Abstracts of the Technical Press

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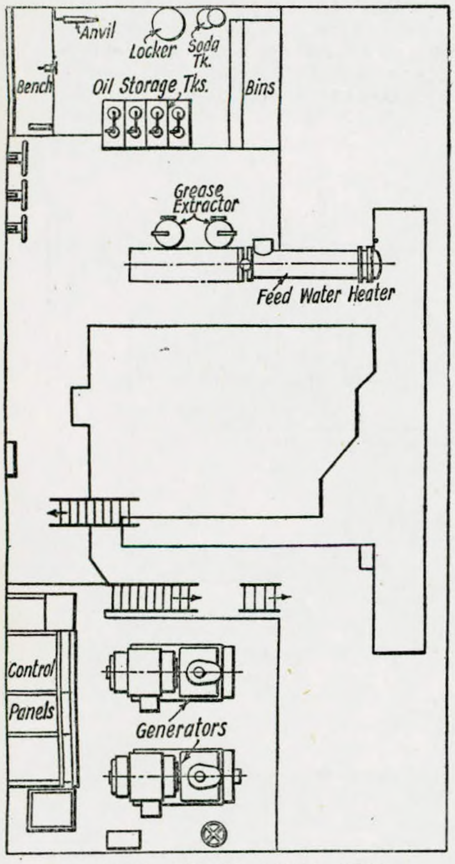
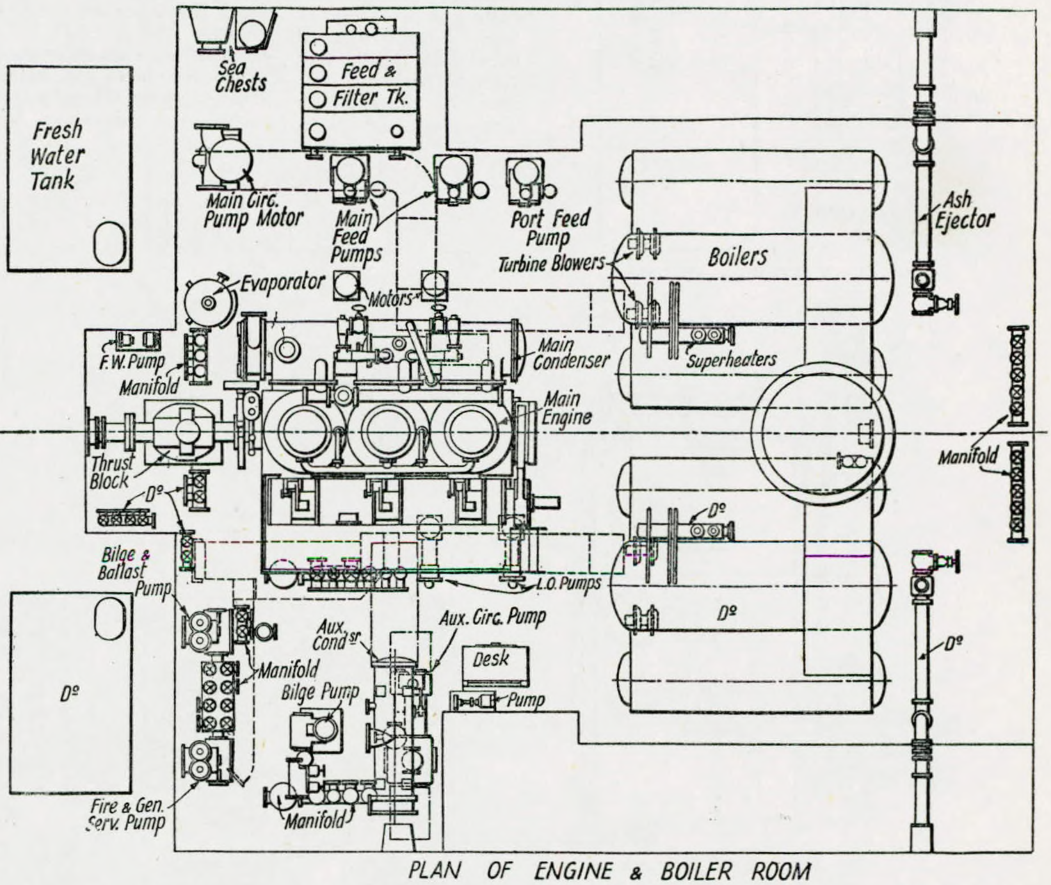
Ajax-engined Steamship "Alden Gifford".

The accompanying drawings show the lay-out of the engine and boiler room of the American-built cargo steamer "Alden Gifford", the first of a considerable number of single-screw vessels of moderate size equipped with Ajax three-cylinder compound uniflow engines to be built for the U.S. Maritime Commission. The Ajax engines (*see abstract on p. 90 of* TRANSACTIONS, *October, 1944*) are units of the steeple type with single-acting H.P. and L.P. pistons on a common rod. There is a common steam-jacketed cover, which houses the piston-type steam-distribution valve, placed at cylinder height between the two pistons. The L.P. cylinder operates on the uniflow principle and the unusual position of the horizontal piston valve provides a measure of interstage reheating and enables one valve to serve both cylinders. All the working parts are totally enclosed and a neat arrangement of chain-driven camshaft and valve gear is provided. The H.P. cylinders are 20in. and the L.P. ones 44in. in diameter, with a piston stroke of 27in. The engine develops 1,300 i.h.p. at 100 r.p.m. when supplied with steam at a pressure of 220lb./in.^{2} and 440° F. total temperature. The unit is arranged for forced lubrication, oil feeds to the double crosshead being a feature of the design. The counterbalanced crankshaft is said to give very smooth and quiet running. Separate duplicated horizontal steam-driven direct-acting forced-lubrication pumps are installed under the lower engine platform, on top of the external lubricating oil drain tank, to which a drain pipe is led from the after end of the bottom of the bedplate. The oil cooler is placed above the pumps, where it is accessible from the platform, and suitable oil alarm horns are incorporated in the system to give warning of any drop in the pressure of the lubricating oil. The circulating water for the oil cooler is tapped from the main condenser circulating pump discharge. Separate mechanical lubricators, with a steam heating device for warming the oil when starting up in cold weather, are fitted for cylinder lubrication. Two coal-fired watertube boilers are installed in the "Alden Gifford" and her sister ships, and most of the E.R. auxiliaries are driven by electric motors. Tabulated results of the sea trials of 26 identical vessels of this type equipped with Ajax engines show that in nearly every case the designed full power was attained or exceeded with a cut-off of about 50 per cent., the corresponding m.e.p. being about 46lb./in.^{2}. The average i.h.p. was appreciably above the rated figure at the designed service speed of 100 r.p.m., while the boiler pressure was more than 20lb./in.^{2} lower than the designed value.—*"The Marine Engineer", Vol. 68, No. 816, July, 1945, pp. 352-357.*



PLAN BELOW MAIN DECK



PLAN OF ENGINE & BOILER ROOM

Cylinder Lubrication on Reciprocating Steam Engines.

The earliest method of lubricating cylinders was by means of tallow cups on the cylinder tops and these are still to be found on many engines for flushing and emergency purposes. Prior to the adoption of mechanical lubricators for cylinder lubrication, hydrostatic lubricators were employed, and there are still a great number of these in service at the present time. In this type of lubricator, oil is forced through the delivery pipe under the action of the steam pressure against a head of water in the lubricator together with the normal tendency of oil to rise above water due to its lower specific gravity. The basic principles are illustrated in Fig. 10. Steam from the main line passes through (A) into the condenser (B), and the water then passes down the pipe (C) under the oil in the lubricator, thus lifting up the oil and causing it to flow down the pipe (D). The hydrostatic pressure of the water then forces it up through the orifice (E) into the sight feed glass (F) and thence into the main steam line via the pipe (G) through the atomiser (H). A hand regulator to govern the supply is provided. The main defect of this type of lubricator is that the quantity of oil fed varies with its viscosity and therefore any change in temperature affects the rate and quantity of supply. Moreover, such lubricators cannot be accurately adjusted to feed very small quantities and the small oil passages are liable to become choked with dirt, resulting in an irregular feed. They also need to be stopped and started with the engine, as omission to stop them means a waste of oil. The mechanical lubricators which have largely replaced the hydrostatic ones give reliable and accurately-controlled feeds under all conditions of temperature and viscosity of oil. The best makes can be regulated to feed as little as one drop per hour and to do this with perfect reliability. They stop and start automatically with the engine and any number of feeds may be contained in the same unit driving from the same source, each feed being from its own individual pumping unit affording individual adjustment of supply. Separate compartments can be provided in the same unit so that two different grades of oil may be used. This provides for two grades of cylinder oil, if required, for H.P. and L.P. cylinders, or the bearing oil may be contained in the one compartment and the cylinder oil in the other. This latter is a somewhat dangerous practice, as a mistake in filling the compartments with the correct grade of oil in each may produce disastrous results. Mechanical lubricators can be designed for almost any type of drive—rotary, ratchet, lever, etc. Fig. 15 shows a modern type of mechanical lubricator with a differential plunger having two diameters. The displacement area equal to the volume of oil pumped per stroke is the difference between these two cross-sectional areas. This gives a very small displacement whilst employing a substantial plunger diameter and a long stroke. Mechanical lubricators of this type having up to 10 feeds each are fitted to the engines of many modern steamships, including those of the "Ocean" and "Liberty" classes.—*E. V. Paterson, "The Steam Engineer", Vol. XIV, No. 166, July, 1945, pp. 309-310.*

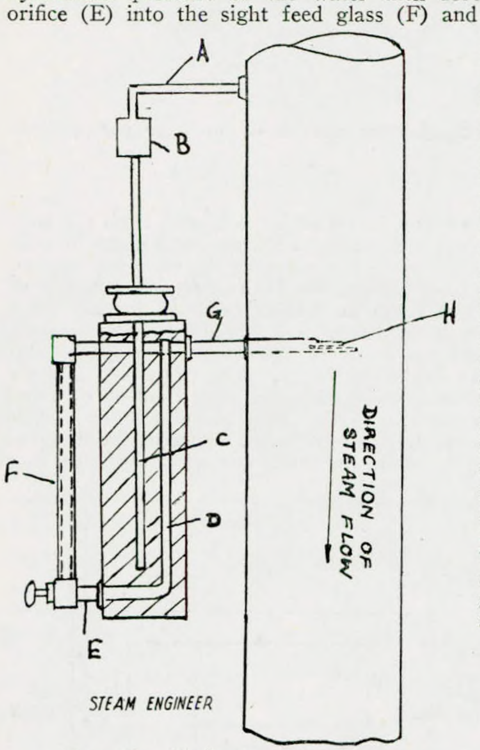


FIG. 10.—*Hydrostatic lubricator.*

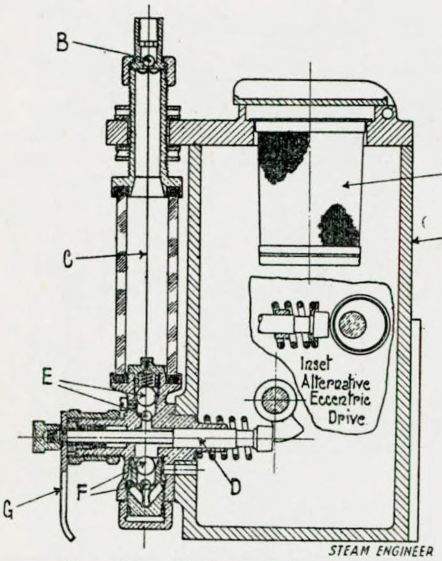
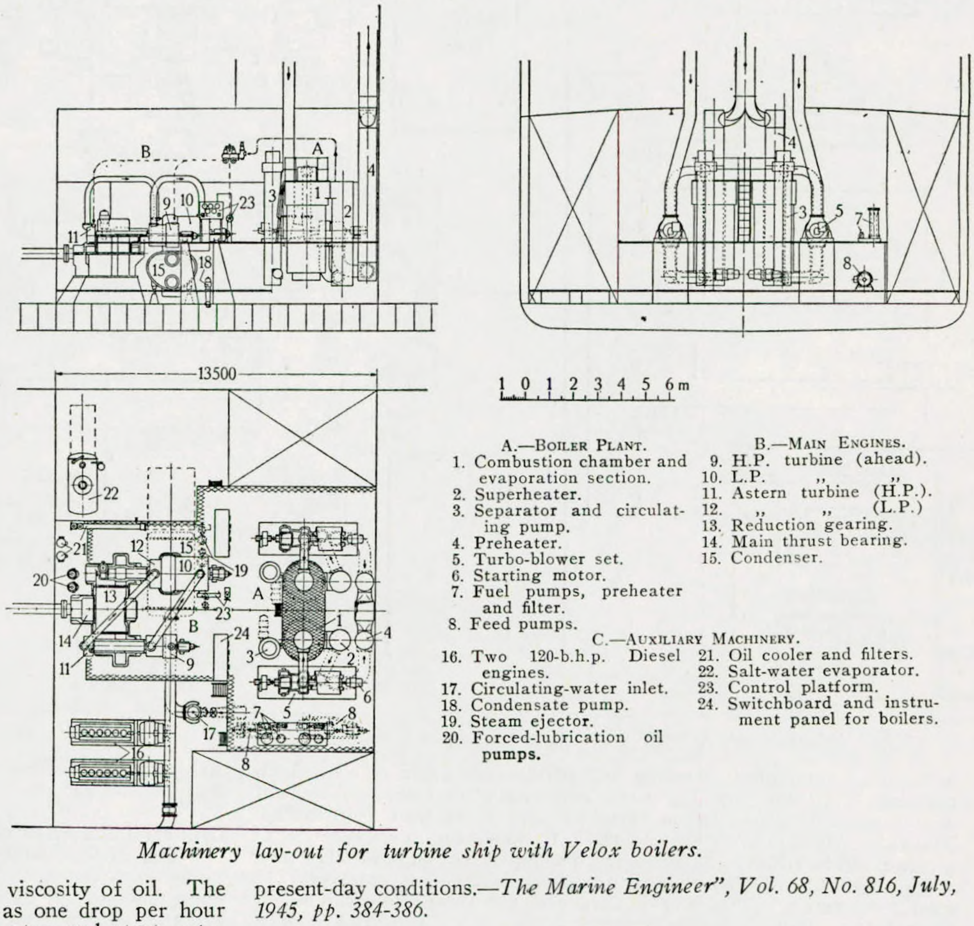


FIG. 15.—*Mechanical lubricator.*

A—Container. E—Delivery valves.
B—N.R. valve. F—Suction valves
C—Guide wire. G—Flushing trigger.
D—Pump plunger. H—Strainer.

Velox Steam Generators for Ships.

The accompanying diagram shows the lay-out of the machinery space of a single-screw vessel with a 6,000-s.h.p. set of two-casing Brown Boveri D.R. geared turbines supplied with steam at a pressure of 570lb./in.^{2} and total temperature of 750° F. by two Velox boilers installed at the forward end of the machinery compartment, the length of which is under 45ft. The auxiliary machinery is electrically-driven, the power being supplied by two generators, each driven by a 120-b.h.p. Diesel engine. The efficiency of the boilers, inclusive of all their auxiliaries except the turbo feed pump, is stated to be 92 per cent. and the total weight 52 tons, *i.e.,* 26 tons per boiler. Each boiler has an output of 12/16 tons of steam per hour. With circulating water at 82° F., the overall specific fuel consumption of the installation is given as about 0·60lb. of oil fuel per s.h.p.-hr. The proposed machinery installation is described in the Jan.-Feb. 1945 issue of *Brown-Boveri Mitteilungen,* which contains a lengthy article dealing with the suitability of Velox boilers for marine applications under present-day conditions.—*The Marine Engineer", Vol. 68, No. 816, July, 1945, pp. 384-386.*



Machinery lay-out for turbine ship with Velox boilers.

Machinery Arrangement of the "Queen Elizabeth".

Although she has been in commission since 1940, it is only quite recently that newspaper representatives have been permitted to inspect and describe the Cunard White Star liner "Queen Elizabeth", 83,673 tons gross, the world's largest liner. The vessel is a companion ship to the "Queen Mary", 81,235 tons gross, but her design embodies a number of modifications and improvements which affect the general appearance of the newer ship. The "Queen Elizabeth" has only 12 watertube boilers instead of 24, as in the "Queen Mary", but they are of much greater size and operate at a higher pressure than those of the last-named vessel. This has made it possible to reduce the number of funnels from three in the "Queen Mary" to two in the "Queen Elizabeth", the latter vessel also being some 20ft. longer than her companion ship. Among other differences is the elimination of the large ventilators on the top deck of the newer vessel, the ventilating trunks being arranged in housings at the bases of the funnels. There is also an additional deck, known as the sun deck, which is mainly occupied by accommodation for the engineering staff and is connected to the engine room by lifts. The arrangement of the machinery and boilers in the two ships is affected by the fact that there are no cylindrical boilers for the hotel services in the "Queen Elizabeth". From forward, the arrangement of her machinery spaces is No. 1 boiler room with two boilers, No. 2 boiler room with four boilers, then the electrical generator rooms, followed by No. 3 boiler room with four boilers and No. 4 boiler room with two boilers, and, finally, the forward and after engine rooms, each containing two sets of S.R. geared turbines, with four turbines per gear-wheel. The boilers are all of the same size and hold 24 tons of water each. The oil-burning equipment comprises seven burners per boiler, fitted in line horizontally, but with the two outer burners on each boiler slightly angled inwards to assist concentration of combustion. The boilers are all fired athwartships. A novel feature in the equipment of the boiler rooms is a radiometer to supplement the usual illuminated smokebox windows. This instrument indicates electrically the density of the smoke in the funnel into which any specific boiler is discharging. The arrangement of the turbines in the main engine rooms is unusual in that two turbines, the H.P. and first I.P., are located on one side of the gear-case, whilst the second I.P. and the L.P. are on the other. Moreover, the pair of turbines which are forward in the forward engine room are aft in the after one, and vice versa. This is to enable the condensers, which are not underslung, to be installed in the wings and amidships in the two engine rooms. Each H.P. turbine has four nozzle valves, and when all these are shut, about 145,000 s.h.p. can be developed. This condition and power are sufficient for normal operation, but the machinery is easily capable of developing over 200,000 s.h.p. when required. All the auxiliaries are electrically driven, power at 220 volts d.c. being supplied by four 2,200-kW. turbo-generator sets, each with its own auxiliaries and condenser. They are arranged in two separate compartments. At the present time the "Queen Elizabeth" is employed as a troop transport and the upper suites of passenger cabins each contain accommodation for six officers in two-tier, steel-framed, spring-mattressed bunks, with a couple of mats, chairs and a utility table to supplement the built-in wardrobe and lavatory basin. A number of minor structural alterations will be necessary for the conversion of the vessel for normal passenger service, but it is not anticipated that this work will take more than three to four months to complete.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,619, 28th June, 1945, p. 3.*

Five New Cunard White Star Liners.

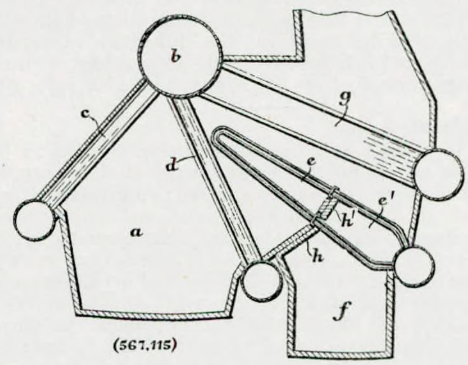
In a statement recently issued on behalf of the Cunard White Star Line, Ltd., Sir Percy E. Bates, Bt., G.B.E., announced that the company are proposing to build five new ships, totalling about 76,000 gross tons. Two of these vessels, to be constructed by Sir Jas. Laing & Sons, Ltd., will be cargo liners; two, to be built by John Brown & Co., Ltd., and Harland and Wolff, Ltd., respectively, will be passenger-and-cargo ships carrying about 250 passengers; while the fifth vessel, also to be built by John Brown & Co., Ltd., will be a passenger vessel similar to the "Mauretania" (35,677 gross tons), but slightly smaller. The cargo liners will be of the two-deck type, 480ft. × 63ft. 9in. × 34ft. 10in., with a d.w. capacity of 12,000 tons and geared-turbine machinery of 8,000 s.h.p. designed to give a speed of 15 knots.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,637, 19th July, 1945, p. 8.*

Silica Deposits in Steam Turbines.

The formation of silica deposits in steam turbines is discussed in an article published in a recent issue of *Combustion,* in which reference is made to a paper on this subject by F. G. Straub and H. A. Grabowski read at a meeting of the American Society of Mechanical Engineers. With steam pressures up to about 600lb./in.^{2}, the deposits forming on turbine blades are soluble in water, but where higher steam pressures are used there is a tendency for the blades in the L.P. stages to become coated with insoluble deposits. Laboratory tests confirm that silica leaves the boiler as vaporised silicic acid, but the conditions are such that the amount in the steam is much lower than that corresponding to the true vapour pressure of the solid silicic acid at the temperature and pressure of the live steam, and it is not until a certain amount of expansion has occurred that silicic acid is deposited in crystalline form. The higher the silica content of the steam leaving the boiler, the nearer to the H.P. end of the turbine will the deposition of silica begin. The authors gave data from power-plant tests designed to determine the relation between the silica contents of the boiler water and steam; also, the changes occurring in the silica content of the steam as expansion proceeds. These tests showed that no appreciable deposition of silica takes place when the silica content of the boiler water is below 5 p.p.m. and the *p*H of the boiler is about 11.0, but that such deposits occur if the silica in the steam becomes greater than 0.1 p.p.m. To avoid this type of deposit, the silica in the steam must be kept very low, either by keeping the silica in the boiler water very low, or by removing it from the steam before superheating, by scrubbing the saturated steam with water low in silica. The latter course offers the advantage that entrained boiler water is also removed, thus avoiding soluble as well as insoluble deposits.—*"The Power and Works Engineer", Vol. XL, No. 469, July, 1945, p. 167.*

Improvements in Watertube Boilers.

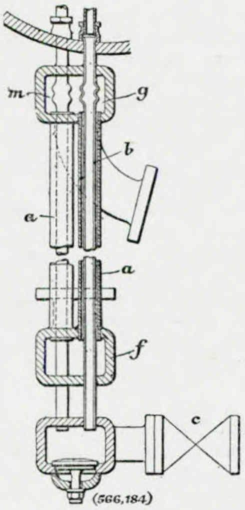
A new British patent issued to Sir Harold Yarrow, Bt., covers an invention which is claimed to afford a means of controlling the temperature of the steam in a watertube boiler irrespective of the rate of generation and with only a single superheater. Referring to the accompanying sectional diagram, the gases pass from the furnace



(*a*) to one side of a steam drum (*b*), a bank of generating tubes (*c*) receiving heat by radiation only. The gases pass in the usual manner through a second bank of generating tubes (*d*). The single superheater is divided into an upper part (*e*) and a lower part (e^1). The gases from the furnace (*a*) transfer heat by convection to the upper part of the superheater, while the lower part is heated by direct radiation from a second furnace (*f*), the gases from which pass through the lower part (e^1) of the superheater and through a further bank of generating tubes (*g*). The two furnaces (*a*) and (*f*) are separately fired, so that the amount of heat generated may be varied to suit different conditions. The arrangement is such that the boiler is operated at its full evaporative capacity and the steam is at its full temperature when only the furnace (*a*) is fired, whilst the second furnace (*f*) is intended to be fired if the boiler is being operated at reduced loads, when the amount of heat generated in the furnace (*a*) is reduced and the temperature of the steam tends to drop. A baffle (*h*) divides the superheater into its two parts, and the upper end (h^1) of this baffle is movable along the superheater so as to vary the relative areas of the parts (*e*) and (e^1), the lower edge of the baffle remaining in contact with the water drum of the boiler. An economiser can be mounted in the uptake, if required. Where the boiler is required at times to operate at a lower steam temperature than that which can be provided with the arrangements shown, the Yarrow system of interstage desuperheating in the superheater drum by means of a water spray can be used. The invention covered by the patent is primarily intended for use with a Yarrow single-flow boiler, but it can equally well be applied to a double-gas-flow Yarrow boiler where, in place of the generating tube bank (*c*), a deep bank is provided, and the gases which pass on either side of the steam drum are damper controlled to vary the proportions passing through the evaporative or the superheating side. The second furnace (*f*) then serves as an additional steam-temperature control, and the damper control replaces the spray for reducing the steam temperature.—*"Engineering", Vol. 160, No. 4,150, 27th July, 1945, p. 80.*

Improved Design of Superheater.

A British patent recently granted to Sir Harold Yarrow, Bt., covers an important type of superheater unit, which is illustrated in the accompanying sectional diagram. It consists of an outer tube (*a*) and inner tube (*b*) connected to the water space of the boiler. A



valve (*c*) controlling the flow of water through the inner tube can be operated either manually or by a thermostat fitted in the superheated-steam outlet. The annular space between the tubes (*a*) and (*b*) forms a passage for the steam, and a saturated-steam inlet leads to a header (*f*) through which access to this space is obtained. An outlet from this space leads to a further header (*g*) from which the superheated steam passes to the steam range. The upper end of the inner tube (*b*) is connected to the steam drum of the boiler. The outer surface of the outer tube (*a*) is in contact with the furnace gases and the temperature of the steam is regulated by the amount of water passing through the inner tube (*b*). If desuperheating is not desired, the valve (*c*) is kept closed, and all the water in the inner tube is evaporated. An intermediate tube between the outer tube (*a*) and the inner tube (*b*) is provided with fins, which are in contact with the inner surface of the tube (*a*). The object of these fins is to conduct heat to the inner tube, and thus prevent overheating of the outer tube. Where provision must be made for the difference in expansion between the tubes (*a*) and (*b*), the inner tube is provided with expansion rings (*m*).—*"Engineering", Vol. 160, No. 4, 148, 13th July, 1945, p. 40.*

Cellular Factory-built Boilers.

An article in *Power* describes how forced-circulation boilers of the sectional type were first developed by the Besler Corporation, of Emeryville, Cal., to meet widely varying requirements in output, temperature and pressure for test purposes and other special needs without the expense of designing and building special units for each. The essential feature is the assembly of a number of mass-produced standard sections in the appropriate number and arrangement to obtain the desired capacity and steam conditions. Such boilers with an evaporative capacity of 500 to 15,000lb./hr., steam pressures up to 1,500lb./in.^{2} and final temperatures of up to 900° F. have been supplied to turbine and engine builders for test-bed use, and to shipyards for testing valves, fittings, pipe-lines, etc. Wider applications are now under consideration, including industrial boilers using sections of 5,000lb./hr. capacity. Fig. 3 shows a Besler sectional boiler having

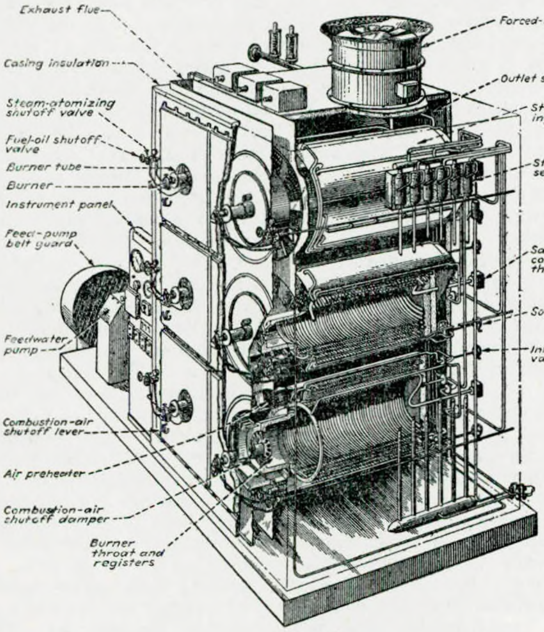


FIG. 3.

separately-fired forced-circulation sections each consisting of a cylindrical combustion chamber formed by a helical coil of small-bore tubing, and equipped with an oil (or gas) burner, soot-blower, air preheater and all the requisite automatic controls. One feed pump and a forced-draught fan serve the entire assembly. The latest arrangement is to use separately-fired superheater sections with cyclone separators to remove excess water from the saturated steam delivered by the evaporative section. A damaged unit can be replaced by a new factory-made assembly within a few hours, if necessary. Sections can be put in or out of service very quickly, so that the units in operation at any given moment are reasonably well loaded. The low water content and small heat-storage capacity permit very rapid heating from cold and almost instantaneous shut-down without damage or serious heat loss. The latest high-capacity industrial boilers of this type can be put into service in 10 minutes from cold if desired. These boilers are particularly useful for peak-load and stand-by service, as they can be shut down without serious loss during the night or at week-ends for single-shift working.—*"Boiler House Review", Vol. 59, No. 7, July, 1945, p. 186.*

Fundamentals of Controlled Forced Circulation.

An article in a recent issue of *Combustion* points out that although descriptions of "controlled" forced-circulation boilers have frequently been published, some of their basic features have not always been understood. Such boilers are not to be confused with forced-circulation designs in which the water is not re-circulated through the steam-generating tubes and which do not employ drums. The accompanying diagram (Fig. 1) shows the arrangement of a controlled forced-circulation boiler in which the circulation is controlled

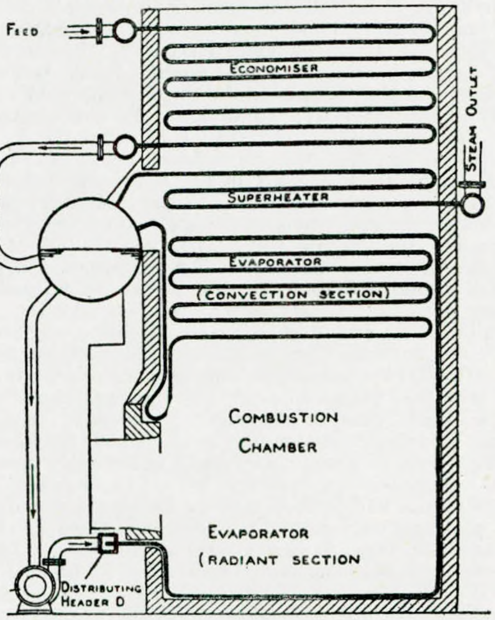


FIG. 1.

by means of orifices at the inlets to the furnace-wall circuits, all selected to provide correct resistance for the desired distribution of flow. Positive circulation is ensured by a pump at the base of the downcomer, between the boiler drum and the inlet to the steam-generating tubes. The steam drum is generally located above the highest point of steam generation, but this is not essential, and very low-head units can be employed, if required, adequate and controlled circulation being obtained regardless of the operating pressure and of whether the steam-generating tubes are vertical or horizontal. It should be noted that the circulating pump has to develop only the pressure required to overcome the resistance of the orifices and circuits, less any thermal head available. This pump is quite independent of the feed pump, and although the pressure it develops rarely exceeds 40-50lb./in.^{2}, it circulates water at a rate usually from three to four times the rate of steam generation at full load. Adjustment of the orifices permits the circulation ratio in individual circuits to be altered as desired; for example, a higher circulation ratio is required in the furnace-wall tubes exposed to high and variable rates of heat absorption, than in the convection heating circuits in contact with cooler gases. Controlled forced circulation makes it possible to operate with a lower circulation ratio than in a natural-circulation boiler. Moreover, smaller tubes can be used with forced circulation than when reliance has to be placed on thermal head alone to overcome friction and maintain circulation. The use of smaller tubes gives various constructional and operational advantages.—*"Boiler House Review", Vol. 59, No. 7, July, 1945, pp. 184-185.*

Improper Boiler Cleaning.

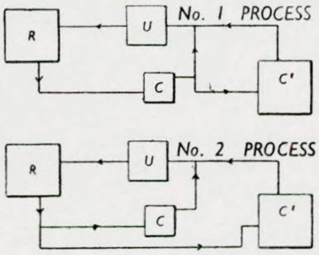
As an alternative to the mechanical de-scaling of boilers, various forms of chemical solutions are available which, while they are undoubtedly quite capable of loosening or dissolving boiler scale, demand that great care should be exercised in their use. The *Proceedings* of the Merchant Marine Council of the U.S. Coast Guard contain a report of a recent investigation carried out with a view to determining the cause of the rapid deterioration of certain internal boiler fittings and tube ends. This showed a severe condition of acid corrosion apparently caused by some agent introduced from an outside source. Laboratory examination of the material removed from the boilers so affected showed that the corrosion was due to chemical solution of the steel parts, and further investigation revealed that a chemical process had been employed for the internal cleaning of the boilers. An analysis of the cleaning solution indicated the presence of hydrochloric acid, and it was found that the application of the chemical process had not been carefully controlled. The cleaning of boilers, engine jackets and so on by chemical methods has, it is stated, long been recognised as a satisfactory procedure, but such methods usually require the use of inhibitors to eliminate the possible reactions between the chemicals employed and the metal of the surfaces to be cleaned. Inhibitors lose their effectiveness during use largely through increase in temperature, and it is therefore essential that the temperature of the process liquid should be checked and the inhibitor replenished to maintain stability. The boiler should also be completely flushed out after treatment with fresh water to which sodium carbonate or some other neutralising alkali has been added.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 1, 5th July, 1945, p. 3.*

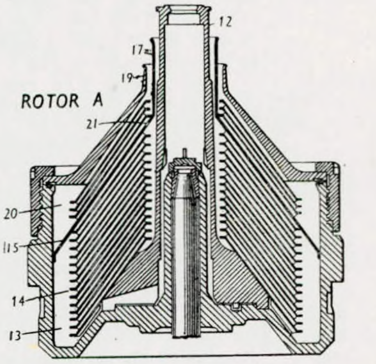
Variable-speed Boiler Fans.

One of the main objections to alternating current on board ship is the difficulty of obtaining a variable-speed drive with the ordinary forms of a.c. motors. This applies, in particular, to the motors of the forced-draught fans where watertube boilers are installed, since the relatively small water capacity of such boilers means that a change in the steam demands requires an immediate change in the volume of air handled by the fans. The author of an article which discusses this subject in the house journal of a well-known firm of electrical engineers, advocates the use of magnetic slip couplings for boiler-rooms fans driven by a.c. motors of the single-speed squirrel cage type. The exciting current for the couplings would be supplied from a metal rectifier where no alternative d.c. supply was available. Among the advantages claimed for such an arrangement are that standard a.c. motors having the most robust type of windings and starting gear could be employed for driving the fans, since the motors would not start up under load; the space taken up by the equipment would be small, commutators would be eliminated and no special cooling arrangements would be required for the magnetic slip couplings. It is also claimed that the efficiency would compare favourably with that of a variable-speed d.c. motor drive or a constant-speed drive with fan-vane or damper control.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 4, 26th July, 1945, p. 75.*

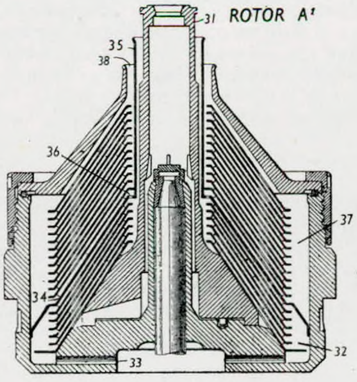
Sharples Oil Purifying Processes.

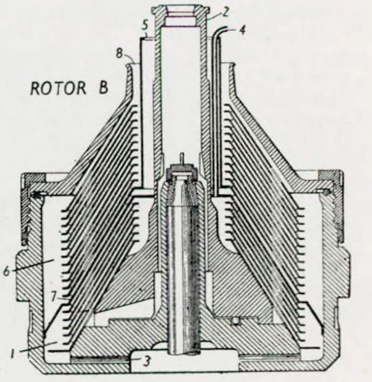
Sharples centrifugal separators employing disc-type bowls may be considered an unusual departure, the machines to which most users have been accustomed being fitted with tubular elements. Three bowls provided with discs are illustrated in the accompanying diagrams, the top left-hand diagrams indicating the processes used in the special method of separation which it is proposed to carry out. The coarser and heavier impurities are removed from a large flow of the oil and the finer particles from a lesser flow during each operation. This is accomplished by dividing the rotor and directing the oil so that the large flow passes through one part and remains under centrifugal force for a relatively short time, the small flow being dealt with by the other part and subjected to a more prolonged centrifugal action. The discs with the wider spacing in the first portion of the rotor permit large particles of sediment to be removed without jamming in the discs or the feed holes, while the second part of the bowl has closer spacings, permitted by the previous removal of the coarser impurities. Referring to the diagram showing No. 1 process, the contaminated oil is taken from a tank (R) and subjected to partial or non-rigorous centrifugal action in a zone (C). The second step of centrifugation (C^1) represents an attempt to remove practically all the finer impurities by retaining the liquid in the rotor for a much longer period than in the first step (C). The purified oil from both steps is passed to the engine (U), where it becomes contaminated and is returned to the reservoir (R) for repurification. In explaining the process, it is assumed that there is a maximum permissible quantity of fine impurities amounting to 0·3 per cent. and the increase is 0·05 per cent. in use, at each interval. This may involve the passage of all the oil through the first step (C) and 25 per cent. through the second step (C^1). If a thorough removal of the fine impurities occurs in the latter step, the quantity unremovable in the former will gradually increase until it reaches 0·15-0·20 per cent. After a condition is reached when the oil contains 0·15 per cent. and this oil accumulates 0·05 per cent. of additional fine impurities during its re-use, it contains 0·20 per cent. upon the next passage to the purifying system. Since 25 per cent. of the oil is passed through the second step (C^1) and all the fine impurities are removed, the percentage extracted from the total flow is 25 per cent. of 0·20 per cent., or 0·05 per cent., *i.e.*, the exact percentage accumulated since the last treatment. When this stage is reached, there is no progressive increase in the proportion of finer impurities in the system. In the event of employing No. 1 process, according to the diagram, rotor (A) or (A^1) is used. Rotor (A) has a central feed (*12*) through which the oil is passed to the bottom of the lower zone of centrifugation (*13*), fitted with frusto-conical stratifying discs (*14*). The main body of the liquid, after the removal of impurities by centrifugal force, passes to the centre of the rotor. A partition (*15*) separates the zone (*13*) from the upper zone (*20*). Restricted passages (*21*) determine the proportion of the liquid passed to the upper zone, where the impurities pass outwardly to the circumference of the rotor. The purified oil is discharged through the space between the bowl neck (*19*) and an extension (*17*) of the partition (*15*). Rotor (A^1) has a feed tube (*31*) which directs the liquid into a zone (*32*) at the lower end, where the heavier fluid impurity is discharged from the rotor through passages (*33*) in the base. With this type of machine the major part of the liquid, partly purified, is discharged up the tube (*35*) surrounding the feed pipe (*31*). A minor proportion of the oil passes through spaces (*36*) in the partition (*34*) to a secondary zone of centrifugation, where a lengthier purifying treatment removes the finer impurities. Thus, the more thoroughly purified liquid is discharged from the zone (*37*) through a passage (*38*). In No. 2 process, the liquid removed from the reservoir (R) is divided into two streams before being subjected to purification.





Sharples centrifugal separator with disc-type bowl.





One stream, comprising the major portion, is passed to a zone of centrifugation (C), where it is subjected to treatment at high capacity for the purpose of removing the coarser impurities. The second stream undergoes more intensive treatment in the zone (C^1) before being recombined with the first separated stream. Rotor (B) is used with this process. The first feed is taken through a tube (*2*) to a lower zone of purification (*1*), passages (*3*) being provided for the discharge of liquid impurities. Purified oil from the lower zone is delivered through a pipe or pipes (*4*). The second and minor portion of the liquid is fed through a tube (*5*) into the upper zone (*6*), divided from the lower zone by a partition (*7*). In the upper zone the fluid undergoes a prolonged centrifugation and in a purified state is discharged through a space (*8*). The streams delivered from the upper and lower zones (*1, 6*) are combined for re-use, as the diagrammatic sketch of No. 2 process indicates.—*"The Motor Ship", Vol. XXVI, No. 306, July, 1945, p. 139.*

The First Marine Gas Turbine.

The first marine combustion propulsion turbine to be completed in America recently underwent shop tests in the Jeannette works of its builders, the Elliott Co. The lay-out of this turbine installation, which is intended for a small vessel of the U.S. Navy, is shown in the accompanying diagram. The output is stated to be about 2,000 h.p. The weight of the turbine structure is 2 to 3lb./h.p., whilst that

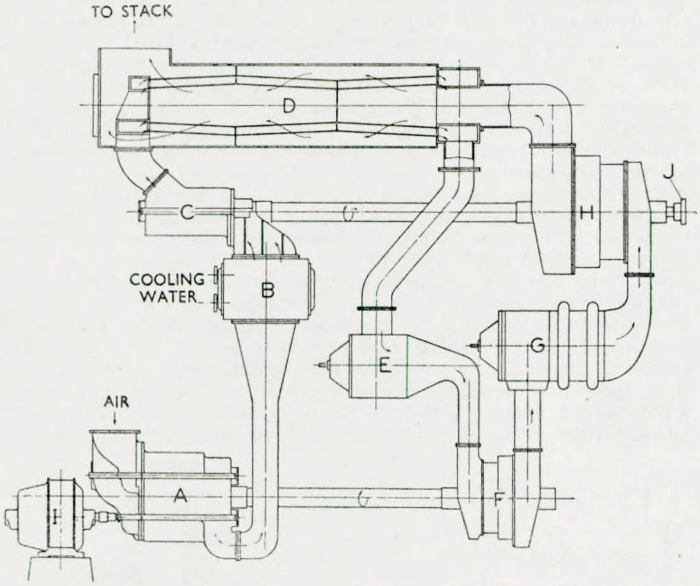


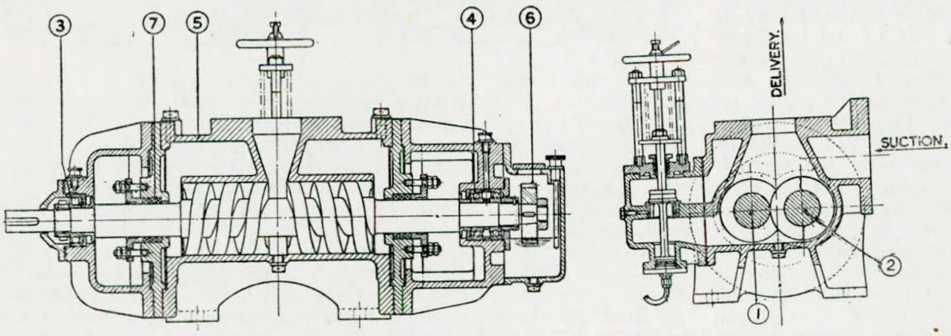
Diagram of the Elliott marine gas turbine installation.

A, L.P. compressor; B, intercooler; C, H.P. compressor; D, regenerator; E, H.P. combustion chamber; F, H.P. turbine; G, L.P. combustion chamber; H, L.P. turbine; I, starting motor; J, coupling.

of the regenerator is from 1 to 1·6lb./ft.^{2}. To these weights must be added those of the combusition chambers, intercoolers, piping, etc., and auxiliaries, which amount to 2lb./h.p., so that the total weight of the installation is likely to be 25lb./h.p., exclusive of the drive. The space required is estimated at 1 cu. ft. per turbine horsepower . The fuel consumption should not exceed 0·45lb./b.h.p.-hr., and boiler oil can be used. The maintenance costs should not be greater than those of comparable steam plants. In this instance, the combustion turbine is to be used in conjunction with electric transmission, so that no special provision for reversing and astern operation has to be made, but it is possible that an adjustable-pitch propeller will also be employed to enable the plant to be run at its maximum efficiency under all conditions.—*"The Motor Ship", Vol. XXVI, No. 306, July, 1945, p. 115.*

Oil Fuel Transfer Pumps.

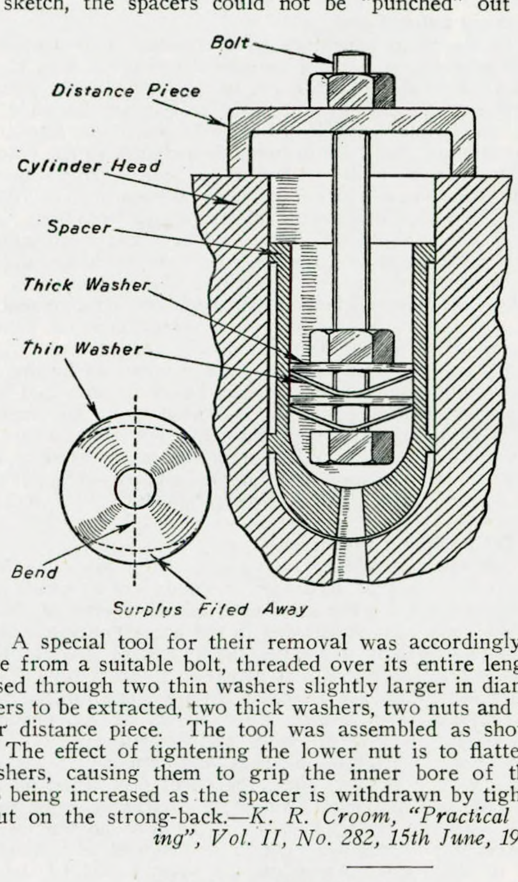
The accompanying sectional drawings show the construction of a Stothert and Pitt screw-type displacement pump for handling furnace-grade oil fuel. The pump has two side-by-side shafts incorporating mating right- and left-hand screws of special profile, with a gap between the "halves" from which the vertical delivery pipe is led. There is no contact between the threads of the mating screws, nor between the threads and the pump housing, so that working contact is confined to the ball and roller bearings carrying the shafts, to the pair of gears connecting and timing them, and to the four stuffing-boxes, all of which are under suction, not pressure. As the screwed members with their shafts rotate in opposite directions, oil is drawn through the suction branch and delivered from the outer ends of the screws towards the central gap, and thus to the discharge pipe. Under normal working conditions there is no need for routine dismantling of the pump for examination and maintenance. It works up to a vacuum of 20in. of mercury and is free from "hammer" at all times. A relief valve of special design, controlled by a pilot valve, is fitted to the pump housing. When in operation, this relief valve short-circuits the fluid by by-passing from the discharge to the suction side of the pump. When handling furnace-grade oil fuel of 1,500 secs. Redwood No. 1 viscosity at 70° F., the capacity of the pump is 200 tons/hr. against a total pressure of 100lb./in.^{2}. A number of these pumps, each driven at 800 r.p.m. through a Vulcan-Sinclair traction-type fluid coupling by an 8-cylr. 109·5-b.h.p. Gardner oil engine, have been supplied for duty overseas by the makers.—*"The Oil Engine", Vol. XIII, No. 147, July, 1945, pp. 76-77.*



1. Driving shaft. 2. Driven shaft. 3. Roller bearings. 4. Ball bearings. 5. Pump housing. 6. Shaft-connecting gears. 7. Packing gland.

Removing Spacers from Diesel Engine.

During a recent overhaul of a Diesel engine it was found that the spacers under the fuel-injection valves, which should have been an easy fit in the cylinder heads, could not be extracted because they had become badly "carboned" in. As may be seen from the accompanying sketch, the spacers could not be "punched" out from the



bottom. A special tool for their removal was accordingly designed and made from a suitable bolt, threaded over its entire length, which was passed through two thin washers slightly larger in diameter than the spacers to be extracted, two thick washers, two nuts and a "strong-back" or distance piece. The tool was assembled as shown in the sketch. The effect of tightening the lower nut is to flatten the two thin washers, causing them to grip the inner bore of the spacer, this grip being increased as the spacer is withdrawn by tightening the upper nut on the strong-back.—*K. R. Croom, "Practical Engineering", Vol. II, No. 282, 15th June, 1945, p. 566.*

New Polar Diesel Engine.

It is reported that the improved design of Diesel engine developed by the Atlas Diesel A.B., Stockholm, has now been standardised as a two-stroke trunk-piston unit with a cylinder diameter of 500 mm. and a piston stroke of 700 mm., the rating being 400 b.h.p. per cylinder at 250 r.p.m. in continuous service, or 320 b.h.p. per cylinder at 200 r.p.m. The engine is equipped with centrifugal fan-type scavenge blowers, and with fuel valves and fuel pumps of the Atlas Diesel special design. Six of these new engines, two with seven cylinders and four with five cylinders, are being built at the present time, all for

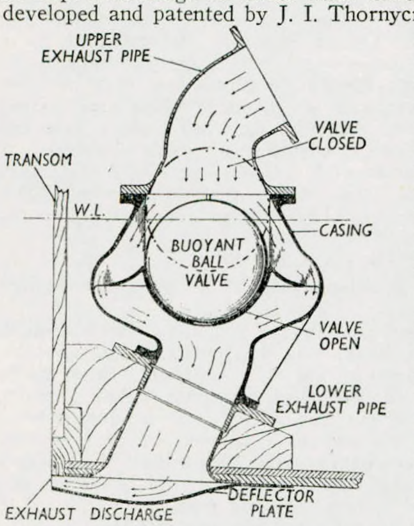
Swedish-owned single-screw ships.—*"The Motor Ship", Vol. XXVI, No. 306, July, 1945, p. 124.*

New Two-stroke Engine.

A new type of s.a. 2-stroke engine, known as the de Waern motor, has been developed in Sweden. It is a 10-12-h.p. single-cylinder unit intended for lifeboat propulsion or as an auxiliary engine in small craft and coasters. It is claimed to operate with as little vibration as a 4-cylr. four-stroke engine, and is equipped with a new type of compressor. A supercharge of combustion air is provided. The cylinder bore and piston stroke of this new engine are 120 mm. and its normal running speed is 1,000 r.p.m. The fuel consumption is about 0·39lb./b.h.p.-hr. An auxiliary unit for small craft supplied by the makers, comprises one of these engines driving an air compressor with a capacity of 886 cu. ft./hr., the air being compressed to a pressure of 365lb./in.^{2}, and a centrifugal pump with a capacity of 132 g.p.m. (=over 35 tons/hr.). There is also a 3-kW. generator driven by belt from a pulley.—*"The Motor Ship", Vol. XXVI, No. 306, July, 1945, p. 133.*

A Thornycroft Silencer.

The accompanying sectional diagram shows the construction of an improved design of under-water exhaust silencer for motor-boats, developed and patented by J. I. Thornycroft & Co., Ltd. The device is claimed to give efficient silencing with no possibility of the water passing back and flooding the engine in the event of a back-fire or sudden stop. No fumes can pass back into the boat and there is no appreciable back-pressure. An outstanding feature of this silencer is a large ball valve. If the exhaust gases are cooled by water injection, the ball may be of solid buoyant rubber or of wood-covered rubber, but these materials would not be suitable for hot dry gases. When the engine is running, the ball is forced out of the mouth of the exhaust pipe on to a cup-shaped seat within an enlarged part of the exhaust passage. The gases pass around the ball, underneath the seat and through the lower section of the exhaust pipe, which terminates in a deflector nozzle, with a streamlined plate at the bottom. When the engine stops, the ball immediately rises from the cup and seats itself in the mouth of the exhaust pipe, which it seals and thus prevents the return of any water or gas. As may be seen from the drawing, the arrangement appears to be simple and effective, although it involves the provision of a somewhat bulky casing around the ball and its seat.—*"The Motor Boat", Vol. LXXVIII, No. 1,933, July, 1945, p. 190.*



Thornycroft exhaust silencer.

Performance of the Motorship "Brisbane Star".

The Blue Star Line's refrigerated motor vessel "Brisbane Star" recently completed 600,000 miles in just over eight years. She is a twin-screw ship of 11,076 gross tons built by Cammell, Laird & Co., Ltd., Birkenhead, ,and is equipped with two sets of 10-cylr. s.a. two-stroke Diesel engines supplied by Sulzer Bros., Winterthur. These engines have a cylinder diameter of 720 mm., a piston stroke of 1,250 mm. and a normal rated output of 6,600 b.h.p. per engine. Except for an enforced stay of four months' duration at Malta due to war conditions, the "Brisbane Star" has been in continuous service since leaving the builders' yard, during which time she has never been held up by machinery trouble. The principal replacements consist of one complete set of cylinder liners, although the engines ran for seven years before the first was renewed. The original cylinder covers and pistons are still in use. During a recent voyage made at an average speed of 16·96 knots at a displacement of 20,353 tons, with the engines developing 13,595 i.h.p. at 115·5 r.p.m., the average daily fuel consumption for all purposes was 41 tons or 0·285lb./i.hp.-hr., whilst the total daily expenditure of lubricating oil (main and auxiliary) was 27·5 gall. for the bearings 31 gall. for the cylinders. During another voyage made at a displacement of 11,027 tons and a mean draught of 17ft. 7in., the machinery developed 13,233 i.h.p. and the ship's speed was 15·6 knots. The average daily fuel consumption for all purposes was 37 tons or 0·26lb./i.h.p.-hr., whilst the daily expenditure of lubricating oil averaged 33 gall. for the bearings and 35 gall. for the cylinders. All the auxiliary and deck machinery of the "Brisbane Star" is electrically driven, with the exception of the two refrigerating compressors for the insulated cargo holds, which are driven by 4-cylr. Brush horizontal Diesel engines. The fuel oil in the ship's tanks during the second of the two voyages referred to above, had a sp. gr. of 0·86.—*"The Motor Ship", Vol. XXVI, No. 306, July, 1945, pp. 126-131.*

East Indies Motor Coasters Building in U.S. Yard for Netherlands E.I. Government.

The Albina Engine and Machine Works Inc., Portland, Oregon, are building 20 identical small motor coasting vessels for the Netherlands E.I. Government. The ships will have an o.a. length of 180ft., a moulded breadth of 29ft., and a moulded depth of 10½ft., with a cargo-carrying capacity of 460 tons. The displacement is to be 850 tons and the laden draught 8ft. The single propeller will be driven by an Enterprise DMG-6 Diesel engine developing 275 b.h.p. at 275 r.p.m. and giving a speed of 8-9 knots. The propelling machinery is installed aft. The auxiliary machinery of each vessel is to include two 60-b.h.p. 3-cylr. two-stroke Venn-Severin Diesel engines driving two 40-kW. generators and a 15-b.h.p. Lister-Blackstone Diesel engine driving a pump, air compressor and emergency generator. The cargo-handling equipment for the two holds includes four 5-ton steel derricks. The vessels will carry a crew of 16 and a war-time gun crew of six, as well as two passengers in a stateroom. Each ship is to cost about $400,000.—*"The Shipping World", Vol. CXIII, No. 2,717, 11th July, 1945, p. 47.*

Connecting Rod Big-end Bolts.

In a letter to the Editor from Mr. F. J. Mayor, superintendent engineer of the Thames Steam Tug & Lighterage Co., Ltd., it is stated that the writer has made it a practice to give special attention to every connecting rod as well as to the bolts themselves. A plug gauge is used, with markings, to check the arbored surface on the connecting rod, which takes the nuts for the bottom-end bolts. This surface is checked and scraped until it is quite true and square with the hole. The seatings for the heads of the bolts are similarly checked and trued (the bolts and nuts having already been checked). The slightest inaccuracy in the squareness of the arbored face under the nut introduces strains which may easily result in the development of a flaw at the root of the thread just below the nut at the part of the bolt where a fracture usually occurs.—*"Gas and Oil Power", Vol. XL, No. 478, July, 1945, p. 228.*

The Motor Tanker "Bela".

The tanker "Bela" is one of a series of single-screw motor tankers of moderate size built in this country during the war. Their hulls were designed for rapid construction on the longitudinal bracketed system with two longitudinal bulkheads arranged so that the three sets of tanks are all of approximately the same width. There is no sheer in way of the main cargo oil tanks. The "Bela", with a sister ship, the "Borus", was built at the yard of Sir Jas. Laing & Sons, Ltd., Sunderland, for the Anglo-Saxon Petroleum Co. She is 335ft. b.p., with a moulded breadth of 48ft. and a depth moulded of 26ft. 9in.. and has a d.w. capacity of 5.000 tons and a full-load draught of 22ft. The gross register is about 3,735 tons. The ship has 15 main cargo oil tanks and the propelling machinery is aft. The main pump-room is amidships, between Nos. 2 and 3 tank, and the ship's fuel tanks are located forward and aft of the cargo oil tanks. Their capacity is about 468 tons. The deck machinery, comprising an anchor windlass, warping winch and eight deck winches. is steam-driven, as is the steering gear. The cargo oil pumps and drainage pump are of the horizontal duplex steam-operated type. The fuel tanks and deep tank are equipped with steam heating coils, but not the cargo tanks, although provision is made for installing them if required. The propelling engine is a three-cylinder Doxford unit of standard design, the rated power being 2,500 b.h.p. at 108 r.p.m. The E.R. auxiliaries, including two 30-kW. 110-volt dynamos and a 200-ton ballast pump, are steam-driven. There are two cylindrical boilers, 10ft. 9in. in diameter and 10ft. 6in. long, on the upper deck abaft the engine casing. The S. boiler is oil-fired, and the P. boiler is heated by the exhaust gases from the main engine. The living accommodation for the officers and men—the former being berthed amidships and the latter aft—is exceptionally roomy and well arranged. The E.R. personnel includes six engineers, a pump man. a donkeyman and nine greasers. The "Bela" has a service speed of 12·8 knots at 103 r.p.m., with the main engine developing 2,390 b.h.p. (2.730 i.h.p.). The fuel consumption under these conditions is about 0·36lb./b.h.p.-hr. or just over 9 tons per 24 hours for all purposes.—*"The Motor Ship", Vol. XXVI, No. 306, July, 1945, pp. 110-113.*

Cleaning Petrol Tanks.

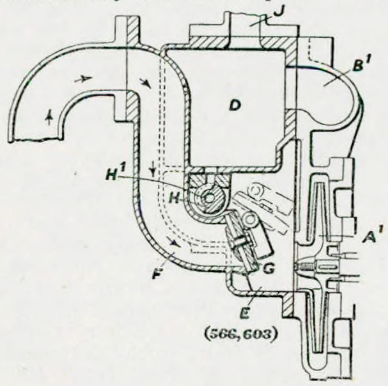
The U.S. Army Transportation Corps are reported to have developed a new method for scaling heavy rust off the inside surfaces of petrol tanks. The process consists of filling the tanks with sea water, and then electro-plating the magnesium content out of the water on to the steel surface beneath the rust layer. In the case of a medium-size petrol-carrying tanker which was urgently needed for the transport of drinking water during the last operations of the European war, the British Admiralty found that their contractors could work only 20 men in the confined spaces at one time and would therefore require 6-7 weeks to complete the job. The U.S. Army authorities were thereupon asked to help. By utilising the new process described above, the Americans succeeded in removing the whole of the heavy, ⅛-in. layer of rust from the tank plating in a minimum of time, leaving the walls clean and bright. Apart from saving over 5,000 man-hours in scaling and cleaning the ship, the use of the new process eliminated the hazards to which men working in closed compartments filled with lead-impregnated iron-oxide dust are liable to be exposed.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 2, 12th July, 1945, p. 27.*

Marine Refrigeration.

Speaking at the June meeting of the American Society of Refrigerating Engineers, Mr. L. J. Westling, technical engineer and member of the Society's Committee on Tropical Refrigeration, expressed the view that present-day developments in the production of quick-frozen foodstuffs will tend to make most existing marine refrigerating installations obsolescent after the war. The tendency will be towards the frequent shipment of smaller consignments of perishables to supply the ship-to-ship marketing periods in off-shore ports. Loading and discharging terminal ports will be equipped with better refrigerating facilities for dealing with incoming supplies of perishable foodstuffs. Furthermore, the cold-storage chambers will be graduated in size so as to facilitate proper segregation of the cargo according to its port-of-call and perishable characteristics. The speaker went on to suggest that conservative shipowners will probably wish to retain the wall coil system of cooling the refrigerated spaces, and for reasons of simplicity, flexibility and absolute control of temperature, they will prefer to have the brine circulating through these coils. Finally, he declared that to centralise all operations and control, it is probable that refrigerating installations will consist of central plants with a limited number of compressors with good modulating characteristics and with an adequate reserve capacity.—*"Modern Refrigeration", Vol. XLVII, No. 568, July, 1945, p. 166.*

Improved Design of Centrifugal Pump.

A recent British patent covers an improved design of centrifugal pump for use in situations where water is drawn from a relatively shallow sump, which has been developed by the Pulsometer Engineering Co., Ltd., Reading. The design is claimed to provide a simplified form of self-priming centrifugal pump which obviates the need for a foot valve in addition to a non-return valve adjacent to the pump and also the risk of the repriming water being lost should the N.R. valve fail to seat. Referring to the accompanying sectional diagram, the pump has a horizontal shaft carrying an impeller A^1 which rotates in a casing, from the underside of which is led an undershot delivery branch B^1. The suction pipe is connected to the pump casing by an intermediate casting comprising an air-separation chamber *D*, a priming-water chamber *E* and a branch *F*. The inner end of the pipe *F* is controlled by a valve *G* carried by a lever which is keyed to the shaft H^1 of a rotary valve *H*. The valve *H* controls ports leading from the reservoir *D* to the priming-water chamber *E* and the two valves are arranged so that when the main valve *G* is closed the auxiliary valve *H* is open. When the pump is to be started, the pump spaces and the chambers *D* and *E* are filled with water. Water from the reservoir *D* is drawn into the chamber *E* and thence through the eye of the impeller into the discharge branch B^1 and back into the chamber *D*. Owing to the restriction caused by the valve *H* a partial vacuum is produced in the chamber *E*, so that air from the suction pipe is entrained through the main valve *G* by the water which is supplied from the chamber *D*. The mixture of water and air then passes through the eye of the impeller into the chamber *D*, where the air is separated from the water and led up into the delivery pipe *J*. This operation continues until all the air has been drawn from the suction pipe, whereupon the incoming water raises the valve *G* and simultaneously closes the auxiliary valve *H* so that no further circulation of water can take place through the chamber *D*.—*"Engineering", Vol. 160, No. 4,147, 6th July, 1945, p. 20.*



E.R. Complement of the Cunard White Star Liner "Queen Elizabeth".

When the "Queen Elizabeth" was moved from her fitting-out berth in Messrs. John Brown's yard at Clydebank in 1940, in order to make room for the launching of the new battleship "Duke of York", she was taken to sea and run up to her normal service speed of 28½-29 knots. As everything went well on that occasion, no further trials were carried out before the vessel was handed over to her owners and despatched on her maiden voyage to New York. The Chief Engineer of the "Queen Elizabeth" was Mr. Wm. Sutcliffe, who stood by the ship while she was building and remained in her until his retirement at the end of last year. He was succeeded by Mr. J. Swanson, the present Chief Engineer, whose deputy is Mr. J. Bewley, at present acting as Staff Chief Engineer. The total complement of engineer officers is 81, the remaining E.R. personnel, consisting of greasers, firemen, plumbers, writers, etc., numbering 142. The machinery of the "Queen Elizabeth" is stated to be in perfect condition. Regular surveys and overhauls have been made throughout the war, and only during the ship's last stay in New York one of the biggest overhauls so far undertaken was carried out, lasting about two months. Actually, the main engines have not yet been opened up. In service, the ship has regularly steamed at 28½ knots on a power of approximately 145,000 s.h.p. The daily fuel consumption for all purposes, it is stated, amounts to about 1,000 tons of boiler oil per 24 hours.—*"The Marine Engineer", Vol. 68, No. 816, July, 1945, pp. 387-390.*

Training Marine Engineers at Kings Point U.S. Merchant Marine Academy.

The training establishment at Kings Point, Long Island Sound, within a few miles of New York, was the fourth Federal Service Academy for prospective officers of the U.S. merchant marine to be opened under the auspices of the War Shipping Administration. Several thousands of deck and engineer officers have graduated from the academy since its establishment in 1943 and are now serving at sea in the U.S. Navy or merchant marine. About half the students —or cadet-midshipmen, as they are termed—at the academy, are destined to become engineer officers. Young men from 17½ to 18 years of age, having a good school education, are eligible for entry on passing a medical examination which is identical with that prescribed for candidates for the U.S. Navy. All cadet-midshipmen are enrolled as Midshipmen in the U.S. Naval Reserve on entering the academy. Under present conditions, those taking up marine engineering undergo a preliminary course of four months' instruction at a basic school, followed by six to eight months' service at sea, after which they spend a year on advanced work at Kings Point. Graduates are awarded a diploma, an ensign's commission in both the U.S. Maritime Service and the U.S. Naval Reserve, and certificates for both steam and Diesel vessels of any horse-power. The engineering curriculum at Kings Point includes a brief survey of mathematics, thermodynamics and mechanics, followed by intensive courses in steam, Diesel and electrical engineering, naval architecture, and engineering drawing. Instruction is also given in shipping economics, including the fundamentals of ship operation, international trade, insurance and economics of the shipping industry. Practical work embraces many hours of machine-shop instruction with an introduction to electric arc welding and foundry practice. Laboratory instruction on marine engines and equipment is also given on a wide variety of steam, Diesel and electrical plant in Fulton Hall, the engineering building of the academy, which contains two oil-fired Liberty ship boilers that supply the steam for running the instructional machinery and heating services. There are also various types of marine steam engines, pumps, turbo-generators, switchboards, centrifugal oil purifiers, Diesel engines, air compressors and marine auxiliaries which are handled under service operating conditions by the trainees. Numerous sectional engines and models are used for demonstration purposes and great value is attached to the use of engineering motion pictures, charts and slides for visual instruction. Graduates thus not only have had many hours of class-room work, but are able to make detailed engineering drawings and sketches, machine new parts on a lathe or shaper, test flue gases and boiler water, check and repair electrical circuits and apparatus, and operate all E.R. equipment. This training qualifies them to keep watch at sea as third assistant engineers and to rise later to higher grades of certificates. The present two-year course is to be extended to three years for both deck and engineering cadet-midshipmen from October, 1945, and candidates for the U.S. Merchant Marine Academies will then be entered by nation-wide competitive examinations. The extended syllabus will include more instruction in shipping economics, the English language and history. It is anticipated that after the war the course of training will be a far more comprehensive one of four years' duration on a full academic level of technical instruction.—*Com'r L. S. McCready, U.S.M.S., "Marine Engineering and Shipping Review", Vol. L, No. 5, May, 1945, pp. 140-141 and 202.*

Drinking-water Obtained from the Sea.

Although several types of small distiller for the production of drinking water in ships' lifeboats were developed during the war, it would appear that until quite recently, no practical method of obtaining fresh water from the sea by purely chemical means had been evolved. Such a process has, however, been invented in this country by a former Austrian citizen, who claims that he is able to render sea water fit for drinking. According to this process, 147 grammes of lead fluoride and 32 gr. of ferric fluoride in the form of a finely ground mixture are added to a litre of sea water which is kept for 24 hours before being filtered into a suspension of magnesium phosphate and kept for another 24 hours. It is stated that the liquid is then drinkable, as it contains less than 3 gr. of salt per litre. For a larger quantity, it is suggested that a 40-gall. barrel (such as would be used in a lifeboat for fresh water) should be filled with 50 gall. of sea water to which a mixture of 48lb. of lead fluoride and 11lb. of aluminium fluoride must be added. After a lapse of 24 hours the water is passed through a cotton filter into another barrel, with the addition of 5 litres (=1·1 gall.) of sea water. After a further period of 24 hours the liquid can be filtered for drinking purposes, as it will then contain less than 0·5 per cent. of salts, without any trace of the harmful magnesia salts.—*"The Motor Boat", Vol. LXXVIII, No. 1,933, July, 1945, p. 190.*

Precision Casting.

In an article on "Castings, Stampings, Forgings and Die Castings", published in a recent issue of *Steel*, it is stated that one of the outstanding developments of the war has been the precision or investment casting process for fabricating parts out of metals that melt at temperatures too high for die casting or which present difficulties in forging, stamping or machining. One of the principal applications has been for turbo-supercharger blades cast from an alloy made up of 60 per cent. cobalt, 35 per cent. chromium and 5 per cent. molybdenum. Dimensions it is stated, may be held within 0·001in. and parts cast from high-strength alloys are said to possess excellent characteristics even in small cross sections. It is expected that the process will be extended to ordinary alloy steels.—*"Foundry Trade Journal", Vol. 76, No. 1,508, 12th July, 1945, p. 230.*

Fretting Corrosion.

A recent issue of the *Journal of the American Society of Automobile Engineers* contains a paper dealing with the phenomenon known as fretting corrosion. After describing investigations carried out with the aid of a so-called chafing test machine, the methods of measuring and the means of preventing chafing corrosion are discussed. The phenomenon is characterized by the apparent picking out and flow of metal on surfaces which are supposedly rigidly clamped to one another. This increases the stress concentration in the area where it is present, resulting in a reduction of mechanical strength and in many cases leading ultimately to failure. It is suggested that chafing and fretting corrosion can be prevented by increasing the compressive load to a value at which all the sliding motion is eliminated; providing a gasket which can absorb the motion; providing a coating which can serve as a shear member or which can provide an anti-friction surface; or providing a surface which has been plated or otherwise treated in such a way as greatly to increase friction and thus stop all sliding motion. These conclusions are, it is suggested, subject to confirmation by engine tests.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 3, 19th July, 1945, p. 51.*

The Salt Spray Test.

The salt spray test is frequently employed in the investigation of various corrosion problems affecting materials used in shipbuilding and marine engineering construction, and yields highly satisfactory results where the conditions under which the tests are made are the same for all the different test pieces. However, when comparative tests have to be made for a number of materials, the time involved may be considerable and the accuracy of the results obtained may be open to question. An article in the *Bulletin of the American Society of Testing Engineers* draws attention to some of the factors influencing the amount of corrosion produced by a salt spray and the variables affecting these factors. Among these are the amount of spray precipitated; the rate of flow of the spray as influenced by the air pressure and the size of the nozzle; and the temperature difference between the interior and the walls of the cabinet in which the spraying is carried out, and the relative humidity in the cabinet as influenced by the temperature and pressure of the air. As might be expected, the concentration of the salt spray as affected by the amount of salt in the solution and also the composition of the salt solution in terms of the purity of the salts and of the water are of considerable importance, while even the composition of the air used in making the spray, such as the percentage of oxygen and carbon dioxide, may have an appreciable effect on the rate of corrosion.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 3, 19th July, 1945, p. 51.*

Marine Corrosion of Steels.

A paper by C. P. Larrabee entitled "Corrosion of Steels in Marine Atmospheres and in Sea Water" recently reproduced in a publication issued by the Electro-chemical Society, comprises a correlation of data obtained in British and American tests in which steels of various types were exposed to different atmospheres and to the action of sea water, and a discussion of general deductions which can be made from such data. The behaviour of unprotected steel under atmospheric exposure has been shown to be conditioned by four main factors, *viz.*, moisture, temperature, contamination of the atmosphere and composition of the steel. The author examines and discusses the various forms of corrosive attack undergone by steels of plain, low-alloy and stainless types, exposed to the effects of dry inland, unpolluted tropical marine or inland, normal marine and industrial polluted atmospheres. The following conclusions are drawn: The effect, on atmospheric corrosion-resistance, of an alloy addition to steel is not necessarily identical in marine and in industrial atmospheres. Low-alloy high-strength steels which exhibit superior resistance in industrial atmospheres, *e.g.*, nickel, copper and nickel-copper steels, are also more resistant to attack under marine conditions, but the extent of the superiority varies in the two types of atmosphere. Exact determinations, under conditions simulating service conditions, are necessary to establish with certainty the resistance of any given steel to specific atmospheric conditions. A very high alloy content is required to confer freedom from tarnish; the austenitic nickel-chromium steels containing molybdenum show the most satisfactory behaviour under marine conditions. Zinc-coated steel shows good resistance to corrosion in many marine atmospheres. Sea-water immersion tests have shown that the attack varies widely under different local conditions. Plain steel loses weight at the rate of 11-42 mg./dm.^{2}/day (0·002-0·0077in./year average penetration). The corresponding averages for most low-alloy steels are 22 mg./dm.^{2}/day (0·004in./year average penetration). The rate of attack on steels exposed between high and low tides varies with the locality, pollution of the water and presence of oil, which may form a protective coating. In some tests the most severe corrosion was found to occur just above the position reached by normal high tides. The presence of 2 to 3 per cent. of molybdenum will usually prevent seriously deep pitting of chromium-nickel steels containing 18 per cent. chromium and 8 per cent. nickel. Molybdenum-free steels containing 25 per cent. chromium and 20 per cent. nickel are reasonably immune from excessive pitting attack.—*"The Nickel Bulletin", Vol. 18, No. 6, June, 1945, pp. 93-94.*

Engineering Developments in Ships of the U.S. Maritime Commision.

The writer, who is the Chief Engineer of the U.S. Maritime Commission, discusses some of the most important engineering developments in the vessels designed and constructed for the Commission during the past few years. For propelling machinery installations of over 9,000 s.h.p. per shaft, a regenerative steam cycle with a steam pressure of 850lb./in.^{2} and 900° F. total temperature is being adopted, but for lower powers a steam pressure of 440lb./in.^{2} with a total temperature of 740° F. and a vacuum of 28½in., has already given satisfactory results. War-time conditions have made it difficult to assess the merits of the 1,200lb./in.^{2} reheat-cycle machinery installation of the cargo liner "Examiner", as the vessel has been in continuous service for the past three years or more, during which time it has not been possible to carry out any important modifications of the original design. The Commission propose to install similar machinery operating at a steam pressure of 850lb./in.^{2} and 900° F. total temperature in post-war American passenger vessels. It is considered that under such conditions an all-purpose fuel rate of 0·5lb./s.h.p.-hr. should be obtainable with 40,000 s.h.p. per shaft and 0·55lb./s.h.p.-hr. with 13,000 s.h.p. per shaft. The number of stages of feed-water heating to be used will be four for the higher powers and three for the lower ones. Electrically-driven auxiliary machinery will be employed wherever practicable. The question of distilling fresh water in lieu of carrying it in the ship's tanks having been carefully considered, the former course has been found to be more economical and convenient. The fuel rates mentioned above include the distilling of fresh water. Double-effect evaporators are regarded as the most economical type available at the present time. Diesel engines have been utilised for the propulsion of many of the C-1, C-2 and C-3 classes of ships of the Commission's long-range programme. All these vessels have slow-turning single screws driven by two or four moderate-speed Diesel engines through hydraulic or magnetic couplings and reduction gears. Diesel-electric propulsion has not been employed for any of the Commission's ships on account of the high cost of this type of drive. The adoption of multiple-engine installations was largely due to the fact that there was only one firm of Diesel-engine builders in the U.S. who had any appreciable amount of experience in the construction of large slow-speed engines for direct connection to the propellers. This last-named type of engine is, however, to be preferred for vessels making long voyages where the use of lower grades of Diesel fuels might be desirable for reasons of economy. A large group of coastal cargo vessels of 4,000 tons d.w.c. have been equipped with 1,700-h.p. Diesel engines coupled direct to the propellers and running at 180 r.p.m. Although the Commission has favoured Diesel engines of moderate speed and rating for generator drive in the larger ships because such engines are, in general, able to run on the same grade of fuel as the main engines, this scheme has not proved entirely successful in practice, and ships' engineers definitely prefer to use light Diesel oil for their generator engines instead of the heavier grades of fuel. The use of centrifuges for fuel oil is considered essential not only where heavy oils are employed, but also where the fuel tanks may have to be used for salt-water ballast. Centrifuges for the purification of lubricating oil were used in earlier ships, but recent improvements in the design and efficiency of oil filters have made it possible to adopt the latter instead, on account of their greater simplicity. The cooling of the cylinder jackets of Diesel engines by fresh water has been adopted in all the Commission's motor vessels. In the case of the Victory ship which is being equipped with a 6,000-h.p. Nordberg engine running at 160-r.p.m. and driving the propeller direct, the main-engine cylinder jackets will be warmed in port by circulating water from one of the two 800-kW. generator engines through the main engine. Experience with the turbo-electric drive installed on board many of the Commission's vessels has been highly satisfactory, but considerable development is still required to make this form of drive equal to the gear drive for general cargo and passenger service. Among the problems which have arisen in connection with E.R. auxiliaries, is pump failure of centrifugal feed pumps due, in most cases, to inadequate flow through the pump. This has been overcome by the provision of an automatic by-pass valve on such pumps for their protection under all conditions without the continuous expenditure of power, such as is required with the usual by-pass method. Some trouble has also been experienced with the feed pumps of certain vessels due to corrosion caused by condensate. This is being overcome by the development of a *p*H control for the feed system which will maintain the water in an uncorrosive state. This equipment is to be fitted in 10 vessels in service, and if operating experience with it proves satisfactory, it will be installed in all ships having centrifugal feed pumps. Single- and double-geared double-drum electric winches of the enclosed type are being standardised for use in all new ships ordered by the Commission. Hydraulic steering gear with two opposed rams and four cylinders has been adopted, with dual pumps. A recent improvement is the provision of a hand-operated pump, worked by four men ,for emergency service. This pump is capable of putting the rudder over from 15°-0-15° in the event of a power failure and has already proved of immense value on several occasions under service conditions. Considerable changes have been introduced during the war in the refrigeration systems for the ships' stores and insulated cargo spaces. Packaged, prefabricated condensing units and room-control assemblies have been used to great advantage in many vessels, thereby saving space in the engine room and reducing the amount of pipe fitting to be done on board. Many of the ships now under construction for the Commission will carry a limited amount of refrigerated cargo at hold temperatures as low as $-10°$ F., if required, to facilitate the handling of quick-frozen products and prepared meat.—*A. C. Rohn, "Marine Engineering and Shipping Review", Vol. L, No. 5, May, 1945, pp. 165-169.*

Electrical Developments in U.S. Maritime Commission's Vessels.

The Commission is installing a rotary torque converter drive in one of its CI-M-AVI type ships. This drive utilises electrical principles for securing a reduction in revolutions without excessive losses. An inner field rotating with the engine and an outer stationery field react upon a set of windings attached to the tailshaft. In this way, the horse-power from the engine is transmitted to the tailshaft at a speed determined by the ratio of the number of poles in the outer stator and the inner rotating field. The installation has the advantage of being in the form of a single unit and the engine is directly in line with the tailshaft. The losses are not excessive, being primarily excitation losses in the field. In general, direct-current systems at 120 or 240 volts, or both, are now employed in all the Comm'ssion's vessels. The 2-wire circuit system was adopted as standard practice with no earth return allowed in the distribution system, but the 3-wire 120/240-volt earth-neutral system has also been used in order that the ship's personnel should not have to deal with a potential exceeding 120 volts between any point in the mains and the ship's hull. Certain large tankers and other vessels of recent design have 440-volt, 3-phase a.c. mains for general ship's service and 2,300-volt or 3,500-volt, 3-phase power for electric propulsion motors. All motor controls have been standardised, motors of each size group having a specified number of steps in their starters. . Electric generators and feeder cables are protected by thermal or instantaneous overload, reverse-current, under-voltage, and overspeed trips.—*A. C. Rohn, "Marine Engineering and Shipping Review", Vol. L, No. 5, May, 1945, pp. 168-169.*

Condenser-tube Corrosion in Ships of the U.S. Maritime Commission.

Considerable trouble was experienced with the condenser tubes in one type of tanker, of which the Commission had built a large number, owing to their exceptionally rapid corrosion. These tubes were of Admiralty metal (70% Cu, 29% Zn, 1% Sn) instead of cupro nickel or aluminium brass, which are the materials ordinarily specified for condenser tubes in the ships of the Maritime Commission. The condensers of the tankers in question were therefore retubed with either cupro nickel or aluminium brass tubes. These tube materials withstood the corrosive action somewhat better than the Admiralty metal, but were not entirely immune from this trouble, which was primarily due to electro-chemical causes. Attention was therefore given to the adoption of a cathodic system of protection based on the imposition of a definite e.m.f. on the condenser and keeping the metallic parts electrically negative at all times. This form of protection has, so far, been applied to six condensers, and the results indicate that cathodic protection is effective in counteracting the type of corrosive action to which condenser tubes are normally exposed. A considerable amount of research work on the part of the manufacturers supplying this equipment was called for, the types of anodes and the density of the current used having to be changed to secure best results. Further changes in these factors may be anticipated as additional experience is gained. When this cathodic system has been perfected, it is believed that it will be quite possible to use the ordinary, and more readily available, material for condenser tubes without detriment to their normally expected life.—*A. C Rohn, "Marine Engineering and Shipping Review", Vol. .L, No. 5, May, 1945, pp. 167-168.*

"Nervous Weld" Process.

An article in a recent issue of *Business Week* gives some particulars of a welding process bearing the unusual, but appropriate, name of the Mogul Nervous Weld Process, and which is primarily intended for plugging blow-holes in aluminium, bronze, grey iron, malleable iron and steel castings, the repair of cracked engine blocks and worn fillets on foundry patterns. The necessary equipment comprises a "nervous weld pistol" with a built-in vibrator, together with a special welding machine and connections for compressed air and electric current. The welding rod is heated by a low-voltage, high-amperage current which also operates the vibrator by means of which the heated welding rod is pushed up and down alternately and at a high speed. Compressed air is used to spray the weld metal into place after the manner of metallizing and cools the surrounding parent metal so that no part will at any time attain a temperature above 126° F. (52° C.). The action of the vibrator serves to forge the weld into the parent metal structure as it is being built up.—*"Mechanical World", Vol. 116, No. 3,014, 6th October, 1944, p. 371.*

Two-stroke Widdop Standardised Engines.

Two-stroke Diesel engines with crankcase scavenging have been manufactured by Widdop & Co., Ltd., Keighley, for a considerable time, and large numbers of their engines are in service abroad, apart from those, particularly in the smaller sizes, which are used in home waters. The makers have standardised a certain type of engine developing 30 b.h.p. per cylinder, and have recently introduced a number of modifications in its design. The largest units of this type now made are a 4-cylr. engine developing 120 b.h.p. at 400 r.p.m. and a similar engine with six cylinders having an output of 180 b.h.p. The cylinder diameter is 8½in. (216 mm.) and the piston stroke is 12in. (305 mm.). The engine is directly reversible by compressed air, and the entire control is carried out with a single lever. Forced lubrication at an oil pressure of about 4lb./in.^{2} has now been adopted for the main bearings, crankheads and gudgeons. The used oil from the pistons, crankheads, gudgeons and the crankcase sealing rings collects in the bottom of the crank chambers (which are separated from each other) and is discharged by the crankcase compression pressure through outlet pipes and N.R. valves, into an oil reservoir. It is subsequently strained and recirculated. The engine-driven auxiliaries comprise bilge, circulating-water and lubricating-oil pumps, together with an air compressor which charges the air containers to a pressure of 350lb./in.^{2}. All these auxiliaries are driven from the forward end of the crankshaft.—*"The Motor Ship", Vol. XXV, No. 299, December, 1944, p. 288.*

Two Spanish Cargo-passenger Liners.

It is reported that Spanish shipyards are constructing two cargo-passenger liners of 6,500 gross tons for the Government-controlled Nacional Elcano's services to America, the Far East and the Philippines. These new ships have an o.a. length of 486ft., a beam of 62ft. and a draught of 26ft. at a full-load displacement of 14,540 tons. The d.w. capacity is 8,700 tons. There are six cargo holds with a total capacity (bale) of about 588,000 cu. ft., in addition to a refrigerated cargo space of 15,400 cu. ft. between Nos. 4 and 5 holds. Accommodation is provided for from 40 to 52 passengers. The propelling machinery is, in each case, to consist of a Sulzer-type 10-cylr. s.a. two-stroke engine of standard design with cylinders 720 mm. in diameter and a piston stroke of 1,250 mm. The normal output of 7,300 b.h.p. is to be attained at 132 r.p.m. .and is intended to give the ships a speed of 16½ knots. The whole of the auxiliary and deck machinery will be motor driven, electric current at 220 volts being supplied by three 420-kW. Diesel-generator sets.—*"The Motor Ship", Vol. XXV, No. 298, November, 1944, p. 261.*

New Type Cargo Ship for Great Lakes Service.

An improved design of cargo vessel for post-war service on the Great Lakes has been developed by the Leathem D. Smith Shipbuilding Co., Sturtevant Bay, Wis. It has been approved by the Post-war Planning Committee of the Maritime Commission, who have indicated their readiness to release surplus materials for the construction of a number of ships to this design as soon as war conditions permit. These so-called "package freighters" will be twin-screw motorships with a length of 420ft., a beam of 39ft. and a depth of 32ft., and will each be able to carry 6,000 tons of cargo in steel road-rail containers, in addition to some general cargo. These containers will be similar to those already in use on certain U.S. railways and will be in the form of steel boxes measuring 7ft. by 9ft. by 7ft. and each capable of holding 8 tons of goods. Three of the ship's four holds will be specially arranged to house these containers and will be equipped with a number of slotted steel cross beams instead of deck floors. Each container will be provided with short legs which will slip into the slots as the containers are lowered into the hold, thereby dispensing with the need for lashings. The fourth hold (forward) will be arranged to accommodate such cargo as motor vehicles, timber, etc., and there will also be a certain amount of refrigerated cargo space. The cargo-handling equipment will consist of an overhead crane travelling on fore-and-aft rails at either side of the upper deck and fitted with a hipped roof large enough to span the 25-ft. by 22-ft. hatches, so as to prevent rain and snow from falling into the open hold. Under present conditions it takes 300 stevedores working with barrows two or three days to load a vessel of this size, whereas the application of the container system to the new type ships will, it is claimed, make it possible for a small party of men to load or discharge 6,000 tons of cargo in 24 hours. Moreover, the present-day cost of handling package freight on the Great Lakes is $1·20 per ton, whereas the estimated handling costs with the containers and the new package freighters amounts to only 15 cents per ton. The ships will cost about two million dollars each to construct. Their design incorporates several features covered by new U.S. patents.—*"Marine Engineering and Shipping Review", Vol. XLIX, No. 7, July, 1944, p. 156.*

Ocean-going Tugs Built in Canadian Great Lakes Yards.

The Midland Shipyards, Ltd., who operate a number of yards at various ports on the Canadian side of the Great Lakes, where corvettes, minesweepers and cargo steamers have been built during the present war, are now turning out ocean-going tugs at their Midland and Kingston yards. These tugs are of the so-called "modified Warrior" type and are single-screw steel-built craft 105ft. long b.p., with a moulded breadth of 30ft. and a moulded depth of 12ft. The propelling machinery consists of a triple-expansion engine developing 1,000 i.h.p. and supplied with steam by oil-fired Scotch boilers. The deck machinery includes a powerful towing winch, a warping capstan and telemotor-controlled steam steering gear. A high-capacity salvage pump is installed in the engine room and the firefighting appliances include a big monitor on deck. The fuel tanks are large enough to give the tugs an exceptionally large cruising radius. Excellent accommodation is provided for a complement of 20 officers and men. The ship's deck and sides are insulated to enable the tugs to operate in tropical waters, and the living quarters are fitted with mechanical ventilation. The provision rooms include cold-storage compartments served by a high-capacity refrigerating installation.—*C. J. Daniels, "Canadian Shipping and Marine Engineering News", Vol. 16, No. 3, October, 1944, pp. 38, 39 and 62.*

Diesel-electric v. Direct Drive.

The General Motors Corporation recently issued an analysis of the Diesel-electric drive in relation to other systems of transmission and published the following table showing the weights of G.M. Diesel-electric installations as compared with those of direct-coupled oil engines:—

Diesel-electric Installations.		Weight, Pounds Per Horse Power.	
Shaft horse power.	Propeller r.p.m.	Diesel electric drive.	Average comparable power available direct-drive engines*.
750 One engine single screw	160/200 One engine single screw	67·90	109·80
1,000 One engine single screw	160/200 One engine single screw	68·65	116·30
1,000 Two engines single screw	131/175 Two engines single screw	85·38	116·30
1,500 Two engines single screw	160/200 Two engines single screw	80·80	103·70
3,000 Four engines single screw	112/140 Four engines single screw	69·76	128·00
3,300 Four engines twin screw	215/240 Four engines twin screw	84·36	86·90 Single screw
6,000 Six engines twin screw	160/200 Six engines twin screw	71·43	85·50 Single screw

*Engine weight only.

The G.M. engines used in the above installations are standard units rated at 1,200 b.h.p. at 750 r.p.m., the o.a. dimensions (including the generator) being 18ft. 4in. by 4ft. 7⅞in., with a height of 8ft. 9¼in. The weight of the complete unit, with the propulsion motor, is given as just over 36 tons, and the space occupied as 1·05 cu. ft./b.h.p. Diagrams are also given showing the lay-out of a 12,000-s.h.p. installation for seaplane tenders, with alternating-current and direct-current machinery respectively. The E.R. length for the a.c. drive is only 63ft., as against 73ft. in the case of the d.c. drive. The G.M. engines, of the V type, have cylinders of 8½in. (213·3 mm.) bore and 10in. (254 mm.) stroke, and apart from the use of welded steel frames, the two special features of their design are the unit fuel-injection system and the uniflow scavenging arrangement.—*"The Motor Ship", Vol. XXVI, No. 307, August, 1945, p. 176.*

New Fruit Carrier "Argentinean Reefer".

Messrs. J. Lauritzen's new fruit-carrying motorship "Argentinean Reefer" of 2,820 gross tons, built at the Aalborg Shipyard at the beginning the war and laid up at Copenhagen pending the retirement of the Germans from Denmark, has now been completed and placed in service. The vessel has an o.a. length of 374ft., a beam of 51ft. 7in., a depth to shelter deck of 29ft. 1½in. and a loaded draught of 19ft. 4½in. She is equipped with a pair of 6-cylr. s.a. two-stroke B. and W. engines developing a total of 4,600 i.h.p. and designed to give her a service speed of 16 knots, but capable of developing 5,000 i.h.p., if required. The ship did 17½ knots on her sea trials. Electric current for power and lighting is supplied by three 240-kW. generators, each directly driven at 500 r.p.m. by a 6-cylr. four-stroke B. and W. engine. The vessel has a total fuel capacity of 935 tons, and the daily consumption is stated to be from 16 to 18 tons for all purposes. The Atlas refrigerating plant, which has an ice-making capacity of 150 tons per 24 hours, serves five insulated holds, each of which can be maintained at any temperature desired independently of the others. This makes it possible to carry refrigerated products such as meat, eggs, butter, etc., at between 0° and 3° F., at the same time as a fruit cargo made up of apples maintained at 32° F., pears at 31° F., oranges at 44° F. and bananas at 54° F. The steel hatch covers, with insulated mattresses and rubber packing, are designed to slide back and drop into steel slots by the aid of the derricks. When the hatches are closed, the axles of the rollers are taken out of centre. The ten 5-ton cargo derricks are served by 10 electric winches. To prevent condensation, the hull plating is panelled internally throughout the ship, even the hold ladders being of wood. There is a foam fire-fighting installation and fireproof doors are fitted in all the passage-ways. The vessel is equipped with electric heating and ventilation. The accommodation for the ship's officers and crew is designed and equipped on a scale to uphold the owners' claim that the standard of living accommodation in their ships is the highest in the world. The wives of senior officers are permitted to spend three months per annum afloat with their husbands when the ship is sailing on distant routes, whilst in home waters up to a fortnight's holiday aboard is allowed. The crew, who are berthed aft, have single cabins for all the A.B.'s, three-berthed cabins for the young ordinary seamen, a dining saloon and a lounge. The "Argentinean Reefer" also has accommodation for eight passengers in four double-berthed staterooms with private bath-rooms.—*B. Klitgaard, "The Motor Ship", Vol. XXVI, No. 307, August, 1945, pp. 156-159.*

Notes on Propeller Blade Design.

In moving a ship from rest, a propeller causes an acceleration of the surrounding water when it commences to revolve; in other words, it draws water from under the hull and propels it against the disc of fluid astern of the ship. Because of the virtual incompressibility of water a violent ebullition then takes place at the stern, until sufficient acceleration has occurred to permit the velocity of the race of projected water to balance the movement of the ship, when a state of comparative quiescence is reached. In reality, a screw propeller is a pump and its action in moving through the water is much more that of suction than is generally realised. In front of the screw the streamlines, assuming a fine-lined stern form, are moving in approximately parallel motion, but as these lines pass through the disc their form is changed, and the total head is suddenly increased by the thrusting pressure imposed upon them by the blade sections. Following the path of the water aft these streamlines, after passing through the propeller disc, ultimately settle down to the same pressure as that in front of the screw, but with a rotational velocity. William Froude put forward a theory that, in considering the design of a propeller blade, it should be treated as being made up of a series of strips, each acting independently of the adjacent sections and subject to forces normal and tangential to itself. In one form or another this blade element theory is the basic condition of modern methods of propeller design. The action of a marine propeller in giving water a sternward thrust is, in a measure, a cross between the movement which takes place in a helical pump and that which occurs round the wing of an aeroplane when in flight. When account is taken of the relative velocity of the water at each blade element to the total section of water flowing through the propeller as a whole, the analogy becomes more apparent. In the pump the rotation of the helix forces the fluid towards the discharge end of the casing. In the aeroplane wing, the leading edge of each section of the wing meets the surrounding belt of air with uniform velocity. In consequence of the slight inclination of the wing to the line of advance, stream lines of air are deflected, and a difference of pressure on the upper and lower surfaces of the wing section generates a lifting force enabling the machine to float. In the design of the wing section, the aim is to secure a maximum lift with a low resistance to motion. In the propeller the thin section of the propeller blade meets the surrounding fluid with a velocity which is a resultant of the forward speed through the water and the rotational energy due to the prime mover. Almost any form of blade section will develop a lifting moment under these conditions, but to achieve a result with the minimum of resistance it will be appreciated that one of streamline section must be the most likely to give an efficient performance, and if each section of the blade is deflected aft a force analogous to that obtaining under flight conditions will be attained. The production of this lift in a propeller blade as distinct from an aeroplane must, however, be associated with a circulation about the blade, and this introduces the appearance of a series of vortices which form a thin sheet of eddies. If these vortices on either face fail to remain in contact with the blade until the trailing edge is reached an eddy region is formed. This condition is a very detrimental one and may be due to a large angle of incidence or to bluntness of form. Moreover, for some distance from the surface of the sea the water is charged with air which is lapped into it by the action of waves and the continual movement of the surface of the water. This mixture of air and water when disturbed by the action of the propeller disc liberates much of the air which it has been holding in solution. If the tip speed of the blade is high the suction created near the tip will cause a breakdown to occur, and a cavity is formed which consists of bubbles of air moving swiftly over the back of the blade. When the suction is diminished over the trailing portion of the blade the water is enabled to flow normally and these bubbles then collapse and explode upon the surface with intense force. Because the effect of these explosions is cumulative, and also because they always occur in and around much the same place, craters are formed, and in many instances have been known to assume large proportions, even in manganese bronze blades. In this connection, because propeller blades are similar, it might be expected that this erosion on the blades on any given propeller would be symmetrical, but minor variations in manufacture have been found to be capable of altering the position where the collapsing of these gaseous bubbles occurs. Correct design in the form of each strip of blade section has been shown to be capable of eliminating, not only erosion and cavitation, but also the tendency to vibration. This is a very insidious complaint and, in general, apart from strength considerations, the thickness of the blades must be determined from practical experiments and the form of each section chosen from the conditions of water flow, taken in conjunction with the appropriate strength ratio required. In the past much propeller design work has been done backwards, that is to say instead of primarily considering the possible speed of the hull to be driven a decision is sought as to what speed the hull can be driven at with the horse-power available. Put in other words, the characteristics of the hull behind which the propeller or propellers are to work should be carefully considered, having regard to the form of the streamline sections which will reach the propeller disc; these characteristics should form the primary factor for efficient propeller performance. In a recent paper dealing with the factors which determine propeller performances, by Professor A. M. Robb, D.Sc., a series of diagrams gives a selection of results obtained by towing planes of different shapes and sections through water. Professor Robb states that effective pitch is the distance through which a blade element travels in one revolution when the thrust is zero and that the effect of drag and thickness is greater the lower the pitch ratio. The effect of thickness, apart from its ability to determine the effective pitch, is not very great at the larger pitch ratios, and there may be an increase in efficiency. The thicker the blade the flatter the crest of the curve of efficiency. Dealing with the question of effective pitch, Professor Robb doubts whether it is the same for all speeds of advance, and suggests that it cannot be a constant for any one propeller; it would appear, therefore, that there is a need for experiments directly concerned with the possible variation of this function. This statement emphasises the necessity of considering the service speed of the hull first, rather than the available power of the propeller. Even when the form of the blades is determined considerable loss of efficiency can occur in the boss unless there is continuous curvature without a break from the barrel of the shaft bossing and the addition of a carefully formed acorn nut to enable the closure of the water to take place uniformly after the propeller disc has passed.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,667, 23rd August, 1945, p. 1.*