Abstracts of the Technical Press

Determination of Horse-power.

The last word on the accurate determination of horse-power still remains to be said, since there can be a difference of as much as 5 per cent. in measuring i.h.p., and there is always a tendency to over-estimate i.h.p. on log sheets, thereby showing a correspondingly low fuel consumption. It was—and possibly still is—common steam engine practice to take a set of indicator cards some time during the day and determine the mean pressure in the usual way from the diagrams. Instead, however, of recording the r.p.m. at the time the cards were taken, the average revolutions for the day were recorded. This custom was widespread, even in important passenger ships. B.h p. figures are assumed to be accurate, but sometimes the author wonders whether this assumption is quite justifiable. Torsion meter results require no comment; discrepancies of 8 per cent. are not unusual. The s.h.p. needed for a certain speed on smooth sea trials, say, in the Firth of Clyde, is about 10 per cent. more than in tank tests, but 11 to 12 per cent. additional power compared with sea trials is necessary for South Atlantic service, and 20 to 25 per cent. for the North Atlantic. These allowances are affected by the size of the vessel; a small ship requires greater margins. By way of example: 15 per cent. margin over trial conditions equals 26·5 per cent. over tank tests.

The fuel coefficient is still a useful yardstick when reasonably used, notwithstanding its lack of refinement. All that the shipowner is normally interested in, so far as engine performance is concerned, is the weight of fuel burned for the amount of cargo carried. An average every-day value for the fuel coefficient for a high-class passenger motorship is 75,000 to 80,000, the latter being a top figure; cargo liners may average 70,000 to 77,000, but 86,000 has been recorded. Comparable figures for a passenger steamer of the 450lb. 750° F. level are 37,000 to 45,000.—*C. C. Pounder, "The Shipping World", Vol. CXII, No. 2,702, 28th March, 1945, p. 368.*

Handling and Burning Fuels on Board American Ships.

This article is a reprint of the paper read by the authors at the annual meeting of the American Society of Mechanical Engineers in November, 1944. After a brief survey of the factors influencing the choice of fuel, the authors give details of an average commercial analysis of bunker C oil fuel and two tables showing the approximate compositions of various coals used by ocean-going and Great Lakes steamships. The oil-fuel bunkering arrangements of ships are briefly described and illustrated, as are the various types of O.F. burners and oil-burning furnaces in general use on board American merchant vessels. The arrangements usually adopted for replenishing the bunkers of coal-burning vessels are likewise described, after which the authors deal with the coal-burning arrangements commonly adopted for Great Lakes vessels. Comments on the results of experiments of pulverised-coal firing and the use of colloidal fuel are unfavourable. Other sections of the paper are devoted to draught and automatic combustion-control equipment, whilst the concluding part deals with the probable trend in fuels for shipboard use in the future.—*D. M. Schoenfeld and G. P. Haynes, "Mechanical Engineering", Vol. 67, No. 3, March, 1945, pp. 161-167.*

Interchangeability of Valve Parts.

A fatal accident in the boiler room of an American merchant ship has caused the U.S. authorities concerned to issue a circular letter calling the attention of engineer officers to the importance of impressing on all E.R. personnel the fact that valve parts are not necessarily interchangeable because the valves are of the same size. The accident in question occurred as the result of a defect in a 2in. angle valve. The threads on the union nut of the valve bonnet were stripped and among the ship's spare gear were some spare parts for a 2in. globe valve of the same size and make as the defective angle valve. Accordingly, the bonnet, union nut and packing nut were removed from the latter and replaced by the spare parts in question. The union nut screwed on easily and was tightened with a spanner. Two days later, when an oiler was closing this valve after blowing the flues, the bonnet of the valve came off and the escaping steam fatally scalded him. In the course of a subsequent investigation, it was found that although the two valves were of the same size, the pitch of the screwed parts was different. Such being the case, only two or three threads in the union nut made firm contact with the threads on the angle valve body. These few threads held so securely under the tightening strain applied by the spanner that a perfect fit was falsely assumed. The circular points out that the size of a valve is not the only factor that determines interchangeability. Every engineer should make certain that his engine room is provided with a thread gauge, and this gauge should be used before connecting any screwed parts together in order to ascertain whether each of these has the same number of threads per inch. Furthermore, care should be taken to make sure that components fitted as replacements for defective valve parts are not going to be subjected to a higher pressure than that for which they are designed. —*"Shipbuilding and Shipping Record", Vol. LXV, No. 16, 19th April, 1945, p. 368.*

Coal-burning Arrangements in Great Lakes Steamships.

A large percentage of the recently constructed Great Lakes vessels is made up of so-called bulk carriers. These ships usually carry coal from Lake Michigan and Lake Erie ports northward to the upper lakes and carry iron ore, grain, or limestone southward. Most of them are equipped with stoker-fired coal-burning boilers. Coal is chuted directly into the ships' holds from coal-truck dumpers, and the bunkers, generally located athwartship, are filled at the same time. They hold about 400 tons, which is sufficient for a voyage of 1,700 to 1,800 miles. If it becomes necessary to bunker coal from a lighter, this is usually done while cargo is being loaded or discharged. The lighters, or coal boats, are generally self-propelled craft with a superstructure housing mechanical coal-handling equipment for discharging coal directly into the ship's bunkers. From these it is carried by mechanical conveyor, through a crusher when necessary, to smaller auxiliary bunkers or hoppers feeding directly to the stoker hoppers. These auxiliary bunkers are filled about six times in 24 hours. In some of the older ships, not fitted with conveying equipment, the stoker hoppers are filled manually. Spreader stokers have gained wide popularity on board Great Lakes vessels and have been installed in all new ships as well as in those recently reboilered. They are used in conjunction with watertube boilers of both the sectional-header and bent-tube types, as well as with Scotch boilers. Mechanical stokers of the overfeed, underfeed and chain-grate types were tried occasionally over a considerable period of time, but their sluggish characteristics in responding to the wide and varied steam requirements during manœuvring proved them to be unsuitable for this service. The modern forced-draught spreader stoker appears to overcome this handicap and has the additional advantage of being capable of dealing with coals of widely varying burning characteristics and of being responsive to simple systems of automatic combustion-control equipment. The spreader stoker as applied to boilers of Great Lakes ships, consists of two or three units mounted on a C.I. front. Each unit comprises the coal hopper, the feeder which measures the flow of coal in proportion to steam requirements, and the distributor rotor which projects the coal into the furnace and distributes it onto the grate. The units may be driven separately or by means of a common shaft. Coal sized to about ¾in. to ⅞in. is fed from the hopper by the rotary feeder to the distributor. The rotary-type feeder has been found to provide positive control of the feed with wide ranges of variation in moisture content and sizing of the coal. The distributor consists of alternate rows of right- and left-hand blades attached to a rotating shaft to obtain equal distribution of the coal over the grate surface. The speed of rotation determines the distance to which the coal is spread and is adjustable so that it may be regulated to suit different coal characteristics. Most of the fires are burned in suspension, whilst the larger pieces of coal burn on the grates. The latter are of either the stationary or the dumping type. Air is supplied both under the grate and over the fire. A number of recent installations incorporate means for recovering fly ash from the flue gases at the induced-draught fan and returning it with the aid of a small high-pressure blower to the furnace for additional burning. The furnaces under sectional-header boilers usually have water-cooled walls, the height of these varying from 4 to 10 tubes. The rear wall is not water-cooled, although it could be if desired. The furnaces of bent-tube boilers have water-cooled side walls and tops, as well as rear walls. The combustion rates are, of course, lower than in similar oil-fired boilers and average about 35,000 B.Th.U/cu. ft.-hr. at normal power, although rates of up to 60,000 B.Th.U/cu. ft.-hr. have been used successfully. The coal consumption varies from 20 to 30lb./ft.^{2} of grate surface per hr. at normal power, with 35 to 40 per cent. excess air. Many of the boilers are equipped with air heaters, the temperature of the preheated air being usually from 275° to 300° F. Boiler efficiencies of 83 to 85 per cent. are obtainable at the normal power of the boilers. A number of Great Lakes vessels are still equipped with hand-fired Scotch boilers of lower efficiency, and the hard manual labour involved makes it difficult to attract and hold skilled firemen. Spreader stokers have already replaced hand firing in many such ships with such success that an increasing trend towards such modernisation has become noticeable. Pneumatic ash ejectors are installed on board practically all Great Lakes vessels. Where the boilers have dumping grates, the ashpit capacity is generally great enough for 24 hours' accumulation of ashes, whilst with stationary grates, the ashes are drawn at regular intervals and accumulated at a convenient location on the stokehold floor-plates in readiness for discharge overboard at points where this is permissible.—*D. M. Schoenfeld and G. P. Haynes, "Mechanical Engineering". Vol. 67, No. 3, March, 1945, pp. 165-166.*

Two Tiers of Machinery.

Among the papers read at a recent meeting of the New York Metropolitan Section of the Society of Naval Architects and Marine Engineers,was one by Mr. S. E. Malmquist, assistant chief engineer of the Sun Shipbuilding and Dry Dock Company, which described the general arrangement, construction and design of a modern turbine-driven marine propulsion plant and its auxiliaries. The author drew attention to the space-saving advantages of a common machinery space for the boilers and engines under a single casing, and pointed out that by placing the boilers at a level well above the E.R. floor, some 25 per cent. of additional floor space could be made available for the auxiliaries without encroaching upon cargo spaces. He claimed that a lay-out of this type was simpler and gave increased reliability as compared with a machinery arrangement in which the boilers were located on the E.R. floor level, in addition to which it involved less space and weight than any other form of marine propulsion, with lowest first costs and operating cost.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,519, 1st March, 1945, p. 12.*

Theoretical Regenerative-steam-cycle Heat Rates .

In a paper by A. M. Selvey and P. H. Knowles presented at a recent meeting of the American Society of Mechanical Engineers, a method is set forth whereby the calculation of heat rates for a theoretical steam cycle with an infinite number of heaters regenerating the feed water to throttle saturation temperature is facilitated by the development of a simple tabular integration method of computation which takes into account boiler feed pump work. A table of theoretical heat rates is given for throttle steam conditions ranging from 300 to 3,200lb./in.^{2} abs., and from saturation temperature to 1,200° F., and for an absolute exhaust pressure of 1in. of mercury. Means are provided for calculating heat rates at other exhaust pressures within the wet steam region. These heat rates serve two purposes: (*1*) as a standard of power plant performance, and (*2*) as a first step in estimating regenerative cycle economy at unfamiliar steam conditions. The derivation of factors necessary for making complete economic estimates must, however, be deferred to a more favourable opportunity. In the meantime, existing plant records can be made to provide approximate factors as substitutes for those it is hoped will be computed and published later. The economy of employing superheated steam, integral moisture extraction, etc., are briefly discussed in the paper. An appendix provides full directions for adapting the tabular integration method for steam cycle studies.—*"The Engineer". Vol. CLXXIX, No. 4,652, 9th March, 1945, p. 199.*

High-speed Reciprocating Steam Engine for Merchant Ships.

Some details are now available of a four-crank triple-expansion totally-enclosed forced-lubrication marine engine developed by Lobnitz & Co., Ltd., Renfrew, for naval service. Although primarily designed for naval work, these engines have been designed to the requirements of Lloyd's Register of Shipping, and they are provided with metal thicknesses and bearing surfaces ample for merchant service standards. A number of such engines have been in successful service for a considerable time under very arduous conditions. The new Lobnitz engine has four cylinders, the diameters of the H.P. and M.P. being 13½in. and 23in., respectively, whilst that of the two L.P. cylinders which are arranged at each end of the unit, is 25in. The piston stroke is 18in., and the power output at a service speed of 333 r.p.m. is stated to be 1,275 i.h.p. with a steam pressure of 200lb./in.$_2$ at the H.P. receiver. It is claimed that the design gives complete balance of the moving parts, with the exception of secondary couples. The entablature and bedplate are welded mild-steel fabrications, whilst the crankshaft is of the semi-built-up type, with balanced crankwebs. The entablature is made in two symmetrical pieces, with a vertical joint at the centre of the engine. Large access doors are provided. The forced lubrication of the engine is on the dry-sump principle and the oil supply to the crossheads is such as to make the provision of water-cooling arrangements for the guides unnecessary. The cylinder units and crosshead guide plates are the only iron castings in the engine. The cylinders have straight ports, and the manner in which they are mounted makes adequate allowance for differences in the expansion of major components. The H.P. cylinder is fitted with a piston valve, balanced slide valves being provided for the other cylinders. The Stephenson link-motion type valve gear is controlled by a direct-acting reversing engine operated from the starting platform. Forced lubrication is arranged for all bearings except the external ones of the reversing shaft, which are grease lubricated. The lubricating-oil pump, driven by gearing from the crankshaft, is the only engine-driven auxiliary and draws oil from the drain tank through filters, discharging it to the distribution main through a self-cleaning, fine-mesh filter and oil cooler. The oil supply to the bearings is ample under all running and manœuvring conditions down to engine speeds of 50 r.p.m., but an independently-driven stand-by oil pump is provided for emergency use. A centrifugal oil purifier is fitted for continuous bleeding and cleaning of the oil in circulation. Distant-reading thermometers at the starting platform show the oil temperatures at the two outlets from the engine to the drain tank and at the inlet to the distribution main. The usual oil pressure gauges are supplemented by an oil flow indicator at the highest and most remote feeder point of the engine, while the amount of oil in the drain tank is also indicated. Two sets of metallic packing are fitted on each piston and valve rod, the upper being in the cylinder stuffing-box, whilst the lower set, of the oil-retaining type, is fitted into the top of the entablature. The clearance between the latter and the bottoms of the cylinders is such that no portion of any rod which works in the oil gland passes into the steam packing. This arrangement prevents any water from passing into the crankcase. The drains from the H.P. and M.P. cylinders and their common steam chest are fitted with steam traps in addition to open funnels. The engine possesses a high degree of manœuvrability and can be reversed immediately when running ahead at 250 r.p.m. Maintenance work is reduced to a minimum by the provision of forced lubrication. Two engines of this type, when opened out after 12 months' running, showed no bearing wear whatever and required no adjustments. The net engine weight is stated to be 22 tons, whereas an open engine of the same horse-power, running at 205 r.p.m., weighs about 28 tons or, if running at 130 r.p.m., about 38 tons. In addition, a further saving in weight is effected due to the reduction in diameter of the shafting.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,578, 11th May, 1945, p. 8.*

Notes on the Machinery and Equipment of Tankers.

The first part of the paper deals with different types of main engines including: (*1*) Reciprocating steam engines, together with boilers, oil-burning equipment and exhaust-steam turbines; (*2*) steam turbines, together with the condensers used with these; and (*3*) heavy-oil engines, together with the boiler equipment for motor tankers. Other items dealt with include E.R. auxiliaries, steering engines, cargo pumps, salvage equipment and ships' galleys. The question of engine-room lay-out is briefly surveyed, as is that of the upkeep and maintenance of reciprocating steam engines, boilers, heavy-oil engines and D.R. geared turbines. The performances of most of the tankers built in this country during the past decade are described by the author as outstandingly good in regard to speed as well as fuel and lubricating-oil consumption. The concluding portion of the paper deals with the selection and training of E.R. personnel for service in tankers.—*Paper by J. N. Hendry, read at a meeting of the N.-E. Coast Institution of Engineers and Shipbuilders on the 9th March, 1945.*

Improved Steam-driven F.D. Fans.

The Westinghouse Electric and Manufacturing Co. have developed an improved type of turbine-driven forced-draught fan which is said to be specially designed for installation in cargo vessels. This fan is a modified and simplified version of the turbo-blowers which have been giving highly satisfactory service in ships of the

U.S. Navy for some time past. Among the simplifications introduced in the design of fan intended for merchant vessels is the omission of the speed-limiting governor, the speed of the turbine being limited by the resistance of the rotating fan impeller, which increases as the cube of the running speed. The omission of a lubricating-oil cooler renders it unnecessary to provide water-cooling connections. The fan is designed for vertical operation, and by placing both bearings below the turbine element (*i.e.*, by overhanging the single stage of blading and the fan) only one steam gland is required. This also makes it possible to lift out the entire rotating element as a unit assembly with the bearings. The design of the oil chambers renders it unnecessary to fit any oiltight packing. The new fan is claimed to possess a wide range of steam control and ease of starting with a low steam pressure.—*"Marine Engineering and Shipping Review", Vol. L, No. 1, January, 1945, p. 246.*

The Concept of Pitch.

The pitch of a propeller is usually defined as the advance per revolution when the propeller advances into an unyielding medium, so that the pitch of the propeller is identified with the pitch of its motion. In this paper the author begins by giving a definition of pitch at a point, this definition being independent of any motion of the propeller. To show how this definition enters into the scheme of things, the effect on pitch of a radial displacement and of a rotation of the blade are considered. To show in what relation his definition stands to the pitch of the motion of the blade, the author has considered the angle of attack of the elements and stalling. He also introduces the new idea of transverse pitch. The considerations are mainly kinematic, as the effects of inflow have been neglected.—*Paper (No. 12) by V. D. Naylor, B.Sc., read at the April, 1945, meeting of the Institution of Naval Architects.*

On Singing Propellers.

The paper deals with the effects of the shape of the propeller blade section. and of the fullness and form of the hull after-body, on the singing of propellers, with special reference to single-screw ships. The author develops a theory in accordance with which he attributes singing to a "blow" caused by a sudden change of pressure which accompanies a local "breakdown" of the flow on the back of the blade near the leading edge. The breakdown is in the nature of an increase of turbulence that takes place during rapidly changing expansion of this flow. The shapes of the blade sections at the leading edge and the manner in which the angle of incidence varies in the mixed wake in which the propeller is working are deduced to be the chief factors affecting singing. The theory is further developed to show the propeller speeds for singing depend on these factors. An analysis is made of detailed measurements of blade section shapes taken from 31 full-scale propellers, and of the average real flow conditions under which these propellers were working. The blade section shape at the leading edge and the average real angle of of incidence are related by a factor Q, the value of which is shown to be the main criterion determining whether the propeller will be completely quiet or will sing between certain limits of speed. A curve of critical values of Q dividing quiet from singing propellers is derived for single-screw ships having after-body sections of average shape, the value of Q depending on the fullness of the hull. Marked agreement is shown between the results of this analysis and the deductions made from the theory. For design work a complete scheme for the calculation of the value of Q, reduced to a short and direct process, is set out in tabular form.—*Paper (No. 11) by G. Hughes, D.Sc.(Eng.), Ph.D., read at the April, 1945, meeting of the Institution of Naval Architects.*

Four-bladed Propellers of Single-screw Cargo Ships.

Sir Amos Ayre recently presented a paper entitled "An Approximate and Simple Formula Concerning Four-bladed Propellers of Single-screw Cargo Ships" at a meeting of the N.-E. Coast Institution of Engineers and Shipbuilders. The author put forward the following simple short formula for use in approximating propeller dimensions, etc., in the early stages of design:—

$$\frac{D^5 \times N^3}{10^8} \times p = \text{s.h.p. at propeller,}$$

where

D = diameter of propeller in feet.
N = revolutions of propeller per minute, and
p = a coefficient varying with the pitch ratio.

The author mentioned that in connection with the measured-mile trials of ships, it had been found that sister vessels, under the same conditions of loading and weather, and with identical propellers, sometimes produced appreciably different values of p. Apart from errors in power recording, the main causes for such discrepancies were found to be: (*1*) Tide effect, (*2*) rudder effect, and (*3*) insufficient running on the straight after turning and on the approach to the course.—*"Lloyd's List and Shipping Gazette", No. 40,692, 2nd May, 1945, p. 9.*

Electrically-controlled Propeller Planer.

An important development in propeller finishing machines was referred to in a paper read at a recent meeting of the American Institute of Electrical Engineers by Messrs. E. A. Morton and W. O. Osbon, who described an electronically-controlled 100-ton propeller-planing machine developed and designed by the Westinghouse Research Laboratories and constructed by the Morton Manufacturing Co., for use in a U.S. Navy yard. The new machine is over 50ft. long and can deal with ships' propellers up to 24ft. in diameter. The "tracer control" device with which it is equipped makes it possible to shape and finish rough propeller castings entirely by machine. The tracer automatically guides two steel cutting tools over both sides of a propeller simultaneously in accord with the movement of a steel "finger" over the surface of a wooden or plaster model about one-fifth of the actual propeller blade. The movement of this steel finger affects a sensitive instrument called a "Silverstat" which controls the speed of the electric motors driving the cutting tools. The authors explained that as the tracing finger moves up or down in contact with the surface of the model, it compresses or releases a series of leaf springs. Silver buttons on the ends of these springs are wired in sequence to consecutive steps of a stationary voltage regulating resistance. When the tracing bar moves to one extreme, the silver buttons are separated from one another, placing maximum resistance in the field circuit of a small generator, the tiny current being amplified by two sets of electronic tubes. The increased resistance reduces the generator voltage thereby decreasing the speed of the motors and slowing down the movement of the tracing finger, duplicating its motion to within 0·001in. of the correct contour. The new machine can shape the blade surfaces of a 24ft. propeller in two days, whereas the job previously took a fortnight to complete and involved a considerable amount of grinding and chipping by hand. The new Morton machine eliminates all hand work except a minimum of finish grinding and buffing of blades made of manganese bronze alloy.—*"Motorship," Vol. XXX, No. 3, March, 1945, p. 275.*

Coffin Jacks Eliminate Liner Shrinkage Gaps.

The Joshua Hendry Iron Works, Sunnyvale, Cal., recently had occasion to manufacture a number of special 5in. four-unit propeller shafts, each set of which required three bronze liners up to 37½in. long. When these liners were heated in readiness for shrinking into position, they expanded to a length about ¼in. in excess of their normal length when cool, but as their subsequent shrinkage took place from both ends to the middle, gaps of from ⅛ to ⅛in. were left between the liners and their collars on cooling. This difficulty was eventually overcome by the use of a hot-air furnace for the controlled heating of the liners and collars. While the liner, with the collar set on top of it, was being heated in the vertical furnace (which extended 16ft. below floor level), the shaft was set up vertically on its flange on the floor of the furnace pit. After one hour's heating, the 3in. collar was removed and slipped into place on the cold shaft. The male joint of the collar, which corresponded with the counterbored female joint of the liner, fitted flush against the shaft and faced upward. To hasten the cooling of the collar, it was sprayed with an annular shower device. When the collar had been shrunk into place, it became essential to work at very high speed. Over the top of the tubular liner still in the furnace, was slipped a specially-designed cam-action clamp, the lifting of which by its own ring-end arms pressed slip-proof jaws against the liner. The latter was then picked up by means of a crane and quickly lowered over the shaft. When it was almost in the correct position, two fixed wings on the clamp rested on transverse beams, the weight of the arms released the jaws, and the liner dropped into place. From this stage of the operation, split-second timing became necessary, as the shrinking process was so rapid that only 30 seconds remained for the rest of the job. Two men applied steel split clamps just above and below the liner, hooked them together with the link chains of two coffin jacks, one on each side, and applied pressure by working the jack handles. The circular spray was applied to the bottom of the liner and moved slowly upwards, while the pressure from the jacks, which were frequently tightened, kept the liner tight against the collar joint, so that effective vertical contraction could take place only in one direction. About 1½ hours after the liner had been placed in the furnace, the lined shaft was complete and ready to be machined.—*"Marine Engineering and Shipping Review", Vol. XLIX, No. 12, December, 1944, p. 187.*

U.S. Turbo-electric Troopships.

Amongst the numerous auxiliary vessels built or building for the U.S. Navy are 63 twin-screw troopships, 31 of which are of the so-called BD-1 type (personnel and equipment transports), whilst the remainder are of the BE-1 type (equipped for the carriage of combat cargoes). The first BD-1 troopship to be completed on the Pacific Coast was the U.S.S. "Gilliam", described by Geo. Skipton in the January, 1945, issue of *The Log*. She is a twin-screw vessel of 426ft. by 58ft., displacing 8,500 tons at a draught of 18ft. and is equipped with Westinghouse turbo-electric propelling machinery of 6,000 s.h.p. There are two machinery compartments arranged in tandem, amidships, each containing one Babcock & Wilcox boiler of the single-pass sectional-header type, one turbo-alternator set and one propulsion motor, in addition to the necessary auxiliaries. The two main turbines are of the straight-impulse type and take steam at a pressure of 440lb./in.^{2} and superheat temperature of 740° F. Each turbine is directly coupled to a 2,550-kW., 2,210-volt, 3-phase, 82½-cycle generator running at 4,950 r.p.m. and supplying current to a 3,000-s.h.p. propulsion motor of the synchronous type. Each of these motors drives a main propeller shaft at 100 r.p.m. If necessary, both motors can be operated from one turbo-generator. The two main condensers are of radial-flow design, each with a cooling surface of 2,200ft.^{2}. There are three 250-kW. 312-kVA, 450-volt a.c. turbo-generator units for auxiliary purposes, as well as two 100-kW. turbo-generator sets supplying d.c. at 240/120 volts for the pump motors and other d.c. requirements. Each 250-kW. turbo-generator set also incorporates a 90-kW. d.c. generator for the provision of excitation current at 125 volts for the main generators and propulsion motors. The steering gear is of the electric-hydraulic type. The ship's fuel tanks have a capacity of about 1,600 tons, including 51 tons of Diesel oil. The fresh-water tanks hold 168 tons, whilst the reverse feed tanks have a capacity of 104 tons. During the reversing trials of the "Gilliam", it was found that when steaming ahead at full power, the ship could be stopped in 1 min. 50 secs., the propellers being reversed and brought to 100 r.p.m. in the astern direction in only 35 seconds.—*"The Shipping World", Vol. CXII, No. 2,703, 4th April, 1945, p. 395.*

Automatic Control of Reavell Electrically Operated Compressors.

A switch for automatically stopping and starting air compressors, according to the pressure in the receiver, is shown in Fig. 1. The switch is opened and closed by adjustable tappets on a rod which is moved by air pressure acting on a piston (*2*). The pipe from the air receiver is coupled to a connection (*20*). A rod (*3*) rests on and is moved by the piston, at the top being a cross-head carrying a bar (*5*) which is fitted with two tappets (*6*). By adjusting these tappets, the mercury tube switch (*8*) can be caused to make and break the circuit of the compressor motor at any predetermined pressure in the receiver. There are two springs (*7*) attached to the crosshead and these have the effect of returning the rod (*3*) and the tappet shaft (*5*) to the starting position when the air pressure falls. The mercury tube switch (*8*) is attached to a pivoted bar (*10*) having a pin (*12*) engaged by the tappet, so that the switch is rocked about the pivot either one way or the other. A flat spring (*14*) completes the movement, which is started by a tappet towards each stop. When either of the tappets has moved the pivoted switch bar (*10*) sufficiently for the spring (*14*) to act, the tappet makes contact with the pin (*16*). Thus, any further movement of the tappets is arrested. The rod (*17*) on the opposite side to the tappet bar acts as a guide and maintains the crosshead in its proper position, in the event of vibration occurring. —*"The Motor Ship", Vol. XXV, No. 302, March, 1945, p. 418.*

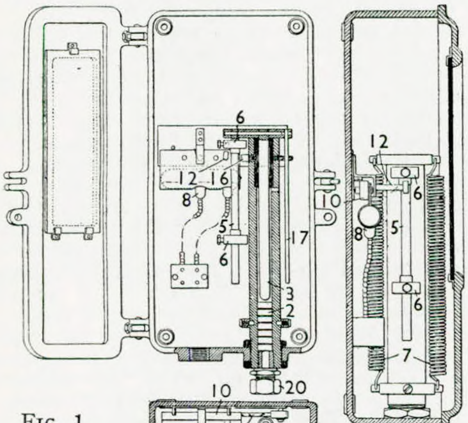


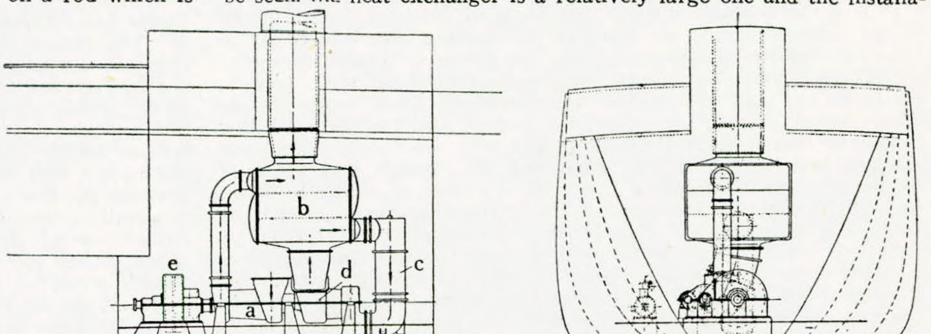
FIG. 1.

Torsion Meter Location.

In the measurement of the h.p. transmitted to a ship's propeller shaft it is necessary to know the "constant" of the torsion meter employed. This constant is usually determined by a static test in the shops, a known torque being applied to a length of the shaft to which the meter has been secured. An article entitled "The Effect of Location Upon Torsion Meter Readings" by Commander H. P. Webster, U.S.N., and F. A. Scanlan, in the November, 1944, issue of the *Journal of the American Society of Naval Engineers* describes an investigation carried out with a view to increasing the accuracy of torsion meters of the usual electrical type. Since the length of the shaft on which the angle of torsion is actually measured is represented by the distance between the two clamping planes of the instrument, and this is of the order of only 3ft., there is considerable flexibility as to the choice of location. It is found, however, that if the constant of the instrument is to be the same when applied to readings taken on board during the trials and subsequent service of the ship as it is when determined in the shops, the torsion meter must be located in the same position on the shaft as it was during the shop calibration. Moreover, prior to the shop calibration, the shaft should be completely machined with its keyways, sleeves, etc., in position. The authors claim that their tests brought out the fact that used in this way the electrical torsion meter is an accurate and serviceable instrument.—*"Shipbuilding and Shipping Record", Vol. LXV, No. 16, 19th April, 1945, p. 363.*

New Marine Combustion Turbines.

It is reported that Brown, Boveri & Co., Ltd., have received an order for a 10,000-kW. alternator and two-stage combustion turbine for erection in a power station. The guaranteed thermal efficiency is to be 28 per cent., and the plant will, therefore, have to be equipped with a large heat exchanger. The accompanying diagrams show the arrangement of a 6,000-s.h.p. combustion-turbine installation for a merchant ship with a thermal efficiency of 26 to 27 per cent. As may be seen, the heat exchanger is a relatively large one and the installation incorporates a v.p. propeller. The weight of the entire plant is stated to be between 15 and 25 kg. (33 and 55lb.) per s.h.p., and the cost, including reduction gearing and auxiliaries, in Switzerland, 250 to 300 Swiss francs (=£14 10s. to £17) per s.h.p. It is now possible to build combustion turbines with an efficiency of up to 30 per cent., but where the plant is to be run for some 6,000 hours per annum, the greatest saving in operating cost is attained at a thermal efficiency of about 27 per cent. for a single-stage turbine or 30 per cent. in the case of a two-stage installation.—*"The Motor Ship", Vol. XXVI, No. 304, May, 1945, p. 43.*



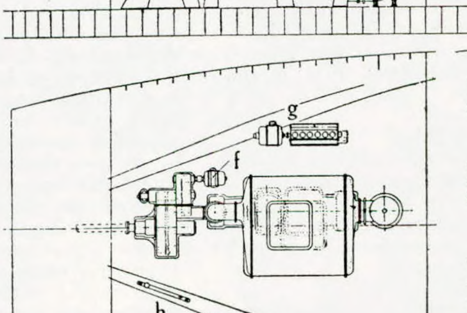
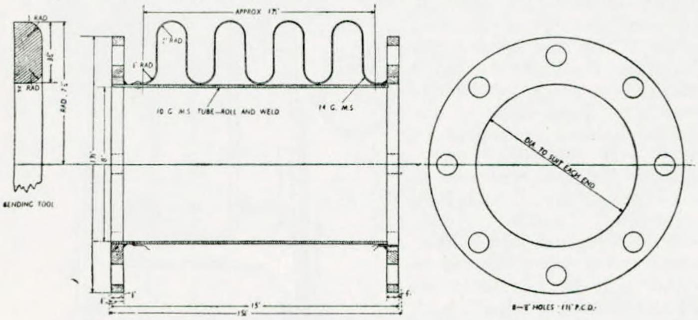


FIG. 2.—*Combustion-turbine plant for a merchant ship of 6,000 s.h.p. with adjustable-pitch propeller.*

a—Compressors. b—Heat exchangers. c—Combustion chamber. d—Gas turbine. e—Gear. f—Starting motor. g—Starting Diesel set. h—Oil cooler.

A Marine Diesel-engine Expansion Joint.

Diesel-engine exhaust pipes usually require provision to be made for expansion and contraction, especially when the length is considerable. Where the variation cannot be compensated by bends in the pipe, it becomes necessary to fit an expansion gland or some special form of joint. The accompanying sectional view shows a bellows arrangement, developed by a London firm, which is claimed to be an



An expansion joint for a Diesel engine exhaust pipe.

improvement on the plain bellows secured at each end. As may be seen, the bellows are located between two flanges. In this instance, the left-hand flange is welded to a section of the exhaust pipe, whilst the bellows, made of 14-gauge mild steel, are welded to the right-hand flange. When expansion takes place in the main exhaust-pipe length the flanges of the bellows joint tend to come together. Thus, the section of the pipe inside the bellows is, to some extent, pushed through the hole in the right-hand flange, which is bored to give the necessary clearance. The bellows are fixed to the left-hand end of the pipe close to the point where it is welded to the flange. The joint cannot leak in the ordinary course of events, and has been found remarkably sensitive to changes in the length of the piping. The particular size illustrated is for a Diesel-engine exhaust pipe of 8-in. bore, but the makers produce a large range of these joints, both large and small, for marine service.—*"The Motor Ship", Vol. XXVI, No. 304, May, 1945, p. 43.*

English Electric Co.'s Propulsion Plant with Electro-magnetic Slip Coupling.

The propulsion plant illustrated diagrammatically in Fig. 1 includes two electro-magnetic slip couplings with a control which varies the ship's speed by altering both the speed of the engine (*1*) and the excitation of the primary field of the coupling (*5*). Critical speeds of the engine are avoided by running it at increased revolutions and reducing the coupling excitation to give the propeller the desired speed through a gearbox (*8*), containing ahead and astern gearing. The field winding for the coupling (*5*) is supplied through slip rings (*9*) and that of the coupling (*6*) through slip rings (*10*). The fuel pumps (*2*) are controlled by a servo-motor (*13*). The pump (*11*) is driven by the engine and draws oil from a reservoir (*12*). A connecting pipe (*15*) from the pump (*11*) to the servo-motor (*13*) also passes to the speed regulator (*16*). The oil escape vents (*18, 19*) are controlled by magnets (*22, 23*). In order to control the plant from the bridge a telegraph-type transmitter (*24*) is provided. When the lever is moved ahead, the field winding of the ahead coupling (*5*) is connected across the supply (*25*) in series with the whole of the resistance (*26*) to apply minimum excitation to the coupling, whereby the output shaft (*7*) is driven in the ahead direction with maximum slip. As the resistance (*26*) is cut out, so the excitation of the coupling is increased and the slip decreased. By selecting the size of the vents (*18, 19*) the coupling excitation is adjusted so that for any particular position of the telegraph (*24*) the desired propeller speed is obtained by the combination of the engine speed and coupling slip without the engine having to run at a critical speed. The controller can vary the speed from full ahead to full astern by a combined reduction of engine speed and excitation of the ahead coupling (*5*) until the lowest engine speed is reached, when the excitation of the coupling (*5*) may be progressively decreased to zero. Further movement of the controller in the astern direction would then progressively increase the excitation of the astern coupling (*6*) from zero, so that the latter, driven by the engine running at its lowest speed, would exert a smooth predetermined braking action on the propeller shaft, eventually bringing this shaft to rest and then accelerating it in the reverse direction.—*"The Motor Ship", Vol. XXVI, No. 304, May, 1945, p. 68.*

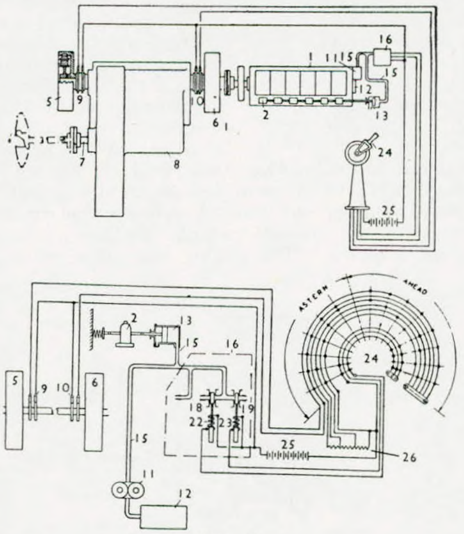


FIG. 1.

Götaverken Control System for Multi-engine Drive.

The control mechanism illustrated in Fig. 2 allows the operation of a number of engines together from one manœuvring position, and on the other hand permits the individual operation of separate engines, independently of the main control. Any engine can be started, brought up to the same number of revolutions as the rest of the plant and then coupled to the common driving shaft. The plant consists of four six-cylinder reversible engines (*1*) which, through electric slip couplings (*2*) and gear-wheels (*3*), convey their output to a wheel (*5*) connected to the propeller shaft (*4*). In the engine room is a manœuvring station with a main control panel (*7*) and an engine-room telegraph (*8*). At the main control panel there is a common operating device for all the engines, comprising a wheel (*9*), which, through a hollow shaft (*10*), is connected to a gear-wheel (*11*). With this wheel two other wheels co-operate and through shafts (*13*) and gears (*14*) transfer the movement of the common operating device to shafts (*15*). Through couplings (*16*) the shafts (*15*) actuate the control devices of the respective engines. The controls comprise a manœuvring handle (*30*) with a shaft (*17*), which is provided with a device (*18*) for actuating, ahead or astern, the starting-air distributor, also with a device for supplying starting air, and with a crank (*19*) for actuating the fuel injection timing gears. In co-operation with the shaft (*17*), there is also a blocking device (*20*) which prevents the turning of that shaft in the wrong direction. When the plant is to be started, the manœuvring couplings for those engines which are to be used are placed under the control of the common operating device. The order from the bridge is repeated by the turning of the telegraph handle (*46*) or the wheel (*50*) whereby the switches (*42*) are closed. The manœuvring current now passes through those switches (*43*) which are closed to the respective solenoids (*38*) and further through switches (*59*) back to the excitation current circuits (*36*). The solenoid (*38*) is energised and closes the switch (*37*) and a switch (*60*) which is arranged in parallel with the switch (*42*). Thus, the manœuvring circuit remains closed even when the engine-room telegraph has passed the starting position. Through connecting the closing of the manœuvring circuit with the engine-room telegraph a certain time is gained, whereby the drive coupling may be excited

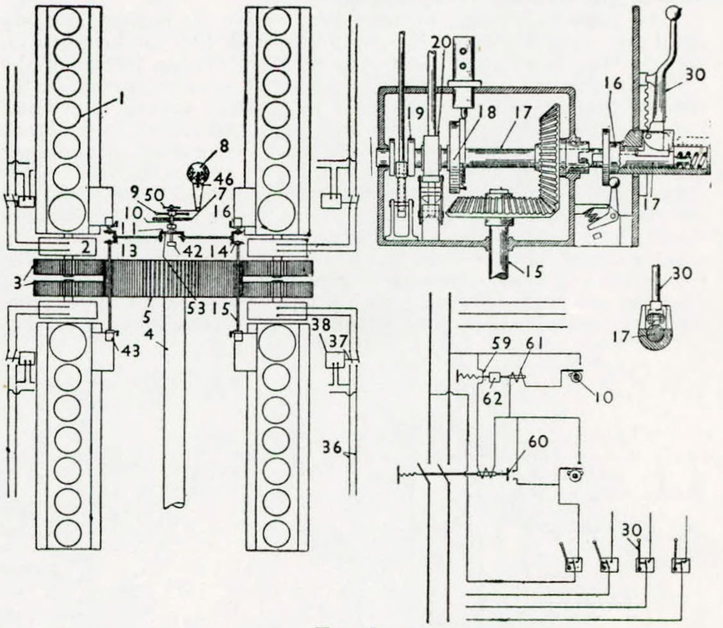


FIG. 2.

before the engine is started. On the other hand, the breaking of the manœuvring circuit is not caused by the engine-room telegraph but by the switch (*53*), which is in a releasing circuit in connection with the manœuvring circuit and is actuated by the common operating device in its stop position. The manœuvring circuit is thus broken only when the engines are at a standstill. When the switch (*53*) is closed, the current passes through a solenoid (*61*). This opens the switch (*59*) in the manœuvring circuit and breaks the current to the solenoid (*38*). This done, the switch (*37*) is opened by a spring. To prevent switching off the manœuvring current by the reversing of the engines, when the common operating device passes through the stop position (or by short accidental stops), a time-limit release (*62*) is inserted between the solenoid (*61*) and the switch (*59*). This release transmits the movement of the solenoid to the switch after a certain time has elapsed, for instance two or three minutes, but leaves the switch unmoved if the switch (*53*) within that time has been opened by a new manœuvre.—*"The Motor Ship", Vol. XXVI, No. 304, May, 1945, p. 68.*

Ruston and Hornsby Turbo-blower.

An improved design of turbo-blower for oil engines, recently developed and patented by Ruston & Hornsby, Ltd., is illustrated in Fig. 2. The bearings at the turbine end are arranged clear of the turbine casing and out of the hot zone of the exhaust gas, whilst the rotating parts form a unit which can be removed without disconnecting the exhaust piping or the air inlet pipes, and placed on the bench for overhaul, as an independent assembly. The removal of the cover plate (*28*) uncovers the outer end bearing of the turbo-blower shaft (*9*) and at the same time permits the impeller (*22*) to be examined and removed if necessary. The space within the mounting (*1*) between the walls (*5, 7, 8*) of the outlet casing (*4*) forms a water jacket (*41*), which extends into the space (*30*). This jacket is supplied from the engine cooling system through a pipe (*42*), shown in the left-hand diagram, and is discharged through a pipe (*44*). The air outlet from the volute chamber (*26*) of the blower communicates with the passage

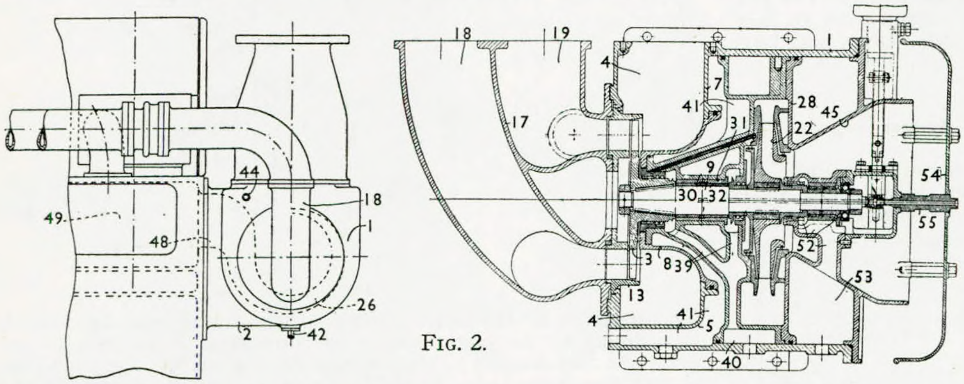


Fig. 2.

(*48*) through a branch (*2*) of the mounting (*1*). The air conduit (*49*) leads to the engine cylinders. A partition (*17*) divides the exhaust-gas inlet casing into two chambers (*18, 19*) from which separate pipes lead to two groups of exhaust ports in a 6-cylr. engine. The gases are thus distributed evenly over the area of the nozzle ring (*13*). The inner shaft bearing consists of a fixed sleeve (*31*) having a floating bush (*32*). Over the end of the flared inlet chamber (*45*) for the air there is a silencing cover (*54*), through which a hole is bored to take a drilled plug (*55*) for the supply of lubricating oil. In assembling the parts of the blower, the shaft (*9*) carrying the rotor (*3*) and air impeller (*22*), together with the different parts of the casing, are all inserted in the mounting (*1*) as a single unit. Waste oil from the inner bearing flows through the passages (*39*) to a chamber (*40*), whilst waste oil from the outer bearing is discharged through similar passages (*52*) into a chamber (*53*).—*"The Oil Engine", Vol. XIII, No. 145, May, 1945, p. 25.*

Oil Engine Repair.

An article by D. A. Dallamore in a recent issue of the *Journal of the South African Institution of Engineers* describes how a 75-h.p. four-stroke Diesel engine was successfully repaired after sustaining damage which included a bent connecting rod, a fractured cylinder liner and breakage of the diaphragm between the water jacket and crank chamber, in addition to extensive cracks in the sides and ribs of the main crankcase casting and bedplate. The crankshaft suffered little damage, except for one pair of counterbalance weights which had to be renewed. The repairs were effected in the following manner: A patch of ½-in. mild-steel plate, suitably gusseted, was fitted and riveted to the underside of the bedplate, and three 1-in. tie-bolts were placed across the axis of the crankshaft. Inside the bedplate, lead was used to fill in cavities where pieces of casting were missing, but as this proved unsatisfactory and caulking of the lead failed to stop oil leakage, the engine was dismantled after 21 months' service, the bedplate lifted and the patch secured in place by electric welding. Both sides of the crank-chamber casting which was over 1in. thick, were drilled for the removal of all cracked metal, and ⅝-in. mild-steel patch plates, 40in. × 27in. and 18in. × 20in., respectively, were secured on either side by ⅝-in. studs at 2¼-in. centres. Sheet lead, $\frac{1}{16}$in. in thickness, provided satisfactory joints after caulking. The broken diaphragm was replaced by one of ¾-in. mild-steel plate, made in halves for fitting and subsequently welded to 3in. × 3in. × ½in. supporting angle cleats which were studded to the casting. After several unsuccessful attempts, a watertight joint between the diaphragm and

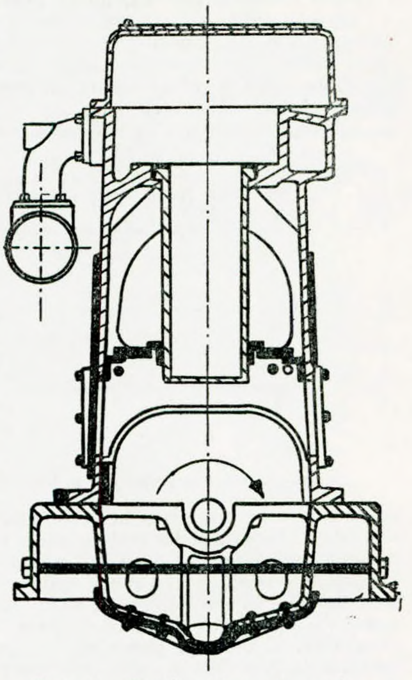


Fig. 1.—*Section through engine. Repairs shown in black.*

engine casting was eventually obtained with the aid of sheet lead and "Smooth-on" cement. The diaphragm plate had a large centre hole to accommodate a split C.I. fitting ring secured by set screws passing through clearance holes. The cylinder liner was correctly located by the spigot joint at its upper end, and the fitting ring thus centred, was then pulled up on an insertion joint on the diaphragm by means of the set screws and spring washers. Some difficulty was experienced in finding a satisfactory jointing material, but after lead sheet, asbestos, red lead and twine, litharge and glycerine had all proved unsuitable, an effective joint was eventually secured with rainbow jointing. The cylinder liner was then withdrawn for the fitting of the rubber sealing rings and reseated. Finally, two 1¼in. tie-rods located immediately below the diaphragm plate were passed right through the crank chamber to guard against any risk of collapse due to the removal of so much metal of the original casting. Details of these repairs are shown in Figs. 1 and 2. The engine has given satisfactory service, carrying

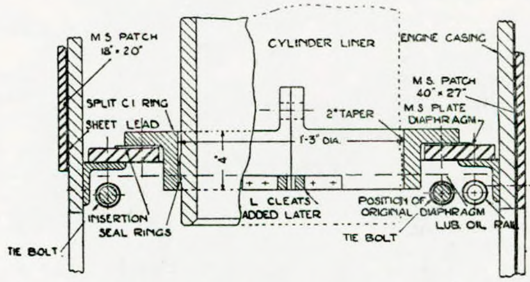


Fig. 2.—*Details of repairs at top of crankcase.*

normal full load for 21 months since its repair. Leakage of water through the split of the C.I. fitting ring has been overcome by fitting cleats.—*"Mechanical World", Vol. 117, No. 3,046, 18th May, 1945, p. 544.*

Marine Reversing Gears.

A reversing gear for high-speed marine oil engines incorporating electro-magnetic slip couplings has recently been developed by a well-known British firm of electrical manufacturers. The high-speed engine shaft is provided with two pinions, the first of which drives its gear-wheel directly while the second drives through an idler pinion so that the second gear-wheel rotates in the opposite direction to the first. Each gear-wheel is secured to a hollow shaft freely mounted on the propeller shaft, the whole gearing being enclosed in a casing with the hollow shafts projecting from opposite sides, while the propeller shaft extends right through both hollow shafts. Two electro-magnetic slip couplings are provided, one on each side of the gear-case, the input members of the couplings being mounted on the hollow gear-wheel shafts, while the output members are attached to the propeller shaft. Thus, according to which input member is energised, the propeller is driven either in the ahead or the astern direction, the gearing being always in mesh.—*"Shipbuilding and Shipping Record", Vol. LXV, No. 13, 29th March, 1945, p. 295.*

Chromium Plating of Diesel-engine Cylinder Liners.

The author's experience in regard to the chromium plating of cylinder liners has, on the whole, been favourable and substantiates the claims made for low rate of wear, but there have been instances where chromium-plated liners have given trouble in the form of piston seizures and flaking. The author's experience indicates that where the chromium deposition has produced a smooth surface, the results have not been good, but where the surface has not been smooth—a condition brought about by reversal of current at the close of deposition, producing a surface which holds lubricating oil—the results have been very good. Thus, in a 4-stroke engine of 650 b.h.p., having cylinders 400mm. (15·75in.) in diameter, 600mm. (23·62in.) stroke, running at 300 r.p.m., with a service rating of about two-thirds maximum rating, the greatest rate of wear after 11,000 hours of running was just under 5 microns (0·0002in. per 1,000 hours.—*C. C. Pounder, "The Shipping World", Vol. CXII, No. 2,702, 28th March, 1945, p. 367.*

Explosions in Diesel Engines.

Two cases of crankcase explosions in Diesel engines have recently been reported in American ships. In this connection, it is pointed out that the lubricating-oil mist that fills the crankcase is normally made up of oil particles fine enough to form an explosive mixture if sufficient air can get to it to supply the necessary oxygen; usually, however, there is not enough air present in the crankcase to create this condition and a spark or tongue of flame in the crankcase cannot ignite this oil mist because of the lack of sufficient air to form a combustible mixture. Nevertheless, should there be any excessive blow-by from the cylinders due to abnormally worn rings or liners, broken rings or broken pistons, it is possible for enough air to blow into the crankcase, accompanied by flames, to create a small pocket of combustible mixture and ignite it. As the bulk of the oil vapour in the crankcase is not a combustible mixture the resulting explosion may be small, but it might be violent enough to break a crankcase door; this would permit an inrush of air sufficient to supply the necessary oxygen for a far more serious secondary explosion. The possibility of such an occurrence, however remote, provides an additional reason for taking care not to run an oil engine with excessively worn piston rings.—*"Motorship", Vol. XXIX, No. 12, December, 1944, p. 1,116.*

Tuned Exhaust Systems for Diesel Engines.

Ten years ago exhaust tuning was much to the front and the technical periodicals of that time contained characteristic illustrations of tuned exhaust systems for main and auxiliary engines. It is a subject upon which comment both favourable and unfavourable can be made. Experiments with single-cylinder engines have shown that tuning can be of value in increasing the mean pressure; but in multi-cylinder main engines—say, where there are six or more cylinders—the gain with a tuned exhaust system may not be more than 1 or 2 per cent. if the system happens to be exactly right—a circumstance which depends upon so many variables that calculation is well-nigh impossible—and then only with a pipe system which is disproportionately cumbersome and costly. For the benefits of exhaust tuning to be obtained a fairly high rating is desirable; the normal rating of the propelling engine at sea is not conducive to good results either with exhaust tuning or impulsive scavenging. Hence a simple system of exhaust piping is generally to be preferred. When it is said that power is limited by exhaust temperature, what is really meant is that torque is so limited. Exhaust temperature is a function of torque and not of power.—*C. C. Pounder, "The Shipping World", Vol. CXII, No. 2,702, 28th March, 1945, p. 367.*

Cast Crankshaft Used for Large Marine Diesel Engines.

Soon after the U.S. entered the war, American manufacturers of Diesel engines began to experience considerable difficulty in obtaining adequate supplies of forged-steel crankshafts, and it was therefore decided to utilise cast-steel crankshafts for some of the relatively large marine oil engines which were at that time being produced in large numbers. Among them were some 8-cylr. supercharged 4-stroke Enterprise engines developing 1,200 to 1,400 b.h.p. at 275 r.p.m., with cylinders of 16in. (406mm.) diameter and a piston stroke of 20in. (508mm.) designed for installation in large Army tugs. The 11in. diameter crankshafts for these engines were proferall castings. This material has a Brinell hardness of 250 to 320 and responds excellently to polishing, thereby providing very good bearing surfaces. The tensile strength is 23·2 tons/in.^{2} for standard proferall and 25 to 25·9 tons/in^2 for special materials. The torsional modulus was 8,000,000 as compared with 11,800,000 for steel. The American Bureau of Shipping formula for the design of cast crankshafts is similar to that used for forged-steel shafts, except that the value $f = 4{,}300$ is used for standard proferall material and $f = 4{,}600$ for the special-grade material. This results in a 7 per cent. increase in the shaft diameter over that required for forgings. The performance of the tugs equipped with engines incorporating these cast crankshafts has proved highly satisfactory under service conditions. It is claimed that cast shafts have the following advantages over conventional forged crankshafts under present conditions: (*1*) Less time is required for production; (*2*) there is less waste material to be removed during machining; and (*3*) the time required for machining is less than that needed for a forged shaft.—*"Marine Engineering and Shipping Review", Vol. L, No. 2, February, 1945, p. 167.*

Crankcase and Cylinder Oils for Diesel Engines.

The tendency in future will doubtless be to burn lower-grade fuels in propelling engines, possibly by delivering hot oil through cooled fuel valves. This may involve modifications in the design of engines, more especially in those of the 2-stroke type, to deal with variations in the physical features of fuel oils. Where very heavy fuels are used, it is necessary to start and stop on lighter oils. In commenting upon the grade of Diesel fuel likely to be used in the future, it is worth noting that the present Diesel pool oil is a high-grade fuel compared with what was used 20 years ago in the old blast-injection engines.

The wisdom or otherwise of using the same brand of oil for crankcase and cylinder lubrication in crosshead propelling engines is a matter which sometimes arises. In the author's opinion, different oils are advisable. The temperature in the neighbourhood of the top piston ring is considerably higher than in a bearing, with a great fall in viscosity; hence an oil of greater initial viscosity is preferable. In a bearing—except when starting and stopping—only fluid lubrication has to be considered. In one of the early large d.a. 4-stroke engines built in Belfast 20 years ago, when oil of crankcase viscosity was tried in the cylinders, exceptional wear and scoring of piston rings took place and the experience generally was unfortunate. There is little doubt that if the engine had first been run-in on higher viscosity oil—as is now standard practice—the result might have been different. During the war, certain motorships have been compelled to use the same brand of lubricating oil in the crankcase and cylinders, but the practice has been reported upon adversely as causing frequent blow-past, and, accordingly, normal cylinder oil has been supplied subsequently where a case has been established. For d.a. 2-stroke engines the preferred arrangement is:—

	Viscosity (Redwood No. 1)		
Temp. °F.	Crankcase	Piston	Pistons (running in)
70	1,300 minimum	—	—
120	250-350	450-500	650-1,000
140	160-200	250-300	350-550
180	75-100	110-130	150-220
200	60 min.	85 min.	105 min.

If a dual-purpose oil is used, one having a somewhat higher viscosity than is normal for the crankcase will be attended with less risk of cylinder wear, but an adverse effect upon the oil-cooling properties, and an increased tendency to carbonise in the pistons, can be expected. Such an oil could have a viscosity of 2,400 sec. maximum at 70° F., 210-240 at 140° F., and 70 minimum at 200° F.

A sufficient number of cylinder lubricating points should be provided. Thus, on, say, a s.a. 4-stroke engine of 740mm. (29·13in.) cylinder bore and 1,500mm. (59·06in.) stroke, four lubricating points are preferable to two points, although two points may be the usual practice. The two additional points are fully justified by the saving in labour and material resulting from the reduced upkeep on piston rings and cylinder liners. Dryness of the liner and subsequent piston-ring leakage never starts in the line of the lubricating connections, but always half-way between the supply points. Once the rings begin to pass gases it is difficult to restore the oil film, even by using an excessive amount of oil.—*C. C. Pounder, "The Shipping World", Vol. CXII, No. 2,702, 28th March, 1945, pp. 367-368.*

Notes on Diesel-engine Maintenance.

The excessive wear which is sometimes experienced in the pedestal bearings and also in some of the main bearings of Diesel generator engines—where the calculated bearing pressures are of low order—may well be caused by insufficiently filtered lubricating oil. The fine, solid particles thus left in suspension in the oil proceed to set up a lapping action, which is severe on the bearing metal. The remedy is to fit an additional filter—say, a small-capacity cloth filter—sufficiently sensitive to keep back the particles which are too small to be stopped by the ordinary filter.

It is false economy to use other than a really high-grade material for springs, even in moderate-speed engines. Granted good design, where spring failures do occur they are usually sporadic and are traceable to a single batch of material. Experience shows that springs may also fail by a process resembling fretting corrosion and where this is so, a protective anti-corrosive coating given to the springs may greatly prolong their useful lives. But, in the author's opinion, the most satisfactory procedure is to grind off the outer surface before coiling.—*C. C. Pounder, "The Shipping World", Vol. CXII, No. 2,702, 28th March, 1945, p. 367.*

Piston Blow-past in Diesel Engines.

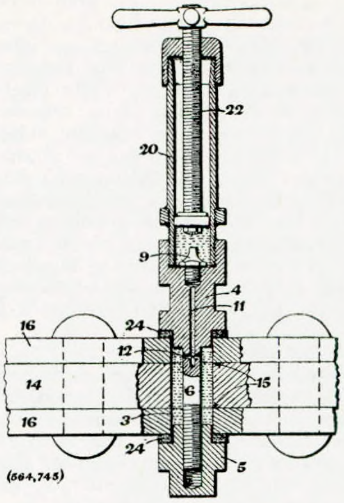
The loss of power which is experienced in service by high-speed 2-stroke auxiliary engines, and the heavy maintenance requirements, have usually been attributed to piston blow-past caused by sticking of the piston rings, which, in its turn, may be the cause of—or an effect of—heavy cylinder wear. Cornish rings have been found to be more satisfactory than normal and taper rings in small, difficult engines. If the power is to be maintained it is essential that the pistons should be withdrawn for cleaning before, and not after blow-past has developed; otherwise, heavy liner wear is inevitable. It is essential that the liners remain cylindrical under working conditions or blow-past will occur, with the creation of dry patches leading to piston seizures and scoring. The casting of cylinder liners in one piece with the jackets can be a predisposing cause of distortion when running.

Two other points are important in connection with the sticking of rings, *viz.*, the timing of injection—late timing is detrimental—and the quality of the lubricating oil. When one of the new U.S. oils, which have an artificially high detergent action, was used recently in some small fast-running engines in which the author is interested, ring-sticking was quickly and effectively prevented—thus obviating blow-past, scavenge-space fires, etc.—the pistons became oily, and the scavenge ports were no longer choked with carbon. When first used upon existing engines, a large amount of sludge is found in the oil pan, but once the engine is cleared this does not occur again. These high-detergent oils are also useful for propelling engines; they are miscible with normal oils.

Where cylinder liners are badly worn the top piston ring can be omitted, excessive wear of the grooves being caused by ring movement consequent upon wear at the top of the liner. It is often believed that the wear and tear on cylinder liners and piston rings is greater in reversible engines—by reason of cold starting air being blown into hot cylinders during manœuvring—than in non-reversible engines. The author has reason to be sceptical of the accuracy of this generalisation, because statistical data for main and auxiliary engines of similar type show that main-engine liners and rings have the longer life.—*C. C. Pounder, "The Shipping World", Vol. CXII, No. 2,702, 28th March, 1945, pp. 367-368.*

Sealing Leaks in Riveted Joints of Boilers.

A British patent recently granted to a well-known firm of boiler manufacturers in the Midlands covers a method of dealing with leaks at the commencement of the leakage channel. The accompanying sectional drawing shows a double-riveted double butt-strap joint of a boiler drum in which one of the rivets leaks externally when the boiler is subjected to an internal water-pressure test. To seal the leak, the leaky rivet is removed and replaced by a hydraulic sealing plug made in two parts (*4, 5*), each consisting of a flanged head, one of which (*4*) has a screwed shank (*6*) which enters a tapped hole in the other. The part (*4*) with the screwed shank also has a tapped recess at its outer end, into which a nipple (*9*) to suit a standard grease gun is fitted. From this nipple, which embodies a spring-loaded N.R. ball valve, a duct (*11*) extends axially into the shank (*6*) and, just beyond the head of the part (*4*), this duct has a radial outlet (*12*). Underneath the head of each plug part is a sealing washer (*24*). The plug parts (*4, 5*) are made to fit in the rivet hole and the plug is assembled by first inserting one of the parts into one end of the

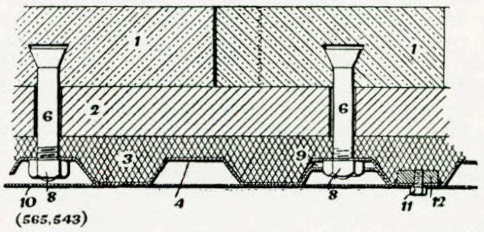


(664,745)

hole and then inserting the other part into the other end and screwing them together. In use, a grease gun charged with an indicating fluid, such as water tinted with aniline dye, is applied to the nipple and indicating fluid is forced through the duct (*11*) into the rivet hole around the plug shank (*6*). The plug dimensions are such that the liquid space extends beyond the boiler shell (*14*) on either side so as to embrace the joint surfaces (*15*) between the shell and the two butt straps (*16*). The indicating liquid under pressure penetrates the cavities of the joint, following (in reverse) the path of the leakage and emerging at the commencement of the leak which can then be caulked at the inner end. This done, the hydraulic sealing plug is removed from the rivet hole (*3*) and a new rivet is inserted. The drawing shows an alternative method of use in which instead of a separate grease gun being used for forcing an indicating liquid into the leak, a cylinder (*20*) containing a piston operated by a threaded rod (*22*) is screwed on to the plug part (*4*) over the nipple (*9*) and charged either with the indicating liquid or some inert substance in plastic form, such as red lead or manganesite paste. This would also show the commencement of the leak, which would be suitably caulked. The use of a plastic substance has the advantage that it can be used to fill any cavities in a leaking joint, and as it fills out the cavities permanently it eliminates the possibility of the occurrence of corrosion effects, as well as stopping the leakage.—*"Engineering", Vol. 159, No. 4,138, 4th May, 1945, p. 360.*

Foster Wheeler Boiler-furnace Floor.

An improved form of construction for the furnace floors of boilers is covered by a new British patent secured by Foster Wheeler, Ltd., and Mr. W. Sampson, of London. When the firebricks of a furnace floor are fitted without attachment to the supporting plating, they are very liable to become displaced, and in marine boilers explosions in the vicinity of the ship may cause complete upheaval of the bricks, especially when they are laid on the plating of the double bottom. The form of construction illustrated in the accompanying sectional diagram, however, is claimed to be capable of withstanding



(565,543)

severe shock without disturbance of the brick lining. With this construction, the inner layer of firebricks (*1*) is backed by a second layer of bricks (*2*), the joints of abutting bricks in the first and second layers being staggered in the manner shown. A layer of insulating material (*3*) is interposed between the brick layer (*2*) and the floor troughing (*4*) produced by corrugating panels of thin metal plate to form troughs with sloping sides between flat regions constituting inner and outer troughs which are capacious yet stiff in character. Bolts (*6*) with tapered heads engage dovetail recesses in the bricks (*1*), and their nuts (*8*) are housed within the troughs locked by washers (*9*), which fit the nuts and have sloping sides fitting the troughs. These washers are held in position by flat plating (*10*) secured to the troughed plating by studs (*11*) passing through the bases of the troughs into flat bars (*12*) welded to the inside of the troughs.—*"Engineering", Vol. 159, No. 4,140, 18th May, 1945, p. 400.*

Cleaning Heat Exchangers, etc.

In an article published in a recent issue of *Power*, R. W. Mitchell discusses cleaning methods and materials for the internal cleaning of oil-fuel heaters and heat exchangers. After stressing the danger from fire and explosion incurred by the use of petrol and benzine as cleaning agents, he points out that it may be economical to pay any price within reason for cleaning materials which are simple to use and allow the cleaning process to be completed rapidly and with a minimum of supervision, provided there is no risk of damage to the equipment. As far as possible, large units should be cleaned in place, without dismantling, and a circulation of a cleaning solution is often the best method. Portable equipment may save considerable expense in making special arrangements. The author then describes and illustrates some typical equipment for circulating solutions and for the immersion-cleaning of heat exchangers. Fig. 2 shows how slight

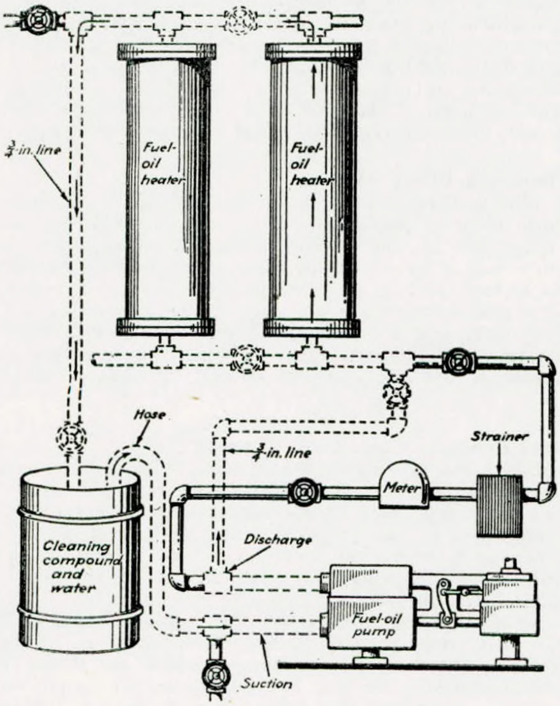


FIG. 2.

alterations in existing piping may facilitate cleaning. In this instance, the replacement of an elbow in the pump suction provides a connection for a hose leading to a drum of cleaning solution. Two T-pieces in the pump discharge are used to by-pass the meter and strainer, giving a direct connection between the pump and the heaters, whilst a T-piece in the heater discharge pipe provides a return connection to the drum. Circulation is maintained by the pump, and the dotted lines show the path of the cleaning compound.—*"Boiler House Review", Vol. 59, No. 3, March, 1945, pp. 77-78.*

Welded Repairs to Boilers of Dutch Steam Trawlers.

Some unusual welded repairs were recently carried out on the boilers of two Dutch trawlers by a Fleetwood engineering firm. In the trawler "Hazael," the cylindrical boiler is 10ft. 6in. in diameter by 9ft. long, with two plain furnaces. The designed working pressure is 180lb./in.^{2}. Corrosion had taken place at the bottom centre line of the shell plating over a triangular area extending from a width of 24in. at the back end and tapering to a point 33in. along the fore-and-aft line. This defect varied in intensity, in some places the original thickness (⅝in.) being reduced to 3/16in., and with a crack at one point. The total area of the bad spot was about 360in.^{2}. The boiler was got ashore and chocked up to facilitate the cutting out of the corroded portion of the shell plating, and a semi-circular section, 40in. in radius from the inner flange of the back end plate was then cut out. The cut was faired, a piece of Lloyd's Register tested boiler plate ⅝in. thick was cut to shape and rolled to the radius of the boiler shell, and the semi-circular edge was then bevelled ⅜in. to match the bevelling previously carried out on the shell. The boiler was then rolled almost completely over and the new piece of plate fitted into position and bolted up. It was tack-welded in five places from the inside, and further welding was then carried out on the inside. When this was completed, the circumferential holes in the back plate were reamered and the welding completed on the outside of the shell. The new plate was then riveted to the flange of the back end plate and caulked. The repair was completed in under two months and a water-pressure test of 45 minutes' duration at 270lb./in.^{2} pressure was then carried out. The job would have been completed more rapidly if the first patch put on had not proved to be laminated when chipping of the edge was commenced. The total quantity of Metrovick R.L.S. electrodes used was 450ft. In addition to this repair, while the boiler was out of the ship, the port combustion chamber bottom wrapper plate was renewed, as well as a section of the furnace crown. A similar but larger repair was made to the boiler of the Dutch trawler "Hornrif" without removing the boiler from the ship. In this instance the state of the back plate necessitated a new section, 30in. wide by 42in. high, being inserted. It was flanged in a similar manner to the boiler back plate, welded to it and riveted to a new circular shell plate. The boiler was stripped of all its mountings and rolled on chocks in order to give access to the parts requiring repair. On test, the work proved to be satisfactory. The boilers of both trawlers have since been in constant use and have not given any trouble at all. The repair work was, in both cases, supervised by Mr. H. G. Ahlers of the Dutch Board of Trade.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,513, 22nd February, 1945, p. 8.*

Some Operating Experiences with High-pressure Land Boilers.

After surveying the present-day trend of steam pressures, the authors discuss operating experiences with boilers, superheaters, economisers, air preheaters and firing equipment, the latter including chain grate and underfeed stokers. Reference is also made to mechanical stokers for marine service. Other matters, dealt with in the paper include feed pumps and packings; feed-water treatment for high-pressure boilers; the fouling of turbines supplied with steam by such boilers; the external fouling of high-pressure boilers and cleaning methods employed.—*Paper by R. Carstairs, B.A., P. Hamer, B.A., and B. M. Thornton, M.Sc., read at a meeting of the N.-E. Coast Institution of Engineers and Shipbuilders on the 20th February, 1945.*

Heat Saving by Lagging Pipes.

A paper on the economics of saving fuel, with particular reference to the insulation of steam ranges, presented at a meeting of the Engineers' Club, Manchester, by G. N. Critchley, gives details of the savings effected by lagging pipes having diameters ranging from ½in. to 12in., with sectional 85 per cent. magnesia of various thicknesses. In general, it may be said that the larger the diameter of the pipe the greater is the effect of insulation. For instance, assuming a steam temperature of 366° F. (the temperature of saturated steam at a pressure of 150lb./in.^{2}) and an average ambient still air temperature of 50° F., the effect of insulating a 1in. internal diameter pipe with a 1in. thickness of magnesia would be to reduce the heat loss per foot run from 355 to 75 B.Th.U./hr., whilst with a 12in. pipe the reduction would be from 3,294 to 435 B.Th.U./hr. It should also be noted that it is the first inch of insulation which has the greatest effect; *e.g.*, in the case of the 1in. pipe the application of 1½in. of insulation reduces the heat loss to 61 B.Th.U/hr., and the application of 2in. of insulation reduces it to 53. The effect of increasing the insulation of pipes of other diameters is similar. It is calculated that for a 12in. pipe the cost of applying 1in. of insulation would be repaid in 3 months, but the repayment time increases for each additional increment of covering, so that in the extreme case of a pipe with 6in. lagging, the repayment time for the last inch would be 36 years. These figures must, of course, be considered in relation to the length of pipe involved, and are affected by the hours of usage per annum, the steam temperature and, to a certain extent, the air temperature, but on the whole, it seems quite clear that failure to provide adequate insulation results in loss of money. The paper includes a table showing the savings effected by the use of other typical fuel-saving devices in a land installation, and in the particular case quoted, it appears that the effect of applying sectional magnesia lagging 1in. thick to a 4in. steam pipe has a greater relative effect than the majority of the other devices. It should be noted, too, that it is of the utmost importance that the flanges should be lagged, for one unlagged flange joint is equivalent to about 18in. of unlagged pipe, and, therefore, the omission of this precaution means that the heat loss is increased by something like 50 per cent. in a range of piping.—*"Fairplay", Vol. CLXIII, No. 3,208, 2nd November, 1944, pp. 632 and 634.*

Götaverken System of Bulkhead Construction.

The bulkhead illlustrated in Fig. 3 (diagram B), which has the same strength as the more normal bulkhead shown in diagram A, comprises a smooth sheet-metal wall (*7*) provided with stiffeners located at distances from each other, which increase upwards. The stiffeners are disposed in a fan-like manner, so that the distance between them becomes gradually greater from the bottom to the top. In the upper portion of the bulkhead the stiffeners are disposed at greater distances than those (*1*) in diagram A, whereas the stiffeners in the lower portion of the bulkhead are closer together. The result of this arrangement is that the load on the stiffeners, according to diagram B, varies as illustrated by the curve (*9*). The thickness of the sheet metal of the bulkhead should, theoretically, follow the curve (*10*), but may preferably be chosen as indicated by the curve (*11*), so that the thickness is over-dimensioned only in the uppermost portion of the bulkhead and may be kept constant along the main portion of the height. In the bulkhead, according to diagram B, the pitch (A[1]) of the stiffeners is 680 mm. at the deck level (*12*). The pitch (A) at the bottom level is 320 mm. The arrangement of the stiffeners, the reduced thickness of the sheet material, and the reduced load on the stiffeners in the lower portions of the bulkhead are stated to result in a total saving in weight, as compared with conventional structures, of nearly 10 per cent. The cross-section of the stiffeners in the bulkhead, according to diagram B, has been assumed constant along the whole length. Diagram (C) illustrates a portion of a longitudinal bulkhead of a ship, comprising smooth, plane sheet-metal portions (*13*), which, between abutting transversal bulkheads (*14, 15*), are reinforced by means of groups (*16, 17, 18*) of stiffeners arranged in a fan-like manner. In all of the groups the pitch of the stiffeners increases from the bottom level (*19*) to the deck level (*20*).—*"The Motor Ship", Vol. XXV, No. 302, March, 1945, p. 418.*

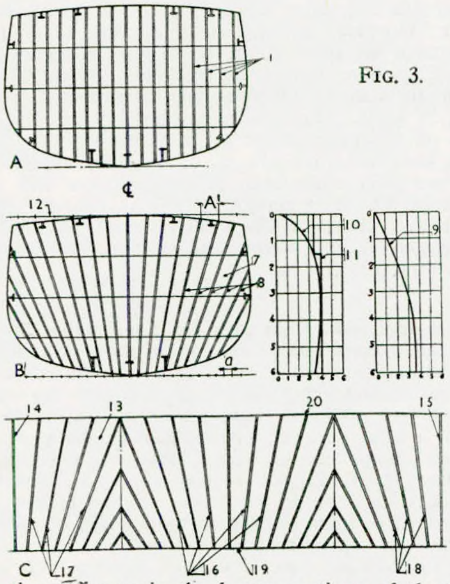


FIG. 3.

The Stopping of Ships.

The paper discusses the emergency stopping of merchant ships. The author claims that the manœuvrability of a vessel, in this respect, increases her commercial efficiency, and then proceeds to deal with measurement of a ship's movements and of astern power during a sudden stop. He analyses various methods of applying astern power and discusses the estimation of the probable time and distance required to stop a ship. Among the conclusions drawn is the fact that when power has been shut off, the propeller speed quickly drops to about two-thirds normal and that in this "propeller turning freely" condition the resistance of the full is augmented by about one-third, whereas if the propeller is stopped, the augmentation is seven-eighths to unity. The negative thrust is slightly higher when the propeller is kept turning dead slow ahead, than when it is stopped and possibly also when turning dead slow astern. Complete control of a propeller during an emergency stop (or crash astern) necessitates the development of a torque almost as great as is required for full speed, and where this is not available the braking effect due to "the propeller turning freely" can be considerably increased by pneumatic or electric braking. A number of trial results for a variety of types of ships are tabulated in an appendix to the paper.—*Paper by L. R. Horne, read at a meeting of the N.-E. Coast Institution of Engineers and Shipbuilders on the 6th April, 1945.*

Grain Cargo Carried in Oil and Ore Steamer.

The American s.s "Steelore", owned by the Bethlehem Steel Corporation, and designed and built before the war as a combined oil tanker and ore carrier, is now doing duty as a bulk grain carrier and recently arrived at a British port with 19,000 tons of grain. She is a twin-screw vessel equipped with geared turbines supplied with steam by two oil-fired cylindrical boilers, and her general appearance is that of a conventional tanker, with the propelling machinery aft. Forward and aft on each side of the hull are eight cargo oil tanks, each about 20ft. wide, whilst in the centre are three large holds, each with a 30ft. by 30ft. hatch and extending in depth from the main deck to within 14ft. of the bottom. The space under these holds forms part of the P. and S. oil tanks. Each of these side tanks is separated from its neighbour on the other side of the ship by a longitudinal watertight bulkhead which runs the whole length of the ship and is virtually an extension of the keel; it serves to stiffen the hull structure very considerably. In normal times, ore is carried in the centre holds and oil in the side tanks, and the ship is capable of carrying up to 25,000 tons. Each of the three holds is equipped with pairs of corrugated steel hatch covers which are hinged and arranged to be lifted by means of the steam deck winches. The hatches extend the full width of the holds and enable the ship to be loaded with her normal cargo of iron ore in 1½ hours. To facilitate such a high speed of loading, two large capstans are installed at each end of the vessel to handle the mooring gear. At the present time the steel hatch covers are welded down and fitted with tank hatches through which the grain cargo can be discharged in the usual way by elevators. The 19,000 tons of grain carried in the three holds can be loaded in six hours. When the "Steelore" is in ballast, *i.e.*, with her side tanks full of either oil or water, she is stated to be an excellent sea boat.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,512, 2nd February, 1945, p. 2.*

New Deep-sea Diving Method.

A new and remarkably effective method of air supply which is claimed to be of particular value for deep-sea diving has recently been developed by the Swedish engineer A. Zetterström. This method, which is based on the idea, when diving to greater depths than 40 meters (131ft.), of exchanging the nitrogen from the air for hydrogen gas, formed the subject of experiments extending over several months, and was recently tested under service conditions for the first time. It is reported that the results were surprisingly good. —*"Mechanical World", Vol. 116, No. 3,019, 10th November, 1944, p. 515.*

The Elder Dempster Cargo Liner "Tamele".

Although the general design of the new Elder Dempster cargo-passenger liner "Tamele", 8,000 gross tons, resembles that of similar vessels of this type built by British yards during the present war, the arrangement of her propelling machinery is unusual. She is a twin-screw ship with two 3-cylr. Doxford engines of practically standard type. The design of these engines has made it necessary to stagger them, the starboard unit being some 7ft. aft of the port unit in order that the controls of both engines might be placed at the forward end. Furthermore, there are no engine-driven auxiliaries except the scavenge pumps, which are driven by beams from the crossheads of No. 2 cylinders in the usual way. The fresh-water circulating and lubricating-oil pumps are driven by electric motors. The exhaust from the starboard engine is passed through a composite waste-heat and oil-fired Clarkson boiler which supplies steam at a pressure of 120ft./in.^{2} for a variety of purposes, including the heating coils in the six palm oil tanks. The latter have a total capacity of about 1,000 tons. Electric current is furnished by three 180-kW. generators, each of which is directly driven at 600 r.p.m. by a 6-cylr. Allen engine of the 4-stroke type. These engines are cooled with fresh water, although salt-water cooling can be utilised in an emergency. There are, in all, 14 motor-driven cargo winches. The telemotor-controlled steering gear is of the hydro-electric type, with an alternative 3-cylr. air motor which comes into operation in the event of emergency. The E.R. personnel of the vessel includes seven engineer officers and one electrician. The "Tamele" was built by Cammell, Laird & Co., Ltd., and engined by Wm. Doxford & Sons, Ltd.—*"The Motor Ship", Vol. XXVI, No. 303, April, 1945, pp. 6-13.*

Liberty Ships for Service as Coastal Colliers.

A number of Liberty ships have been converted for the carriage of oil cargoes in bulk, but have not proved particularly effective in this service, and now, according to the New York *Journal of Commerce,* 24 vessels of the Liberty type are to be adapted for service as colliers for the carriage of coal from Hampton Roads to the Boston area. In this trade, loading and discharging are done by shore equipment, and in order to operate the service in an efficient manner, the colliers have to be loaded in 5 or 6 hours and discharged in about double that time. The first vessel, which is due to enter the trade "at any moment", is a standard Liberty ship with the machinery and crew accommodation aft; the navigating bridge is retained amidships. The masts and cargo-handling gear have been eliminated and the size of the cargo hatches increased. The tank tops have been raised in the wings to facilitate the rapid discharge of cargo, with the result that the d.w. capacity of the vessel has been reduced to about 8,000 tons, as compared with the 10,500 tons of the standard Liberty ships. The fact that these vessels have a second deck will militate against their efficiency as colliers, as it will mean a considerable increase in the time and cost of trimming the coal, in addition to which the design of the vessels is such that the capacity provided is greatly in excess of that required for a coal cargo. The conversion of these Liberty ships must, therefore, be regarded as a purely temporary expedient designed to meet the acute shortage of coastal and ocean-going colliers that is likely to continue for a considerable time.—*"Fairplay", Vol. CLXIV, No. 3,232, 19th April, 1945, pp. 676-677.*

Thames (Dumb) Barges.

The paper describes all the various craft used on the Thames from the wooden barge and its method of construction, to a proposed 86ft. barge of all-welded design of 250 tons carrying capacity which the author considers to be particularly suitable for use on the London river. The author gives details of towing trials carried out in the William Froude Tank with models of such barges and gives some details of the design and construction of the all-welded barges in question. He points out that the number of craft in service on the river before the war was in the region of 10,000, and that the replacement of Thames barges is a serious problem for the post-war period. A standard design with reduced resistance should prove an admirable replacement unit and would benefit both the owners and the operators.—*Papers (No. 10) by E. O. Stephens, M.I.Mar.E., read at the April, 1945, meeting of the Institution of Naval Architects.*

The Habitability of Naval Ships under War-time Conditions.

The paper deals with the difficulties, which war conditions have accentuated, in obtaining optimum habitability conditions in H.M. ships, and describes some of the measures which have been taken to overcome them. Arctic conditions have produced problems of heating and anti-condensation, whilst tropical conditions have called for special attention to air movement, volume of air flow, lagging, air cooling and air drying. Some recent developments in air conditioning are referred to and some of the considerations involved are explained. Other amenities to improve habitability under tropical conditions are also described.—*Paper (No. 3) by A. J. Sims, O.B.E., R.C.N.C., read at the April, 1945, meeting of the Institution of Naval Architects.*

Crews' Accommodation in Tramp Ships.

The author discusses the evolution of tramp ship accommodation, both in regard to spaciousness and lay-out, and illustrates his points by means of descriptions and plans of the accommodation provided in five of the tramp ships owned by the British Steamship Company. These vessels are typical products of the period under review by the author, *viz.*, the coal-burning steamships "Maidenhead" (ex-"Newquay") of 1914; "Blackheath", of 1936; "Twickenham", of 1940; and "Ascot", of 1942. The accommodation arranged in the motorship "Greenwich", of 1943, is also included in the survey. Although the author was personally responsible for many of the features incorporated in the design of the accommodation in these vessels, he is sharply critical of what he considers to be shortcomings and errors. He concludes by pointing out that there is room for further improvements and that modern progress in interior decoration, domestic science, sanitation, heating and lighting may well be adapted to improve conditions afloat.—*Paper (No. 2) by E. H. Watts, read at the April, 1945, meeting of the Institution of Naval Architects.*

The Stabilization of Ships by Activated Fins.

After a general introduction, the author considers the question of what moment is theoretically required to hold a ship against the upsetting moment of a regular sea. He then gives an account of the application of stabilizing moments in model tests, along with other observations on stability and resistance to rolling. The paper then deals with the development of efficient types of fin designs, including the consideration of cavitation "breakdown", the interference effects of multiple fin arrangements, both longitudinal and transverse, and the effect of stabilization on ahead resistance. This is followed by brief descriptions of the hydraulic operating gear and the control system employed with activated-fin stabilizing gear, and in conclusion the author presents some interesting ship records, together with general data for two typical applications.—*Paper (No. 8) by J. F. Allan, B.Sc., read at the April, 1945, meeting of the Institution of Naval Architects.*

Marine Engine Forgings.

A paper entitled "The Manufacture of Large Marine Engine Forgings" by Mr. R. Lister, which recently appeared in the *Journal of the West of Scotland Iron and Steel Institute,* deals with four main stages in the production of such components, *viz.*, the production of the steel in ingot form, the forging of the ingot into the required shape, the heat treatment of the forging and the final machining to size. The author states that while carbon steel is invariably used for heavy forgings of this type, the actual carbon content varies from 0·2 per cent. in forgings for propeller shafts, connecting rods and boiler drums, for which an ultimate tensile strength of 30 tons/in.^{2} is required, to 0·4 per cent. for crankshafts with a tensile strength of 40 tons/in.^{2}. In the case of turbine rotors and gear-wheel shafts, for which 35 tons/in.^{2} is called for, the carbon content is 0·35 per cent., whilst the rims of the gear-wheels are made of 0·3 per cent. carbon steel with an addition of 3·5 per cent. of nickel, the tensile strength being thereby increased to 40-45 tons/in.^{2}. These steels are usually made by the open-hearth process, although basic electric furnace steel is sometimes used. The author expresses the view that the shaping of large ingots under a forging press is rather a crude process, because it is not possible to work to close dimensional limits or to form intricate shapes. A compromise has therefore to be made between the extra work involved in the production of a forging approximating closely to the desired dimensions and the extra amount of machining required if a very rough forging is produced. There is also a limitation on the shape of the forging which can be forged under the hammer, since, in order to make rotation under the hammer possible, the forging must be of such a shape that it is symmetrical about its longitudinal axis. Having thus determined the required shape of the forging, a drawing can be made and the weight of the forging calculated. Thence, the total weight of the ingot can be determined, the usual allowance being that the forging represents from 65 to 70 per cent. of the weight of the ingot. Among the factors which affect the shape of the ingot itself is the amount of work necessary to produce the desired shape, bearing in mind that sufficient work must be done to ensure that the coarse-grained "as-cast" structure of the steel is thoroughly broken down. Another factor is the production of suitable flow lines or fibres in the forging, and in this connection the author gives three examples of ingots which can be used to produce the crankshaft of a large marine engine. The forging temperature is likewise an important consideration, it is in the region of 1,200° to 1,222° C. (2,192° to 2,228° F.), and involves the use of special reheating furnaces, various types of which are briefly described in the paper. Some particulars are also given of the forging presses and tools used in the actual forging process. In conclusion, the author gives a short description of the methods employed in forging a propeller shaft, a boiler drum and a three- and six-throw crankshaft.—*"Shipbuilding and Shipping Record", Vol. LXV, No. 4, 25th January, 1945, p. 80.*

Reclamation of Cracked Castings.

Some details of a new process for the repair of cracked castings are given in a recent issue of *Production and Engineering Bulletin.* The repair is made without risk of heat distortion by an electrolytic process which is covered by a British patent and is approved by the Ministry of Supply (T.T.3). Among the advantages claimed for it is the relative ease with which it can be applied to cylinder-block castings of petrol engines without dismantling the latter completely. The block is first dressed with a portable grinder to expose clean metal round the crack, the area then being wiped over with a rag soaked in a degreasing solvent. A cell approximately 2in. deep, made from sheet bitumen, is thereupon built round the crack, and the crack itself is plugged with plaster of paris or some similar material. The cell is then filled with a mixture of sulphuric and nitric acid, in which a lead cathode is immersed, the block itself being connected to a positive power lead. On passing an electric current through the electrolyte, the clean metal surface is anodically etched. The solution is then removed and replaced by a nickel-plating solution. A nickel electrode, substituted for the lead, is then made to serve as an anode, and a current is passed through the electrolyte for about half an hour in order to deposit a thin film of nickel on the etched surface of the block. At the next stage a deposit of copper, approximately 0·005in. thick, is applied on top of the nickel. This is done by removing the nickel-plating solution and replacing it by an acid copper solution, a copper anode being substituted for the nickel anode previously used. Both the nickel and the copper anodes are partly encased in a thin piece of filter paper or muslin. Subsequent stages in the process involve the temporary removal of the copper solution and the dusting of brass powder over a fresh filling of plaster placed in the crack to make it conducting; the scouring of the plated surface with pumice; the replacement of the copper solution; and continued deposition until about 0·1in. of copper has been deposited. The cell is then removed and the copper deposit trimmed up. Castings having cracks varying from hair lines to gaps up to ⅛in. have been repaired by this process, and it is understood that no failures have so far been reported. The scope of the process is, of course, not restricted to the repair of cracked cylinder blocks, but it is essential in all applications to take into consideration the degree of stress to which the repaired area will be subjected in service. Further information about the process can be obtained from the Secretary, Electro-deposition Technical

Advisory Committee, c/o S.T.A.M., Ministry of Supply, Room 1043, Shell Mex House, Strand, London, W.C.2.—*"Modern Refrigeration", Vol. XLVII, No. 560, November, 1944, p. 278.*

Light Alloys for Marine Engines.

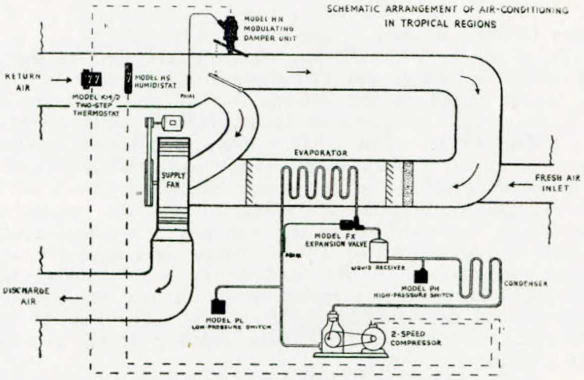
Since resistance to corrosion is of minor importance for materials to be used in the ship's engine room, a wider range of light alloys is available than when external fittings are under consideration. For pistons the choice of Y-alloy is confirmed by recent data on creep strength and on performance under combinations of steady and alternating stresses at temperatures up to 300° C. When alloys of low coefficient of thermal expansion are being selected for pistons, their thermal conductivity must be taken into account as a factor influencing the actual diameter attained under running conditions. There is a prospect that a cylinder head made of a corrosion-resistant aluminium-magnesium alloy might permit direct cooling by sea water. Wrought alloys of aluminium find application in marine engines for connecting rods, rockers, operating rods, fan blades and covers. Modern means of controlling foundry technique and inspection have made it possible to use light alloy castings for stressed components in aeronautical engineering and it is reasonable to apply this experience in marine engine design. Evidence is given regarding the tensile and fatigue strength of specimens taken from aluminium and magnesium-alloy castings. Light alloys generally are not more notch-sensitive than steels in dynamic loading. Internal stresses in light-alloy castings can be largely relieved by heating to about 300° C., but where strong heat-treated alloys are involved, the effect on the mechanical properties has to be studied. In Y-alloy, quenching in boiling water introduces lower internal stresses than quenching in oil.—*Paper by A. J. Murphy, M.Sc., "Transactions of the Institute of Marine Engineers", Vol. LVII, No. 2, March, 1945, pp. 31-42.*

Damage to Welded Ships.

Although major fractures of a kind rarely found in riveted vessels have occurred in a number of the all-welded American "Liberty" ships, others have stood up to damage caused by enemy action remarkably well. Among such cases is that of the "Anne Hutchinson", which was struck by two torpedoes, the first of which did extensive damage to the ship's bottom, causing her to break in two. During heavy weather the after part sank, but the forward part, containing the engines and boilers, remained afloat. The fore end of the vessel was again torpedoed in the boiler room, but the surviving portion of the hull still remained afloat and was eventually towed into port. Similar cases can be instanced of all-welded oil tankers reaching port after sustaining serious damage from underwater explosions. Thus, the "Pennsylvania Sun" was torpedoed amidships, the explosion tearing away the shell plating and one wing bulkhead and piercing the other wing bulkhead, thereby opening about seven cargo tanks to the sea. Experience of the behaviour of welded ships subjected to war damage has demonstrated in an unmistakable manner the ability of this form of construction to localise damage, this being a characteristic to which appropriate weight should be given when the relative merits of riveting and welding are being assessed.—*"Fairplay", Vol. CLXIV, No. 3,226, 8th March, 1945, p. 469.*

Air-Conditioning Installation for Severe Tropical Conditions.

The accompanying schematic diagram shows the general arrangement of an automatically-controlled dehumidifying and air-cooling plant, of British design, for use in the tropics. No air heating or washing is provided for, but the plant is designed to maintain a temperature of 70° F. at 65-68 per cent. relative humidity in the conditioned space, preference being given to humidity. The refrigerating compressor is driven by a 2-speed motor, controlled by a 2-step thermostat, in addition to which there is a master humidistat which over-rides the full running speed contact of the thermostat. These two master controls are located in the return air duct, which also contains the temperature-sensitive bulb of a modulating-damper unit. This damper unit proportions the amount of return air fed back into the eye of the fan with passing through the air cooler; thus if the return-air temperature is too high, the modulating damper tends to close off the by-pass duct and open the duct feeding back through the air cooler. The operating motor of the damper unit is electrically interconnected with the first contact of the 2-step thermostat and when the circuit is broken, the damper unit automatically closes the duct which feeds the return air through the cooler. The sequence of operations is briefly as follows: When the temperature of the air in the return duct reaches 68° F., the first



contact of the 2-step thermostat "makes" circuit and energises the modulating damper unit and, at the same time, starts the motor of the refrigerator compressor at low speed. The damper unit then proportions the amount of air passing through the cooler, according to the temperature at its sensitive bulb. Should the temperature in the conditioned space, and thus in the return-air duct, continue to rise, the second step of the thermostat "makes" circuit and switches the compressor motor over to full speed. Assuming that the temperature of the air in the return duct is below 68° F. and neither step of the thermostat has yet "made" circuit, and also that the relative humidity at this point is in excess of the prescribed 68 per cent., then the master humidistat "makes" circuit, thereby energising the modulating-damper unit and causing the compressor motor to run at full speed. The effect of this will be to dehumidify the fresh air entering the conditioned space. It will be appreciated that if the relative humidity goes up to over the predetermined amount of 68 per cent., the master humidistat takes control irrespective of the temperature of the return air. The controls of the compressor motor are quite normal. The air cooler inlet is controlled by a thermostatic expansion valve which will maintain the required degree of superheat of the suction gas. In addition, there is a high-pressure cut-out to protect against overloading in the event of an excessive condenser temperature. As an additional precaution there is also a low-pressure safety switch which stops the compressor motor if the suction gas pressure drops below the equivalent to 40° F. evaporating temperature.—*"Modern Refrigeration", Vol. XLVIII, No. 565, April, 1945, p. 86.*

"Some Modern Applications of Welding to Engineering".

The author points out that welding has introduced a new technique in manufacture and that if full advantage is to be taken of this, the underlying principles of the process must be fully understood. He then discusses the first important point involved, *i.e.*, the question of design and the way this can be interpreted and issued to the manufacturing departments. The designer of a welded structure has not only to consider the metallurgical characteristics of the materials to be utilised and their suitability for the purpose, but must also deal with the mechanical stresses involved and take due account of the manner in which these materials react to the welding processes. The subject of heat treatment after welding is briefly discussed in the paper and some guidance is given as to the occasions when it should be employed. The author states that shop organisation is an equally important matter and that the efficient and economical production of fabricated components and structures demands a considerable amount of attention to the problems previously referred to. The types of tools used and general procedure for welding are also discussed and examples of the typical welded structures employed in marine engineering are shown in the illustrations accompanying the text of the paper, and considered in a general way.—*Paper by J. A. Dorrat, "Transactions of the Institute of Marine Engineers", Vol. LVI, No. 10, November, 1944, pp. 195-203.*