Abstracts of the Technical Press

Neither The Institute of Marine Engineers nor The Institution of Naval Architects is responsible for the statements made or the opinions expressed in the following abstracts.

Failure of Turbine Blading.

On taking the load off a 30,000-kW., 3,000-r.p.m. turbo-alternator set, the usual overspeed test was carried out, the emergency governor trip operating at 3,300 r.p.m. and the set apparently slowing down satisfactorily. At about 2,000 r.p.m., however, a peculiar noise was heard and at 1,500 r.p.m., when the auxiliary steam pump cut in, a pronounced rattle developed in the L.P. turbine. This persisted and became worse during the 20 minutes the set took to come to rest, but no vibration was observed. An examination of the L.P. turbine was thereupon carried out to ascertain whether any damage had been sustained. The unit is of the duplex exhaust type, with 10 stages of stainless iron blading per side, the inlet edges of the last two rows having hardened shields to minimise erosion. The L.P. rotor weighs about 12 tons. It was found that one blade had broken off the first row of the left-hand (No. 1) rotor, but that it had fallen to the bottom of the casing without doing any apparent damage; in the right-hand (No. 2) rotor, however, about 50 blades in the first row were broken and the remainder damaged, further damage being done to many blades in the next five rows. The L.P. rotor and top half of the casing were then sent to the makers' works for examination and repair. Some of the blades in the bottom half of the casing, which had also been damaged, were renewed on site. The makers expressed the view that the failure of the blades at the alternator end was definitely due to fatigue failure of the first-row blades as the result of prolonged running while subjected to vibration caused by the original roughness of the alternator. The set had in fact been subjected to a period of about 18 months' rough running (the set was new), apparently due to electrical rotor out-of-balance combined with lack of rigidity of the exciter-end alternator pedestal. The vibration had also been aggravated by occasional carry-over from the boilers, and the running speed had sometimes risen to 3,700 r.p.m., due to the passage of steam through the gland-steam connections to the turbine. The arrangement of the gland steam connections (shown in Fig. 4)

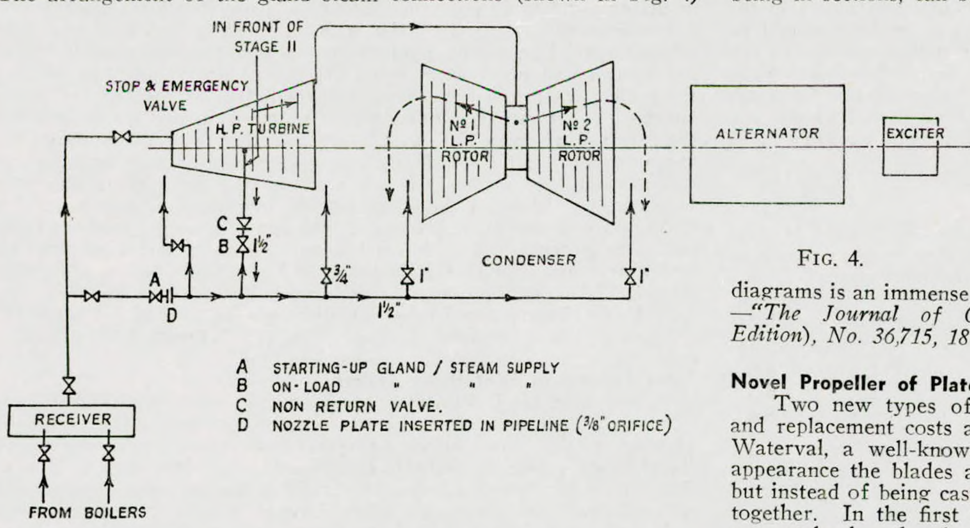


Fig. 4.

was such that steam could enter the turbine at the eleventh stage by way of the "on load" gland steam pipe. Instead of packing with "live" steam when the set is on load, the turbine glands are supplied with steam bled from the eleventh stage of the H.P. turbine. As this steam is at a slightly higher temperature than the steam in the L.P. turbine, there is a small thermo-dynamic gain. The effect of this arrangement was, however, to allow enough steam to enter the turbine through the gland steam connections to produce over-speeding of the unit when taken off load with the main steam valve closed. To overcome this trouble a N.R. valve and nozzle plate (Fig. 5) were fitted in the steam pipes supplying the turbine glands to limit the amount of steam passing through to approximately 800lb./hr., which is sufficient for a light-load unexcited turbine consumption of something like 8,000lb./hr. The replace blading has been provided with lacing wires of different sizes and length in order to remove the blading further from the sensitive region. The turbine supports were stiffened and tests were made to show

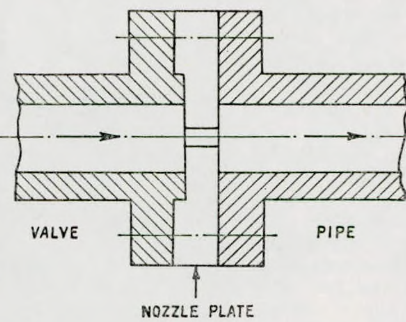


Fig. 5.

that the amplitude of vibration at the pedestal where the trouble had previously occurred did not exceed the permissible limits. The set is now running satisfactorily, and no further trouble has been experienced with it.—*T. H. Carr, "Boiler House Review", Vol. 59, No. 10, October, 1945, pp. 263-265.*

Descriptive Machinery Instructions.

One of the advantages of standard types of machinery is that the provision of descriptive literature, including diagrams showing the various pipes and valves in the machinery spaces, etc., becomes an easy matter. The literature supplied in American-built vessels of standardised types is particularly good in that it meets the requirements of the engineering personnel and is, in some respects, more convenient than the large-scale blue prints usually provided by the shipbuilders. Moreover, these books are neatly bound in leather and, being in sections, can be readily referred to. They contain not only instructions, but photographs and line drawings of certain intricate parts of the machinery, such as a turbine with the half-casing removed, or a turbine bearing showing the method of inserting a dummy bearing and of slinging the rotor, etc. One of the difficulties with which an engineer officer joining a new ship has to contend with, is to learn the lay-out and connections of her various pipe systems, etc., and while it is clear that this cannot be done entirely from books and drawings, the provision of instructions and diagrams is an immense help, and deserves to be more widely adopted. —*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,715, 18th October, 1945, p. 6.*

Novel Propeller of Plate Construction.

Two new types of propeller blades for which low production and replacement costs are claimed, have been designed by Mr. Wm. Waterval, a well-known New York marine engineer. In outward appearance the blades are similar to those of the conventional type, but instead of being cast they are made of rolled metal plates welded together. In the first type the blade is made of two metal plates accurately shaped and rolled to the correct helicoidal surfaces to form the face and the back of the blade, and then welded around the edges. The root of the metal plate that forms the face of the blade is then welded into a helical slot machined in the hub to receive it. The back of the blade does not enter the slot but is welded to the hub direct. The hollow centre of the blade extending from the inner apex to the top of the hub is then filled with resin, pitch or some similar substance to prevent water from entering the space through any fissures in the edges or at the hub line. The second type of blade is a laminated structure made up of four rolled and shaped blades of different lengths, the largest plate forming the face of the wheel while the stepped-up laminated side constitutes the back of the wheel. All the blades are securely welded at the roots and along the hub, and the edges of the laminations are filleted by welding to present a smooth surface. The inventor claims that the use of rolled plates, which can be of any suitable metal possessing the necessary strength and non-corrosive properties, lightens the weight of the propellers, thereby reducing wear on the shaft bearing and increasing the efficiency of the engine, since less power is needed to move the inert weight of the propeller. He also claims that great repair economies can be attained if one or more blades are damaged by burning off the shoulder welding and driving out the defective blade or blades—a less arduous job than removing the entire propeller and one that need not necessarily involve dry-docking the vessel. Whatever the merits of these propeller blades, however, unless the present cost of the welding and rolling involved in their production is substantially reduced, it is difficult to see what savings would be achieved by their use.—*"Motorship", Vol. XXX, No. 9, September, 1945, p. 932.*

Leakage in Astern Turbines.

The necessity for providing astern turbines is probably one of the weakest links in the marine geared-turbine drive. Apart from their cost and the space they occupy, astern turbines represent so much deadweight which has to be carried for the sake of a few minutes' use at the beginning and end of each run. With a view to reducing the power wasted in driving the astern turbines when the ship is steaming in the ahead direction, the astern turbine casings are put into direct connection with the condenser so that the rotors are really rotating in a vacuum, but this, in turn, may cause a considerable loss of steam through leakage, unless entirely separate casings are employed for the astern turbines. In ships of low or moderate power, where separate astern turbine casings would not be practicable, the loss due to leakage can be reduced by the provision of well-designed labyrinth packing with an adequate number of well-fitting rings, and keeping the pressure difference across the packing as low as possible. Thus, no astern turbine should be arranged in the H.P. ahead turbine casing, and the H.P. astern turbine should be located in the low-pressure end of the I.P. ahead turbine casing. In this way, while there will be a certain temperature difference while manœuvring—which can be overcome by thoroughly warming through before starting—the leakage loss during the long period of the run will be a minimum.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 13, 27th September, 1945, p. 291.*

Latest M.A.N. Engines.

The following table gives details of the latest, so-called ZM type, of double-acting 2-stroke M.A.N. engine reported to be under construction at Augsburg until the collapse of Germany:—

Bore, mm.	Stroke. mm.	R.p.m.	B.h.p. per cylinder.	Mean piston speed, ft./sec.	M.e.p. lb./in.^{2}.	Specific weight lb./b.h.p.
190	300	900	128	30	53·2	2·6
230	340	750	225	28	71·1	6·6
300	440	600	443	29	81·7	8·8
420	580	450	789	28·7	73·8	13·2
650	950	263	2,000	27·5	80·5	22·0

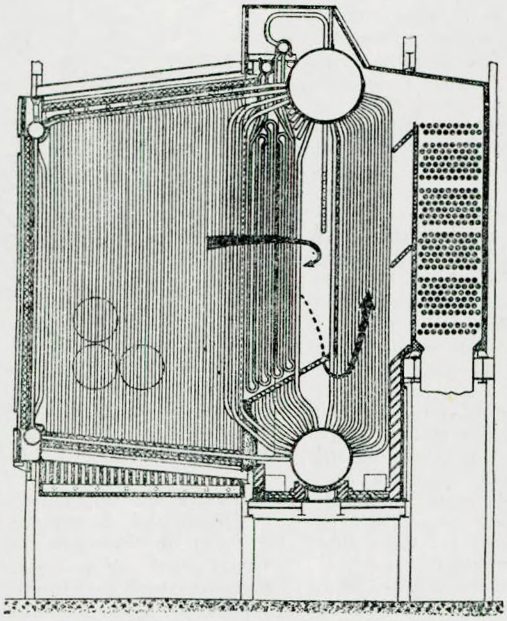
—*"The Motor Ship", Vol. XXVI, No. 309, October, 1945, p. 223.*

Ignition Quality of Diesel Fuel.

Among the physical and chemical characteristics of Diesel oil referred to in specifications for this type of fuel are specific gravity, viscosity, flash point, sulphur content and so on. None of these qualities, however, give an accurate indication of the suitability of the fuel for use in the cylinder of an oil engine, particularly as regards ease of starting and smoothness of running. With the development of high-speed Diesel engines of the types that are being increasingly employed for the propulsion of small craft and for driving the electrical generators in larger ships, these properties become matters of some importance, and suggestions have been put forward that what has been termed the ignition quality of the fuel should be specified. Good ignition quality denotes easy starting and the property of ignitiing regularly and rapidly so as to eliminate the possibility of combustion knock, but the difficulty is to find some property which can be easily assessed, and which will command general acceptance as an indication of the ignition quality of the fuel. It has been generally recognised that oils having a paraffin base make good Diesel fuels.—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 14, 4th October, 1945, p. 315.*

Chemical De-Scaling of Modern Steam Generator.

An article by M. E. Brines in *Power Plant Engineering* describes how the Foster Wheeler, two-drum, D-type boiler shown in Fig. 1 was chemically cleaned with inhibited hydrochloric acid. The boiler was designed for a maximum steam output of 150,000lb./hr. at 425lb./in.^{2} and 735° F. total temperature. It has a 1,960-ft.^{2}, four-loop, pendant-type undrainable superheater, an internal economiser of 12,852ft.^{2} and a completely water-cooled furnace designed for oil firing. An X-ray analysis of samples of scale from representative tubes, after 7,077 hours' service (equivalent to 63,400lb. of evaporation per ft.^{2} of heating surface), showed compositions ranging from 45 to 50 per cent. hydroxy-apatite; 10 to 20 per cent. serpentine; 15 to 20 per cent. vermiculite; 10 to 20 per cent. analcite; and 5 to 15 per cent. hæmatite. From trials on single tubes, it was decided to treat the boiler with inhibited hydrochloric acid containing special additions appropriate to this particular scale. The economiser and superheater were left full of water and shut off, and the boiler was drained and vented through the air cock to the atmosphere. The treating solution was then pumped into the boiler at a temperature of from 170° to 175° F. to within 6in. of the top of the steam drum. After six hours, the boiler was drained and washed through with hot water. On the average, 99·3 per cent. of the scale was removed from all the tubes by this treatment. After a further 9.055 hours of operation, the boiler was again cleaned by substantially the same process, but with certain improvements including flushing under pressure, and in this instance 99·7 per cent. of the scale was removed. It is now proposed to design a boiler rated at 500,000lb./hr., 1,250lb./in.^{2}, having small tubes which cannot be cleaned mechanically. —*"Boiler House Review", Vol. 59, No. 10, October, 1945, p. 282.*



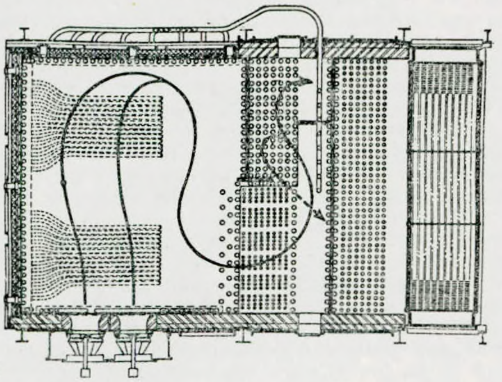


FIG. 1.

Tube Failures in Watertube Boilers.

An article by J. Van Brunt in a recent issue of *Combustion* is devoted to a discussion of the cause and appearance of 15 types of failures in the water tubes of steam generators. A number of sketches are given to facilitate identification. Failure may be due to defective tubes, overheating,, various forms of corrosion, internal or external cracking, external erosion, fatigue or caustic embrittlement, and with each type of failure there are physical characteristics peculiar to the failure concerned and usually enabling it to be identified with certainty. The nature and cause of these peculiarities are examined in detail. Though the underlying cause of some failures may appear to be obscure, it is generally possible to determine it by careful examination of the inside and outside of the damaged tubes, examination of adjacent tubes, study of operating conditions, and careful analysis of the observed facts.—*"Boiler House Review", Vol. 59, No. 10, October, 1945, p. 284.*

Diesel Engine Building in Spain.

Considerable developments in the manufacture of marine Diesel engines for motor fishing craft and larger vessels have taken place in Spain in the last few years. At the Barcelona works of La Maquinista Terrestre y Maritima, a large output of oil engines has now been attained. No fewer than 15 two-stroke units of the B. and W. type have been completed for 350-ton Spanish fishing vessels. These engines have six cylinders 240 mm. in diameter with a piston stroke of 370 mm. and develop 500 b.h.p. at 400 r.p.m. or 384 b.h.p. at 350 r.p.m. A reverse gear is incorporated. A number of 470-b.h.p. engines running at 450 r.p.m. have been built for installation in Spanish coasters, whilst a larger type of six-cylinder engine with light-alloy pistons, developing 1,050 b.h.p. at 350 r.p.m., is being utilised for Spanish trawlers. Their cylinders have a diameter of 430 mm. and a piston stroke of 550 mm. A fourth design, the largest size, is a six-cylinder standard B. and W. 4-stroke engine with cylinders 630 mm. in diameter, the piston stroke being 1,300 mm. This engine has a normal output of 1,950 b.h.p. at 125 r.p.m., with a fuel consumption of 0·37lb./b.h.p.-hr. The weight of the unit is 230lb./b.h.p. The b.e.m.p. at the rated output is 83lb./in.^{2}, with a piston speed of about 1,060ft./min. Several of these engines have been installed in the oil tankers of 8,500 gross tons built in Spanish yards.—*"The Motor Ship", Vol. XXVI, No. 309, October, 1945, pp. 241-242.*

B. and W. Boilers of U.S.S. "Franklin".

The American aircraft carrier "Franklin", which recently returned to the U.S. from Japan, sustained two direct hits last March during an attack by a Japanese dive-bomber, as the result of which four of the ship's Babcock and Wilcox boilers were damaged. The ship sat "dead in the water" for ten hours, less than 60 miles off the coast of Japan, unable to generate steam or electric current, while emergency repairs were carried out. The bomb explosions inflicted heavy casualties on board and caused extensive damage to the hull and machinery. The ship's engineer officer, Lieut.-Commander T. J. Greene, U.S.N., described how the O.F. burners of two of the boilers which had been flooded by the suddent inrush of cold sea-water were relit as soon as the furnaces had been drained and cleaned out. The brickwork of these boilers was probably at a temperature of between 2,800° and 3,000° F., the superheater tubes at 1,000° to 1,100° F. and the remaining tubes at between 550° and 700° F., when the bombs exploded, as the ship was steaming at full speed at the time. A bomb which burst on the hangar deck wrecked the uptake casings of the other two boilers, thereby putting them out of action, although the boilers themselves were in the same condition as the two in which steam was raised again after draining and cleaning out. Despite the severe damage suffered by the aircraft carrier, she was able to make the 13,000-mile voyage home under her own steam. Lieut.-Com'r. Greene stated that this was the second time he had been compelled to order flooded boilers in the "Franklin" to be drained and relit without further repairs. The first occasion was in October of last year, during operations off Formosa, when four Japanese aircraft attacked the American ship. Some of her condensate drains were damaged, and salt water entered the closed-feed system. Two days after the boilers had been put back in service, feed-water tests showed that the salt concentration in one of the boilers had risen to 128 grains per gallon, although the boiler did not prime, due to the efficient performance of the cyclone steam separators in the steam drum. Shortly afterwards the E.R. staff were able to reduce the salt content of the feed water to a reasonable amount.—*"Marine Engineering and Shipping Review", Vol. L, No. 9, September, 1945, p. 240.*

A Development in Water Softening.

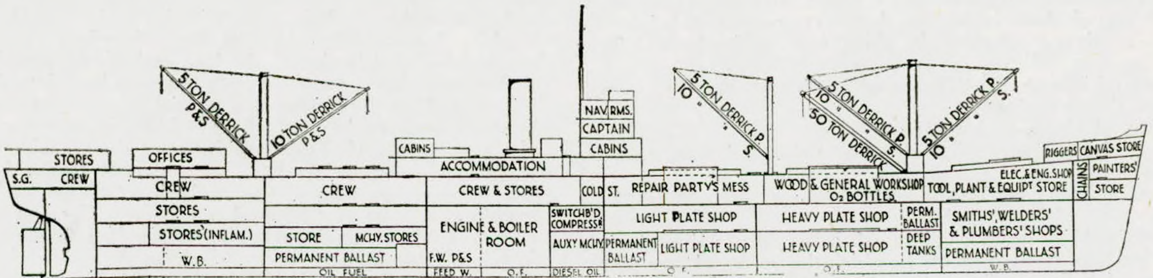
Among the various methods of softening and conditioning the feed water of watertube boilers in use at the present time, is the continuous-flow lime-and-soda ash softening plant, for which a number of advantages are claimed. As against this, however, the process of precipitation of the scale-forming constituents with this form of treatment is very slow. This difficulty has, it is claimed, been overcome in an improved lime-and-soda ash softening plant recently placed on the market, the basic principle of which consists in the use of a coagulant, alum, to hasten precipitation, and the mixing of the precipitated sludge with the softening reagent by mechanical means. The effect of this agitation of the sludge is to increase the rate of the operation of the calcium carbonate and magnesium hydrate, which, if not removed, will cause scale. It is stated that with this plant a high degree of efficiency in operation is attained, and the hardness reduced well below acceptable limits. The design of the plant, in which the lime cream and soda ash solution are introduced separately, lends itself to accurate control, and among other advantages claimed are a reduction in the amount of chemicals used, and a reduction in the amount of washing of the filtering material.—*"Fairplay", Vol. VLXV, No. 3,256, 4th October, 1945, p. 530.*

Seat Grinder.

An automatic handhole seat grinder for boiler-room use has been put on the market by a well-known engineering firm of Springfield, Ohio. The device consists of a double-faced grinding wheel mounted on a ball bearing spindle, an adjusting plate with four screws, a clevis arm and a face plate screwed on to a handhole plate stud near the hole to be refaced. The grinding is accurately controlled by a very finely threaded feed screw. The clevis arm allows the spindle to move freely around the handhole, so that any handhole within reach of the grinder can thus be ground from a single position of the face plate, since the spindle arm can be moved from one handhole to another. The grinder is driven by a high-speed 2-in. compressed-air motor of the type used for driving boiler-tube cleaning brushes. The grinding wheel is interchangeable with a wire brush which is used for cleaning such seats as do not require refacing. As an example of the time and labour saved by the use of this grinder, the case of a man who recently spent three days refacing a single handhole in a boiler economiser by hand methods may be cited; the same man using this new pneumatic grinder, refaced 14 badly cut handholes in a similar economiser in just under five hours. The complete outfit for this handhole seat grinder comprises two grinding wheels, three guide rollers for grinding seats of different widths, a wire brush, stud adapters, a plastic-mounted viewing mirror, a spanner, air hose and a motor lubricator, all packed in a carrying case weighing 25lb. and fitted with a shoulder strap for carrying.—*"Canadian Shipping and Marine Engineering News", Vol. 17, No. 1, August, 1945, pp. 37-38.*

Equipment of Converted Hull Repair Ship.

Two of the partially fabricated C-type cargo vessels built in this country during the war, the "Mullion Cove" and "Dullisk Cove", have been converted for service as hull repair ships in the Far East. They are single-screw steamships with 2,500-i.h.p. triple-expansion engines and three single-ended Scotch boilers working at a pressure of 220lb./in.^{2}. Their average speed on trials, in the deep-load condition, was about 12 knots. Their arrangement, as hull repair ships, is shown in the accompanying sectional elevation. Among the heavy machine tools installed in each vessel are an 8-ft. bending rolls, weighing 23½ tons; a 200-ton vertical flanging press, weighing 38 tons; and a punching and shearing machine capable of punching 1-in. holes and shearing 1-in. plate, weighing 14½ tons. About 350 tons of heavy steel plates, channels, I-bars, T-bars, bulb angles and Z-bars are among the repair materials carried on board. Although the ship's crew live on board, the repair staff are normally accommodated in an "accommodation" ship, but emergency quarters for about 100 men are provided in each hull repair ship. To ensure continuity of work, midday meals are served on board the latter, and a dining hall capable of seating about 250 men has been arranged forward on the second



Arrangement of hull repair ships, after conversion.

deck, together with washing facilities.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,715, 18th October, 1945, p. 8.*

High Pressure Floating Power Stations.

The "Seapower" is one of four identical 30,000-kW. floating power stations constructed by the U.S. Government to meet a serious shortage of electric power in the Ohio and Mississippi valleys, the Gulf states and Great Lakes states. The hulls of these vessels were built by the Bethlehem Steel Co., and are 318ft. in o a. length, with a beam of 30ft. and a maximum draught of only 9ft. when loaded with a week's supply of oil fuel. Taking the "Seapower" as a prototype, her all-welded hull is divided into 11 watertight compartments and is provided with a 3-ft. 6-in. double bottom extending over its entire length, the D.B. tanks being used for oil fuel or water ballast. There are altogether 30 O.F. tanks with a total capacity of 1,500 tons, in addition to two O.F. settling tanks which hold 108 tons and a Diesel-oil tank with a capacity of 62 tons. The main turbo-generator room, 68ft. in length, is amidships and contains a single land type turbo-alternator with its exciter, control panels, hydrogen cooling unit, condensers, circulating pumps and feed-water heaters. The impulse-type turbine has 19 stages and runs at 3,600 r.p.m., taking steam at a pressure of 825lb./in.^{2} and 900° F. total temperature and exhausting at a pressure of 2in. of mercury H.G. absolute. Steam is bled from the turbine at four points for regenerative feed-water heating. The generator, which is directly coupled to the turbine, is a two-pole rotating-field hydrogen-cooled machine designed for a normal full-load output of 30,000 kW. at 13,800 volts and 0·8 power factor. The exciter is driven from the generator shaft through reduction gearing. A compartment forward of the main generator room contains two 300-kW. generators driven by 6-cylr. four-stroke Ingersoll-Rand Diesel engines. These generators supply current for the auxiliary machinery when the plant is started up. Steam at 835lb./in.^{2} pressure and 910° F. total temperature is generated in two oil-fired Babcock and Wilcox divided-furnace, single-uptake, express-type boilers, operating with forced draught. The boilers are arranged in two separate compartments aft of the main generator room. Their normal rated output is about 76 tons/hr. of steam when supplied with feed water at a temperature of 350° F. A complete system of Bailey automatic combustion control with automatic feed-water regulation and superheat control is installed. An evaporating and distilling plant with a capacity of about 85 tons per day supplies make-up feed water. Living quarters for a crew of about 52 officers and men are provided on board. Two of the floating power stations were taken over by the U.S. Army for service overseas and the hulls had to be altered to stand towing at sea. Rudders and electric steering gear, a wheel-house, windlass, mast, boats, life-saving equipment, etc., were added to fit the vessels for this service.—*"Marine Engineering and Shipping Review", Vol. L, No. 9, September, 1945, pp. 132-141 and 188.*

Relaxation of War-time Requirements for New Ships.

The Ministry of War Transport recently issued a statement giving details of a number of items which will no longer be required as a condition for the grant of a shipbuilding licence by the Admiralty Shipbuilding Department, and shipowners are now at liberty to decide for themselves on the advisability of incorporating the features to which these items relate in any ships which they may propose to construct. Some of these items are, however, recommended by the Ministry for continued adoption in ships now to be built. They include:—

The fitting of horizontal stiffeners on hatch end coamings as well as on side coamings.
The fitting of shoes on hatch covers.
Extending of spindles of bilge injection valve and main injection valve.
Provision of hose suction to connection on independent bilge pump of coal-burning ships.
Provision in bilge suction pipes of non-return valves on the bulkheads of compartments in which the open ends are placed.
Provision of "all-round" crank motion for operating watertight doors.
Increased standard of heating for crew spaces.
Fitting of mechanical ventilation to officers' and crew spaces.
Increased capacity of domestic store rooms.
Provision of engineers' duty mess.
Fitting of extra accommodation for junior deck ratings.
Provision of separate mess for stewards.
Provision of entrance from the open deck to the domestic refrigerating-plant compartment where methyl chloride is used as the refrigerant.
Protection of steam pipes when led through the alleyways of rooms in crew spaces.
The provision of special steel fire-resisting lifeboats for oil tankers, together with gravity davits.
The provision in tankers of four lifeboats as a minimum.

A further list of items which it is not proposed to adopt in new construction, includes:—

(*1*) The omission of the door from the engine room to the tunnel and consequently the fitting of a forward tunnel escape.
(*2*) The extension of watertight bulkheads to the shelter deck (subject to the side frames in the 'tween deck spaces being arranged to facilitate the construction of W.T. bulkheads, if required).
(*3*) The provision of additional scantlings to permit deeper loading if the shelter deck is closed.
(*4*) The fitting of watertight lobbies.
(*5*) Raising of auxiliary engine seats.
(*6*) Fitting of pump discharges below the water line.
(*7*) Provision of wire-rope ladders in companion-way, engine room, etc.
(*8*) The fitting of compressed-air salvage equipment in tankers.
(*9*) Provision of emergency escapes.
(*10*) Anti-sabotage precautions—wire netting in vent cowls, etc.
(*11*) Self-lubricating tunnel bearings.
(*12*) Voice pipe and sight valve to tunnel in view of no W.T. tunnel door.
(*13*) Second passageway between engine room and stokehold.
(*14*) Master valve on bilge main to tunnel.
(*15*) Fabricated circular hatches for oil tankers.
(*16*) The fitting of steel deckhouse tops.
(*17*) The fitting of steel or steel-sheathed external doors.
(*18*) The fitting of steel plates on ventilator plugs.
(*19*) Duplication of essential leads in tankers.
(*20*) Provision of deep 'tween decks.
(*21*) Provision of 10-ton derricks at each main hatch.
(*22*) Fitting of special cargo securing arrangements.
(*23*) Fitting of large clear hatchways in tramps.
(*24*) Fitting of recessed hatch coamings and sliding webs.
(*25*) De-icing arrangements for ship's side valves.
(*26*) Fitting of additional ballast tanks.

—*"Shipbuilding and Shipping Record", Vol. LXVI, No. 15, 11th October, 1945, p. 343.*

American Car Ferry Steamers.

The car or train ferry services of the Pere Marquette Railway are to be augmented by a new steamer for the Detroit River crossing. This railway operates two car ferry lines, one crossing Lake Michigan (about 85 miles) and the other the Detroit River (about ¾ mile). The rough weather and ice conditions met with on Lake Michigan make it necessary to employ vessels of the sea-going type with a high freeboard, a completely covered main or car deck, and a hull designed for icebreaking. Conditions on the Detroit River, however, permit the use of low-freeboard steamers with sides extending only up to the car deck, the wheel-house being carried by a steel bridge spanning the forward end of the main deck. The steamer now building for this service has a hull of riveted construction, with nine watertight bulkheads extending from the keel plate to the main deck. The ship is 400ft. by 53ft. by 22ft., with a loaded draught of 16ft., and will have three railway tracks each capable of accommodating nine 40-ft. freight cars. The latter will be embarked and landed at the bow end of the vessel, the after ends of the tracks being provided with bumpers built into the hull framing. The propelling machinery will consist of two sets of three-cylinder "uniflow" engines, having cylinders 24½in. in diameter by 24in. stroke, with poppet valves. The crankshafts of these engines will be coupled at each end to propeller shafts extending along the full length of the ship and carrying twin screws at the bow and stern. The four-bladed propellers will be of cast steel and have a diameter of 10ft. Steam at a pressure of 180lb./in.^{2} will be supplied to the engines by four Scotch marine boilers, arranged along the sides of the car deck.—*"The Engineer", Vol. CLXXX, No. 4,684, 19th October, 1945, p. 314.*

Refitting of the "Orontes".

Only 22 days after sustaining serious damage through fire, the 20,000-ton twin-screw Orient liner "Orontes" sailed from Tilbury on October 5 in her peace-time paint to resume service as a troop transport. The ship only reached Tilbury on September 5 for a month's refit, so that she sailed on time. A start was made with dry-docking, withdrawing the propeller shafts and fumigating, all of which work was to have been completed in 14 days, but fire broke out on board after eight days, causing extensive damage. Fortunately the fuel tanks were not affected, despite their close proximity to the fire. Over 700 workpeople (including 60 charwomen) were employed in repairing the fire damage and in carrying out the normal refit of the vessel, in addition to which nearly 200 tons of defensive equipment, including 18 guns, had to be removed. Every possible hour of overtime was worked, and the charwomen even brought their meals to the ship. So well did all concerned do their work that the vessel was ready 10 hours before she sailed. The "Orontes" is said to be the first big ship to leave Tilbury in her peace-time colours since 1939.—*"The Syren", Vol. CXCVII, No. 2,564, 17th October, 1945, p. 94.*

Germany's Projected 288,000-b.h.p. Battleships.

For two or three years prior to the outbreak of war, the M.A.N. at their Augsburg works carried out experiments with high-powered double-acting, high-speed oil engines. An 8-cylr. unit of this type was constructed with a cylinder diameter of 650 mm. and a piston stroke of 960 mm. It developed 16,000 b.h.p. at its normal running speed of 450 r.p.m., with a fuel consumption of about 0·37lb./b.h.p.-hr. The weight of this engine was stated to be 26lb./b.h.p. Its trials were commenced in January, 1939, but before that time the German Admiralty had ordered 36 12-cylr. engines of similar type for installation in three battleships. Each ship was to have 12 engines developing a total of 288,000 b.h.p. and driving quadruple screws, three engines being coupled to each propeller shaft. The machinery was to have been delivered in 1943, but within a fortnight of war breaking out, the entire contract was cancelled, as it was evidently considered that the war would be over before the ships could be completed, and that, in any event, the air weapon would be decisive. In addition, a V-type engine with 16 cylinders was being developed, with a cylinder diameter of about 450 mm. and an output of 700 b.h.p. per cylinder.

By the end of the war about 40 per cent. of the M.A.N. works at Augsburg had been destroyed by Allied bombing and there were only some 300 men employed there, compared with 10,000 during the war. It is understood that the number of men working there has now been increased to about 2,000 in order to carry out certain essential repairs to the smaller M.A.N. engines used for transport and similar purposes.—*"The Motor Ship", Vol. XXVI, No. 309, October, 1945, p. 215.*

Trolley Docks 3,000-ton Ships.

The so-called "Tokyo Trolley" at Portland, Oregon, used for hauling ships broadside on from the Williamette River up a repairing slip, was the eighth conveyance of this kind to be equipped with G.E. motors during the war. Built at a cost of over 1½ million dollars, it is the largest side-haul marine railway yet built, being capable of "docking" a ship of 3,000 tons d.w. in two hours, and of handling as many as seven vessels a day. Two small craft can be hauled up simultaneously. The trolley is a 380-ft. by 42-ft. steel cradle with a 50-ft. beam which travels on six rails. The tracks are 329ft. long, mostly under water, and terminate at a depth of 40ft. The operators handling this marine railway have become so expert at their work that no divers are required. The blocks and supports on a carriage inside the cradle being arranged to fit the hull of any vessel which is to be repaired. This marine railway's main advantage over a dry dock is that the capacity of the latter is limited to at most three ships at a time, whereas the railway can bring as many ships ashore as the repair yard will hold. At Portland, three 300-ft. and two 200-ft. vessels can be accommodated at one time. Furthermore, there is no water to pump out, the ship's keel is only 45in. above ground, and trucks and machinery can be brought alongside the job with a minimum of trouble.—*"Motorship", Vol. XXX, No. 9, September, 1945, p. 925.*

Bulk Oil Measurement.

This paper, originally published in *The Journal of the Institute of Petroleum*, describes how oil tanks of various types are calibrated and gauged. The special conditions relating to ship's tanks are referred to, and the different systems used in the compilation of tank calibration tables—the British, American and metric systems—are briefly discussed. Some examples of gauging problems are also given.—*Paper by E. Stokoe, "Transactions of the Institute of Marine Engineers", Vol. LVII, No. 8, September, 1945, pp. 93-96.*

Turbo-Electric Warships in Royal Navy.

A large number of the frigates and destroyer-escorts built in Canada and the United States for the Royal Navy are electrically driven, and of welded construction. The framing of the hull is longitudinal, with fabricated vertical stiffeners arranged as necessary, but the superstructure and machinery arrangement differs materially from normal British warship practice. Instead of the non-continuous structures found on the deck of a British destroyer, there is a continuous structure running fore and aft, giving a protected working alleyway on the starboard side. The officers' quarters, with the wardroom, are forward under the bridge, whilst the galley, engineers' workshop, etc., are entered from the working alleyway. The machinery spaces are entered by the usual circular hatchways with coamings, but are afforded the protection of the superstructure. The arrangement of a typical ship of this class from the forward end is: boiler room, forward engine room containing a turbo-generator on the port side and the starboard propelling motor, a second boiler room, and then the after engine room, in which the port propelling motor is fitted together with its own turbo-generator. Two Foster-Wheeler boilers with superheaters and economisers supply the steam. They are designed for a working pressure of 400lb./in.^{2} superheated to 700° F., and are oil-fired, each having four Todd sprayers arranged on the front, where there are also four electrical soot blowers on the tubular side of the boiler, *i.e.*, that remote from the combustion chamber. Internal desuperheaters are fitted in the upper steam drum. Two feed pumps are provided for each boiler, the main one being turbine driven and of the rotary type; the auxiliary feed pump is of the reciprocating type. In the after boiler room above the welded-in main feed tank is an evaporator capable of producing 8,000 gallons of distilled water per 24 hours from sea water, and using steam at 3lb. pressure. All the water is dealt with twice before being finally distilled, thus ensuring that the feed water supplied to the boilers is of the purest quality. Just forward of this evaporator is a multi-way direct reading salinity indicator which is duplicated in the engine rooms. Air for combustion is provided by a turbine-driven fan which discharges into the air ducts surrounding the boiler. In this way the boiler room is open and no air locks are necessary. The arrangement of uptakes is unusual in that the single funnel is placed on the top of the superstructure somewhere about the centre of the forward engine room and has two rectangular ducts leading to it at an angle. One of these is from the forward boiler room and the other from the after room. Unlike the boiler rooms, both engine rooms are similar, because the turbo-generator is placed centrally in the hull of the ship. In the forward engine room, the starboard propelling motor and its control position occupy the starboard portion of the machinery space, whilst the port side is filled up with auxiliary machinery. In contrast, the after engine room is the reverse in arrangement, so that space is available for the motor coupled to the port propeller. Each main generator is driven by an impulse type turbine exhausting into a fabricated underslung single-flow condenser. Circulating water is provided by a scoop when running at any speed over 10 knots, but for slower speeds and when manœuvring, a turbine-driven circulating pump is provided over the main induction pipe, with a separate inlet to the condenser. At the after end a single outlet pipe is provided with a sluice valve at a suitable angle to facilitate underwater discharge. It is understood that the auxiliary circulating pump is always kept running at a ticking-over rate to provide for emergency. The condensers work continuously at 29in. of vacuum. The speed of the turbo-generators can be varied from about 1,000 to 5,600 r.p.m., which is necessary to attain the full speed of 24 knots. The generators produce three-phase power at 2,700 volts, and are direct-coupled to their respective propelling motors; they are unidirectional, there being no astern blading. Control is effected from one position in front of the motor, by means of a totally-enclosed panelled switchboard on which all the instruments, including the bridge and revolution telegraphs are mounted. Just below and in front of this switchboard is a quadrant with five levers, four of which perform electrical connections, whilst the fifth operates the nozzles on the turbo-generator for obtaining increases and reductions of speed. When starting up, the propelling motors are set in motion in two stages as induction motors; when run up, a further alteration puts them into synchronisation with the generator and, thereafter, they can be manœuvred by the notched hand control lever on the quadrant. Although the levers work automatically, arrangements are provided for manual operation of the excitation of the fields, so that should any of the mechanism fail efficient control can still be maintained over the machinery. In the event of anything happening in the other engine room, one of the five levers is connected in such a way that the control stations are coupled, but only for dual control. Under these conditions, although the propellers can be varied in speed and, if necessary, reversed, they cannot be manœuvred independently. In other words, the ship becomes a twin-screw vessel with the equivalent of a single engine. To ensure the cool running of both the main generators and propelling motors, there is a salt-water circulating system with direct-reading thermometers on the main control switchboard to indicate at once if anything is going wrong. The propeller shafts are fitted with Michell-type thrust blocks. One unit, which provides the excitation power, consists of an a.c. induction motor driving a separately excited generator capable of producing a maximum current of about 500 amperes at 110 volts. The exciter for this motor, generator is mounted on top of the generator and is belt-driven from its shaft at the end remote from the induction motor. Another unusual fitting is a large rectangular heavily-lagged surge tank into which all the auxiliary exhaust branches are led. On the top of this tank, a motor-driven fan is mounted which exhausts any accumulated air. The turbine glands are controlled from this tank, which acts as a steam collector, the outlet pipe from the fan being used as a breather pipe for the turbine glands. In this way the vapour usually associated with the running of steam-packed turbine glands is prevented from causing a high degree of humidity in the machinery space. For the provision of electrical power throughout the ship two turbo-driven dual-purpose generators are provided, one in each engine room. These machines are designed for a speed of 4,800 r.p.m., the turbines being of a similar type to the main generators, but geared down so that the generators run at 1,200 r.p.m. The generators are wound to give 450-volt three-phase power for running the larger motors in the ship and 120-volt direct current for lighting. It is also possible, using single-phase with three transformers to obtain 117-volt a.c. if desired. In the event of damage occurring to cables, nine-way (three sets of three) plugs are provided throughout the ship in such a way that power can be plugged direct from the bus bars on the engine room power and lighting switchboard to any part of the ship where the damage has occurred. For the efficient regulation of voltage two alternative automatic regulators are fitted, geared to a vertical multi-way sliding contact which is exceedingly sensitive in its action and responds instantly to alterations of load on the generators, ensuring that a constant voltage is available irrespective of load. These units are independent of the governors on the turbines, and obviate the necessity for continuous watch-keeping at the switchboard. Some of these ships have been built in six weeks to three months. This, of course, really refers to the time occupied in assembling, and although the arrangement generally does its work, the piping systems, for example, are not designed for ease of overhaul. In many instances it would be necessary to cut away large sections in order to effect a repair. The sections would thereafter have to be replaced and welded in position again. There seems to be an entire absence of T- and Y-pieces, all branches being made by cutting a hole into a pipe and welding a branch on. This applies, equally, where it is necessary to place a connection for a pressure gauge or to provide a main steam branch where both pipes are of similar diameter. The ships are amply provided with extension spindles for the remote operation of various valves, but instead of the well-known method of using mitre and bevel wheels the connections are made with flexible copper hose of varying diameter. Most handwheels are of welded steel wire with four welded spokes and the use of mitre wheels, where a right angle turn is necessary, is avoided by a species of flexible universal joint which has a series of cast steel balls; these mesh with each other as the bulkhead spindle to which they are attached is revolved. The wiring throughout these ships is not fitted to perforated plates, but placed in large "bunches" upon a series of circular-faced shelves which are welded to the various bulkheads or ship's side as necessary. All the cable is of the steel-braided pattern and seems to stand up well to its work, even when fitted in places where it is almost continuously exposed to moisture, as, for instance, under the evaporator in the boiler room.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,109, 11th October,, 1945, pp. 1-2.*

Electrical Power in Ships.

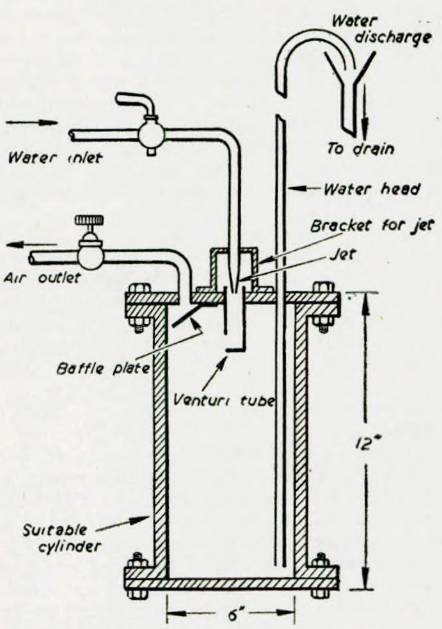
Among the outstanding features of the equipment of ex-German warships is the lavish scale on which electrical power, both a.c. and d.c., is provided for. Furthermore, a large proportion of the generators are driven by Diesel engines, thus ensuring an adequate supply of power without the necessity of keeping the boilers under steam. The inclusion of a.c. generators is significant as indicating the introduction of three-phase power. This has been in use in the U.S. Navy for some time and is claimed to possess advantages for the distribution of electrical current on board ship. In view of the general adoption of alternating current ashore, it is somewhat surprising that a more widespread use of this system afloat has not been made.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,715, 18th October, 1945, p. 6.*

Pipe Coupling.

A Chicago engineering firm have developed a portable pipe coupling, known as the Presto-Lock Flexible Coupling, which provides a convenient form of temporary coupling for steam, gas, oil and water pipes at all normal working pressures, without the need for any threads, grooves or flanges. The coupling is made in 11 sizes, for pipes of 1¼in. to 16in. in diameter and consists of two malleable-iron castings and a quick-locking wedge key. One such wedge key is used for couplings up to 3in. in diameter, whilst the larger ones have two wedge keys. No spanners or special tools are required for the attachment of the coupling, only a hammer being needed to tighten the wedge keys after the two sections have been fitted over the pipe ends and the wedge keys have been inserted in their slots. Three types of jointing material are available for use with the coupling, viz., synthetic rubber, neoprene and natural rubber. The makers claim that these couplings give up to 40° flexibility at each joint, *i.e.*, that they act as sleeves, elbows and ball unions. They can be used for repairing leaks of any size that they can cover, and can be released immediately by a top on the wedge key. When not in use, the two sections of the coupling are clamped together for carriage or storage as a unit. The couplings can, of course, be used over and over again, provided the gaskets are in good condition.—*"Canadian Shipping and Marine Engineering News", Vol. 17, No. 1, August, 1945, p. 36.*

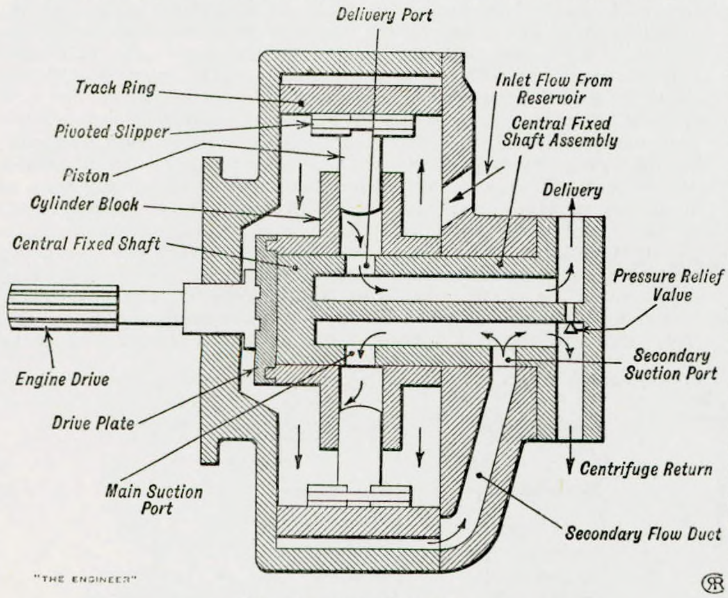
Air Compressor.

The accompanying sketch shows the construction of a low-pressure air compressor for supplying air at about 4lb./in.² for a small forge or a blow lamp, and made from a scrap engine or other cylinder. The general dimensions are not critical, but the pressure is dependent on the head of water in the tube marked "water head". This tube should be up to 10ft. in height, and must discharge at that level, otherwise syphon action lowers the pressure in the air cylinder. When starting up, the air valve must be closed to ensure that the level of the water falls below the air outlet.—*W. R. Cumming, "Practical Engineering", Vol. 12, No. 300, 19th October, 1945, p. 352.*



"Live Line" Rotary Pump.

When positive acting pumps are used to supply a hydraulic system from which variable quantities of pressure fluid are to be drawn, they must be fitted with relief valves or have associated with them hydraulic accumulators and unloading gear. In the first case there is a wastage of power whenever the full capacity of the pump is not being utilised, whilst in the second case it becomes necessary to provide accessory plant and automatic gear in addition to the pump itself. A novel design of positive acting pump made by a Cheltenham firm and known as the "Live Line" rotary pump is, however, claimed to be capable of operating continuously and unloading itself automatically whenever the delivery pressure exceeds a predetermined value, whilst maintaining the pressure in the delivery line at all times. As may be seen from the accompanying sectional diagram, the rotating member of the pump is carried on a central stub shaft fixed in the casing, and containing seven pistons working in radially disposed cylinders. These pistons are actuated by pivoted slippers working within a track ring which normally occupies a position in the casing axially excentric to the fixed stub shaft. The ring is unable to rotate, but is pivoted in the casing on a knife edge and is forced into its excentric position by a laminated spring strut. If the effect of the latter is overcome, the track ring can swing back into a concentric position, thereby stopping the reciprocating action of the pistons in the cylinders and causing delivery to cease. In operation, the working fluid is drawn in through a port in the casing to the space around the pivoted slippers. As a result of the movement of the slippers, the fluid is driven centrifugally out through a slot in the track ring to the space outside the latter and thence through a suitable passage to a secondary suction port in the central stub shaft. The fluid then flows through a passage in the stub shaft into the pumping cylinders, from which it is forced to a delivery port, also in the stub shaft, for discharge to the hydraulic main. As the pistons and attached pivoted slippers are maintained in contact with the track ring by centrifugal force alone, the pumping forces within the cylinders are resisted by the ring, but their influence tends to restore the ring to that concentric position from which it is displaced by the laminated spring. Thus, since the pumping force will rise as the delivery pressure is increased, whilst the force exerted by the spring remains constant, a time will come when the power of the spring is partially or completely overcome and the excentricity of the ring reduced or wholly removed. Delivery is then reduced, or if the spring force has been wholly overcome, ceases altogether, although pressure in the delivery main is maintained. But though pumping has ceased, fluid entering the pump through the port



Arrangement of pump.

in the casing is still centrifugally driven outwards through the slot in the ring and thence to the secondary suction port in the central shaft. Being then unable to enter the cylinders, the fluid will flow freely back to the suction tank through the centrifuge return pipe. This arrangement ensures a sufficient flow through the pump to keep it cool under the no-delivery condition. Maximum delivery is determined by the strength of the laminated spring, which is chosen to suit requirements. Sudden excess pressures in the delivery main are relieved by a relief valve between the suction and delivery channels in the central shaft. The weight of the "Live Line" pump is only 10lb. and it is designed for running speeds of up to 4,000 r.p.m. and delivery pressures of up to 3,000lb.in.^{2}.—*"The Engineer", Vol. CLXXX, No. 4,684, 19th October, 1945, pp. 312-313.*

Foster Wheeler Fuel Oil Heater.

Foster Wheeler, Ltd. have developed and patented an improved type of steam-operated oil-fuel heater, the construction of which is

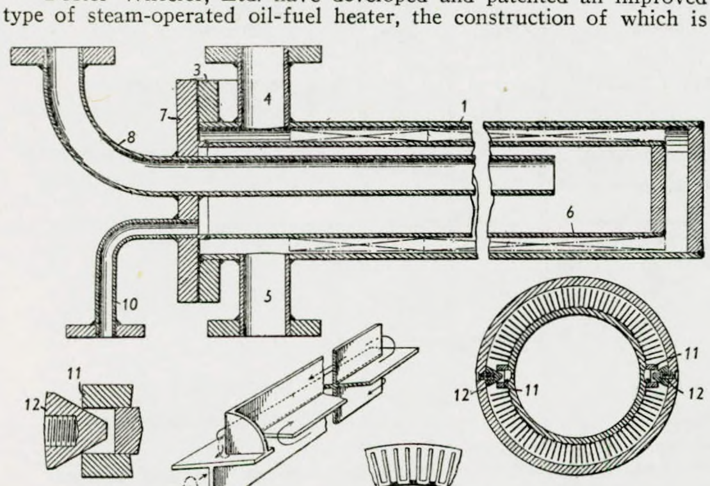


FIG. 2.

shown in Fig. 2. It comprises inner and outer shells, which can be detached for cleaning purposes. The oil fuel circulates through the space between the shells, the outer casing (*1*) having a flange (*3*) and branches (*4, 5*) for entry and discharge of the fuel. The inner casing (*6*) is closed by a plate at one end and is attached at the other end to a flange plate (*7*) having a steam inlet pipe (*8*). The condensate is discharged from the casing or tube (*6*) through a pipe (*10*) secured to the flange plate (*7*). In order to retard the flow of oil fuel between the inlet and outlet, the annular space between the inner and outer casing or tubes is divided into a number of passages which are traversed in series backwards and forwards by the fuel. Longitudinal channel strips (*11*) and triangular section strips (*12*) are provided for locating the inner tube, but the latter is allowed a small amount of longitudinal and radial movement. As may be seen from the diagrams, the inner casing (*6*) is fitted with external longitudinal fins which extend into the oil passages.—*"The Oil Engine", Vol. XIII, No. 150, October, 1945, p. 160.*

A Ribbed Piston Head.

A recent British patent covers a design of I.C. engine piston, illustrated in Fig. 1, having a head incorporating an annular depression (*4*). The centre of the piston head forms a point (*5*) projecting above the level of the top plane, while the inside of the depression contains a number of radial ribs (*6*) leading from the centre-point (*5*) to the outer edge of the depression. A flat level portion (*7*) is left round the periphery of the piston crown. The ribs (*6*) are curved both in plan and in elevation along their lengths, for the purpose of creating turbulence. A similar depression with ribs may be formed on the inside of the cylinder head, either in addition to the depression in the piston or in place of it.—*"The Oil Engine", Vol. XIII, No. 150, October, 1945, p. 160.*

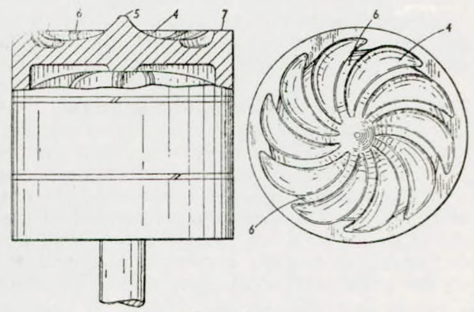
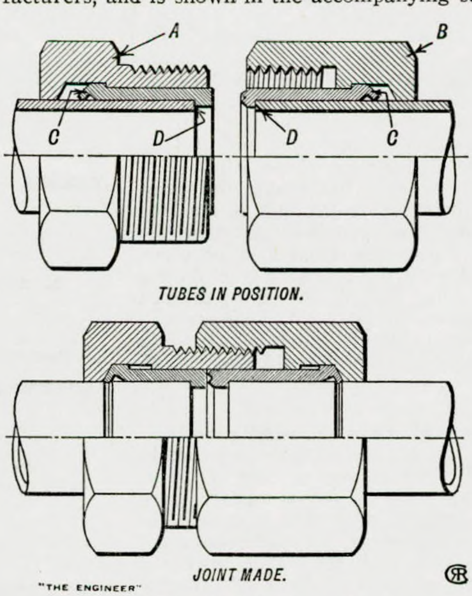


FIG. 1.

The "Crownall" Pipe Coupling.

A simple and effective form of pipe coupling known as the "Crownall", has recently been developed by a London firm of manufacturers, and is shown in the accompanying sectional drawings. The coupling is made in a wide range of sizes to comply with the new B.S.I. pipe standards, and consists of two components, a body (*A*) and a nut (*B*), each containing a sealing ferrule. The latter have retaining shoulders (*C, C*) which fit in tapered-end recesses in the head of the body and the head of the nut, respectively. The faces of the retaining shoulders are made with a less acute taper than the ends of the recesses, and under each shoulder in the bore is a V-shaped annular groove. The ends of the pipes of tubes to be coupled together abut against internal shoulders (*D, D*) in the ferrules. Around the face of the nut ferrule, V-serrations (*E*) are cut, whilst the face of the body ferrule is flat. When the coupling is assembled in position, the tightening of the nut (*B*) causes the serrations (*E*) to cut into the face of the body ferrule, thereby making a liquid-tight seal. Continued



"Crownall" Pipe Coupling.

tightening of the nut (*B*) forces the ferrule shoulders inwards and downwards under the pressure exerted by the tapered ends of the recesses, and the inner edges of the ferrules are forced into the pipe surfaces to make a seal. The line of contact made by the ferrule ends and their two faces forms a continuous liquid-tight joint. When it is necessary to couple a pipe to a tap, stop-cock, spigot or similar fitting, the nut part of the coupling is used alone and no adapter of any kind is required. In such cases the serrations (*E*) form a seal with the spigot end, whilst the shoulder edge of the ferrule is forced into the pipe surface, as in the case of the complete coupling already described. A special feature of the design is the use of the nut (*B*) alone in cases where tubes have to be inserted between fixed points. To make such a joint the tube is cut to length and its ends pushed into coupling nuts till they abut against the sealing ferrule internal shoulders (*D*). The tube complete with nuts is then fitted in position between the fixed screwed spigots and the nuts are tightened in the normal way to form a joint. No special tools are required to fit the couplings, and it is not necessary to square off the ends of the pipes or tubes, as the seal made by the shoulder edges is a fair distance in. A rough outer surface on a pipe does not impair the sealing efficiency of the coupling. It is stated that tests made at the National Physical Laboratory with Crownall couplings fitted on ½-in. 17-gauge copper tubes which were then subjected to a bursting pressure of 8,288lb./in.^{2}, did no damage whatever to the couplings themselves.—*"The Engineer", Vol. CLXXX, No. 4,682, 5th October, 1945, p. 272.*

The Lubrication of Geared Motor Units.

The accompanying illustration shows the arrangement of a new type of oil-level indicator developed by the British Thomson-Houston Co., Ltd., which has been fitted to a large number of geared motor units for use on board ship, built by the company. A method of casting glass directly into steel has been evolved, thus permitting a simple circular glass window attachment to be fitted to the gear housing of each unit. This allows the oil

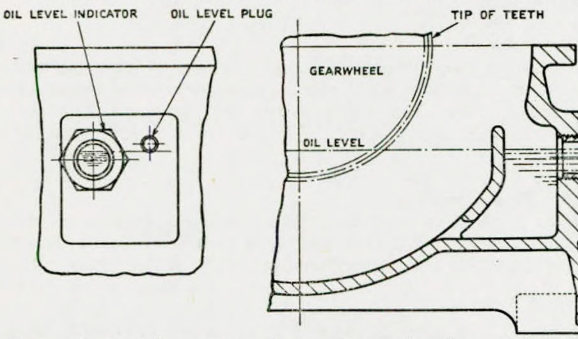
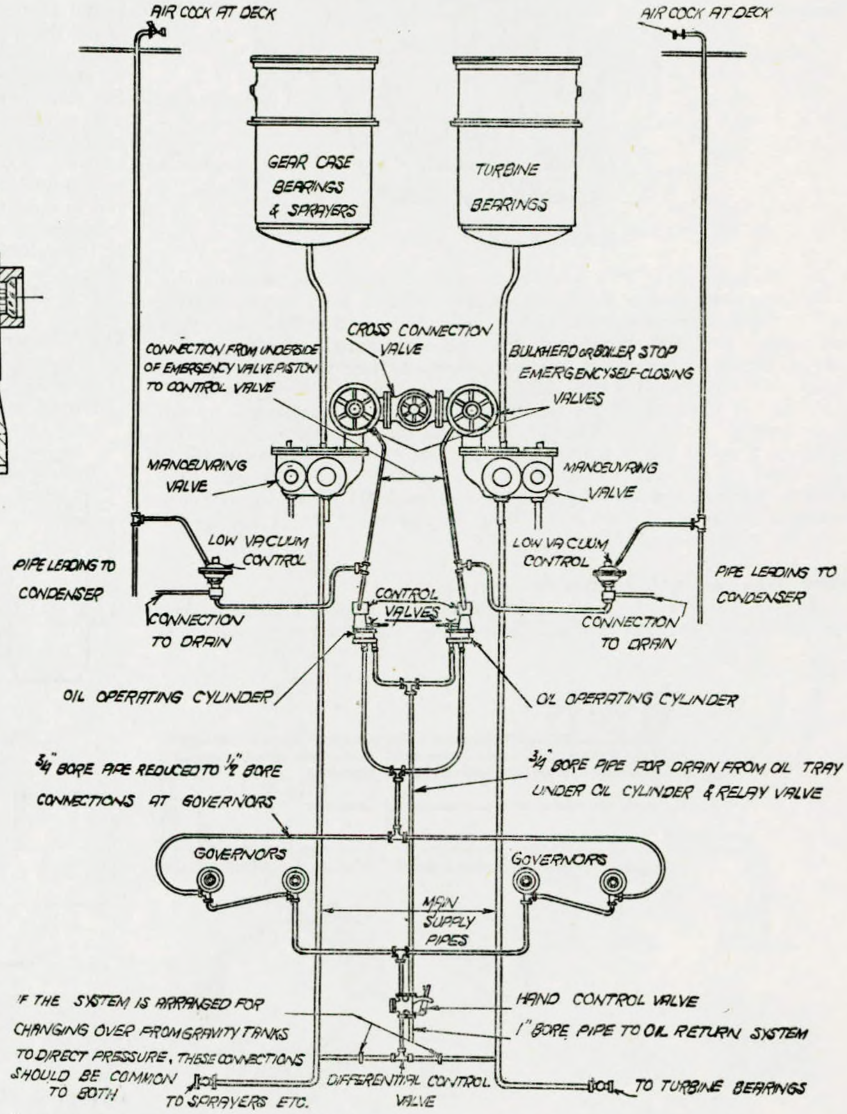


FIG. 5.—*Section through gearbox showing oil-level indicator.*

level to be easily ascertained at any time, and as long as it remains within the visible area of the window no further attention is necessary. To enable the right quantity of oil to be added before the unit is put into service, a filling plug has been provided alongside the glass window. Regular attention must also be given to the quantity and quality of the lubricating oil during the whole life of the unit. The oil should be drained periodically from the housing and purified if possible, or new oil should be used.—*S. A. Couling and C. F. Wells, "BTH Activities", Vol. 18, No. 11, July, 1945, pp. 251-253.*

Emergency Controls for High Pressure Installations.

The accompanying drawing shows the lay-out, in diagrammatic form, of a present-day system of Cockburn-Aspinall emergency controls for a high-pressure marine steam turbine installation. The system comprises emergency steam valves of the piston-operated type working in connection with the r.p.m. governor and closing automatically when the balance of pressure normally maintained on the valve piston is disturbed. The system also includes a low-vacuum control device for the main condenser. The emergency bulkhead (or boiler stop) valves are designed to close automatically if (*1*) the forced-lubrication oil pressure drops to a predetermined low level; (*2*) when the speed governor cuts into action due to a tendency to overspeeding of the turbines; (*3*) if the fore-and-aft movement of any of the turbine rotors becomes excessive, thereby endangering the turbine-blade clearances; and (*4*) when the emergency hand control is operated. As regards condition (*1*) a reduction of the oil pressure in the f.l. system produces a corresponding drop of the pressure in the oil cylinder of the control valve, thereby opening the latter. This in turn relieves the pressure of steam on the under side of the main valve piston, causing the main steam valve to close. As regards condition (*2*), any increase in the r.p.m. of the turbines above a predetermined speed, causes the governor to cut into action, the effect being a sudden drop in oil pressure at the governor and then at the pressure-breaking relay valve, so that the main steam valve closes as described above. Excessive movement of a turbine rotor forward or aft involves movement of the governor bush, thereby uncovering a port in the index bush through which the oil is able to escape, with the result that the oil pressure falls and the main steam valve closes. Operation of the hand emergency control, from the E.R. starting platform or from the deck by means of the deck control gear, instantly lowers the oil pressure in the f.l. system, thereby causing the emergency steam valve to the turbine to close. An adjustable orifice on the discharge side of the hand control allows the flow of oil to the governor gear and oil cylinders of the emergency valves to be limited so as to control the speed of operation of the self-closing device. An adjusting screw is fitted to enable the emergency control to be effected at the pressure existing at any bearing or at any point in the forced-lubrication control system. The self-closing boiler stop valves included in the Cockburn-Aspinall emergency control system are designed to close in the event of a sudden drop in the

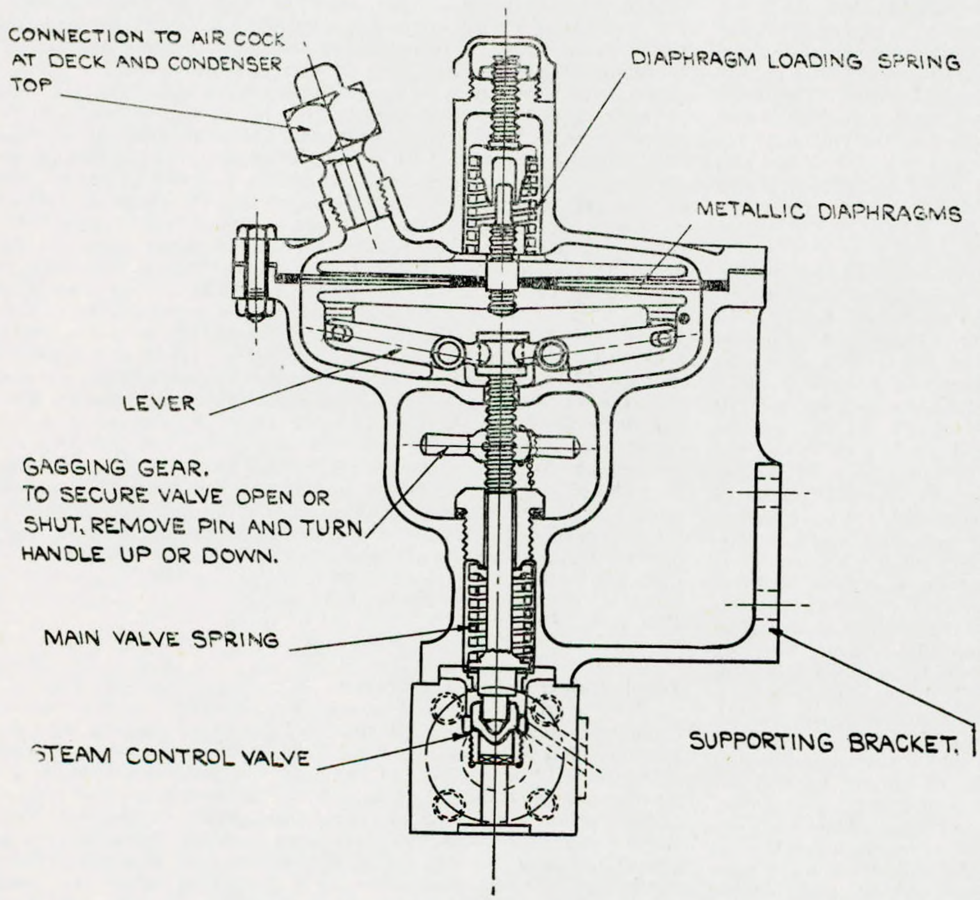


Arrangement of Cockburn-Aspinall emergency control system for turbine installation.

steam pressure in any of the boilers fitted with these valves, so as to prevent a reversal of steam flow. A small non-return valve incorporated in the stop-valve mounting traps the steam on the upper side of the valve piston and the pressure thereby built up, added to that caused by the back flow of the steam on the cover of the main valve, causes this valve to close.—*"The Marine Engineer", Vol. 68, No. 819, October, 1945, pp. 541-542.*

Cockburn-Aspinall Low-vacuum Control.

The low-vacuum control device incorporated in the Cockburn-Aspinall emergency control system (*see preceding abstract*) comes into operation if the vacuum in the main condenser falls below a predetermined figure. The control unit, the construction of which is shown in the accompanying sectional diagram, consists essentially of a steam needle valve controlled by an enclosed flexible metallic diaphragm assembly which is in communication with the steam side of the condenser. Should the vacuum in the latter fall to the "danger" value, the air pressure on the diaphragm assisted by the effect of the loading spring shown, deflects the disc and opens the small steam control valve by means of the system of levers shown in the diagram. This allows the steam on the underside of the emergency valve piston to escape, causing the main steam valve to close. The operating pressure for this control is adjusted by tightening or slackening the diaphragm loading spring.—*"The Marine Engineer", Vol. 68, No. 819, October, 1945, pp. 545-546.*



Cockburn-Aspinall low-vacuum control unit.

Gas Turbine Research.

A fund of $500,000 has been raised in America for establishing a gas turbine laboratory at the Massachusetts Institute of Technology. The fund has been provided by a number of prominent manufacturing firms who are, or will be, concerned with the production of gas turbines. Among them are the General Motors Corporation, the General Electric Co., the Westinghouse Electric Co. and the Hoover, Owens, Rentschler Co. The new laboratory will undertake technical studies, and investigation of new technique required in the construction of machines operating at high speeds, high temperatures and high compression. The equipment will include special provision for research on the elements of compressors, combustion devices, jets and gas turbines, and facilities will also be available for the operation of such devices under controlled conditions. Dr. J. C. Hunsaker, head of the Department of Aeronautical and Mechanical Engineering at the Institute in question, has declared that the gas turbine promises to be the next major step in the evolution of power plant, comparable in its effects on technology with the steam turbine introduced at the beginning of the century.—*"The Motor Ship", Vol. XXVI, No. 310, November, 1945, p. 25.*

Coupled Engine Torsional and Propeller Flexural Vibrations.

In the course of the discussion which followed the publication of the above paper contributed by Capt. J. Morris, B.A., it was pointed out by Dr. J. F. Shannon that marine engineers would be interested to know to what extent propeller flexibility influenced torsional vibration in marine engine installations. The fundamental frequency of a typical marine system was about 3 cycles/sec. and the higher mode, with a node in the engine, was about 15 cycles/sec. The fundamental mode of the propeller was 40 cycles/sec. and the first overtone 110 cycles/sec. This would result in totally different propeller-engine frequency curves from those shown by the author (for airscrews), because the fundamental propeller curve would follow the rigid propeller curve and cut the engine curves twice before it crossed the zero ordinate at its fixed root frequency. Hence in typical marine torsional calculations the rigid propeller assumption gave a sufficiently close approximation to the frequencies of the combined engine-propeller system for the useful running range. In special cases where flexibility in marine units might have to be considered, the calculations involved would be much more difficult than in the case of an aero-propeller because of the skewed plan form and low aspect ratio. Here the torsional and flexural modes were closely coupled and plate vibration also occurred. In such cases it might be preferable to determine the blade vibration characteristics by experiment, although it would certainly be profitable to investigate a marine case analytically.—*"Proceedings of the Institution of Mechanical Engineers", Vol. 153, No. 3, p. 58.*

Torsional Vibration Amplitudes at Non-resonant Speeds, with Special Reference to the Interpretation of Torsiograph Records.

The seismic torsiograph is commonly used for recording torsional vibration because it can be applied to many different types of oscillating systems without elaborate preparatory measures. This instrument is available in a variety of types, each suitable for a particular measuring range, so that there is little difficulty in choosing equipment to record with reasonable accuracy the vibratory motion at a selected point in any present-day system of transmission. The motion recorded by a seismic instrument may, however, be very complex, and this implies that care must be taken when attempting to interpret the records in terms of shaft stress, particularly at non-resonant speeds. This problem can be very difficult, and is discussed in the present paper with the help of typical examples. It is shown that the interpretation of records obtained at resonant speeds is comparatively straightforward, provided that the system is reasonably linear and does not include components having a complex distribution of mass and/or elasticity. Methods for computing shaft stresses from measured amplitudes are discussed, and attention is drawn to the use which can be made of tabulation methods when dealing with records obtained at non-resonant speeds and with systems containing complex components or having a marked degree of non-linearity. Cases where shaft stresses at non-resonant as well as at resonant speeds must be taken into account are by no means unknown. The author shows that under certain conditions a seismic torsiograph will show no appreciable response or will become very unreliable at some non-resonant speeds. Finally, he draws attention to the employment of torsional strain gauges as an alternative to seismic torsiographs. The strain-gauge method allows measurements of total shaft stresses to be made even if the system is markedly non-linear or contains complex components. The development of compact and reliable torsional strain-gauge equipment for general use appears to be desirable. —*Paper by W. Ker Wilson, D.Sc.(Eng.), Ph.D., Wh.Ex., "Proceedings of the Institution of Mechanical Engineers", Vol. 153, No. 3, pp. 83-98.*

The 1,200-b.h.p. V-type Deutz Submarine Engine.

The latest design of Deutz two-stroke engine developed mainly for the propulsion of submarines and produced in a special factory near Hamburg (now destroyed) had 12 cylinders in V formation, the angle between the two rows being 33°. The cylinders had a diameter of 220 mm. with a piston stroke of 300 mm., and the unit was designed to develop 1,200 b.h.p. at 700 r.p.m. The m.e.p. was about 52lb./in.^{2} and the piston speed was 1,520ft./min. The weight with auxiliaries was stated to be 13lb./b.h.p. The centrifugal-type scavenge blower was driven from the crankshaft by spur gearing. Aluminium-bronze was used for the connecting-rod and crankshaft bearings. The pistons were of silicon aluminium alloy and worked in C.I. liners. The latter were free to expand downwards and contained the scavenging-air and exhaust ports. A vibration damper was built into the engine to reduce the effect of the vibrations of the ninth and twelfth orders. The fuel consumption amounted to 0·36lb./b.h.p.-hr.—*"The Motor Ship", Vol. XXVI, No. 310, November, 1945, p. 274.*

Boiler Control.

An aspect of marine boiler installation in which British marine boilermakers seem to have lagged behind U.S. and Continental manufacturers is in the provision of adequate and centralised control. In these days of high-pressure, high-temperature steam, the provision of instruments to control boiler operation at sea is very desirable. It is well known that air in excess means that fuel is wasted. This loss can easily reach 1 per cent. of the total fuel burned for each 10 per cent. of air supplied in excess of requirements. A still greater loss in inevitable when less than the required air is admitted to the furnace; this may be as high as 10 or 12 per cent. for each 10 per cent. air deficiency. Without suitable instruments, owing to the varying conditions of the fuel in use, the thickness of the fire, if coal is being used, or the grade of oil, or even the prevailing weather conditions, accurate control of the air supply is impossible. Efficient combustion takes place only when there is practically no smoke and when the analysis of the products of combustion shows that there is no carbon monoxide present. On the other hand the proportion of carbon dioxide in the gases should not be less than 10 to 12 per cent. by volume. The latter figure to some extent depends upon the fuel used and the method of firing. When burning oil, the flue gases from a boiler contain a smaller proportion of CO_2 than when using coal. This is largely due to the greater proportion of hydrogen in the fuel. It will thus be realised how difficult it becomes for any watch-keeping engineer in a ship to maintain continuously the correct relation between the supply of fuel and air without instruments. Moreover, without some means of ascertaining the conditions obtaining from time to time in the furnaces and uptakes, he is not in a position to obtain the best results from the fuel used. In a paper on boiler control, read before the Society of Naval Architects and Marine Engineers, New York, by E. C. Bailey and P. S. Dickey, the results are given of tests carried out in 10 modern ships of the Pittsburgh Steamship Company over a period of three years. These figures show that the average fuel rate per 1,000 B.Th.U. per mile when automatic combustion control was used was 3,530, whilst for ships not thus equipped the figure was well over 4,000. Automatic steam pressure and temperature regulation also presents another factor for improved engine efficiency, because accuracy in these values results in the machinery being operated continuously closer to the designed figures, instead of the tendency to work at a safe point below owing to the impossibility of maintaining constant vigilance. Quite a number of systems have been devised for the purpose of automatically controlling the operation of large steam generators, and the use of apparatus of this kind results in smoother, more efficient and, in general, safer operation. The problem in the main is to regulate fuel and air in accord with variations in the demand for steam, and since the constant pressure of steam is essential for efficient service, this is a very useful medium to use to bring about other changes in the system as and when necessary. In dealing with the subject of boiler operation generally, it is not suggested that automatic control can be done better by mechanical devices than by a competent watchkeeper, but it has been proved that, with a centralised panel and sufficient instruments to guide him, an operator is able to maintain in perspective all the units in the plant under his control, and thus to detect faulty performance in any of the contributory items in advance of the time when a shut-down would be necessary. Again, with multiple units, suitable metering equipment facilitates a more accurate balancing of the load between the boilers, resulting in the most economical operation and consequent longer life of the component parts. The operation of the various instruments needed may be electrical or by compressed air. In the systems so largely used in America, the latter source of power is favoured because, in addition to offering no fire hazard, the simplicity of the equipment, also the accuracy and speed of its operation, are strongly in its favour. Different types of boilers and furnaces demand variations in the methods of connecting up the equipment, but in the main there can be said to be four arrangements. In the series arrangement, the steam pressure adjusts the volume of fuel. In another scheme the pressure can be arranged to control the air supply to the furnaces, and an indication of the air flow will control the fuel necessary for efficient combustion. Another system is that under which steam pressure adjusts both the fuel rate and air flow simultaneously. Another aspect of marine power control is the provision of recording meters, which give a continuous reading of steam pressure, combustion ratios and base-of-funnel temperatures, so that a record of the performance of the boilers is available at all times. Another important aspect of marine boiler operation, is that of feed regulation, because it is essential that the feed should be steady and at all times approximately equal to the steam output. There are a variety of reliable feed regulators available but probably the most satisfactory, is the self-actuating single-element type in which the generator connected to the steam drum develops sufficient pressure to actuate the feed control valve placed in the main feed line before the check valve. Again, there is a regulator depending upon a thermal expansion device, which also causes the feed valve to function as necessary. Whatever type of regulator is used, a water level indicating device for each unit should be included on the boiler control panel because, especially with the modern types of watertube boiler, the gauge glasses are so far above the firing platform as to be removed from the operator's vision, even when provided with reflecting mirror attachments which, incidentally, so often become dirty. Other instruments which could be included are electrically-operated smoke density instruments and salinity indicators which are now largely in use in warships, enabling the degree of density in the feed water to be checked. These instruments are almost a necessity when watertube boilers working at high rates of evaporation are in service.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,733, 8th November, 1945, p. 8.*

Training of Engineers and Stokers.

The Merchant Navy Training Board's report on the post-war training of engine-room and stokehold personnel contains five main recommendations. These are (*a*) That, without prejudice to useful experiments in sea training of engineers, the fundamental training of marine engineers should continue to be in workshops and technical colleges ashore. (*b*) That to improve the quality of engineer officers there should be specific improvements both of workshop practice and of technical training for all apprentices, and that for a limited number of selected apprentices there should be two years' special training after the third year of apprenticeship. This special training should be divided equally between full-time attendance at a marine engineering college and at a works, including experience in erection and in a drawing office. (*c*) That a new scheme should be started under which suitable ratings should be enabled after four years at sea to become engineer officers by technical college training for two years. (*d*) That in between the present donkeyman and the certificated engineer officer there should be a new intermediate grade of "engineer assistant". This would provide a practical chance of promotion to ratings who can never hope to obtain a professional qualification, and would also go some way towards meeting the complaint that the title "engineer officer" is far too lightly bestowed and detracts from the status of ships' engineers as a whole. The institution of this grade is wholly opposed by the Marine Engineers' Association and the Amalgamated Engineering Union. It is, however, strongly supported by the National Union of Seamen, by the shipowners' representatives and, in principle, by the Navigators and Engineer Officers Union. The representatives of the Government Departments, considering this to be essentially an industrial matter, have expressed no view. (*e*) That for training ratings, something on the lines of the war-time firemen's training schools should be continued, and that these arrangements should deal not only with coal-burning firemen, but also with oil burners.—*"The Syren", Vol. CXCVII, No. 2,568, 14th November, 1945, pp. 219-220.*