Abstracts of the Technical Press

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Marine Boiler Draught.

Various methods of draught control for boilers are available, but of these speed variations of the fans has proved to be the most satisfactory. Steam-driven fans are gradually being superseded by electrically-driven ones, and for these d.c. shunt-wound motors are generally used, despite their relatively high first cost, fairly heavy maintenance and operating cost and limited speed range. One-third fan speed corresponds to roughly 11-12 per cent. boiler output, below which no control is available. The principal types of a.c. motors suitable for speed control are the resistance-controlled slip-ring induction motor, and the commutator motor. Machines with wound rotors, external resistance starting and control are somewhat expensive and less economical in operation than shunt motors. Commutator motors are likewise expensive and their weight constitutes a disadvantage. Squirrel-cage motors are relatively cheap, robust, reliable and easy to maintain, but are essentially designed for constant-speed service. Such motors can, however, be provided with infinitely-variable speed control by equipping them with eddy current v.s. couplings and electronic speed-control gear. A section of such a coupling is shown in Fig. 1. The advantages claimed for it are its simplicity, ease of control, relatively small dimensions, the ease with which it can be installed and the fact that it can be used on vertical shafts. These couplings have been developed for fan motors of above 50 h.p., so that they should be suitable for use in steamships having propelling machinery of or above 6,000 s.h.p. Referring to the sectional diagram, the coupling has an outer or driving member on the driving shaft and an inner member on the driven shaft. The outer member is mounted on the motor shaft, whilst the inner member has a shaft extension connected to the v.s. fan. The outer element comprises a mild steel shrouded ring carried by a side plate from a hub keyed to the driving shaft, and has cooling slots in its periphery, the inner surface being a smooth cylinder. The shrouds direct a cooling air flow through the slots to dissipate the heat generated by the eddy currents in the rim. The outer member is on the driven side, so that maximum ventilation is always obtained. It is constructed of special steel annealed before machining. The inner half comprises a steel rim of special magnetic characteristics, in the periphery of which are machined slots forming a large number of poles. This element is carried on a side plate and hub supported on a shaft bearing which may, in certain cases, be of the pedestal type. The steel shaft carries a self-aligning bearing supporting the driving half. The inner half includes a circumferential glass-insulated recessed exciting coil for the magnetic circuit, the excitation being by d.c. As the driving half rotates the inductance of the magnetic circuit in any section of the core is varied, thereby generating H.F. eddy currents The flux changes induce eddy currents in the core which react to produce a torque in the driven half. For a particular exciting current the torque speed curves resemble those of an induction motor having comparatively high resistance in the rotor circuit. The greater the difference in speed between the two members for a specific excitation the greater the torque exerted. With maximum excitation, full-load torque is developed with a slip of only about 3 per cent. The excitation is about 0·3 per cent. of the power transmitted for the large sizes and about 0·5 per cent. for small capacities. The efficiency, which is dependent upon the slip, is highest at maximum excitation and attains 97 per cent. for the large size, the efficiency for relatively low powers being about 95 per cent. The maximum loss is 16·5 per cent. of the driven-member rated input power and occurs at about 66·7 per cent. speed or 48·5 per cent. maximum power. The minimum slip can be reduced and the efficiency increased where an oversize coupling can be employed. The coupling has only two working parts and is entirely self-contained. Speed changes are extremely flexible, the motor can be disconnected from the load instantaneously and started up against no load, if required. It is simple to provide remote control, and the control panels of several couplings can be arranged together at one place, with a lamp for each coupling to show when the motor is running, a speed indicator or ammeter, and an excitation control knob.—*S. B. Jackson, "Shipbuilding and Shipping Record", Vol. LXV, No. 6, 8th February, 1945, pp. 133-135.*

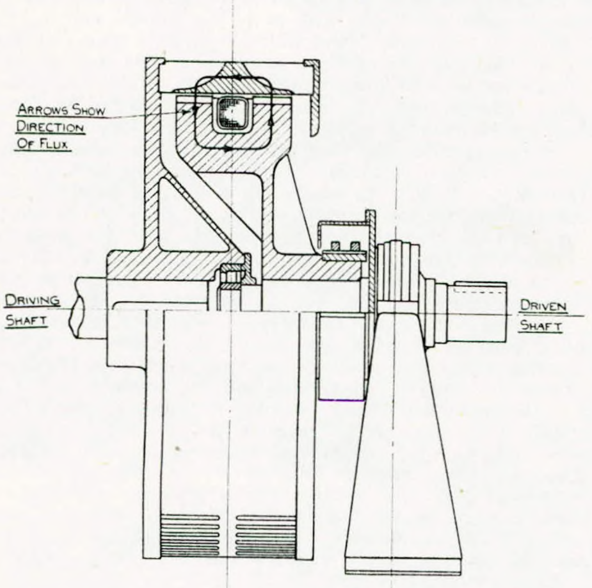


FIG. 1.—*Eddy current v.s. coupling.*

Turbine Blading.

The main portion of the annual Parsons Memorial Lecture delivered by Dr. C. E. Inglis at a joint meeting of the N.-E. Coast Institution of Engineers and Shipbuilders and the Institution of Engineers and Shipbuilders in Scotland, on the 15th December, 1944, dealt with the development of a method which the lecturer believed to be the natural process of determining critical speeds and modes of vibration of the shafts as well as the natural frequencies and modes of vibration of the blades of steam turbines. No matter what form of directional constraint was exerted by the end supports, or how variable in section the shaft or blade might be, calculation could be reduced to the solution of two linear simultaneous equations, which always took the same form and were of general application. The method depended upon expression of the mode of movement in terms of basic functions that represented the distribution of load on a beam of uniform section which produced a similar curve of deflection. By a sort of glorified harmonic analysis any load distribution on beams supported in different ways could be resolved into a series of basic components and in the case of turbine blades, simple formulæ had been evolved for estimating the growth of natural frequency due to centrifugal action.—*"Electrical Review", Vol. CXXXV, No. 3,500, 22nd December, 1944, p. 898.*

The Variable-pitch Marine Propeller.

The author begins by discussing propeller performance, dealing in turn with the order of the possible gain in efficiency to be expected by adopting v.p. propellers for different types of ships working within a range of operating speeds. The maintenance of speed in heavy weather and with a foul hull is then considered, and reference is made to the possibility of feathering for economical cruising, to the special application of v.p. propellers to tugs and trawlers, and to engine fuel consumption characteristics at part load and varying propeller r.p.m. Details of manœuvring and control are discussed, from the aspect of a possible elimination of engine reversing gear and the direct manipulation of the prime mover generally. The control of the ship's speed from the bridge is considered, and an estimation is made of astern performance, followed by a comparison with the normal reversing of a fixed-pitch screw. Factors influencing blade design are then reviewed, such as the type of root and size of boss and the effect of the type and number of blades on the efficiency of the propeller. Reference is also made to the calculation of pitch-changing moments and the possibility of balancing hydrodynamic and centrifugal components by suitable design and tilt of the blades. Various types of blade-operating mechanism are then examined—hydraulic, electric, mechanical, and combinations of these —and mention is made of the sealing of the hub against sea water. The author also refers to the need for indicating the pitch at the control station. Finally, a comparison is made with aeronautical applications, and it is shown that the range of operating conditions as affecting engine r.p.m., with a fixed pitch, is in general much less for marine screws, the blade widths of the latter being much greater. In the author's conclusions it is suggested that full-scale determination of the optimum pitch setting may be valuable; consideration is also given to possible size and limitations of blade width, and to the effect of the costs involved.—*Paper by Dr. J. Lockwood Taylor, read at a meeting of the Institution of Mechanical Engineers on the 12th January, 1945.*

Steam Engines in New American Ships.

Among the U.S. cargo vessels recently visiting U.K. ports was the first war-built steamship to be equipped with an Ajax engine. Built by a firm with considerable experience of stationary steam engines, the Ajax marine engine is of the compound steeple type with uniflow L.P. cylinders. A three-crank arrangement has been standardised for American tonnage, the engine being rated at 1,300 i.h.p. when running at 100 r.p.m. Each crank is driven by a single-acting H.P. cylinder superimposed on a central steam-jacketed cylinder cover which incorporates a piston-type steam-distribution valve, a s.a. uniflow L.P. piston attached to the common piston rod operating in a cylinder below the common central cover. The H.P. and L.P. cylinder diameters are 20in. and 44in. respectively, and the common stroke is 27in. The working surfaces are the lower side of the H.P. piston and the upper side of the L.P. piston, and this unusual application of the Woolf receiverless compounding principle enables the centrally-placed steam-jacketed cylinder cover to provide a certain amount of reheating for the steam passing from the H.P. stage to the L.P. stage. The Ajax engine has a simple and ingenious form of valve gear, consisting of what is virtually a three-throw crank rotating in an oiltight cylindrical housing secured to the side of the crankcase. Each of these valve-gear cranks has an obliquely arranged crankpin of considerable length, which carries a spherically mounted bearing and strap actuating a light vertical rod and right-angled bell crank to which the piston-valve rod is attached. The valve-gear shaft is chain-driven, and is moved horizontally by a hydraulic piston when it is desired to reverse the engine. In consequence of the obliquity of the crankpins, this movement alters the position of each piston valve in relation to the main crank. A single control lever serves to alter the cut-off, as well as to effect reversal of the engine. All the mechanism inside the crankcase, including the valve gear, is enclosed, and the principal bearings are force-lubricated. Although the design of the Ajax engine is novel and ingenious from a thermodynamic aspect, it is doubtful whether a single-acting engine of this type can compare favourably as regards cost and weight per horsepower with a more normal double-acting engine. The specific weight of the engine, including the condenser, is said to be nearly 100lb./i.h.p.; and while this is not excessive, it is not such a low figure as could be obtained with a more conventional modern design. Data of the performance have not been published, nor is it known how the engine has behaved in service. It is believed that only a limited number of relatively small cargo vessels have so far been equipped with Ajax engines.—*"The Shipbuilder", Vol. 429, No. 52, January, 1945, p. 10.*

Zinc Plates for Boilers.

In recent years the use of zinc anti-corrosion plates for boilers has been prohibited in order to conserve supplies for the production of armaments, but the Non-Ferrous Metals Control has now withdrawn this prohibition. Zinc for the production of boiler and other anti-corrosion plates has accordingly been released, and supplies of these plates will be available through the usual trade sources. Since the manufacture of zinc boiler plates has been prohibited, the Zinc Development Association state that they have received information from a number of sources that the restriction has had an injurious effect on the condition of many boilers.—*"Engineering", Vol. 159, No. 4,121, 5th January, 1945, p. 14.*

Steam Tanker "Empire Collins".

The single-screw oil tanker "Empire Collins", 14,690 tons d.w., built by Sir Jas. Laing & Sons, Ltd., Sunderland, is one of a number of similar vessels constructed in this yard during the war. These tankers are of a type standardised by the M.W.T., but although the arrangement of the cargo oil tanks (18 in number) and their pumping equipment is the same in all cases, the type of propelling machinery installed has varied according to the supply position. Some standard tankers have Diesel engines, but the majority have steam machinery of the type fitted in the "Empire Collins". It consists of a triple-expansion engine of the latest reheated design and was built by the North-Eastern Marine Engineering Co., Ltd., Wallsend-on-Tyne. The cylinders are 27in., 44in. and 76in. in diameter, with a stroke of 51in. The H.P. and M.P. cylinders, which are at the forward and after ends of the engine respectively, have poppet type admission and exhaust valves, while the L.P. cylinder is provided with a special type of balanced slide valve. All the valves are actuated by Stephenson type link motion. The reheater is mounted at the back of the H.P. cylinder and is supplied with steam direct from the superheaters of the main boilers at a temperature of 750° F. This steam passes through the reheater tubes and serves to heat the steam exhausted from the H.P. cylinder and flowing around the reheater tubes, before entering the H.P. cylinder at a temperature of about 600° F. There are three oil-fired Scotch boilers 16ft. 6in. in diameter by 12ft. 6in. long, generating steam at a pressure of 220lb./in.^{2} and 750° F. total temperature. The boilers are equipped with combustion chamber type superheaters, three-flow tubular air heaters and steam-operated soot blowers. They are fitted with Wallsend-Howden oil-burning equipment and operate on Howden's system of forced draught. The steam-driven auxiliaries are arranged to work with superheated steam or, alternatively, with de-superheated steam taken from a de-superheater of the injection type fitted in the auxiliary steam system which controls the auxiliary steam temperature under certain operating conditions. Electric current at 110 volts is furnished by two 30-kW. d.c. generators directly driven at 685 r.p.m. by two vertical single-cylinder steam engines.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,407, 19th October, 1944, p. 2.*

Coastal Tanker "Empire Harp".

Among the smaller types of merchant vessels which have been rendering such valuable service to the Allied cause in connection with the recent invasion of N.-W. Europe is the coastal tanker "Empire Harp", built by the Goole Shipbuilding and Repairing Co., Ltd., to the order of the Ministry of War Transport. She is a single-screw oil-burning steamship of the single-deck type with a flat plate keel, raked stem and cruiser stern. The hull is constructed on the longitudinal system of framing, except in the deep tank forward, machinery spaces and after peak. The fore peak serves as a ballast tank, with a store-room above it, and aft of this is a deep tank of 58 tons capacity with a hold for dry cargo above it. A cofferdam separates these spaces from the six cargo oil tanks, aft of which is the pump-room and an O.F. cross bunker to hold 158 tons, the boiler room, engine room and after-peak ballast tank. The d.w. capacity of the vessel is about 884 tons. The deck machinery comprises a steam windlass on the forecastle deck and a steam capstan aft, as well as a ballast pump of the duplex steam type under the forecastle. The telemotor-controlled steering gear is of the combined steam- and hand-operated type. The pump-room contains two horizontal steam-driven cargo oil pumps each of 100 tons/hr. capacity. The ship's officers are accommodated in the midship deck-house, whilst the crew are berthed in a large deck-house on the poop. The propelling machinery consists of a triple-expansion engine with cylinders of 15in., 25in. and 42in. diameter by 27in. stroke, supplied with steam at a pressure of 200lb./in.^{2} by an oil-fired cylindrical boiler operating with forced draught on the Wallsend-Howden low-pressure oil-burning system. The steam-driven E.R. auxiliaries include a 12-kW. generator set running at 550 r.p.m.—*"The Marine Engineer", Vol. 67, No. 807, October, 1944, pp. 430-432.*

Concrete Steamers Cross Atlantic.

Two reinforced-concrete steamers, the "Vitruvius" and the "David O. Saylor", recently arrived at a British port from the U.S., having crossed the North Atlantic in a slow convoy under their own power. The "Vitruvius" was built for the U.S. Maritime Commission at McCloskey & Co.'s yard, Hooker's Point, Tampa, Fla., and was one of three vessels laid down simultaneously, these being the first of a contemplated series of 24. This vessel is the builder's yard No. 1 and was completed last December, after having been under construction for nearly 12 months. She is reported to have cost rather more than a Liberty ship. This concrete-built steamer is a flush-decker without 'tween decks, with a raised bridge amidships and a raised poop. The boilers and machinery are aft, and in profile the ship resembles a tanker without the usual fore-and-aft flying bridge. She is just over 366ft. 4in. in length, with a beam of 54ft., a register of 4,820 gross tons and a deadweight of 5,403 tons. The vessel draws 26ft. 3½in. at her full-load displacement of 10,920 tons. It is estimated that the weight of concrete in the hull structure increased the displacement by 200 tons, as compared with a steel ship, and that 60 per cent. of steel was used to reinforce the concrete. There are altogether seven holds, of which one (No. 0) is used solely for ballast. The total bale capacity of Nos. 1-6 holds is just under 228,000 cu. ft. The cargo-handling equipment comprises 12 three-ton derricks each served by a steam winch. The telemotor-controlled steering engine is also of the steam-driven type. Tanks are arranged for the carriage of 133 tons of fresh water, 456 tons of oil fuel and 950 tons of water ballast in wing tanks abreast of No. 4 hold. The captain, chief officer and W/T operator are accommodated under the bridge, whilst the other 41 officers and men of the vessel's complement are berthed in the poop and on the main deck below the latter. The propelling machinery consists of a 1,300-i.h.p. triple-expansion engine on a C.I. bedplate built into the reinforced-concrete hull structure. Steam is supplied by two Wickes Boiler Co.'s watertube boilers with Foster Wheeler superheaters and Todd oil burners. Some of the E.R. auxiliaries are of the steam-driven type, whilst the remainder are motor driven. There are three turbo-generators which provide d.c. at 125 volts for power and lighting. The commander of the vessel, Capt. J. C. Wingate, stated that the "Vitruvius", although thoroughly seaworthy, was not really suitable for service in the North Atlantic. The chief engineer, Mr. R. Edenfield, said that the vessel's propelling machinery had so far operated in a very satisfactory manner. The ship brought a cargo of timber to this country, although her relatively small holds are not well adapted for this class of cargo. A more suitable cargo would be sugar in bags. She has already made two voyages from Cuba to Baltimore, carrying over 28,000 bags of sugar on each occasion.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,359, 24th August, 1944, p. 8.*

The Fire in the s.s. "Fort Stikine" in Bombay.

The disastrous explosion and fire which occurred in the s.s. "Fort Stikine", in Bombay, last April, formed the subject of discussion at a recent meeting of N.F.S. officers in the North-Western Region. Among the speakers was a senior officer of wide experience in dealing with fires on board ship, who made a number of comments on the particular incident under discussion and on the fire-fighting equipment of merchant ships in general. He pointed out that even when it is possible to land trailer pumps on the deck of a ship, the maximum "lift" of such pumps under normal conditions is only about 24ft. If a partly-filled hold is flooded, the buoyancy of the cargo, if well bonded, may cause it to lift bodily, so that a certain proportion of the cargo will always be above the water level until the hold is completely filled. During the latter part of the flooding, therefore, the burning upper surface of the cargo may be pressed closer and closer to the lower surface of the deck above it. The resultant deck heating can only be countered by the maintenance of an adequate water seal above the deck. The amount of cooling achieved in a hatchway by playing jets down on to the cargo from the upper deck level is negligible, whereas the effect of the same volume of water played down the hatchway from numerous spray branches would be far greater, in addition to which the water would still play its part in the flooding and would facilitate access to the top of the burning cargo for the firemen. A point which must be borne in mind is the method of cooling the engines of the N.F.S. trailer pumps. The water in the radiators of the latter is cooled by a coiled pipe system fed with water from the pump deliveries, this water then running to waste underneath the pumps. This means that a discharge pressure of at least 20lb./in.^{2} must be maintained in order that the cooling water may be ejected as soon as it has extracted some heat from the radiator water. In rotary pumps, pressure can only be developed by resistance to the flow of water; the use of open-discharge nozzles would reduce this resistance factor to a very low value, so that it becomes necessary to provide adequate throttling of the discharge to build up the required water pressure. The speaker suggested that the provision of N.R. sluice valves operated from the upper deck in the bilge pipe system would be preferable to the non-return valves normally fitted in the latter, and pointed out that the size of these pipes limited the quantity of the water that could be passed through them irrespective of the capacity of the pumps and the amount of pressure maintained. The discharge from a 4-in. fire main is far too small for urgent and rapid flooding purposes and outbreaks of fire in cargo holds and 'tween-deck spaces could be dealt with more effectively by an efficient system of water drenchers or diffuser nozzles fitted under the deck-heads and supplied direct from the ship's pumps through large-diameter pipes rising to the level of the freeboard deck and fitted with valves controlling branches to every under-deck compartment.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,419, 2nd November, 1944, p. 12.*

Foaming in Boilers.

Priming in a boiler is violent ebullition usually indicated by turbulent action, with intermittent slugs of water passing over with the steam into the pipes, whereas foaming is a surface condition of the water inside the boiler, the steam space becoming filled or partly filled with bubbles or foam, due to a soapy or alkaline condition of the concentrated water. Steam produced under these conditions contains moisture, the amount of which depends on the nature and quantity of foam in the steam drums. Foaming is not indicated by any surging of the water in the gauge glass, as commonly occurs with severe priming. Although priming is the more common and serious of the two evils, certain detrimental conditions may also arise as a result of foaming. The fundamental conditions of foaming are the presence of substances which concentrate either at the surface or in the mass of the water and thus either increase or reduce the surface tension, and of substances which by imparting viscosity to the films stabilise them and prevent them from bursting immediately after foaming. In average boiler water, any change of surface tension is brought about by dissolved sodium salts, and the stabilisation of the foam by finely divided solid matter, neither being sufficient to produce foaming by itself. To test this theory, solutions of chloride, sulphate, hydroxide, carbonate and bicarbonate of sodium and various mixtures, in concentrations from 25 p.p.m. up almost to saturation, were boiled in pressure and vacuum flasks, with little or no evidence of foaming. In the stronger solutions the surface would be covered with large "goggle-eye" bubbles, which had only a momentary existence, and there was also momentary violent ebullition on adding solids. Various insoluble powders, such as pumice, sulphur, bone black, lead sulphide, boiler scale, precipitated calcium carbonate and limestone, were also boiled in distilled water, with no appreciable foaming except in one or two instances with large quantities of solids, especially with limestone, which may have been slightly soluble. When present in sufficient concentration, any one of the sodium salts, together with one of the insoluble materials mentioned, produced a white froth or foam of a certain degree of permanence, and, in extreme cases, several inches thick. A smaller concentration of sulphate than of the other sodium salts sufficed to produce foam, but the difference was slight. Among the solids, powdered boiler scale and limestone were the most effective foam producers. The foam-producing tendency of powdered boiler scale increased, for equal weights, as the size of the particles was decreased, but all the scale, which passed through a 40-mesh sieve, produced foam. Tests with calcium chloride, potassium chloride, hydrochloric acid, acetic acid, potassium dichromate, sugar, ethyl alcohol and acetone as the soluble substances all produced foaming mixtures, with scale or limestone as the solids, but no foaming in water alone. A fair amount of foam was obtained with concentrations of 1,000 p.p.m. of sodium salts where there was a sufficient amount of insoluble material, the foaming increasing till the sodium salts reached 7,000 p.p.m. Foams were produced with low soluble material and high insoluble, and vice versa, but with less than 500 p.p.m. (30 grains per gall.) of soluble salts, no reasonable amount of insoluble material would produce foam, and with less than 500 p.p.m. of insoluble matter, no concentration of soluble salts was sufficient to cause foaming. Changes in pressure from 0·3 to 0·5 atmospheres produced no effect, except that at the higher pressures the bubbles were smaller and more nearly uniform in size, and a temporary violent ebullition accompanied by a momentary increase in foam was noticed if, during the boiling, the pressure was suddenly reduced. A mere trace of castor oil stopped almost instantly the foaming of all the mixtures of soluble material, the films of which had been stabilised with finely divided solids, regardless of whether the dissolved substances had raised or lowered the surface tension of the liquid. The obvious way to prevent foaming is to keep, as far as possible, all impurities, whether soluble or insoluble, out of the boiler by periodical blowing down. If foaming does occur, check the draught and cover the fire with fresh coal, or shut off the oil burners. Then close the stop valve long enough to find the true level of the water. If this is sufficiently high, blow down the boiler and feed in fresh water, repeating this several times, if necessary. If the foaming does not stop, it is best to shut down, cool off and empty the boiler to investigate the cause. After foaming has occurred, the gauge glass and pressure gauge connections and safety valve should be tested to make sure that they are clear.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,501, 8th February, 1945, pp. 1-2.*

Release of Steam in Watertube Boilers.

In an article on the above subject in a recent issue of *Power Plant Engineering,* M. H. Kuhner states that there is little or no relation to the operating conditions in modern watertube boilers in the questions: What is the correct steam disengaging surface in the boiler drums; what steam storage space should be provided; and how high should the steam outlet be above the working water level? The author points out that the steam is not formed on the surface of the working water level, but is generated in the evaporation tubes; if the latter discharge below the water level in the drum, the steam has to pass through the water and in doing so it causes very violent disturbance of the surface. For this reason, the steaming tubes in modern boilers generally discharge into the drum above the working water level, so that there is no disengagement at the latter and the level remains quiescent. By condensing part of the steam by means of feed water at lower temperatures, and using the condensate to wash the remainder of the steam, the quantity of solids carried by the latter is reduced. The space in the drum above the working water level holds only enough steam for a fraction of one second's operation in most cases. This space is only useful for the separation of steam and water, and for the accommodation of the steam-cleaning apparatus. The effective steam storage capacity is determined by the amount of water stored in the boiler, ready to be flashed into steam when the pressure is reduced. Finally, although the vertical height available below the steam outlet is of some importance where steam separation and drying are effected by gravity, the water-carrying capacity of the steam depends on the velocity of the steam near the outlet, to reduce which most modern boilers are designed so that steam is taken off uniformly along the whole length of the drum.—*"Boiler House Review", Vol. 59, No. 2, February, 1945, p. 49.*

Causes of Turbine Vibration.

Vibration in a turbine-generator unit is a sensitive indication of one or more of many possible defects, the nature and cause of which are discussed by R. E. Turner in an article that appeared in a recent issue of *Power Plant Engineering.* Lack of dynamic balance causes very noticeable vibration and may develop in operation by loosening, cracking or wear of the turbine blades. Hence ,the importance of improvements effected in recent years in the design and support of blades, the distribution of steam nozzles, and other factors influencing blade vibration. Good operation cannot be expected unless steam is supplied at the pressure and temperature for which the unit was designed, and the presence of "slugs" of water, from whatever cause, introduces risks of mechanical damage, erosion and thermal strains, all contributing to increased vibration. One of the troubles still to be eliminated is that arising from the accumulation of deposits on the blades. Vibration may sometimes be caused by water returned to the turbine because of the failure of traps or drains to remove condensate from the exhaust pipes. Rubbing between the rotor and stator is one of the commonest causes of vibration, and may be due to wear in the bearings, lifting of the blade packings or (if intermittent) warping as the result of unequal heating and expansion. Cracks in the shaft or the turbine wheels give rise to vibration which it is important to detect at the earliest possible stage. Because of the importance of vibration as a symptom of damaging or dangerous conditions, and because the rate of increase of vibration may be so slow as to be difficult to detect by direct observation, it is advantageous to employ a recording vibration meter, one type of which is described by the author. Faulty operating methods may likewise produce vibration; for example, neglect of the water-sealing glands may allow water to come into contact with the dummy piston or spindle, causing temporary warping. Faulty provision for pipe expansion, defective lubrication and unbalance in geared or direct-coupled turbine-generator units, as well as electrical faults in the generators, are among other possible causes of vibration.—*"Boiler House Review", Vol. 59, No. 2, February, 1945, p. 49.*

Electric Propulsion of Ships.

The machinery of the new C.P.R. steamships for the London and Montreal service, which was designed by Mr. J. Johnson, is now being constructed by C. A. Parsons & Co., Ltd., who will supply the turbo-alternators, propulsion motors and auxiliary alternators. The machinery arrangement comprises a turbine unit with H.P. and L.P. cylinders in tandem, taking steam at a pressure of 800lb./in.^{2} and temperature of 850° F. The steam is reheated after expansion in the H.P. unit to 850° F. before it enters the L.P. turbine. A double-unit propulsion motor in a single housing is employed. A Diesel-driven alternator will supply current for auxiliary purposes, but will also be available for connection to either half of the motor for emergency use. Steam will be furnished by oil-fired Babcock-Johnson boilers with a designed working pressure of 850lb./in.^{2} and a superheat temperature of 850° F.—*"The Engineer", Vol. CLXXIX, No. 4,646, 26th January, 1945, p. 76.*

Expanded Tube Joints in Boiler Drums.

The paper deals with the special problems which arose in connection with two extra-high-pressure boilers at Battersea "B" Power Station, each boiler having four alloy steel drums with interconnecting mild steel tubes. On completing the tube-expanding work on the first boiler, preliminary tests disclosed numerous leaks caused by the elastic strain which occurs in the tube holes of highly stressed drums, which, at Battersea, amounts to about twice that obtaining in mild steel drums. The holding power of the joint is thus relaxed to an abnormal extent. The elastic deflections or total "spring" of the joint resulting from the expanding operation must therefore be correspondingly increased to accommodate the increased drum strain. Various methods of achieving this were tried. Insertion ferrules were chosen as the most promising, and tests were carried out both on boiler drum joints and on experimental seat plate joints. The authors describe the final ferruling and testing of the boilers, and make a number of general observations on the procedure. The causes of the leakage are discussed in detail. In order to take full advantage of the benefits of high-tensile steel boiler drums, with mild steel tubes expanded into the drums, it is considered essential that the expected operating conditions of the expanded joints should be investigated in the design stages on the lines suggested in the paper. The adoption of high-tensile steel ferrules as a design feature is justified by the results obtained at Battersea.—*Paper by W. B. Shannon, C. W. Pratt, B.Sc., T. B. Webb, B.Sc., and W. B. Carlson, B.Sc., read at a joint meeting of the Institution of Electrical Engineers and the Institution of Mechanical Engineers on the 23rd March, 1945.*

Turbo-electric for Tanker of High Power.

Among the items completed by the B.T.H. Company during the past year referred to in the firm's progress report for 1944 is a set of turbo-electric propulsion equipment for what will probably be the highest powered tanker ever to be constructed. The arrangement of the turbo-alternators and propulsion motors is believed to be novel in that it incorporates the advantages of twin-screw turbo-electric machinery in a single-screw vessel. This is done by having two electrically independent half motors mounted together in the same frame and driving a single shaft. Each of the two sets of windings contributes half the total s.h.p. under full-load conditions, but economical operation can be obtained by running only one turbo-alternator on one half-unit of the motor at about three-quarters of the ship's maximum speed. Turbo-alternators for electric ship propulsion completed during the year include units having a rating of 5,000 kVA. at 4,000 r.p.m. They operate on steam at a pressure of 425lb./in.^{2} and superheat temperature of 740° F., and exhaust into a vacuum of 28½in., provision being made for feed heating. The auxiliary sets for the ships for which these main units are being supplied have a rating of 550 kW. at 220 volts d.c. These sets are of the self-contained condensing type. The turbines run at 8,000 r.p.m., and the generators at 1,000 r.p.m.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,489, 25th January, 1945, p. 8.*

Efficiency of Turbo-electric Drive.

In the course of a letter on the above subject to the Editor, Mr. W. J. Belsey states that his firm—the B.T.H. Company—recently completed a set of D.R. geared turbines of 3,000 h.p., which have proved to be as satisfactory in the matter of noise as any others made either in this country or in the U.S.A. The pinions are fitted with quill shafts and multi-tooth couplings which had to be made to a standard of accuracy that would ensure an 80 per cent. bearing surface. The gearing itself had to be finished with a tolerance of ±0·0005in. to ensure satisfactory operation. Mr. Belsey points out that these conditions compare unfavourably with those necessary for a turbine-electric drive where the minimum running clearances in the transmission are of the order of ¼in. Marine engineers who criticise the electric drive on the grounds of "complication", may be surprised to learn that the cost of the electrical spares for two 28,000-s.h.p. passenger liners equipped with this type of transmission which have been in constant service since 1931 has amounted to less than £5 p.a. per ship. The B.T.H. Co. have designed and built 24 sets of geared turbines, and their experience in the design of these and of the turbo-electric machinery which they manufacture clearly indicates that the overall efficiency of the electric drive is equal to, if not better than, the geared turbine drive.—*"Shipbuilding and Shipping Record", Vol. LXV, No. 2, 11th January, 1945, p. 32.*

Bowes Drive: A Promising Development

A novel design of electric drive for ships' propellers evolved by Thos. D. Bowes, a Philadelphia marine engineer, and recently subjected to satisfactory tests at the Ridgway, Pa., works of the Elliott Company, provides an efficient alternative to the conventional form of mechanical reduction gearing. Not only does the Bowes drive operate as an electric coupling and a reduction gear capable of keeping a substantially constant speed ratio between the engine and propeller, but it likewise provides a certain amount of electrical power for E.R. auxiliaries, etc., this power being taken off by special slip rings which are fitted at the after end of the thrust bearing which is incorporated in the system. It is claimed that this feature of the Bowes drive eliminates, a tail-shaft-driven generator or separate auxiliary generators. Furthermore, when the vessel is in port, this form of drive constitutes a supply of electrical energy greatly in

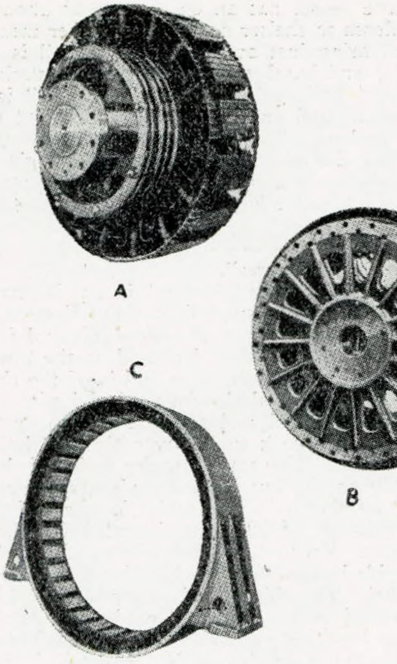


FIG. 1.
A—engine element. B—shaft element. C—stationary element.

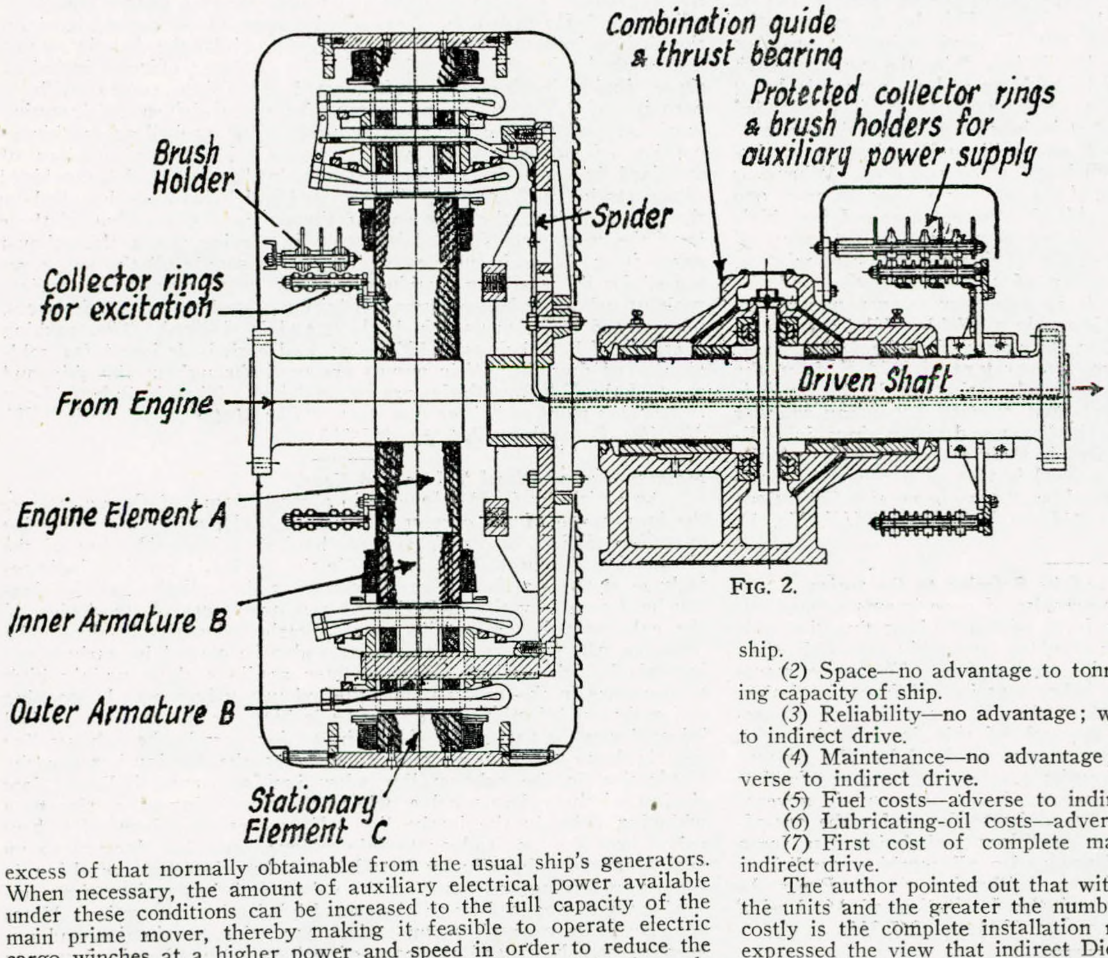


FIG. 2.

excess of that normally obtainable from the usual ship's generators. When necessary, the amount of auxiliary electrical power available under these conditions can be increased to the full capacity of the main prime mover, thereby making it feasible to operate electric cargo winches at a higher power and speed in order to reduce the time required to load or discharge cargo. The Bowes drive is made up of three main elements, as shown in Fig. 1. These are the engine element *A*, bolted to the shaft of the Diesel engine or steam turbine; the driven shaft element *B*; and the stationary element *C*, fixed to the ship's hull. The engine element is virtually a synchronous-generator rotor with poles selected for the desired predetermined speed ratio; being mechanically coupled to the engine or turbine shaft its speed is that of the latter. The driven-shaft element *B* consists of a rotating spider on which two armatures are concentrically mounted in relation to the engine element *A*. The inner armature and the engine element together form a generator whose winding not only generates electric energy but also transmits torque to the driven shaft. The outer armature on the spider operates electrically in conjunction with the stationary element *C* to form a motor, taking electric energy from the generator unit and converting it into mechanical energy at the driven shaft. If the driven-shaft element *B* is held stationary by locking, the inner parts of the assembly operate as an ordinary synchronous generator, and by means of slip rings electric energy can be taken for auxiliary purposes. In an emergency, a ship equipped with the Bowes drive could easily supply power for dock and harbour purposes. Under normal operating conditions the shaft element rotates at the desired speed for the driven shaft. The relative speed between the field of the engine element adjacent to it results in the generation of alternating current. The reaction torque, absorbed by the frame supports in ordinary generators, is available to turn the shaft element. The Bowes drive can be arranged to effect propeller reversal if required, although the experimental installation tested at the Elliott works in 1944 was of the non-reversing type. A range of sizes, from 300 b.h.p. upwards, will be manufactured. Fig. 2 shows the assembly of the three elements of a Bowes marine electric transmission system with a 3 to 1 reduction between the engine and propeller shaft.—*"The Marine Engineer", Vol. 68, No. 811, February, 1945, pp. 104-105.*

Diesel or Diesel-electric?

Comparisons were made between direct-coupled installations and Diesel-electric combinations for different classes of ships by Mr. C. C. Pounder in his paper, "Diesel Propelling Engines: A Comparison of Some Alternative Arrangements", read at a recent meeting of the N.-E. Coast Institution of Engineers and Shipbuilders. A number of the latest types of Harland & Wolff oil engines, ranging from d.a. 2-stroke units to trunk-piston V-type engines, were briefly described, and the comparisons were entirely on the basis of the engines with which the author is associated. This ensured straight comparisons on the same specification basis. After a careful examination of the evidence and reducing the various items to something like a common denominator, the author reached the following conclusions:—

(*1*) Weight—in favour of the Diesel-electric drive only if the engines are fairly highly-rated 2-stroke units; no saving with 4-stroke supercharged, or 2-stroke engines with moderate rating. No advantage to the d.w. carrying capacity of the ship.

(*2*) Space—no advantage to tonnage; no increase in cubic carrying capacity of ship.

(*3*) Reliability—no advantage; with highly-rated engines, adverse to indirect drive.

(*4*) Maintenance—no advantage; with highly-rated engines, adverse to indirect drive.

(*5*) Fuel costs—adverse to indirect drive.

(*6*) Lubricating-oil costs—adverse to indirect drive.

(*7*) First cost of complete machinery installation—adverse to indirect drive.

The author pointed out that with multi-engine drive, the smaller the units and the greater the number of engines required, the more costly is the complete installation relative to the direct drive. He expressed the view that indirect Diesel drive could only be justified in large, fast ships, where the propelling power was too great to be transmitted by direct-coupled engines; and for certain craft of special types. In the case of those vessels which constitute the great bulk of passenger- and cargo-carrying tonnage, the balance of advantages was with the direct drive. It was not accurate, therefore, to describe the large direct-coupled Diesel engines as an anachronism. On the contrary, it was the most profitable form of Diesel-engine propulsion at present known. Accordingly, if it should become the fashion to utilise indirect-Diesel drive, it would be a change of practice, but it would not be progress.—*"Mechanical World", Vol. 117, No. 3,035, 2nd March, 1945, p. 233.*

Vapor-phase Engine Cooling and Waste-heat Recovery System.

A novel system of engine cooling and waste-heat recovery for the main and auxiliary machinery of motorships has been developed by an engineering firm in Los Angeles, Cal. Known as the Vapor-Phase system, it is already being employed in the U.S. Navy for oil-engined small craft of various types. A typical Vapor-Phase installation is that which is fitted in a Diesel-electric vessel of the U.S. Navy equipped with a main Diesel engine of 350 h.p., two auxiliary Diesel-driven a.c. generators of 30 kW. and one Diesel-driven d.c. generator of 15 kW. All four oil engines are connected to a single, compact Vapor-Phase flash tank by means of which the cooling water in the jackets of the engine cylinders is maintained at a uniform temperature of 212° F. under all operating conditions, *i.e.*, whether under full power, idling or shut down, as long as one auxiliary engine is running. Water from the engine cylinder jackets at 212° F. circulates in a closed circuit to the Vapor-Phase flash tank, in which it flashes into steam and is condensed before returning to the cylinder jackets. One of the two condensers in the flash tank, fed from the ship's fresh-water storage tanks by automatically-controlled motor-driven pumps, supplies a hot-water storage tank with water heated to a temperature of between 130° and 160° F. for the galley, showers and wash basins. The other condenser in the flash tank supplies a second storage tank with water at 205° F. for the radiators of the ship's heating installation. Small thermostat-controlled motor-driven circulating pumps maintain the water in the hot-water storage tanks at the desired temperature and pressure. Any surplus waste heat is recovered by a very small boiler connected to the exhaust system of the two 30-kW. auxiliary Diesel engines. This boiler reduces the exhaust-gas temperature to about 230° F., and ordinarily requires no maintenance, as condensation is eliminated by the constant high temperature. When the ship is in harbour and no power is being consumed on board, the auxiliary generators can be artificially loaded by the use of immersion-type electric heating elements in the hot-water storage tanks. Thus loaded, an auxiliary Diesel-generator becomes a boiler with a thermal efficiency of 80 per cent. Whenever the Diesel engine driving the main generator is not in use, one auxiliary generator is able to provide the current required for ship's lighting and auxiliary power requirements and the water pump of this one unit, assisted by a small amount of thermo-syphon circulation, serves to heat the circulating water of the main engine and the other auxiliary Diesels. When it is necessary to get under way quickly, full power is therefore instantly available. The makers of the Vapor-Phase system claim that by maintaining the jacket water of the Diesel engines at a uniform temperature of 212° F. from the top to the bottom of the cylinders, condensation inside the latter is eliminated and oil sludging is prevented, thereby improving cylinder lubrication and reducing wear on the liners and piston rings, in addition to which the rings are kept free in their grooves. Although the Vapor-Phase installation just described is that of a relatively small vessel, it may be regarded as typical. as there are no size limitations to the application of the system.—*"Motorship", Vol. XXIX, No. 11, November, 1944, p. 951.*

The Double-beat Throttle Valve and its Relation to Governing.

The paper gives details of the results of experiments carried out on the balancing of a particular form of double-heat throttle valve with the object of elucidating the troubles frequently met with when using it for the speed control of steam engines. The experiments showed that though apparently in balance, as judged from the design, there was a force tending to close the moving valve of an unexpectedly large amount. The strength of this force varied with the size of the valve, the steam pressure at the inlet, the amount of lift from the seating, and the outlet pressure. The paper further gives the application of the results towards improvement in governing: a formula for obtaining an approximate figure for the out-of-balance force from given working conditions, and design data for a valve giving almost perfect balance under all working conditions. Curves and tables in explanation are likewise given.—*Paper by F. O. L. Chorlton. "Proceedings of the Institution of Mechanical Engineers", Vol. 151, No. 3, December, 1944, pp. 247-255.*

Swedish Lloyd Motorship Built on Götaverken System.

The cargo motorship "Scandinavia", built at the Götaverken, Gothenburg, for the Swedish Lloyd Co., was recently handed over to her owners after completing a basin trial of the main engines, the usual sea trials having been omitted on account of the shortage of oil in Sweden. The vessel has an o.a. length of about 383ft., a beam of 50ft. and a depth to shelter deck of 32½ft., her mean draught on summer freeboard being just over 22½ft. The hull is of almost all-welded construction and has been built on the Götaverken system with welded corrugated bulkheads. The "Scandinavia" is the first cargo vessel to be constructed on this system, which had previously been applied only to tankers. The propelling machinery of the ship consists of a 6-cylr. s.a. 2-stroke Götaverken Diesel engine developing 3,850 i.h.p. and designed to give her a speed of 13 knots in loaded condition.—*"Lloyd's List and Shipping Gazette", No. 40,576, 13th December, 1944, p. 14.*

The P. and O. Cargo Liner "Socotra".

The new P. and O. cargo liner "Socotra" is a twin-screw motorship of 7,840 gross tons, designed specially for the Eastern trade and with accommodation for 12 passengers in four single and four double staterooms at the fore end of the boat deck and on the lower bridge. The vessel has a deadweight of 10,575 tons and is of the shelter-deck type, with forecastle and 'tween decks forward and aft. There are five cargo holds, three forward and two aft of the engine room, with upper and lower 'tween-deck spaces over Nos. 1-4 holds and an upper deck over No. 5 hold. The total capacity (bale) of the general-cargo spaces is 531,570 cu. ft., but there are also two deep tanks at the sides (P. and S.) of the main fuel tanks forward of the engine room, with a total capacity of 204 tons, intended for the carriage of vegetable oil cargoes. Up to 1,537 tons of fuel oil can be carried in the main and double-bottom fuel tanks, No. 6 D.B. tank being used for boiler oil fuel. The ship's fresh-water tanks hold 325 tons and up to 1,500 tons of water ballast can also be carried, when necessary. The cargo-handling equipment includes a 50-ton derrick at No. 2 hatch and a 30-ton derrick at No. 4 hatch, in addition to the usual 10-ton and 5-ton derricks. The deck machinery, comprising 20 cargo winches and an anchor windlass, is steam-driven, as is the telemotor-controlled four-ram hydraulic steering gear. The ship's officers and European members of the crew are accommodated on the shelter deck and upper deck amidships, whilst the Asiatic ratings are berthed aft. The vessel carries 11 engineer officers, including three junior engineers. Refrigerated provision rooms with a capacity of 1,650 cu. ft. are served by motor-driven refrigerating machinery of the methyl chloride type. The propelling machinery consists of two sets of 4-cylr. Barclay Curle-Doxford engines of standard design with cylinders 670 mm. in diameter and a combined piston stroke of 2,320 mm. Two cylindrical boilers are installed on the lower deck at the fore end of the engine room. One of these is of the composite type and is always in service at sea, the exhaust gases from the main engines enabling it to supply all the steam required for the auxiliary machinery and for heating and hotel services without using the low-pressure oil burners fitted to its two furnaces. The second boiler is used in harbour and is oil-fired. The working pressure of both boilers is 120lb./in.^{2}, and each is designed for cold-air forced draught. Weir pumps are used throughout the ship and most of the E.R. auxiliaries are steam-driven. They include a 15-ton evaporator plant and three dynamos.—*"The Motor Ship", Vol. XXV, No. 299, December, 1944, pp. 282-287.*

Maintenance of Diesel Valves and Gear.

An article by G. H. Menefee in a recent issue of *Power* stresses the importance of the correct adjustment of Diesel valves and valve gear for efficient operation and mechanical safety. Heating of the air-starting line near the valve, while the engine is running, indicates leakage at the starting valve. Leakage at the cylinder relief valves can be detected by the flickering of a match flame. Late closing of the exhaust valve gives rise to soft carbon deposits in the intake passages, although such deposits may also be caused by early opening of the inlet valve. If pyrometer readings show unduly high temperature in the exhaust line, the exhaust valves may be opening too early, an injection valve may be leaking, or the amount of fuel injected may be too great. If an inspection port in the exhaust line reveals flame when the exhaust valve opens, the opening is too early. Detonation in the exhaust line when ignition occurs indicates late closing of the exhaust valve, whereas early closing gives rise to a whipping noise in the intake line. Examples are given of a bent valve stem due to inadequate lubrication: extensive damage to an engine caused primarily by insufficient valve clearance, resulting in the piston fouling and breaking the valve; and destruction of a camshaft assembly caused by an obstructed lubricating connection. Notes are also given on rocker-arm maintenance, the examination and upkeep of camshafts and the care of valves. Attention is drawn to the effect of excessive grinding of valves and to various other valve defects, some of which can, while others cannot, be remedied without replacement of the defective components. Any relief valve that fails to lift when the engine is suddenly accelerated should be examined, because the proper functioning of these valves is vital in an emergency.—*"The Power and Works Engineer", Vol. XXXIX, No. 462, December, 1944, p. 286.*

Allen Two-stroke Engine for Marine Auxiliary Service.

For the past 15 years the Diesel engines for marine auxiliary service manufactured by W. H. Allen, Sons & Co., Ltd., of Bedford, have been of the 4-stroke type, but the firm are now supplementing their range of such engines by a uniflow-type 2-stroke unit operating on the Harland-B. & W. through-scavenge system in which the exhaust gases are discharged through two poppet valves in each cylinder head. With a cylinder diameter of 290 mm. and a stroke of 470 mm. the rating is 135 b.h.p. per cylinder at 375 r.p.m., and as the new engine is available with 3, 4, 5, 6 or 8 cylinders, the power range extends from 405 to 1,080 b.h.p. At full load the b.m.e.p. is 76lb./in.^{2}, which is about the same as that of most modern 4-stroke engines operating at the same speed. This results in substantial reductions in the size and weight of the new 2-stroke units. For instance, a 6-cylr. engine of this design, rated at 810 b.h.p. and coupled directly to a 410-kW. ship's generator, has a length of only 13ft. 2in. to the flywheel coupling and weighs only about 23 tons, whereas a 4-stroke engine, not pressure-charged, of the same speed and power, is about half as long again and weighs about twice as much. Moreover, the 2-stroke unit is somewhat lower in height. The piston speed at 375 r.p.m. is approximately 1,150ft./min., whilst the fuel consumption of the new type 6-cylr. engine does not exceed 0·37lb./b.h.p.-hr. at 75 to 110 per cent. of full load. Each cylinder liner is in one piece, with two rubber water seal rings and one seal ring below the air ports, the disposition of which causes air swirl on entry. Only that portion of the liner which is above the air ports is water-cooled, but the cooling water is circulated well up outside the liner, into a recess in the flange, in order to ensure adequate cooling of the hot zone at the top of the area which is swept by the piston. Oil cooling of the pistons is effected by taking lubricating oil up the connecting rods into chambers below the piston crowns. Drainage is by fixed pipes, so that no telescopic tubes are required. The scavenge blower, of the three-lobed Roots type, is driven from the crankshaft by a chain drive and gearing which incorporates a resilient coupling. Air is drawn through a large silencer forming an integral part of the engine and is delivered to the air casing around the port belts of the cylinder liners at a pressure of about 3lb./in.^{2}. Starting air at 300lb./in.^{2} is supplied to two or three cylinders, according to the size of the engine, but it can be delivered to all cylinders if required. A high degree of accessibility for all working parts had been achieved by the designers of the engine. As an instance, any piston can be withdrawn upwards in about 20 minutes.—*"The Motor Ship", Vol. XXV, No. 300, January, 1945, pp. 338-339.*

The Refrigerated-cargo Motorship "Port Phillip".

The twin-screw motorship "Port Phillip", one of the latest additions to the fleet of the Port Line, Ltd., is a vessel of 12,439 gross tons, built and engined by Swan, Hunter and Wigham Richardson, Ltd., at their Wallsend shipyard. She was specially designed for the carriage of refrigerated cargo (meat, fruit and dairy produce) between Australasia and the U.K. There are three complete steel decks, besides a long forecastle, bridge deck and poop. Accommodation for 12 first-class passengers is provided in a deck-house at the forward end of the boat deck. There are three cargo holds forward and three abaft the machinery space, Nos. 1-5 being insulated. The lower 'tween-deck spaces are similarly allocated, while of the upper 'tween-deck compartments, No. 1 is insulated, Nos. 2, 3, 4 and 5 spaces having insulated lockers at the sides of a central space devoted to general cargo. No. 6 'tween-deck space is wholly devoted to general cargo, which may also be carried in the forecastle and bridge. The total capacity of the refrigerated-cargo spaces is 513 000 cu. ft., in addition to which about 229 000 cu. ft. (bale) of general cargo can be carried. The capacity of the ship's fuel tanks is about 2,140 tons. The cargo-handling equipment comprises an adequate number of steel derricks of from 7 to 15 tons' capacity, in addition to a 60-ton derrick at No. 2 hatchway, served by 18 electric winches. The telemotor-controlled steering gear is of the electro-hydraulic type. A motor-driven windlass is installed on the forecastle deck and two electric warping capstans on the poop deck. The propelling machinery consists of two 5-cylr. Doxford type engines with cylinders 670 mm. in diameter and a combined stroke of 2,320 mm. These engines are of standard design and drive outward-turning four-bladed twin propellers. The latter have C.I. bosses and manganese-bronze blades of aerofoil section. The whole of the auxiliary machinery is electrically driven, but steam for tank-heating, fire-extinguishing and domestic purposes is supplied by a small exhaust-gas boiler when the vessel is at sea and by an oil-fired auxiliary boiler in harbour. Both these boilers are of the Cochran vertical type. Electric current at 220 volts d.c. is provided by four Allen 245-kW. Diesel-driven generators. Their engines are 8-cylr. four-stroke units running at 600 r.p.m., the cylinders being 230 mm. in diameter, with a piston stroke of 300 mm. There is also a 40-kW. emergency dynamo, directly driven at 1,100 r.p.m. by a 6-cylr. Ruston and Hornsby oil engine, in a special compartment abaft the engine casing on the boat deck, adjoining a well-equipped engineers' workshop. The E.R. staff of the vessel includes seven engineer officers for general duty, two refrigerating engineers, four assistant engineers and two electricians.—*"The Shipbuilder", Vol. 52, No. 429, January, 1945, pp. 31-36.*

Refrigerating Machinery of Port Line Motorship "Port Phillip".

The refrigerating plant of the t.s. motorship "Port Phillip" (*described in preceding abstract*) is installed on the second deck of the after end of the engine casing and comprises three large horizontal, enclosed twin-compressor CO_2 machines, each directly driven by a 160-b.h.p. variable-speed motor running at from 200 to 300 r.p.m. There are also three evaporators and three CO_2 condensers, with an 8-in. circulating salt-water main, the circulating pumps being installed in the main engine room. They are of the vertical centrifugal type and have each a capacity of 200 tons/hr. against a head equivalent to 70ft. The driving motors are variable-speed units rated at 27 b.h.p. The brine is pumped through the cooling grids by four motor-driven 6-in. centrifugal pumps, one 4-in.×4½-in. plunger-type pump and one 2½-in. centrifugal pump. The arrangements are such that brine may be circulated at different temperatures, as required for the various classes of cargo, a steam brine heater being provided to raise the brine temperature when necessary. With the exception of No. 3 hold, which is cooled by brine grids alone, the insulated spaces are cooled by a combination of brine grids and cold-air circulation. A motor-driven fan capable of maintaining approximately 25 changes of air per hour is provided for each space, except Nos. 2 and 4 holds, each of which is equipped with two such fans. The trunking in way of the air-circulating fans in the various compartments is so constructed that an Ozonair plant can be inserted at any time for deodorising. CO_2-injection apparatus is provided for the chilled-beef compartments, as well as CO_2 indicators in all spaces. By maintaining a CO_2 concentration of about 10 per cent. in the spaces filled with chilled beef, the formation of bacterial growths on the cargo can be prevented.—*"The Shipbuilder", Vol. 52, No. 429, January, 1945, pp. 33 and 36.*

The Future of the Diesel Engine.

A paper bearing the title "Future Horizons in Diesel Engine Design" was recently read at a meeting of one of the American technical societies by Capt. L. F. Small, U.S.N., who called attention to the fact that since October, 1943, the combined horse-power of the Diesel engines installed in vessels of the U.S. Navy has been greater than the total power output of the steam turbines in service. Although the Diesel engines are used for the propulsion of the smaller types of ships only, some of the units being installed are of 12,000 h.p. The author pointed out that among the advantages possessed by the Diesel engine were its instant readiness to take full load which means a quick get-away for a ship at anchor; he went so far as to declare that such disasters as Oran, Taranto and Pearl Harbour would have been greatly lessened had the ships concerned been propelled by Diesel engines. The question of utilising oil engines for the propulsion of large ships of the highest power was therefore deserving of consideration. At the end of the last war 29 cu. in. of piston displacement were required for each h.p. of output, but this figure has now been reduced to 2½ cu. in. in the latest types of Diesel engine. The specific weight has, at the same time, been reduced from 60 to 4½lb./h.p., with a corresponding decrease in bulk, while the development of welded steel construction and the adoption of novel and ingenious cylinder arrangements have also contributed to the progress made in this direction. Current problems now being investigated are the need for simplified treatment of torsional vibration and the development of uniform standards of acceptable porosity in the chromium plating of cylinder liners. The author expressed the opinion that there will be no room in the future for the 4-stroke naturally-aspirated engine, although the supercharged 4-stroke engine equipped with a high-speed supercharging blower of light and simple construction may survive. New developments in the production of heat-resisting metals will probably render it possible to increase the m.e.p. on the pistons and the h.p. output of the engine, thereby reducing its weight and bulk. This will also result in a higher exhaust pressure and hence the energy of the exhaust gases will have to be utilised to their fullest extent in the exhaust turbo supercharger. The success of the Büchi systems depends upon the grouping of the cylinders exhausting into one manifold to secure non-interference, and the author suggested that the next step might be the use of individual exhaust ducts from each cylinder to the turbine. As regards the 2-stroke engine, the author believed that the future belongs to the unidirectional scavenging type; he advocated the use of the opposed-piston engine in which each piston controls a row of ports, thereby elminating poppet valves with their seats, springs, rockers, camshafts and drives for the latter. In this type, too, the exhaust gases mixed with the surplus scavenging air will be expanded finally in a turbine of much higher rotative speed and therefore lighter construction, with consequent lowering of the weight per h.p. of the complete unit. This, if the exhaust pressure is sufficiently high, might prove to be the solution of the problem of the compound I.C. engine. Moreover, as the exhaust pressure is raised, the blower may be transformed into a compressor, and the engine, turbine and compressor geared into one common unit, as was recently done in the case of the new Sulzer engine. The final and most attractive step of all would be the elimination of the crank mechanism in what is usually termed the gas turbine, although the author suggested that this development will require considerable time and effort before a thoroughly practical means of ship propulsion will emerge.—*"Shipbuilding and Shipping Record", Vol. LXV, No. 1, January, 1945, p. 4.*

Notes on the Büchi System.

The author begins by giving a brief outline of the theory of pressure charging, and states that the system invented and developed in Switzerland by Dr. Alfred Büchi, constitutes a method of increasing the useful power of a Diesel engine by 50 per cent. or more, compared with the normal output of a naturally aspirated engine. The system is generally applied to s.a. 4-stroke engines and enables the latter to compete with d.a. 2-stroke engines. After a reference to the employment of Büchi superchargers for wood-gas-producer engines of the type used for road vehicles on the Continent, the author describes a typical pressure-charged oil engine equipped with a blower and gas turbine of modern design. Notes are given on the testing of pressure chargers, the performance of pressure-charged engines and some operating experience as regards effect on scavenging and prevention of corrosion obtained with the motorships "Maron" and "Hylton". The paper concludes with a few reflections on the future of the Büchi system of pressure charging. The text is illustrated with 16 diagrams and sectional drawings.—*Paper by R. Walker read at a meeting of the N.-E. Coast Institution of Engineers and Shipbuilders on the 12th January, 1945.*

Recent Clyde-built Ships.

Some particulars have now been released of two new ships built and engined by Barclay, Curle & Co., Ltd., Glasgow. One of the vessels in question is the twin-screw motorship "Behar", constructed for the Eastern service of the Hain Steamship Co., Ltd., London. She is of the shelter-deck type and of 10,575 tons d.w., having a cargo capacity of 577,630 cu. ft. (grain). There are five cargo holds with upper and lower 'tween decks for the carriage of general cargo, which is handled by an efficient arrangement of derricks and winches. In addition to the normal 5-ton and 10-ton derricks, a 50-ton derrick is installed at No. 2 hold and a 30-ton derrick at No. 4 hold. The double bottom is arranged for the carriage of fuel oil and a deep tank to supplement these fuel tanks is provided at the centre line immediately forward of the machinery space. Two deep tanks are arranged at the P. and S. sides of the deep fuel-oil tank for the carriage of vegetable oil cargoes, for which special pumping arrangements are provided. The cargo winches are steam driven. Accommodation for 12 passengers is provided in four single and four two-berth cabins. The propelling machinery consists of two sets of 4-cylr. Barclay Curle-Doxford engines of standard design with cylinders of 670 mm. bore by 2,320 mm. combined stroke. The circulating pumps for the distilled water used for cooling the cylinder jackets and pistons are, in this instance, independent of the main engines, as are the pumps used for circulating the sea water for cooling the guides, and the F.L. pumps. The only auxiliaries driven by the main engines are the fuel pumps. Two cylindrical boilers are installed on the lower deck, one being of the composite type with two oil-fired furnaces and two nests of tubes taking the exhaust gases from the two main engines, whilst the other is arranged for oil firing only and supplies steam to the deck machinery and E.R. auxiliaries in harbour. The working pressure of both boilers is 120lb./in.^{2}. The second vessel is the single-screw cargo steamer "Urlana" of 6,852 gross tons, built for the Indian trade of the British India Steam Navigation Co., Ltd. She is of the two-deck, three-island type, carrying 9,170 tons d.w. on her normal draught. The five cargo holds have a total capacity of 520,000 cu. ft. and are served by derricks of 8 and 5 tons' lifting capacity, in addition to which a heavy-duty derrick is fitted at the foremast. The cargo winches are steam driven. The propelling machinery consists of a triple-expansion engine having cylinders 22½in., 37½in. and 63in. in diameter by 45in. stroke, working in conjunction with a Bauer-Wach exhaust turbine which transmits its power to the main shaft through D.R. gearing. Saturated steam at a pressure of 250lb./in.^{2} is supplied by four coal-burning cylindrical boilers equipped with tubular air heaters and arranged to work with forced draught.—*"The Syren", Vol. CXCIII, No. 2,512, 18th October, 1944, p. 87.*

Electric Starters for Oil Engines.

In order to provide for electric starting of relatively large Diesel engines, a new C.A.V. 7-in. type of electric starter has been developed for use in conjunction with a 300-A.H. battery which is capable of giving a lock torque of 230lb./ft. at 60° F. Under these conditions the starter motor develops 21 b.h.p., and the torque at engine cranking speeds of 100-150 r.p.m. is about 1,000lb./ft. The starter is fitted with an inertia engagement drive, and a special double-solenoid switch unit is provided to ensure smooth engagement of the pinion with the engine flywheel. This switch unit is designed so that the pinion is engaged whilst a resistance is connected in the starter battery circuit, and not until the pinion is in mesh with the flywheel teeth can the full power of the starter be obtained. When the engine starts, the pinion is thrown out of mesh by its acceleration along the sleeve due to the increase in speed of the engine flywheel. The completion of the main solenoid circuit which cuts out the resistance is effected by a pair of contacts operated by the movement of the pinion, thus ensuring that the full power of the starter motor cannot be developed until the pinion is in mesh with the flywheel teeth. Due to the cyclic variation in cranking torque of an oil engine, there may sometimes be a tendency for the pinion to move backwards and forwards along the sleeve, thereby causing the pinion operating contacts to re-open. In order to prevent this from happening, a holding-on winding is arranged in the solenoid system, by means of which satisfactory operation of the starter on full power is assured until the operating push is released, whereupon the correct sequence of solenoid operation is once more available.—*"The Motor Boat", Vol. LXXVIII, No. 1,928, February, 1945, p. 37.*

Clyde-built Motorship Added to British India Fleet.

The new B.I. cargo liner "Chupra" is a single-screw motorship of 7,200 gross tons and 10,700 tons d.w., built and engined by Barclay, Curle & Co., Ltd., Glasgow. The total capacity of her five cargo holds and the 'tween-deck spaces is about 625,000 cu. ft. (grain). No 1 D.B. tank is arranged for boiler feed water, Nos. 2, 3 and 7 tanks for fresh water and Nos. 4, 5 and 6 tanks for the carriage of fuel oil, in addition to which the wing tanks at the sides of the machinery space are arranged to contain fuel oil. The cargo-handling equipment includes 50-ton derricks at Nos. 2 and 4 hatches, in addition to the normal 5-ton and 8-ton derricks. The deck machinery is steam driven, the cargo winches being of a special heavy pattern. The telemotor-controlled steering gear is of the four-ram steam-hydraulic type. There is accommodation for 24 passengers in four two-berth and four four-berth cabins at the forward end of the boat deck and on the lower bridge. Mechanical ventilation and steam heating is provided for all living spaces in the ship. The main engine is a 6-cylr. unit of the standard Doxford type, the cylinders having a diameter of 670 mm. with a combined piston stroke of 2,320 mm. The propeller-shaft bearings are of the self-oiling whitemetal-lined type and requires a minimum amount of attention, there being no direct access to the shaft tunnel from the engine room. Except for the motor-driven priming pump and fuel valve cooling pumps for the main engine, all the E.R. auxiliaries are steam driven. They include three 30-kW. generator sets and two cooling pumps for the main engine, each comprising one centrifugal sea-water pump of 410 tons/hr. capacity and one two-stage centrifugal pump for piston and jacket cooling. The jacket stage delivers 210 tons/hr. at a pressure of 20lb./in.^{2}, and the piston stage 105 tons/hr. These two pumps are driven by a single-cylinder engine, 11in. in diameter by 7in. stroke, one pump being coupled to each end of the engine shaft. One set is of sufficient capacity for the main engine, the other serving as a stand-by. There are two cylindrical boilers arranged for forced draught and having a working pressure of 120lb./in.^{2}. One of these boilers is for harbour service and has three oil-fired furnaces, while the other is of the composite type with one nest of tubes to take the exhaust gases from the main engine and two oil-fired furnaces, one of which is normally required at sea to supplement the main-engine exhaust. When manœuvring or in convoy at reduced speed, the two oil-fired furnaces of the composite boiler can generate all the steam required.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,489, 25th January, 1945, p. 2.*

Fuel Oil for the Combustion Turbine.

It is reported that high-powered combustion turbines can now be manufactured with a guaranteed thermal efficiency of 27 per cent., from which it would appear that the fuel consumption would be reduced to something like 0·57lb./b.h.p.-hr. Moreover, it has been found from experience that combustion turbines will operate just as satisfactorily on fuel oil as on Diesel oil. After preliminary running tests on boiler oil, it was found possible to operate the gas-turbine locomotive constructed for the Swiss Federal Railways by Brown, Boveri & Co. on this type of fuel with satisfactory results and a substantial saving in fuel costs. Dr. Meyer, of the above-named firm, who was largely responsible for the development of the gas turbine, has pointed out that the assumption that combustion turbines must use Diesel oil is therefore "quite unfounded".—*"The Oil Engine", Vol. XII, No. 142, February, 1945, p. 249.*

Vickers Oil-tight Gland for Stern Tubes.

In Fig. 4 is illustrated an oil-tight gland for stern tubes. The gland is secured to the after end of the stern tube (E) and comprises three stationary metal rings (D) secured to the tube by studs (*1*). An oil-retaining ring (F) is provided. A protective sleeve (C) is fitted on the propeller shaft (A) and studs (*2*) secure the flange of the sleeve to the propeller boss (B). In the part of the sleeve (C) within the gland (D), a keyway (*3*) is cut and the key fits in the oil-retaining ring (F), which is thereby rotated with the propeller shaft. On the other hand, a limited amount of fore-and-aft play is permitted. Eccentric oil grooves (*5*) are provided. Between the outer parts of the glands (D) there is a composite flexible washer (*6*). On the inside surface of the sleeve (C), three longitudinal oilways (*7*) are spaced 120° apart. Accordingly, oil can pass from the gland into the sleeve and thus prevent corrosion.—*"The Motor Ship", Vol. XXV, No. 302, March, 1945, p. 418.*

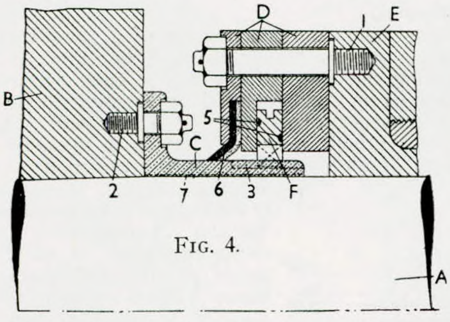


FIG. 4.

Harland and Wolff Fuel-injection Pump with Buffer Cylinder.

A recently published British patent concerns an improved design of fuel-injection pump for Diesel engines developed by Harland and Wolff, Ltd., and shown in section in Fig. 1. The fuel-injection pump is operated by the pressure in the engine cylinder, without using the plunger as a buffer for ending the delivery stroke, thereby avoiding rapid plunger wear. The length of the stroke is regulated by generating pressure in a buffer cylinder (*8*) in line with the fuel-pump plunger (*1*). When the plunger is at the bottom of the stroke, fuel is drawn through the ports (*3*) and when these are closed by the upward movement of the plunger, delivery takes place through the hole (*5*) to the fuel valve on the engine cylinder. The plunger (*1*) has a circumferential groove (*32*), shown in a detail diagram, a slot (*33*) being formed in the buffer piston (*7*) to provide sufficient axial play for the adjustment of the plunger (*1*) and the piston (*7*). The buffer piston (*7*) is secured by means of a distance piece (*9*) to a lower piston (*10*). Compressed air from the engine cylinder is admitted below this piston through a central hole (*12*). The return stroke of the pump plunger is effected by a spring (*13*). Fuel from the inlet (*4*) flows through a circumferential groove in the pump housing (*6*) and along a passage (*15*) to a valve chamber (*16*). When the valve (*17*) is open, fuel also flows from the chamber (*16*) through the passages (*18*) to the space in the buffer cylinder (*8*) above the buffer piston (*7*). Excess fuel escapes through the passages (*31*) to the fuel tank. The valve (*17*) is closed by a spring (*19*) bearing on a cap (*20*), and is lifted off its seat by a rod (*26*) having a portion of its length screwed through a crosshead (*25*) which is rigidly attached to a lower crosshead (*23*) by adjustable rods (*24*), as shown in the detail diagram. The crosshead (*23*) is driven by direct attachment to a bracket (*21*) carried on a sleeve (*22*) which moves with the piston (*10*). On the upstroke of the pump plunger (*1*), if the engine is running at a uniform speed, the valve rod (*26*) moves upwards until it leaves the valve (*17*) free to close under the action of the spring (*19*). The closing of this valve cuts off the escape of fuel from the buffer cylinder (*8*) at a point determined by the setting of the valve rod (*26*), thus arresting the upward movement of the buffer piston (*7*) and the pump plunger (*1*). The stroke of the pump may also be regulated by the engine governor actuating a lever (*27*) fixed to a bush (*28*) which receives the upper squared end of the valve rod (*26*). As the rod is screw-threaded through the crosshead (*25*) rotation of the lever (*27*) by the engine governor will shorten the operative length of the rod and thus allow the valve (*17*) to close earlier. Advancing of the cut-off of the escape of fuel from the buffer cylinder (*8*) will cause the piston (*7*) to stop earlier in the stroke. As a result, the quantity of fuel delivered by the pump will be decreased and the engine speed will be reduced. Speeding up the engine is attained by the reverse action.—*"The Motor Ship", Vol. XXV, No. 300, January, 1945, p. 350.*

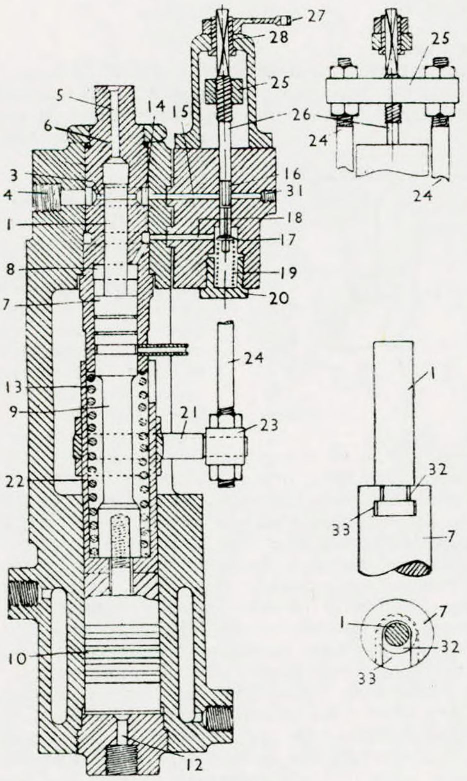
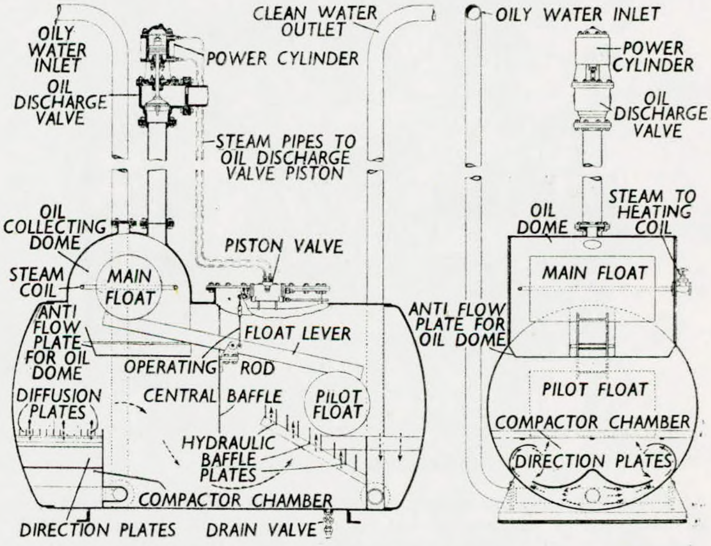


FIG. 1.

The Coastguard Oily Water Separator.

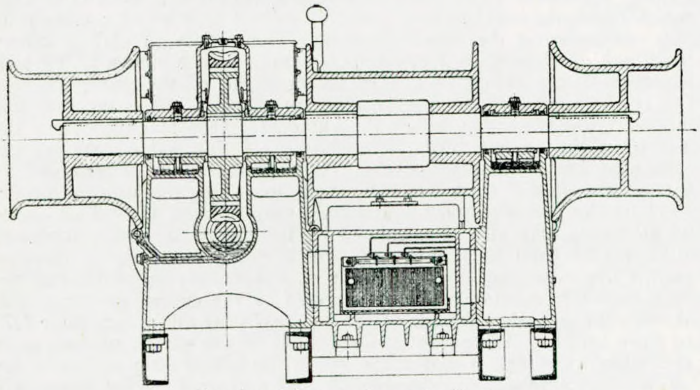
The accompanying sectional diagrams show the construction of the Coastguard oily water separator which is fitted in certain cargo vessels recently built in this country. The oily water entering the separator is first dealt with in a "compactor" chamber, where a rotary motion compacts the oil content into masses, which can free themselves and pass up the oil dome. When a certain quantity of oil has accumulated the main float becomes heavier than the pilot float and falls, thereby operating a piston valve. This valve is controlled by a steam (or compressed air) cylinder, and the recovered oil is discharged to a reception tank. When a given quantity of oil has been ejected from the dome, the main float rises and moves the piston valve to cause the reversal of the steam supply to the power cylinder. The oil discharge valve thus closes before any free water can enter the tank. The flow from the compactor chamber may contain small traces of oil, and in order to remove these the fluid is made to pass below a baffle in the middle of the separator drum and through the hydraulic baffles shown on the right of the left-hand diagram. It is claimed that the apparatus needs no manual control or supervision, and it may be noted that there are no test cocks or observation troughs. Accumulated gases are automatically discharged through the oil valve and delivery pipe, and pass to the atmosphere from the tank through the usual gas-freeing pipes.—*"The Motor Ship", Vol. XXV, No. 300, January, 1945, p. 349.*



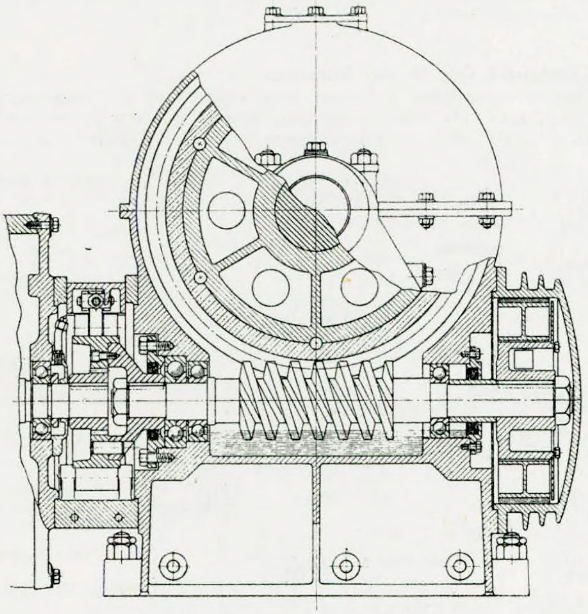
Coastguard oily water separator.

A New Electric Cargo Winch.

One of the latest electric cargo winches to be put on the market in this country is the Ulro winch, which is manufactured by a firm in Dundee, who are also makers of electric capstans. The Ulro worm-reduction type winch is produced in 2-ton, 3-ton and 5-ton sizes, and the construction of the intermediate size is shown in the accompanying sectional drawings. The 2-ton winch has a rope speed of 150ft./min. and is driven through worm-reduction gearing by a 27-b.h.p. motor running at 450 r.p.m. The lift is 1½ tons at 180ft./min. and the light-hook speed is 600ft./min. The motor power and speed of the 3-ton winch are the same, but the rope speed is 100ft./min. and a 1½-ton lift is dealt with at a speed of 200ft./min., the light-hook speed being 400ft./min. The 5-ton winch has a rope speed of 70ft./min. and is driven by a 33-b.h.p. motor running at 300 r.p.m. This winch lifts 2½ tons at 140ft./min., the light-hook speed being 350ft./min. The motor for each size of winch is a totally enclosed compound-wound machine with a speed-limiting shunt winding. The field-magnet frame consists of a fabricated steel cylinder, and each pole piece, together with its coils, forms a self-contained unit. A self-contained detachable commutator is provided. The lever-operated master controller is mounted over the motor and is fitted with a magnetic blow-out with contact rings for reversing the motor armature and for making the contactor-coil circuits in the correct sequence. The contactor panel is housed in a welded, water-tight casing and includes a line contactor and those required for short-circuiting the resistances in the armature circuit. There is also a field diverter contactor and current relay, adjusted to give increased speed with light loads. An overload relay with an adjustable time limit is likewise provided. The resistances are carried in the winch bed and are readily accessible for inspection. The winch controls include three brakes, one of which is a disc type magnetic brake mounted on the commutator-end-cover of the motor, which is released when the current is switched on, but is automatically applied in the event of a failure of the supply or when the current is switched off. A hand release lever allows the operator to lower any load on the centre barrel. On the end of the worm shaft is a centrifugal brake which is entirely automatic in its action and prevents any over-speeding of the motor when lowering heavy loads. The third brake is foot-operated and acts on a large drum arranged on the coupling between the armature and worm shafts. The application of this brake causes a switch to open the operating coil circuit of the resistance contactors, thereby putting all the series resistance in the armature circuit.—*"The Motor Ship", Vol. XXV, No. 299, December, 1944, p. 280.*



Sectional front view of winch.



Section through worm shaft.

Sulzer Pump Made of Plastics.

A recent British patent covers the construction of a pump made of plastic tubes, rods and sheets by Sulzer Bros., Winterthur. It is claimed that by constructing the parts of the pump from elements, instead of machining them from solid material or forming them in a press, deformation in consequence of warping is avoided. This has particular reference to synthetic resins. Referring to the accompanying sectional elevation of the pump (Fig. 5), the principal parts are the impeller (*1*), which is made from a single sheet, the hub (*2*) made of a rod, the casing, made of tubular pieces (*9, 10*), and the delivery branch, which consists of a tube (*14*) and a sheet forming the flange (*15*). Blades (*2*) are fixed on the front of the impeller, similar blades (*3*) being secured to the back; alternatively, the rear blades (*3*) may be milled out of the plate (*1*). The pump shaft (*5*) is of steel and passes through a hole in the hub (*4*). The suction branch consists of a tube (*19*) and a sheet forming the flange (*20*).—*"The Motor Ship", Vol. XXV, No. 301, February, 1945, p. 384.*

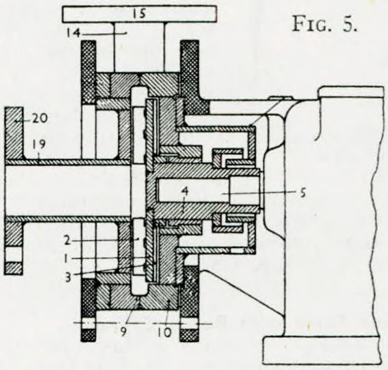


FIG. 5.

Pulsometer Self-priming Pump.

A simplified form of self-priming centrifugal pump is illustrated in Fig. 2. It is stated that the device may be applied to an existing pump as an auxiliary attachment, or it may be incorporated in the structure. The casing comprises a branch with a non-return valve connected to the suction pipe line and a reservoir for priming water, supplied from the delivery pipe. An auxiliary valve is connected to the non-return valve for controlling the flow of water from the reservoir. When the pump is started the chambers (D, E) are full. Water is drawn through the port (D^1), into the chamber (E), thence through the impeller into the discharge branch (B) and back to 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 (C, F) 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 impeller into the chamber (D), where the air is separated and passes up the discharge pipe (J). This continues until all the air has been drawn from the suction pipe. The water then raises the non-return valve (G) and simultaneously closes the interconnected auxiliary valve (H), so that no further circulation of water can take place through the chamber (D). Accordingly, all the water delivered to the impeller is discharged through the pipe (J). If air enters the suction pipe (C) while the pump is running, the main valve (G) will return to its seat and the original priming operation will take place. An opening (F^1) above the discharge branch ensures that there is always sufficient water in the chamber (D) to start the operation and prevents the chambers (D, E) draining should the valve (G) fail to seat properly.—*"The Motor Ship", Vol. XXV, No. 302, March, 1945, p. 418.*

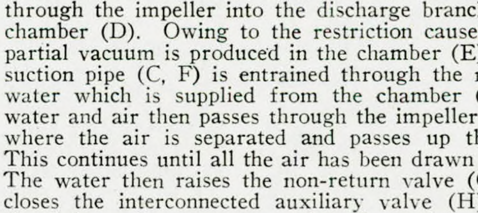
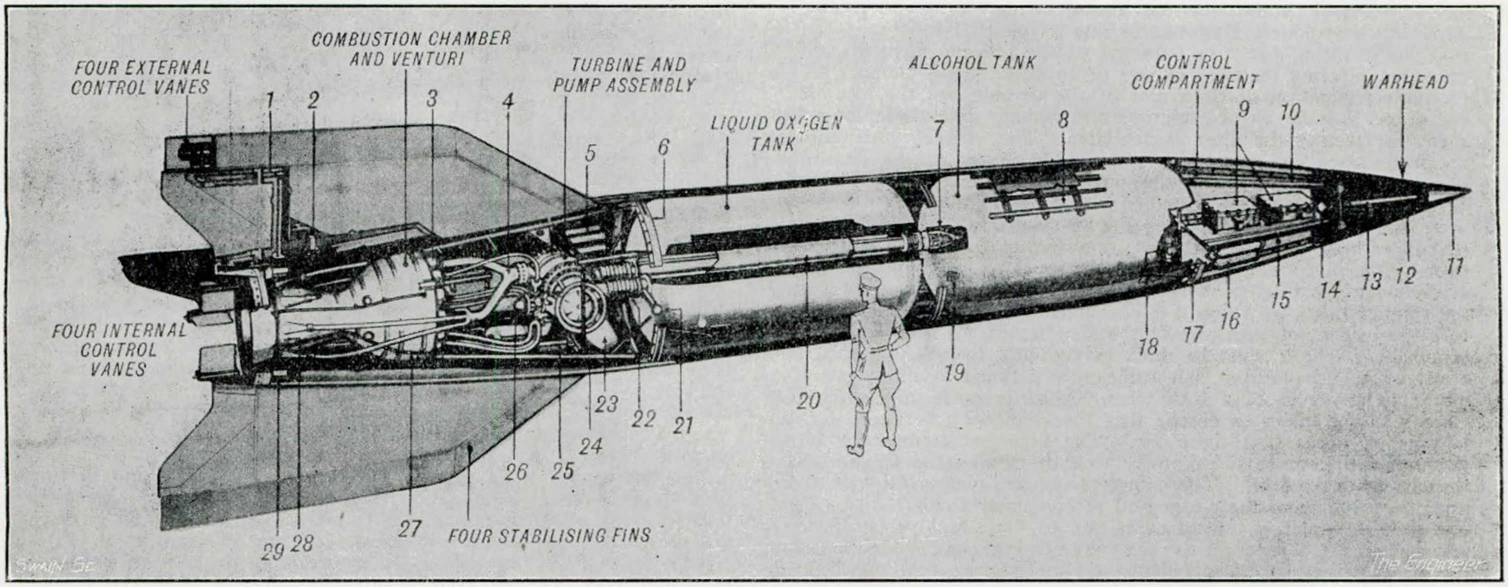


FIG. 2.

The Rocket Bomb.

The German V-2 rocket bomb is 46ft. long and 5½ft. in diameter. When loaded with fuel ready to take off, it weighs about 12 tons, only about 1 ton of which is accounted for by the explosive warhead. Power for propulsion is derived from the burning of alcohol, of which some 7,500lb. is carried, with liquid oxygen, the tank for which holds some 11,000lb. Turbine-driven pumps of large capacity deliver the fuel and oxygen through numerous jets to a combustion chamber and venturi arranged at the tail of the bomb. The hot gases in escaping create a propulsive thrust of about 26 tons. Complete combustion of the entire fuel supply takes place within a minute or two, by which time the rocket has reached a speed of some 3,000 m.p.h. and has entered the stratosphere. Stability in flight is maintained by four vanes at the rear and control is exercised through control tabs at the rear of these vanes and around the jet orifice. According to all reports, the rocket is launched vertically. At a predetermined height, a gyroscope takes charge, operates the control vanes, and tilts the device towards the target. When the stratosphere is reached the rocket is pointing upwards at an angle of about 45°, by which time the fuel supply is either exhausted or, more probably, cut off. The flight is continued along a path similar to that which a shell would follow. The range amounts to about 200 miles, and the distance is covered in about five minutes. A number of details in the arrangement of the bomb still remain insufficiently explained. It is known that the turbine driving the pumps is operated by steam produced at a high pressure and temperature by the admixture of highly concentrated hydrogen peroxide and calcium permanganate—a mixture in which the latter chemical apparently acts as a catalyst to break down the structure of the peroxide. But how the rate of steam production and the speed of the turbine are controlled, for instance, has not been revealed. The presence of pipes leading from at least one of the pumps to the rear end of the venturi suggests either that combustion is not completed in the chamber, or, as probably, that alcohol is used to cool the products of combustion before they pass over the control vanes located just behind the exhaust orifice. It may be assumed that these vanes regulate the flight as the stratosphere is approached, since the tabs on the main stabilising vanes would serve the purpose where the air density is greater. Since the oxygen tank appears neither to have double heat-insulating walls nor to be strong enough to stand up to any considerable pressure, it would be interesting to know in what exact state the oxygen is stored. Amongst the equipment shown in the accompanying drawing are the nitrogen bottles (*16*) and the air bottles (*5*). The purpose of these items remains unexplained, but it has been suggested that the nitrogen may be used to fill the fuel tanks as the alcohol is withdrawn. No doubt all the component parts of the bomb are designed for mass production, but even so, the man-hours of work accounted for by each bomb must be considerable. In addition to the turbine and pump assembly—itself quite an elaborate little plant—the combustion chamber and venturi and associated pipes and jets, the fuel and oxygen tanks, and gyroscope equipment, there are the contents of a miniature chemist's laboratory to produce—calcium permanganate, hydrogen peroxide, nitrogen, alcohol, liquid oxygen, and compressed air. All this work is devoted to the production of a device which carries only about 1 ton of explosive and the accuracy of which cannot be guaranteed!—*"The Engineer", Vol. CLXXIX, No. 4,645, 19th January, 1945, pp. 46-47.*

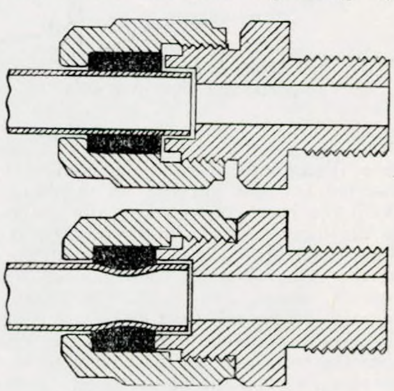


Arrangement of rocket bomb.

(1) Chain drive to external control vanes; (2) Electric motor; (3) Burner cups; (4) Alcohol supply from pump; (5) Air bottles; (6) Rear joint rings and strong point for transport; (7) Servo-operated alcohol outlet valve; (8) Rocket shell construction; (9) Radio equipment; (10) Pipe leading from alcohol tank to warhead; (11) Nose, probably fitted with nose switch or other device for operating warhead fuse; (12) Conduit carrying wires to nose of warhead; (13) Central exploder tube; (14) Electric fuse for warhead; (15) Plywood frame; (16) Nitrogen bottles; (17) Front joint ring and strong point for transport; (18) Pitch and azimuth gyros; (19) Alcohol filling point; (20) Double-walled alcohol delivery pipe to pump; (21) Oxygen filling point; (22) Concertina connections; (23) Hydrogen peroxide tank; (24) Tubular frame holding turbine and pump assembly; (25) Permanganate tank (gas generator unit behind this tank); (26) Oxygen distributor from pump; (27) Alcohol pipes for subsidiary cooling; (28) Alcohol inlet to double wall; (29) Electro-hydraulic servo motors.

A Small-pipe Union.

Fuel-oil and lubricating oil pipes subjected to vibration are liable to fracture at or near very rigid unions because the latter are stiffer than the pipes themselves. In consequence, nodes of vibration are established, the pipe metal becomes crystallised and sooner or later a fracture will occur. The problem has been to devise a union which is at once sufficiently flexible and yet adequately tight up to the maximum pressure for which it is designed. It is claimed that experience with the Clayflex patented flexible pipe union, shown in the accompanying sectional diagrams before and after tightening up, solves this problem, for though there is certainty of tightness, there is actually no metal contact through the union. The end of one pipe is, indeed, rigid and screwed to the union, but the other pipe-end is plain initially, and is automatically gripped by slight deformation when the synthetic rubber gasket around it is tightened down by screwing up the union. Gaskets are available of various materials to withstand steam, oil, water or any other liquid, whilst the standard unions will withstand pressures up to 1,500lb./in.^{2}. The gaskets not only provide a positive seal and locate the pipe-end with certainty without any risk of fracturing the pipe, but also possess sufficient flexibility to eliminate any trouble due to vibration. Single-ended female connectors are also available, employing the same principles, and high-pressure types are made for designed pressures of up to 6,000lb./in.^{2}. It has been shown that

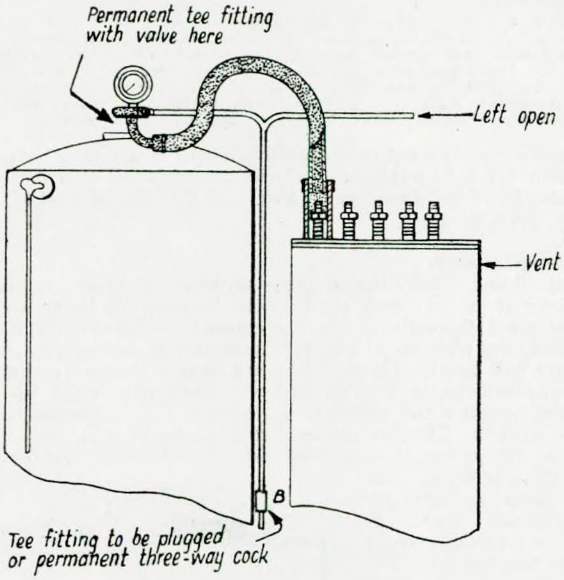


Before and after tightening.

these unions remain perfectly leak-proof in practice, even after repeated dismantling.—*"The Power and Works Engineer", Vol. XL, No. 463, January, 1945, p. 22.*

Stream-Line Filter Testing.

Unsatisfactory operation of an oil filter of the Stream-Line type can be detected by the fact that the oil in the cleaned-oil receiver is very dark in colour. This may be due to one of two causes, *viz.* (*a*) insufficient spring pressure on some of the filtering elements, or (*b*) damaged filtering material in one or more of these elements. The exact determination of the cause of the trouble and the location of the defect is liable to be a tedious undertaking unless suitable equipment for testing the filter is available. The writer claims that by making use of the procedure and accessories which he has found extremely satisfactory for the purpose, defective operation of a Stream-Line filter can be remedied with a minimum amount of trouble. The gear required for making the test includes two short lengths of rubber hose of different sizes; one of these hoses must fit tightly over a $\frac{1}{2}$-in. pipe bend, whilst the other must be large enough to pass freely over the filter-pack springs and of sufficient length to reach the smaller hoses to which it is connected without allowing the latter to come in contact with any of the spindles of the filter packs. The larger hose length must be thick enough not to collapse under the effect of a high vacuum, but sufficiently resilient at its open end to eliminate any risk of a leak when placed in position for the test. Care must be taken to ensure that the connection between the two lengths of hoses is a tight one. The filter packs must be blown through with compressed air to remove the sludge, the oil and sludge then being drained off. The complete vacuum gauge fitting is thereupon removed from the cleaned-oil receiver and a suitable pipe bend, one end of which is tightly connected to the small rubber hose, is attached to the connection for the gauge fitting, the copper pipe from the latter being left connected to the change valve. At the T-fitting (marked *B* in the accompanying sketch), where the copper pipe has been disconnected from the control valve, an air cock should be inserted for the purpose of breaking the vacuum when necessary. With the hose connected to the gauge fitting, the control valve set to the filter position, the vent pipe from the renovator opened and the special air cock closed, the pump is started up. The open end of the larger hose is then pinched together, or closed by any convenient means, and if all the joints in the system are tight, the vacuum gauge will then quickly register its maximum reading. The pump is thereupon stopped, the free end of the larger hose is pushed over the spring of the first pack to be tested and held hard down to prevent any leakage at the base. If the pack under test registers a poor vacuum reading, open the air cock to break the vacuum, remove the hose, and tighten the pack spring. Should the pack itself be faulty, it will continue to show a low vacuum reading when the test is repeated; it must therefore be marked for attention, prior to the testing of the remaining packs. When the test has been completed and the defective packs located, they can be attended to when the complete filter is removed from the renovator. After the requisite renewals of defective elements have been carried out, the filter packs can be tested before the filter is replaced in the renovator, the spring pressure being adjusted to suit each individual pack in the manner previously described. The hose may be effectively sealed during the test by filling the concave space formed by the cork jointing ring with oil. Where periodical tests of the filter are carried out, it is desirable to fit a permanent 3-way cock at *B* and a T-piece under the vacuum gauge with a valve between it and the cleaned-oil receiver.—*R. J. Watler, "Gas and Oil Power", Vol. XL, No. 472, January, 1945, pp. 12 and 22.*



Testing a Stream-Line filter.

A Quick-setting Oil-resisting Sealing Compound.

There is often a demand for an inexpensive, rapidly prepared and quick-setting sealing mixture, which will not decompose when in contact with oil. Sealing mixtures employing shellac as the base material are commonly used for this purpose, but these have the disadvantage of not adhering well to polished steel, in addition to which they are apt to chip away or peel off because of their extreme brittleness when set. These disadvantages are not features of a sealing compound made up of approximately equal parts of sulphur and plaster of paris, the sulphur being first melted in a clean pot or ladle and well stirred to remove any lumps before the addition of the plaster of paris. The stirring must be continued throughout and the two ingredients must be thoroughly mixed and brought to a very smooth consistency. Before this cement is applied, the steel or iron surfaces must be well cleaned. The sealing mixture is then applied, either by pouring or with a brush, whilst it is still hot. Setting occurs very quickly, and the mixture then forms an extremely tenacious seal which is impervious to oil. When the unused mixture has cooled into a solid block it is not necessary to retain it in an air-tight container. It may be heated up again to bring it to a molten state and used over and over again as required.—*"Industrial Power and Production", Vol. 20, No. 229, November, 1944, p. 418.*

Salvage of a Large Steel Drum by Metallising.

An article in a recent issue of the American periodical *Iron Age* describes how the employment of metal spraying enabled the Tampa Shipbuilding Company to overcome the effect of a mistake made in the machining of a large cylindrical component part of a boat and aircraft crane of 45 tons' capacity that was to be installed in a ship. The cylinder or drum weighed over $5\frac{1}{2}$ tons and was of welded steel construction. The interior had to be machined to a press fit, and an error during the machining process resulted in excessive material being removed from one half of the cylinder, covering an area of over 30ft.^{2}. As the drum had to be fabricated to close tolerances, its critical dimensions were carefully controlled during assembly on the slab. After welding, it had been completely stress relieved to eliminate any risk of distortion during the machining process. Any method of salvage involving welding would have probably introduced distortion and, in any case, would have required an additional heat treatment of the entire drum. It was therefore decided to employ metal spraying instead. By using the ingenious method of attaching the oxygen and acetylene tanks and air hose to the boring bar it was not even necessary to remove the cylinder from the boring machine. The spray gun was mounted on the regular cutting arm, being connected with the gas containers by means of $\frac{1}{4}$-in. brass tubing placed on the keyway of the boring bar, thereby permitting the passage of the tubes through the outer bearing. The steel metallising wire was looped over the boring bar. Prior to spraying, a series of circumferential cuts were made across the area to be built up to give sufficient roughness to ensure effective bonding of the sprayed-on metal to the parent metal. Approximately 200lb. of steel was continuously sprayed on, after which the spray gun was removed from the boring arm and replaced by a cutting tool. The cylinder was then machined to the correct dimension, giving a perfect surface for the press fit.—*"Mechanical World", Vol. 117, No. 3,029, 19th January, 1945, p. 65.*

The Efficiency of Marine Screw Propellers and the Drag Coefficient.

The paper comprises four principal parts, Part I being devoted to a discussion of the efficiency curve for a propeller; Part II deals with the drag of an airfoil; Part III describes how screw propeller drag is determined; and Part IV deals with scale effect. Details of test results of circular back blade sections are set out in an appendix to the paper, the text of which is amplified by numerous tables and diagrams.—*Paper by Dr. G. S. Baker, O.B.E., read at a meeting of the N.-E. Coast Institution of Engineers and Shipbuilders on the 23rd March, 1945.*