b.p.	550ft.
Breadth, moulded	72ft.
Depth, moulded	42ft. 6in.
Deadweight	20,000 tons
Draught, maximum	30ft.
Trial speed at 30-ft. draught	13½ knots

As the *Alexander T. Wood* will operate on the ore carrying run between the St. Lawrence river ports of Seven Islands and Contrecoeur during the summer, and deep sea during the winter, the design incorporates equipment required for two different types of service. The vessel is constructed on the combined transverse and longitudinal framing system, longitudinal members being fitted to the upper deck in way of the cargo holds and to the bottom shell and tank top plating in double bottom spaces. A tunnel forming a walkway and cable space is arranged to run through the wing tanks at each side of the ship. Various piping systems and the wing tank water ballast filling and discharge valves are fitted in this tunnel. There are five holds, each with a hatch 40ft. wide, fitted with MacGregor steel hatch covers, operated by two 5-ton electric winches. The transverse bulkheads between the holds are corrugated vertically, the two longitudinal bulkheads being used to form one side of the wing water ballast tanks. Double bottom water ballast tanks are arranged under Nos. 1, 2, 3 and 4 holds, with oil fuel under Nos. 5 and 6 holds and Diesel oil under the aft end of No. 6 hold. The four Baensch electric hydraulic, constant tension, mooring winches are located on the upper deck, two being forward and two aft. The propulsion unit of the *Alexander T. Wood* is an eight-cylinder, two-stroke Nordberg Diesel engine of the non-reversing type, directly coupled to a controllable pitch propeller which absorbs 6,800 b.h.p. at 168 r.p.m. Oil purifying equipment including heaters is provided, suitable for the heaviest type of boiler oil likely to be encountered. The KaMeWa controllable pitch propeller can be operated from either the bridge or the engine room, the arrangement being particularly suitable for manœuvring in locks, when it will be possible to operate at slow speeds while



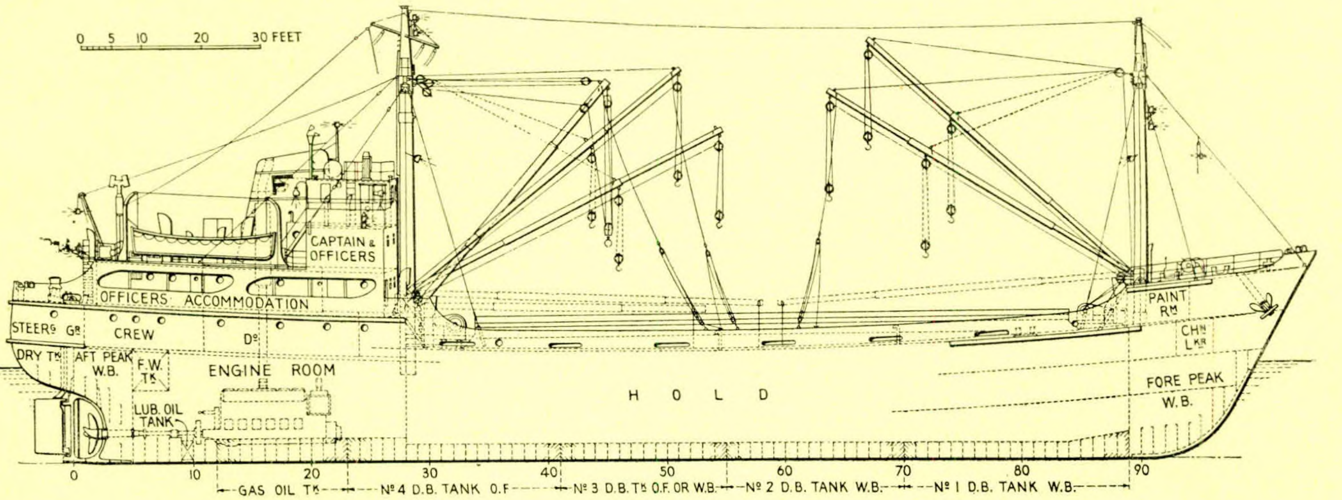
Profile of the ore carrier **Alexander T. Wood** the main engine continues to run at constant revolutions. This is made possible by the hydraulic governor on the engine being coupled to the propeller controls and the fuel supply.—*The Motor Ship, August 1958; Vol. 39, pp. 232-233.*

Motor Vessel for Large and Heavy Objects

The motor vessel *Bay Fisher,* built by Ardrossan Dockyard for James Fisher and Sons, Barrow-in-Furness, has been specially designed to carry large and heavy objects. The principal particulars are as follows:—

Length overall...	220ft. 10in.
Length b.p.	200ft. 0in.
Breadth moulded	36ft. 6in.
Depth moulded to upper deck	18ft. 6in.
Gross tonnage	1,289 tons
Deadweight tonnage	1,646 tons
Service speed	11 knots

The *Bay Fisher* is of the single deck type with raised poop, with machinery located aft. Distinguishing features of the profile are a well raked, soft nosed stem and a cruiser stern. Heavy plate bulwarks are provided in way of the upper deck and the raised poop deck. A three-tier deckhouse surrounds the machinery casing and on the boat deck there is a well-proportioned funnel of modern design. Her one cargo hold is designed for the carriage of bulky machinery and plant of exceptional dimensions. It is 122ft. long, clear of obstruction and has a cubic capacity of 82,170 grain or 74,590 bale. There is one hatchway 100ft. long by 24ft. wide. The vessel has been built under the survey of Lloyd's Register of Shipping for the classification ✠ 100 A1. Some of the scantlings, however, are in excess of Rule requirements, and the vessel is stiffened for navigation in ice. A combination of riveting and electric arc welding has been employed, the arrangement being such as to facilitate construction and also to keep down corrosion replacement and repair costs. The construction is based on the transverse deep frame principle with large cantilever brackets supporting the deck in way of the hold at approximately every fourth frame. The cellular double bottom extends from the collision bulkhead to the machinery bulkhead, solid floors being arranged at every frame. In the machinery space the floors are of increased depth. Two longitudinal girders are located on each side of the centre girder in way of the double bottom. The hatchway is served by two 5-ton and one 20-ton tubular steel derricks at the after end and two 3-ton and one 10-ton tubular steel derricks at the fore end. The derricks are operated by four self-contained electric hydraulic cargo winches supplied by Vickers Armstrongs (Engineers), Ltd. There are two 3-ton winches at the forward end of the hatchway and two 5-ton winches at the after end. The vessel is propelled by a type M46M six-cylinder British Polar Diesel engine. With a cylinder diameter of 340 mm. and a stroke of 570 mm., the engine is designed to develop 1,040 b.h.p. at 275 r.p.m.—*Shipbuilding and Shipping Record, July 1958; Vol. 92, pp. 137-139, p. 146.*



Profile of the Bay Fisher

Cargo Motorship *Essex Trader*

One of the first problems to be tackled by the Sunderland firms, S. P. Austin and Son, Ltd., and William Pickersgill and Sons, Ltd., when they amalgamated to become Austin and Pickersgill, Ltd., in September 1954, was to reorganize their facilities to enable them to adopt the most modern building methods. The basic plans provided for the complete rebuilding of the old Pickersgill yard to increase the constructional capacity from 12,000 to 24,000 tons. This entailed reducing the number of berths from five to three, the erection of a large fabricating welding and assembly shop, the building of new jetties and cranes, and building a completely new fitting-out section, including a fitting-out quay. The fitting-out section is still in the early stages of construction, but the steel side is now gradually working up to maximum production, and the firm have, in fact, recently completed their first vessel, employing the new constructional methods. The vessel was launched in April last, from the new No. 1 slipway, and was named *Essex Trader.* She has been built for the Trader Navigation Co., Ltd., of London, and is designed to navigate the Manchester Ship Canal. Built in accordance with the requirements of Lloyd's Register of Shipping for the classification ✠ 100 A1, the vessel has a deadweight of 10,450 tons on a summer load draught of 25ft. 10in., and a light ship weight of 3,790 tons. The principal dimensions and other leading characteristics are:

Length b.p.	435ft. 0in.
Breadth moulded	59ft. 6in.
Depth moulded to shelter deck	38ft. 6in.
Depth moulded to main deck...	29ft. 6in.
Summer load draught... ...	25ft. 10in.
Corresponding deadweight, tons	10,450
Corresponding displacement, tons	14,240
T.P.I. at load draught ...	52·3
Lightweight, tons	3,790
B.H.P.	4,400
Corresponding r.p.m.	115

In the construction, units were designed and fabricated to a maximum lifting weight of 20 tons, inclusive of slings, lifting gear, etc. Welding has been adopted for all connexions, with the exception of the side frames, stringer angle, lower sheerstrake seam and the upper bilge seam. Transverse framing has been adopted for the side shell, but longitudinal framing has been used for the decks (except in line of hatchways), tank top and bottom shell. The propelling machinery for the *Essex Trader* has been constructed by the North Eastern Marine Engineering Co., Ltd., of Wallsend, and consists of an N.E.M.-Doxford, four-cylinder, opposed piston oil engine capable of developing 4,400 b.h.p. at 115 r.p.m., and arranged to operate on heavy fuel oil. The auxiliary machinery is all electrically operated, with the exception of the main feed pumps. Two Weir motor-driven air compressors of the vertical three-stage, two-crank, trunk piston design are installed. These units each have a diameter of 8in. and a stroke of 7in. They are each capable of delivering 125 cu. ft. of free air per minute against a pressure of 600lb. per sq. in. at 750 r.p.m., and are driven by a 52-b.h.p. motor complete with hand operated drum type starter.—*The Shipbuilder and Marine Engine-Builder, September 1958; Vol. 65, pp. 522-532.*

Dutch Motor Cargo Vessel

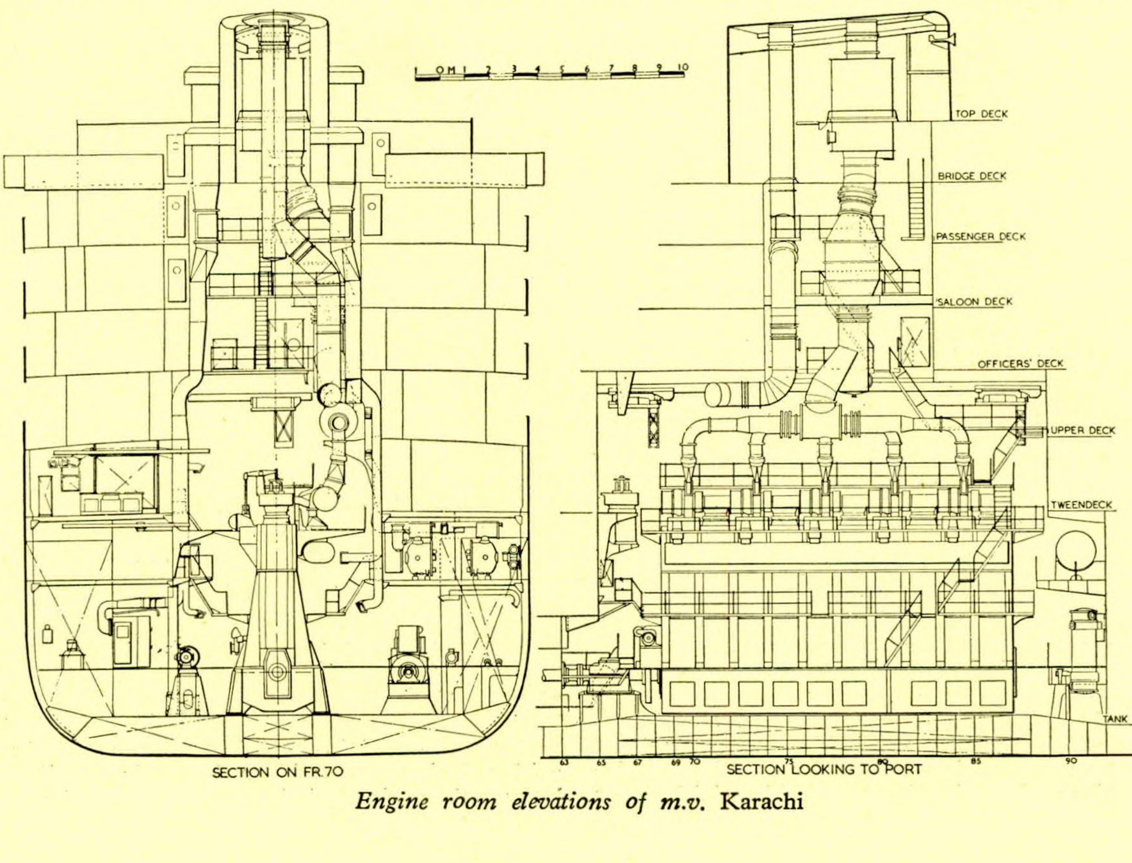
The recent trials of the 12,600-ton d.w.c. 17½-knot m.s. *Karachi* marked the completion of the highest powered cargo liner in the extensive fleet of the N.V. Stoomvaart Maatschappij Nederland, also the first in a series of seven ships ordered from Dutch and German yards. Six of these are having Stork turbocharged two-stroke engines installed, developing 10,500 b.h.p. at 118 r.p.m., three of the vessels, including the *Karachi,* being built by C. van der Giessen and Zonen's Scheepswerven N.V., at Krimpen a.d. Ijssel, while Howaldtswerke A.G., Hamburg, are constructing the remaining three vessels which, although having similar engines, are slightly smaller. In addition, a ship with essentially the same hull but with a turbocharged Smit-B. and W. engine of 10,500 b.h.p. has been ordered by these owners from P. Smit, Jnr. A point of particular interest is that the Stork engine in the *Karachi* and for others of this class develops in nine cylinders the same power (10,500 b.h.p.) as does the ten-cylinder unit of similar cylinder dimensions installed in the *Maas Lloyd,* the first of a series of three Stork engined cargo liners for the Koninklijke Rotterdamsche Lloyd. The engine in the *Maas Lloyd,* which was completed in 1956, has at its service output a b.m.e.p. of 6·21 kg./cm.^{2}, this representing a boost over a corresponding non-pressure charged unit of 18 per cent, but this latest engine represents a further stage in its development with the b.m.e.p. increased to 6·75 kg./cm.^{2}—a boost of 27·5 per cent. The *Karachi* has the following characteristics:—

Length o.a.	535ft. 10in.
Length b.p.	500ft. 0in.
Breadth, moulded	67ft. 0in.
Depth to upper deck	41ft. 3in.
Deadweight capacity	12,600 tons
Corresponding summer draught	30ft. 0$\frac{3}{16}$in.
Net register	6,367·83 tons
Gross register (British) ...	10,891·41 tons
Bale capacity	687,000 cu. ft.
Total capacity of deep tanks...	3,443 tons of palm oil

All cargo winches are electrically driven and of Laurence Scott manufacture. Sodium gas cargo floodlighting arrangements have been adopted, the owners considering that these lights give better working conditions than mercury lamps. Alternating current for these lamps and for the engine room fluorescent lamps, the smaller fan motors and the cooling fans in the refrigerated chambers, is supplied by one of two d.c./a.c. converters in the engine room. Nearly all deck and engine room auxiliaries have d.c. motors.—*The Motor Ship, July 1958; Vol. 39, pp. 160-162.*

Auxiliary Air System

When adopting turbocharging for the higher power output of large marine two-stroke Diesel engines, some engine builders wish to dispense entirely with the original scavenge pumps while others prefer to retain one or more of these units in the interests of safety and manœuvrability. If scavenge pumps are not provided on a turbocharged engine, then the following three requirements must be met: 1. The engine must have a sufficient amount of air for manœuvring and lower power running ahead and astern over extended periods. 2. The engine must be capable of being operated and manœuvred satisfactorily with at least one cylinder out of action or



Engine room elevations of m.v. Karachi

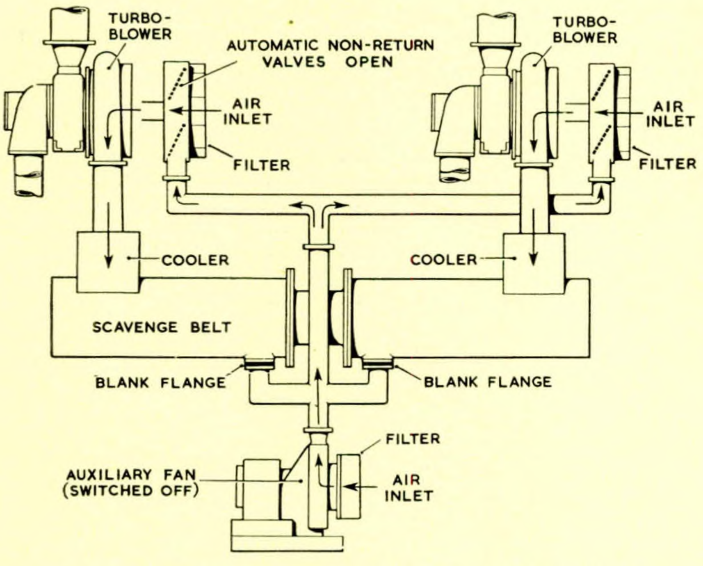
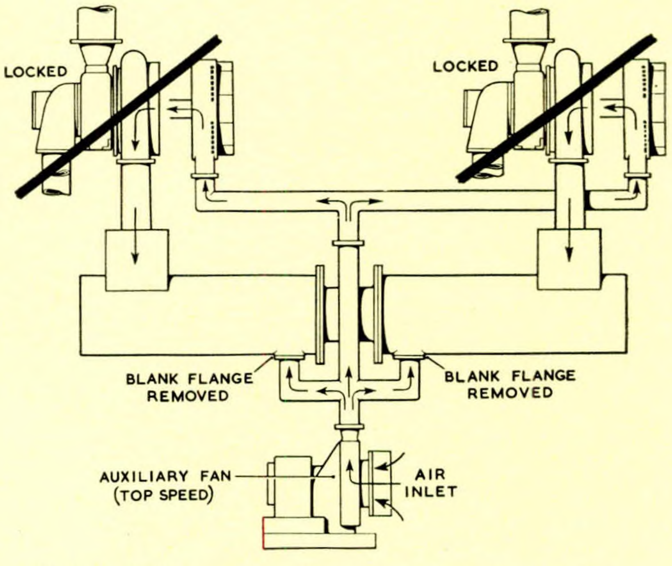


Diagram showing normal arrangement of auxiliary air system



Both turboblowers out of action and engine running with auxiliary fan

alternatively when the performance of the engine or turboblower has been allowed to deteriorate. 3. The engine must perform satisfactorily at some prearranged percentage of full power, with any or all of the turboblowers out of action. To fulfil these requirements D. Napier and Son, Ltd., have developed what is termed an auxiliary air system which consists, in essentials, of an auxiliary fan driven by a two-speed (or constant speed) electric motor, so arranged that during the manœuvring period the auxiliary fan is switched on at low engine speed to supply air in series with, and into the inlet of, the turboblowers. As the engine speed increases the suction of the turboblowers opens the non-return valves and when a speed corresponding to 25 per cent of full power is reached the auxiliary fan can be switched off. The normal air intake of the main turboblower is fitted with automatic non-return valves which open when the suction of the blower exceeds the air supply from the auxiliary fan. More than one auxiliary fan may be fitted. The general layout of the system can be seen from the accompanying diagram. During normal running the auxiliary fan is switched off and under these conditions a portion of the air drawn in by the main turboblowers is sucked through the auxiliary fan causing it to slowly rotate, thereby preventing Brinelling of the ball bearings, if these are fitted. If one turboblower is out of action, special locking gear is used to lock it in position and a blank flange is inserted in the ducting connecting the auxiliary fan to the serviceable turboblower. The section of the air manifold normally supplied by the inoperative turboblower is then placed in connexion with the auxiliary fan by removing a blank flange, and with the fan running at full speed it is placed in parallel with the working turboblower. In the event of both main blowers becoming inoperative it is only necessary to remove the two blank flanges between the auxiliary fan discharge and the main air manifold or scavenge belt. The system would still work even if these blank flanges were not removed, although the air pressure would be reduced due to the air having to pass through the stationary blowers.—*The Motor Ship, September 1958; Vol. 39, pp. 268-269.*

Electrostatic Shaft Voltage on Steam Turbine Rotors

Several different types of shaft voltages can be present on steam turbine rotors. The one type that has recently gained increased significance is the direct current, or electrostatic, voltage which has been causing damage to different parts and has been responsible for a number of serious turbine breakdowns. The authors describe some field and laboratory investigations which were undertaken as a result of bearing failures. It was shown that the cause of these failures was due to a static voltage generated in the steam turbine. The solution to the problem appears to be to earth the voltage without causing bearing damage rather than trying to eliminate the generation of the voltage at the source. Many possible means of earthing the voltage have been suggested, including carbon brushes, metallic shoes, mercury baths, water seals, lubricating oil with high conductivity, and ionized air paths. The effects of the d.c. voltage could be eliminated by applying an equal voltage of opposite polarity. The elimination of the voltage at the source might eventually be accomplished by the control of droplet size, or a change of bucket and nozzle material or surface finish.—*J. M. Gruber and E. F. Hansen; A.S.M.E. Paper No. 58-SA-5. Journal, British Shipbuilding Research Association, July 1958; Vol. 13, Abstract 14,372.*

Single Screw Vessel for Bulk Cargoes

Specially designed and strengthened for carrying bulk cargoes, such as coal, iron ore or timber, on the Atlantic or Mediterranean trade routes, the single-screw motorship *Susan Constant*, built by J. Samuel White and Co., Ltd., for Constants, Ltd., of London, has been handed over to her owners after completing successful trials. The *Susan Constant* is of the single-deck type, with forecastle and poop, and with the main machinery, accommodation, boat deck and navigating bridge deck all aft. The principal dimensions and other leading characteristics of the *Susan Constant* are:—

Length overall	351ft. 8in.
Length b.p.	330ft. 0in.
Breadth moulded	47ft. 0in.
Depth moulded	25ft. 0in.
Draught	20ft. 7¾in.
Corresponding deadweight, tons	4,850
Grain capacity, cu. ft. ...	224,350
Gross tonnage	3,464
Net tonnage	1,815
B.H.P.	1,500
Trial speed, knots	11·475

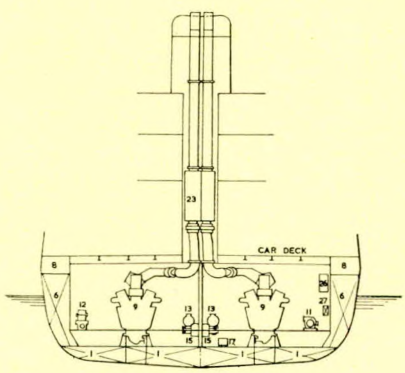
The *Susan Constant* is propelled by a British Polar type-M.48.M. direct reversing engine, constructed by British Polar Engines, Ltd. The engine is capable of developing 1,500 b.h.p. at 300 r.p.m., and is coupled to the propeller through a co-axial reducing gear, with a hydraulic coupling interposed between the engine and the gear to protect the gearbox from torsional vibrations and to secure a good vibratory system. The Hindmarch/MWD gearbox has been designed and manufactured by Modern Wheel Drive, Ltd., and is of rather unusual type. The overall reduction ratio is 2 : 1, and the gearbox incorporates two trains of gears, the primary ratio being 1 : 1 and the final reduction ratio being 2 : 1. The primary train of 1 : 1 ratio is included to make the input and output shafts co-axial. The secondary shaft carries the final pinion and the primary wheel is offset horizontally from the input and output shafts; this arrangement, in combination with the co-axial shafting, makes for a machinery installation of very low overall height. Incorporated in the main gearbox casing is a hydraulic coupling, which has been manufactured by Barclay, Curle and Co., Ltd. The coupling ensures the protection of the gear teeth from severe fluctuations in the load. The efficiency of these couplings for marine propulsion remains constant for all speeds of the ship, since the propeller and the hydraulic coupling both function according to the same law. The coupling in the *Susan Constant* has been designed to give a slip of 3½ per cent, corresponding to an efficiency of 96½ per cent. The power lost in the coupling due to fluid friction is transformed into heat; and, in order to avoid an increase in temperature inside the coupling, small holes are arranged in the periphery to allow a certain amount of the driving fluid to leak off.—*The Shipbuilder and Marine Engine-Builder, August 1958; Vol. 65, pp. 469–475.*

French Car Ferry *Compiègne*

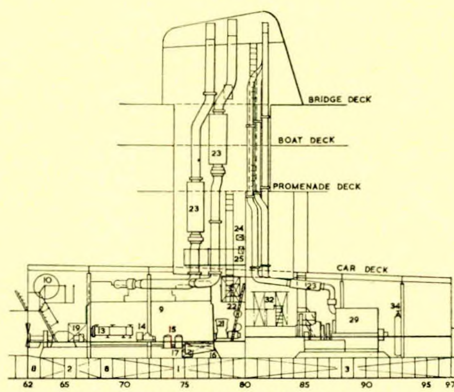
The *Compiègne* was constructed by the Soc. des Ch. Réunis Loire-Normandie at Rouen for the French Railways, Ltd., with S.E.M.T.-Pielstick main engines built by the Société Générale de Constructions Mécaniques. The vessel's main particulars are as follow:—

Length overall...	... 115·0 m.	377ft. 0in.
Length at waterline	... 109·0 m.	357ft. 6in.
Mean breadth over fenders ...	... 18·35 m.	60ft. 4in.
Draught ...	... 4·0 m.	13ft. 0in.
Gross register ...	... ...	3,450 tons
Deadweight ...	... ...	650 tons
Speed, trials maximum	...	over 21 knots
Speed, trials at 9,000 b.h.p. ...		20·2 knots
Speed, service ...	... ...	20 knots

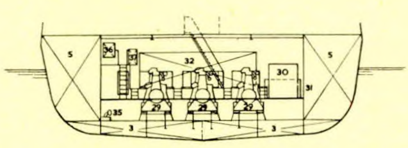
As the length/depth ratio of the hull is small, the strains in a heavy swell are reduced; a transverse form of construction is adopted, with special attention being paid to the superstructure scantlings. With the exception of the upper strake of the side plating, the hull is completely welded. Forward of the main car deck, which has a clear headroom of 3·8 m., are two intermediate car decks each with a clear headroom of 2·25 m. The lowermost car deck is reinforced by a compact grid of deck beams and longitudinals. As it is essential that the number of deck pillars is a minimum, the upper forward

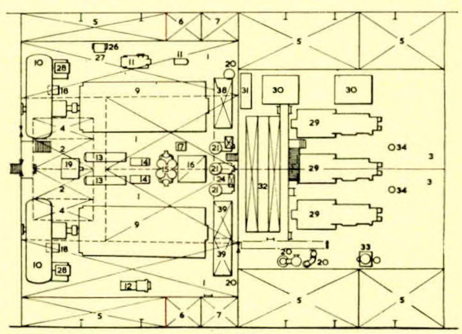


TRANSVERSE SECTION AT FR. 75 LOOKING AFT



LONGITUDINAL SECTION ON THE CENTRE LINE


TRANSVERSE SECTION AT FR. 86 LOOKING AFT


PLAN

Engine room plans of the Compiègne

KEY FOR ENGINE ROOM EQUIPMENT

1) Fuel oil; 2) Res. lubricating oil tank; 3) Ballast valves; 4) Lubricating oil tank; 5) F.W. tank; 6) Settling tank; 7) Overflow tank; 8) Cofferdam; 9) Main engine; 10) Air reservoir; 11) Standby pumps; 12) Warm water circulating pump; 13) F.W. cooling pump; 14) Lubricating oil pump; 15) Lubricating oil filter; 16) Sludge tank; 17) L.O. drain tank; 18) Fuel oil drain tank; 19) Control desk; 20) S.W. filter; 21) Separator; 22) Fuel oil heater; 23) Silencer; 24) Injector cooling water observation tank; 25) Cylinder oil; 26) Compressor oil; 27) Daily L.O. tank; 28) Air compressor; 29) Diesel alternators; 30) Hot water boilers; 31) Transformer; 32) Switchboard; 33) Ballast pump; 34) Air bottle; 35) F.W. inlet; 36) Fuel tank; 37) F.W. header tank; 38) Unpurified oil tank; 39) Purified oil tanks.

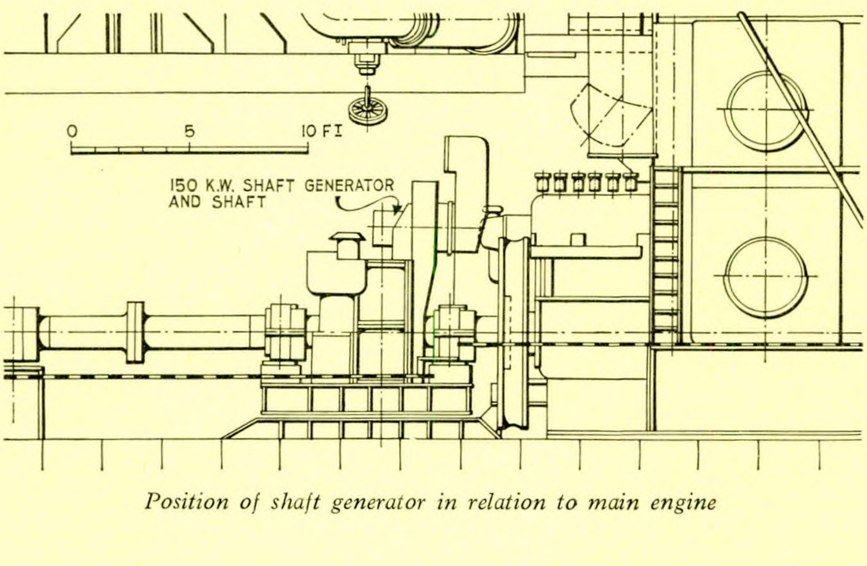
car deck is formed by web frames considered for calculation purposes as complex beams. With the extra headroom available at the after end of the main vehicle deck, coaches or heavily loaded lorries may be carried with a loading of 13 tons per axle. Loads of 1,600 kg./m.^{2} and 800 kg./m.^{2} may be carried on the upper and lower car decks respectively. By adopting the three-deck arrangement the effective car space available is 1,790 m.^{2}, although if only a single deck had been used the space would have been 1,275 m.^{2}. Thus a gain in effective area of 40 per cent is achieved without increasing the vessel's top hamper. The two S.E.M.T.-Pielstick main engines are sixteen-cylinder, four-stroke, turbocharged, vee-type units, built under licence from S.E.M.T. by the Société Générale de Constructions Mécaniques. Each engine drives one fresh water and one sea water pump through gearing, and for standby use the following pumps are provided: One Guinard lubricating oil pump of 73 m.^{3}/hr. capacity; one Guinard sea water or fresh water pump of 200 m.^{3}/hr. capacity; one Guinard warming water pump of 30 m.^{3}/hr. The main engines, which are of the directly reversible type, are connected through the line shafting to two "supra-convergent" KaMeWa variable pitch propellers. In order that the turning moment of each propeller may be a maximum, the engines are set as far apart as possible.—*The Motor Ship, September 1958; Vol. 39, p. 256.*

Shaft Driven Generators for Tankers

Electric generators for the supply of auxiliary power, driven by the ships' main engines, have been installed in a number of ships. In some cases the generators have been chain or belt driven and in others by direct gear drive or through couplings of various types. An installation of a more permanent type, whereby the generator is built round the intermediate propeller shaft, has recently been provided in the two motor tankers *London Majesty* and *London Victory*. Except for that section of shaft carrying the commutator and armature, the generator shaft conforms exactly to the design and proportions of the existing intermediate propeller shaft. The section which carries the commutator and armature is forged up to a diameter greater than the coupling. Longitudinal ventilating ducts are ploughed out of this increased diameter, forming arms to which the core discs are keyed by means of tapered keys. As on the intermediate propeller shaft, solid forged couplings are incorporated in the generator shaft. Due to its special design, the commutator can be withdrawn over the coupling if this should be necessary at any time. In order to provide constant voltage at any speed of the ship, the generator is designed so that it will provide normal voltage when running at speeds between 80 and 126 r.p.m., the voltage being automatically controlled by a Brown Boveri automatic voltage regulator. The time constant of the shunt coils and the A.V.R. is such that there should be no appreciable flicker under bad weather conditions. The magnet and pedestal bearings are secured by means of fitted bolts to a substantial bedplate, which, together with the pedestal bearings, were designed, manufactured and installed by the North Eastern Marine Engineering Company, who had previously built and installed the main machinery for these two vessels. The generator incorporates an unusually large air gap, thus providing a margin of safety and thereby avoiding damage due to exceptional wear in the bearings, each of which is fitted with a wear down gauge for checking the amount of wear taking place. The design of the connexions received special consideration in order to eliminate any magnetic field around the shaft. Nevertheless, to short circuit any stray currents and prevent any electrolytic action, either within the ship's structure or the main engine bearings, two special quality brushes capable of running on an oily steel shaft are provided at each end of the machine, the brushes being earthed directly to the ship. The commutator end bracket is designed to take a commutator grinder, so that trueing-up can be carried out when necessary with the minimum of inconvenience. The main poles and interpoles are detachable and can be withdrawn from the driving end. Because of the water which is often present in the tail shaft compartment, the generator is of watertight construction to the underside of the shaft. Heaters are fitted in the bottom of the commutator end plate and so prevent condensation when the machine is out of use. Because of its slow speed, the machine is force ventilated by a separate motor driven fan at the driving end, designed to provide the necessary quantity of cooling air when the machine is running at 80 r.p.m. A filter is fitted in the air trunking for removing oily vapour, and the direction of air flow is such that the carbon dust is blown away from the commutator and windings. Audible alarms are provided for operation in the event of failure of the ventilating motor, or a drop in voltage below 110 volts due to the speed falling to well below 80 r.p.m., or the engine stopping. No difficulties are anticipated when the engine is reversed.—*Shipbuilding and Shipping Record, 18th September 1958; Vol. 92, pp. 365-366.*

Project for a 35,000-t.d.w. Nuclear Tanker

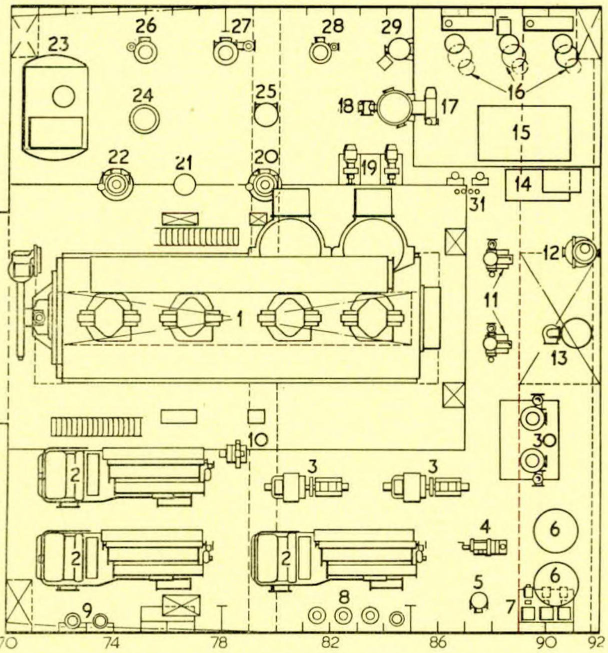
A description is given of a preliminary design project for a nuclear propelled tanker of 35,000 t.d.w., carried out by a study group in Poland. The reactor uses solid uranium dioxide fuel slightly enriched with plutonium, and is moderated and cooled by an organic liquid (diphenyl). The primary loop comprises two heat exchangers in which superheated steam is raised for the secondary loop at 340lb. per sq. in. (abs.) and 554 deg. F.; this drives a two-casing cross compound steam turbine geared to the propeller shaft. The weight of the reactor and shielding is estimated at 320 tons, and its



Position of shaft generator in relation to main engine dimensions are 13ft. diameter and 18ft. height. The thermal output of the reactor is 83 MW, and the shaft horse power of the turbine is 24,000, giving a service speed of about 20 knots. Diesel electric emergency propulsion is provided. The article also contains the results of an economic comparison between a 35,000-t.d.w. nuclear tanker with a pressurized water, heterogeneous reactor providing 24,000 s.h.p. (service speed about 20 knots), and a 35,000-t.d.w. conventional tanker having a 16,000-s.h.p. steam turbine, with a service speed of about 17 knots. The calculations are based on published British and American data, and all figures are in dollars. For both ships a route of 24,000 nautical miles is assumed, with an operational time of 320 days in one year, and eight days in port per voyage (this includes loading and unloading times, manœuvring in port, loss of time in canals, etc.). The analysis shows that the capital return from the nuclear ship would be about 46 per cent lower than that from the conventional ship. To break even, the estimated construction cost of the nuclear tanker as a whole would have to be lowered by about 43 per cent, and that of the power plant alone by about 75 per cent.—*J. Beszczynski et al. Budownictwo Okretowe, 1958; Vol. 3, p. 84. Journal, The British Shipbuilding Research Association, June 1958; Vol. 13, Abstract No. 14,188.*

British Motor Cargo Vessel

The first of eight similar cargo vessels ordered from North East Coast shipbuilders for H. Hogarth and Sons, Ltd., has completed her sea trials and is now in service. This vessel, the *Baron Jedburgh,* a single screw motorship of 11,675 tons d.w., has been built by John Readhead and Sons, Ltd., South Shields. The *Baron Jedburgh* has been specially designed for



Baron Jedburgh

KEY TO ENGINE ROOM ARRANGEMENT

1) Main engine; 2) Generators; 3) Compressors; 4) Aux. compressor; 5) Gen. S.W. circ. pump; 6) Air receivers; 7) Dom. water press. pumps; 8) Gen. starting air bottles; 9) Streamline filters; 10) Priming pump; 11) O.F. trans. pumps; 12) Evaporator; 13) D.W. cooler; 14) Feed filter tank; 15) Sludge tank for H.O. purifiers; 16) L.O. standby and D.O. purifiers; 17) Sludge pump; 18) Cooling oil cooler; 19) F.V. cooling pumps; 20) Standby cooling and L.O. pump; 21) L.O. pump; 22) Cooling oil pump; 23) Oily water separator; 24) Streamline filter; 25) S.W. circ. pump; 26) Bilge pump; 27) Ballast pump; 28) G.S. pump; 29) L.O. cooler; 30) D.W. pump; 31) Feed pumps.

the carriage of bulk and general cargo and for service in any part of the world. She has a high cubic capacity for her size and a good fuel consumption of about 13¾ tons of Diesel fuel per day (all purposes) at a service speed of 13½ knots. She is powered by a Hawthorn-Doxford Diesel engine of 4,400 b.h.p. output. During trials over the measured mile off Newbiggin a maximum average speed of 14·70 knots was attained at restricted revolutions. Although the vessel can be easily equipped to operate on heavy fuel it is the owners' intention to run on Diesel fuel only: this, together with the use of correct cylinder lubricants, will give the least possible cylinder liner wear. The principal particulars of the *Baron Jedburgh* as a closed shelterdecker are as follows:—

Length o.a.	461ft. 8in.
Length b.p.	430ft. 0in.
Breadth, moulded	59ft. 6in.
Depth to upper deck	39ft. 0in.
Depth to second deck... ...	30ft. 0in.
Draught	28ft. 10½in.
Deadweight	11,675 tons
Gross tonnage	8,337 tons
Net tonnage	4,687 tons
Machinery output	4,400 b.h.p.
Service speed	13½ knots
Fuel consumption (all purposes)	13¾ tons
Bunker capacity	1,085 tons
Cargo capacity:	
Bulk...	604,905 cu. ft.
Bale	542,865 cu. ft.

The propelling machinery in the *Baron Jedburgh* consists of a four-cylinder Hawthorn-Doxford Diesel engine of the latest design, developing 4,400 b.h.p. at 115 r.p.m. The engine room layout is particularly well planned and there is ample room for maintenance of each item of equipment. The exhaust gases from the main engine can be discharged through a Cochran composite boiler fitted with Wallsend oil burner equipment. An Elcontrol system of flame failure protection has been installed.—*The Shipping World, 3rd September 1958; Vol. 139, pp. 208-211.*

Behaviour of Thick Walled Steel Cylinders Subjected to Internal Pressure

In this paper the literature on the strength of thick walled cylinders subjected to internal pressure is reviewed and equations are given which enable the initial yield pressure, collapse pressure, and ultimate pressure to be calculated from shear stress-strain data. Pressure tests on thick walled cylinders made from 0·15 per cent carbon steel, 0·3 per cent carbon steel, and Vibrac steel are described, the maximum pressure reached being 42 ton/in.^{2}. For 0·15 per cent carbon steel, results of tests on cylinders with a ratio of outer to bore diameter of up to 8·05 are given. Numerous tensile and torsion tests have been carried out on these steels and these are fully reported. For the 0·3 per cent carbon steel which was tested first no measurements were made of initial yield and collapse pressures. The results for the 0·15 per cent carbon steel, however, show good agreement with the calculated values if allowance is made for the influence of shear stress gradient when computing the initial yield pressure. With Vibrac steel the experimental results lie between the two curves computed from the extreme shear stress-strain curves. The experimental pressure expansion curves at large strains and the ultimate pressures for the three materials all agree very well with the computed values. Values of the ultimate pressures have also been calculated from several empirical equations, but they all give considerable errors, though up to a diameter ratio of 4 the mean diameter formula is satisfactory.—*Paper by B. Crossland and J. A. Bones, submitted to the Institution of Mechanical Engineers for written discussion, 1958.*

Dutch-built Cargo Motorship for French Owners

The cargo motorship *Monte Cinto,* built by Scheepsbouwwerf v.h. De Groot and Van Vliet N.V., Slikkerveer, for the

Compagnie Méridionale de Navigation, Marseilles, has entered the services of her owners. The ship is of the open shelter-deck type and has been constructed for the carriage of general cargo. She is of largely welded construction with riveted seams and welded butts. The longitudinal system of framing is applied in the double bottom. The leading characteristics of the ship are:—

Length overall	214ft. 8¾in.
Length b.p.	191ft. 11⅛in.
Breadth...	32ft. 5¾in.
Depth to main deck	12ft. 3⅝in.
Depth to shelter deck... ...	19ft. 4 5/16in.
Draught...	12ft. 2½in.
Deadweight	970 metric tons

Cargo is handled by four derricks suitable for handling 3- and 5-ton loads. These derricks are attached by two masts placed at the forward and after ends of the cargo section. These derricks are served by four electro-hydraulic Baensch cargo winches. The windlass and the capstan placed aft are also of the electro-hydraulic Baensch type. The steering engine is of the Frydenbö type. The ship does not carry any lifeboats, but is fitted with two R.F.D. rubber dinghies, each suitable for accommodating twenty persons. The main propulsion machinery consists of an MWM Diesel engine arranged for supercharging by Brown Boveri turboblowers and capable of an output of 1,000 h.p. at 375 r.p.m. The engine drives a four-bladed Lips Limabronze screw having a diameter of 1,850 mm. and a pitch of 1,200 mm. The engine gives the ship a speed of 11·5 knots. For auxiliary purposes the ship is fitted with three MWM Diesel engines, each developing 36 h.p. at 1,500 r.p.m.—*Holland Shipbuilding, August 1958; Vol. 7, p. 35, p. 37.*

Fatigue of a Nut and Bolt

The object of this paper is to examine the main factors that tend to reduce the fatigue life of a nut and bolt loaded in tension and to show their relationship to one another. It is shown how the adverse effects can be deduced from basic structural theory by means of a detailed study of the stress pattern in a tension bolt. These adverse effects include basic stress diffusion, concentration of shear loading, shank constraint and interference, geometric stress concentration, thread effects, effects of distortion of the structural elements, and eccentric loading through inclination of the contact faces. The derivation of these factors is given in summary form in a table. Finally, the modifying effects of plasticity and pre-tensioning are considered. Both effects are generally beneficial and may counteract the adverse effects to some extent. The most direct effect of plasticity under fatigue loading conditions is the relief of high local stress in regions of stress concentration. Plasticity may also have a beneficial effect on the distribution of applied force at the threads of the bolt. Pretensioning of the bolt produces improvements in thread form and in applied load distribution; reduction of range of tension load fluctuations; alleviation of adverse effects at inclined bedding faces; and general stiffening of the complete joint. For plastic relief, material having a reasonably high ductility should be chosen for the nut and bolt. Care is necessary in applying pre-tensioning, not only to ensure that the beneficial effects are realized, but also to avoid the introduction of harmful effects. For this reason material of low ductility, or subject to stress corrosion, must not be used. The initial tightening must in some measure be controlled and the tension should be maintained by periodic retightening. It is suggested that the complex interaction of the adverse factors, with the further complications of plasticity and pretensioning, is the main reason why the behaviour of a tension bolt in fatigue is so difficult to predict. Accurate and smooth machining, particularly of the threads, is most important in the manufacture of the nut and bolt. There should be a reserve of unused thread and it is advisable to introduce a terminal groove. True alignment of the bedding faces of the nut and the structure is also very important.—*P. B. Walker, Journal, Royal Aeronautical Society, 1958; Vol. 62, pp. 395-407. Journal, The British Shipbuilding Research Association, August 1958; Vol. 13, Abstract No. 14,417.*

Inert-gas-shielded Arc Welding of Silicon and Aluminium Bronze

The purpose of this paper is to provide detailed information pertinent to the welding of silicon bronze and aluminium bronze by the inert-gas-shielded metal-arc and the inert-gas-shielded tungsten-arc welding processes. For many years the oxyacetylene, carbon arc or metal arc processes provided the only successful methods of welding these alloys. In most applications, however, the inert gas shielded, arc welding processes, when employed with proper techniques and procedures, are more efficient for welding both silicon and aluminium bronze than any of the above-mentioned processes. The inert gas shielded, arc welding processes can also be employed successfully for welding these alloys to some other metals. Complete details pertinent to proper joint design, welding procedures, shielding gas, operational techniques and mechanical strength of welded joints are included. Procedure details and operational techniques relative to welding these alloys to some other metals are also discussed.—*P. L. Hemmes, The Welding Journal, August 1958; Vol. 37, pp. 779-788.*

Project for the Machinery of a 65,000-ton Nuclear Tanker

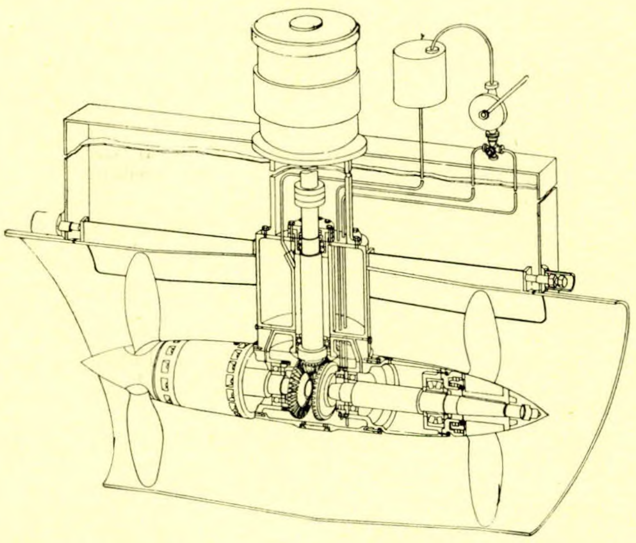
A first design of a nuclear powered ship was made at Götaverken Shipyard during the autumn and winter of 1956. The purpose was primarily to obtain a subject for further discussions, detailed investigations and calculations. The project was intended for a tanker of 65,000 tons d.w. with a machinery power of 30,000 s.h.p., and the reactor was of the boiling water type with the steam formed in the core and fed directly to the turbines. The main propulsion machinery should at normal load produce 30,000 s.h.p. divided between two propellers. This gives a trial speed of 18·25 knots, and a corresponding speed in service of about 17·75 knots. The power transmission from the turbine to the propeller shaft should be electrical *via* two independent turbogenerators with 11·7 MW coupling power each and two propeller motors with a shaft power of 15,000 s.h.p. each. For propulsion in passages, where the reactor is forbidden to operate, there are two high speed Diesel alternators of 2,000 kW, which are expected to give the ship a speed of about 9 knots. For production of all auxiliary power needed there are 6 Diesel alternators, each of 400 kW. These are running the pumps of the reactor, the pumps and exciters of the turbogenerators and the rest of the auxiliary machinery on the ship. Two oil fired header type boilers, with a total capacity of 34 tons of steam per hr. of 170lb. per sq. in. gauge are supplying heat to the heating coils, etc. The machinery is located in two engine rooms, one amidship and one aft. In the midship space the reactor with its pumps and the main turbogenerators with their condensers, pumps, etc., are placed. In the aft room are located the propeller motors, the auxiliary Diesel engine, the emergency Diesel engines, the steam boilers and all other conventional equipment. The reactor control room is situated in connexion with the aft engine room. The equipment for water purification, etc., for the primary system is located in a deck house above the midship engine room. With the arrangement described above, several advantages are obtained. Thus, there will be a complete separation of those spaces which are containing radioactive material or might be filled with radioactive material in connexion with a failure or an accident, and those spaces which people normally occupy, i.e. cabins, bridge and the remaining part of the machinery. In the first mentioned spaces admittance will not be allowed during reactor operation. The reactor is normally producing 132 tons of saturated steam per hour at a pressure of 585lb. per sq. in. gauge, corresponding to a thermal power of 100 MW. Four circulating pumps, located inside the primary shield, provided a 30-fold circulation of the reactor water. The fuel elements are made up of plates of uranium metal canned in Zircaloy. The large cooling area means that the demands upon the purity of the water need not be exaggerated and the materials in the plant might be of normal quality. As nobody is allowed to enter the midship space where the reactor is located during operation, the primary shield around the reactor can be of relatively small weight, about 750 tons, instead of normally 1,000 tons. However, 20 minutes after shut down the reactor space might be occupied for an unlimited time without any risk of over exposure. In respect of weight a boiling water reactor is particularly favourable; as the pressure vessel is relatively light, a "pressurizer" is not needed, and there are no heat exchangers. The total machinery weight will therefore not exceed that of a Diesel or turbine plant with more than 500-1,500 tons. The nuclear ship has accordingly a greater real loading capacity even on the Suez route, and on the Cape route the loading capacity is 10 per cent greater than that of a conventional steamship. In this case the cost per ton loading capacity is almost the same as that of a steamship. A comparison with a Diesel ship, however, turns out more unfavourable.—*L. Nordström and J. Thunell, International Shipbuilding Progress, August 1958; Vol. 5, pp. 365-376.*

German Buoy Layer with Bow Propeller

The service requirements for a modern buoy layer are very exacting. The ship must be able to find the edge of the navigation channel and follow it marking it out with buoys; to lift and stow away buoys weighing up to 9 or 10 tons; or to bring to the surface heavy buoy sinkers deeply embedded in sand. All these operations may have to be executed in adverse conditions of current, wind, or seaway. A ship which has already proved its worth in the performance of these duties is the German buoylayer *Walter Körte,* built by the Jade shipyard, Wilhelmshaven, for the Navigation and Ship Traffic Authority at Brunsbüttelkoog, on the Kiel Canal. The principal particulars of the ship are as follows:—

Length, o.a.	179ft. 9in.
Length, b.p.	163ft. 4in.
Breadth	29ft. 7in.
Draught...	11ft. 6in.
Gross tonnage	800 tons
Machinery output	1,800 b.h.p.
Speed	14 knots
Range	3,500 miles
Deck area for stowing buoys ...	1,786 sq. ft.

The *Walter Körte* has been built to Germanischer Lloyd classification 100 A/4 (K(E+) "Buoylayer". The stability requirements were that the maximum heeling moment caused by buoy laying or lifting operations should not produce a heel of more than 8 degrees, and that the period of roll (for one complete cycle) with the ship carrying normal equipment should be about 9 seconds. Manœuvrability was naturally given special consideration. Instead of using twin-screw propulsion, as is usual in ships requiring especially good manœuvring characteristics, it was decided to use a much more unusual and effective method, namely a propeller working inside a transverse bow tunnel in conjunction with a Pleuger active rudder aft. A limited amount of experience with the bow tunnel propeller was available but was not sufficient for the design of a ship with the degree of manœuvrability expected of the *Walter Körte;* therefore, before the design could be finalized, manœuvrability tests on models had to be carried out. This was done at the Hamburg Shipbuilding Experiment Establishment. The four engines are Maybach six-cylinder Diesels, each with an output of 530 h.p. at 1,500 r.p.m., arranged in two pairs with the gearbox between the forward and the after pair. Each Diesel of the forward pair also drives three generators as follows:—Port engine: one generator 192 kW, 185 volts d.c.; one generator 65 kW, 230 volts d.c.; one generator 37·5 kW, 230 volts d.c. Starboard engine: one alternator 285 kVA, 400 volts; one generator 65 kW, 230 volts d.c.; one generator 37·5 kW, 230 volts d.c. The two 37·5-kW generators are mounted on top of the 65-kW machines and are belt driven off them; they act as exciters for the larger generators in each group. The couplings between the units of the propulsion system are elastic both in torsion and in bending, and the units are mounted on elastic rubber supports. To use the available engine room space more efficiently, the forward pair of Diesel engines with their associated generators are slightly inclined, in the vertical plane, to the gearbox and the after pair of engines. This configuration is made possible by the use of Cardan couplings of the locomotive type; these are inserted between each engine and the gearbox. The Diesel engines are situated in the main engine room, which is watertight and sound insulated. There is no control or indicating equipment in the main engine room and therefore the constant presence of personnel is not needed there. The *Walter Körte* is believed to be the largest ship of its type to be provided with a bow tunnel propeller installation. This is of the Jastram type and consists of a pair of contra-rotating propellers of about 47-in. diameter symmetrically placed within the transverse bow tunnel with the propeller parallel to the ship's longitudinal centre plane. The propellers are driven through bevel gearing by a 250-h.p. d.c. motor and provide a side thrust of 3 tons at 204 h.p. motor output. The motor is placed inside the hull, with its shaft directed vertically downwards into the tunnel. By unscrewing a few bolts the whole installation can be lifted into the interior of the hull without the need for dry docking the ship.—*The Shipping World, 17th September 1958; Vol. 139, pp. 251-254.*



Sketch showing arrangement of Jastram bow tunnel propeller unit. The propellers are contra-rotating and provide a side thrust of 3 tons. They are driven by a 250-h.p. d.c. electric motor

Engine Room Noise

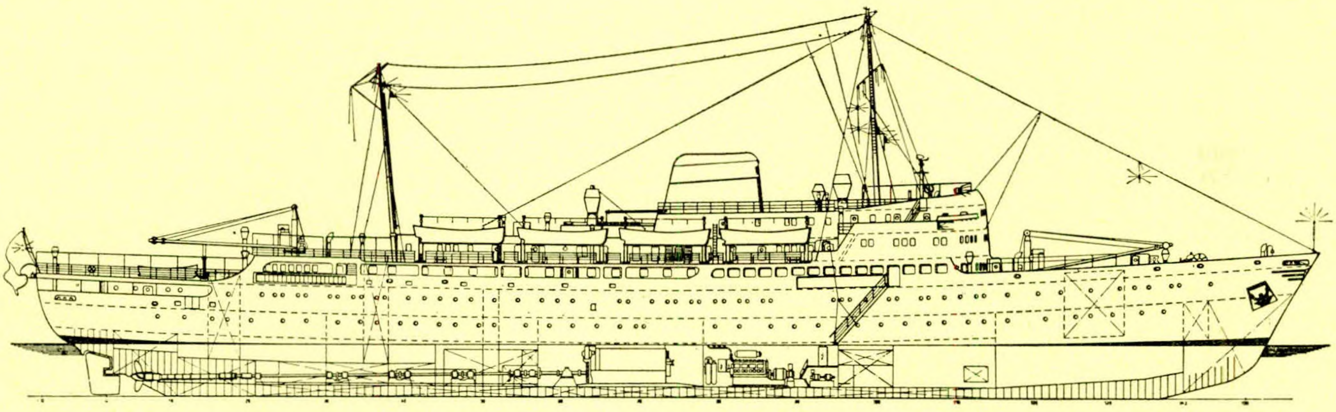
Hitherto noise control on board ship has mainly been confined to the passengers' compartments. The noise level in engine rooms has also been checked in order to control for instance the good working of reduction gears, etc., and exhaust and intake silencers are usually fitted to reduce air noise. Beyond this, however, not much has been done, and noise levels of 100-110 decibels are accepted as normal in engine rooms on board ships. Further local noise levels in the engine room of 115-116 decibels are not infrequently encountered. The noise spectrum and intensity level in ship engine rooms are usually harmful to the ears, and a great many seagoing engineers suffer from reduced hearing ability. It has been a steady complaint in recent years that it has proved very difficult to get maintenance and repair work done by the engine room crew. This problem has, of course, several causes, but a number of superintendents have experienced that the working intensity increases sharply when a noisy auxiliary engine is shut off and power supplied from ashore. There is probably a certain connexion between noise level and job turnover; it is likely that inattentiveness due to heavy sound has cost owners vast sums of money.—*European Shipbuilding, 1958; Vol. 7, No. 4, p. 85.*

Russian Passenger Vessel

The first of a group of 11 passenger vessels building in East Germany for Russia has been handed over, and is now in service. This vessel, *Mikhail Kalinin,* is a twin-screw Diesel ship of some 4,700 tons gross with accommodation for about 340 passengers and a speed of 18 knots. The 11 ships of the *Mikhail Kalinin* type are all due to be completed by 1960. They are being turned out in a building time of less than a year, with five months on the berth. Presumably they will be used to expand Russian passenger services in the Baltic and North Sea area, and possibly also in the Black Sea and Far East. These ships are being built by the VEB Mathias-Thesen Werft, at Wismar, a yard which is now specializing in the construction of passenger tonnage. The main Diesel engines, of M.A.N. type, were constructed under licence by a large new East German engine works, VEB Diesel-motorenwerk at Rostock. This works is eventually to build Diesel engines of its own design, as is done at the two other principal engine manufacturing concerns in East Germany, the VEB Schwermaschinenbau "Karl Liebknecht" at Magdeburg (formerly Buckau-Wolf) and a subsidiary works at Halberstadt, VEB Maschinenbau Halberstadt. The principal particulars of the *Mikhail Kalinin* are as follows:—

Length o.a.	400ft. 9in.
Length b.p.	360ft. 10in.
Breadth moulded	52ft. 6in.
Depth moulded to upper deck	33ft. 9in.
Depth moulded to main deck	24ft. 1½in.
Draught (maximum)	16ft. 11½in.
Gross tonnage	4,722 tons
Displacement	5,443 tons

As the accompanying plans show, the ship has three continuous decks and three superstructure decks. The construction is all-welded, except for the bilge and sheer strakes which are riveted. Strengthening for navigation in ice is provided. Cargo can be carried in a hold forward, with a hatchway trunked through the accommodation, while a similar trunked hatchway aft leads to luggage and mail compartments. Each is served by a single deck crane. A total of 280 tons of cargo can be carried. The two six-cylinder M.A.N.-type main Diesel engines develop 3,945 b.h.p. each, giving a total of 7,890 b.h.p. Four Diesel generators are arranged abreast in a separate auxiliary machinery room forward of the main engine room, having the main switchboard on a flat across its forward end. At its service speed of 18 knots, the ship has a range of 4,200 miles.—*The Shipping World, 20th August 1958; Vol. 139, p. 161.*



PROFILE

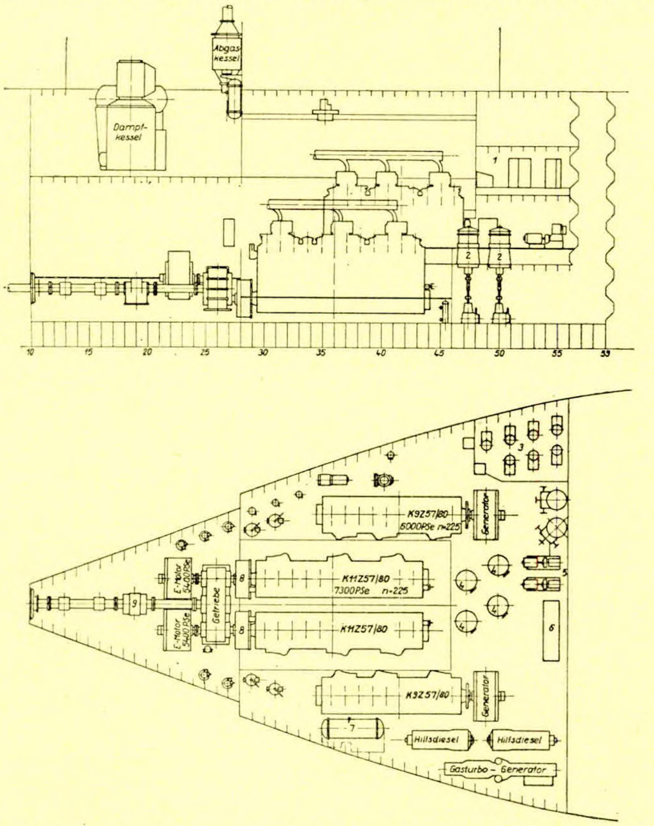
Russian passenger motor vessel Mikhail Kalinin

The Potential Problem of the Optimum Propeller

The increasing use of propellers operating within circular ducts has indicated the need for a better understanding of the effect that fixed boundaries have on propeller operation, particularly regarding their circulation distribution and total thrust. Furthermore, the investigation of propeller characteristics and cavitation phenomena in "closed throat" propeller tunnels requires also a knowledge of the magnitude of such effects. A large amount of effort has been devoted to the investigation of "slotted wall" tunnels for axial bodies of revolution in order to decrease the "blockage" interference, but little work has been done in this field regarding the operation of a propeller in a circular duct. The duct walls, whether "slotted" or continuous, will affect the local flow near the tips, thereby altering the radial distribution of circulation and the cavitation characteristics. The present investigation has been limited to the effect of a continuous wall. Correction factors pertaining to the increase in thrust for a propeller operating in a duct were given in 1920 by Wood and Harris. They considered the propeller as an actuator disc and determined the "blockage" interference due to the contraction of the slipstream. This correction is, therefore, applicable to moderately heavily loaded propellers when the contraction of the slipstream is appreciable. The presence of the walls will also affect lightly loaded propellers with a finite number of blades, and it is for such propellers that the following theory has been developed. A similar investigation has been made by Goodman, who, however, assumed the propeller slipstream to be identical with the Prandtl model; i.e. the helical vortex sheets were replaced by parallel lines. The analysis given in this paper is conducted for a propeller having a minimum energy loss and operating in a circular duct of constant diameter and of infinite or semi-infinite length. The theory is applicable to the case of ducted propellers even where the clearance from the propeller tips to the walls is small, giving the optimum distribution of circulation for such propellers when they have a finite number of blades. A circulation distribution factor relating the circulation for a propeller operating within a duct to the circulation for the same propeller operating in open water has also been derived, and can be used in the design of ducted systems. This theory might possibly be extended also for propellers operating relatively short ducts. The potential solution given is not dissimilar to the solution already published for a propeller having a finite hub. The boundary conditions in this case are changed. The mathematical analysis is followed by curves showing the effect of the tunnel walls on the circulation distribution, as well as the percentage increase in thrust for 3-, 4-, 5- and 6-bladed ducted propellers when operating in a tunnel whose propeller-tunnel diameter ratio is unity.—*A. J. Tachmindji, David Taylor Model Basin; Report 1228, July 1958.*

German Multi-engine Propulsion Proposal

An unusual design for ship propelling machinery developing 24,500 s.h.p. on a single shaft has been prepared by Maschinenfabrik Augsburg-Nurnberg A.G. in close co-operation with shipyards and tanker owners. The use of multiple engine propulsion has been advocated for a number of years, and examples of this form of propulsion will be found in a large number of ships. As an alternative to the direct coupled engine, the geared Diesel engine is the most satisfactory form of indirect drive, for it offers several advantages to the prospective user. These include: a saving in space; increased reliability, as there is very little chance of all engines breaking down at once; the ability to overhaul the engines while at sea; and the advantage that for economical reasons one or more of the engines can be shut down when the ship is light. The project prepared by M.A.N. is unusual because it is a combination of geared Diesel and Diesel-electric drive. The weight of the complete installation including Diesel engines, gears and couplings, electric generators and motors, without the auxiliary equipment, is about 1,240 tons. The entire machinery can be accommodated in the same amount of space as that required for a turbine installation of similar capacity, without having to extend the hull. The installation consists of two M.A.N. engines, each of 7,000 b.h.p., coupled to the shaft through electro-magnetic couplings or hydraulic couplings and gearing; and two 6,000-b.h.p. engines on flats above and to the side, each driving an alternator which supplies current to electric motors coupled to the main gearbox. With this system, various combinations of drive may be obtained, each having different economic advantages, depending on the amount of cargo being carried, and other circumstances. It must be admitted, however, that the fuel consumption of this proposed scheme would be about 0·021lb. per h.p. higher than that of a slow running engine. For one reason the fuel consumption of the high speed engine is higher because of its slightly lower efficiency, and for another the gearing losses and electrical transmission losses must be taken into consideration. The M.A.N. engines used for the scheme would be suitable for operation on heavy fuel, and would be of the cross-head design with complete separation of cylinder block and crankcase.—*The Shipping World, 24th September 1958; Vol. 139, p. 283.*



M.A.N. design for combined geared Diesel and Diesel electric drive of 24,500 b.h.p.

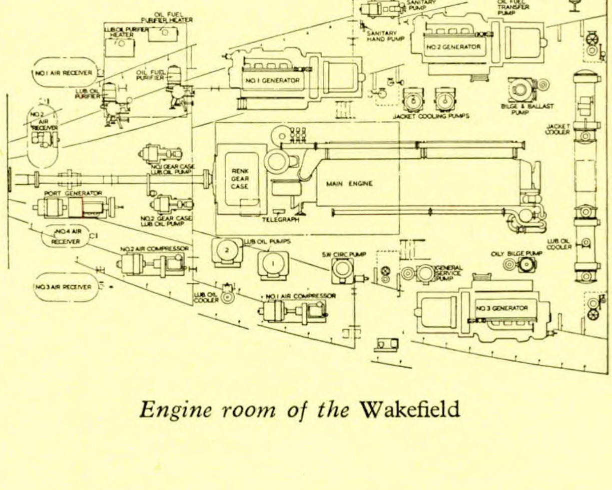
Vessel for U.K./Continental Service

The open shelterdecker m.s. *Wakefield,* nearing completion at the Glasgow yard of A. and J. Inglis, Ltd., is the first of three similar vessels ordered from these builders by Associated Humber Lines, Ltd., Hull, for the shipment of general cargo, palletized cargo and containers between the United Kingdom and the Continent—generally between Goole and Antwerp. Consequently, the two holds and 'tweendecks are designed to carry a total of at least 25 containers of the largest British Railways B type—16ft. 6in. by 7ft. 8in. by 8ft. 5in. high. These will be stowed by "vertical drop" only and the weather deck and 'tweendeck hatch covers are all of MacGregor sliding steel type, those in the 'tweendecks being flush fitting. The *Wakefield* has been ordered to a particularly detailed and stringent specification, and is mainly of welded construction. Her main characteristics are:—

Length o.a.	244ft. 2in.
Length b.p.	225ft. 0in.
Breadth, moulded	39ft. 0in.
Depth, moulded to second deck	13ft. 4in.
Depth, moulded to upper deck	22ft. 10in.
Height of forecastle above upper deck	7ft. 0in.
Sheer on upper deck	Normal
Sheer on second deck... ...	Nil
Camber on upper deck and superstructures	10in. in 39ft.
Camber on second deck ...	Nil
Bale capacity (approximately)...	90,000 cu. ft.
Machinery	1,580 s.h.p.
Service speed	12½ knots

For propulsion, there is a Ruston unidirectional four-stroke pressure charged 7VOXM-type engine, giving a power of 1,580 s.h.p., continuous rating, at the gearbox output coupling. This engine has seven cylinders with a bore of 17in. (432 mm.), a piston stroke of 18in. (457 mm.) and a b.m.e.p. at maximum output of 119·2lb. per sq. in. It transmits through a Renk oil operated, reverse reduction gearbox with a reduction ratio of 2:1. The output ratings are:

S.H.P. at gearbox output coupling, 12-hr. rating 1,767



Engine room of the Wakefield

S.H.P. at gearbox output coupling, continuous rating	1,580
R.P.M. at engine coupling	435
R.P.M. at propeller (approximately)	217

Electrically driven oil pressure and scavenge pumps serve the Renk gearbox, which incorporates the Michell thrust blocks. Shaft brakes are also fitted.—*The Motor Ship, September 1958; Vol. 39, pp. 250-252.*

Cavitation and Nuclei

Contrary to the general impression, water and other common liquids, when pure, have high tensile strength. Cavitation would be impossible at the highest velocities currently encountered. In practice all liquids appear to cavitate as soon as the pressure tends to drop below the vapour pressure, thus implying that liquids have no tensile strength. This discrepancy is explained by the presence of "weak spots" whose characteristics have as yet only been inferred. This paper presents the results of an experimental investigation of the weak spots present in ordinary water. The results are consistent with the model of the nucleus proposed by Harvey, but are apparently inconsistent with other models currently found in the literature.—*R. T. Knapp, Trans.A.S.M.E., August 1958; Vol. 80, pp. 1,315-1,324.*

Overcurrent Protection in Large Capacity Shipboard Electric Systems

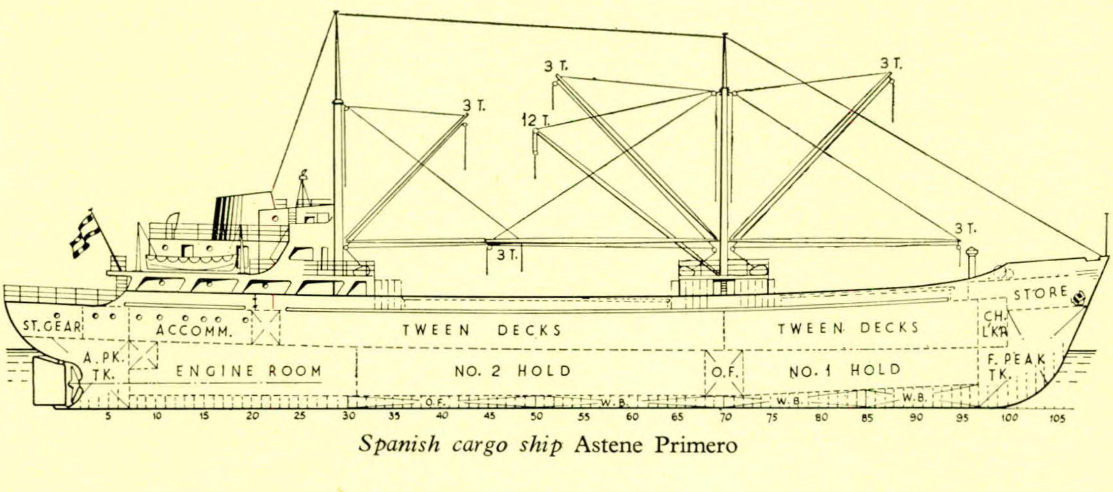
In all power systems the continuity of power service is dependent upon the characteristics of the devices that are employed in the distribution systems and the proper co-ordination of these devices. It is desirable to have these devices so arranged as to isolate any fault with a minimum disruption of power in the remainder of the power systems. Shipboard power plants have continued to become larger, thus resulting in higher available fault currents. This paper describes these larger systems and discusses the shipboard protective systems and devices employed. It is the objective in navy shipboard distribution systems to have each unit of the equipment and all circuits protected from short circuit currents and thermal overloads. The objective is to arrange and select the various protective devices to provide a complete co-ordinated protective system having the following characteristics: 1. High speed clearing of all low impedance faults. 2. Maximum continuity of service under fault conditions to be achieved by the selective operation of the various protective devices. 3. Maximum protection for electric apparatus and circuits under fault conditions by co-ordination of the thermal characteristics of the circuit or apparatus with the circuit interrupting characteristics of the protective device. 4. Adequate interrupting capacity in all circuit interrupting devices, or the provision of suitable back-up protection, if the interrupting capacity of the device may be exceeded. 5. Adequate thermal rating in all of the various circuit protective and switching devices for operation under all service conditions. 6. Short circuit, current carrying capacity of circuit breakers and bus transfer equipment in excess of the maximum time limitations of circuit opening. Selective tripping is accomplished by means of a time delay in the circuit breakers that is inversely proportional to current. This time delay is in the order of cycles. The breaker closest to the load may have an instantaneous trip. Each circuit breaker as it appears in the system proceeding from the load must then have a time-current band that will prevent it from initiating a trip until the circuit breaker in the system next closer to the load has sufficient time to trip and clear the fault. The availability of circuit breakers with 100,000-ampere interrupting rating and a 100,000-ampere, short time current rating permits the use of larger ship's service generator capacity. The availability of these circuit breakers and the development of fused moulded-case circuit breakers have resulted in a great degree of selective tripping.—*J. R. Cole, Applications and Industry, July 1958; No. 37, pp. 126-131.*

Spanish Cargo Vessels

A series of twenty-two small refrigerated cargo vessels is under construction at the shipyards of Empresa Nacional Elcano de la Marina Mercante, Madrid. Two of these ships, the *Astene Primero* and the *Astene Segundo,* have already been delivered to the Naviera Comercial Aspe, S.A. These two vessels are of 1,100 tons d.w. and are slightly different in construction to the remainder of the series which are designed for a deadweight of 1,200 tons. These vessels, which are known as Type "Q" ships, have been designed for the carriage of fruit and are of the shelterdeck type. They are Diesel engined vessels with the engine room and accommodation aft and are equipped with bipod masts and steel folding hatch covers. Their speed in service, fully loaded, is about 12½ knots. The principal particulars of these ships are as follows:—

Length o.a.	222ft. 6in.
Length b.p.	216ft. 0in.
Breadth...	36ft. 9in.
Depth to second deck... ...	13ft. 0in.
Depth to shelter deck... ...	20ft. 4in.
Draught...	12ft. 9in.
Deadweight	1,200 tons
Gross tonnage	688 tons
Net tonnage	366 tons
Machinery output	1,250 b.h.p.
Speed	12½ knots
Range	6,000 miles
Cargo capacity—	
Grain	89,440 cu. ft.
Bale	83,790 cu. ft.

Deck equipment includes an electrically-driven Elcano BDT windlass with two warping ends, six electric cargo winches, also of Elcano make, and an Elcano vertical type electrically-driven capstan. The steering gear is of the electro-hydraulic type supplied by the builders. The propelling machinery consists of a Smit-Bolnes four-stroke supercharged Diesel engine



Spanish cargo ship Astene Primero

type SB 310, developing 1,250 h.p. at 275 r.p.m. Electricity for power and lighting is obtained from two sets of 65-kW 220-volt d.c. generators driven by Maquinista M-320 four-stroke Diesel engines of 100 h.p. running at 750 r.p.m. Each engine has cylinders of 200-mm. bore and 270-mm. stroke. When the vessel is at sea electricity is supplied by a 25-kW generator coupled to the propeller shaft. For use in port there is a 5-kW Diesel engine driven generator which is also coupled to an air compressor.—*The Shipping World, 20th August 1958; Vol. 139, pp. 164-165.*

Nuclear Ship *Savannah*

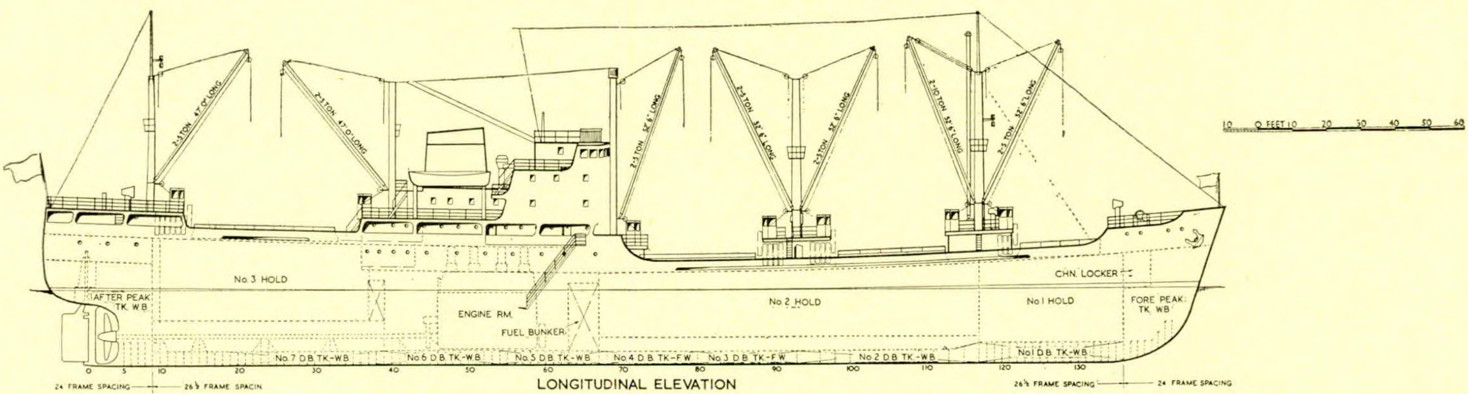
One of the more vexing problems encountered in the nuclear power field is that associated with the safe and economic disposal of radioactive waste products. At the present time no adequate set of ground rules exists for world-wide disposal of radioactive materials into the oceans. It is anticipated that the final solution of the waste disposal problem will involve the regulatory dictates of an internationally accepted code of practice. To minimize the possibility of causing undue concern to other governments, the *Savannah* is designed so that all liquid and solid waste materials can be automatically disposed of from the ship while at sea or in port. All radioactive materials generated aboard the *Savannah* in the course of her operation will be transferred in special containers to dockside and disposed of on land in accordance with established procedures. If a primary system leak should occur, this material would be accumulated within the containment vessel and be pumped into special hold-up tanks from which they would be pumped to receptacles through special dockside facilities for shore retention. While it is important to build a safe, reliable ship and nuclear propulsion system, it is equally important to provide a skilled and qualified crew to operate this nuclear ship. In order to provide for the availability of an adequately trained crew, a training programme will be undertaken for the first crew of the *Savannah,* beginning with the engineering officers in October. The proposed training programme will consist of three closely integrated and synchronized phases. The first phase will provide a comprehensive academic background and a thorough grounding in the functional design, arrangements, and operational characteristics of the ship's systems and power plant. This is supplemented by the second phase, which places emphasis on the practical operating problems utilizing an electronic reactor simulator, operation of similar pressurized water reactors, and the solution of emergency and routine maintenance problems employing a full scale mock-up of the *Savannah* reactor plant. In the third phase, the *Savannah's* crew will be brought to the shipyard to assist in the assembly and test of the reactor propulsion system. It should be noted that the crew members who were elected as the first crew of the *Savannah* were chosen from the normal operating ranks of the States Marine Corporation and were not preselected from a specialized highly trained or skilled group.—*Address by R. H. Godwin to the Council of the International Union of Marine Insurance. The Journal of Commerce and Shipping Telegraph, 11th September 1958; No. 40,812, p. 7.*

Australian Built Cargo Ship

An order has been placed by the Adelaide Steamship Co., Ltd., with the Australian Shipping Board for a single-screw motor cargo vessel to be built by Evans, Deakin and Co., Ltd., Brisbane. The general particulars are:—

Length o.a.	340ft. 10¼in.
Length b.p.	320ft. 0in.
Breadth, moulded	52ft. 0in.
Depth to upper deck	27ft. 0in.
Deadweight (approximately) ...	5,200 tons
Service speed	12½ knots

It is intended that the vessel shall be delivered about September 1959. It will be constructed as a single deck ship with combined poop, bridge and forecastle. The accommodation for the officers and crew is amidships. Cargo is carried in three holds, two forward of the accommodation superstructure and one aft. The bottom of the latter is a hold flat under which the propeller shafting is led. No 2 hold is fitted with hopper sides. There are four hatches, No. 2 hold being fitted with two hatches having MacGregor steel covers of the single pull type. The peaks and double bottom tanks are arranged for fresh water or salt water ballast. The deck auxiliaries are electrically driven and comprise a windlass forward, a five-ton mooring winch on the poop deck aft, and ten three-ton and two five-ton winches. Eight of the winches are seated on two platforms forward, two on an extension at the fore end of the bridge deck and the other two on the docking bridge. There are 12 five-ton, two ten-ton and one twenty-five-ton tubular steel derricks, the three heavier derricks being located at the forward end of No. 2 hold. The propelling engine is an Australian-built Doxford 2,800-b.h.p. unit running at 110 r.p.m. and having four cylinders, 560 mm. in diameter with a piston stroke of 2,160 mm. Three 420-b.h.p. Ruston-engined generators are installed for the supply of current throughout the ship.—*The Motor Ship, July 1958; Vol. 39, p. 179.*



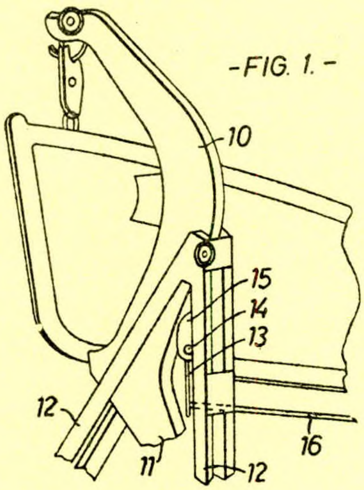
Cargo ship for the Adelaide Steamship Company

Patent Specifications

Gravity Davit

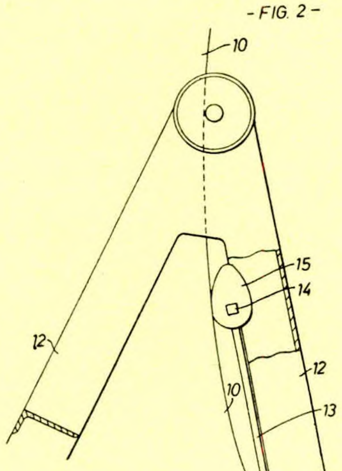
The gravity davit according to this invention incorporates means whereby additional force can be applied to the davit arm to encourage it in its outboard movement under the action of

-FIG. 1.-



gravity. This means has no connexion with the davit arm, so the arm can move outboard independently of the device. It is desirable that in a gravity davit the arm should be capable of moving outboard even when the vessel on which the davit is fitted has an adverse list of up to 25 degrees. With the invention it is possible even with a greater adverse list than 25 degrees easily to start the davit arm outboard to a sufficient extent for gravity to come into operation to complete such outboard movement of the arm. The same applies

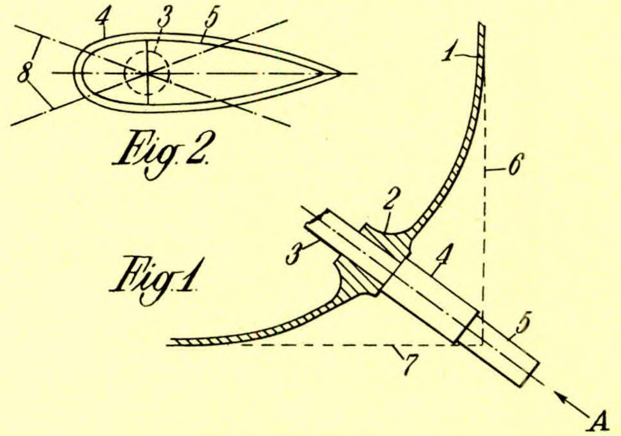
-FIG. 2-



should the arm for some reason "freeze" or stick in its stand. In Figs. 1 and 2 the davit arm (10) is shaped as shown and has a single pivot at its lower extremity or heel, a part of which is shown at 11, by which it is pivoted to the triangular stand (12). The lower part of the davit arm is located within the members forming the stand (12) so that these members provide good lateral support for the arm. In the fully inboard position the davit arm nests within the vertical channel member forming the rear of the stand, as can be seen in Fig. 1. A hand lever (13) is pivoted to the stand (12) as indicated at 14. This hand lever has a cam part (15) which acts on the rear of the davit arm (10). By turning the hand lever (13) in the anti-clockwise direction, a force can be applied to the rear of the davit arm to assist it or start it in its outboard movement. An extension piece may be provided for fitting to the hand lever (13) so as to provide increased leverage. If desired the hand levers of the two davits between which the boat is supported may be coupled together by a connecting rod (16), as shown in Fig. 1. This enables one man to control and operate both davits.—*British Patent No. 803,594, issued to Marine and Allied Industries (C & I), Ltd., and W. C. Rouse. Complete specification published 29th October 1958.*

Stabilization of Ships

This invention consists of a fin comprising two or more sections arranged to telescope into each other. In one construction the fin may be arranged so that when telescoped the projection of the fin is within the angle formed by producing the side and the bottom of the ship, and in an alternative arrangement the telescoped fin is retracted into a fin box within the hull of the ship. Obviously a given size of fin may be accommodated in a much smaller box when telescoped. The telescopic construction has a further advantage in that



the fin may be used for stabilizing the ship while in the telescoped condition. Thus, when the vessel is proceeding at high speed, the fin might be used in the telescoped condition, whereas when the vessel is proceeding at low speed, the fin might be extended to present the maximum effective area. In Fig. 1 a portion of the hull (1) of a ship carried a support (2) for a fin shaft (3). The latter carries the major portion (4) of a fin which has a second portion (5). This portion (5) can be telescoped into portion 4. When portion 5 is telescoped into major portion 4, the whole fin is within the angle bounded by lines 6 and 7. Fig. 2 shows on a larger scale a view of the fin (4, 5), when looking in the direction of arrow A of Fig. 1. Telescoping portion 5 of the fin is of the same form as major portion 4, but is smaller in dimensions to enable it to fit inside portion 4. The dotted circle represents the fin shaft (3), while the chain lines (8) represent the limits of movement of the centre line of the fin when it is being oscillated for the purpose of stabilizing the ship against roll.—*British Patent No. 803,602, issued to Muirhead and Co., Ltd. Complete specification published 29th October 1958.*

Protective Hood for Hatch

This invention concerns a water excluding hood for use in goods loading and unloading operations. The loading and discharging of goods must often be stopped in wet weather, especially if there is no available device to protect any such goods which may be damaged by water. Devices have been adopted to be arranged over loading hatches through which the goods are passed. However, such devices have often suffered from the disadvantage that only the middle part of the hatch can be employed. A still further disadvantage often exists in that such devices are so complicated that it is not possible to use them in practice. The invention seeks to eliminate or at least to mitigate these disadvantages and to provide a hood device which adequately protects goods during loading and discharging operations. The hood shown in Figs. 1 and 2 is fabricated of a watertight material and is intended to protect the goods from rain during loading and discharging. In the main it is the direction of the wind which governs which parts of the hood must be used. The side parts (2a) of the hood are supported by arms (3) consisting of two rods (3a), to which the edges of the hood are attached. By arranging the rods (3a) at a fixed spacing a slit is formed between them. The free ends of the rods (3a) are splayed somewhat in order to facilitate the insertion of lifting ropes, as from a winch.—*British Patent No. 802,234, issued to E. A. Sjoeman. Complete specification published 1st October 1958.*

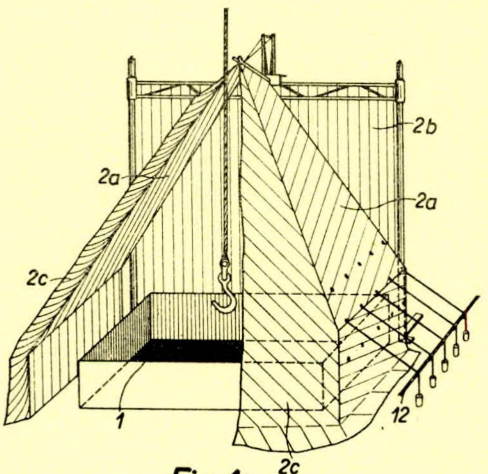


Fig. 1

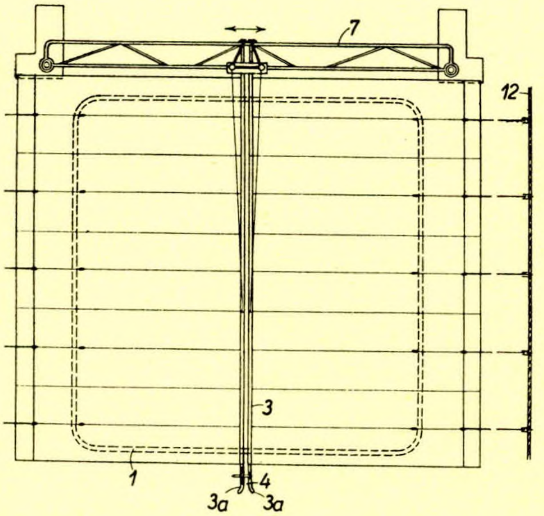


Fig. 2

Ship's Stabilizer

This ship's stabilizer is characterized by a two-part gear, one part being driven continuously by an electric motor and the other part being reversible and connected through a lever to the shaft of the stabilizer, about the axis of which the stabilizer moves to damp the rolling motion of the ship. The two parts are operatively interconnected through an electromagnetic coupling influenced by a device responsive to the rolling movement of the ship to drive the second gear

Fig. 1

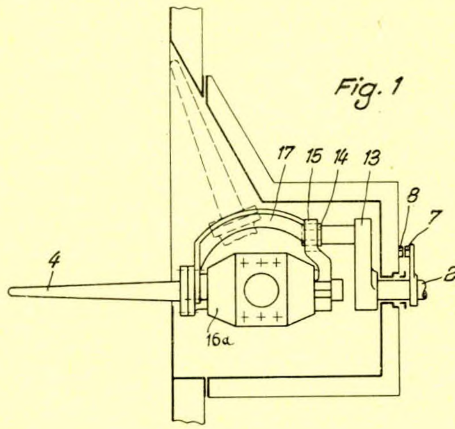
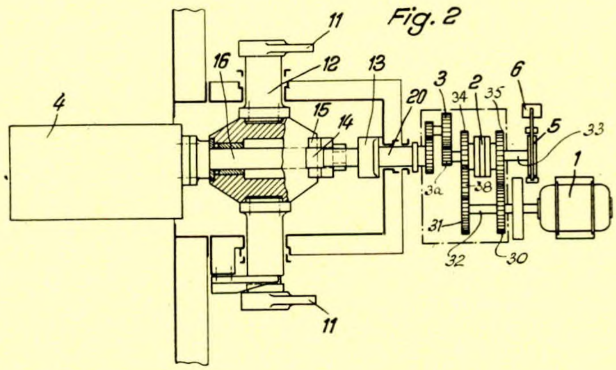


Fig. 2



from the first part gear in such a direction that a rolling movement of the ship will result in the stabilizer being moved to dampen such a movement. Referring to Figs. 1, 2, 3, a stabilizer in the form of a fin (4) is mounted on the outer end of a shaft (16) for rotation in the extended shaft position of Figs. 1 and 2 about a horizontal axis to dispose its stabilizing surfaces in a positive, negative, or central position. The shaft (16) is journalled in a bearing block (16a) to the sides of which are journalled two parts of a horizontal shaft (12) parallel to the sides of the ship. The shaft (16) is coupled to a driven shaft (20) by a forked lever (15) secured at one end to the shaft (16) and engaging at its other end with a slide member (14) rotatably secured to a crank (13) fixed to the shaft (20). The shaft (20) is connected through a gear train (3) to an electric motor. The gear (3) has one pinion (3a) fixed to the shaft (33) connected at its free end to a brake (5) having a releasing magnet (6) which, when energized to lock the brake (5), ensures that the fin (4) is firmly held

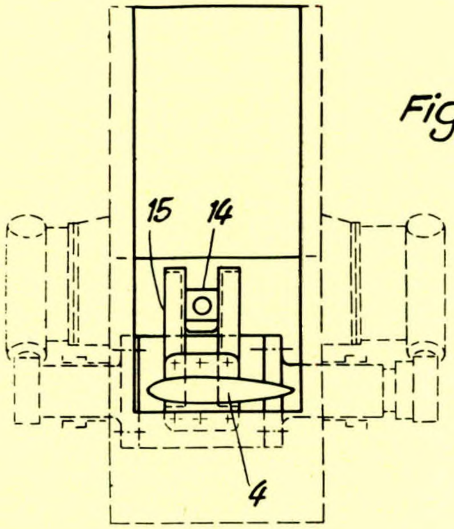
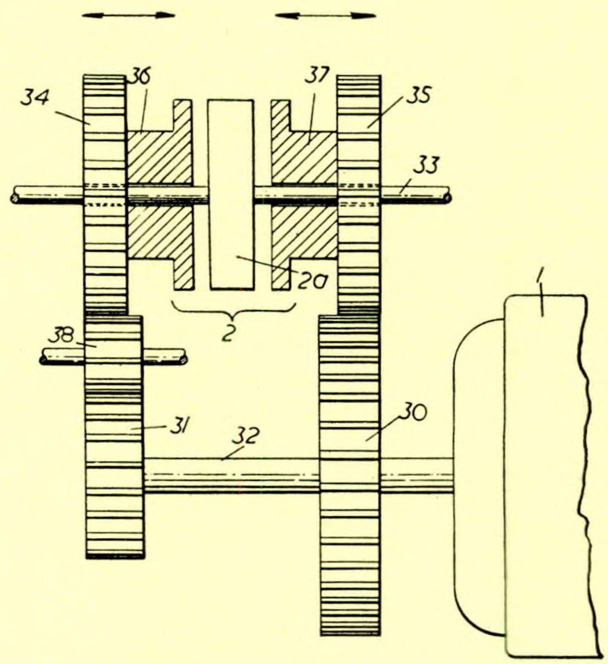


Fig. 3

FIG: 12.



in its stationary position. The pinion (3a) is connected through the gear train of Fig. 12 to an electric motor (1), which is continuously rotating when the fin is in action. This gear train has one part continuously driven by the motor (1) and consists of permanently meshing pinions 30, 35 on the one hand and permanently meshing pinions 31, 38, 34 on the other hand, and a second part (2a) secured to the shaft (33). The pinions 30 and 31 are fixed to rotate with the motor shaft (32) and the pinions 34 and 35 are freely rotatable and slidable on the shaft (33), while the intermediate pinion 38 causes the pinion 34 to rotate in the opposite direction to the pinion 35. To the pinions 34 and 35 are fixed members 36 and 37 respectively which form part of an electromagnetic coupling; the second part (2a) of this gear train also forms part of the coupling (2) and is energized by a so-called anti-roll gyroscope (not shown) responsive to the rolling motion of the ship. When the coupling coil is energized, member 36 or the member 37 is coupled through the part 2a to the shaft 33 to rotate the fin (4), and at the same time the magnet (6) is influenced to release the brake (5). The anti-roll gyroscope operates consecutively and in opposite directions so that the stabilizer surfaces of the fin (4) receive alternately a positive and a negative adjustment according to the direction of the rolling movement of the ship. Disconnexion of the coupling (2) occurs as a result of the position of the fin (4), there being located on the driven shaft (20) a contact segment (7) having a number of contacts, only one of which is made to be effective on each particular occasion. When moving against a fixed co-operating contact (8), the contact on segment (7) interrupts the current of the coupling (2). Adjustment of the contacts and hence of the desired angle of incidence of the stabilizing surfaces of the fin (4) is also effected by means of a gyroscope, the same terminating the angular movement of the fin (4)) in accordance with the angle of roll of the ship. To simplify the installation and to avoid the use of a second gyroscope, adjustment of the desired angle of incidence of the stabilizing surfaces of the fin may also be effected by previous adjustment of the corresponding contacts by hand. On the forked lever (15) and on the stabilizer shaft (16) there are located two parallel yoke pieces (17), between which the slide member (14) moves upon the lowering or lifting of the fin, and which ensure that the fin will be fitted and lowered with its stabilizing surfaces at a constant angle of incidence which is preferably approximately zero degrees.—*British Patent No. 802,105, issued to Deutsche Werft A.G. Complete specification published 1st October 1958.*

Marine Engineering and Shipbuilding Abstracts

Volume 22, No. 2, February 1959

* Patent Specification

Study of Corrosion and Cavitation Erosion Damage

The effects of fluid cavitation and cavitation bubble collapse on a guiding surface have been investigated, using two water tunnels, a magnetostrictive-transducer apparatus, a piezoelectric transducer apparatus, and a rotating disc apparatus. Studies of the mechanism of damage to a surface and its relationship to change in fluid pressure and stream velocity were made. These studies and examination of numerous ships in service showed that although fluid cavitation may occur adjacent to underwater appendages of vessels at normal operating speeds, the areas in which cavity collapse is the primary cause of damage are restricted to propellers. Damage to ships' struts, rudders, and other appendages is shown to be primarily corrosion in nature, aggravated by mechanical scouring action.—*J. Z. Lichtman, D. H. Kallas et al. Trans.A.S.M.E., August 1958; Vol. 80, pp. 1325-1341.*

Slewing Derricks with Automatic Movements

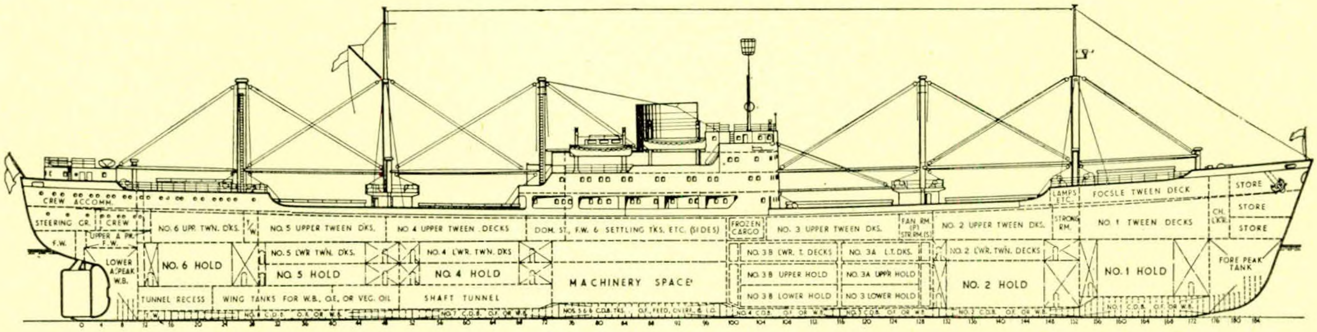
A system has been worked out in Sweden in which the boom functions rather like a crane and is operated by one man. This boom can take the full load without risk of dangerous overloading in any part of the rigging. Two winches are used, one for the cargo fall and the other for the central topping lift which runs down through pulleys on a hinged longitudinal outrigger to the winch. All the movements of the boom are produced solely by this winch, and the boom automatically executes two simultaneous movements. It can thus swing with full load over the ship's side and luff for the whole length of the hatch by shortening the central lift or *vice versa.* A load can thus be placed in the required position without any adjustment. By a simple adjustment on deck the boom can swing over the port or starboard side, or can be made to swing in a larger or smaller radius. A good view and clear space is obtained at the hatchway as the winches are placed close to the mast and all lines run vertically down to the winches. The boom is provided with a movable socket by means of which the detrimental effect on the swing of the boom caused by a list can be completely eliminated. Derricks of this type, lifting between 2·5 and 6 tons, are already in use, but the system is suitable for considerably heavier loads.—*Teknisk Tidskrift, 1958; Vol. 88, pp. 614-615. Journal, The British Shipbuilding Research Association, August 1958; Vol. 13, Abstract No. 14,445.*

Sprayed Tungsten Carbide

The introduction of tungsten carbide to the range of materials available for hard facing will provide excellent wear resistance under the most severe conditions of service. Tungsten carbide is extremely hard—Rockwell A88 to 90—and should provide excellent surface. For such extreme conditions the maximum carbide content is required in the coating, and this is now successfully achieved. While straight tungsten carbide can be sprayed, the coating deposited is of no value since the particles are poorly bonded together and the mass cannot be fused within itself or to the base. Therefore the tungsten carbide is mixed with a suitable matrix that, after fusing, will give a homogeneous coating completely fused to the component base metal. The new "Metco Thermo-Spray Powder" will give a deposit efficiency of 93 per cent, containing almost 80 per cent tungsten carbide. An important feature of the new material is its very low thermal expansion coefficient, eliminating high stresses during cooling. Even on straight chrome steels a coating of tungsten carbide can be applied with no difficulty and without the need for slow cooling.—*Shipbuilding Equipment, September 1958; Vol. 1, p. 12.*

Cargo Liner with A.C. Winches

The latest addition to the fleet of Westfal-Larsen and Co. A/S, of Bergen, Norway, is the motor cargo liner *Villanger.* This ship has been built at Sunderland by Joseph L. Thompson and Sons, Ltd. The *Villanger* is a closed shelterdeck ship of 10,590 tons deadweight with a speed of 17 knots in service. Her design incorporates a number of unusual features. These include winches of alternating current Ward Leonard type, deep tanks coated with stainless steel, a new design of aluminium shifting board, a new type of radio aerial, and



Westfal-Larsen liner Villanger, *10,590 tons deadweight, built by Joseph L. Thompson and Sons, Ltd.*

the first turbocharged Doxford engine to be built by the North Eastern Marine Engineering Co., Ltd. The principal dimensions of the ship are as follows:—

Length o.a.	504ft. 11½in.
Length b.p.	470ft. 0in.
Breadth, moulded	64ft. 0in.
Depth, moulded to upper deck	40ft. 0in.
Summer draught	28ft. 8¾in.
Gross tonnage	9,348 tons

The layout of the ship can be seen from the accompanying general arrangement drawing. There are six large holds, five of them being suitable for general cargo and the sixth being insulated and arranged for the carriage of fruit in cartons, with a capacity of 100,000 cu. ft. The refrigerating plant for the insulated hold and domestic stores is by STAL, Norrkoping, with insulation by Gregsons. There are deep tanks in holds Nos. 5 and 6 on either side of the shaft tunnel, which can be used for vegetable oils, fuel oil or water ballast. They have a capacity of 511 tons. These tanks are arranged with side cofferdams, thus giving a smooth surface which is easily cleaned. They are coated inside with a liquid stainless steel coating. The main engine of the *Villanger* is a six-cylinder N.E.M.-Doxford engine of the 650-mm. size. It is the first turbocharged Doxford engine to be built by the North Eastern Marine Engineering Co., Ltd. Three of the normal Doxford, lever driven, scavenge pumps are fitted, and in addition there are two Brown Boveri turbochargers. The engine develops 8,000 b.h.p. in service at 115 r.p.m. to give the service speed of 17 knots. The first of these engines built by Wm. Doxford and Sons (Engineers), Ltd., themselves was installed in the Westfal-Larsen tanker *Spinanger*. The electrical supply is derived from the three Electromekanos alternators, each designed for a normal output of 390 kVA at 440 volts, 60 cycles alternating current. They are driven by Bergens Mek. Verksted six-cylinder turbocharged oil engines. An Electromekanos 95-kVA alternator driven by a Sunderland Forge compound steam engine is also fitted and arranged to operate in parallel with the other three alternators.—*The Shipping World, 24th September 1958; Vol. 139, pp. 275-277.*

Gaseous-fuel Reactor

Although many combinations of solid and liquid fuel reactors have been proposed, no one, at least in the unclassified literature, has described a reactor that uses fissionable fuel in a gaseous form. Generally, one would be inclined to eliminate such gas phase reactors because the fuel concentration would be too low. However, adequate fuel densities can be achieved with some gases at fairly moderate pressures. Uranium hexafluoride, for example, would make a good gaseous fuel since its density is reasonably high at the pressures and temperatures of interest in reactor design. In addition, UF_6 is conveniently available and there is a wealth of information on its properties and methods of handling from gaseous-diffusion isotope-separation experience. Information on the fission-product

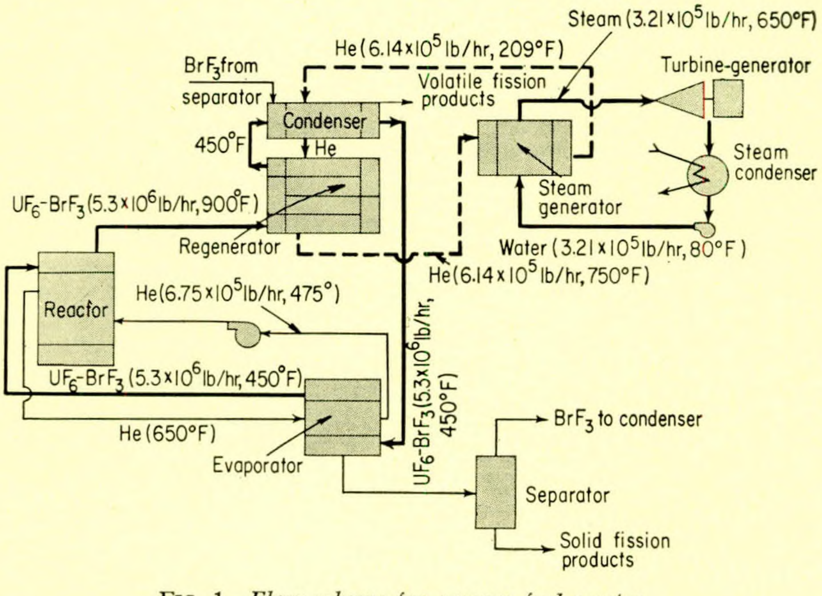


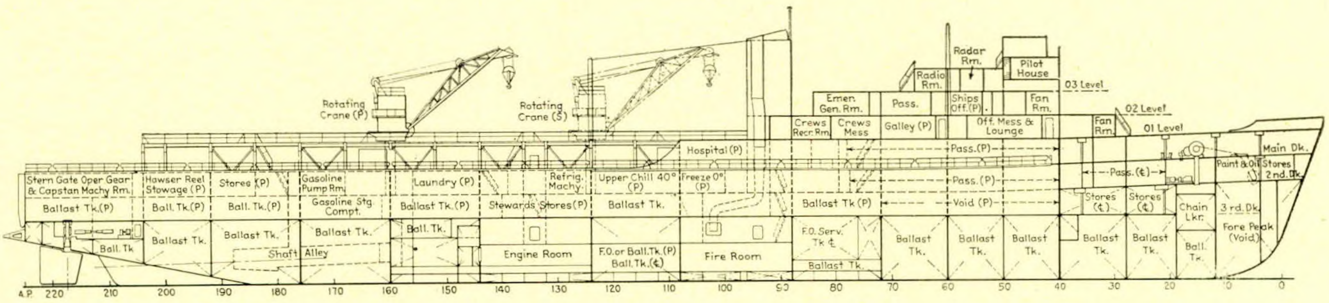
FIG. 1—*Flow scheme for gaseous fuel reactor*

Heavy solid lines show circuits for UF_6 gaseous fuel (with BrF_3 additive) and turbine steam. Heavy dotted line represents He gas intermediate coolant circuit.

fluorides that would be formed in such a reactor is available from fuel-element reprocessing by fluoride distillation. Fig. 1 shows a possible flow diagram for a UF_6 gas phase reactor. As it flows through tubes piercing a graphite core, the gas is heated internally by fission energy. The gas leaves the reactor at 900 deg. F. and enters the regenerator where it gives up its sensible heat to an intermediate helium coolant, which is recycled from the steam generator. The UF_6 then condenses at 450 deg. F. in the condenser section, giving up its latent heat to the helium. From there the UF_6 liquid passes to the evaporator, where it is vaporized at 450 deg. F. and returned to the core. Generally, the advantages of a UF_6 gas phase reactor would be similar to those of other homogeneous reactors. Thermodynamically, a gas phase reactor produces superheated steam at temperatures higher than the water type reactors, but not as high as the liquid metal type. The major disadvantage in this reactor type is the poor heat transfer characteristics of the gaseous fuel, which results in a high hold-up of fuel and large heat exchanger surfaces. Experimental data are required to determine more reliable heat transfer coefficients for UF_6 gas. The generator output for this particular design and fuel flow rate would be 35,000 kW. The auxiliary power requirements (mostly to circulate helium in the various pieces of equipment) are somewhat higher than those of non-gas cooled reactors. About 5,000 kW would be required for the helium compressors, circulating water pumps, condensate pumps, and other miscellaneous plant electrical loads. The net available power would then be 30,000 kW.—*S. Baron, Nucleonics, August 1958; Vol. 16, pp. 128, 130-133.*

USNS Cargo Ship (Dock) ***Point Barrow***

The T-AKD-1 USNS *Point Barrow* is a cargo ship (dock) especially designed for lighterage operations of remote bases in an adverse polar environment. The vessel is 465½ft. overall and has a full load displacement of 9,415 tons. Her twin-screw propulsion plant gives her a speed of 15 knots. At this speed her cruising range is 10,000 miles. The ship bears a strong resemblance to an LSD (landing ship dock). This reflects the similar functions of the two vessel types: both launch and retrieve small craft *via* their floodable stern areas. However, although the *Barrow* can provide emergency dry docking facilities, its primary function is to launch and retrieve lighterage and landing craft. These units are needed to serve the remote bases where no port facilities are available. *Ice Features.* The *Point Barrow* was constructed to very stringent design criteria: 1. Maximum wind velocity for any area is considered to be 100 knots from any quadrant. Wind may reverse its directions in a few minutes. Further, it may increase from a dead calm to 70 knots in a few minutes, then subside just as rapidly. 2. Minimum air temperature is assumed to be −65 deg. F., temperature changes of up to 50 deg. F. in 1 hr. Heating systems were designed on the basis of outside air temperature of −20 deg. F. with supply fans operating at one-half of their supply capacity. 3. Equipment in exposed locations was designed to operate satisfactorily at −20 deg. F. concurrently with a 40-knot wind velocity. 4. Relative humidity can change 50 per cent in 4 hours or 80 per cent in 7 hours. Specific attention was given to topside fittings, dogs, controls, etc., to facilitate easy operation by personnel encumbered with bulky clothes and mittens. Where needed, special materials having notch-tough physical properties were utilized to maintain structural strength at low temperatures. This includes the 1¼-in., high tensile strength, steel ice belt which girds the ship. It extends from 3ft. above the full load waterline to 3ft. below the light load waterline. Additional "arctic design" features are the extra ice belt framing the ice strengthened bow and reinforced double bottoms. The twin propellers are of nickel aluminium bronze alloy, which minimizes the possibility of the vessel being disabled by ice damage. (Conventional propellers operating in low temperature sea water are prone to become brittle and susceptible to easy fracture when striking ice.) Deck steam lines and two portable heaters are provided for cargo gear de-icing. Similar attention was given to sea valves and sea chest to keep them operable. The wheelhouse windows are electrically heated, as are the wiper blades. Two main turbine and reduction gear units are provided. Each serves a separate shaft and propeller—one left handed and one right handed. Each unit consists of a high speed, double reduction geared turbine set, rated at 3,000 s.h.p. at 180 propeller r.p.m. The combined 6,000-s.h.p. normal output is developed with 440lb. per sq. in. gauge and 740 deg. F. steam at the throttle. Vacuum of 28½-in. Hg is maintained in the main condenser. The units are designed to operate continuously at 10 per cent in excess of normal rate power, i.e. 6,600 s.h.p. Astern turbines are designed to deliver 80 per cent of normal ahead torque at 50 per cent of the normal ahead r.p.m. The reduction gears are the double helical type. Each gear set has an integral main thrust bearing of the double pivoted, segmental type. Each is designed to take a maximum load of 65,000lb. Thrust is transmitted, well distributed, directly to the foundations. Two oil fired, watertube boilers, complete with superheaters, economizers, air heaters and internal desuperheaters are provided. These are bent tube units with single uptakes and single furnace. Each unit produces 465lb. per sq. in. gauge, 750 deg. F. steam. Total evaporation is 36,000lb. per hr. normal and 54,000 on overload. Feed to the economizers is 275 deg. F. (normal). Boiler efficiency (normal) is 87·5 per cent. The rear and side walls and roofs are water cooled. Superheaters are of the multi-pass convection type, arranged for walk-in access. The desuperheaters are the submerged-tube type capable of desuperheating 20,000lb. of steam per hr. Air heaters are of the horizontal two-pass, tubular type. These operate on 63lb. per sq. in. gauge steam. The high pressure superheated steam system, in addition to serving the main propulsion turbines, supplies the turbogenerators and clean ballast pump turbines. An auxiliary steam line from each of the desuperheaters supplies the various auxiliaries. This serves the main feed pump turbines, port feed pump, contaminated evaporator and sootblowers. Pressure reducing valves (415 to 275lb. per sq. in. gauge and 415 to 150lb. per sq. in. gauge) also are served. The clean ballast system is one of the most interesting aspects of this ship. Its ballast system lowers the ship to receive or discharge its craft. The system permits ballasting from a 23-ft., 4-in. even keel draught, to 31-ft. 4-in. draught in less than 30 minutes. Deballasting back to the 23-ft. 4-in. draught is accomplished in 40 to 50



Profile of the USNS Point Barrow

minutes. Ballast tanks are arranged fore and aft. Four clean ballast pumps, each of 6,000-g.p.m. capacity, are provided. These are vertical, single-stage centrifugals with geared turbine drive. These four turbines are served by two individual condensers and associated air ejectors, circulating and condensate pumps, etc. The following operations can be performed by the versatile system: 1. Both the upper and lower tanks can be ballasted by pump discharges. 2. Upper tanks, forward and aft, can be ballasted by one pump, while another pump ballasts the lower tanks. 3. The lower tanks can be ballasted by the pumps while the tanks above the third deck are drained directly overboard by gravity. Similarly, the lower tanks can be filled by gravity. There are several other combinations possible due to the great degree of cross connexions between the individual pumps and the tanks.—*Marine Engineering/Log, August 1958; Vol. 43, pp. 49-56.*

Flow Meter

One of the newer types of flow measuring elements is the target meter, consisting of a supported obstruction directly in the flow path. In one version, the instrument consists of a round, flat disc suspended in the centre of the pipe in which the fluid is flowing. The disc is attached by means of a stiff rod through a nozzle in the pipe to the diaphragm mechanism of a modified force transmitter. As the flowing fluid impinges upon the flat disc, an impact force is produced which, when transmitted through the rod to the transmitter, produces a signal related to flow. In a sense this device is the physical opposite of an orifice installation, the flow path being located in the annular space between the pipe wall and the obstructing disc. A second version utilizes the same principle as a variable area meter. In this device the obstruction moves within the boundary of a tapered insert, and is effectively a variable area meter on its side. In place of the float weight in a variable area meter, a constant restraining force is provided. The obstruction is then directly proportional to the rate of flow. A third target meter senses the rate of fluid flow as a function of the dynamic forces of fluid friction acting upon a streamlined obstruction. This "drag" force is converted to an electrical signal proportional to the flow area. These devices are generally compact, easily installed, can handle a variety of materials, and are relatively inexpensive. However, they required measuring systems close coupled to the flowing line and are thus subject to temperature limitations and physical disturbance from the piping system.—*J. J. Combes and M. J. De Pasquale, Bureau of Ships Journal, July 1958; Vol. 7, pp. 9-18.*

Sulphuric Acid Corrosion in Oil Fired Boilers

Experimental studies on economizer and air heater corrosion resulting from the formation of sulphuric acid in residual oil fired boilers are described. Factors controlling the oxidation of sulphur dioxide to sulphur trioxide have been investigated in small experimental boilers. The fuel used was distillate oil to which synthetic compounds were added to simulate the sulphur and metallic components commonly found in residual oils. The sulphur trioxide content of the flue gases was determined indirectly by measuring the corrosion of, and sulphate deposition on, a steel specimen maintained at a controlled temperature. In an initially clean boiler, approximately equal quantities of sulphur trioxide formed in the flame, furnace and convection sections, while less formed in the economizer-air heater section. Nickel, iron, sodium and vanadium in the fuel each decreased the corrosion normally experienced by the test specimen, the magnitude of the effect increasing in the order given. Deposits of these metallic fuel ash components in the boiler had a relatively small effect on the corrosion of the test specimen. Only the iron deposits indicated significant catalytic activity for the oxidation of sulphur dioxide to sulphur trioxide. Combinations of sodium and vanadium in the fuel were found to decrease corrosion in an initially clean furnace, but boiler deposits from certain combinations of these elements were found to increase corrosion substantially. This catalytic effect is predominant over extended periods of time.—*D. R. Anderson and F. P. Manlik, Trans.A.S.M.E., August 1958; Vol. 80, pp. 1231-1238.*

German-built Cargo Vessel

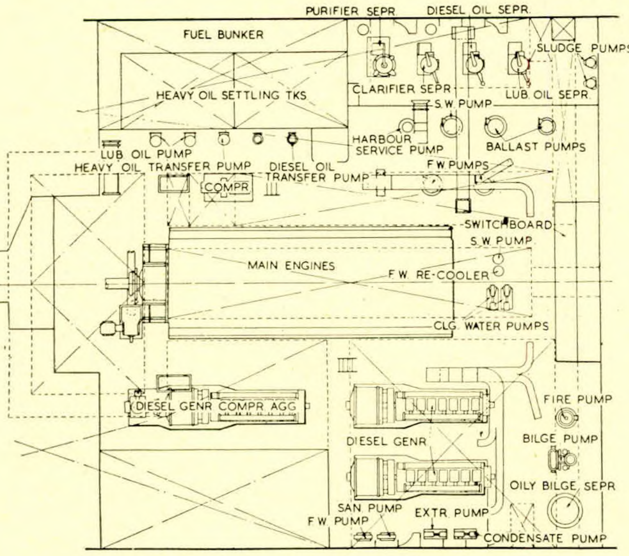
In design, construction and general arrangement the motor ship *Henri G*, recently completed by Rheinstahl Nordseewerke G.m.b.H., Emden, is a good example of a modern general cargo carrier. The registered owners are the Compagnie des Enterprises Maritimes (C.E.M.) S.A., Geneva, Switzerland. The main particulars of the new ship are as follows:

Length, overall	502ft. 4⅞in.
Length, b.p. (closed shelter-decker)	466ft. 3¾in.
Breadth, moulded	62ft. 0⅛in.
Depth to second deck ...	30ft. 3⅜in.
Depth to upper deck ...	39ft. 3¼in.
Draught as open shelterdecker	26ft. 3in.
Draught as closed shelter-decker	29ft. 8in.
Deadweight, closed	13,200 tons
Deadweight, open	10,800 tons
Machinery	6,850 b.h.p.
Speed (open)	15·75 knots
Speed (closed)	16 knots

A full scantling vessel, the *Henri G* is of the open or closed shelterdeck type with a raking stem, long forecastle, sunk poop and cruiser stern. With the exception of the seams of the bilge strake, the seam below the second-deck stringer angle, and the frames in the fore and aft peaks, which are riveted, the vessel's seams as well as the butts are welded. A covering of Oregon pine, 63 mm. thick, is laid on the weather deck, the boat and bridge decks, Form-flex white caulking being used. In the accommodation and passageways Vinyl is laid on Semtex. All the necessary fittings are installed for the carriage of grain and the vessel can load ore cargoes down to her marks. There are five holds served by the following derricks:—

Position	*No. and capacity*	*Hatches served*
At the foremast ...	2-5 tons	No. 1
At the foremast ...	2-5 tons	No. 2
At the foremast ...	1-30 tons	No. 2
Derrick post between hold Nos. 2 and 3	2-5 tons	No. 2
	2-10 tons	No. 3
Derrick post forward of amidships ...	2-10 tons	No. 3
At the mainmast ...	2-5 tons	No. 4
	2-5 tons	No. 5
	1-15 tons	No. 4

Both masts are of substantial construction and are unstayed, and by placing eight of the 14 winches on platforms the clear deck space is further increased. All the winches, which are of Nordseewerke manufacture, have long drums and topping winches. Each winch is driven by a Siemens-Schuckert three-speed, squirrel cage a.c. motor, the necessary contactors and pole changing equipment being arranged in the mast houses and at the after end of the long forecastle. The windlass and mooring winch are also a.c. operated. Pedestal controls for the winches are so positioned that one man may operate two units, care having been taken to ensure that the operator has a clear view into each hold. If required, timber deck cargo may be carried, the necessary equipment being available. Special attention is given to the arrangements for grain cargoes. For propelling purposes, the *Henri G* is fitted with a six-cylinder, two-stroke, turbocharged, M.A.N. Diesel engine having cylinders 780 mm. in diameter and a piston stroke of 1,400 mm. The service power at 115 r.p.m. is 6,750 b.h.p. and the engine is directly coupled to a four-bladed Zeise propeller made of Alcunic. Operation of the two Brown Boveri type, VTR 630, exhaust gas turbochargers is on the impulse system. The gases from the engine cylinders are led through short pipes to the turbines and the turbochargers supply air through sea-water coolers to the main scavenge air pipe. Only two main



Engine room plan of the Henri G

pistons are arranged to operate as scavenge pumps, the underside of pistons Nos. 3 and 6 being so used, the delivered air passing through coolers before entering the main scavenge pipe. For emergency purposes there is an electrically driven centrifugal blower using 7 h.p. per 1,000 b.h.p. of the main engine. The propelling machinery is designed to operate on boiler oil having a viscosity of 3,500 seconds Redwood No. I, and the guaranteed fuel consumption in this grade having a heating value of 10,000 k.cal. is 157 gm. per b.h.p. hr., the m.i.p. being 7·5 kg. per $cm.^2$. The exhaust from the main engine passes through a La Mont exhaust gas boiler with a heating surface of 145 $m.^2$. When the engine is developing 6,758 b.h.p. and delivering 47,200 kg. per hr. of gas at 320 deg. C. through the boiler, the output is 1,800 kg. per hr. of steam at 8 kg. per $cm.^2$. There is also a La Mont oil fired tubular boiler with a steam output of 2·5 tons per hr. and provided with Saacke fully automatic control consisting of one large and one small oil burner.—*The Motor Ship, October 1958; Vol. 39, pp. 318-322.*

German-built Motor Trawler for Iceland

The motor trawler *Gerpir* is the first fishing vessel for Iceland built in Germany after the war. The design of the propelling machinery was based on the experience gathered with similar vessels built in Great Britain for Icelandic owners and which appear to have given very satisfactory results in service. It was, therefore, decided to install a very powerful main engine which would meet all the specific requirements involved, i.e. supply of propelling power in free running and trawling, net winch drive through a Ward Leonard generator and, as far as possible, power supply to the ship's electrical system. The latter function is performed by the Ward Leonard generator and additional power from an auxiliary Diesel generating set is required only while the net winch is in operation. Attached to the main engine at the flywheel end, is a Voith turbocoupling and a reverse gear which transmits the power direct to the propeller through the shafting. The opposite end of the crankshaft drives a 240-kW Ward Leonard generator through a combination unit consisting of a Vulcan flexible coupling and a disengageable Lohmann clutch. With this arrangement the operating characteristics of the fixed pitch propeller can be exploited in manœuvring, free running and trawling, change of direction being effected through the reverse gear. Speed control is obtained by changing the rotational speed of the engine through the governor. However, if the engine speed is to be kept constant, as in trawling when the net winch is in operation and a steady supply of current from the generator is required, the variation in propeller speed is accomplished by "slipping", i.e., bleeding of the Voith turbocoupling. If necessary, all the fluid can be drained from the coupling. This will disconnect the main engine from the gear unit and propeller. "Slipping" is effected through a discharge pipe provided in the coupling. The Voith turbocoupling also acts as a flexible link between the engine and gear unit and protects the latter against impact stresses. Fig. 5 shows the arrangement of the gear unit and propeller shaft at one end of the main engine and the Ward Leonard generator at the other. The main engine is a four-stroke seven-cylinder trunk piston engine of the G7 V40/60 type equipped with a Büchi supercharger. The main data are:

Maximum power output: 1,470 h.p. at 275 r.p.m. (this speed is reduced to 115 r.p.m. at the propeller).

Bore	400 mm. (15¾in.)
Stroke	600 mm. (23⅝in.)
Mean effective pressure	9·1 kg/cm^2 (130lb. per sq. in.)

The reverse gear is a hydraulically operated unit of the SWV 40/71 SO type which includes the propeller thrust bearing. A second oil pump supplying the gear unit was attached to the main engine as the owners did not want to have a separate electrically driven pump installed. All other auxiliaries required for operation of the main engine, such as the fresh water

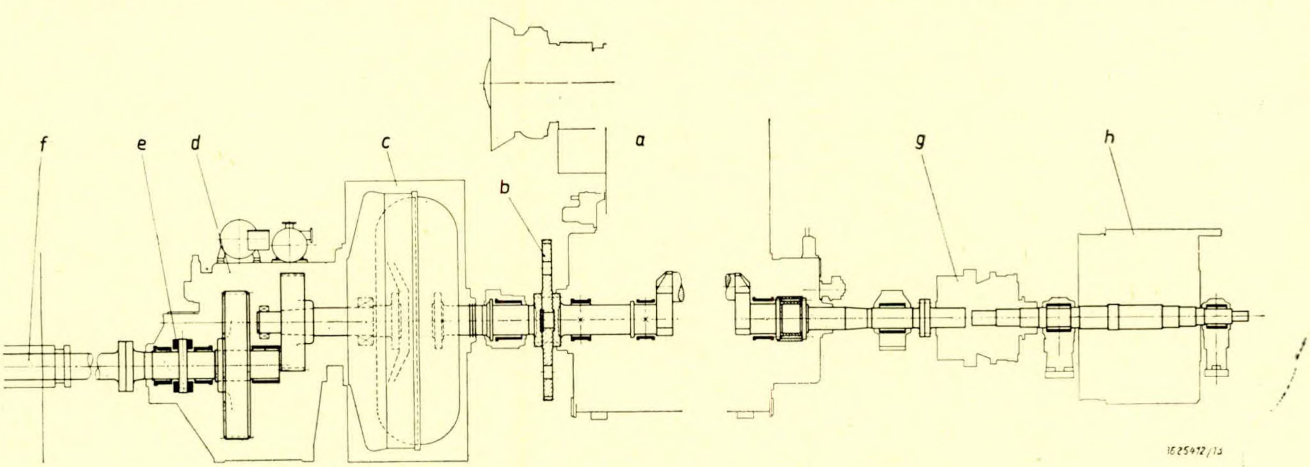


FIG. 5—*Single engine propulsion plant for trawlers*

a) Engine; b) Engine turning gear; c) Fluid coupling; d) Reduction gear; e) Thrust bearing; f) Propeller shaft; g) Coupling/clutch unit; h) Net winch generator pump, sea water pump, etc., are electrically driven, power being supplied by two 80-kW generating sets and one 30-kW set for use while the ship is in port. All of them are equipped with fresh water recoolers and the necessary pumps to render them independent of the main engine. Comparatively small air compressors are required because the reverse gear eliminates the need for frequent starting of the engine in manœuvring. For the same reason, starting air reservoirs of limited capacity are sufficient. In order to make the main engine self-contained with respect to lubrication, it has been provided with a simple oil pump, as usual with engines in this power bracket. The pump draws oil from the service tank below the engine and forces it to the moving parts through a dual oil filter located outside the engine and an oil cooler. The oil collecting in the engine sump flows back to the tank by gravity, outlets of adequate size being provided at both ends of the sump to ensure that it is returned to the tank regardless of the motion of the ship. The oil tank holds 2,000 litres (435 Imp.gal.). In case of failure of the aforementioned pump an electrically driven standby pump of the same capacity can be resorted to. Also, there is an electrically driven standby pump to supply the gear unit in an emergency. The Voith turbocouplings are supplied with oil by two electrically driven pumps of which one is a standby. The shipyard installed a shunt-connected lubricating oil separator for continuous purification of the oil in the circuit. An electrically driven cooling water pump keeps the engine cooling jackets supplied with fresh water. The hot water leaving the engine at a maximum temperature of 65 deg. C. (150 deg. F.) returns to the pump which forces it back to the engine through a fresh water cooler. A compensating tank communicating with the suction pipe of the pump makes up for leakage and evaporation losses. This tank is arranged just above the engine to ensure that the cooling system is filled with water up to the highest point while the engine is out of operation. The fresh water in the circuit is recooled with sea water. The water drawn by the sea water pump, having passed through a filter, is forced through the oil cooler and fresh water cooler, these two units being connected in series, and ejected overboard. A standby unit of equal capacity can replace any of these two pumps, the circuit being arranged so that it can be used either as a sea water or fresh water pump.—*J. Dunst, MAN Diesel Engine News, 1958; No. 35, pp. 6-9.*

French Cargo Ship for South Pacific Trade

A cargo ship of unusual but attractive appearance has been delivered to the Compagnie Générale Transatlantique, for service in the South Pacific. This vessel, the *Magellan,* 9,840 tons d.w., it the first of four cargo vessels ordered from the Chantiers et Ateliers de Provence, Port-de-Bouc. She is also the first vessel to be powered by a turbocharged Doxford type Diesel engine working without scavenge pumps. This is the third turbocharged Provence-Doxford engine to be built. The *Magellan* is a development of the *Equateur* type of ship built for the C.G.T. in 1951, but has her machinery further aft and bridge amidships. Three sister ships, the *Maryland, Michigan* and *Mississippi,* also under construction at the Port-de-Bouc shipyard, will be operating in the North Pacific trade when they are completed: the *Maryland* is due for delivery in November. All four vessels have been designed to carry twelve passengers. The principal particulars of the *Magellan* are as follows:

Length, o.a.	499ft. 0in.
Length, b.p.	457ft. 8in.
Breadth, moulded	61ft. 8in.
Depth to upper deck	39ft. 0in.
Draught	26ft. 11in.
Deadweight	9,840 tons
Service speed	16 knots

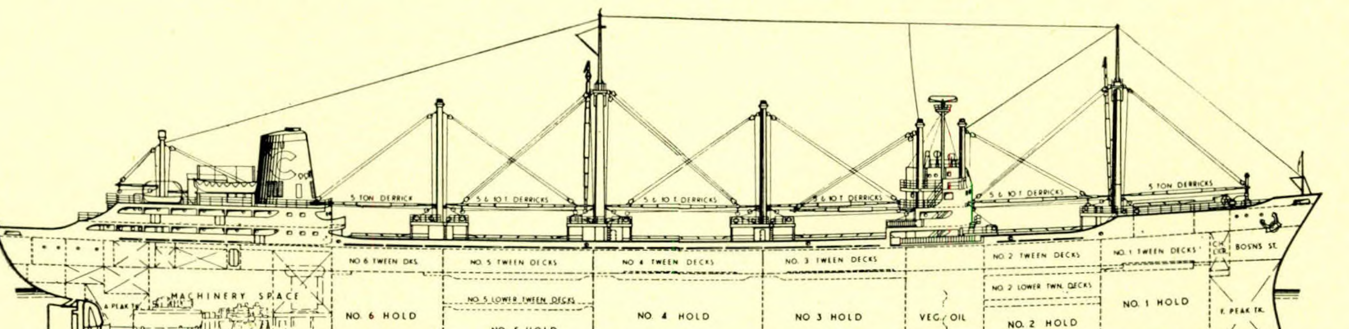
The main engine of the *Magellan* is a six-cylinder type 65 LBD6-S Provence-Doxford turbocharged Diesel engine having an output of 9,000 h.p. at 120 r.p.m., capable of giving her a speed of over 17 knots. The engine has been designed to run on heavy fuel. Being turbocharged it takes up less space in the engine room, and has a good fuel consumption and low operating costs. The turbochargers for this engine are of the Brown Boveri type and the engines have operated so satisfactorily in two previous ships that it has been found possible to disconnect the scavenge pumps. An electrically driven blower has been supplied for use when the vessel is manœuvring or running at very low speeds. This is the third Provence-Doxford turbocharged engine to be built at the Marseilles works of Chantiers et Ateliers de Provence and so far as is known is the first Doxford type engine to be run in service without the scavenge pumps.—*The Shipping World, 8th October 1958; Vol. 139, pp. 316-317.*

Cargo Motorship for Tonga Archipelago

The cargo motorship *Aoniu,* constructed by Gebr. Niestern N.V. Scheepswerven, Delfzijl, for the Tonga Copra Board, has been handed over to her owners. The *Aoniu* is intended primarily for the promotion and extension of inter-insular traffic in the Tonga Archipelago and for the maintenance of communications with other island groups such as the Fiji Islands, New Zealand, etc. The leading particulars of the ship are as follows:

Length, overall	176ft. 11$\frac{5}{8}$in.
Length, b.p.	160ft. 10$\frac{1}{4}$in.
Breadth, moulded	27ft. 7in.
Draught at summer freeboard	10ft. 4$\frac{1}{2}$in.
Deadweight	550 metric tons
Gross tonnage	514·42 R.T.
Net tonnage	269·87 R.T.
Fuel capacity	75·18 cu.m.

Since the ship is intended for interinsular service in a part of the ocean the cartography of which is still sketchy, but in which submerged rocks are known to abound, highly specialized echo-sounding equipment had to be used instead of the instruments normally employed. The type of equipment selected for this purpose is the ELAC Lodar which has as its principal feature that both vertical and horizontal soundings can be



General arrangement of the cargo vessel Magellan taken. The horizontal range extends over a distance of 3,000 metres through a sector of 150 degrees so that an area around the ship of some 3,000 million cu.m. of water can be scanned within the span of only five minutes operation. This means that submerged objects can be located even in dense fog at a distance of at least 3,000 metres. The transducer (projector) is connected to the hoist/sweep gear, and the unit is operated electrically. In the wheelhouse are installed: 1. The control panel indicating the angle of the transducer in comparison with the direction of travel of the ship. This panel accommodates the main switch, the voltage regulator and the switches for hand or automatic operation. 2. The ELAC echographs of the Atair type which registrates the echoes received and which builds up a complete and true picture of the sea bottom around the ship within a radius of 3,000 metres (1,700 fathoms). 3. The high performance impulse generator which is placed in the heart of the set, because it not only operates the horizontal, but also the vertical transducer. The main propelling machinery consists of an MWM Diesel engine, type RH 348 supercharged, developing 500 h.p. at 375 r.p.m. The engine is fresh water cooled and drives a four-bladed bronze screw to give the ship a speed of 10·5 knots. Two fresh water cooled, Ruston Diesel engines, type 3YCZ, each of 30 h.p. at 1,250 r.p.m., are placed in the engine room for auxiliary purposes. These engines drive two 12-kW generators. In addition to the main generators, the ship is fitted with a 12-kW shaft generator driven from the main shaft through V-belting and a Conax coupling.—*Holland Shipbuilding, June 1958; Vol. 7, pp. 32-36.*

Shielding Aspects of Nuclear Marine Power Plants

In this paper basic considerations of nuclear reactor shield design are discussed with regard to designing a minimum weight shield for marine applications. The discussion is held on a fundamental level so that the problems, basic limitations, and magnitude of the shielding task can be understood by those not expert in nuclear reactor design. It is pointed out that reactor shields are designed to attenuate neutron and gamma-ray beams which arise due to the fission process and neutron capture. A shield is composed of hydrogenous material for neutron attenuation and heavy, dense material such as lead for gamma attenuation. Minimum shield thickness is determined by the radiation sources in the reactor core. A minimum weight shield can be attained by placing the heavy, dense gamma shielding material at a small radius. The necessity of shielding the coolant piping and equipment in a pressurized water reactor plant produces a large increase in shield weight because one must move the heavy material to a large radius where it can shield both reactor core and equipment. A rough shielding analysis of a 20,000-s.h.p. pressurized water plant is performed in order to illustrate these points quantitatively. Reactor shields are bulky and heavy. Although actual shields cannot be analysed exactly, the fundamental processes involved in neutron and gamma attenuation within a shield are well understood. One should not expect a fundamental "breakthrough" which will significantly reduce shield weights. Factors which may permit reductions in shield weight are discussed. It is concluded that major reductions in the weight of shields for pressurized water plants will be difficult to attain. An area where significant reduction in shield weight might be attained is the reduction or elimination of equipment shielding. One suggested approach is the incorporation of the equipment within the primary reactor shield, although this leads to development and accessibility problems. Another approach is the use of reactor types other than the pressurized water reactor. A number of possible types have been suggested. Some of these, such as the boiling water and the organic moderated reactor, have been proposed for commercial maritime applications. None of them has been proven for marine application and all involve questions of applicability and/or require considerable development effort. However, the use of new reactor types may be the only way to reduce shielding weights significantly.—*Paper by H. E. Vann, M. L. Weiss, and B. Wolfe, read at the Annual Meeting of the Society of Naval Architects and Marine Engineers, New York, 13th-14th November 1958.*

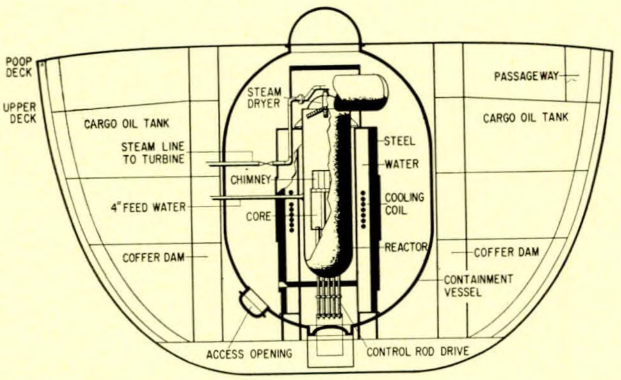


FIG. 5—*Typical arrangement of boiling water reactor machinery in containment vessel*

Design Criteria of U.S. Naval Ship Electrical Systems

Reliability and continuity of service are the keywords in U.S. Naval ship electrical system design. First the number, size, voltage, and frequency of the ship service and emergency generators are selected on the basis of an electrical load analysis. The ship service, emergency, casualty, and any special power distribution systems are then designed to provide this reliability by supplying three sources of power to vital loads. Special distribution systems with voltage and frequency regulation of plus or minus ½ per cent are often required for guided missile ships. These loads are fed by a motor-generator set with either a magnetic particle, hysteresis or eddy current type clutch between the motor and the generator for frequency regulation. Close voltage regulation is obtained by employing a combined static exciter and voltage regulator. Increased use of 400-cycle power is anticipated as the number and size of shipboard electrical loads steadily grow. Single-phase transformers are used on Navy ships, connected delta-delta in three-phase banks. If one transformer is lost, the remaining two can operate open delta at 58 per cent of the three-phase rating. The fused circuit breaker represents a new development in the moulded case breaker. It has a maximum interrupting rating of 100,000 amperes and yet is the same size as the standard AQB circuit breaker. It is used for system back-up protection. Navy electric cable is designed to withstand excessive temperature, moisture and mechanical abuse. The rectifier is replacing the motor-generator set for direct current power supply; it provides higher efficiency, weight and space savings and greater dependability since it is a static device. Electric propulsion of Navy ships has been replaced by the geared drive except for certain types of ships such as tugs and icebreakers. Direct current power provides greater flexibility of control for propulsion than alternating current power. Navy ships have more stringent electrical system requirements than do commercial ships. Continuity of service is emphasized by a more flexible distribution system. Electrical equipment on Navy ships must withstand higher shock and vibration. Future electrical equipment for the Navy will have fewer moving parts. Present designs must attempt to anticipate electrical system and equipment developments of the future.—*Paper by R. A. Brand, T. E. Broderick, and J. J. Moyer, read at the Annual Meeting of the Society of Naval Architects and Marine Engineers, New York, 13th-14th November 1958.*

Strength of Aluminium at Elevated Temperatures

The materials examined were a 99·5 per cent aluminium, the 2¼ per cent magnesium alloy to B.S. 1476:1955 NE4, the 3½ per cent magnesium alloy to B.S. 1476:1955 NE5, a 1¼ per cent manganese alloy and the magnesium-silicide alloy to B.S. 1476:1955 HE30, all being in the form of extruded rod.

Excepting for the HE30 alloy, which was fully heat treated, all tests were carried out with the material in the as-extruded condition. Short time data covers a temperature range of 20 deg.-250 deg. C., the stress-rupture curves, which mostly extend up to 10,000 h, relating to temperatures of 100 deg., 150 deg., 200 deg., and 250 deg. C. Creep tests, a number of which were taken into the tertiary stage, have been carried out at 200 deg. and 300 deg. C. for the 1¼ per cent manganese alloy, and temperatures employed for the HE30 alloy were 100 deg., 150 deg., and 200 deg. C. Stress rupture tests still in progress and creep data for the remaining three materials will be reported in an addendum. Stress temperature curves are plotted which enable a direct comparison to be made of the effect of temperature on rupture strength for specified amounts of time. The paper concludes with a fairly detailed report of the effect of time, stress, and temperature on the micro-structure and discusses the types of fracture encountered.—*Paper by N. P. Inglis and E. C. Larke, submitted to the Institution of Mechanical Engineers for written discussion, 1958.*

Hong Kong-built Motor Cargo Vessel

Specially designed for the fruit carrying trade, the m.s. *Tarawera* has recently entered the service of the Union Steam Ship Co. of New Zealand, Ltd., the vessel's refrigerated spaces extending to all decks except one upper 'tweendeck space. The builders are the Taikoo Dockyard and Engineering Company of Hong Kong, and the principal particulars are:—

Length, overall	292ft. 3¼in.
Length, b.p.	270ft. 0in.
Breadth, moulded	46ft. 0in.
Depth, moulded	25ft. 6in.
Draught loaded	16ft. 4¾in.
Deadweight	1,825 tons
Machinery	2,400 b.h.p.
Speed, loaded trials	13·5 knots

With the exception of one riveted seam at the upper turn of the bilge the ship's hull is welded throughout. Combined longitudinal and transverse framing is used in the double bottom for about half the amidships' length. The five holds, having a total bale capacity of 92,400 cu. ft., are served by eight 3-ton derricks and two 10-ton derricks operated by Clarke Chapman electric winches. The propulsion unit is an eight-cylinder, two-stroke, trunk-piston Sulzer Diesel engine built at Winterthur. The cylinders have a diameter of 480 mm. and the piston stroke is 700 mm.; when operating at 225 r.p.m. the engine develops 2,400 b.h.p. A right-handed bronze propeller of Stone's Heliston design is fitted. Electrical requirements are met by four six-cylinder Ruston Mark 6 VEB2 engines, each coupled to a 225-kW., 220-volt, 500 r.p.m. d.c. generator. The main refrigerating machinery comprises three twin-cylinder Hall compressors using Arcton gas. There are thirteen cross-grid air coolers, supplied with cooled brine, the coolers being located in the lower holds, 'tweendecks, and deep-freeze deckhouses. All holds and 'tweendeck spaces can be maintained at a minimum temperature of +10 deg. F. and the two deep-freeze compartments at −5 deg. F. in tropical conditions.—*The Motor Ship, November 1958; Vol. 39, p. 381.*

Sugar Carrier

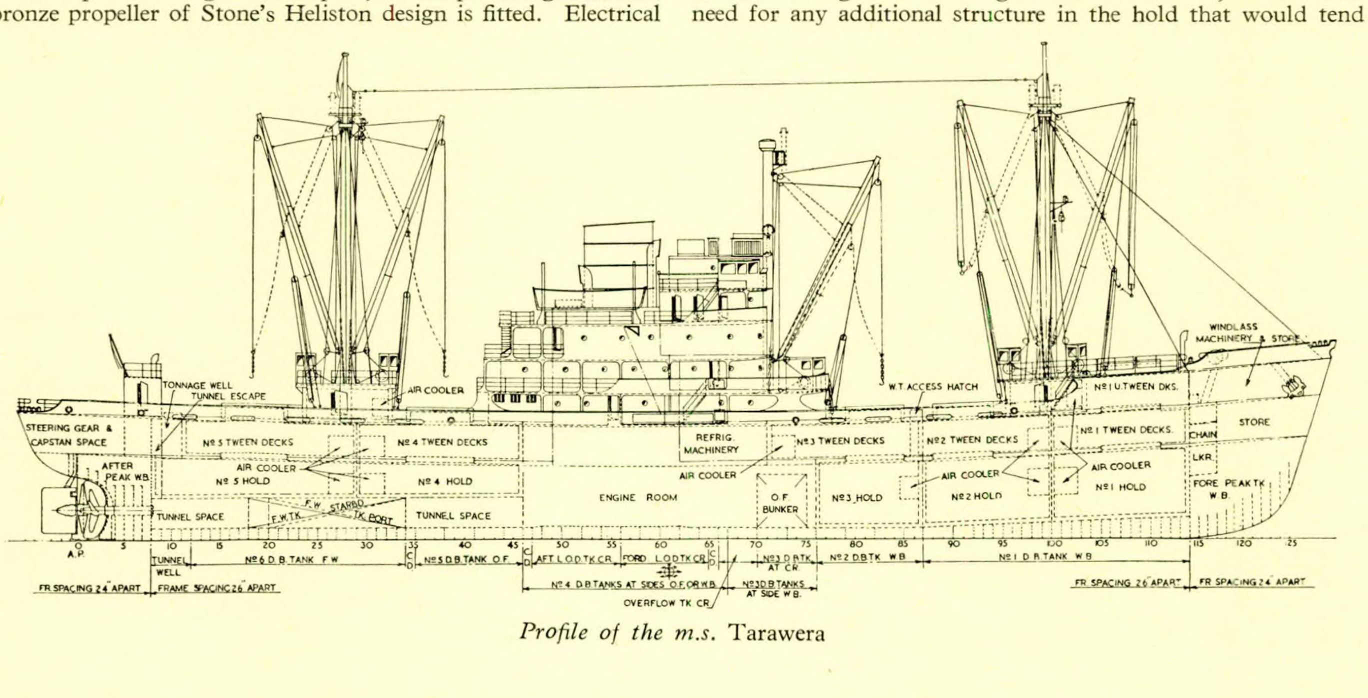
The first of four sugar carriers to be built at the Atlantic Shipbuilding Company's yard to the order of the Banco Cubano del Commercio Exterior, from designs of Sir Joseph W. Isherwood and Co., Ltd., has been completed. The vessel, named *Pinar del Rio* has the highest powered Ruston-Paxman propelling installation yet made. The ship's leading particulars are:—

Length, b.p.	310ft. 0in.
Breadth, moulded	45ft. 0in.
Depth, moulded	27ft. 6in.
Speed on trials (ballast) ...	15·08 knots
Machinery	3,320 s.h.p.

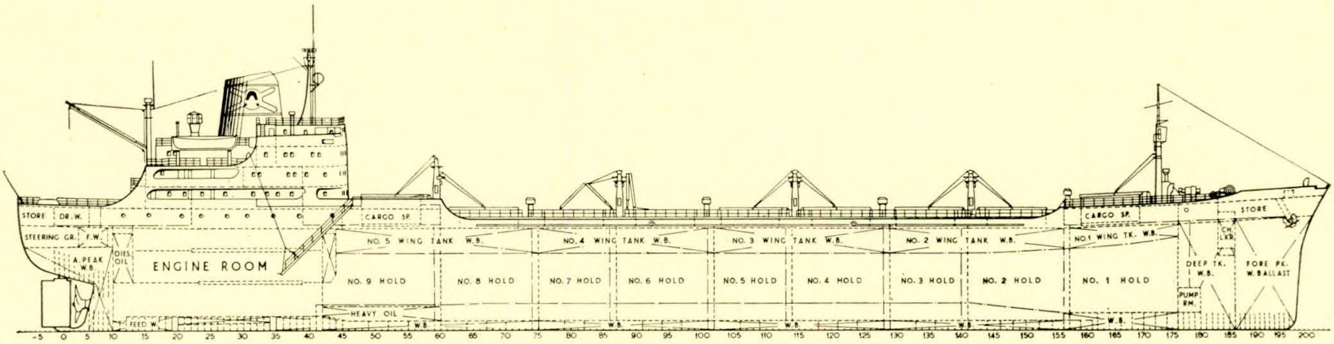
The *Pinar del Rio,* the largest ship built by the Atlantic Shipbuilding Co., is a shelterdecker with three main cargo holds and three 'tweendeck cargo spaces. The deck machinery is electrically operated, the capstan, windlass, winches and steering gear being of the Thrige type. Mechanical ventilation is provided in the holds and engine room by Norris Warming plant and there is Pyrene CO_2 fire extinguishing equipment in these compartments. The two sixteen-cylinder pressure charged Ruston-Paxman Diesel engines running at 750 r.p.m. drive a single screw through a 3 : 1 Renk oil operated reverse reduction gear, the power at the shaft being 3,320 s.h.p. Current is supplied from three Ruston-engined 100-kW dynamos.—*The Motor Ship, November 1958; Vol. 39, p. 371.*

German Bulk Carrier

Two vessels recently under construction at Rheinstahl-Nordseewerke G.m.b.H. Emden, are of an interesting design. These vessels, the *Rheinstahl* and *Ahrenberg,* 16,600 tons d.w., following the modern trend in bulk carriers, have no midship superstructure and are without derricks. The owners of these new ships are Seereederei "Frigga" A.G., Hamburg. The ships have been designed so that the nine holds can be used either for the carriage of coal or grain as well as ore, without the need for any additional structure in the hold that would tend



Profile of the m.s. Tarawera



Profile of the bulk carrier Rheinstahl

to obstruct loading and discharge. The *Rheinstahl,* the first of the ships to be delivered, is powered by an M.A.N. Diesel engine which gives her a loaded speed of 13·8 knots—when light she is capable of nearly 15 knots. The principal particulars of the *Rheinstahl* are as follows: —

Length, o.a.	528ft. 2in.
Length, b.p.	498ft. 8in.
Breadth	66ft. 3in.
Depth to upper deck	41ft. 10in.
Draught...	30ft. 9in.
Deadweight	16,600 tons
Displacement	22,820 tons
Gross tonnage	12,141 tons
Net tonnage	7,170 tons
Speed loaded	13·8 knots
Cargo capacity:	
Grain	790,873 cu. ft.
Bale...	732,744 cu. ft.

The *Rheinstahl* makes use of all her holds when carrying light cargo, but when carrying ore only the odd numbered holds are utilized to begin with. Later, depending on the specific weight of the various types of ore being loaded, the intermediate holds are either filled completely or partially, and the ship is trimmed correctly by the amount of cargo loaded into the end holds, Nos. 1 and 9. This method ensures a relatively high position of the centre of gravity, resulting in roll periods of 10 to 12 seconds. Deep hatch coamings have been provided to add to the longitudinal strength, as longitudinal strength calculations have shown that high stresses occur not so much in the heavy load condition as when the ship is ballasted: the large number of transverse bulkheads which have been fitted also contribute to the transverse strength. A total of about 192,333 cu. ft. of water ballast can be carried in the wing tanks, which are placed high up in the ship's hull and in double bottoms. This large quantity of water ballast improves the vessel's seakindliness. The layout of the tanks in the hull is shown by the accompanying sketch. A novel arrangement is used for guiding the anchor chains, consisting of two special rollers fitted above the hawse pipes. Navigational aids include "True Motion Decca" radar and Anschutz gyro-compass and auto-pilot. The propelling machinery in the *Rheinstahl* consists of a single-acting six-cylinder two-stroke M.A.N. Diesel engine, type K6Z 78/640A, having an output of about 5,400 s.h.p. at 118 r.p.m. The engine has been arranged for burning heavy fuel and the daily fuel consumption is about 20·6 tons per day. It is stated that there is very little vibration. *—The Shipping World, 12th November 1958; Vol. 139, pp. 431-433.*

Ocean Ore Carrier Economics and Preliminary Design

The interest aroused by an earlier paper by the author on tanker economics, plus rapidly developing activities and plans in connexion with the transoceanic shipment of various ores, have led to the engineering economy studies reported here. Recent articles on ore carrier design have not emphasized the economic factors. Thus the present paper is principally concerned with this area of preliminary design. Economy studies are of primary importance in making technical decisions because potential commercial success is the best thing available for a universal measure of engineering success. The paper furnishes a method for blocking out the principal dimensions of the ship and provides a rational economic basis for determining the optimum power and speed. Curves and formulas given in the text allow quick approximations to be made of the sea speed, weight, and construction cost. Families of curves show the economic influence of variations in size and speed. Estimates of annual operating costs and income can be made by methods developed in the study. The merits of various economic criteria are discussed briefly and the decisive influence of intangible factors is emphasized. A typical problem, worked out in detail, illustrates the use of the material presented in the text.*—Paper by H. Benford, read at the Annual Meeting of the Society of Naval Architects and Marine Engineers, New York, 13th-14th November 1958.*

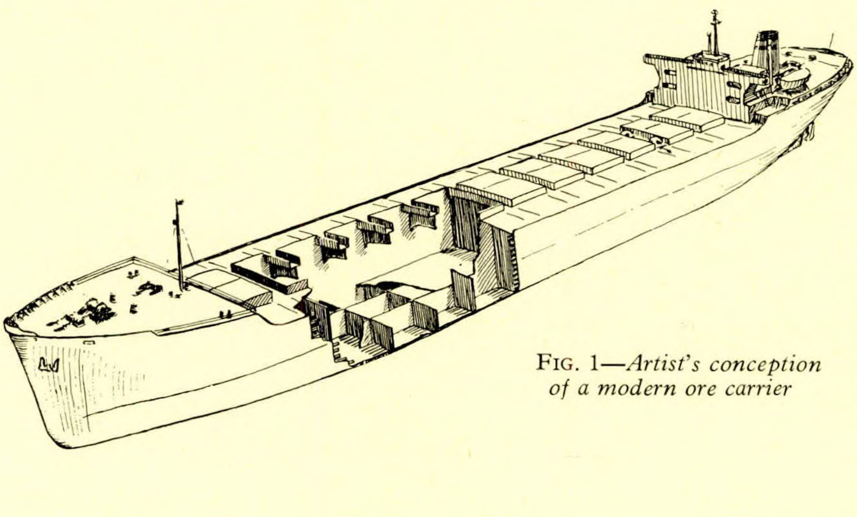


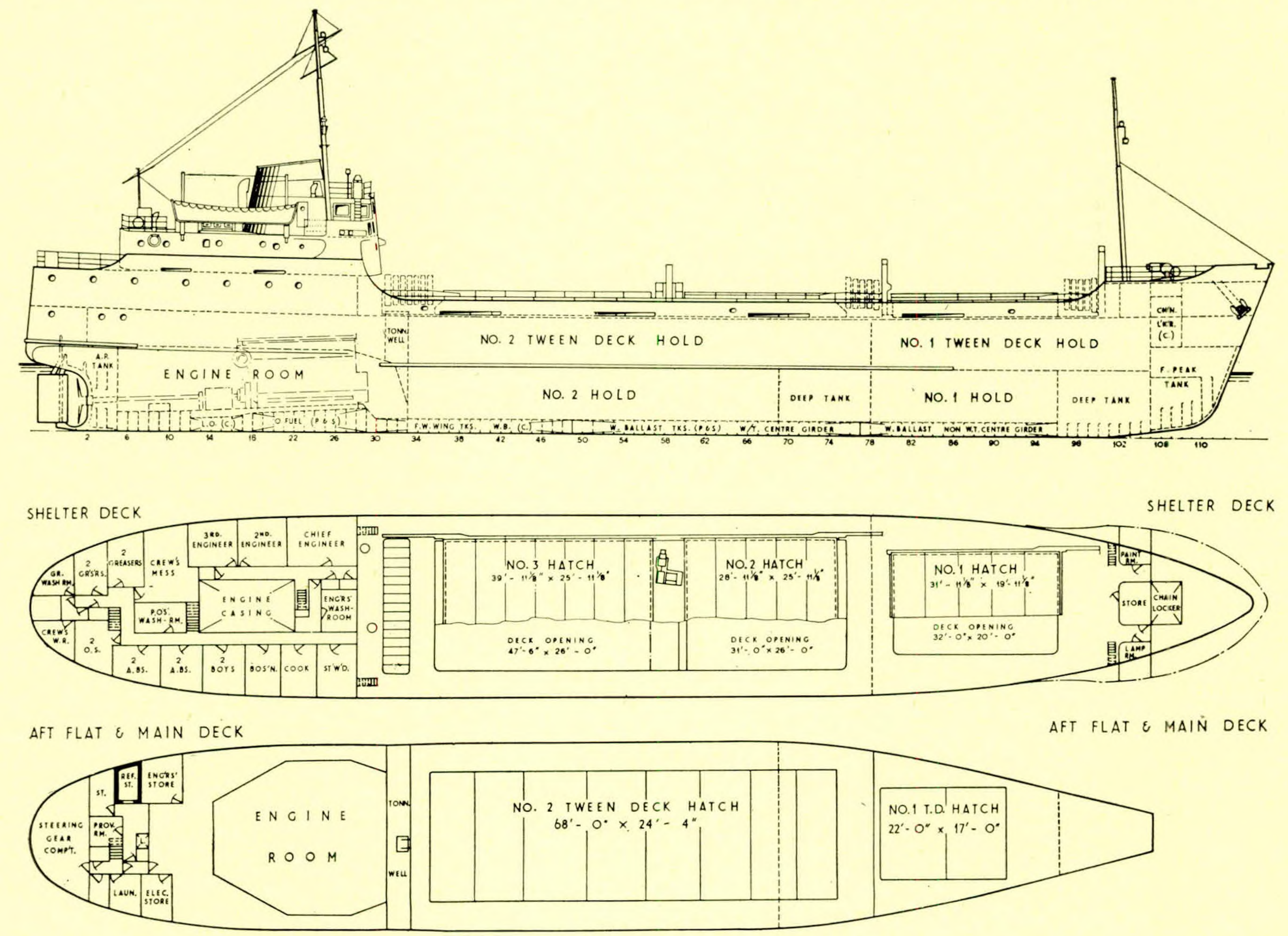
FIG. 1—*Artist's conception of a modern ore carrier*

Studies for 25,000-maximum S.H.P. Steam Power Plant for Single-screw Tanker

During recent years tank vessels have increased in deadweight tonnage and shaft horse power. The question arises: "Is it economically sound to increase the steam conditions of the power plants?" To answer this question a study was made for a specific installation, namely a 25,000-maximum s.h.p. steam power plant in a 46,000-dwt. tanker. Specific steam conditions and cycles were selected to cover a wide range of values, and fuel rates were calculated for these conditions. Economic evaluations were made. Factors such as initial costs, operating costs, and cargo-carrying capacity were included in the studies. The initial cost estimates were prepared for the machinery components that are affected by the variations in steam conditions. The operating costs consisting of the fixed charges and fuel costs were evaluated. Two specific round trip routes of 3,500 and 25,000 miles were chosen and an analysis made of the return on the initial investment for each of the steam conditions selected. The results indicate the following: (1) The optimum steam conditions are 600lb. per sq. in. gauge and 860 deg. F. (2) Additional investment made on using steam conditions of 850lb. per sq. in. gauge and 860 deg. F. can be justified at higher fuel prices. (3) For vessels designed for long hauls the additional investment made on using steam temperature of 950 deg. F. at either 600 or 850lb. per sq. in. gauge pressure may be justified at higher fuel prices. (4) At present it does not appear practicable to use temperatures in excess of 950 deg. F. (5) The cycle with two-stage feed heating, economizer and steam air heater should be used at the 600lb. per sq. in. gauge condition. The cycle with four-stage feed heating and gas air heater would be used with the higher steam pressure of 850lb. per sq. in. gauge at current fuel prices or with the 600lb. per sq. in. gauge at higher fuel prices.—*Paper by H. M. Cheng and C. E. Dart, read at the Annual Meeting of the Society of Naval Architects and Marine Engineers, New York, 13th-14th November 1958.*

Container Ship for British Railways

The first of two rail container vessels ordered from the Goole Shipbuilding and Repairing Co., Ltd., has now entered service. This vessel, the *Isle of Ely,* 935 tons d.w., has been built for the Eastern Region of British Railways for duty between Harwich and Rotterdam and Harwich and Antwerp. She has been specially designed to carry full loads of rail containers or general cargo, or alternatively part loads of each. The hatches on the main deck and on the 'tweendeck are fitted with MacGregor patent steel covers, those on the shelter deck being of the single-pull type. The covers on the main deck hatches are of the latest flush fitting type permitting the use of fork lift trucks. As will be noted from the accompanying drawing, the size of the hatches is such that all containers may be stowed on board either by lowering them directly on the tank top or by "drifting" them under the hatch coaming while still suspended from the crane hook. Although it might appear that it might be a little difficult to stow containers in the wings of the hold, owing to the inevitable overhang of the 'tweendecks, this is not so; and both at Harwich and Rotterdam this operation is carried out most efficiently. The hatch covers are operated by means of a



The container cargo vessel Isle of Ely

5-ton electrically driven winch mounted between Nos. 1 and 2 shelterdeck hatches. The *Isle of Ely* is powered by a turbocharged Ruston and Hornsby Diesel engine of 1,806 b.h.p. The principal particulars of the *Isle of Ely* are as follows: —

Length, o.a.	241ft. 9in.
Length, b.p.	226ft. 0in.
Breadth, moulded	37ft. 0in.
Depth, moulded to main deck	13ft. 3in.
Depth, moulded to shelter deck	23ft. 0in.
Draught	13ft. 1⅞in.
Deadweight	935 tons
Gross tonnage	866·46 tons
Displacement	1,905 tons
Total cargo capacity (bale) ...	89,171 cu. ft.
Total water ballast	514·6 tons
Machinery output	1,806 b.h.p.
Service speed	13½ knots

The *Isle of Ely* is an open shelterdeck vessel with two holds. The most efficient hull form and propeller design were determined after tank tests had been carried out at the National Physical Laboratory, Teddington. So as to allow her to maintain her normal schedule in moderate weather while in ballast, and to provide for variation in loading, a total of about 514 tons of ballast can be carried in tanks shown on the accompanying drawing. The *Isle of Ely* is powered by a type 8VOXM Ruston and Hornsby turbocharged Diesel engine driving a single propeller shaft through a Modern Wheel Drive 2 : 1 oil-operated reverse/reduction gearbox and giving an output of 1,806 s.h.p. which gives her a service speed of 13½ knots.—*The Shipping World, 19th November 1958; Vol. 139, pp. 452-454.*

Pielstick-engined Passenger Vessel with Alternative Speeds

The keel was laid last month at the Forges et Ch. de la Méditerranée, La Seyne, of an unusual passenger vessel being built for the Cie. Générale Transatlantique, to be operated, according to season, either on the Nice-Corsica or the Marseilles-Corsica service. She is a ship of 4,500 gross tons, to be equipped with 8,000 b.h.p. Pielstick machinery and will have a service speed of 18 knots or 14½ knots, according to the requirements, namely, whether on the Nice or Marseilles run. The four 2,000-b.h.p. SEMT-Pielstick engines are coupled to two shafts through an ASEA electro-magnetic clutch, and with two engines in operation the lower speed of 14½ knots will be easily maintained. The length b.p. is 326ft. 5in., the moulded breadth 51ft. 10in. and the maximum draught 15ft. 7in. The deadweight is 1,000 tons and in addition to accommodation for 114 first class, 224 second class and 700 third class passengers, 80 motor cars can be carried, of which 44 will be accommodated in a closed garage. The name of the ship will be *Napoleon.—The Motor Ship, November 1958; Vol. 39, p. 374.*

Deep Diving Equipment

In all deep diving operations where the depth of water involved may be anything up to about 600ft. the difficult task of bringing the diver back to the surface and to normal atmospheric pressure in the shortest time, and with the least amount of discomfort and risk, has long been a serious problem. The best solution evolved so far has been the use of a "Submersible Decompression Chamber," fitted, at top and bottom, with hatches which are both watertight and airtight. This is lowered before the dive commences to a depth calculated to be the most advantageous to the diver when he makes his ascent. The chamber, with an attendant aboard, is lowered with the bottom door open and, therefore, with the internal air pressure equivalent to the depth. Having completed his task and carried out one or two depressurizing stops on the ladder carried by the S.D.C., the diver enters the chamber, the ladder is drawn in, the bottom door is shut, after which he can remove part of his equipment with the assistance of the attendant. The S.D.C. is then hoisted aboard the diving ship and the pressure inside the chamber is "broken-down" in stages, governed by recompression tables, until the "surface" is reached. This process is often lengthy and risky, and, owing to the confined space within the S.D.C., is extremely uncomfortable for both the diver and his attendant. The diver must, therefore, be transferred with the greatest haste to a more roomy recompression chamber when he is recompressed and "brought to the surface" in comparative comfort under medical supervision. Unfortunately, even this slight contact (equivalent to surfacing and re-entry into water at depth) with air at normal atmospheric pressure has often resulted in the diver being subjected to an attack of the "bends". It was to overcome this problem that Saunders-Roe (Anglesey), Limited, working in close co-operation with the British Admiralty, has designed and built a combined unit whereby the diver transfers from the S.D.C. to the main recompression chamber whilst still under pressure. In this method, the S.D.C. is connected directly to the recompression chamber and the diver can climb down the S.D.C. ladder into the main chamber, both chambers being at equal pressure. The whole process from deep water to comparative comfort in the large chamber is therefore greatly shortened and simplified, and is achieved with far less discomfort and considerably greater safety to the diver. Furthermore, on completion of the transfer, the S.D.C. is free for further operations. The main chamber is constructed of welded steel plate and is divided into two compartments. The larger of them is for the divers and their attendants, the smaller one serving as an air lock to enable personnel to enter or leave whilst the chamber is still under pressure. Hot drinks or medical supplies may be handed into the main chamber through a small air lock in the end bulkhead. Viewing ports are let into the shell of the chamber and comprehensive pressure, oxygen and telephone circuits are incorporated. All controls and gauges are mounted on a single control panel. A circular, pressure tight hatch in the roof of the larger chamber connects with the lower door of the S.D.C. when this is clamped into position, the locking being accomplished by specially designed Ivanhoe clamping rings welded to the base of the S.D.C. and the upper surface of the recompression chamber. The S.D.C. is also of welded steel construction and consists of a circular vertical chamber equipped with two glass fibre seats, a retractable ladder and all the necessary pressure, telephone and "mixture" circuits. A viewing port is let into the side of the chamber, and an external stowage for oxygen bottles is provided. Three steel fittings welded to the top of the S.D.C. provide the necessary points of attachment for securing lifting gear.—*Shipbuilding Equipment, November 1958; Vol. 1, p. 17.*

World's Largest Tanker

What will be the world's largest tanker is now in an advanced stage of construction in Kure, Japan, at the shipyard operated by National Bulk Carriers Inc.—an American company known familiarly as "NBC". This vessel, to be called *Universe Apollo,* will have an estimated tonnage of 104,520 tons d.w. The principal particulars of the vessel will be as follows: —

Length, o.a.	949ft. 9in.
Length, b.p.	900ft. 0in.
Breadth	135ft. 0in.
Depth, moulded ...	67ft. 6in.
Draught fully loaded ...	48ft. 0in.
Deadweight	104,520 tons
Estimated cargo capacity	1,021,000 barrels
Main engine	25,000-s.h.p. General Electric double reduction geared turbine
Main boilers	Three Foster Wheeler, 98,000lb. per hr.
Propeller	5-bladed, of manganese bronze, 24ft. 8in. in diameter.
Speed	15·5 knots
Cargo pumps	Four sets, 7,250-g.p.m. capacity

A total of 64 cargo tanks is included in the design of the *Apollo.* They are divided by longitudinal bulkheads into four sections of 16 tanks. Each tank is 67ft. in depth, and in the two middle sections each measures 40ft. long by 40ft. wide. The wing tanks are smaller, measuring 40ft. long by 27ft. 6in. wide. No anti-corrosion equipment is provided for the tanks. A feature of their construction is a series of three horizontal girders, each 6ft. wide and spaced one above the other, which circle the inside of each tank to give added structural strength. Also, extending from stem to stern on each side of the welded hull itself, there are several narrow longitudinal riveted wales. Each of the four cargo pumps is powered by a 1,000-s.h.p. turbine, which is driven by steam from the main boilers. It is estimated that the pumps will be able to discharge a full cargo within thirty hours, a period which would also allow ample time for stripping. The main boilers supply steam for the main feed pumps, generators, forced draught fans and deck machinery, as well as for heating and cleaning the tanks. The problems of mooring such a large vessel have been taken into account by providing two bow and two stern anchors. The bow anchors weigh 18·5 tons and will have 390 fathoms of 3⅞-in. cable. The stern anchors are smaller (15,000 pounds) and are secured with 300 fathoms of 2 9/16-in. cable.—*The Shipping World, October 29th 1958; Vol. 139, pp. 380-381, p. 387.*

15,000-s.h.p. 26,700-ton Soviet Whale Factory Ship

Details are now available of the first large whale factory ship to be built in Russia. She is under construction at the Nikolaiev yard and is named *Sovietskaya Ukraina.* The displacement will be 44,000 tons, the length overall 217·8 m., the breadth 27·8 m. and the loaded draught 10·6 m. She is propelled by two 7,500-b.h.p. Burmeister and Wain six-cylinder turbocharged units running at 115 r.p.m. and the speed will be 16 knots. For the supply of current, four 750-kW Diesel engined generators are installed. The crew and factory workers will total 487 men. A helicopter will be carried on deck. To operate with the factory ship there will be a number of 18-knot whalers constructed, also at Nikolaiev, each 63·6 m. in overall length with a breadth of 9·5 m. and a draught of 4·41 m. Diesel electric machinery of 3,100 b.h.p. is to be installed in each ship and they could operate for 25 days without refuelling. —*The Motor Ship, November 1958; Vol. 39, p. 374.*

Vessels for Servicing Aids to Navigation for U.S. Coast Guard

To provide background material for naval architects and marine engineers, the author has covered over 100 years in the development of vessels servicing aids to navigation. The evolution of buoy tenders from the wooden sailing vessels of the mid-nineteenth century to the modern, safe, and versatile craft of the present day closely parallels the development of aids to navigation for ships and aircraft on the oceans, bays, sounds, rivers, and lakes. Modern buoy tenders are divided into four broad classifications: coastwise or ocean going tenders, bays and sounds tenders, river tenders, and buoy boats, the latter covering boats under 65ft. in length. Each type has its characteristic look and functions, and the development of each classification is presented in detail. Considerable material pertaining to the operating requirements for buoy tenders is presented. For example, such requirements as icebreaking, search and rescue, and logistic support duties have given the hull in each classification a special form. The effect of heavy lifting on stability, the necessity of having working and storage areas on deck, the living and working accommodations required for all-weather operations, as well as the special gear required on all tenders to set and relieve buoys in a positive, safe, and efficient manner, have all had their impact on hull design. Likewise, propelling and auxiliary machinery has had to be designed and developed for these special and versatile ships. As present-day demands for aids to navigation increase, not only as to type but also in numbers, the operating load on each buoy tender has increased many fold. The designs of these vessels are presented not as something final for the future tender, but as thought provoking and challenging to naval architects and marine engineers to produce improvements in these not too highly publicized but very necessary vessels.—*Paper by K. K. Cowart, read at the Annual Meeting of the Society of Naval Architects and Marine Engineers, New York, 13th-14th November 1958.*

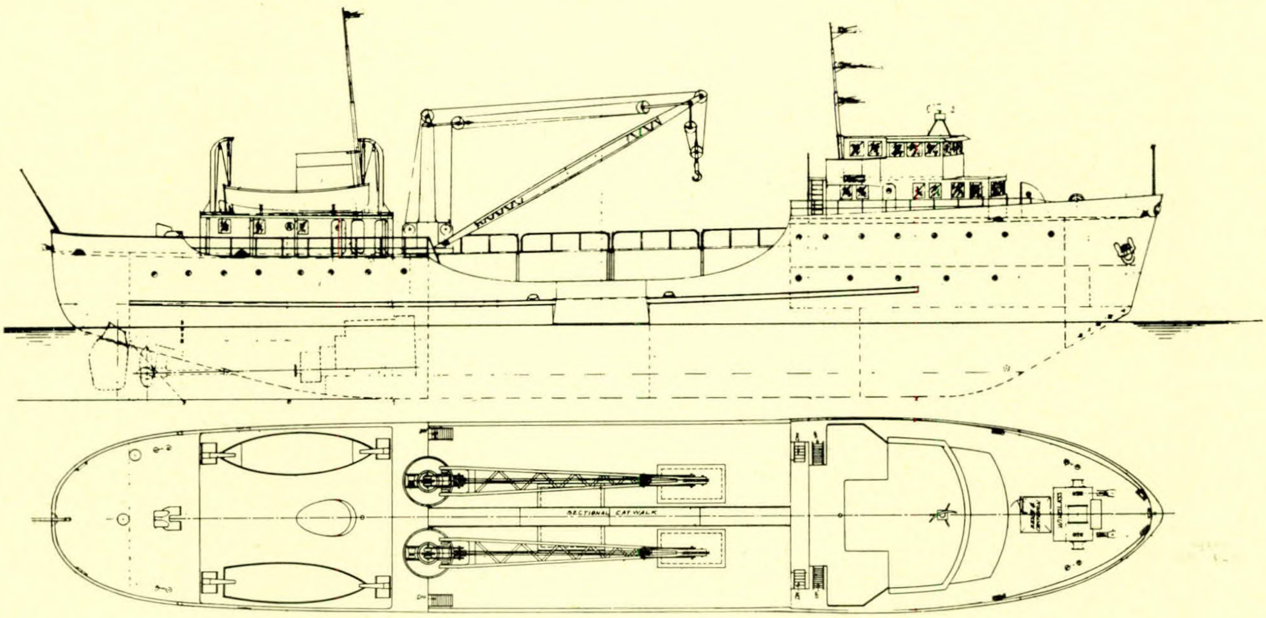


FIG. 39—*Proposed coastwise tender with midship buoy deck*

Pilot Launch

The Corporation of Trinity House has been experimenting with the use of a high speed launch, working from shore, in place of the normal pilot cutter. The experiment has been successful, and it is likely that the practice will be extended. The experimental launch was built by John I. Thornycroft and Sons, Ltd., at the firm's Woolston yard. Named *Leader,* the launch is 70ft. long with a beam of 15ft. and a draught of about 4ft. 6in., and has a speed of 16 knots. It is propelled by two Rolls Royce Diesel engines driving twin screws. The hull is of round bilge form, and is constructed of double skin mahogany planking with oiled fabric between the two skins. The engine room is immediately forward of the wheelhouse with the saloon for pilots aft. The two Rolls Royce engines are eight-cylinder in-line engines of the manufacturers' type C.8.SFLM. They have centrifugal superchargers mechanically driven off the engine. These engines have a designed rating of 366 b.h.p. at 2,100 r.p.m., but in the *Leader* are being operated at 1,700 r.p.m., when each develops 296 b.h.p. They drive through Thornycroft "B" type reverse gears and 2:1 reduction gears. Both engines are left handed, the starboard gearbox reversing this rotation to give outward turning propellers. A version of this engine with exhaust turbocharging is being developed by Rolls Royce at present, and this will have an output of 400 b.h.p. Auxiliary power is supplied by a 1½-kW Lister Diesel generating set in the engine room, with batteries on each side of it. Two fuel tanks, each of 250 gallons capacity, are fitted, one on each side of the boat, and there is a 25-gal. lubricating oil tank forward. Twin rudders are fitted, and the general manœuvrability of the boat is good. The topmast is telescopic.—*The Shipping World, 5th November 1958; Vol. 139, p. 409.*

Analysis of Shipboard Cargo Cranes

This paper describes the experimental installation of cargo handling cranes on the motor vessel *Thomas Nelson,* one of four Liberty ships converted by the Maritime Administration in its programme of upgrading the Reserve Fleet. The characteristics of this ship as converted are as follows: Length overall, 467ft. 3in.; Beam, 57ft. 1½in.; Depth, 37ft. 4in.; Draught, load, 26ft. 5½in.; Deadweight, 8,651 tons. Since this project was considered to be purely experimental in nature, emphasis was placed on covering as much ground as possible on the cranes themselves at the expense of sacrificing something in the overall cargo handling efficiency of the ship. Working with an existing ship also imposed certain restrictions. The principal variables considered were the following: 1) Fixed mounting *versus* movable cranes. 2) Electro-hydraulic *versus* electric control. 3) Long radius *versus* short radius. Early paper studies indicated that movable or positionable cranes possessed distinct advantages over the fixed type owing primarily to their superior degree of utilization and flexibility. Further studies indicated that it would not be necessary to make a choice of items 2) and 3), since it would be possible to include both types in the experiment. The final result of these deliberations resulted in the arrangement shown in Fig. 1. The three forward cranes are of the athwartship positionable type with electro-hydraulic control. The positionable crane has two attributes not possessed by a fixed-mounting type. It can be used equally well for loading either side of the ship, and it requires a shorter working radius for the same outreach. This latter feature becomes of importance for ships of large beam where the required boom length to obtain a satisfactory outreach becomes excessive. The two after cranes are of the fore-and-aft travelling type, designed to be fully mobile under load. These machines are mounted on gantries spanning the hatch openings, giving them free run for the full length of the after deck. The drive and control are entirely electric. To take full advantage of the travelling feature, No. 4 hatch was lengthened to the maximum possible extent. This resulted in an opening 47ft. 6in. in length compared with the original opening of 35ft. The specifications for the cranes, and the technical features of the cranes as finally built are given. A comparison is made of the cost and weight of the cranes with that of the original Liberty cargo gear. The evaluation procedure consisting of controlled loading tests, shipboard reports and in-service tests is described and results presented. Conclusions as to the relative advantages of cranes *versus* conventional gear are given. The application of cranes to new ship designs with considerations of cost, weight, and arrangement is discussed. A suggested method of economic analysis for determining justification for capital investment in cargo gear is presented.—*Paper by F. G. Ebel, read at the Annual Meeting of the Society of Naval Architects and Marine Engineers, New York, 13th-14th November 1958.*

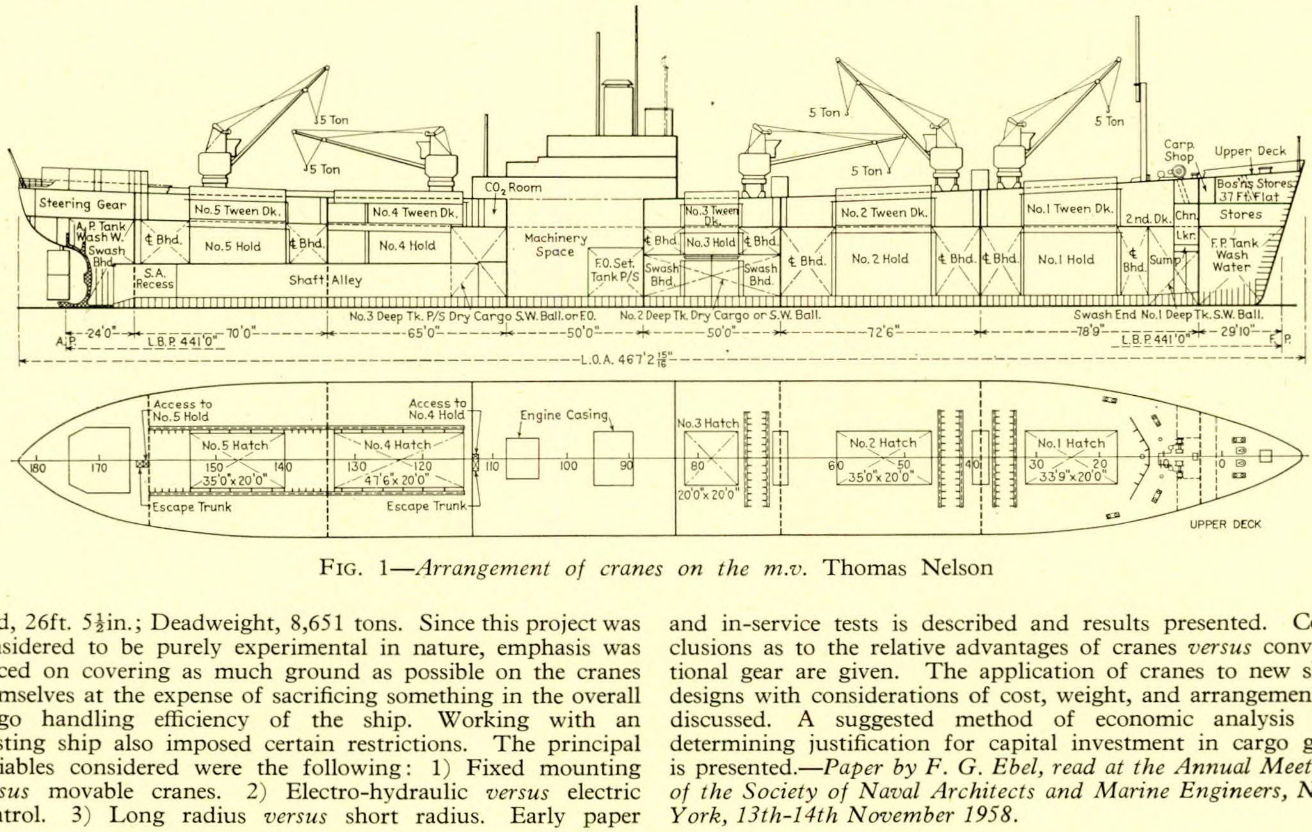


FIG. 1—*Arrangement of cranes on the m.v.* Thomas Nelson

Patent Specifications

Pressure Fired Vapour Generator

The pressure fired boiler shown diagrammatically in Fig. 1 includes a horizontal steam and water drum (13) above an upright cylindrical shell (14) which forms the pressure casing within which is a concentric metal baffle (15) surrounding a combustion chamber (16). The latter has a refractory floor (17) spaced from the lower edge of the baffle (15). A circumferential row (18) of substantially vertical watertubes (19) lines the inner surface of the baffle (15). A second row (20) of watertubes is arranged concentrically within the row (18), the tubes of which row partly accommodate the tubes of the row (20) between them. The tubes (19) are bent towards the axis of the combustion chamber (16) near their top ends, and then out towards an upper circular outlet header (21) into which they are connected. The header (21) is rectangular in transverse cross-section. The lower parts of the tubes (19) are inclined toward the axis of the combustion chamber for a short distance, and then resume their vertical run. The lower ends of the tubes (19) are connected into circular header (22). The lower parts of tubes (19) are spaced apart in order to provide a gas outlet (23) for combustion gases to leave the combustion chamber (16). Three burners (24) at the top of casing (14) fire down into the chamber (16). A second circular baffle (26) is arranged in the casing (14), concentric with the baffle (25) with which it defines an annular gas passage (27). A vertical bank of watertubes (29) is arranged in the passage (27) in circular rows concentric with the baffles (15 and 26). The upper ends of the tubes (29) are connected into the header (21) while the lower parts, at about the level of the lower edge of the baffle (15), are slightly inclined outwards and then resume their vertical run across the gas outlet (23). The lower ends of the tubes (29) are connected into a circular inlet header (30), rectangular in cross section, and concentric with the inlet header (22). The lower parts of the tubes (19 and 29) define between them an annular space (31) which connects the combustion chamber (16) with the annular gas passage (27) in order to provide for the passage of combustion gases. Combustion gases in the passage (27) are discharged from the boiler by a port (32) in the shell (14). In the space (31), which is traversed by combustion gases flowing from the chamber (16) to the gas passage (27), is a superheater (34) which comprises an annular bank of sixteen horizontal layers (not shown) of superheater tubes; each layer consisting of three circular tubes (not shown). Should any superheater tube fail or need attention, the closure plate (60) may be removed, and the entire superheater assembly (34) may be moved downwards out of the boiler casing (14).—*British Patent No. 801,768, issued to Foster Wheeler, Ltd. Complete specification published 24th September 1958. Engineering and Boiler House Review, December 1958; Vol. 73, p. 414.*

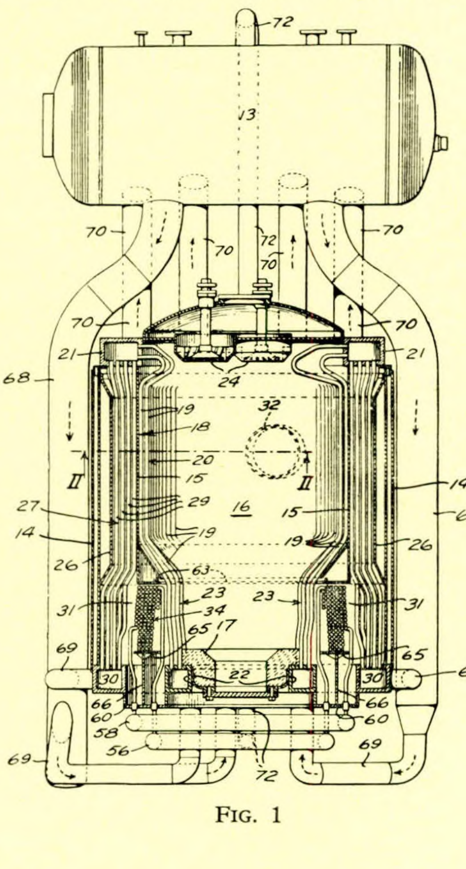


FIG. 1

Supporting Superheater Elements

Fig. 7 shows an outline arrangement of a marine boiler (11) in a setting (12) having a roof (12a) of a combustion chamber (13) lined with boiler tubes (14). A bank of vertical (slightly inclined) boiler screen tubes (21) is arranged on the side of combustion chamber (13) opposite the wall (18) between the front of the setting (12) to the rear wall (15). The tubes (21) are arranged in three parallel rows (22, 23 and 24). The tubes (27) are substantially parallel with the tubes (21) and are connected at their upper ends to the drum (17) and at their lower ends to the water drum (26). Each superheater element (31) comprises a pair of substantially parallel legs

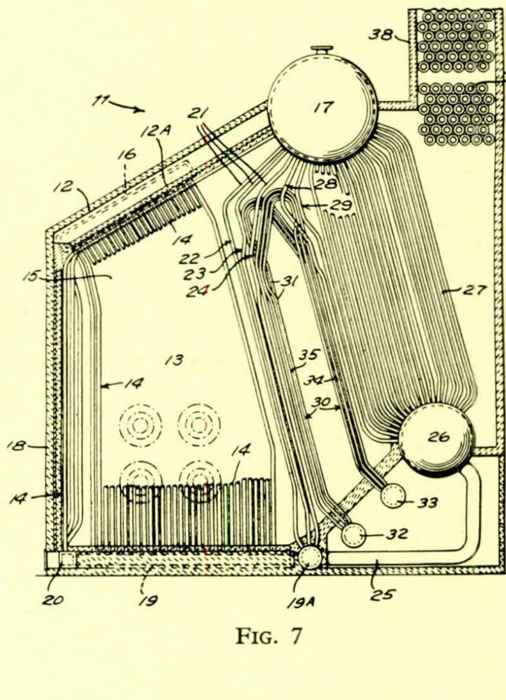
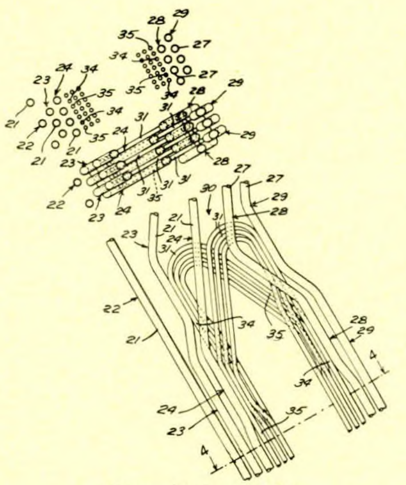


FIG. 7

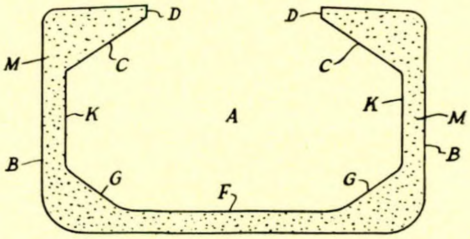


FIGS. 8, 9 and 10

(34 and 35). The leg (34) of each superheater element (31) is substantially straight throughout its entire length and merges into the arcuate intermediate part of the element. The leg (35) is substantially straight to a point vertically below the point where the leg (34) merges into the arcuate part and thereafter is inclined toward the opposite leg (34) to merge into the arcuate portion near that point. Figs. 8, 9 and 10 show in outline that the superheater elements (31) are arranged in parallel planes which are horizontally spaced and that the elements are arranged in a predetermined pattern in which the tube in one plane is rotated through 180 degrees from the position of the superheater tubes in the preceding and succeeding planes. The elements are nested within one another. Each of the outermost elements (31) is co-planar with a tube (21) of the row (23 or 24) and a tube (27) of the row (28 or 29). Fig. 9 shows that the first plane containing superheater tubes (31) has the outermost tube engaged by a boiler tube (21) in the row (24) which then runs parallel to the inclined part of the superheater tubes (Fig. 8). The leg (34) of the outermost element (31) is engaged by a tube (27) in the row (29) and the superheater elements (31) in each row are thus supported. In the next plane, the leg (34) of the outermost element (31) is engaged by a tube (21) in the row (23), and the leg (35) of the element (31) in the same plane is engaged by a tube (27) in the row (28). Motion of the superheater elements (31) is constrained in all directions except along their length, to permit thermal expansion of the latter.—*British Patent No. 801,767, issued to Foster Wheeler, Ltd. Complete specification published 24th September 1958. Engineering and Boiler House Review, November 1958; Vol. 73, pp. 381-382.*

Cargo Vessel for Transport of Loose Materials

This invention relates to cargo vessels for the transport of loose materials of the kind in which a water ballast space is enclosed between the hull of the vessel and the walls and bottom of the hold. The transport of loose material of different weights, such as for example coal, grain, gravel, ore, and the like, imposes a number of conditions on the form of the ship's hull, firstly for the cargo carrying journey, and secondly for the journey under ballast. For the cargo carrying journey, the first requirement is that the vessel should be self-trimming; the cargo should also be removable at the port of discharge as far as possible without leaving any residue. For the journey under ballast, sufficient ballast space must also be provided and this must be so located that the vessel has good stability and seaworthiness during the journey under ballast. The invention has for its object to co-ordinate the different types of requirements for the journeys with and without cargo in such a manner that they become mutually complementary and can be fulfilled with the use of a minimum amount of structural material. According to the invention, in a cargo vessel of the kind specified, the water ballast space totally surrounds the hold as far as the hatchway coamings, and the hold has smooth walls which have inclined portions at the two upper corners and the two lower corners of the cross-section of the hold. Preferably, the two upper inclined wall portions are of equal length and similar inclination, and the two lower inclined wall portions are also of equal length and similar inclination, so that a large symmetrical ballast space surrounds the hold in a shell-like manner. The provision of the upper inclined wall portions of the hold renders the vessel self-trimming. Because of the provision of the lower inclined wall portions of the hold, the cargo constantly slides, whilst being unloaded, into a zone accessible to a grab which enters through the hatchway, whereby a minimum amount of cargo is left behind. All supporting constructional elements, such as frames, fore and aft girders, floor plates and the like can be arranged without difficulty within the ballast space which surrounds the hold in shell-like manner. Referring to the drawing, the smooth walls (K) and the



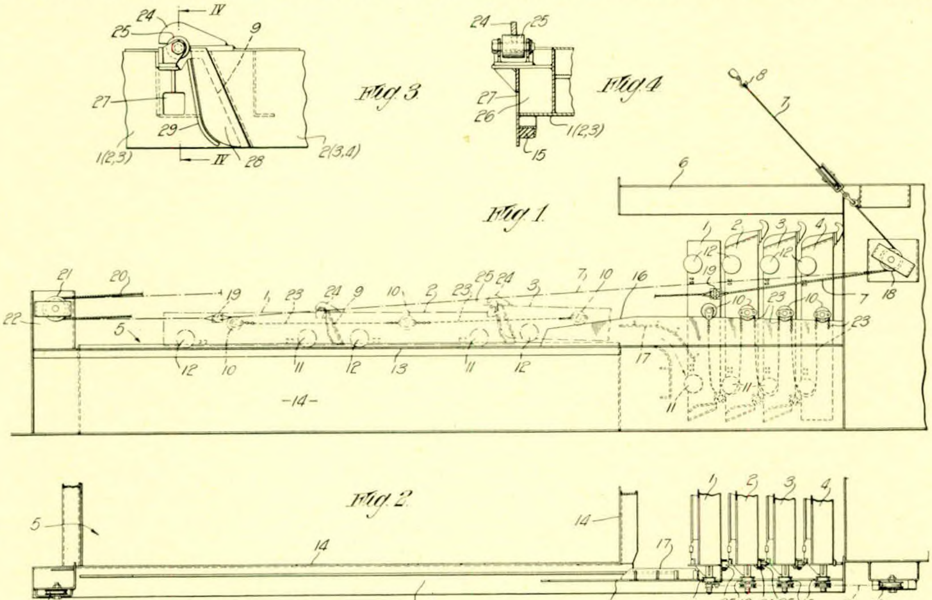
bottom (F) of the hold (A) are spaced from the hull (B) of the vessel so as to provide a water ballast space (M) which totally surrounds the hold as far as the hatchway coamings (D). The walls of the hold have inclined portions (C) at the two upper corners of the cross-section of the hold extending to the hatchway coamings (D). Inclined wall portions (G) are provided at the two lower corners of the cross-section of the hold.—*British Patent No. 804,707, issued to A. G. Weser. Complete specification published 19th November 1958.*

Plastic Coated Ship's Propeller

Ships' propellers, whether having fixed, detachable or feathering blades, are generally first formed as castings, which in order to obtain a smooth surface on the propeller blades, are machined. This machining operation often comprises cutting, grinding and polishing, since it is of importance that the blades present the smallest possible frictional resistance in the water. Such machining of the blades is both difficult and complicated. Propellers for small boats and smaller vessels are generally made from bronze, in spite of the relatively high cost because this material is easier to machine than steel castings or cast iron. In larger vessels, the propellers are usually constructed from steel castings which are essentially stronger and considerably cheaper than bronze castings, but on the other hand have an outer surface which is more difficult to machine than the outer surface of bronze castings. An object of this invention is to provide for a ship's propeller made by casting, the surfaces of which are covered with a coating which makes machining of the surfaces unnecessary. According to the invention the coating consists of a fibre reinforced organic plastic material which is resistant to mechanical wear and shocks, and to corrosion and to electrolytic action, while at the same time it has a smooth external surface. The coating can be made of such thickness that it has no difficulty in forming a completely smooth surface, and such an internal strength as to prevent the formation of dangerous cracks, which, during rotation of the propeller, might cause wear and tearing off of the coating from the blades. The coating is also able to resist impacts and consequent bending of the blades without being spoilt. In one process, according to the invention, the coating, constituted by reinforced foil of plastic material is applied to the rough surface of the casting which has been cleaned in advance. Without after-treatment, a perfectly smooth surface of the propeller is obtained.—*British Patent No. 803,853, issued to B. G. Andersen. Complete specification published 5th November 1958.*

Steel Cover for Ship's Hatch

This invention relates to improvements in ships' hatches and to steel covers for them, the latter being divided in sections. Referring to Figs. 1-4, a hatch cover is divided into four separate sections (1, 2, 3 and 4), which close together at cross joints to give a weather tight joint. At one end of the hatch



(5), preferably under a deck structure (6), arrangements are made to stow the sections in substantially vertical position. Stowing is effected by means of a pull on a single cable which is fitted with a cargo hook (8) from which extend a pair of cables (7) so that a separate cable can be brought along each side of the cover sections. The cable is operated by a suitable winch, etc. The cross joints (9) are inclined at the abutting faces from the bottom upwards in a direction away from the stowing end. This enables a section leading in the direction of the stowing end to tip up about a pivot (10) and freely clear the leading end of the succeeding section. Each cover has a pair of fore wheels (11) and a pair of aft wheels (12) running on runways (13) on each side of the coaming (14) or along the deck edges of a flush hatch opening. These wheels are mounted on eccentric bushes, so that by rotating the bushes the cover sections may either be lifted to disengage the weather tight sealing strips (15) (Fig. 4) for rolling or alternatively may be lowered into the sealed position. Intermediate of these runner wheels there is mounted on each side of the cover sections the pivot wheels (10) running up on the rising track (16) at the stowing end, whereupon the section may pivot about the pivot wheels into the vertical stowing position. The fore ends of the sections are deflected downwardly, guided by the curved runner ledge (17). The cables (7) are carried around a sheave (18) and are brought along for attachment to the side of the section 1 at 19, whereby the section 1 may be pulled towards the stowing end and in so doing push the remaining sections along. By this means a single pull from the cargo hook (8) serves to draw the whole group of sections towards the stowing end where they tip up in turn. In order to unstow the sections and refit them on the hatch opening, a further pair of side cables (20) are employed.—*British Patent No. 804,228, issued to Macgregor and Co. (Naval Architects), Ltd. Complete specification published 12th November 1958.*

Collector for Lost Oil Products Floating on Water

This invention relates to the collection of lost oil products floating on water, for example oil let out into the sea from ships cleaning their tanks or due to leakage of oil pipes during loading or unloading of tankers. Such lost oil products float all over the surface of water and great damage is caused to beaches and ships. Also, many marine birds are killed through landing on oil patches. Fig. 4 shows a fence arranged in the sea around a tanker (8) as a kind of flexible breakwater. The tanker (8) is shown moored at a quay (9) belonging to an oil station. At two intermediate points the fence is anchored by anchoring wires (10) for keeping it clear of the ship (8), and at both ends it is anchored to the quay or the shore by other wires (11). If some oil should leak out into the sea during loading or unloading of the tanker, the same will be kept within the space defined by the fence, comprising a fabric wall of plastic material, the quay and

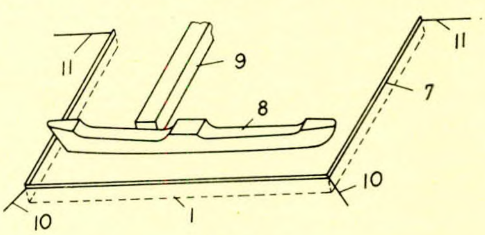


FIG. 4

the shore. It can then easily be removed by pumps before the fence is taken away. In order to facilitate this operation, before removing the oil the fence may be pulled together to reduce the area. By this operation the oil is dammed and may easily be pumped out. The oil cannot escape underneath the fence since its lower edge will always be located deeper than the oil floating within it.—*British Patent No. 804,640, issued to T. Thune. Complete specification published 19th November 1958.*

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