Marine Engineering and Shipbuilding Abstracts

Volume XVII, No. 10, October 1954

New Furness-Withy Tonnage

Built to the order of Furness, Withy and Co., Ltd., London, by Vickers-Armstrongs, Ltd., Walker-on-Tyne, the turbine cargo and passenger ship *Pacific Northwest* (10,740 tons d.w.) has completed successful trials and has been handed over to her owners. General cargo is carried in five main holds with corresponding upper and lower 'tween decks. Of the 'tween decks Nos. 2 and 4 upper and lower, totalling 132,000 cu. ft., are insulated for refrigerated cargo. The Cargocaire system of ventilation has been adopted throughout the holds and 'tween decks, one dehumidifying unit of 2,000 cu. ft. per. min. and ten axial flow fans being employed for the purpose. The propelling machinery of the *Pacific Northwest* was constructed by the Parsons Marine Steam Turbine Co., Ltd., and consists of geared turbines, developing 7,700 s.h.p. at 115 r.p.m. and capable of developing an overload of 10 per cent above this power. The main machinery has been designed to operate with superheated steam at a pressure of 450lb. per sq. in. and a total temperature of 750 deg. F., and consists of three turbines working in series. The main condenser is of the two pass regenerative type arranged under and supported from the l.p. turbine. An economical method of "make-up" feed is provided by two evaporators and one distilling condenser supplied by G. and J. Weir, Ltd. The closed feed system comprising extraction pumps, turbo feed pumps, feed heaters, etc., were also supplied by Messrs. Weir. The main circulating pumps were supplied by Drysdale and Co., as were the bilge, general service, sanitary, ballast, fire, oil fuel transfer and lubricating oil pumps. The lubricating system includes oil coolers by Serck Radiators, Ltd., and oil purifiers by Alfa Laval Co., Ltd. Steam for the propelling machinery is supplied by two water-tube boilers built by the Wallsend Slipway and Engineering Co., Ltd. These are of the Yarrow three-drum type and each boiler is fitted with a superheater of the MeLeSco single-pass type supplied by the Superheater Co., Ltd. Under normal conditions steam is evaporated at a pressure of 450lb. per sq. in. and temperature of 750 deg. F. at the superheater outlet from feed water at a temperature of 300 deg. F., when burning oil fuel under forced draught.—*The Syren and Shipping (Illustrated), 7th April 1954; Vol. 231, p. 31.*

Storm Location at Sea

When the waves from a storm at sea travel outwards, the long waves arrive first at any distant fixed point and are succeeded by shorter and shorter ones. Observation of the wavelength of the arriving train as a function of time determines the distance away of the storm centre. A description of the phenomenon involves an account of the progress of an arbitrary disturbance in a dispersive medium, and it is suggested that this might prove an interesting illustration for teaching purposes of the concept of group velocity.—*E. Mendoza, American Journal of Physics, April 1954; Vol. 22, pp. 208-211.*

Working Conditions Ambient to Inert-gas-shielded Metal-arc Welding

The development of new welding techniques and procedures requires a reinvestigation of the possible exposure of operators to new or different health hazards. This particular study is primarily directed at conditions in the breathing zone of the newly developed inert-gas-shielded metal-arc welding process with consumable electrode. On the basis of this study it is apparent that inert-gas-shielded metal-arc welding does not create any unusual health hazards. Fume and gas concentrations are not markedly different from conventional electrode welding. Ozone concentrations are greatest near the arc and exceed permissible limits outside the helmet in the working zone if no control is applied. Ozone concentrations inside the helmet are below recommended limits due to dilution and ozone decomposition. Inert-gas-shielded metal-arc welding produces higher ozone concentrations on aluminium than on stainless steel but no difference could be noted between argon- and helium-shield gases. Stainless-steel inert-gas-shielded metal-arc welding does not produce significant hexavalent chromium concentrations. Iron fume should be controlled within specified limits for elimination of visibility loss and nuisances (15 mg. per cubic meter). The fume hazard from silicon alloy welding of aluminium is proportional to the amount of silicon present. Silica fume concentrations exceed permissible limits with 5 per cent silicon-aluminium alloys unless local ventilation is used. As a tentative limit in the light of present knowledge on the effects of mixed alumina and silica exposures, it is recommended that total fume concentrations be maintained below 15 mg. per cubic meter for aluminium alloys where silicon is only an impurity. The total fume concentrations where silicon is present should be such that the silica concentration does not exceed 0·1 mg. per cubic meter. Oxides of nitrogen concentrations are below allowable limits even in the absence of ventilation. The inert-gas shield, reactions with fumes, and ozone prevent abnormal air concentrations in the working zone. When it is desirable to control fumes and gases from arc welding, the use of lateral exhaust ventilation is the most efficient. Care must be taken in its use, however, to avoid disturbing the inert shield. Fume concentrations with the inert-gas-shielded metal-arc welding process appear to be independent of the type of shielding gas. There is no basic reason to believe that the general specifications for arc welders' filter glass which are ordinarily used in coated electrode welding do not give adequate protection against long-wave infra red although a more highly absorbent infra red glass combination is recommended at present until an adequate quantitative study is made. The recommended composition for satisfactory control is given in this article. Operators sensitive to gaseous products of welding, such as ozone, should use local exhaust supplemented by air supplied helmets if necessary. In terms of deposited material, inert-gas-shielded metal-arc welding produces less fume per unit weight of electrode wire used when compared to coated electrode arc welding.—*L. Silverman and H. Gilbert, The Welding Journal, May 1954; Vol. 33, pp. 218s-229s.*

German Passenger and Cargo Vessel

The *Hamburg,* second of a series of six sister ships, ordered jointly by the Orlanda Line, Bremen (Norddeutscher-Lloyd) and the Hamburg-Amerika Line, has recently completed her maiden voyage to the Far East. She was built by the Bremen Vulkan Shipyard, Bremen, Vegesack. The principal particulars of the *Hamburg* are: —

Length o.a.	535ft. 0in.
Length b.p.	492ft. 1in.
Breadth	63ft. 8in.
Depth to shelter deck	39ft. 3in.
Maximum draught	26ft. 2in.
Corresponding deadweight ...	9,200 tons
Gross tonnage	9,008 tons
Net tonnage	5,278 tons
Speed on trials	17·25 knots
First-class passengers	86
Crew	91

The scantlings of the *Hamburg* comply with the rules of Germanischer Lloyd 100 A4 (E). There are eight watertight bulkheads, the forward and after peak bulkheads being carried to the shelter deck and the others to the second deck. Maierform, Bremen, were responsible for the design of the hull form and the propellers. Tank tests were carried out. Welding has been used generally throughout the ship with the exception of the connexion between the sheerstrake and the shelter deck stringer, the bilge strake seams, the connexion of the framing to the shell, the bilge brackets and the beam knees. Above the boat deck the structure is of riveted aluminium construction. An air-conditioning system serves all passenger cabins, the dining saloon, the children's playroom and the barber's shop. In the tropics temperatures may be maintained at 5 to 6 deg. C. below the outside air temperature, and with a relative humidity of 40-60 per cent. In winter inside temperatures may be kept at + 20 deg. C., with an outside temperature of − 15 deg. C. The crew are generally accommodated in one- and two-berth cabins, but there are some three-berth cabins. The total number of 91 in the crew is made up of 27 deck, 24 engine room and 40 who are mainly concerned with passenger service. Cargo-handling equipment consists of one 50-ton and four 10-ton derricks on the foremast and fourteen 5-ton derricks on the eight derrick-posts. This gear is operated by eighteen electric cargo winches. McGregor steel hatch covers have been fitted. The steering gear is electro-hydraulic and is capable of manœuvring the rudder from hard to port to hard to starboard within 30 seconds, with the ship fully loaded. Four light-alloy lifeboats comprise the main life-saving equipment. A fire-prevention and detecting system has been installed, in accordance with international regulations. The fire-detecting and alarm installation is combined with an automatic stop of all ventilation machinery when a fire alarm is given. The fire-resisting doors below the shelter deck are of steel, while those above are of insulated aluminium alloy. The main propelling machinery consists of two double-acting, two-stroke, 7-cylinder M.A.N. engines of the manufacturers' type D7Z 53/80, with piston diameter of 530 mm. and 800 mm. stroke, geared to a single shaft. Each of the two units develops 5,280 h.p. at 210 r.p.m. Two La Mont exhaust gas boilers of 1,300 sq. ft. have been fitted. The reduction gear, supplied by A.G. "Weser", Bremen, reduces the revolutions from 210 to 116 r.p.m.—*Shipbuilding and Shipping Record, 8th July 1954; Vol. 84, pp. 45-48.*

Miniature Dutch Cargo Liner

The latest venture of the Rotterdam shipowners, Van Nievelt Goudriaan and Co. is a remarkable one. Since the war they have developed their business in several new directions, including tanker operation, and they are now to extend the scope of their Rotterdam-South America Line by providing a service between Asuncion, some 600 miles up the Parana and Paraguay rivers, and European ports *without transhipment.* For this purpose they have had built by one of the best-known yards in the Gronigen district, a new ship named *Mariscal Lopez.* She has been constructed as an open shelter decker to Bureau Veritas class for unrestricted ocean-going service and has principal particulars as follows: —

Length overall	230ft. 8in.
Length between perpendiculars...	206ft. 3in.
Depth to maindeck	10ft. 10in.
Depth to shelterdeck	18ft. 0in.
Draught on summer freeboard...	10ft. 8in.
Corresponding deadweight capacity	885 tons
Cargo capacity (grain)	67,700 cu. ft.
Cargo capacity (bale)	60,700 cu. ft.
Deep tanks	3,540 cu. ft.
Bunkers (including reserves) ...	141 tons
Loaded service speed	10½ knots

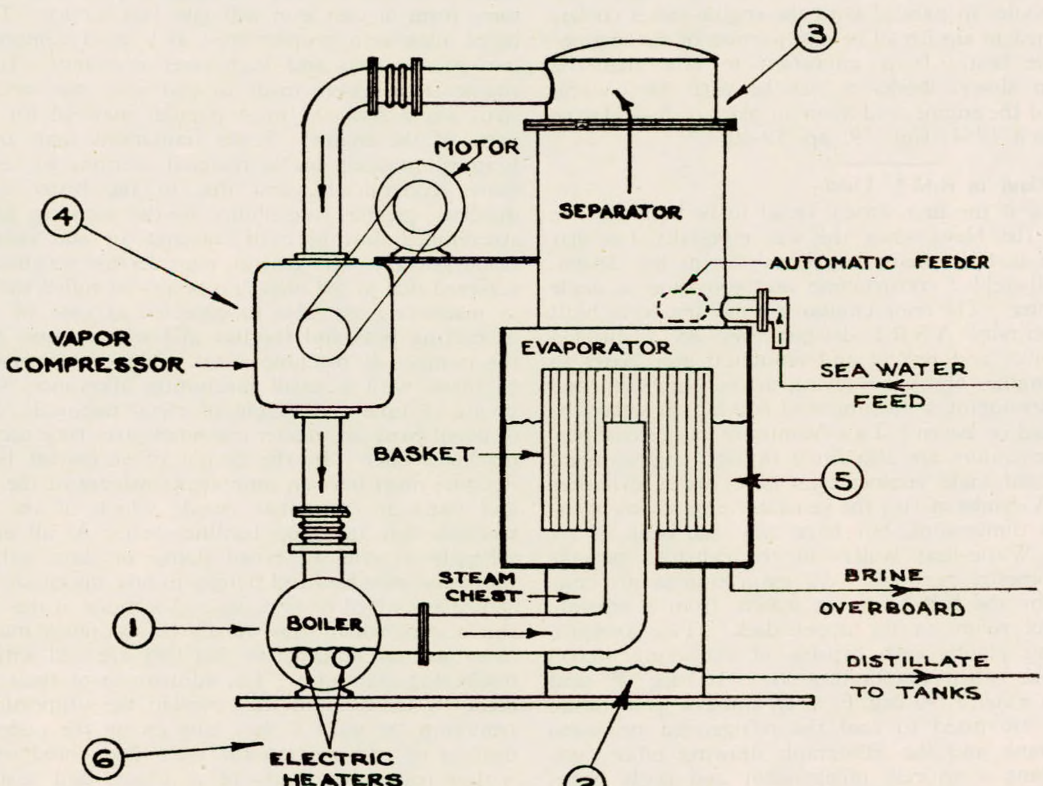
There are two holds, each with 'tween decks, closed by hatches measuring 36 feet by 16 feet (No. 1) and 55 feet by 16 feet (No. 2). Six 5-ton derricks are carried on two unstayed rectangular masts and worked by electric winches. All the deck machinery is electrically operated. In view of the arduous climatic conditions likely to be encountered in the upper reaches of the Parana River, all the accommodation is fully air-conditioned. The recently-introduced Nordisk Hi-Press system is employed, whereby high-velocity air streams are delivered through small bore ducts to individual mixing units in the various cabins and public rooms. A 700 b.h.p. Werkspoor engine running at 300 r.p.m. is installed.—*The Marine Engineer and Naval Architect, July 1954; Vol. 77, p. 256.*

Stability and Compatibility of Fuel Oil and Diesel Fuel

A residual fuel oil can be described as a colloidal system in which the disperse phase consists of micelles of asphaltenes and certain maltene fractions, the continuous phase being an oily medium formed by the rest of the maltenes. The terms "asphaltenes" and "maltenes" derive from the experimental observation that when a residual fuel oil is diluted with a hydrocarbon of low C-H ratio or a low boiling point ether, it is divided into two parts: (*a*) an insoluble part, called by definition the asphaltene fraction, which separates in the form of a dark brown or black powder; and (*b*) a soluble part, i.e. the rest of the fuel, termed by definition the "maltene" fraction. The sum of the two gives the total fuel oil, the division between the two being a function of the nature of the fuel, the precipitating conditions, the nature of the diluent, and the dilution ratio up to a maximum. It can be shown experimentally that the disperse phase of the system is not formed only of asphaltenes, but by a complex consisting of the asphaltenes and part of the maltenes (the most aromatic components of high molecular weight). This complex will be referred to as a "micelle". Hence in regarding a furnace fuel oil or asphaltene (residual) containing Diesel fuel as a colloidal system it is necessary to distinguish between the disperse phase (consisting of the micelles) and the continuous or intermicellar phase (consisting of those maltenes which are not associated with the micelles). It is perhaps not sufficiently widely appreciated that two fuel oils or Diesel fuels may each be satisfactorily stable by themselves but give rise to dry sludge, i.e. exhibit incompatibility when mixed. The essential fact here is that whereas the continuous phases are miscible, the two systems are not. In general, it may be assumed that the disperse phases of the two asphaltene systems, i.e. of the fuel oils or Diesel fuels involved, are unique, and hence require different peptizing powers (or peptizing capacities) from their respective continuous phases. Now suppose one of the fuels concerned has a system of asphaltene micelles requiring a certain peptizing power from the oily medium, i.e. the continuous or intermicellar phase and that this condition is satisfied, i.e. the fuel is stable. The micelle system of the second fuel will also require a certain peptizing capacity from its oily medium, so let this peptizing capacity be less in magnitude than that for the first fuel. On mixing, the two continuous phases blend, and the peptizing power of the blended continuous phase will now have a value somewhere between those of the individual continuous phases. If this new peptizing power is less than the minimum required to keep the micelle system of the first fuel fully dispersed, then precipitation of part of the asphaltenes from the first fuel will occur, i.e. the fuels, although separately stable, will be incompatible when mixed. There is evidence for believing that in mixtures of residues, the characteristic for the peptizing power (or "dissolving" power) of the oily medium and that for the peptizability (or "solubility") of the asphaltenes are nearly additive. It should be noted that an essential condition to be fulfilled if two or more fuel oils or Diesel fuels are to be compatible is that the combined phases should possess sufficient "aromatic reserve", i.e. peptizing power, to keep fully dispersed the more intractable micelle system involved.—*C. W. G. Martin and D. R. Bailey, Journal of the Institute of Petroleum, May 1954; Vol. 40, pp. 138-150.*

Tubeless Evaporators

The Maxim tubeless evaporator incorporates a deeply corrugated heat exchanger arranged in cylindrical form, to give maximum heat-transfer surface for unit space, and to permit easy descaling. Since the type of scale deposited is a function of the temperature at which evaporation takes place, low-pressure steam is used, with boiling taking place below 212 deg. F. The scale formed under these conditions is brittle, when dried, and easily removed. The Maxim evaporator has high velocity circulation around the corrugations as shown by laboratory motion-picture studies. These high velocities result in high heat-transfer rates, and also, reduce scaling to a minimum by eliminating the tendency for high-concentration water to remain near the heat-transfer surface. While scaling is reduced in the Maxim design, it is not completely eliminated. In time it is necessary to descale, to maintain high efficiency, and in most evaporators, this is a major overhaul problem. But descaling has been simplified in the Maxim evaporator.



Components and operating cycle of Maxim vapour-compression evaporator

(1) Electric heaters boil fresh water, producing steam; (2) Steam condenses inside basket; its latent heat boils sea water on outside of basket at amospheric pressure; (3) Vapour flows through separator to suction of compressor; (4) Compressor pumps up steam to 4lb. to 5lb. per sq. in. gauge and discharges it into steam chest. Heat of compression being added to vapour makes up radiation and other losses; (5) Compressed vapours inside basket condense and evaporate more sea water, completing cycle; (6) Electric heaters cut out.

With the water drained from the evaporators, 30lb. per sq. in. absolute steam is admitted to the heating section. The flat sides of the corrugated basket expand and the 250 deg. F. temperature quickly dries the scale. Then cold water is poured on the outside of the heating section to condense the steam. The resulting fast drop in pressure from 30lb. per sq. in. absolute to 1lb. per sq. in. absolute sucks in the flat surfaces of the basket, and coupled with the change in temperature, the brittle scale drops off, leaving the metal surfaces almost completely bare. The Maxim Silencer Company over a year ago commenced development of a sea-water vapour-compression type evaporator. The system now undergoing tests is the model VC-75D capable of producing 1,000 gallons per day of pure distilled water. It uses a unique float valve, automatic-feed and brine-discharge system, plus electronic controls. The Maxim heat-economy evaporation system operates on the energy normally wasted from the engine jacket of an internal-combustion engine. This system is divided into two parts: (1) An ordinary internal-combustion engine complete with its own jacket-water circulating pump, heat exchanger and thermostatic-control valve; (2) A completely independent, Maxim evaporator. These two are wedded by means of only two pipe lines, one from the outlet of the engine jacket to the evaporator steam chest, and the other returning this water from the steam chest back to the engine-jacket-water-circulating pump. Essentially, this is an evaporative cooling system, but it should be noted that it is not a high-temperature system, neither is it a steam-cooling system. In no way is the regular cooling system of the engine disturbed, since a small amount of water is merely borrowed at the engine-jacket outlet, and is returned to the engine-jacket inlet after some of the heat has been removed. The evaporator system acts in the manner of an auxiliary engine cooler in parallel with the engine-jacket cooler, and can be designed to absorb all or any portion of the engine-jacket-water waste heat. It is important to note that the evaporator system always works in parallel with the cooling system common of the engine, and *never* in place of it.—*Marine Engineering, March 1954; Vol. 59, pp. 59-60.*

Air-conditioning Plant in H.M.S. *Vidal*

H.M.S. *Vidal* is the first survey vessel to be built for the hydrographer of the Navy since the war especially for that purpose, and she includes many novel features in her design. The hull is of all-welded construction and provision is made to carry a helicopter. The main engines are the first to be built to the new Admiralty A.S.R.1 design; they are connected through fluid drives and reverse and reduction gear boxes to each shaft, the engines always revolving in one direction, and each capable of developing a maximum of 800 h.p., whether the ship is going ahead or astern. Two Admiralty designed supercharged Diesel-generators are also fitted in each engine room. The unsupercharged main engines each have twelve cylinders arranged in two V-banks of six; the generator engines are identical in all main dimensions, but have only one bank of six cylinders each. Waste-heat boilers in the exhausts provide hot water for domestic purposes. All main engines are controlled together by the E.R.A. of the watch, from a separate machinery control room on the upper deck. Two arcton-6 main refrigerating plants, each capable of extracting 40,000 B.Th.U. per hour when evaporating at -10 deg. F. and supplied with sea water at 90 deg. F. in an ambient temperature of 110 deg. F., are fitted to cool the refrigerated provision rooms, the ice tank and the lithograph drawing office cupboard. Each plant is entirely independent and cools brine, which is circulated through the room. The flooded shell-and-tube evaporators (brine coolers) are supplied with refrigerant through h.p. float-controlled expansion valves, and conventional oil return systems are fitted. The ventilation arrangements required were worked out in the Naval Construction Department, Admiralty, Bath, and it was decided that the ship should be divided into three separate sections, each supplied by its own air-conditioning unit. On the cooling cycle, the plant is required to maintain inside conditions of 85 deg. F. d.b. and 73 deg. F. w.b. (56 per cent R.H.), when the outside conditions are 88 deg. F. d.b. and 80 deg. F. w.b. (70 per cent R.H.) and this involves an estimated cooling load of 810,000 B.Th.U. per hour. When heating, the plant is required to maintain an inside temperature of 60 deg. F. when the outside temperature is 20 deg. F., and this involves an estimated heating load of 750,000 B.Th.U. per hour. When heating or cooling, a minimum of 10 cu. ft. per min. per man of fresh air is required for hygienic reasons. The plant is also required to operate as a normal ventilation system in temperate climates with forced air supply and exhaust. The machinery has been designed to operate on the cooling cycle with sea water and ambient air temperatures of 90 deg. and 110 deg. F. respectively. When heating, it is designed for a sea temperature of 35 deg. F., but the water actually supplied to the plant is slightly heated by a minimum of 5,000 gallons per hour of sea water at not less than 40 deg. F., obtained from the Diesel generator cooling water system. As the plant is so large, it was decided to cool fresh water as a secondary refrigerant and to circulate this through the three air-conditioning units. This made it possible to effect the change-over from cooling to heating or *vice versa*, without disturbing the primary refrigerant circuit; the only safeguard required was to design the secondary refrigerant circuit to resist corrosion due to contamination with sea water. —*Modern Refrigeration, May 1954; Vol. 57, pp. 174-179.*

Welding Marine Diesel Engine Structures

In ships' machinery the materials employed have to withstand a variety of conditions. For instance, cylinder liners have to resist corrosion and wear at elevated temperatures, so has the piston, while other parts transmit or carry varying mechanical loads. For the sliding parts and cylinder liners some form of cast iron will give best service. The liners may be of alloy iron proportioned as a good compromise between low friction loss and high wear resistance. In the past all engine frames were made in cast iron, but welded steel construction is now the most popular material for the structural parts of the engine. Fewer limitations than are imposed by foundry practice enable material sections to be proportioned more economically, and due to the better distribution of material, greater accessibility to the working parts and more streamlined flow of both scavenge air and exhaust gases are made possible. In general, considerable weight saving can be achieved due to the better properties of rolled steel. Economies in machining can also be expected in view of the possibility of making beds and the like in fewer sections, thus saving in the number of machine joints. Modern fabrication can now be made with a small machining allowance, so achieving a saving in time and weight of metal removed. Pre-machining of detail parts on smaller machines saves time occupied on large machines later. In the design of successful fabrications the designer must have an intimate knowledge of the shop processes and must at the outset decide which of the two assembly methods suit the shop facilities best. As all engine beds are virtually a series of broad flange or deep web girders with transverse members and flanges to take the engine columns, they can be assembled from plates and sections to the shape required; the facings, which must finally be accurately machined, can be fitted last and adjusted so that they are well within the desired machining allowance. The adjustment of these facings can be made by the amount they overlap the supporting webs or by trimming the webs if they butt up on the underside. In this method of construction the main body need only be held to within reasonable limits of accuracy, and distortion due to welding will be less important, as the facings are fitted last. This method, described in its simplest form, may include a number of sub-assemblies designed to facilitate welding and reduce the risk of major error on final assembly.—*J. A. Dorrat, The Welder, January-March 1954; Vol. 23, pp. 126-130.*

Effect of Impurities in Magnesium Electrodes

Laboratory investigation has shown that the efficiency of magnesium anodes can be adversely affected by certain impurities at concentration levels well below those previously indicated by salt water corrosion data. The impurities of most concern are nickel, copper and silicon, but detrimental effects are also noted with lead and tin at above normal concentrations. Based on these data a revised primary alloy anode specification has been introduced and its superior performance confirmed by field testing. Alloying elements such as aluminium and zinc are without significant effect in the ranges ordinarily specified. Beryllium, at the concentrations employed to prevent oxidation, is likewise without effect. Iron levels as high as 0·02-0·035 per cent are well tolerated at manganese contents in excess of 0·2 per cent, but not without appreciable sacrifice in efficiency. Low iron ($<$ 0·003 per cent) composition of intermediate Mn ($>$ 0·15 per cent) content offers superior performance and a more practical casting composition. The effects of copper are inconsistent but the bulk of the data indicate an adverse effect beginning at surprisingly low ($<$ 0·05 per cent) copper contents. There is some evidence to indicate that the effect of copper can be confused with or masked by the presence of other elements, notably silicon. Manganese additions not only control iron content and iron tolerance but also appear to partially offset the effect of copper. A manganese content of 0·2 per cent (min.) is indicated at high (0·1-0·4 per cent) copper levels for improved performance in saline environments. Nickel can adversely affect anode efficiency at levels distinctly below previously recognized limits, an appreciable effect being observed down to as little as 0·0005 per cent Ni. In primary grade alloy, a nickel maximum of 0·002 per cent is indicated if efficiencies are to be held at or above 50 per cent for the current densities obtained in underground service. Silicon exhibits a detrimental effect at concentrations in excess of about 0·1 per cent, the effect taking the form of scatter with an attendant reduction in average anode efficiency. The minor impurities, lead and tin, have detrimental effects when present in amounts exceeding those normally found in anodes. Efficiencies fall off markedly for lead contents in excess of 0·04 per cent, whereas a slight downtrend of efficiency is indicated at tin levels above about 0·005 per cent. Limits for these elements have not been included in the revised primary alloy specification largely because the lead and tin levels in this alloy fall well below the above limits.—*H. A. Robinson and P. F. George, Corrosion, June 1954; Vol. 10, pp. 182-187.*

Pilot Vessel for Queensland

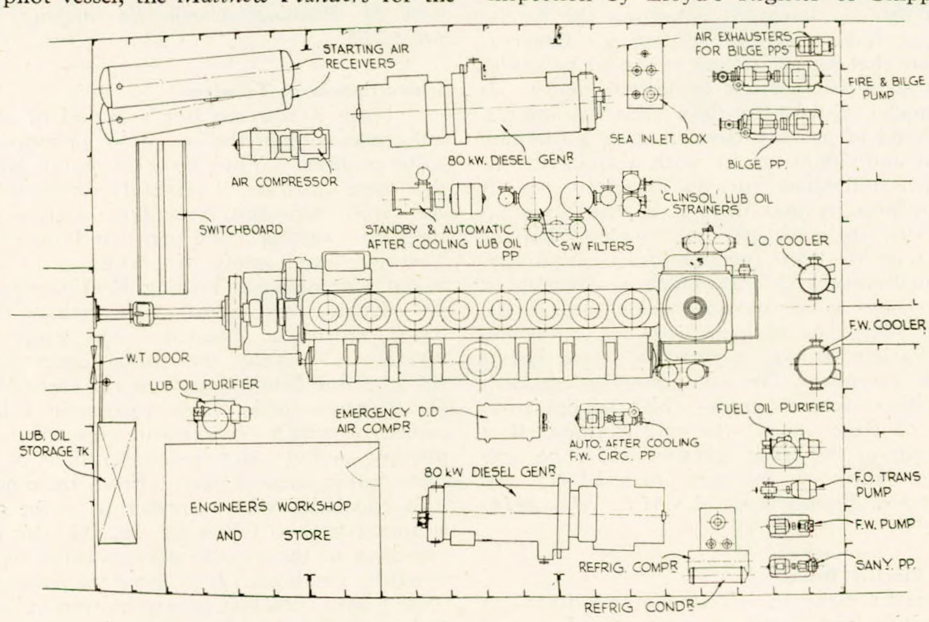
Now under construction at the lower yard of J. Samuel White and Co. is a pilot vessel, the *Matthew Flanders* for the Queensland Government. She is 185 feet in length b.p. with a beam of 16 feet and a mean draught of 11 feet. A 1,500 b.h.p. British Polar engine is to be installed running at 300 r.p.m. and direct-coupled to the propeller. The service speed is expected to be about 14 knots. Two Crossley-engined 80 kW generators are to be fitted.—*The Motor Ship, July 1954; Vol. 35, p. 142.*

Heat-reflective Paint

A heat-reflective coating for exterior surfaces is claimed to be highly effective for keeping buildings cool in hot climates. It is reported that this paint will lower the temperature inside a galvanized-steel building to within 1 deg. F. of the shade temperature and that temperatures under a steel roof have been reduced by as much as 45 deg. F. in summer weather. In the case of an asphalt roof, the temperature can be lowered by some 30 deg. F. The "coolness" of the new paint depends upon the reflective qualities of the pigment combination used. To reflect heat waves, it is not necessary for the paint to be extremely white. In fact, since the pigment used contains titanium dioxide, its whiteness tends towards yellow rather than blue, but this holds no disadvantages as regards reflectivity. Whiteness of the coating is effective only in the visible spectrum. The remainder of the reflectivity is in the invisible (infra red) range and, therefore, does not depend on degree of whiteness for maximum efficiency. The film thickness required for most applications will depend upon the colour of the surface to which it is applied, as a completely opaque coating must be created for maximum efficiency. The new paint can be applied by any conventional method, but a considerably thicker coating than usual must be used. It is further claimed that the painted surfaces resist mildew and mould growth, as a bactericide and a fungicide are incorporated. The new paint may also prove useful in the painting of chemical barges and storage tanks to reduce losses by evaporation. Tests are now under way to ascertain its salt-spray resistance.—*The Engineers' Digest, July 1954; Vol. 15, p. 268.*

Radiography in Dry Dock

The use of radiological examination for the discovery of internal defects in castings, assemblies and various complicated structures is no new discovery, but with the availability of radio-active isotopes, this type of inspection has been given a new incentive and a wider field of application. A ship owned and operated by F. T. Everard and Sons, when subjected to inspection by Lloyd's Register of Shipping, revealed a fault



Engine room arrangement of the Matthew Flanders which consisted of a lamination in the bossing of the stern frame. The fault was machined out and the hole made good by filling in as a welding. From an appearance point of view and as welded under Lloyd's supervision the job was satisfactory. It was not, until recently, possible to use a non-destructive method of internally examining the weld *in situ*, which, therefore, remained suspect and subject to continuous inspection. The ship was put into dry dock, the propeller was removed and the propeller shaft withdrawn together with the tail end bush and located so that a gamma-radiograph could be obtained through the stern frame boss and tube, the film being strapped to the outside of the boss immediately adjacent to the weld. A powerful isotope rated at three Curies was used. The penetration required was through 7½ inches of steel and a gamma-graph was obtained with such high definition that it was possible to interpret the fusion of the weld throughout its entirety and to confirm the success of the repair. Naturally, much preliminary experimental work was put in before the job was undertaken, even to the casting of a replica of the stern frame so that it was possible to ascertain exposure and most suitable position for the isotope under laboratory conditions. It was found possible to prove that a fault detection of well under three per cent of the total thickness could be achieved. In the final results taken in the dry dock, the lapping or beading on the surface of the weld was clearly discernible on the radiograph. Because of this preliminary work, the examination was speedily and confidently carried out. Actually the ship was ready for the replacement of the propeller, etc., five hours from starting time, all the radiographic apparatus being placed in position and removed in this period. *—R. O. Couchman, Shipbuilding and Shipping Record, 27th May 1954; Vol. 83, p. 666.*

A Concept of Fatigue Damage

The fatigue failure of machine parts has been the subject of study by numerous investigators. There are many aspects of this phase of design which require a great deal of investigation before satisfactory design methods can be developed. The problems involved are extremely complex. Any attempt to describe the behaviour of materials subjected to fluctuating loads involves a large number of variables. As with most design procedures, it is desirable to attempt to express the complex behaviour of machine parts under actual operating conditions in terms of the behaviour of laboratory test specimens of relatively simple geometry under simple loading conditions. The realization of this desire will depend upon the degree of understanding which can be developed regarding the fundamental nature of fatigue failure and fatigue damage. Observations appear to indicate that fatigue failure is caused by cracks which progress from some stress risers or fatigue nuclei. It is possible that these nuclei existed before any stress was applied. Apparently the likelihood of a crack developing is a function of the seriousness of individual nuclei with respect to the stresses applied. Each individual nucleus, therefore, has its own threshold of susceptibility and there is a wide variation of susceptibility in any aggregate of such nuclei. Fatigue damage is a difficult term to define precisely or quantitatively. It may be defined qualitatively as that which is experienced by a material subjected to cyclic stressing which reduces the number of cycles of stress the material will yet withstand before final failure. Fatigue damage is probably a function of the following physical variables: The number of independent fatigue nuclei or progressive-fracture cracks which are operative, the sizes and shapes of these cracks, the cold-working effect on the material adjacent to the crack surfaces, and a possible thermal-recrystallization effect in the same material.*—S. M. Marco and W. C. Starkey, Transactions, A.S.M.E., May 1954; Vol. 76, pp. 627-632.*

Selection of Auxiliary Electric Drives

The first decision to make in selecting auxiliaries is to choose between electricity and steam as a source of power. In making such a decision, the advantages of both types of drive should be considered. The advantages of electric drives are as follows:—1. More flexible controls. 2. More efficient equipment in the range of auxiliary-drive ratings. 3. Instantly available for use, no warm-up required. 4. Cleaner, quieter, and cooler in operation. 5. Proven simplicity of installation and maintenance. 6. Monitoring of performance with electrical instruments extremely simple. The advantages of steam drives for use with auxiliaries are as follows:—1. First cost of equipment is usually lower. 2. Principles of operation are more widely understood. 3. Equipment is inherently explosion-proof. 4. Use of steam-turbine drives reduces the required electrical capacity, thus permitting use of smaller turbine generators. 5. In larger sizes, equipment may be more efficient. Detailed consideration of these advantages and disadvantages usually indicates that electric drives are more practical for use with auxiliaries. However, there are cases where unusual factors dictate the use of steam drives. If electrically powered auxiliaries are selected, then it must be decided whether to use A.C. or D.C. current are given in Tables 1 and 2.

TABLE 1.—A.C. DRIVE ADVANTAGES

1. The A.C. squirrel-cage motor, used for the majority of auxiliaries, is the most rugged, simple, light, and inexpensive of all motors.
2. Most A.C. motor starters can be of the simple across-the-line type.
3. Fewer moving parts, with resultant reduced maintenance.
4. Most standard hotel, machine-tool, and personal appliances can be used.
5. Generation and distribution of power for lighting is simpler.
6. Alternating current does not affect accuracy of magnetic compasses, or cause destructive electrolyzing currents in the hull and piping.

TABLE 2.—D.C. DRIVE ADVANTAGES

1. D.C. drive-motor speed can be varied in a smooth and satisfactory manner to meet almost any requirements. It was because of the superior speed control of the D.C. motor-driven winch that most general cargo ships have been D.C. powered. (A D.C. winch powered for an A.C. to D.C. motor-generator set is now available for use on A.C. ships.)
2. Equipment can be modified easily to incorporate dynamic-braking characteristics.
3. The D.C. motor can be designed to deliver a higher starting torque than any A.C. motor (when starter on a limited-power system).
4. Starting currents are lower.

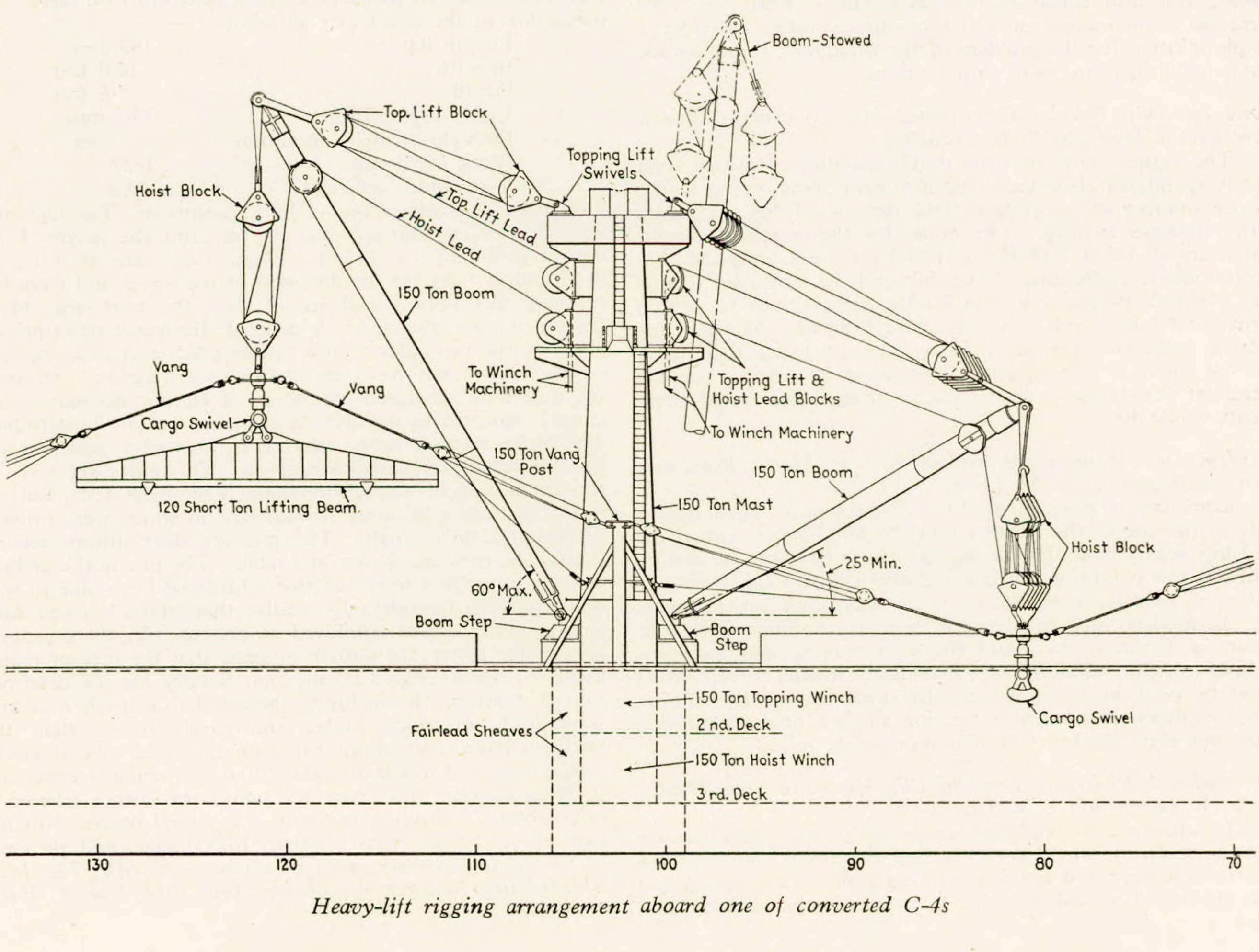
—A. M. Bruning, Marine Engineering, June 1954; Vol. 59, pp. 62-68.

Seaworthiness of Trawlers

There is scarcely ever a period of severe weather around our coasts without the loss of one or more fishing vessels having to be recorded. This, however, is not entirely due to the fact that these craft are of relatively small size in comparison with the cargo ships and passenger vessels which safely encounter the same weather conditions, and in a paper entitled "Seaworthiness and safety of trawlers in a seaway", read at the recent International Fishing Boat Congress, the author, Mr. W. Mockel, drew attention to some of the possible causes of these unfortunate disasters. The study of the behaviour of trawlers in a seaway, the author suggests, is of primary importance because fishing must often be carried out in heavy weather. He therefore made three voyages in fishing trawlers, in the course of which observations were made on the rolling and pitching periods, and the accelerations of the bridge and foredeck during these periods. From these and other observations it is concluded that a trawler is in the greatest danger when steaming with a following sea, the risk of broaching to and capsizing in these circumstances being increased if the ship is down by the head. It is therefore recommended that trawlers should have sufficient reserve buoyancy, i.e. sufficient freeboard and a high forecastle; a closed poophouse should cover the whole breadth of the ship; and the rolling acceleration on the bridge should be less than 3·28 feet per sec. It is also considered advisable that there should be a metacentric height of about 33 inches at the start of a voyage falling to about 20 inches by the end.—*Shipbuilding and Shipping Record, 13th May 1954; Vol. 83, p. 599.*

Ship Conversion for Heavy Lifts

Unloading of cumbersome military supplies at ports where cargo-handling facilities are inadequate or have been wrecked will be speeded in the future by two heavy-lift ships converted by Bethlehem Steel Company's New York District shipyards for the Military Sea Transportation Service. The U.S.N.S. *Pvt. Leonard C. Brostrom* was converted by Bethlehem Steel Company's Brooklyn 56th Street Yard. The second ship, the U.S.N.S. *Marine Fiddler*, is nearing completion at Bethlehem's Hoboken, N.J., Yard. The *Brostrom* now can handle cargoes weighing up to 150 long tons in a single-boom lift. With two 150-ton, two 30-ton, eight 10-ton and four 5-ton booms, she has a total boom capacity of 460 tons. Prior to the conversion her biggest single-boom lift was 30 tons. Several foreign-flag ships claim single-boom lifts of up to 180 tons. However, the *Brostrom* also has lifted as much as 180 tons at the hook in yard tests although her rated safe working-load capacity is 150 long tons. In operation, the *Brostrom* will be able to carry from 30 to 60 railroad locomotives, some weighing as much as 120 tons, and even bulkier cargo. She will be able to load and unload these units with complete independence from shoreside facilities. The arrangement of the ships was changed completely between the poop and forecastle bulkheads to obtain increased hatch sizes, deck heights and compartment lengths. Existing watertight bulkheads and 'tween decks which formed ten cargo spaces on the *Marine Fiddler* were removed, or relocated, to form four new cargo areas. One of the major tasks on the *Brostrom* was the lowering of the second deck by 4 feet and stiffening it to form a new third deck. The original third deck was removed except for stringers at the shell. Hatches were increased in size from 36 × 20 feet to 75 × 35 feet for loading of large cargo units. Hatch openings extend to within 18 feet of the ship's side and to within 10 feet of the compartment ends to reduce the necessity for skidding of heavy cargo into the wings. The deck structure was reinforced to permit loading of 120-ton locomotives on the upper deck, 'tween deck, tank top and on the Nos. 3 and 4 hatch covers. Due to widening of hatches and the 'tween deck removals, it was necessary to add heavy doubler straps to the sheer strake and upper deck for maintenance of hull-girder strength. The outboard upper deck doubler on the *Brostrom* and the gunwale angle on the *Marine Fiddler* were riveted to provide crack arresters. Heavy hatch coaming girders also were installed on the upper deck. To permit the loading of long-dimensions cargo outboard of the hatchside girders, only two columns were provided in each of the large holds. This resulted in a girder span of 62 feet between column and bulkhead. With her single stack aft, the *Brostrom* has the usual appearance of the C-4 except for a gargantuan mast rising from midships. Rising 60 feet above the upper deck, the mast is located between two huge new hatches, Nos. 3 and 4. The mast is 10 feet square at the base and 6 feet square at the top. Of high tensile steel, it is free standing to permit maximum loading space on the upper deck. Supported by the mast are the two big booms, each 80 feet long, 3 feet in diameter at the centre and weighing 16 tons. Serving the main rigs are four 200-h.p. winches, believed to be the largest ever made. They measure about 10 feet in length, 11 feet in width and 6½ feet in height, and weigh 17½ tons each.—*Marine Engineering, May 1954; Vol. 59, pp. 64-67.*



Heavy-lift rigging arrangement aboard one of converted C-4s

Minutes of the Tenth American Towing Tank Conference

Among the papers presented and discussed were the following:—

Propulsion Scale Effect Tests at the Stevens E.T.T., by E. V. Lewis.

Theoretical and experimental work on the smallest practicable model (length 7·8 feet, propeller diameter 4 inches) showed that full-scale predictions are further from trial results than are those obtained from models of normal size. As regards propulsion components in general, it may be said that propeller scale effect is fairly well, and the scale effect in wake even better, understood; but the scale effect on thrust deduction and relative rotative efficiency require further elucidation.

Notes on Propeller Scale Effect as Determined from Model-Ship Correlation, by R. B. Crouch.

A considerable volume of propulsion data is available from 22 trials on four sister ships (destroyers) undertaken for the investigation of ship's bottom paints. A statistical average from all trials run with clean propellers shows that the propeller open-water efficiency at the operating slip is within 0·5 per cent of the value obtained in the tank tests with model propellers of 7·8in. diameter. Discrepancies of about 3 per cent between the ship data and those for 16-in. diameter bronze propellers, which were also tested in the tank, have been traced to fouling. Wire brushing of the blades under water raised the propeller efficiencies to their original values.

Frictional Drag of Ship Forms, by A. J. W. Lap and L. Troost.

The usual assumption that the form-drag coefficient is independent of Reynolds' number is not supported by tests with geoisms. An equation showing a simple relation between the local and integrated viscous-drag coefficients of pipes, planks, and hull forms is presented which, when the scale effect on form resistance is taken into account, provides a simple solution for the problem of the roughness allowance for clean, freshly-painted new ship bottoms.

Notes on Ship Frictional-Resistance Measurements Obtained from Recent Trials, by R. B. Crouch.

The figures show that the roughness allowances for naval vessels are higher than those for merchant ships owing to the greater number of appendages and the use of bottom paints with a rougher surface. The values for the merchant vessels, which are all below 0·0004, are based on the assumption that the propulsive coefficients of the ship and the model are identical. Analysis of the trial data for the naval vessels for which thrust and torque values are available indicates that the propulsive coefficients for the ship are somewhat less than those for the model. Consequently, roughness allowances for the merchant vessels are probably higher than values based upon thrust would be.

Problems in Obtaining Reproducibility of Model Resistance Tests in Waves, by E. V. Lewis.

Comparative tests on models of a passenger ship differing only in the size of the bulbous bows (0 to 13·5 per cent of the midship area) show that great care must be taken to ensure uniform test conditions, if small differences between the resistances of models in waves are to be determined satisfactorily, e.g. the models must be identical in regard to lines, freeboard, radius of gyration, etc.; and the wave-making and test procedures must be standardized. A constant towing force method must be used in all cases, and the methods of determining supplementary data, such as heaving and pitching amplitudes, must not affect the freedom of motion of the model.

Correlation of Resistance Tests on Ship Models in Short Waves, by W. R. Jacobs and E. V. Lewis.

In attempts to establish trends in gravity dynamometer tests on seven models in waves of half the model length or less (so that pitching and heaving are negligible) it was recognized that the added resistance is due to interaction between the hull and the encountered waves. It was found that this added resistance in waves did not depend on the speed. Reasonably good correlation was obtained between the values calculated by means of a modified form of Kreitner's equation and the experimental results.

Seaworthiness Tests of Afterbody Variations, by W. F. Taylor.

For a given longitudinal radius of gyration, a model with transom stern in head seas was superior to a double-ender, but the superiority diminishes as the radius of gyration increases. In stern seas the shape of the afterbody had little effect at either radius of gyration. Reducing the natural pitching periods by decreasing the radius of gyration improved the behaviour of a given model in waves. For a given natural pitching period, the double-ender was superior to the model with transom stern. The critical wave length for pitching and speed loss, the pitching amplitude, and the loss of speed were sensitive to the wave height-length ratio.

Model and Full-Scale Studies of Ship Motions, by S. C. Gover.

Tests on models in waves showed that in waves of one ship length the V-bow, and in shorter waves the U-bow, was slightly the better; a cruiser stern suffered less loss of speed than did a transom stern in rough seas; a model at heavy displacement made faster speed than did one at light displacement. Full-scale trials included stereo-photographic studies on a ship rounding Cape Horn.—*Journal, The British Shipbuilding Research Association, June 1954; Vol. 9, Abstract No. 8,966.*

Strength of River Vessel in Waves

This paper, by R. Klaman, in the July 1953 issue of Morskoi, Rechnoi Flot, gives details of full-scale tests on the passenger and cargo river vessel *Uralsk*. The purpose of the tests was to determine the distribution of loads due to the waves, that may be encountered by a river craft on lakes. The particulars of the vessel were as follows:—

Length b.p.	185 feet
Breadth	26·6 feet
Depth	7·6 feet
Light displacement	330 tons
Draught in light condition ...	3 feet
Block coefficient	0·85
Water-line coefficient	0·88

The tests were carried out in light condition. The maximum wave length encountered was 33 feet and the height 3 feet, with a period of 3·8 seconds. Runs were made at 0 deg., 90 deg., and 270 deg. to the direction of the waves and records of pressure distribution and strains over the starboard side of the vessel were obtained. A detailed illustrated description is given of the type of pressure gauges used, and their positions on the hull of the vessel are shown in a diagram. Strains in the hull were measured by means of electric resistance strain gauges cemented to the deck, frames, and bottom longitudinals. The latter measurements were taken at twelve positions only and no details of gauges are given. No figures are given for the magnitude of stresses obtained from these tests, but it is stated that the additional stresses due to waves were found to be insignificantly small. The pressure distributions recorded during the tests are shown in a table. The practical conclusion derived from these tests was that additional loads due to waves on lakes were considerably smaller than those allowed for in strength calculations employed at present. In the concluding part of the paper, the author suggests that the present requirements of the Russian Classification Society for the determination of scantlings by inclining the vessel to a single on-coming wave leads to much higher theoretical stresses than those obtained from calculations based on the vessel placed head-on to the wave and much in excess of stresses actually experienced in river vessels. To prove his point, the author carried out calculations of bending moments for several barges with load-carrying capacities from 1,000 to 10,000 tons, and the results of his calculations are given in a table.—*Journal, The British Shipbuilding Research Association, June 1954; Vol. 9, Abstract No. 8,978.*

Welded Reinforcement of Openings in Structural Steel Members

The report serial No. SSC-56, 1954 of the Ship Structure Committee (U.S.) by D. Vasarhelyi, D. Hechtman, and Y. Yoshimi, includes the application of the methods of plastic analysis to reinforced plates. It deals with the tests of an unreinforced plate with a circular opening, two unreinforced plates with a square opening, and two plates with a reinforced square opening with rounded corners. The methods of plastic analysis previously applied to unreinforced plates gave satisfactory results for reinforced plates. Some of the conclusions reached are as follows: The maximum values of elastic and plastic stress, elastic and plastic strain, and unit distortional energy were located at the same point, the point where failure started. Apparently no theory of failure based upon a limiting value of stress, strain, or energy would yield a numerical value accurately indicating the imminence of failure. Such factors as the metallurgical characteristics and testing condition should be considered. The effect of low temperature was a steeper gradient of stress and unit energy in the neighbourhood of peak values, and the occurrence of low values over a larger area of the specimen. Cleavage fracture was accompanied by a less efficient stress distribution in the plastic range than shear fracture. The addition of reinforcements brought about a more uniform plastic stress and energy distribution, with smaller differences between extreme values.—*Journal, The British Shipbuilding Research Association, June 1954; Vol. 9, Abstract No. 8,983.*

Refrigerated Holds and Quick-freezing Installations in Trawlers

In a recent issue of Nouveautés Techniques Maritimes, J. Koch describes some early types of quick-freezing machinery installed on fishing vessels, and then discusses more recent developments in this field. Among the latter is the equipment on the trawler *Mabrouk* belonging to the Compagnie Marocaine de Pêcheries; this installation is identical to that tested earlier on the British trawler *Fairfree* and can handle some 12 tons of fish in 24 hours. One of the most recent quick-freezing vessels is the German trawler *Caribia,* put into service in 1953, and designed for tuna fishing in the warm zones of the Atlantic. The freezing of 22 tons of fish in 24 hours is achieved by direct expansion of freon 22. The compressors work with two stages of compression, and are directly coupled to electric motors fed by four 510-kVA Diesel-generators. The refrigerating circuits are combined to enable fruit, and particularly bananas, to be carried if necessary. The freezing tunnels are situated in the after 'tween-deck space, and are divided into 18 compartments which contain 18 trolleys carrying the fish pans of light alloy. Air at − 36·5 deg. F. is circulated by 18 fans, one for each compartment, while four evaporators each serve a block of four or five compartments. The doors of the compartments can be heated with electric current if they become frosted up. The frozen fish are kept in two holds having a total capacity of about 550 tons, and maintained at − 4 deg. F. by banks of cooling coils attached to the ceiling and walls. Mention is also made of the American experimental trawler *Delaware* designed for freezing the fish as caught for later processing ashore. The important advantage of this arrangement is that no space and manpower are needed on the trawler, which is usually a small vessel, for the gutting of the fish. According to an American report, quick freezing of whole fish gives good results, provided that it is done immediately after the catch.—*Journal, The British Shipbuilding Research Association, June 1954; Vol. 9, Abstract No. 9,037.*

Aluminium Sheathed Cables in Dutch Vessels

During the past four years, the Royal Netherlands Navy has had a number of new warships under construction and several have recently been commissioned. The ships have been fitted with a full complement of radar equipment and other recently developed electrical apparatus, and their electrical installations have, therefore, involved large quantities of electric cables. The Dutch engineers responsible for the construction were anxious to employ a type of cable that would provide efficient electrical screening without excessive weight, and sufficient mechanical strength to protect the insulation from damage without special coverings. A form of construction obviously satisfactory from the weight point of view was that employing a metal braid finish, but this was found to be unacceptable because the degree of screening afforded by braid fell short of the necessary high standard. Lead sheathed cable, on the other hand, while found to be satisfactory so far as screening was concerned, introduced additional weight on a scale that was sufficient to affect the desired loading of the ships. Eventually, after exhaustive investigations and tests, it was decided to employ aluminium sheathed rubber insulated cables produced by Johnson and Phillips, Ltd., these cables having been found to provide 100 per cent electrical screening with a minimum of weight. A high purity grade of metal is used for the sheath to afford the maximum resistance to corrosion in salt-laden atmospheres and to effect the necessary ductility. It contains 99·6 per cent aluminium, the main impurities being silicon, iron, and a little copper.—*Shipbuilding and Shipping Record, 8th July 1954; Vol. 84, pp. 43-44.*

Directionality of Strength in Hot Worked Steels

Steel that has been rolled or forged does not have the same mechanical properties in all directions. This directionality is called anisotropy and occurs in both cold-worked and hot-worked steel. In pressure vessel steels the greatest interest is in the properties parallel to and transverse to the rolling or forging direction. In rolled, forged or otherwise hot-worked steel, the tensile and yield strength exhibit little or no directional properties over a wide range of testing temperatures including sub-zero temperatures. However, other related tensile properties usually show anisotropy. Both elongation and reduction of area, for instance, decrease markedly as the angle between the test specimen axis and the rolling direction increases and approaches 90 deg. All notch properties exhibit directionality and invariably are inferior in the transverse direction, although the magnitude of the difference will, in some cases, depend upon the test employed and the criteria selected for comparison. This applies to the transition temperature, which may be considerably higher for specimens in which the notch is parallel to the direction of rolling than for specimens notched transverse or perpendicular to the direction of rolling. There is some indication that fatigue properties also are affected. The extent to which hot-worked steels exhibit anisotropy depends upon many variables. One of these is the amount of reduction in working. It has been demonstrated repeatedly that reduction by forging up to 3 : 1 or 4 : 1 improves both longitudinal and transverse properties (tensile and yield strength excepted). With continued reduction beyond this ratio the longitudinal properties improve only slightly but the transverse properties deteriorate markedly. Cross rolling tends to reduce the amount of directionality in plates. Steel quality, as evidenced by non-metallic inclusions, banding, segregates, porosity and voids, is probably the single most important variable which influences the amount of directionality found in hot-worked material. Evidence indicates that the number of discontinuous stringers of oxides and other brittle inclusions fragmented in rolling, as well as continuous stringers such as silicates and sulphides, correlates quite well with transverse ductility. As the inclusion count increases, transverse ductility decreases while the longitudinal ductility is not affected appreciably. There is agreement that non-metallic inclusions account for only a part of the anisotropy, and that segregation, such as carbide stringers, as well as heterogeneous distribution of elements in solid solution accounts for most of the remainder. Rolled plate used in construction of pressure vessels usually will exhibit lower ductility in the transverse direction than in the longitudinal direction. This difference, which is a function largely of steel-making and rolling practice, tends to be relatively low in cross-rolled plate. Since this directionality in properties is not recognized by any of the applicable Codes except in limiting the maximum thickness of structural quality plate, and since no failures of pressure vessels have been attributed to it, it is not always rated as a significant factor in pressure vessel design or fabrication.—*A. R. Troiano and L. J. Klingler, The Welding Journal, May 1954; Vol. 33, pp. 209s-217s.*

M.A.N. Diesels on Boiler Fuel

The success of heavy oil operation is to a large extent dependent on the design and the competent handling of the oil purifying plant. This problem has been repeatedly investigated. A layout for a 9,000 h.p. power plant elaborated by M.A.N. is shown in Fig. 10. Points deserving special mention are as follows: Arranged in front of the heated duplex filter is a preheater of ample dimensions. This serves as the main heater, the flow of steam being controlled by a thermostat provided on the control platform. A fuel pressure gauge, of course, should also be installed there. The pressure valve springs of the fuel pump should be powerful enough to prevent opening of the valves when the pressure goes up to 3-6 kg./cm.^{2}. In all modern power plants accurate measurement of the fuel consumption is considered very important. It is nowadays mostly accomplished with recording dial gauges (such as elliptic gear type meters) which afford the advantage that both interim checks and long-time consumption records can be obtained. However, there is reason to doubt the suitability of such meters for heavy oil operation and the makers have, therefore, installed a measuring tank. The valves indicated in the diagram permit the following alternatives: Normal operation on heavy oil:

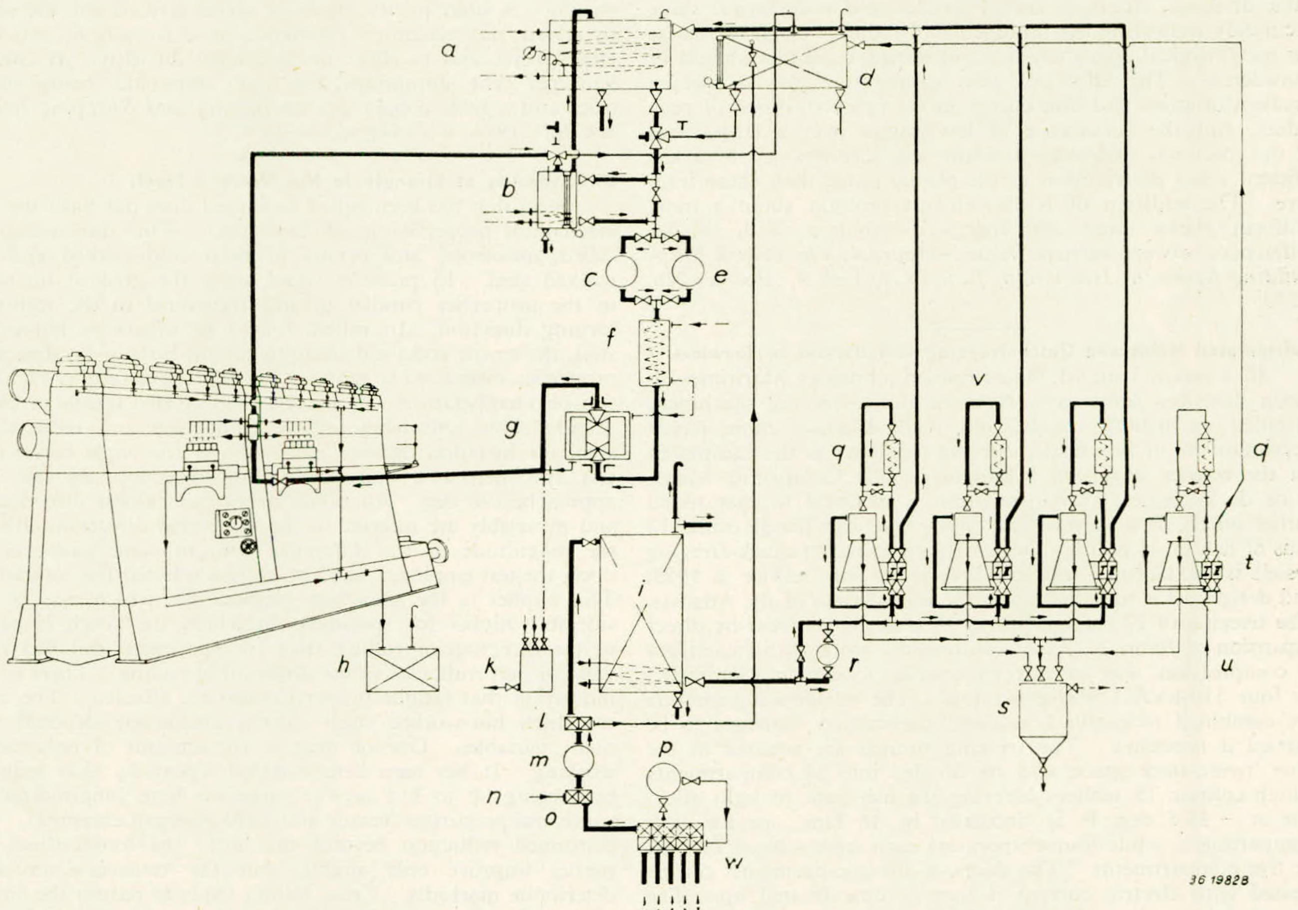


FIG. 10—*Layout of heavy oil pipes* ———; *heavy oil pipes with steam jacket* ———; *Diesel oil pipes* — · — · —; *steam pipes*

(a) Heavy oil service tank; (b) Measuring tank; (c) Fuel supply pump; (d) Diesel oil service tank; (e) Standby supply pump; (f) Preheater; (g) Duplex filter; (h) Leak oil tank; (i) Settling tank; (k) Condensate trap; (l) Pressure valve housing; (m) Service pump; (n) From Diesel oil storage tank; (o) Suction valve housing; (p) Refuelling pump; (q) Heater; (r) Strainer; (s) Sump tank: (t) Diesel oil separator; (u) From Diesel oil storage tank; (v) Heavy oil separators; (w) Valve manifold heating pipes.

located in the pipe between the filter and the engine. In many plants a reserve preheater is arranged in parallel. The two fuel supply pumps are electrically driven because the engine-driven pump would no longer be safe in case of accidental cooling. Since the lubricating oil and cooling water pumps, whose drive is also independent of the engine, must be started before the engine is put in operation, the fact that the fuel supply pump is added to the units requiring separate control cannot be considered an undue complication. In consideration of the aforementioned risk of getting fuel into the cylinders through leaky pressure valves and needle valve seatings, it is suggested cutting out the fuel supply pump whenever the engine is stopped for an extended period. It is, therefore, good practice to start and stop the fuel supply pump through a push-button switch Intermediate valve in main supply pipe open; two valves on measuring tank closed; 3-way cock over the tank set so that the spill fuel passes directly to the measuring tank. The latter serves as a buffer and venting tank from which the leak fuel is conveyed back to the heavy oil service tank through the riser pipe. Normal operation on Diesel oil: 3-way cock set so that the spill fuel passes to the Diesel oil tank. The three valves mentioned in the preceding paragraph remain in their original position. Measurement of heavy oil and Diesel oil consumption: Intermediate valve in the supply pipe to the fuel pumps closed; two valves on the measuring tank open. Setting of 3-way cock permits discharge into measuring tank to obtain an indication of the actual consumption of the engine.—*F. Schmidt, M.A.N. Diesel Engine News, 1954; No. 29, pp. 2-19.*

Contemporary Tugs

There are many classes of tug. Harbour tugs alone have a wide variety of characteristics, as witness the contrast between a ship handling tug in Liverpool and one in New York. Barge handling tugs, which may tow astern on the Thames, are required to tow alongside in most American harbours. American inland waterways are the home of tugs which do not tow at all, but push, and the pushing unit has to have fitted to it a false bow. There are, too, a few pushing tugs which combine pushing with normal towing. They operate in the Gulf of Mexico and on the eastern seaboard of the United States. One common characteristic, at any rate for the majority of tugs, is the large draught aft compared with that forward, and the single screw with large diameter coarse pitch propeller. And even then, some shiphandling tugs in Southampton, for example, have twin screws—why it has never satisfactorily been explained, but tradition may have much to do with it; and, of course, twin-screw, triple-screw and even quadruple-screw shallow-draught tugs operate on canals and riverways. A very general characteristic, in spite of a recent example to the contrary in Southampton, is the type of propelling machinery used to operate the screw or screws, and this is increasingly one of a number of good available makes of internal combustion engine. Now that this prime mover has achieved the reliability of maturity, coupled with the interest of the manufacturer after he has sold his engine and a good service of spare parts, its low fuel consumption with consequent effect upon endurance, and elimination of stand-offs for boiler cleaning, has given it wide recommendation. The most disturbing influence in tug evolution recently has been the arrival of the very large tanker and ore carrier. One ship of 60,000 tons deadweight is now in service, and a good average tonnage for ocean-going tankers today is in the neighbourhood of 20 to 25,000 tons deadweight. This has called for the construction of shiphandling tugs whose duties are more exacting than those intended to handle passenger ships; for however big a passenger ship may be the differences in draught light and loaded are not great and the windage it carries is generally understood, whereas a tanker may be loaded to well over 30 feet on her arrival and may be light at some time between her arrival and her departure. The example in the table of a New York harbour and Hudson River tug of 1,500 h.p. shows the way in which the Americans are tackling things. This big tanker-handling tug is typical of the latest American Diesel-electric practice, in which one standard machinery unit is fitted complete with generator and exciter, and supplies the current to two electric motors geared to the shaft. This is now standard American practice. Bridge control is fitted, though there is also complete propulsion control in the engine room in the event of its being required. Holland is building a tug for tanker work in the Suez Canal which is claimed to be the most powerful ever constructed; it will develop 4,500 s.h.p., and is a twin-screw unit with Diesel engines driving variable pitch propellers direct. The hull is 150 feet 10 inches in length, with a beam of 39 feet 3 inches. Dimensions and power are well in the zone of those of an ocean-going salvage and towage vessel, and the latter are invariably built with a single screw. The large tanker is posing problems to tug owners everywhere. The position is not an easy one for tug owners, because while they may require some units capable of handling the large ship, they cannot neglect their ordinary bread and butter work, which may well range from docking a 10,000-ton tramp to taking hopper barges to sea. The table accompanying this article has been prepared as a cross-section to recent completions of tugs in the general shiphandling category; it includes three important steam examples, two of which have ordinary triple-expansion units direct coupled to the screw and taking steam from oil-fired Scotch boilers, while the third—working in a North African port—is fitted with a compound engine having one high pressure and two uniflow low pressure cylinders; this takes steam from a Scotch boiler burning fuel oil. Unfortunately, no details are available concerning steam temperatures or pressures, but a very

SOME RECENTLY COMPLETED SHIPHANDLING TUGS.

Zone of operation	Tug type	Total horsepower (r.p.m.)	No. of screws	Type of main machinery	Drive	Draught L. × B.	Remarks
St. Nazaire	Harbour and sea-going	12-1,500 s.h.p. (250-320)	1	S.A. two-str. Diesel	Direct	14 ft. 10 in. (aft) 109 ft. (b.p.) × 25 ft. 7 in.	Built in Holland, U.K. engines.
Le Havre	Shiphandling	1,500 i.h.p. (128)	1	Steam triple expansion	Direct	13 ft. 9½ in. (aft.) 125 ft. × 34 ft.	Built and engined in U.K.
Suez Canal	Ship and barge handling	1,150 i.h.p.	1	Steam triple expansion	Direct	13 ft. 6 in. (aft) 138 ft. (o.a.) × 26 ft.	Built and engined in U.K. Fitted for alongside towing.
Oran	General port towage	400 i.h.p. (160)	1	Steam compound	Direct	9 ft. 7 in. (mean) 94 ft. 8 in. × 22 ft. 2 in.	Dutch built and engined.
Thames	Shiphandling	500 s.h.p. (143)	1	S.A. four-str. pressure-charged Diesel at 430 r.p.m.	Reduction-reverse gear	— 82 ft. 6 in. × 21 ft. 6 in.	Bridge control.
Thames	Shiphandling	1,200 b.h.p. (250)	2	S.A. two-str. Diesel	Direct	12 ft. 2 in. (aft) 85 ft. × 24 ft.	Telegraph control
Freetown harbour	Shiphandling	1,000 b.h.p. (216)	2	S.A. two-str. Diesel	Direct	12 ft. (aft) 110 ft. × 30 ft.	10-ton derrick on main mast.
New York harbour and Hudson River	Ship and barge handling	1,500 b.h.p. —	1	Diesel-electric with one generator S.A. two-str.	Electric	— 105 ft. × 27 ft.	Built for handling large tankers.
Cleveland harbour	Ship and barge handling	1,600 b.h.p.	1	Diesel-electric with one generator, S.A. two-str.	Electric	— 110 ft.	Low superstructure for bridge work.
Copenhagen harbour	Shiphandling	500 b.h.p.	1	S.A. two-str. Diesel	Reduction gear and V.P. propeller	78 ft. × 20 ft.	Icebreaker bow.
Middlesbrough harbour	Shiphandling	750 b.h.p. (320 engine r.p.m.)	1	S.A. two-str. Diesel	Reduction-reverse gear	— 80 ft. × 33 ft. 6 in.	Bridge control.

low steam consumption is claimed. The propulsive machinery for the tugs built respectively for Le Havre and the Suez Canal in a British shipyard call for little comment, being quite orthodox.—*A. C. Hardy, "The Shipping World", 9th June 1954; Vol. 130, pp. 593-594.*

Welding Manganese Steel

Manganese steel is very tough, but it is difficult to retain this toughness after welding. Experience and research have shown that the following procedures are helpful. 1. Manganese steel weld metal should not be mixed with carbon or low alloy steels. The result is brittle metal that is likely to contain serious cracks. Electrodes containing from 0·060 to 0·90 per cent carbon, over 13 per cent manganese and either 3-4 per cent nickel or 1-2 per cent molybdenum should be used for welding on manganese steel. If manganese steel is to be overlaid on carbon steel, separate them with a layer of austenitic stainless steel like Type 310 (25 per cent Cr: 20 per cent Ni). 2. Manganese steel can be welded with austenitic stainless electrodes, but their use should be avoided if any flame cutting may be done later, since they resist it very effectively. They also are comparatively expensive. Nickel or molybdenum manganese steel can be cut readily with an oxy-acetylene torch. 3. Oxy-acetylene welding of manganese steel should be avoided. It is likely to cause marked embrittlement of the base metal. 4. The lowest possible arc power should be employed. The limit is imposed by arc instability and incomplete fusion bonding. For critical jobs experiment with scrap metal before proceeding. 5. Generators supplying a high open-circuit voltage are preferred for ease in arc striking. 6. Reversed polarity direct current (the work should be negative) is preferred for both coated and bare rods. 7. Small weld beads should be avoided. A bead with a large cross-section is stronger and resists cracking better. This is particularly important for the root pass of butt welds. 8. Deposition with a weaving, crescent motion is helpful in avoiding slag inclusions. 9. Immediate peening of the red hot bead will minimize cracking, which is more common than is generally realized. Peening will also reduce warping.—*H. S. Avery and H. J. Chapin, The Welding Journal, May 1954; Vol. 33, pp. 459-479.*

R.T. Contact Between Fishing Vessels

The first application of V.H.F. radio communication in fishing craft in this country is that recently supplied by Rees Mace Marine to the Claydeep Fishing Company, of Grimsby. The equipments concerned are PTC, 115 V.H.F. transmitting and receiving units working on 156·3 mc/s. for inter-ship communication between the two vessels *Nenana* and the *Tenana*. Included in the equipment is a loudhailer/loudspeaker which has an audible range of about two miles. The *Nenana* and *Tenana* use the V.H.F. equipment primarily when pair-fishing so that direct communication can be established on the radio-telephone clear of the congested channels associated with medium frequency communications. The equipments are powered by 24 volts from the ship's battery supply.—*Shipbuilding and Shipping Record, 1st July 1954; Vol. 84, p. 14.*

Largest Irish Lightship

Irish Lights vessel No. 1, the *Gannet*, the largest ever to go into service on the Irish Coast, has arrived in Dunlaoghaire Harbour after being towed 350 miles from Dartmouth by the Irish Lights tender *Isolda*. The vessel has been specially strengthened to withstand the severe gales round the Irish Coast, and exceptionally large bilge keels have also been fitted to minimize rolling. She is shortly to proceed to the Kish Bank Station to relieve the *Albatross* which has spent three years at sea. The crew accommodation consists of two single-berth cabins and two double-berth cabins with one single-berth cabin for the leading hand. The master's accommodation is separated from the crew's and consists of a sleeping cabin on the port side and a day cabin on the starboard side. All accommodation is heated by hot water radiators which are operated from an oil-fired boiler in the machinery space. The fog signal diaphone fitted at the fore end of the steering shelter is of the "G" type, air operated and supplied by Chance Bros. The steering shelter is linked up with the master's cabin and machinery space by telephones and a loudhailer is installed for communication with vessels in the vicinity. Radio beacon and radio-telephony have been installed by the Marconi Wireless Telegraph Company. The machinery space is situated amidships where the lighting sets, fog signal sets and three large air receivers are installed. The lighting sets consist of four Ruston and Hornsby IVSHZ oil engines of 7½ b.h.p. at 1,000 r.p.m., each coupled with a clutch to a Reavell F.R. 5¼ × 16 air compressor for supplying air to receivers. Explosive fog signals are operated electrically and are fitted to booms port and starboard at the after end of the vessel. The mainmast has a truck fitted for hoisting a trysail for steadying purposes, also provision has been arranged for a day mark. The light in the new vessel is in a fixed structure amidships in the shape of a tower, the beam of the light, which is electric, being 40 feet above sea level and visible in clear weather for twelve miles. —*Shipbuilding and Shipping Record, 1st July 1954; Vol. 84, pp. 13-14.*

Shielding Corrosion

The type of pitting which occurs on stainless steels beneath adherent deposits of dirt, etc., from polluted atmospheres is also known to occur under other conditions where the surface of the steel is shielded in such a manner that free access of oxygen is precluded. Stainless steels depend for their corrosion-resisting properties on an invisible oxide film which is spontaneously formed and maintained by the oxygen in the atmosphere and prolonged stationary contact with damp substances such as wood, asbestos, leather, etc., can cause breakdown of the passive oxide film. When this occurs, quite appreciable pitting and corrosion can be produced by simple moisture, etc., which under normal conditions, with free access of oxygen to the surface of the steel, would not cause any attack at all. Stainless-steel spindles fitted with asbestos or leather packings usually operate entirely satisfactorily in service, where the spindles are moving in the packings. "Shielding" corrosion can occur, however, if new spindles fitted with such packings are held in store for long periods, under conditions which are not perfectly dry, or if the packings have absorbed moisture during hydraulic or steam pressure testing before storage. As with atmospheric corrosion (which may be regarded as being partly due to "shielding" effects), molybdenum-bearing stainless steel offers a superior degree of resistance to "shielding" corrosion. Here again, however, the use of this relatively expensive quality is not always necessary if simple precautions can be taken in design and service to avoid circumstances under which "shielding" corrosion may occur. This description of shielding corrosion is based on an article published in a recent issue of "Enchiridion", the house magazine of Firth Vickers Stainless Steels, Ltd.—*Corrosion Technology, June 1954; Vol, 1, p. 9.*

Theory of Propellers

This paper contains a brief exposition of the propeller theory, giving exact expressions for thrust torque and efficiency based on the knowledge of the flow function ψ, as it appears far behind the propeller. The expressions obtained depend almost entirely on one field parameter, the mass coefficient x, with only a very slight dependency on a second factor ϵ, the axial-loss factor. As a consequence, the propeller-selection problem has been reduced to its simplest form. The blade-design problem is reduced to a final and separate step requiring only the knowledge of the usual two-dimensional section characteristics.—*T. Theodorsen, European Shipbuilding, Vol. 3, No. 4, 1954; pp. 104-107.*

Compiled and published by the Institute of Marine Engineers