ENGINEERING ABSTRACTS

Section 3. SHIPBUILDING AND MARINE ENGINEERING

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Italian-built Cargo Vessels

The *Star of Suez* is one of three vessels built by the Cantieri Riuniti dell'Adriatica for the Alexandria Navigation Co. This single-screw vessel has a tonnage of nearly 6,700 d.w.c. and is engined with a C.R.A.-Sulzer two-stroke single-acting Diesel with six cylinders, 720 mm. in diameter, the piston stroke being 1,250 mm. The normal service output of 4,200 b.h.p. is developed at 130 r.p.m. and the engine drives its own cooling-water and lubricating oil pumps. The propeller is of manganese-bronze, 4·9 m. in diameter, the pitch being 3·75 m. A Clarkson composite boiler, built by the C.R.A., is installed, and the working pressure is 100lb. per sq. in.—*The Motor Ship, Vol. 30, April 1949, pp. 11-13.*

Light Alloy Cross-Channel Ship Design

This paper is concerned with the design of a complete ship using the marine type light alloys. Cross-channel ships are costly ships, whose machinery and outfit is a large proportion of the total cost, and in which any saving in structural weight has an appreciable effect on the load displacement, due to the low deadweight-displacement ratio. A ship of this type was therefore chosen for the purpose of investigation and it was decided to base this on a modern ship for which sufficient data were available. This ship, being mainly riveted, was suitable for comparison with the alloy design and in addition was known personally to the author, who was therefore familiar with details of construction, etc. This ship does not carry cargo and hence any saving of structure weight must, *de facto*, reduce the displacement. The prismatic coefficient of this ship being close to the Taylor optimum for the relevant speed-length ratio, the alloy ship design would be at a disadvantage if her hull were fined on the same length. The power requirements of the two ships were estimated on a strictly comparative basis using Taylor's Standard Series. The author shows that the alloy design has 2 feet less beam and just under 2 feet less draught than the steel design. There is a 16 feet reduction in the length of the boiler-room, the resulting increase in passenger space, together with certain other smaller increases, due, for instance, to the removal of bulkheads on account of the greater freeboard of the alloy design, cancelling the loss in space due to the reduced breadth of the ship. The alloy design is much finer and has a large but not excessive beam/draught ratio. The displacement is two-thirds that of the steel ship and for the power requirements of some 72 per cent of the original 8,500 s.h.p. the propulsive efficiency would be satisfactory. It is possible, however, that the sea-going qualities would suffer due to the fine ends. The paper includes a tentative approach to the economies of the light alloy design, and the point is made that if the price of the light alloys involved could be reduced to about £110 per ton, or, taking scrap values into account, to £130 per ton, the alloy ship would cost no more than her steel counterpart.—*Paper by E. C. B. Corlett, read at a meeting of the Institution of Naval Architects, 7th April 1949.*

Behaviour of Deck Plating After Buckling

The author presents a simple theory of the behaviour of a panel of plating after buckling, based on certain broad assumptions. An attempt is made to calculate the total stress in such a panel of plating and to ascertain when permanent set is likely to occur. The investigation is extended to the case where plating buckles over a large area. The results are compared with compressive tests on steel plates. A method of calculating the section modulus of the section of a ship whose deck has buckled is described. The question of degree of fixity of plating at beams is considered. The limitations of the theory are discussed and some general conclusions given.—*Paper by W. Muckle, read at a meeting of the Institution of Naval Architects, 7th April 1949.*

New Marine Primer Paints

This article gives the formulations of eleven new primer paints providing fast-drying metal protective paints suitable for priming ship bottoms and top sides. The formulations represent the results of an exhaustive test progress carried out by the Lead Industries Association at marine test basins located at Sayville, Long Island, and Daytona Beach, Florida. It is claimed that the new formulations surpass the performance of the control standards, U.S. Navy and U.S. Maritime Commissions specifications; the new primers contain 55 per cent to 70 per cent red lead in combination with smaller percentage of other pigments such as zinc chromate, zinc oxide, iron oxide and magnesium silicate.—*K. H. Roll and C. J. Vander Valk, Marine Engineering and Shipping Review, Vol. 54, March 1949, pp. 51-53.*

Tanker *Olympic Games*

The tanker *Olympic Games,* recently delivered by the Bethlehem Steel Co. to the Olympic Oil Lines, is the first of four 18,000-ton deadweight tankers on order at the Sparrows Point Yard of that company. Overall length is 551ft. 2in. and length b.p. is 524 feet. Breadth moulded is 68 feet, draft to summer load line is 29ft. 9½in., and cargo capacity is 152,208 barrels. The cargo space is divided into twenty-seven compartments, the full depth of the hull, by oil-tight bulkheads extending from the bottom shell to the upper deck, there being ten transverse and two longitudinal bulkheads. Longitudinal framing is used for the hull with equal spacing of transverses and with heavy flat plate connections on all longitudinals at transverse bulkheads. The main propulsion machinery consists of one high-pressure and one low-pressure turbine, driving a four-bladed solid bronze propeller of 19ft. 3in. diameter through double-reduction gears. This unit has a normal ahead rating of 5,500 shaft horse-power at 100 revolutions per minute. Steam is supplied to the throttle at 440lb. per sq. in. pressure and 740 deg. F., with 28½ inch of vacuum at the exhaust flange. The high-pressure turbine is of the combined impulse-reaction type, exhausting downward to a main condenser athwartship below the turbines. Either turbine may be operated single, in case of emergency. An astern turbine, capable of providing ample torque for stopping and manœuvring the vessel, is fitted in the low-pressure turbine casing. Two single-pass, cross-drum, straight-tube boilers are located on a flat in the machinery space above and aft of the turbines. They are fired with oil burners operating under forced draft from two blowers, each with a capacity of 11,500 cu. ft. per min. at a static head of 10in. of water. One blower is sufficient for normal full-power operation of the ship. Economizers are located in the uptakes from each boiler just below the smoke-stack. Steam-jet soot blowers are provided for both the economizers and the boilers. Each boiler has 4,215 sq. ft. of heating surface, including water walls; the superheater has 687 sq. ft. and each economizer 1,438 sq. ft. of heating surface. The boilers are designed for 465lb. per sq. in. working pressure and 750 deg. F. at the superheater outlet. Normal rated capacity of the boiler is 27,500lb. of steam per hour, which is in excess of full-power requirements and sufficient to permit supplying the tank-cleaning system at cruising speed. Maximum rated capacity is 41,250lb. of steam per hour at 465lb. per sq. in. pressure and 775 deg. F. at the superheater outlet. The superheater has a normal capacity of 25,000lb. of steam per hour, the desuperheater 2,500lb. In addition to the desuperheaters in the boiler drums, there is an external desuperheater for supplying deck steam and steam to the salt-water heater for cargo-tank cleaning. This external desuperheater will maintain 250lb. per sq. in. pressure and 480 deg. F. when supplied with 30,000lb. per hour of 465lb. per sq. in. superheater steam at 750 deg. F., and about 4,280lb. per hour of fresh water at 525lb. per sq. in. and 240 deg. F.—*Marine Engineering and Shipping Review, Vol. 54, March 1949, pp. 36-45, 72.*

Dredge Carried on Deck of Landing Barge

A recently completed unusual towing project involved the transport of an entire suction dredge from San Francisco to Vancouver, B.C., a trip of approximately 813 miles. The dredge and its equipment was carried on the *Island Logger*, a 252-feet converted landing barge. On the barge was loaded the 300-ton dredge, two miles of 16-inch diameter pipe in 36-feet sections, two power-driven barges used in connexion with the dredge, 100 large pontoons used for floating the pipeline, and other equipment belonging to the dredge. Most unusual phase of the towing project was the method by which the dredge was loaded on to the barge *Island Logger*. The barge entered a floating drydock in San Francisco. Plugs in the bottom of her hull were removed; the drydock was lowered. As the dock went down, water flooded into the steel-hulled barge and it submerged with the drydock. The dredge was then floated into the drydock over the submerged barge. The dock was lifted again and the dredge settled on the barge's deck. Water was emptied out of the hull, and the metal plugs replaced. The drydock was then lowered again, leaving the *Island Logger* floating with the dredge on her deck.—*Canadian Shipping, Vol. 20, April 1949, p. 38.*

Norwegian 20-knot Liner

Before the war the Hamburg America Line ordered two fast cargo liners, 515·1 feet in length, with a beam of 66·3 feet designed to maintain a speed of 17·18 knots in regular service. These ships were equipped with four Krupp four-stroke Buchi pressure charged engines, developing a total of 16,000 i.h.p. and driving 2,600 kVA, 3,800 volt alternators. The first ship, the *Steiermark*, was converted to an armed cruiser and was sunk by the British Navy. The second was apparently completed as a cargo ship and taken over by the Ministry of Transport at the end of the war. She has now been converted to a passenger liner for a Norwegian shipowner and will carry emigrants between Italy and Australia. The Krupp engines have nine cylinders, with a diameter of 570 mm. and a piston stroke of 750 mm. There are two 500 kVA. transformers, reducing the voltage to 380 for the operation of the auxiliaries on board. When under way, the necessary current is obtained from the main generators, but in harbour two 200 kW. Diesel-engined alternators come into service. The machinery is controlled from a platform above the top of the engines. There are two propelling motors. A new type of propeller, the Schnitger, is employed, and the apparently extravagant claim is made that this will give the ship a speed 9 per cent higher than with normal propellers.—*The Motor Ship, Vol. 30, May 1949, p. 47.*

19-knot Cargo Liners

The various cargo liners which are being built for two Swedish companies, with trial speeds, under fully laden conditions, of 19 to 20 knots, are for different services, and in all, about a dozen of these ships will be in commission within the next year or two. Two ships coming within this category, the *Oklahoma* and a sister vessel, ordered by Rederiaktiebolaget Transatlantic, Gothenburg, from A.B. Götaverken, are for the North Atlantic trade and have a special interest for this and other reasons. Among the numerous unusual features on board is the arrangement, for safety purposes, of two sets of electric cables between the engine room and the steering machinery, one passing through one of the tunnels, whilst the other is led through the 'tween decks. There is also an extra cable which can be connected to switchgear in the engine room and run over the weather decks to any of the winches, so that in the event of any one of the cables in the 'tween decks to this machinery being broken down, the winches can be kept in service. The principal particulars of the *Oklahoma* and her sister ship are: length o.a. 470 feet, length b.p. 440 feet, breadth moulded 59 feet, deadweight about 6,900 tons, draught loaded 25ft. 1in. The propelling machinery consists of two six-cylinder Götaverken standard two-stroke engines with cylinders 760 mm. in diameter, the piston stroke being 1,300 mm. At 130 r.p.m. the total output of the two engines is 13,200 i.h.p. or about 11,000 b.h.p. Current is supplied by two 165 kW. generators and two of 240 kW., these being driven respectively by four-cylinder and six-cylinder Götaverken Diesel engines.—*The Motor Ship, Vol. 30, May 1949, pp. 48-49.*

Scavenger Boat

The *Driftmaster* built by a Baltimore shipyard for the use of the U.S. Corps of Engineers in New York Harbour is especially designed to pick up or "scavenge" loose debris and driftwood floating about the harbour. The boat has a double pontoon-like hull, is 100-feet long, has a 36-feet beam and is about 250 tons gross. It is Diesel powered with twin screws and twin rudders, each screw developing 350 h.p. There is an engine room in each hull, pilothouse controlled. There are two chain nets for collecting debris and on deck is a 12½ ton boom with an "A" frame. The boat is completely welded.—*The Welding Journal (N.Y.), Vol. 28, April 1949, p. 374.*

New Towing Tank

Plans for the immediate construction of a hydrodynamics laboratory and model ship towing tank at the Massachusetts Institute of Technology, Cambridge, Mass., were recently announced. The tank will be 8½-feet wide and 106-feet long, with special equipment to move accurate models of ship hulls at variable speeds through the length of the tank, either in still water or in waves of predetermined sizes. A glass side on the tank will permit underwater observations which cannot be made in any other towing tank now in use in the United States.—*Marine Engineering and Shipping Review, Vol. 54, March 1949, p. 84.*

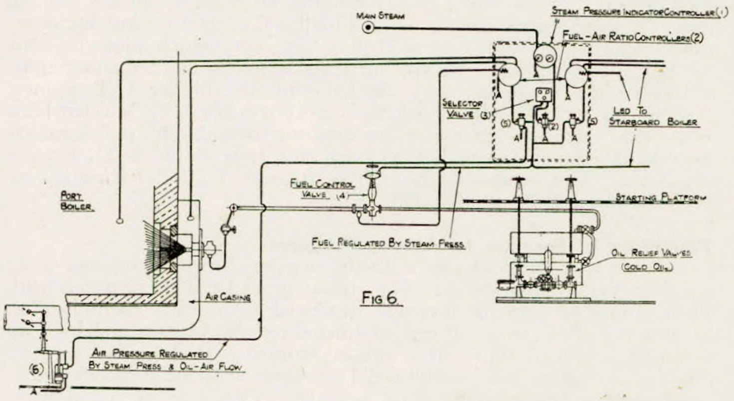
Reinforced Concrete Vessels

From 1942 onwards the design and construction of ships hulls of reinforced concrete was actively pursued in Germany. In order to overcome the disadvantages of framed construction, the principle of the self-supporting monocoque type construction, originally for veloped for the building of planetarium cupolas, was adapted to the construction of hulls. In this design the reinforcement consists of two quadrangular wire meshes; between these a third mesh, with its quadrangular openings making an angle of 45 deg. with the openings of the outer meshes, is placed. With the employment of a special sintered porous aggregate this design combines great strength and elasticity with light weight. The following four types of vessels were designed and built: (1) motor-tankers of 3,770 tons d.w., (2) cargo steamers of 3,650 tons d.w., (3) river barges of 1,000 tons d.w., and (4) motor vessels of 300 tons d.w. for coastal service. Only one vessel of the first mentioned class was built. Its dimensions were 90 m. length, 15 m. breadth, and 6.5 m. draft. Two vessels of the second class, having a displacement of 6,570 tons were built at Ruegenwalde on the Baltic. Prior to fitting out the vessels were taken away to Russia by the Soviet occupation force. Of the river barges (3) two vessels were built at Neuss-on-the-Rhine and eight at Neusatz on the Danube. The coastal craft (class 4) were equipped with Diesels of 200 b.h.p. and had a speed of 8·2 knots. Twenty-four vessels were built at Rotterdam, fifteen were constructed at Ost Swine on the

Baltic, and the construction of twelve vessels was begun, but not completed, at Larvik, Norway. Repairs are easily carried out, and because of the strength of the hull construction employed, vessels of this type will in future be classified by the Germanic Lloyd in the corresponding classes for steel vessels.—*U. Finsterwalder, VDI Zeitschrift, Vol. 91, 1st April 1949, pp. 157-163.*

Application and Flexibility of Liquid Fuel Burning

This paper deals with practical aspects of oil burning, especial stress being laid upon the maintenance of correct CO_2 percentages. The author points out that automatic control for marine work is certainly receiving more consideration in view of the necessity of stricter fuel economy, and one of the losses in the operation of boilers is due to the uneven maintenance of the correct ratio of air and oil supply. When the CO_2 content in the gases fall to 9 per cent, the excess air is 70 per cent, so that if the correct fuel and air ratio can be maintained with a CO_2 of 13 per cent, a saving of approximately 3 per cent in fuel will be effected, based on a funnel temperature of 400 deg. F. and a saving of approximately a further 2 per cent in fuel if the funnel temperature is reduced to 300 deg. F. A combustion control unit has been installed to operate the electrically driven forced draught fans and the electrically driven oil fuel pumps in vessels having two water tube boilers with a working pressure of 430lb. per sq. in. and a total steam temperature of 750 deg. F. During long voyages a steady percentage of CO_2 has been maintained between 13·75 and 14·0, with a funnel temperature of 335 to 340 deg. F. With a pressure jet burner, operating at pressures from 90lb. per sq. in. to 290lb. per sq. in., the range of output for a given size would be from



TYPICAL ARRANGEMENT OF FUEL-AIR CONTROLS.

FIG. 6.

450lb. of oil per hour to 820lb. of oil per hour, therefore, this is well within the range of normal firing, but if manœuvring is required over a lengthy period, it is advisable to use the spare burner bodies with nozzles of a smaller size with the same range of output. To obtain the desired boiler capacity, i.e., load, the steam pressure is a guide indicating the balance between the B.Th.U.s required by the main engines and the necessary auxiliaries, and the input of B.Th.U.s by combustion of the liquid fuel. Under steaming conditions, should the steam pressure fall slightly, then an increase in the fuel supply is required, involving a higher rate of combustion. To supply this heat, more air is required, and if this balance of oil and air can be maintained throughout a voyage, higher combustion efficiency is ensured. The arrangement shown on Fig. 6 is a typical example of Bailey automatic control. The master indicator—controller (1) measures steam pressure and establishes an air loading pressure in the control system corresponding to load requirements. This loading pressure passes firstly through a standardizing relay (2), then through the selector valve (3) to the diaphragm operated fuel control valve (4) which regulates the fuel supply, and through the averaging relay (5) to the Bailey control drive (6) which regulates the air supplied for combustion. Changes in fuel and air, made simultaneously by the steam pressure controller (1) may cause deviation from the most economical fuel-air ratio, and the variation is instantly corrected by automatic re-adjustment of the air supplied for combustion by the use of the fuel-air ratio controller (7).—*Paper by A. G. Dobbs, read at a meeting of the Liverpool Engineering Society, 2nd March 1949. Bulletin of Liverpool Engineering Society, Vol. 22, No. 7, 1949, pp. 13-35.*

Experimental Investigation of Oiliness

Considerations concerning the nature of sliding in friction-measuring instruments, in which friction is measured by the deflexion produced in an elastic system which presses one surface against another moving surface, have led to the design of an instrument which allows the variation of boundary friction with velocity to be determined at very low velocities. The author suggests that curves of the coefficient of boundary friction versus velocity constitute the correct form in which the results of measurements of kinetic boundary friction should be stated. Results are presented illustrating the influence of temperature, material nature of the surfaces, and surface finish on kinetic boundary friction for a variety of lubricants. These allow the boundary lubricating quality, or "oiliness", of lubricants to be assessed in some measure. Curves of kinetic boundary friction were determined for four bearing metals (cast iron, phosphor-bronze, lead-base, and tin-base bearing metals) having very different properties, running on five different steels, and also for cast iron running on cast iron. With every combination of surfaces, three lubricants were used: a light mineral oil containing a small addition of stearic acid, a good quality mineral oil, and a compounded oil. All combinations of metals rate these three lubricants in the same order: light mineral oil poorest, and compounded oil best. The results show that so far as boundary conditions are concerned, cast iron is, in general, not a good bearing material when run against steel, but is quite good running against cast iron. Phosphor-bronze is, on the average, as good as lead- and tin-base bearing metals when running against soft steel, particularly when lubricated with an oil having good boundary properties. The tin- and lead-base alloys are, however, generally superior to phosphor-bronze when run against hard steel with poor lubricants. It is difficult to generalize on the difference between the lead- and tin-base alloys but, roughly, the lead-base alloy is the better with soft steel and good boundary lubricant. It is noteworthy that the lowest coefficients of friction recorded were obtained with the lead- and tin-base alloys (with phosphor-bronze not much inferior) when running against the two hardest steels, and using compounded oil, the best lubricant.—*Paper by J. R. Bristow, read at an Extra-General Meeting of The Institution of Mechanical Engineers, 1st April 1949.*

New Method of Eliminating Oil Slick

Floating oil slicks are among the greatest dangers in most waterways. Not only are slicks highly inflammable in many cases, but unless they are removed immediately, costly damage is inflicted on waterfront installations. Until recently most of these slicks were a permanent hazard. Up to the close of the war nothing very practical had been done to combat them. In 1945 the U.S. Navy suffered some severe losses from oil blazes on water, and steps were taken to find a means to deal with this serious problem. This research led to the development of a new product and a method of using it known as "Carbosand" which has been adopted by the U.S. Navy as standard systems for the elimination of slicks. Carbosand is a finely divided sand which has been heat processed to obtain a carbon coating. This coating is impervious to water but will combine with oil, with the result that it will float on water until it comes in contact with oil. When this contact occurs, a stable oil-solid suspension is formed, which unlike oil alone, is heavier than water and consequently sinkable. To rid an area of an oil slick by the Carbosand process, powder is sprayed over the surface until it is evenly blanketed. If no oil blotches appear in the blanket of powder, the coating laid down is ready for submersion. Breaking the surface tension by agitating the area—with a stream of water under pressure, for instance—is all that is required to sink the Carbosand and the slick. The process is most conveniently accomplished from a self-propelled barge or boat capable of going anywhere in the affected waterway. The craft used should provide space for the simple equipment needed, namely, two tandem sand tanks, a light compressor, a sand hose, light water pump, and a water hose. Three or four men can handle the entire operation. Several such rigs can be employed effectively for treating a wide area, such as a harbour after an oil pipe break or a large tanker loss. The quantity of sand necessary to remove a certain area of oil depends entirely upon the amount, thickness, and type of oil. Actual tests show, however, that one ton of Carbosand will permanently and completely remove from 4,000 to 6,000 sq. ft. of solid fuel oil slick.—*Motorship (New York), Vol. 34, February 1949, p. 58.*

The Surface Toughness of Bearing Surfaces and Its Relation to Oil Film Thickness at Breakdown

In this paper the relation of surface roughness of bearing surfaces to allowable film thickness is studied quantitatively with a simple Michell pad apparatus. The pads used were faced with white metal and ran against mild steel collars. The lubricants studied were water, soap solution, paraffin, and light oil. There was little difference in the frictional behaviour of any of the lubricants, except that the aqueous lubricants would not run with very finely finished steel surfaces. The onset of metal to metal contact was detected by an increase in the frictional drag, and also by the change in electrical conductivity between the pad and collar—and extremely sensitive method. The paper shows that there is, at any rate for this system, a quantitative relation between the total surface roughness of the rubbing surfaces and the calculated oil film thickness both at the initial metal to metal contact and seizure. Initial contact occurs when the outlet film thickness, calculated from normal hydrodynamic theory, falls to three times the *maximum* surface roughness and seizure occurs when it is double the *average* roughness.—*Paper by A. Cameron, accepted by The Institution of Mechanical Engineers for written discussion, 1949.*

Fatigue Tests of Shafts

In 1943, a design of welded intermediate propeller shafts for corvettes and frigates was prepared, in which it was proposed to use solid-drawn steel tubes of 28-32 tons per sq. in. U.T.S., and dropped forged steel flanges welded to the tubes. Two forms of weld preparation were considered, one employing a "U" butt joint and the other a fillet joint. In view of the very limited information concerning the fatigue strength of such welded joints it was decided that fatigue tests should be carried out on a full-scale model with one flange attached by a butt weld, the other by fillet welds. Although it was, in practice, found possible to produce sufficient forgings for the programme, and fitting of welded shafts was dropped, it was decided to proceed with the fatigue tests. The fatigue testing machine was designed by Dr. G. H. Forsyth and the tests were carried out for the Admiralty by Lloyds. A torsional vibration method was used, and the general arrangement of the machine and the test procedure are described. Results of tests on three shafts tend to show that the fatigue strength of the two welded designs was in the region of ±7,000lb. per sq. in., whilst that for the forged shaft was in the region of ±9,000lb. per sq. in. The lower results for the two butt-welded shafts are apparently due to the fact that in each case the welds were in the region of stress concentrations. It is evident that welds should be kept clear of both stress concentrations and regions of maximum stress. The poor result for the third shaft, which was fillet welded, is due to the presence of stress raisers caused by porosity in the weld metal. It is impossible to avoid having the welds in the region of stress concentration in the case of fillet welds, and butt welds are therefore preferred. Results obtained with two shafts, one with a composite fillet and the other with a 2-inch radius fillet, gave a probable fatigue strength of at least ±15,000lb. per sq. in. Since the composite fillets avoid excessive arboring of fillets in way of bolt heads it is considered that they should eventually be adopted by the Admiralty. The improvement in fatigue strengths of the last two shafts can be attributed in part to the improved form of control of the motor speeds used in the tests.—(Admiralty, Engineer-in-Chief's Department. ACSIL/ADM/48/634).—*Abst. No. 2,547, Journal, The British Shipbuilding Research Association, Vol. 4, No. 4, April 1949.*

Fatigue Strength of Cast Crankshafts

The paper gives the results of a systematic investigation into the effects of the proportions of a cast crankshaft on its bending fatigue strength. A single-throw shaft of 4½-inch diameter was chosen, but to obtain some information on a possible scale effect, tests on a geometrically similar shaft of 2¼-inch diameter were included. It is considered that, with a few exceptions which are indicated in the paper, most of the conclusions from these tests will apply equally to forged and cast crankshafts. The paper refers also to tests made on a number of different cast-iron and cast-steel crankshafts of the same design, to determine, from the point of view of fatigue strength, their merits as crankshaft materials, and to find out to what extent the fatigue strength of the finished crankshaft can be predicted from the usual mechanical tests on the materials.—*Paper by H. R. Mills and R. J. Love, read at a meeting of the Institution of Mechanical Engineers, 12th April 1949.*

The Seizure of Metals

The seizure of metals is a complex process, and this paper gives a brief review of the simple underlying physical principles involved. It is shown that in the seizure of sliding metals, an important part is played by localized welding at the points of intimate contact, with the consequent formation of metallic junctions between the surfaces. These junctions are often stronger than the metals themselves and when sliding occurs heavy damage may be produced which is not limited to the interface at which intimate contact occurs. The extension of this localized damage constitutes seizure. This localized welding is due largely to the intense local pressure which produces plastic flow at the summits of the surface irregularities. Even under static conditions, or when the sliding speed is too low to produce an appreciable temperature rise, inter-metallic junctions may be formed by this process of "cold welding" and strong adhesion may occur. At high speeds of sliding, very high temperature flashes may be produced at the points of rubbing contact, and the behaviour depends, not on the mechanical properties of the metals at room temperature, but on their properties at the actual temperatures which obtain at the regions of contact. In many cases, the high surface temperatures will facilitate the formation of the welding junctions, either by softening the metal or by partially removing surface films. Any factor of this sort which facilitates local welding will increase the chances of large-scale seizure. The effect of interposing surface films of oxide, of soft metals, of appropriate boundary lubricants, or of hard metallic films in reducing the localised adhesion and seizure is discussed.—*Paper by F. P. Bowden and D. Tabor, read at an Extra General Meeting of The Institution of Mechanical Engineers, 1st April 1949.*

Hot Working of Cast Iron

The authors refer to the fact that it is not generally known that cast iron provides a highly suitable material for rolling, pressing and extrusion operations. The temperature for hot working ranges from 1,050 deg. C. to 750 deg. C. Deformation by rolling leads to the orientation of the graphite inclusions in the direction of rolling with an attendant increase in the tensile strength in that direction. Moreover, the deformation process destroys the cast structure and a far reaching refinement of the structure by recrystallization is produced. Generally the hot worked material exhibits a sorbitic-pearlitic structure of small grain size. A graph included in the original article, but not reproduced here, shows that hot worked cast-iron may attain U.T. strength values as high as 85 to 120 kg. per sq. mm. (55 to 77·5 tons per sq. in.) and yield points ranging from 60 to 70 kg. per sq. mm. (39 to 45·5 tons per sq. in.). Finally, the hot working increases the elongation to values from 2 to 5 per cent, which must be considered as a remarkable result, particularly as the higher elongation-values of the range are co-ordinated with the higher U.T. values. Fatigue strength of the material is also increased by hot working while the corrosion resistance remains unchanged. In the form of unbreakable piston rings hot worked cast iron shows a high wear resistance.—*E. Piwowarsky and A. Wittmoser, VDI Zeitschrift, Vol. 91, 15th April 1949, pp. 183-185.*

Production of Forgings for Marine Purposes

This paper deals chiefly with the heavier forgings and one-piece forgings made from ingots. The author gives brief descriptions with illustrations of various forgings produced by normal methods, i.e., shafting, gearing, engine forgings (including crankshafts and built-up rudders). Special types of forgings requiring forging followed by bending operation are exemplified by reference to rudderstocks, one-piece rudder frames, and shaft brackets.—*Paper by R. C. Benson, read at a meeting of the North-East Coast Institution of Engineers and Shipbuilders, 25th February 1949.*

Notch Sensitivity of Steel Evaluated by Tear Test

This paper presents and discusses data on the notch-sensitivity characteristics, as revealed by the tear test, of a number of ship plate steels consisting of rimmed, semi-killed, and fully killed medium

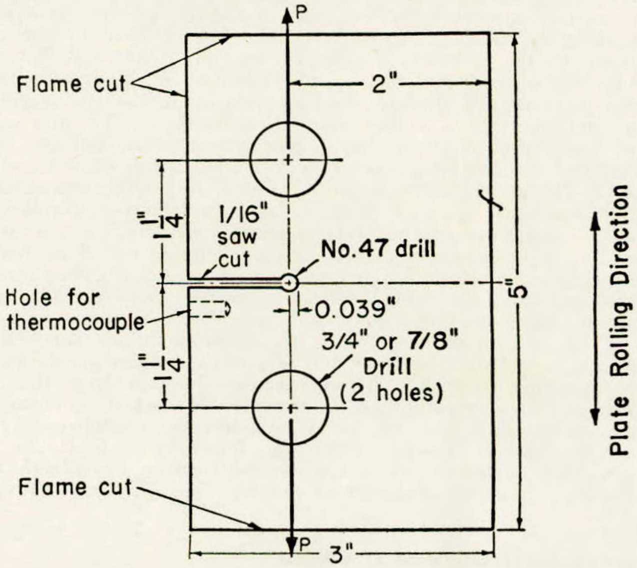


FIG. 1.

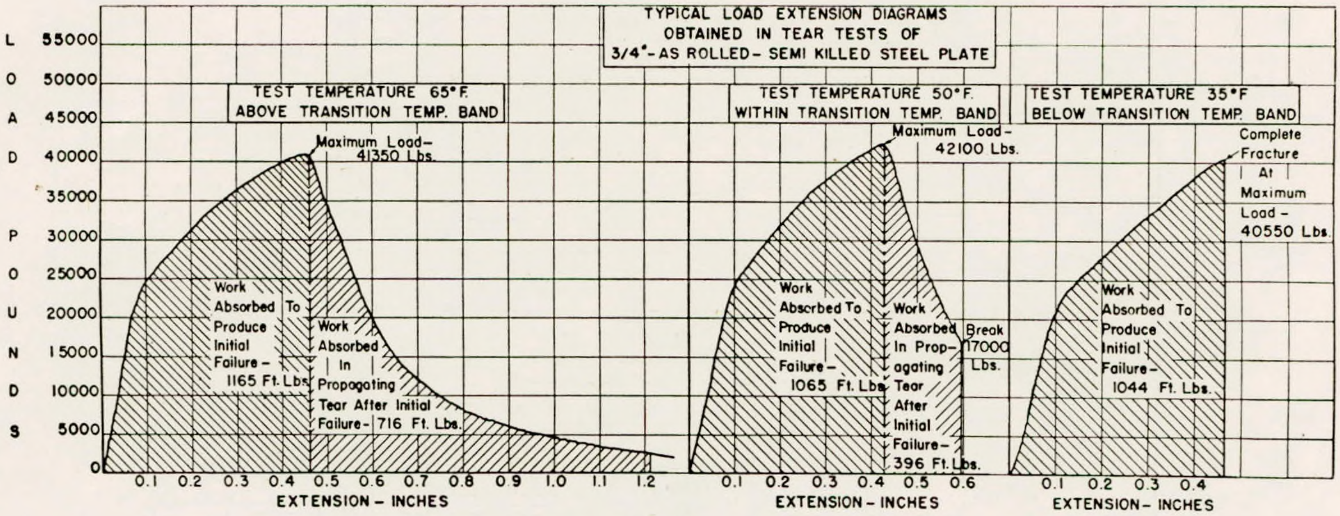


FIG. 2.

steels, and also of high tensile steels and of special high-yield alloy steels. The Navy tear test method utilizes a specimen of the type shown in Fig. 1. The specimen is 3×5 inch and of full plate thickness and is notched to provide for asymmetric loading in static tension with an initial eccentricity of 0·039 inch. The specimen is loaded to complete failure under controlled temperature conditions at a cross-head speed of approximately 0·1 inch per min. An automatic load-extension diagram is obtained for each specimen to complete failure. Characteristic load-extension diagrams obtained on medium steel plate specimens tested at temperatures above, within, and below the transition temperature region are shown in Fig. 2. The area to the left of the perpendicular erected at the point of maximum load represents the energy required to induce initial cracking, while the area to the right represents the energy input to propagate the tear or crack from start to completion. On the basis of the test data obtained the authors conclude that the Navy tear test method is capable of sharply defining the transition temperature of ship plate and related structural steels using either the energy to propagate tearing or the percentage of shear in the fracture as the basis for evaluation of the change from ductile to brittle-type failure. The two bases of evaluation indicate the same transition temperature. The tear test method reveals in a marked manner differences in the behaviour of such steels with respect to their relative susceptibility to cleavage fracture. The authors consider the tear test method as worthy of consideration for quality control of ship plate and related steels inasmuch as it is economical in regard to material, time and cost of preparation and testing. It utilizes a test specimen which is simple in design and readily reproducible. The plate is tested in full thickness and the specimen includes an adequate fracture area for visual evaluation of the fracture type. The evaluation may be made by a visual estimation of the percentage of shear in the fracture without the need for making energy measurements.—*N. A. Kahn and E. A. Imbembo, The Welding Journal (N.Y.), Vol. 28, April 1949, pp. 153-s-165-s.*

Transmission Systems for Marine Gas Turbine Propulsion Plants

The author discusses various transmission systems now available which might be used in connecting a gas turbine power plant to the propeller of a merchant ship. The major problems to be met by any transmission system are those relating to reversibility and manœuvrability. It is concluded that alternating-current electric drive, mechanical reversing gears, and mechanical reduction gear with the controllable and reversible pitch propeller offer acceptable solutions to the problem. In contributing to the discussion of this paper R. E. Sharp, with the permission of the Maritime Commission referred to the results of the open water test of the model of the controllable pitch propeller which will be installed in the Liberty collier EC2-G-A-W2. The prototype propeller will be driven by a 3,000 h.p. gas turbine at 90 r.p.m. It has four blades with a tip diameter of 17ft. 6in. Its hub to tip diameter ratio is 0·286 and its efficiency is 47 per cent. No self-propelled test data and no propulsion coefficient value is available.—*W. E. Hammond, Trans. ASME., Vol. 71, January 1949, pp. 43-57.*

Temperature Stresses in Gas Turbine Rotors when Starting

The starting of steam and particularly gas turbines is attended by considerable temperature differences in the rotors; these have often been treated in technical publications. In the present article the internal stresses arising from such temperature differences are calculated and the results plotted in the form of curves. From these it follows that very slow heating is necessary, if temperature stresses are to be effectively diminished. Quick starting theoretically causes heavy temperature stresses, but long working experience shows that such stresses are offset by the initial set of the material, and therefore become harmless.—*A. Meldahl, The Brown Boveri Review, Vol. 35, 1948, Nos. 9/10, pp. 247-.252.*

Air-conditioned New Vessels of American Export Lines

The new "Four Aces" of the American Export lines, i.e. the *Excaliber, Exeter, Exochorda,* and *Excanbion,* replacing four pre-war vessels with the same names, are equipped with air-conditioning systems of the latest type, including the spaces for the officers and crew. Three fifty-ton Carrier reciprocating compressors are provided, one of them being a spare unit for both the air conditioning service and cargo refrigeration. The various air-conditioning systems are grouped under three headings. Class A-1 systems supply conditioned air to main lounge, smoking room, cocktail bar and dining room. During the winter, the air is filtered, preheated, and reheated. During the summer, the air is filtered, cooled, and reheated if necessary. The temperature of the air entering the reheat coil is at all times low enough to cool the room space. The room temperature is controlled by a room thermostat which actuates a modulating steam valve on the reheat coil line. The thermostat positions the automatic steam valve to admit the correct amount of steam to reheat the air as required to maintain the room temperature. Class D systems are used for passenger staterooms, foyers, miscellaneous small passenger spaces, crew and officers' staterooms and deck officers' mess and recreation rooms. During the winter the air supplied to the room space is filtered, preheated, and reheated, and during the summer the air is filtered, cooled, and reheated if necessary. A room thermostat is installed in each room to permit individual control of the room temperature by the occupant. Each room served is provided with a small reheat coil which is installed in the duct supplying air to the room. Either outdoor air or a mixture of outdoor and recirculated air is preconditioned in a central fan room system, then delivered to the individual reheat coils at a temperature of 58 deg. F. The desired room temperature is controlled by a room thermostat which modulates a modulating hot water valve on the coil line. A supply of hot water is available to this valve at all times and is circulated through the coil to heat the air to the demands of the thermostat (see Fig. 2). Fan room control is as follows: A duct thermostat mounted on the control panel with its bulb located in the discharge side of the fan, controls the automatic steam valve on the preheat coil line and the automatic chilled water valve on the cooling coil line, in sequence. This duct is set to maintain 58 deg. F. At discharge air temperatures above 58 deg. F., the automatic steam valve on the preheat coil line will close and the automatic chilled water valve will open straight through to the coil and maintain a discharge air temperature of 58 deg. F. A duct thermostat, mounted on the control panel with its bulb located in the minimum fresh air duct, controls the position of the outside air, return air, and exhaust air dampers. At 85 deg. F. outdoor air temperature, the outside air and exhaust air dampers will be open. As

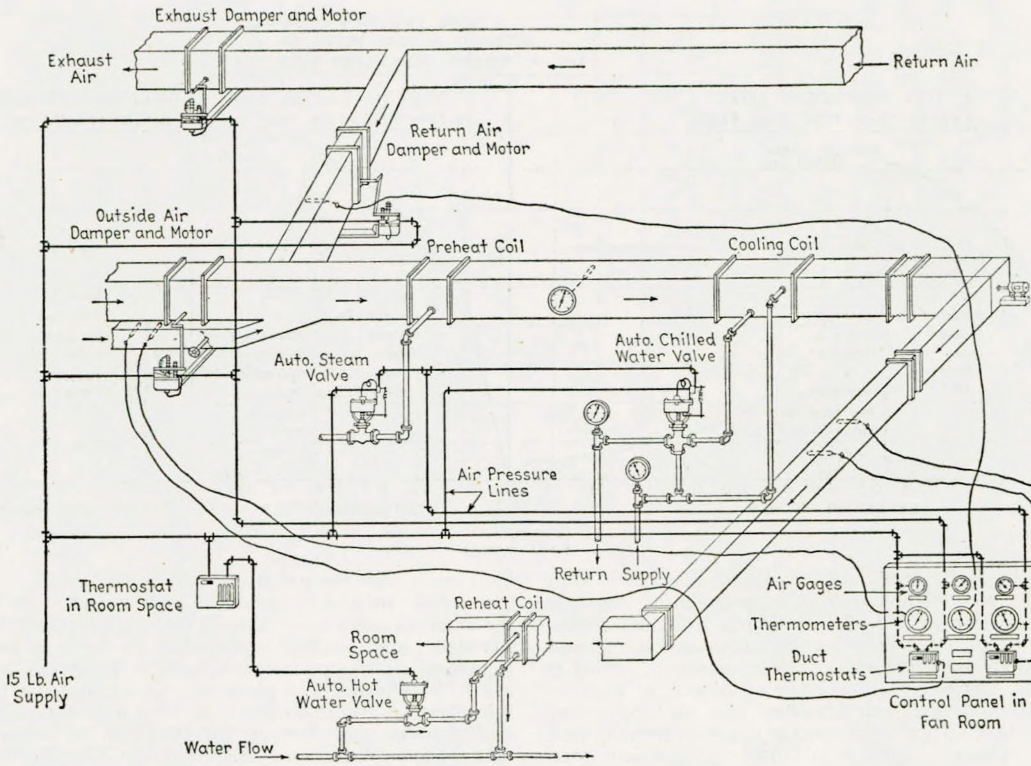


FIG. 2.—TYPE "D" SYSTEM

the outside air temperature drops, tending to lessen the load on the cooling coil and reduce the discharge air temperature, the outside air and exhaust air dampers will start to open and the return air damper will start to close, thus imposing a constant load on the cooling coil with a consequent constant discharge air temperature. At 70 deg. F. outside air temperature, the outside air and exhaust air dampers will be fully open and the return air damper will be fully closed. Stateroom control is as follows. When the room temperature starts to rise above the setting of the thermostat located in the room space, the automatic hot water valve on the reheat coil line will modulate the flow of water through the coil as required to maintain the desired room temperature. If the room temperature continues to rise the thermostat will close the valve completely and admit cool air to the room. When the room temperature drops below the setting of the thermostat, the valve will modulate to the open position as required to maintain the room temperature. Class D-1 (100 per cent D) systems are used for crew and engineering officers' mess rooms and recreation rooms, crew hospital and passenger hospital. These systems use 100 per cent fresh air all year.—*Marine Engineering and Shipping Review, Vol. 54, March 1949, pp. 46-50.*

Stress Corrosion in Welded Naval Brass Evaporator Shells

This paper reports the results of an investigation into the causes of the cracking of the shells of salt water evaporators. In the autumn of 1941, two U.S. battleship class naval vessels were being fitted out in two East Coast naval yards. Each of these vessels were equipped with batteries of salt water evaporators with shells of 6-feet diameter and 6-feet length, made of $\frac{5}{16}$-inch thick half hard Naval Brass procured in accordance with Bureau of Ships Specification 46B6. These shells were fabricated by arc welding using phosphor-bronze electrodes. On completion of the installation, the shells were tested by hydrostatic pressure at 50lb. per sq. in. This test revealed the presence of cracks emanating from the ends of the fillet welds which joined the tube supporting brackets to the inside of the shells. Prior to installation these welded shells had been stored for approximately 18 months in the open, adjacent to the fitting-out piers. Chemical analyses were performed of samples from the defect zones to determine whether the crack development could be attributed to lead content in excess of the specified values, but this examination was negative. Microscopic examination of transverse sections of the samples showed that the cracks were intergranular and had the earmarks of stress corrosion failure. This was confirmed by the results of an experimental investigation from which it was concluded that restrained portions of naval brass weldments fabricated by arc welding are subject to stress corrosion unless stress relieved. The investigation further showed that in restrained naval brass weldments residual stress of 9,000lb. per sq. in. in tension is reached in the direction of the weld. The investigation also showed that preheating alone, even though the preheat temperature of 400 deg. F. is employed, is insufficient to prevent stress corrosion. Finally, from this investigation, it is also evident that a postheat treatment at 750 deg. F. maintained for a period of not less than $1\frac{1}{2}$ hours for each $\frac{1}{2}$ inch of the material followed by cooling to 250 deg. F. and at the rate of maximum 150 deg. F. per hour prevents stress corrosion regardless of the preheat temperature employed in course of fabrication.—*B. Ronay, The Welding Journal (N.Y.), Vol. 28, April 1949, pp. 358-363.*

Absence of Galvanic Corrosion

In a discussion of the factors which, under certain conditions, will retard galvanic corrosion to a tolerable limit, the author refers to the area effect. Where the corrosion reaction is under cathodic control, which is commonly the case, the extent of galvanic acceleration of the corrosion of the anodic material will be determined by the relationship between the area of the cathodic material. Consequently where the exposed area of the cathodic material is relatively small the galvanic action may be negligible. Examples are provided by Monel fastenings in contact with a steel plate in aerated sea water which showed no evidence of accelerated corrosion of the steel where it had been in contact with the Monel bolt, nut and washer assemblies. Similarly, carbon and low alloy steel plates welded with 25 per cent chromium-20 per cent. nickel austenitic stainless steel welding rods showed no acceleration of corrosion alongside welds after exposure in sea water for over two years.—*F. L. LaQue, Corrosion, Vol. 5, March 1949, pp. 86-91.*

Corrosion Behaviour of Aluminium Alloys

A detailed account is given of the first stages of the second part of a comprehensive investigation of the corrosion characteristics of light alloys exposed to half-tide conditions. An abstract of the report on the first part of this investigation was published in Abstract No. 595 (Dec. 1946). In the present series of tests thirteen alloys are being studied. The specimens each consist of two 6-inch×6-inch plates riveted together through a 1-inch overlap. The aluminium panels are coupled either to similar aluminium panels or to galvanized steel. A painted and an unpainted specimen of each type are being used. The appearance of the specimens after a month's exposure is described in an appendix. The condition of most of the specimens involving aluminium alloys joined together and exposed unpainted is practically unchanged, although there are definite signs of nodular attack on the specimens of AW16, a fully-heat-treated Cu-Mn-Zn alloy. Some of the cast panels shows traces of white nodules of corrosion product in the heads and points of the rivets. The condition of the aluminium alloys joined to galvanized steel is excellent, with the exception of the AW16A specimens, which show a slight nodular attack in areas remote from the steel. The galvanized steel panels all have a thin white coating oxychloride. All the painted specimens are in excellent condition.—(Admiralty Corrosion Committee, Hull and Non-Ferrous Corrosion Sub-Committees. ACSIL/ADM/49/63. Metallurgical Report DMQ.).—*Abst. No. 2,609, Journal, The British Shipbuilding Research Association, Vol. 4, No. 4, April 1949.*

Crankshaft Damping

The author attempts to give a correct physical explanation of natural damping by torsional vibrations, and also to obtain approximate formulæ for pre-calculation of the damping in any given case. The paper describes experimental work with a single-cylinder engine driven by external power, and excited to torsional vibrations by a spring-loaded cam disk. In this way the damping from the moving parts could be investigated separately, and it was found that the damping was almost entirely due to hysteresis in the crankshaft, and oil damping, due to lateral shaft movements in the main and crankpin bearings, which was directly proportional to the bearing clearance. The paper also gives a simple and practical method for the calculation of damped vibrations in arbitrary elastic systems, and the calculation of hysteresis and bearing damping in a single-cylinder engine. Formulæ are given for the total damping in multi-cylinder engines, with or without heavy flywheels, and the results are compared with the measured damping in a number of oil engines in service.—*Paper by P. Draminsky, read at a meeting of The Institution of Mechanical Engineers, 25th February 1949.*

Modernised Ship Model Testing Tank

This article describes the experimental tank and installations of Vickers-Armstrongs Ltd. at St. Albans, Herts. The original installation was completed in 1912 and comprised two main sections—the model-making shop and the tank proper—with a subsidiary section for propeller investigation. The tank proper comprised a concrete basin, filled with water, 385ft. long, 21ft. wide and 15ft. deep, with a dock at one end and an artificial beach at the other. The original towing carriage remained in regular use for over twenty-five years until shortly before the outbreak of the second world war, when, due in particular to the degree of wear on the wheels and track, the installation of a new test carriage with automatic features of control, and the renewal of the existing track, was projected. At the same time, the opportunity would be taken of extending the tank by a further 90ft. to increase its overall length to 475ft. The outbreak of hostilities delayed the contract, and it was not until the summer of 1946 that the installation of the new equipment was commenced. The electrical drive and control are designed to fulfil the following conditions: The carriage speed in the forward direction is to be infinitely variable between 1ft. and 25ft. per second without a variation in speed of more than ± 1 per cent throughout the complete run, and the required speed must be pre-set with the closest degree of accuracy. The acceleration is to be variable, dependent upon the pre-set speed of the carriage, so as to permit of the maximum possible length of constant-speed run. At the same time, the acceleration must be perfectly smooth and no "overshooting" of speed is permissible, since this may give rise to hunting which would set up an unnatural surging of the model under test. The return speed of the carriage, though not regulated, has to be variable, and certain special conditions such as "inching" and "creeping" in either direction of travel are required for general carriage manœuvring or tank sweeping..—*R. A. Johnson, The Engineer, Vol. 187, 20th May 1949, pp. 561-563; 27th May 1949; pp. 578-580,*

Engine Wear Research

In this paper the subject of "engine wear" has been limited to piston rings and cylinder bores as affected by various fuels. The only fuel property showing significant correlation with wear and deposits in these tests was sulphur content. Work on two engines: one operating at a moderate b.m.e.p. and speed, the other at high b.m.e.p. and high speed, showed that the more heavily loaded engine consumed three times more fuel per hour, per cylinder than the moderately rated engine and the increase in wear for a ½ per cent increase in sulphur was also three times that encountered in the moderately rated engine. This indicates that high rates of wear and more deposits encountered at high b.m.e.p. and speeds are not so much a function of the higher mechanical and thermal loading of the parts, but are primarily due to the fact that more fuel is required to carry the higher loads. The authors submit the following theory regarding the way in which sulphur causes wear and deposits in a Diesel engine: An engine operating under heavy load conditions with normal jacket temperatures shows more wear and deposits with the higher sulphur fuels because of the possibility of the sulphur combining in the combustion reaction with hydrocarbon molecules and forming a black, abrasive product similar to synthetic rubber which has been hardened by the addition of sulphur in the vulcanizing process. Most types of wear are, therefore, caused by these abrasive deposits. Analysis of the black deposits found in the centre of the combustion chamber on top of the pistons (a position not very likely contacted by the lubricant) shows essentially the same percentage of sulphur, 1-3 per cent, regardless of the sulphur content of the fuel. Exhaust port deposits also showed the same percentage of sulphur. This may indicate that the black product formed in combustion is a hydrocarbon compound containing a maximum of 3 per cent sulphur when saturated, and thus the higher sulphur fuel permits formation of greater quantities of the same product.—*L. D. Thompson, S. J. Backey, and E. L. Conn, S.A.E. (Society of Automatic Engineers), Quarterly Transactions, Vol. 3, No. 1, 1949, pp. 41-47.*

Flow of Oil Through Pipes

Simple methods are described for obtaining numerical solutions to most of the problems associated with the flow of oil through pipes that arise in the use of oil-hydraulic machinery and mechanism in H.M. Navy. The accuracy attainable is enough for most practical purposes. The essentials are presented in a way that enables the answer required to be worked out quickly with a slide rule, without any knowledge of the underlying theory; but reference is made to suitable text books in case a more detailed study is desired. The relevant equations have also been translated into nomograms, from which the answer to a problem can be read off without any calculation. A number of examples are worked out to illustrate the use of the notes in dealing with specific practical problems.—*Abstract No. 2,621, Journal, The British Shipbuilding Research Association, Vol. 4, May 1949; (J. M. Ford, Admiralty Gunnery Establishment, No.10/A.26/13.P. ACSIL/ADM/43/1008.)*

Ammonia Carrying Ship

Three ships designed for carrying liquid ammonia are under construction at a Norwegian yard. These vessels, the first of which, the *Heröya*, was launched in February last, will be employed for bringing liquid ammonia from the factory of the owners, Norsk Hydro, at Glomfjord, Northern Norway, to the saltpetre works at Heröya, near Porsgrunn, Southern Norway. The second and third vessels will be launched at intervals of six months. The following are the main particulars of the *Heröya* and her sister ships:—

Length o.a.	76·90 m.—252ft. 3⅝in.
Length on w.l.	69·90 m.—228ft. 4⅛in.
Breadth moulded	11·45 m.—37ft. 6¾in.
Depth moulded	7·90 m.—25ft. 11in.
Draught	4.50 m.—14ft. 9⅛in.
Machinery	1,500 s.h.p.
Service speed, laden ...	12½ knots.

The vessel is constructed to carry the liquid ammonia in cylindrical tanks. There are 27 cylindrical high-pressure tanks arranged in a main cargo hold amidships. The engine room is aft and right forward is a small hold for carrying ordinary cargo. The engine is a five-cylinder Nordberg type running at 180 r.p.m.; it is directly coupled to the propeller.—*The Motor Ship, Vol. 30, June 1949, p. 88.*

Temperature of Gas Turbine Blading

The author explains that analytical solutions of the gas temperature distribution in gas turbine blading heretofore have been based upon the assumption of a uniform gas temperature distribution over the blade height. In this investigation the gas temperature distribution over the height of the blading is assumed to be parabolical, the temperatures at tip and root of the blading being below that prevailing at the midpoint. The mathematical solution given by the author is applied to the case of an internally cooled blade, and a graph is given which shows that the metal temperature of the blade tip is slightly above the ambient gas temperature, while at the blade root the metal temperature is slightly below the gas temperature.—*W. Zeller, MTZ Motortechnische Zeitschrift, Vol. 10, No. 1, January/February 1949, pp. 9-10.*

Faulty Refacing Leads to Valve Ruin

Using a dull or loaded grinding wheel to reface valves of internal combustion engines can produce grinding checks on the valve face, which will lead eventually to valve burning and failure. Microscopic examination reveals that these grinding checks are actually hairline cracks. They result apparently from intense local heating and subsequent cooling at the region of contact between the wheel and the valve face. Refacing operations not sufficiently severe to blue the the valve face can be severe enough to initiate cracks. A dull or loaded wheel accentuates the temperature fluctuation. The tiny cracks become foci for stress concentrations. High-temperature operation and temperature cycling enlarge the cracks, and deposits wedge into them. At high temperatures, the deposits burn. Eventually, burning washes out gutters across the valve face. The cracks continue to grow until finally sections of the valve burn and break away.—*J. E. Lackner. SAE Journal, Vol. 57, May 1949, pp. 94-95.*

Marine Oil Engine Research

The last report of the British Shipbuilding Research Association shows that comprehensive investigations have been carried out by the Physics Division of the National Physical Laboratory on board two cross-channel vessels to investigate noise in Diesel engine installations. The results have been analysed and a report is being prepared. Sub-sections deal with failure of built-up crankshafts, maximum bearing pressures and rubbing velocities with crankshafts and oscillating bearings, alternative fuels for Diesel engines including heavy oils, electric couplings, and scavenging of two-stroke engines. With regard to the latter, proposals for research are being considered, a fact of great interest having regard to the immense amount of scavenging research already made by commercial firms in this country and abroad.—*Gas and Oil Power, Vol. 44, May 1949, p. 132.*

Emergency Repairs to a Piston Rod at Sea

Defective piston-rod packing damaged the piston rod to such an extent that replacement packing was believed to be useless unless the piston rod was machined. The ship was in mid-Pacific and the lathe on board was too small to swing the rod. The piston and rod were removed and placed on top of the engine cylinders on two sawhorses. A Dutch lathe was made up and the rod was ground by hand. The completed rod was replaced in the engine, new rod packing was fitted and installed, and the work was considered satisfactory. A Dutch lathe consists of two pieces of wood joined together with a metal or leather hinge at one end. The centre of the two pieces of wood (when placed together) is bored out to the diameter of the rod or journal to be ground. Emery paper is secured around the periphery of the centre hole. Handles of adequate length are left on the two pieces of wood to give sufficient leverage for turning the "lathe" and for applying a compressing pressure on the emery paper. A man stationed on either side of the "lathe" turns it around and around the rod, making progress from end to end.—*F. G. Corneau, Marine Engineering and Shipping Review, Vol. 54, May 1949, p. 79.*

Accident When Installing New Gaskets

The Proceedings of the Merchant Marine Council, United States Coast Guard, report an accident suffered by two men when installing new gaskets in a main steam line. The stop valve was closed but leaked slightly, so that it was necessary to keep a drain valve open to avoid building up pressure. One gasket had been replaced without difficulty, but when a second flange was broken a little later, steam rushed out and burned both men. Investigation disclosed the fact that someone had closed the drain line after the first flange had been closed and before the second was broken and so allowed pressure to build up. Accidents of this kind can be very largely prevented through the use of tags bearing some such notation as "Warning—Men Working on Line—Do Not Touch". These tags should be put on by the man who is doing the work and should be removed by no one but him. An even safer procedure is to provide a means of pad-locking a valve so that it cannot be turned. Also, valve locking gear can be easily made.—*Marine Engineering and Shipping Review, Vol. 54, May 1949, p. 59.*

Inert Arc Welding as Applied to Shipbuilding

The modern high speed ship puts a premium on cargo space and light ship weight. Trends have been toward smaller and lighter ship propulsion systems, and demands are always being made for larger deck accommodations. This results in an unfavourable balance of weight which can be corrected by the use of a lighter material for the superstructure. Aluminium is an ideal alloy for this use. Aluminium weighs one-third of steel, but a structure built of steel usually is made of heavier thickness; therefore the weight saving is such as to make the aluminium structure about half the weight of the steel structure. The welding of aluminium always carried the danger of flux corrosion before the advent of the Inert-Arc welding process. This process utilizes an electrode of tungsten which is not consumed. The arc between the tungsten and the aluminium is a source of heat melting the aluminium and breaking down the aluminium oxide without the use of any flux. The arc, weld puddle and electrode are protected from the atmosphere by an inert gas envelope, usually argon. Two types of machines are available for welding. Direct current is not a feasible source for welding aluminium and alternating current must be used. Standard welders do not have the required characteristics alone, so it is necessary to have a high-frequency, high-voltage pilot current superimposed on the welding current to produce arc stability. This combination has the disadvantage of being a potential source of radio interference. The amount of interference that can occur is not easily predictable, nor is the removal of interference, once it occurs, an easy task. Direct current is generated in the arc due to rectification. One explanation of this is that current finds it easier to flow when the tungsten is emitting electrons than when the aluminium is emitting. This can be due to the fact that tungsten is so hot, 6,000 deg. F., as compared to aluminium about 1,200 deg. F. This unbalance in flow can be considered a direct current. This will cause serious overheating of welders; and, what is even more important, will cause penetration into the work. The second type of machine does not use continuous high-frequency pilot current, and therefore the interference from this source is minimized. A special starting circuit is used for automatic control of power, starting sequence, and time delay on gas and water. It is important to prevent oxidation of the tungsten, by protecting it with gas, otherwise considerable tungsten is deposited in the weld. The direct current generated in the arc is blocked by the use of series capacitors, so overheating of the welder is prevented and greater penetration or travel speed is obtained.—*Abstract of a paper read by R. W. Tuthill at a meeting of the Philadelphia Section 21st February 1949; Bulletin, The Society of Naval Architects and Marine Engineers, Vol. 4, May 1949, pp. 26-27.*

Handling of Tanker Cargoes

The author explains that the safe handling of any tanker cargo depends almost entirely on the abilities of the people actually doing the work, and the successful accomplishment of the work can be determined largely by the type of man employed. Spills and contaminations continue, both of which can be very costly. Contaminations many times are due to leaks in bulkheads or for other reasons beyond the control and responsibility of the men employed in the handling of the cargo, and at other times they are due to negligence. Spills are due almost entirely to negligence on the part of the men. The possibilities of cargo spillage could be substantially reduced if tankers enjoyed some of the mechanical improvements installed in the refineries where quantities of combustible liquids are handled. One means to this end would be the installation of a liquid level control or liquid level recognition system. The present method of having the deck personnel shut off the pumps when a certain commodity is completely loaded could be improved. The present practice of calling or shouting to the dock is not entirely satisfactory because a misunderstanding or shouting at a distance to the man on the dock to shut down the pumps can be disastrous. An extension control box could be placed on the ship with adequate identifying marks and the men actually handling the cargo would control the starting and stopping of the pumps that deliver the cargo to the ship. Present regulations require all doors opening onto the main deck to be kept closed during the loading or discharging of cargoes. As long as personnel are permitted to remain on the ship while cargoes are being handled it is almost impossible to keep the doors closed. The doors are usually of heavy construction and when used it is seldom that they are properly dogged down. If these doors were fitted with a quick closing mechanism similar to those used in the (U.S.) Navy, the doors would probably be kept closed. It is the author's opinion that cargoes should be loaded on board a tanker with the ullage plugs closed. If the tanker was equipped with a liquid level control or recognition system, loading a cargo with closed ullage lugs would be simple. In dealing with a subject closely related to cargo handing the fire-fighting equipment on a tanker is important to all concerned, and there is room for improvement. The open end nozzle is practically worthless in fighting an oil fire, but it is still being used. The fog nozzle is far superior to the open end nozzle; however, the old type is still in use. Each tanker should carry an adequate supply of foam on board and the equipment should be kept in excellent working condition at all times. There should be at least four asbestos suits on each tanker and hung up in a place easily accessible to all personnel. All the fire-fighting equipment should be prominently placed and easily accessible to all personnel loading the cargo. A few seconds saved by trained personnel with the proper equipment may save a ship.—*Abstract of a paper by N. McKenzie, read at a meeting of the Southern California Section, 21st December 1949; Bulletin, The Society of Naval Architects and Marine Engineers, Vol. 4, May 1949, p. 29.*