# ENGINEERING ABSTRACTS

Section 3. SHIPBUILDING AND MARINE ENGINEERING

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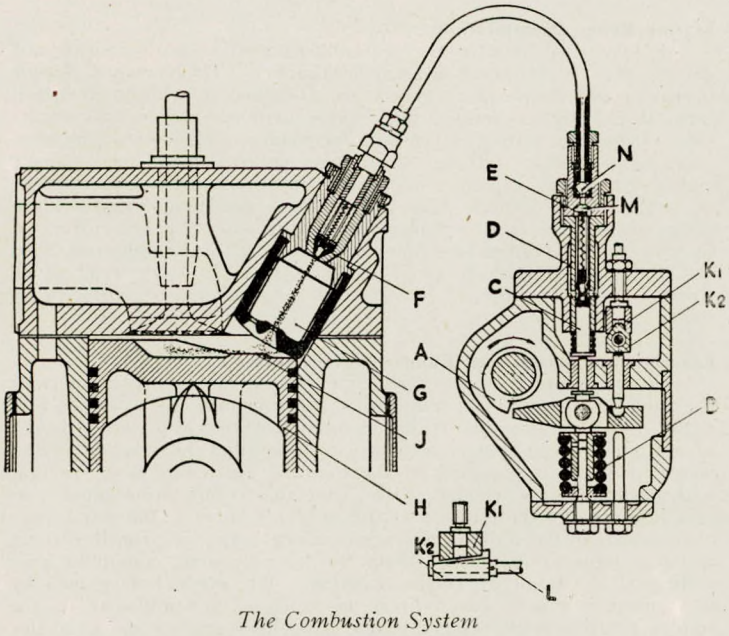
### Sentinel-Ganz Oil Engines

The Sentinel-Ganz engine designs now being built by Sentinel (Shrewsbury), Ltd., are British versions of the Ganz-Jendrassik units made in Hungary. These engines incorporate a combination of spring-actuated injection pump, open nozzle, and a pre-combustion chamber enabling the engine to run on inferior classes of fuel. Other merits claimed are consistency of injection performance regardless of crankshaft speed, freedom from excessive stresses in event of the delivery-line blockage, and good atomization for easy starting from cold. Another feature is "natural" air heating for starting. The camshaft is axially movable from the normal "running" position to a "decompressed" position, also to a third or "delayed inlet opening" position. Each inlet valve cam has three different profiles to give the aforementioned conditions. In the "delayed inlet opening" condition the inlet valve does not open until about 90 degrees after T.D.C.; a considerable vacuum has thus been built up by the portion of the suction stroke already effected; air then rushes in. and the ensuing rise of pressure is accompanied by a considerable rise in temperature, thus more than counteracting "gas to walls" losses and an easy start can be made by hand or power. No extraneous heat aids are needed and cranking speed need not be high. The injector nozzle has a single open orifice, the diameter of which is greater than 0·04 inch. The combustion chamber is disposed in the cylinder head at an angle of 30 deg. to the cylinder axis; the base of the chamber has two orifices with bevelled air-entry faces on the cylinder side. One hole is exactly opposite the injector's large single aperture, the other is at the highest point in the pre-combustion chamber "floor" when installed. The fuel spray issuing from the central hole of the chamber impinges upon a raised disk on the piston crown and is dispersed therefrom throughout the clearance volume between piston crown and cylinder head. Using fuel of 19,350 B.Th.U.s gross calorific value, the rated-power fuel-consumption figure of the smaller engines is 0·42lb. per b.h.p.-hr. The list of engine models includes an eight-cylinder reversible unit for marine purposes developing 400 b.h.p. at 750-800 r.p.m. Other models suitable for marine use range from two- to eight-cylinder units covering an output range from 26 b.h.p. to 400 b.h.p.—*The Oil Engine and Gas Turbine, Vol. 16, February 1949, p. 332-334.*




*The Combustion System*

Key: A, instantaneous-release cam on fuel-pump camshaft; B, injection spring; C, plunger; D, suction chamber connected to fuel gallery; E, suction valve; F, single-hole atomizer; G, pre-combustion chamber; H, piston; J, baffle on piston for fuel jet dispersal; K1, fixed wedge; K2, sliding wedge for fuel-quantity control; L, fuel-control rod connected to governor and speed lever; M, pump chamber; N, non-return valve.

### Unidirectional Marine Engines

In the new survey vessel now completing at Northwich for the Mersey Docks and Harbour Board, there is a novel arrangement of machinery in that two Davey Paxman oil engines running at 490 r.p.m. are connected by B.T.-H. electric-magnetic couplings and drive a single bronze propeller at 327 r.p.m. through an oil-operated reverse reduction gear. Arrangements are to be made for either bridge or engine-room control. Manœuvring with the S.L.M. gear is very simple and consists of moving a small lever, like an engine-room telegraph handle, through a three-notch positioning quadrant. The reverse-reduction unit consists of a gearcase containing, in all, fifteen helical machine-cut gearwheels. The ahead and astern wheels incorporate oil-operated couplings or clutches, each of which consists of

two inner and two outer members. Engagement between them is effected by directing oil under 75lb. per sq. in. pressure into the chamber between the two inner members. Disengagement, when required, consists in releasing the oil pressure and is accelerated by an opposing oil pressure which ensures a speedy release and a return to the idling or free position. In operation this gear is smooth, speedy and certain. Long periods of astern running are possible if necessary without risk of overheating. In this gear the input shaft from the engines is above the output coupling, which is an advantage in a small ship, because it means that it is not necessary to tilt the engine in order to obtain sufficient immersion for the propeller.—*The Journal of Commerce (Shipbuilding and Engineering Edition), No. 37,746, 17th February 1949, p. 6.*

**The Influence of Valve Port Design on the Volumetric Efficiency of the Compression-ignition Engine**

In the paper the author discusses the cause of the loss of pressure in the induction system of an internal combustion engine, and also the essential difference between the breathing conditions of a carburetting engine and those of a compression-ignition engine, and the features which are peculiar to the latter. Particulars of some experiments on the influence of valve ports of different shapes upon the breathing of a given compression-ignition engine cylinder are given. The experiments cover the measurement of the pressure loss under the steady air flow as well as the effect upon the volumetric efficiency under actual operating conditions. The effect of a change in valve lift is discussed also. The results of the experiments show that the governing factor in volumetric efficiency is the velocity of the air at the actual valve opening, and that a venturi form of port provides much needed room for the accommodation of the fuel injector, without any sacrifice in volumetric efficiency, by allowing a material reduction in diameter of the port at a short distance ahead of the valve opening. It does not, however, possess any other great advantage over a parallel port with an equal diameter of valve seat.—*Paper by C. B. Dicksee, read at a General Meeting of the Automobile Division of The Institution of Mechanical Engineers, 8th February 1949.*

**Auxiliary Diesel-electric Power in C-2 Vessels**

The *Garden State,* which is a shelter-deck-type L-2 vessel of approximately 10,400 tons d.w. and 6,000 s.h.p., has recently been equipped with an auxiliary Diesel-electric power plant. Other ships which will soon be similarly equipped are the *Magnolia State, Golden State,* and *Cotton State.* Each ship's new auxiliary installation consists of an 8-cylinder, 2-cycle, General Motors Diesel engine, rated at 800 b.h.p. and direct-connected to a 500-kW. electric generator. This unit has been installed in the forward upper flat on the port side, where part of a storeroom has been removed to provide the necessary space. With C-2 freighters, the uppers is the operating platform for the main engines, and, therefore, the logical place for the auxiliary. Prior to the installation of the auxiliary Diesel engine, the average fuel consumption of the *Garden State,* when in port, was about thirty barrels per day, when loading cargo. There are sixteen 50 h.p. winches serving double booms at each hatch, the current requirements of which will be met by the new auxiliary unit. The daily port consumption, of course, varies with the number of hours consumed in working cargo. With the steam generators shut down and the Diesel engine in action, the fuel consumption is 17 gallons per hour, or approximately 9·5 barrels for an equivalent number of cargo hours. In view of the current high cost of oil fuels, the saving in a year should be substantial, but the general convenience and utility of the arrangement should outweigh the financial gains.—*Marine Engineering and Shipping Review, New York, Vol. 54, January 1949, p. 74.*

**Scale Formation and Control in Compression Distillation of Sea Water**

Various principles which have been used to combat the formation of scale in sea-water distillation equipment are outlined briefly. The object of this paper is to present data on the results obtained through the application of some of these principles to the removal or prevention of scale in the compression type of distillation equipment. This form of still was widely used during the war for military water supply and is now in use in several marine and industrial installations. All of the data reported were taken on compression stills which used a short vertical tube, natural circulation, calandria type of condenser-evaporator with boiling inside the tubes. The paper reports that the rate of scale formation in current models of compression sea-water distillation units is such that 200 to 300 gallons of distillate can be produced per sq. ft. of evaporation surface before it is necessary to clean the surface; periodic treatment with solutions of sodium acid sulphate or hydrochloric acid can be used to obviate the need of mechanical cleaning; and vacuum operation to give boiling temperatures of 150 deg. F. offers a good possibility for prevention of any significant formation of scale.—*Paper by J. J. Campobasso and A. Latham, read at the 1948 Annual Meeting of the American Society of Mechanical Engineers; Paper No. 48-A-115.*

**German Marine Boiler**

The article reviews the various types of small marine boilers and refers in particular to a small water-tube boiler as installed for the first time in a trawler. The boiler heating surface is 90 sq. m. of which 7·75 sq. m. is radiant surface. Normal boiler output is 3·25 metric tons of steam per hour at 16 atmospheres gauge pressure. There is a needle type cast iron economizer of 66 sq. m. heating surface raising the feedwater temperature from 110 deg. C. to 160 deg. C. The total service weight of the coal-fired boiler is 21 metric tons as compared with 57 tons for a Capus boiler and 69·5 tons for a cylindrical boiler. The steam is supplied to a high speed totally enclosed reciprocating engine.—*H. Hansen, Hansa, Vol. 2, 29th January 1949, pp. 124-126.*

**Chattering of Safety Valves**

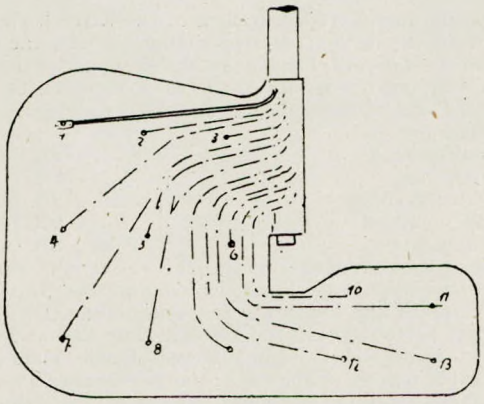
Safety valves and similar mechanisms include a piston which is acted upon on one side by the fluid pressure to be regulated and on the other by a spring. When the fluid pressure increases, the piston uncovers a larger exit opening and in this way regulates the pressure. To examine the question of chattering, it is assumed that the piston oscillates about a middle position. If the fluid is incompressible and the pump discharge constant, then the pressure is always given by the instantaneous position of the piston and is, of course, least for the upper position of the piston and greatest for the lower position. The energy transmitted by the fluid to the piston during its upward movement is equal to the energy transferred to the fluid by the piston during its downward movement. This means that the piston in moving neither gains nor loses energy and when damping is present (friction of the piston in the guide-way) the oscillation must gradually die away. But with an elastic fluid the alteration in the volume of the fluid due to the movement of the piston must be taken into consideration. Thermodynamic analysis shows that the average pressure acting upon the piston is greater while the piston is moving upwards than when it is moving downward. Therefore energy is imparted to the moving piston and an oscillation once begun must continue to increase. A correspondingly great damping effect must be provided by having resort to a special design.—*J. V. Freudenreich, The Brown Boveri Review, Vol. 35, No. 5/6, 1948, pp. 147-50.*

**Marine Boiler Deterioration**

A survey is made of the several forms of boiler corrosion and deterioration encountered in marine practice. Problems of design, operation and maintenance at sea are discussed in relation to metallurgical and electro-chemical phenomena involved. As regards waterside corrosion, pitting is more frequently encountered; general wastage, corrosion fatigue, strain age embrittlement, and caustic embrittlement are in decreasing order of importance. Other forms of deterioration include high-temperature oxidation, bursts, high-temperature creep, and corrosion on the fire side. Several forms of each of the phenomena are illustrated and basic principles involved are discussed.—*Paper by I. G. Slater and N. L. Parr, read at an Extra General Meeting of The Institute of Mechanical Engineers on 4th February 1949.*

**Experimental Analysis of Rudder Performance**

An article by C. Perracci published in Rivista Marittima describes the tank investigation of the rudder performance of a twin-screw vessel. The author explains that in order to arrive at a rudder design of optimum efficiency it is necessary to determine the reaction of the water upon the rudder and of the moment exerted by this reaction with respect to the rudder stock. But this computation must also take into account the position of the rudder relative to the screw propellers and of the hull of the vessel, since both the propeller wake and the shape of the vessel affect the hydrodynamic conditions prevailing at the point of rudder location. The method developed by the author is chiefly based upon the study of the influence of the rudder position with respect to the propellers and of the propeller wake. In order to ascertain the hydrodynamic pressure distribution over the surfaces of the rudder, the tank model of the vessel considered was fitted with a flat plate having the same contour of the rudder and equipped with a number of Pitot tubes distributed over both sides of the rudder as indicated in the accompanying figure. The article describes the various experiments carried out by the author with the model of the twin-screw vessel and shows that overbalancing



*Distribution of Pitot tubes over rudder surface*

of the rudder will be avoided if the rudder position is so chosen relative to the propellers that with the rudder in the middle position only the trailing edge of the rudder is swept by the propeller wake. For small rudder angles—from 3 to 7 deg.—the rudder should be completely swept by the propeller wake.—*The Marine Engineer and Naval Architect, Vol. 72, February 1949, p. 107.*

**Riveted versus Welded Ship Structure**

This paper represents a survey of direct and indirect evidence relative to the incidence of cracking in riveted and welded ship structures respectively. In discussing direct evidence the author points out that records are available for study of 331 riveted or welded ships which were torpedoed during the 1939-45 war. Of these vessels forty-eight broke in two. For the ships constructed by riveting, those breaking in two made up 14 per cent of the total number struck by torpedoes. For the welded ships the percentage was 18. The number of ships involved in this study is nowhere sufficient for a valid statistical conclusion. But, even if the sample were adequate the results would not prove that the incidence of cracking is lower in the riveted ships because the riveted seams prevented the ships from breaking in two in many instances, of which several reported cases can be cited as examples. The evidence is, therefore, invalid, and must be discarded. Riveted ships have suffered structural distress. The famous liners *Leviathan* and *Majestic* cracked their maindecks, and several riveted tankers have broken in two. No longer ago than March 1947, the *Oakey L. Alexander,* a riveted collier thirty-one years old, broke in two, off the coast of Maine. Summing up the author finds that both types of structures crack, the characteristics of the fractures in the two types being similar. With regard to the relation between the method of fabrication and physical parameters which are known to be of influence upon the incidence of cracking it is stated :—(1) stresses locked in the welded decks of ships are not appreciably affected by the presence of riveted seams in either the deck or side shell; (2) riveted joints may slip in service at moderate loading (above 6,000lb. per sq. in. shear stress on the rivets); (3) the shear deflexion in a riveted seam is usually less than $\frac{1}{32}$ inch when it slips in service; (4) extensive rivet slip might occur without appreciably increasing the deflexion of the hull; (5) rivet slip under service loads may be accompanied by an increase in stress at critical locations in the structure. It is therefore concluded that from the evidence examined, it cannot be determined whether a welded or a riveted structure is more susceptible to inception of cracks. Furthermore rivet slip may occur at loads within the normal operating range and it could result in an increase in stress in critical portions of the structure.—*E. M. MacCutcheon, The Welding Journal, N.Y., Vol. 28, February 1949, pp. 111-117.*

**Research in Shipbuilding**

In this review of shipbuilding research the author makes special reference to small-model tank technique. It has long been the practice to use models of some 16 feet or more in length in order that the Reynolds number might be high enough to ensure that the models were running in a substantially turbulent flow regime. On the other hand, the much lower cost of building and operating small-model tanks makes them very attractive, but their advocates have from the beginning admitted that the results could only be relied upon if adequate steps were taken to ensure turbulent flow from the bow of the model, so that laminar flow would not cover a great deal of its surface. This turbulence promotion has been done in various ways—by having a vertical strut ahead of the model, or by attaching a trip wire or sand strips to the hull near the bow. It has come to be recognized of recent years, however, that 16 feet, 20 feet, or even 25 feet models are not always free from error because of the persistence of laminar flow over a substantial part of the surface at the fore end of the model. Experiments with turbulence-promoting devices on such models have indicated in some instances a substantial change in resistance. The author recalls that at the 1948 autumn meetings of the Institution of Naval Architects it was pointed out by several speakers that none of the systematic series of models run in the past have had turbulence stimulated ahead of them. Since the effects of this lack of turbulence will vary from model to model of a series, the small changes in resistance which have been attributed to changes in hull shape may in fact have been partially or wholly due to the former factor. It is not too much to say that all model series results are now subject to considerable doubt, and indeed the recognition of the necessity for turbulence stimulation may explain many of the anomalies found in the results of standard series model tests. It is therefore essential to solve this problem before further series tests are undertaken, and it is most important, too, in the everyday commercial work of model experiment tanks. The author also points out that in the past almost all predictions made from model tests have been based on ideal smooth water conditions. Whilst this was inevitable in the early stages of model technique, it has long been recognized that the best form for smooth water performance is by no means necessarily the best at sea. Some research work on models in rough water has been carried out, but the time has not yet arrived when such tests can be treated with confidence as a basis for full-scale predictions. Here is a fruitful field for research, but it is essential that such model work shall be pursued hand in hand with actual observations at sea. It is impossible to attain real sea conditions in a tank—the essential thing there is that the wave conditions should be susceptible of close control and be repeatable at any time. In this way alternative models can be tested and compared under identical conditions. The performance of ships at sea must be observed more closely than has been done in the past.—*F. H. Todd, The Marine Engineer and Naval Architect, Vol. 72, February 1949, pp. 85-90.*

**Diesel-engined River Barge with Reversible Propeller**

The recently completed river barge *Défi* is of all welded construction. It was built by the Chantiers Navals Franco-Belges and is remarkable for the incorporation of a Deutz Diesel propulsion plant of 80 h.p. driving a reversible propeller designed and built by the Ateliers et Chantiers de Bretagne. The dimensions of the barge are 38·9 m. length and 2·7 m. breadth with a draught of 1·8 m. when carrying 225 tons of coal. The vessel was recently demonstrated on the river Seine.—*Journal de la Marine Marchande, Vol. 31, 3rd February 1949, p. 193.*

**New French Motor Cargo Vessel**

The recently launched *Edouard-Corblet* is a motor cargo vessel of 7,300 tons deadweight built by the Chantiers de Penhoët for the Cie Fluviale et Maritime de l'Ouest-Africain. It is especially equipped to serve as timber carrier. Overall length of the vessel is 124·0 m., length b.p. 121·8 m., breadth 17·25 m., draught 7·2 m., deadweight 7,300 tons and specified speed 14 knots. The propulsion consists of a 7,300 tons and specified speed 14 knots. The propulsion plant consists of a Penhoët Burmeister and Wain engine developing 4,280 s.h.p. at Diesel generating sets, each rated 133 kW. An exhaust steam boiler supplies 2,000 kg. of steam per hour at 10 atmospheres pressure, and there is also an oil-fired boiler operating at the same pressure.—*Journal de la Marine Marchande, Vol. 31, 17th February 1949, p. 274.*

**Italian-built Norwegian Ship**

The motor cargo line *Ferndale,* built by Ansaldo at Genoa for Norwegian owners, has the following principal dimensions :—

| | |
|---|---|
| Length overall ... ... ... ... | 488 feet |
| Length b.p. ... ... ... ... | 455 feet |
| Moulded breadth ... ... ... ... | 64 feet |
| Draught ... ... ... ... ... | 27 feet |
| Deadweight capacity ... ... ... | 9,000 tons |
| Machinery ... ... ... ... ... | 7,500 b.h.p. |
| Trial-trip speed ... ... ... ... | 16 knots |

The engine is of the standard Fiat double-acting two-stroke type, of which a large number has now been built and many are under construction. It has cylinders 640 mm. in diameter, with a piston stroke of 1,160 mm., and the output of 7,500 b.h.p. is attained at 125 r.p.m. It is stated that a very substantial overload may be carried, and the speed raised to 145 r.p.m., this being part of the test-bed routine. The pistons are cooled with lubricating oil, and the cylinder heads

and jackets by fresh water, although, if necessary, salt-water circulation may be used. The three generating sets are installed in the port wing. These are of 200 kW., the dynamo in each case being driven by a four-stroke five-cylinder Ansaldo engine with cylinders 260 mm. in diameter. The sets run at 360 r.p.m. An emergency of 30 kW. Diesel general plant is installed. A combined oil-fired and exhaust-gas Ansaldo-Clarkson boiler is provided, capable of producing 700 kg. of steam per hr. at 100lb. per sq. in., with exhaust-gas firing and 1,500 kg. with oil firing. The oil burner is a Todd rotating injector, which is electrically driven. The boiler is installed on the engine-room floor on the starboard side at the forward end. On trials with the vessel half-loaded (displacement 8,900 tons) a speed of 17·52 knots was attained at 129 r.p.m., the output being 8,200 b.h.p. The maximum speed reached was 18·43 knots at 136 r.p.m. The fuel consumption at 8,200 b.h.p. was 173 gm. per b.h.p., or 0·38lb.—*The Motor Ship, Vol. 29, February 1949, pp. 438-439.*

**Cable Ship *Edward Wilshaw***

The cable ship *Edward Wilshaw*, building at the Neptune Yard of Swan, Hunter and Wigham Richardson, Ltd., has an approximate length overall of 311 feet, a breadth moulded of 41 feet, and is designed to carry a deadweight of about 2,900 tons on a draft not exceeding 19 feet and is built in accordance with the Merchant Shipping Acts, and to class in Lloyd's Registry as a steel decked vessel, 100 A.1, with scantlings for a draft of 19 feet. A clipper stem carries three cable sheaves. The upper and main decks run all fore and aft and a lower deck is fitted at the fore end. A bridge deck, with steel house at the forward end containing the captain's accommodation, is fitted with a navigating bridge above. A cellular-double bottom runs from the fore peak bulkhead to as far aft as practicable (except in way of the boiler room where open floors are arranged), and is subdivided for the carriage of oil fuel, fresh water and water ballast. The fore and aft peaks are also arranged for water ballast. The propelling machinery is fitted aft and fuel tanks are arranged port and starboard in way of the boiler room. Forward of the machinery space are three cylindrical cable tanks, with a total coiling capacity of 18,850 cu. ft., and a hold for the storage of buoys and cable gear. Two independent cable gears are fitted abreast on the main deck forward. These work on full boiler pressure. The windlass engine is fitted in a separate compartment on the main deck and has cable lifters on the upper deck worked by vertical shafting from the engine below. A capstan head is fitted on the centre line on the upper deck forward and warping capstans port and starboard at the after end and a combined steam and hand steering gear on the main deck aft. The electric power is supplied by three steam-driven generating sets, each having an output of 40 kW. at 110 volts. The main propelling machinery consists of two triple expansion engines having cylinders, 15½ inch, 26 inch and 44 inch diameter with a piston stroke of 27 inch, designed to develop 2,100 i.h.p. collectively, at about 130 r.p.m. on trial. Steam is supplied by three multi-tubular Scotch boilers generating saturated steam at a pressure of 220lb. per sq. in. and designed to burn oil fuel under forced draught conditions.—*The Shipyard, Vol. 22, October-December 1948, pp. 23-26.*

**New French Cargo Vessels**

The recently launched mixed cargo vessels *Cavelier-de-la-Salle* and *Le-Moyne-d'Iberville* were built by the Forges et Chantiers de la Gironde for the Compagnie Generale Transatlantique. The principal dimensions of the first of the two vessels are: overall length 146 m.; length between perpendiculars 140 m., breadth 18·8 m.; deadweight 9,200 tons; contract speed 16 knots. The vessels have bulbous bow and cruiser stern and were built under special survey of Bureau Veritas. Electric welding and pre-fabrication have been employed to a considerable extent, the number of rivets being reduced to 350,000 as compared with 1,200,000 rivets required for an equivalent all-riveted vessel. The propulsion plant driving a single screw consists of a 10-cylinder two-stroke single acting Sulzer Diesel built by the Compagnie de Construction Mécanique, Procédés Sulzer, Saint Denis. The engine develops 8,000 h.p. at 132 r.p.m. under test conditions. Two auxiliary boilers of the La Mont type are installed in each vessel, each boiler generating from 1,500 to 1,800 kg. of steam per hour at three atmospheres pressure.—*Journal de la Marine Marchande, Vol. 31, 27th January 1949, pp. 143-147.*

**All-welded Tug for Thames Service**

The motor tug *Brent Brook* recently delivered to the River Lighterage Co., Brentford, by Richard Dunston, Thorne, has been built for service on the Thames and is claimed to be the first all-welded tug specially constructed for service on the London river. Constructed at the Hessle yard of the builders, to designs prepared by Mr. G. Austin, marine superintendent of the River Lighterage Co., the *Brent Brook* is the first of two similar vessels, the second of which is named *Stamford Brook*. In the design, consideration has been given to the onerous nature of the work in which the tugs will be engaged and special strengthening has been provided. The principal particulars are:—

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|---|---|
| Length overall | 72ft. 6in. |
| Length b.p. | 68ft. 0in. |
| Breadth moulded | 19ft. 6in. |
| Depth moulded | 9ft. 6in. |
| Draught aft | 8ft. 3in. |

Four bulkheads are arranged, dividing the vessel into five compartments, comprising fore peak, fore cabin, engine room, aft cabin, and aft peak. Three of the bulkheads are watertight. The stem is of rolled flat steel bar 6×3 inch, and the flat plate keel is ¾-inch thick throughout. An all-welded semi-balanced double plate rudder is fitted. A notable feature of the tug is the thickness of the shell plating. The main propelling machinery consists of an Atlas 2-stroke reversible Diesel engine type M.47.1, developing 520 b.h.p. at 300 r.p.m. Fresh water cooling is arranged, the water being circulated through a Serck fresh water cooler by the main engine circulating pump. The cooler is circulated with sea water by the main engine bilge pump.—*Shipbuilding and Shipping Record, Vol. 73, 27th January 1949, pp. 109-110.*

**Light Alloy Hatch Beams**

The employment of aluminium and its alloys in many ships and boatbuilding applications is today an established practice, but, up to the present, their use has been limited so far as structural and stressed members are concerned. In considering what parts of a ship's structure and equipment might be reduced in weight by employing aluminium alloys, hatch beams are deserving of particular attention. These parts are manhandled on every occasion the ship is loaded and unloaded, and at sea the larger proportion of them are above the centre of gravity. After discussion of this particular application with the superintendent engineer of one of the principal shipping lines, it was decided by I.C.I. to review the comparative weights, strength and characteristics of a light alloy hatch beam and its mild steel counterpart. It was considered that to obtain information of the greatest value, it would first be necessary to procure a steel beam of a type in general use and to design and build a light alloy beam which would correspond with it in general principles. For this purpose Cammel Laird and Co. supplied a hatch beam identical with one of the types in service on the steamship *Robert L. Holt*, a vessel of 5,000 tons d.w. The light alloy beam was built in magnesium silicide alloy, "Kynal", in the fully heat-treated condition, except for the rivets which would have to be in the solution heat-treated condition. This alloy has a high resistance to corrosion in marine atmospheres. From the report of the tests made under the direction of Pro. C. Batho of the University of Birmingham, it has been concluded that the tests described demonstrate that the hatch beam fabricated from light alloy material afforded advantages over mild steel since an appreciable saving of weight was effected without sacrifice of mechanical strength. In fact, the light alloy beam showed a 56 per cent saving in weight and permitted 30 per cent greater loading than the mild steel beam before the limit of proportionality was reached.—*F. Boyles, Shipbuilding and Shipping Record, Vol. 73, 3rd February 1949, pp. 145-48.*

**Cargo Liner *Somali***

The *Soudan* and the *Somali* are among the highest powered and fastest cargo liners to be completed for British owners since the war. They were both built and engined by Barclay, Curle and Co., Ltd. On trials, a speed of over 19 knots was attained, and in service they are able to average about 18 knots. Among other features of special interest is that the motors of the electrically driven pumps in the engine-room are mainly operated on the push-button starting system. The main details of the *Somali* are as follows:—

| | |
|---|---|
| Length overall | 525 feet |
| Registered length | 501·9 feet |
| Length b.p. | 490 feet |
| Moulded beam | 67 feet |
| Depth to shelter deck | 43 feet |
| Gross register | 9,080 tons |
| Deadweight capacity | 11,000 tons |
| Corresponding draught | 29ft. 6in. |
| Machinery | 13,600 b.h.p. |
| Speed in service | 18 knots |

Her two main engines are of the standard 6,800 b.h.p. Barclay, Curle-Doxford type with the scavenge pump at the centre, driven from the

main crankshaft. There are six working cylinders, with a diameter of 670 mm., the upper and lower piston strokes being 1,340 mm. and 980 mm. respectively, or a total of 2,320 mm. The output of each unit of 6,800 b.h.p. is attained at 116 r.p.m. and, as is usual with this design, a Bibby detuner is fitted. The exhaust gases from the port engine may be delivered to a Cochran composite boiler (8ft. diameter and 19ft. high) or by-passed to the silencer without passing through the boiler. On the starboard side of the engine-room are two 350 kW. Allen generators driven by eight-cylinder Ruston engines running at 350 r.p.m. A similar unit is installed in the port wing.—*The Motor Ship, Vol. 29, February 1949, pp. 451-457.*

### Heavy-lift Motorship *Belbetty*

The cargo motorship *Belbetty* is the first of its kind to be built at Burmeister and Wain's Copenhagen yard. She is specially designed for the transportation of heavy goods, such as locomotives, railway waggons, small lighters, tugs and lightships, etc. The vessel has been built for Belships Co., Ltd., Skibs A/S, Oslo, wsich specialize in ships of this type. The *Belbetty* has been built to the highest class, +100 A.1, of Lloyd's Register, and has two complete decks and a raked "soft nose" stem and cruiser stern. The engine room has been placed aft so that the space amidships may be used for holds, which can thus be made as rectangular as possible. The *Belbetty* has the following particulars:—

| | |
|---|---|
| Length b.p. ... ... ... ... | 315 feet |
| Beam ... ... ... ... ... | 51 feet |
| Depth to upper deck ... ... ... | 32 feet |
| Depth to main deck ... ... ... | 22ft. 5in. |
| Deadweight ... ... ... ... | 5,100 tons |
| Corresponding draught ... ... ... | 23 feet |
| Gross tonnage ... ... ... ... | 3,984 tons |
| Speed, loaded on trials ... ... ... | 12 knots |

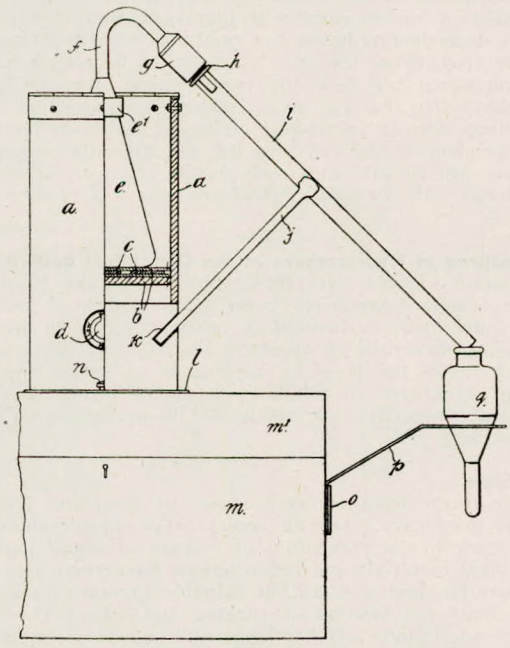
The vessel has three hatchways, each of 23-feet width and as long as possible, No. 1 and 2 hatchways measuring 38ft. 3in. each, and No. 3 measures 78ft. 8in. The hatchways are served by four 5-ton, two 10-ton, one 40-ton, and one 125-ton derricks; all winches are electrically driven. On the forecastle there are two 5-ton winches, with two of 7 tons in the forecastle, two of 5 tons amidships, and two of 5 tons on the boat deck aft. In addition there are two winches for the 125-ton derrick. Aft, a 3-ton warping capstan has been fitted. The *Belbetty*'s main engine is the first Burmeister and aWain 2-cycle, single-acting crosshead engine of the 50-VTF-110 type. This engine type has cylinder diameter of 500 mm., stroke of 1,100 mm., and with 4 to 10 cylinders per engine will cover the output range from 1,600 to 5,300 i.h.p. at revolutions from 125 to 170 per min. The *Belbetty*'s engine has five cylinders and a capacity of 2,250 i.h.p. at 145 r.p.m. In proportion to the cylinder diameter, this engine type has an unusually large stroke, 2·2 times the diameter. The reason is that, in view of the efficiency of the propeller, it is desirable that marine plants, especially for single-screw vessels, should not have too high a number of revolutions. An 8-cylinder engine of the new type will, at the same number of revolutions, have the same output as a 10-cylinder engine of type 50-VF-90, and it will be about 18 per cent shorter, whereas the height will be somewhat greater, due to the greater length of stroke. Like all B. and W. 2-cycle engines, it has longitudinal scavenging with the scavenge ports placed at the bottom of the cylinder. The exhaust valve has been placed in the cylinder cover where starting valve, fuel valves, and safety valve are also located. Piston and cylinder are completely separated from the crankcase, as only the piston rod passes through a stuffing box in the wall between scavenge box and crankcase; in this way, a very small consumption of lubricating oil from the crankcase is achieved. The crosshead guides have been carried out as for the big, twin-screw, 4-cycle engines, as in the *Gripsholm*, the crosshead pin having been lengthened outside the crosshead bearings and provided at either end with guide bars placed on the sides of the A-frames. The engine has two camshafts, the upper one for the exhaust valve motion, and the lower one for the fuel pump motion. This arrangement has made it possible to simplify the reversing mechanism considerably. The results of the tests with this new type were most satisfactory, the fuel oil consumption turning out to be only 133 grammes per i.h.p., corresponding to about 162 grammes per b.h.p. at normal load.—*The Shipping World, Vol. 120, 16th February 1949, pp. 231-232.*

### New Propeller Design for Liberty Ships

Good results are reported to have been gained with the new propeller designed by Bethlehem Steel Co.'s Shipbuilding Division. These propellers were specially designed and constructed for Liberty ships. Following a report last year by the American Bureau of Shipping that a torsional critical occurred at or near the designed engine speed of 76 r.p.m., all operators of Liberty ships with engines located amidships were instructed to reduce the shaft revolutions to a maximum of 66 r.p.m. until measures were taken to eliminate the vibratory stresses. Corrective measures recommended by the Bureau were (a) fit a new propeller designed to absorb the maximum horsepower available at 66 r.p.m.; (b) fit a flywheel at the after end of the engine; (c) fit counterweights on the main engine crankshaft; or (d) increase the diameter of the line shafting. The soundness of these reports and recommendations was emphasized when it was found that, of more than 600 Liberty vessels which were examined, more than 40 per cent of them had broken or cracked tailshafts. Of these, approximately 4 per cent had failures at sea. The new propeller has already been fitted to a number of ships under a variety of service conditions and reports indicate that, operating on a 27-feet draught and with an engine speed of 66 r.p.m., an increase in speed of 1¼ knots can be attained, a speed gain of about 10 per cent. This average gain is believed to be at least equal to the speed lost when the engine speed was reduced to the recommended level, and independent reports even suggest that, using the Bethlehem propeller and operating at 66 r.p.m. higher sea speeds have been averaged than were obtainable when using the original propeller at 75 r.p.m. Reports from companies operating Liberty ships at the reduced speed suggest that the lowering of the engine speed has resulted in an easier running engine with consequently reduced maintenance work and costs.—*The Shipping World, Vol. 120, 16th February 1949, pp. 229-230.*

### Determining Water in Fuel Oil

The usual standard laboratory apparatus for determining the water content of petroleum products consists of a glass or metal flask in the neck of which a glass tube extending laterally from the upper portion of a graduated glass receiver is fitted, a glass reflux condenser with a water-cooled jacket being fitted in the neck at the upper end of the receiver. The method for the determination of the water content of petroleum products consists of mixing a measured sample of the oil with a volatile liquid such as petroleum spirit which distils above the boiling point of water and which acts as a carrier, and from which water readily separates. This mixture is heated in the flask until no further water collects in the receiver from the reflux condenser. The volume of water collected can be read and yields the percentage by volume of water present in the sample. The




standard apparatus described above is too fragile for use on board ship, and the object of this invention is to provide an apparatus sufficiently robust for this purpose. Referring to the accompanying illustration, the apparatus comprises a heat-insulated metal casing (a), a flat electrical resistance heater (c), a metal flask (e), a metal outlet tube (f) connected to the mouth of the flask and terminating in a stuffing box (g) adapted to receive the glass tube (i). The graduated glass receiver (q) is so placed that the lower end of the inclined glass tube (i) discharge into it. The glass tube (i) serves as an air-cooled condenser, and conveniently may be a boiler water

gauge glass. The apparatus works as a still and distillation is continued until the whole of the volatile liquid added to the sample has been distilled off, together with any water contained in the sample under test. In this way a subsequent distillation to recover the volatile liquid, as necessary in the standard laboratory method, is avoided.—Brit. Pat. No. 609,170, issued to Sir John Kingcome, K.C.B., Engineer Vice Admiral, Engineer-in-Chief of the Fleet, W. Killner and C. J. Gray, Engineer Captain, R.N.(ret.). Complete Specification accepted 27th September 1948.—*The Shipping World, Vol. 120, 9th February 1949, p. 206.*

**Admiralty Turbine Oil O.M.88**

This paper has been authorized for publication by the Engineer-in-Chief of the Admiralty at whose request and in collaboration with whose department the specification "Turbine Oil O.M.88" issued by the Director of Navy Contracts was devised by the Petroleum Board Lubricating Oil Technical Committee. A feature of the specification is that not only does it permit the use of chemical additives, but in effect demands them, since some of the important requirements laid down cannot at present be met by plain mineral oils. This applies in particular to anti-oxidants and to rust prevention. Since defoamants may also be required to meet the foaming test specified, it is possible that an oil to meet the specification may contain three chemical additives of widely different type.—*Journal of The Institute of Petroleum, Vol. 34, December 1948, pp. 911-921.*

**Adhesive Properties of Lubricating Oils**

The power of adhesion of the oil plays an outstanding part in all lubrication processes, and influences the origin of the oil film on the lubricated surface. There are many processes and additive agents designed to improve this property. However, in spite of much research, there is as yet no accurate, reliable method for the quantitative measurement of adhesion which would aid in research on improvements in lubricating oils. This is probably because most of this research is concerned only with semi-dry friction in boundary phenomena or the properties of mono-molecular layers. In the method developed by the author a pre-treated and weighed disk of sheet metal, exactly dimensioned, is dipped in the oil to be examined, allowed to drain, and then fixed on the spindle of a centrifuge and spun to constant weight in the closed rotor chamber at a fixed temperature and speed. It was found that the film of oil adhering to the surface reaches a limited value with increasing time of centrifuging, and this is dependent only on the condition of the surface of the disk and the viscosity of the oil. It appears to be independent of the material composing the disk and the chemical composition of the oil. It appears also that for given conditions, equilibrium is always attained with a definite number of molecular layers in the film, and this is independent of the viscosity and the molecular weight of the oil. Surface forces are apparently ineffective for the thicker oil films produced.—*M. Freund, Petroleum, Vol. 12, February 1949, pp. 29-33, 39.*

**Ignition Qualities of Hydrocarbons in the Diesel-fuel Boiling Range**

Information Circular No. 7474, published by the United States Bureau of Mines, summarizes present knowledge of the ignition qualities of pure hydro-carbons likely to be present in modern Diesel-engine fuels, as shown by an extensive search of the technical literature, and discusses the possible significance of cetane number and hydrocarbon structure. It tabulates cetene or cetene numbers and other physical properties for about 100 hydrocarbons.—*Petroleum, Vol. 12, February 1949, p. 36.*

**Hydraulic Seals**

Leakage is the most common source of complaint with regard to hydraulic machinery. During recent years considerable advances have been made in the prevention of leakage of liquid past moving surfaces. New materials and constructions have come into common use, and there has been a small but valuable amount of research into the action, wear and friction of packing and seals. The object of these papers is to initiate a comprehensive discussion of existing knowledge on the subject, which will perhaps indicate the fields to which future research and development might best be directed. The author's experience has been mainly in connexion with hydraulic machinery in which oil is the working medium; in this field particularly, the improvement of sealing methods has been very marked. As the subject covers a wide field, it has been limited by excluding joints. For the purpose of this paper, a hydraulic seal is defined as one whose function it is to prevent the leakage of liquid between surfaces having relative movement.—*Papers by T. E. Beacham and F. H. Towler, read at a General Meeting of The Institution of Mechanical Engineers, 18th February 1949.*

**Internal Stresses Produced by Surface Rolling**

Surface rolling of shafts and axles is known to improve the fatigue resistance, and in the case of crankpins of locomotives has been found to more than double it. A method for the computation of the residual stress distribution in material treated by surface rolling was developed by Timoshenko, but this is not very accurate. In his analysis of the stress distribution the Author proceeds from a surface rolled solid round bar which is assumed to consist of an undeformed core and a uniformly plastically deformed tube, the two being held together by stresses produced by elastic deformation. Theoretical considerations yield a criterion for determining the thickness of the plastically deformed outer layer. The theoretical values could be verified by actual measurements obtained with the employment of Sachs' boring-out method. The author's method permits ascertaining the stress distribution in the plastically deformed outer layer with any required degree of accuracy. [A concise treatment of this promising method which was developed by the author of this article is given in O. J. Horger's contribution to "Surface Stressing of Metals" published by the American Society of Metals, 1947. (The Abstractor)].—*O. Föppl, VDI Zeitschrift, Vol. 90, No. 12, December 1948, pp. 369-372.*

**X-Ray Measurement of Strain in Metal**

It is possible, by means of X-ray diffraction, to measure the interatomic spacing of crystals. Because a crystal deforms under the influence of an applied stress, with a resultant change in the interatomic spacing, X-ray diffraction can be utilized to determine the magnitude of strain in the crystal. Such a method of measuring strain offers many advantages, but several unresolved difficulties have limited its application, though the technique has been under study for the past twenty-five years. Comprehensive investigations by the Metallurgy Division of the National Bureau of Standards in the field of X-ray strain measurements have been directed towards improving the sensitivity and precision of this method of determining strain in metals. The Bureau's special interest lies in the possible importance of the method in detecting fatigue damage in metal before an actual fracture occurs. Fatigue is the term used to denote the progressive fracture of metals under the action of fluctuating stress. The magnitude of the fluctuating stress which will eventually cause failure is much smaller than that required to fracture the metal under static conditions, and as a result fatigue is a primary cause of failure in machine elements. The course of a fatigue fracture can be divided into two stages: first, the metal undergoes some sort of deterioration or damage which finally results in the formation of a very small crack; and second, the crack grows until the member is weakened to such an extent that it fractures suddenly. At the present time no reliable method is known for the evaluation of the damage which takes place during the first stage except through a fatigue test. It would be extremely valuable if some means were available for measuring this damage by non destructive means. In 1941, Glocker, in Germany, reported the results of X-ray stress measurements made on fatigue specimens, by means of which he claimed to be able to detect fatigue damage. The method involved the measurement of surface stress in the specimen under static load after various amounts of fatigue stressing. He found that after the specimen had been damaged by fatigue stressing, the stress is the extreme surface layers was not as large as it would be if the material were homogeneous. Because of the apparent significance of these results, it seemed desirable at the Bureau to pursue further this line of investigation. Tests were made on a flat steel specimen loaded in bending to produce a tensile stress in the surface under examination. From these tests it was concluded that plastic deformation in one direction in a crystal does not affect the atomic spacing or elastic properties in other directions where the strain is not great enough to cause slip. Such results suggest that the measurement of lattice strain by means of X-rays might provide a powerful tool for the investigation of the mechanism of plastic deformation.—*The Welding Journal, New York, Vol. 27, December 1948, pp. 612-s-613-s.*

**Scuffing and Wear**

The authors explain that in some recent studies on the basic phenomena of lubrication, the twin problems of the reduction of wear and the prevention of "scuffing" (or incipient seizure between metallic surfaces sliding upon each other) have been approached along three main lines of investigation in the course of which the following three highly specialized pieces of apparatus have been evolved:—(1) The pin-and-ring machine, in which a flat-ended pin wears a track on a rotating flat ring. This was designed to enable the problem of wear between parallel surfaces to be tackled at the fundamental level. (2) The reciprocating wear machine, in which a cylindrical slider rubs to and fro against a flat plate. Here the

emphasis is upon the specific problem of wear between the piston rings and cylinder walls of an internal combustion engine. (3) The two-ball machine, in which balls in contact rotate with a combined sliding and rolling motion. This was specially designed to enable the problem of the scuffing of gear teeth to be studied under simplified and controlled conditions. In the paper the machines were described in outline, their mode of operation being explained, and some preliminary results obtained with them, presented and discussed. The influence of various factors such as viscosity, temperature, presence and nature of additive, constructional materials and surface finish of the test pieces, and sliding speeds were considered.—*Paper by H. F. Kenyon, S. G. Daniel, and T. B. Lane, read at a meeting of the Stanlow Branch of the Institute of Petroleum, Abstracted in Institute of Petroleum Review, Vol. 3, January 1949, p. 28.*

**Carbon Packing Rings**

The New York Naval Shipyard Naval Base Station, Brooklyn, New York, has developed a method of manufacturing carbon packing rings such as those used in turbines that results in a uniform precision interchangeable sectional carbon ring. Formerly it was necessary to match-mark each end of every section of each ring and install according to the marking. No such markings are necessary with this new method. Heretofore, if one section were damaged, it was necessary to replace the entire ring. With the new method any part of one set is now interchangeable with any like part of a similar set. The new method also reduces the chance of error in installation because of improper matching of parts. Furthermore, it is reported that costs were cut an estimated 75 per cent. Because of the variety of types and sizes, exact dimensions have not been given of the jigs and fixtures used. It is necessary to design the jigs and fixtures according to the type and size of packing required. A detailed description of the operation required to make a carbon ring by the new method is given.—*Mechanical Engineering, Vol. 71, February 1949, pp. 159-160.*

**Torsional Viscous-friction Dampers**

Since Lanchaster's patent on viscous friction dampers, there have been innumerable variations of his patent for both viscous- and dry-friction dampers. Due to the fact that in the early days there was no suitable viscous fluid, most dampers were of the spring-loaded dry-friction type. Most of these devices suffer from the defect that their usefulness was dependent on close adjustment of springs, which adjustment rarely was at the optimum point after a period of operation. Around 1930, Dashefsky developed a viscous-friction damper similar in construction to the damper described in the paper. For his viscous medium he used a furniture glue. This damper was quite successful for the use for which it was intended. With the wartime development of the silicone oils there became available a new fluid with desirable properties necessary for the successful operation of a viscous-friction damper. The paper describes the large torsional viscous friction of "Lanchaster" dampers manufactured for use on Diesel engines. Some properties of the new silicone fluids that are necessary for damper design, are given. The theory of the torsional viscous-friction damper as applied to multimass systems is developed. Constructional details of the damper and methods of manufacture are discussed. Some test results are given and compared with calculations.—*Paper by J. C. Georgian, read at the 1948 Annual Meeting of the American Society of Mechanical Engineers; Paper No. 48-A-67.*

**Flame Spraying of Metals and Plastics**

The author traces the development of metal spraying guns and describes practical applications of zinc spraying to prevent marine corrosion. Reference is made to the rust proofing by this method of the deep tanks of a number of cargo ships. The tanks were shot-blasted to present a perfectly clean and slightly roughened surface, and they were then zinc-sprayed and painted. These vessels have now made many long voyages, and while in the ordinary way it would have been necessary to scale and paint the tanks at frequent intervals, no such attention has been needed at all over a period of more than twelve months. The cargo tanks have carried water ballast, grain, salt, sugar, etc., and have, in fact, been exposed to the customary severe conditions. The cost of shot-blasting and zinc-spraying followed by painting is usually about double the cost of scaling and painting without zinc spray, but, as the author states, this higher first cost is repaid many times over. Powder flame spraying has also been adapted to a wide variety of plastics. An interesting marine application is the flame spraying of thiokol, which is a synthetic rubber. This material is readily applied and gives a tough, flexible and abrasion-resistant coating. Unlike natural rubber, thiokol is resistant to oil. It is also resistant to dilute acids and alkalis and is widely used for the protection of fan impellers and casings. It also affords protection of condenser doors against corrosion by hot sea water. During the war it was necessary to change from bronze to welded steel construction and the steel doors were sprayed with a thick coating of thiokol to prevent rapid corrosive attack which would otherwise have occurred. Very large numbers of these doors were sprayed. Recently the opportunity arose of examinating one after long service. The condenser door had been stripped for overhaul and it was found that the coating was in first-class condition except round the flange, where it had been damaged while being dismantled. The flange was resprayed and the door put back into service.—*Paper by F. A. Rivett, read at a meeting of The Institution of Engineers and Shipbuilders in Scotland, 8th February 1949.*

**Dimensional Changes in Steel**

In a very large completely welded structure, such as a ship, in which there are hundreds of longitudinal and transverse joints, the total shrinkage resulting from welding is astounding. If a 400-feet ship were completed tacked together and then welded, the total shrinkage would be about 8 inch—i.e. about 2 inch per 100 feet. Not only would the ship have shortened, but she probably would be badly

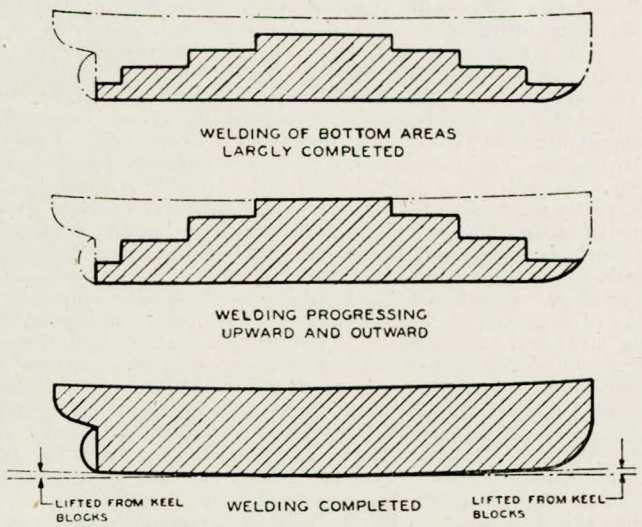



FIG. 34.—*Lifting of ship from keel blocks as a result of shrinkage*

distorted. In Fig. 34 is shown a ship in which the final welding is carried out in what might be considered the normal manner. The welding as shown by the shaded area was completed at the bottom first. By the time the hull welding was finished, both the bow and

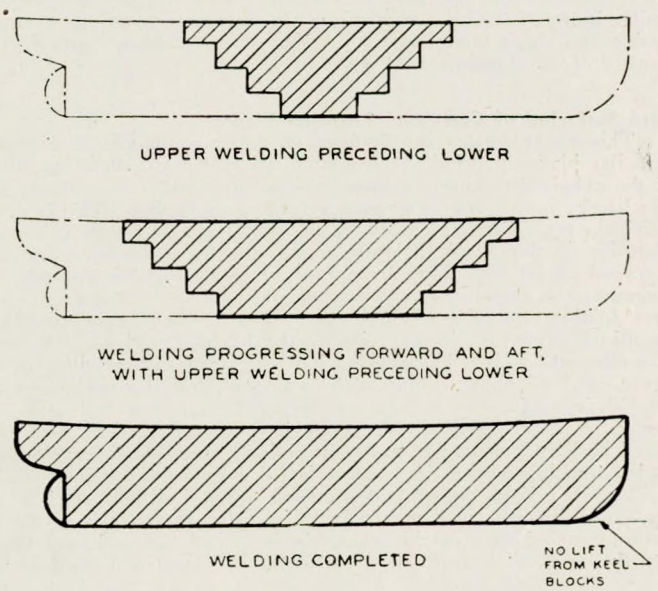



FIG. 35.—*Corrective procedure for welding strip to prevent distortion*

stern had lifted from the keel blocks. This lift has in some cases been as much as 8 inch. However, it is not necessary to let shrinkages and distortions become cumulative to the extent just described. In erecting large plate structures, of which ships are a good example, the shrinkage can be constantly corrected and allowed for as the work proceeds. Joint openings can be increased, large subassemblies used and many other measures taken. In the case of ships, an erection procedure something as shown in Fig. 35 has been used with such success that the bow and stern were actually slightly depressed.—*L. C. Bibber, The Welding Journal, Vol. 27, December 1948, pp. 1009-1024.*

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**Tensile Tests of Small-scale Welded Joints**

The David Taylor Model Basin frequently builds and tests small-scale steel models of ship structures of welded construction. Some of these models involve steel less than 0·05 inch thick. Since the successful welding of fillets in such thin stock is impracticable if not impossible with the commercially available steel electrodes, the Taylor Model Basin usually substitutes Everdur brazing with the carbon arc for steel welding in making fillet joints in these thin plates. This process is especially advantageous in model-making, as it permits the joining of thin plates without the usual disadvantages of steel welding, e.g., high operating temperatures, burn-through, instability of the arc on small steel electrodes, large out-of-proportion deposits, and generally poor control. "Everdur" (a copper silicon alloy) in models has proved satisfactory, but heretofore it has been used only in structures which have not been loaded beyond the elastic range or in which similitude of behaviour at the connections has been of no particular interest. The Taylor Model Basin was requested by the Bureau of Ships to construct a 1/10 scale model of a ship structure and to subject it to destructive test by underwater explosive loading. It was desired that the failures and fractures which commonly occur in the full-scale ships be reproduced in the model with reasonable accuracy in both type and degree. Specifications call for close similitude to the prototype in all structural details, with special emphasis on fidelity of behaviour at the connexions. Consequently an investigation of the structural properties of "Everdur" points under both dynamic loading and static loading was undertaken. For this purpose two sets of small-scale welded specimens each embodying four common types of joints were fabricated from black-iron sheet and tested in tension. One set was made with "Everdur" and the other with steel welds. Welds of "Everdur" were not as strong or as ductile as those of steel. However, good "Everdur" butt welds may be expected to withstand stresses in the neighbourhood of 30,000lb. per sq. in. Helium shielding of the carbon arc used in "Everdur" brazing usually improved the strength and ductility of the welds. Failures in longitudinal tee, longitudinal angle and longitudinal butt joints of both sets of welds were characterized by initial fractures in the weld beads. Failures in specimens with transverse butt joints occurred in the base metal except where the beads were filed down before testing. A study of the effect of varying the width or tensile specimens showed that the behaviour of standard tensile specimens provides only a limited index of the behaviour of metal in a structure, as, for example, plating in a ship's bulkhead.—*T. D. Tuft, The Welding Journal, New York, Vol. 28, January 1949, pp. 41-s-48-s.*

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**Hard Surfacing of Cast-steel Propeller Blades**

This paper relates the findings of the examination of cast-steel propeller blades which had been surfaced with hard-surfacing alloys of the cobalt-chromium-tungsten type in an attempt to enhance service life by preventing or at least retarding cavitation. The vessel in which the coated steel blades were installed is a twin screw cable ship operating in the North Atlantic and in the West Indies. The ship averaged an estimated 40 per cent of time at the cable grounds. In operation, the vessel often tows a grapple with several miles of cable out. In this type of work high slip ratios are encountered and these conditions favour cavitation of propeller blades. In June 1938 seven of a new set of eight blades were hard-surfaced with an alloy of the type mentioned above. This work was preceded by grinding of the new blade surfaces. A total of 35 sq. ft. was covered using the atomic hydrogen method. A single layer technique was used, followed by light grinding to a smooth finish. In September 1938 these blades, together with a single unsurfaced blade, were put into service. In December 1941, the set was removed and the pitting attack at the alloy-steel junction was repaired by depositing another layer of the same surfacing alloy further along the length of the blade and fusing into the original deposit. In this case the oxyacetylene method was used. At the same time the blade which originally had not been surfaced was now coated with so-called "lead wipe" (a tin-lead-antimony composition). In April 1944, the entire set of blades was again put into service on the same vessel. In November 1946, two blades were damaged and removed from service. One was an alloy-surfaced blade and the other the originally uncoated blade. In all, up to the time of this accident, their service life had been fifty-five months. These two blades were replaced by two more, coated with lead wipe, and the service tests were resumed. In February 1948 the vessel was docked for a routine overhaul and at that time all blades were examined. All alloy coated blades revealed pitting of the uncoated steel adjacent to the boundary of the second alloy coating. The pitting occurred in a band 3-4 inch wide with areas of advanced attack within this band. Several alloy coated blades evidenced severe localized pitting in the alloy at the junction of the first and second coatings. All coatings revealed slight porosity at the junction line between the first and second alloy deposits and fine, discontinuous hairline cracks; and also a slight undermining of the second alloy deposit at the boundary between it and the uncoated steel. Since no sacrificial zinc or aluminium plates were used during the test period, galvanic corrosion is considered to be the basic cause of the attacks noted. Cavitation is possible also, in view of the service conditions, as a contributing factor aggravating the condition at the alloy boundary on the after faces of the blades. The fine cracks in the alloy coatings are characteristic coatings produced without using sufficient preheat before deposition.—*K. B. Young, H. J. Nichols and M. J. Nolan, The Welding Journal, N.Y., Vol. 28, February 1949, pp 153-157.*

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**Paralleling Alternators in Diesel-electric Drives**

Alternating current Diesel electric drives involve the paralleling of alternators without elaborate equipment for maintaining synchronism. Such schemes make greater use of the flexibility of control offered by electric transmission, as they permit the introduction of a choice of medium or high speed Diesel engines in multiples to suit ship powers up to the largest likely to be considered. As in the case of turbo-electric drives, the optimum propeller revolutions can readily be accommodated. One established scheme, meeting the requirement just mentioned, involves the use of double unit alternators. In construction each alternator has two separate stators and two salient pole rotors mounted on a common shaft in correct electrical alignment. One of the stator windings is star connected with neutral point, whilst the other is open star. The two windings are connected in series, phase to phase. The midpoint between windings is tapped off at busbars through an isolating switch, and the free ends of the open star windings are connected to the main busbar system via an isolating switch. The intermediate busbars are termed the synchronizing bars. When the two field windings of each double unit alternator are excited equally with the same polarity, the voltage across the main busbars is twice the voltage across the synchronizing busbars. Conversely, if the two windings are excited equally but in opposition, the main busbar voltage will be zero, but that of the synchronizing busbars will remain unchanged. This second condition enables zero power switching to be effected by simple control equipment, but the important feature is the maintenance of inter-connexion between alternators through the synchronizing busbars, thus keeping them in step with either additive or bucking fields.—*R. G. A. Dimmick, B.T.H. Activities, Vol. 20, No. 1, 1949, pp. 39-40.*

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**Small Refrigerated Ship**

In the recently completed 1,800-ton Norwegian motorship *Vera* all the holds are insulated on the Gregson system by glass wool covered by salt-waterproof aluminium alloy plates. It is claimed that not only is it simple to clean the holds properly and allow of a variation of cargo, but that weight is saved and cargo can always be guaranteed to arrive in a satisfactory condition. As the ship is intended to carry all kinds of refrigerated produce, the employment of aluminium sheeting is desirable, and it is interesting that the *Vera* is the first ship of the type and with such equipment to be built in Norway. The refrigerating machinery is designed to maintain the holds at a temperature of 8 deg. F., and the vessel is wholly refrigerated. The cooling coils with the blowers are arranged in houses between the hatches. The propelling engine is a 900 b.h.p. Polar-type of standard design, and on trials a speed of 13·5 knots was attained with the vessel on light draught. The displacement of the ship when fully laden is 2,715 tons. When loaded with 1,000 tons of cargo the draught is 3·65 m.—*The Motor Ship, Vol. 29, February 1949, pp. 430-431.*