ENGINEERING ABSTRACTS

Section 3. SHIPBUILDING AND MARINE ENGINEERING

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Oxy-kinetic Flame Cutting Process

Stainless steel is difficult to flame-cut. The slag is highly viscous, sticks to the cutting edge, and the oxygen jet alone cannot expel it. Several processes attempt to liquefy the slag by injection of chemicals or reacting metal particles. The process described here, however, consists in charging the jet of oxygen with solid particles, thus strongly increasing its kinetic energy, and in expelling the slag by purely mechanical action. Favourable test results have been obtained with 18-8 stainless steels and special steels of still higher alloy content, as well as with cast iron. The complete plant is shown schematically in Fig. 1. From a hopper, the particles fall through a regulating valve into a small receiver, where the stream of oxygen accelerates the flow of the particles until they leave the burner at a high velocity. The burner itself resembles the ordinary flame-cutting burner, except that a special nozzle has been introduced to withstand the abrasive action of the particles. The operation is the same as for the normal flame-cutting process; first priming and heating up, then cutting with the high-pressure jet charged with particles. The burner may be moved by hand or automatically. Several, even thick, plates can be stacked on top of each other and cut simultaneously; even if warped, they need not be clamped together. The particles must resist shock and must not disintegrate under the combined effect of shock and temperature; moreover, they must pass in a continuous and regular stream through the small orifice of the burner. Sand is a good material for these requirements, but it must be homogeneous, carefully sifted for uniform grain size, and uncontaminated with dust or foreign matter. The oxy-kinetic process produces clean cutting edges and narrow cuts without cutting fringes at the top or bottom. A rapid and economic cut is obtained. In 18-8 steels, stabilised by additions of niobium or titanium, a change in grain structure can be observed directly at the cutting edge, but it does not extend to a depth greater than 0·024 to 0·04 inch. The Brinell hardness of such a steel drops from 200 in the unaffected metal to about 140 at the cutting edge, so that the machining of a flame-cut edge is greatly simplified. The edge need not be ground, but can be planed, shaped, or milled. Stainless steels which are not stabilised undergo a change in grain structure near the cutting edge and will be less resistant to corrosion at these faces. A water jet can, therefore, be arranged to follow immediately behind the cutting jet, so that the material is quenched and regains its initial austenitic structure. The local modification of the structure, however, is usually not very important, especially if the metal is welded after cutting. Industrial cuts have been taken on stainless steel plate up to 8 inches in thickness, yet this it not the maximum thickness that can be cut. In the case of cast iron, the oxy-kinetic process gives a clean narrow cut, whilst the usual high-temperature burner leaves a wide,

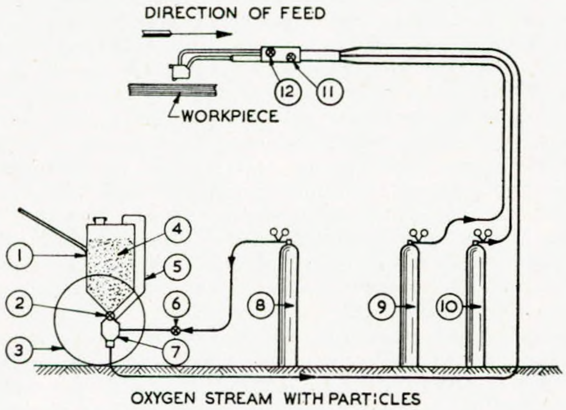


FIG. 1.

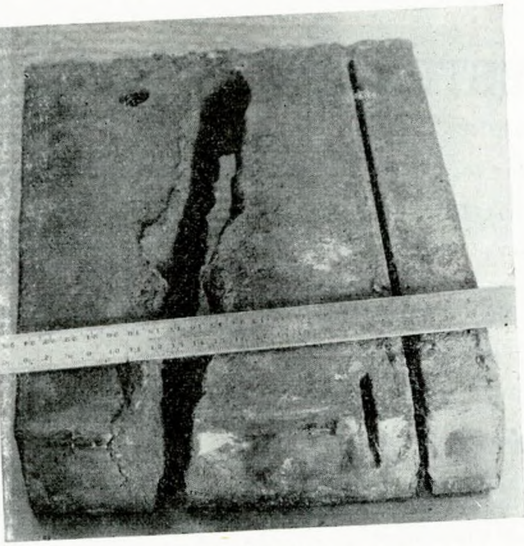
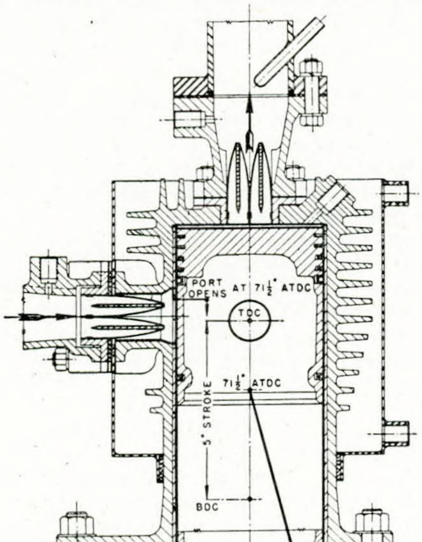


FIG. 4.

irregular groove in the metal (Fig. 4). The economic advantage of the new process is, therefore, very pronounced. The cut edge is not as smooth as with stainless steels, but its appearance is remarkably regular, with only a small fringing effect at the top of the cut. Changes in the grain structure of the material are again localised and do not penetrate further than 0·04 inch into the material. Castings of 8 inches wall thickness have been successfully cut, and again, this is not the maximum of which this process is capable.—*A. E. Leduc, L'Ossature Métallique, Vol. 15, No. 1, 1950, pp. 37-41. Abstracted in The Engineers' Digest, Vol. 11, April 1950, pp. 124-125.*

Pulsating Air Intake for Free-Piston Gasifiers

The problem of induction of atmospheric air into a high-speed reciprocating cylinder is discussed and past efforts to secure greater efficiency are reviewed. An effective solution is presented by a pulsating air intake column tuned to develop three standing half-waves during the period it is isolated from the cylinder and on-half-wave with cylinder content added. Piston-controlled ports, opening at the region of maximum piston velocity with automatic valves to close with reversal of air flow, accurately time the events. Results of tests on a small air compressor are given which demonstrate substantial improvement in volumetric efficiency of th compressor and its output. The effect of supercharging on pulsating air intake column was also tested and encouraging results are presented. The experimental air compressor, a 4 × 5 inch single-cylinder compressor, was thoroughly tested at speeds of 1,500, 2,000, and 2,600 r.p.m., and at discharge pressures of 40, 70 and 100lb. per sq. in. A steel barrel was used as a surge tank and to maintain the temperature of the intake air. The discharge pipe from the centre was led to a large receiver and standard A.S.M.E. nozzles were used for measuring the air flow. During the actual tests a constant inlet-air temperature of 100 deg. F. was maintained throughout. Three liners were used with different port location and timing of intake and three different intake pipes, one for each speed of 1,500, 2,000 and 2,600 r.p.m. The air flow was measured by standard nozzles according to A.S.M.E. Power Test Code Specifications. The evaluation of the test data has been made on the basis of measured volumetric efficiency and the ratio of measured volumetric efficiency to the theoretically possible volumetric efficiency. The effectiveness of the pulsating air column as a superior means for charging a compressor cylinder is demonstrated. Optimum results have been obtained when the mechanically controlled vacuum in the cylinder served as excitation for the pulsating air system consisting of cylinder and intake pipe and produced one half-wave, while the intake pipe alone would generate three standing half-waves of higher natural frequency per cycle. Resonance in a pulsating air system of variable capacity was thus produced with the resultant compression wave of maximum pressure amplitude in the compression cylinder at the end of suction stroke. The automatic intake valves closed when air flow into the cylinder stopped, thereby trapping the compression wave in the cylinder and supercharging it. A redesigned cylinder is required to modify an existing compressor.— *E. C. Magdeburger, Bureau of Ships. 1950 A.S.M.E. Spring Meeting Paper No. 50-S-20.*



Marine Gas-turbine Research

In this paper, which describes marine gas-turbine research in Britain, the author points out that the main research required is to establish the ability to burn heavy fuel without fouling or corroding the turbine blading or heat-exchanger surfaces. As long as efficiencies of the order of 30 per cent are all that can be obtained, and the production cost of gas-turbine units is high, it is essential that the gas-turbine units should be capable of burning boiler oil of the same quality as that used in furnaces of boilers in steam-turbine-driven vessels. The problem is so important that the Admiralty has commissioned many researches on it, including contracts placed with Pametrada. It has provided the following statement for inclusion in this paper: "The field of study has been regarded as divided into six groups, each of which is briefly remarked upon below: (1) *Fuel Characteristics.*—In order to evaluate the problem, a survey is being carried out aimed at giving a comprehensive picture of the nature of the ash forming constituents of crude oils from the various world sources. Work is also in progress on the problem of developing economical and efficient methods of removing undesirable impurities from residual fuels prior to combustion. (2) *Atomization.*—An extensive research programme is in progress to determine the factors affecting efficient atomization of viscous fuels; rig tests of various types of burner and tests on aircraft-type gas-turbine engines provide complementary information. (3) *Combustion.*—Cyclone chambers designed to remove ash from the products of combustion are under active development by N.G.T.E. More orthodox types of combustion chamber designed primarily for use with residual fuel are also to be tested. Some combustion work on aircraft-type gas-turbine engines has been carried out. (4) *Heat*

Transfer.—A study of the radiation characteristics of heavy fuel flames and the means of evaluating flame tube, etc., temperatures by heat-transfer calculations has been undertaken with particular reference to the elimination of "cold spots" upon which carbon deposits might form. (5) *Blade and Heat Exchanger Fouling.*—Tests on static blades are being carried out and the composition of deposits and their metallurgical effects are being studied. Aircraft-type engines designed for operation of distillate fuel are being run for extended periods on residual fuel to obtain practical data on fouling effects under various conditions of flow. A study of the best means of removing deposits from blading and heat exchangers is contemplated. (6) *Materials.*—Work is in hand on the effects of the commoner types of impurities of residual fuel, viz., compounds of sulphur, sodium and vanadium upon the structure and properties of the high-temperature materials used in gas turbines. "In addition specimen blades from static and engine fouling tests receive detailed metallurgical examination".—*T. W. F. Brown, Mechanical Engineering, Vol. 72, May 1950, pp. 379-388.*

Machining of Heated Metals

This paper gives a report of studies made with regard to the machinability of several materials at elevated temperature. It was found that tool life, cutting austenitic stainless steel, was increased twofold by heating to 400 deg. F. High temperature alloys, including vitallium, machined freely at temperatures from 700 to 2,000 deg. F. Long curling chips and a smooth, cleanly cut surface were produced in hot-machining. The same materials cut at room temperature developed a glazed uneven surface and the chips were powdery. Austenitic manganese steel machined easily at 1,200 deg. F., as did fully hardened high-speed steel. An arc-heating method was developed which permitted continuous heating while machining without heating the work throughout. Through the use of this method, surprising improvement in machinability may be achieved. Many materials which were known to be unmachinable by usual methods have been found to machine with ease at elevated temperatures.—*E. T. Armstrong, A. S. Cosler and E. F. Katz, 1950 A.S.M.E. Spring Meeting, Paper No. 50-S-5.*

Properties of Thin Walled Curved Tubes of Short-bend Radius

Flexibility and stress-intensification factors have been measured for a series of U-bends and right-angle bends having values of α-tR/r^2 between 0·04 and 0·14, with r/R=1/3. A theoretical analysis and a corresponding experimental study have been carried out to determine the importance of omitting terms containing the ratio of the tube radius to the bend radius. Experimental work has also been performed to determine the effects of constraints at the ends of the bends. This latter problem has not been studied theoretically. Measurements were made on the foregoing types of bends with (a) straight sections, (b) one rigid flange and one straight section (this condition used for right-angle bends) and (c) two rigid flanges attached to the ends of the bend. Reasonably good agreement between theory and experiment has been found for U-bends and 90-degree bends with straight sections of piping attached to the bend. Rigid constraints attached to the ends of the bend have been found to affect the measured quantities greatly.—*T. E. Pardue and I. Vigness, Naval Research Laboratory, Washington, D.C. 1950 A.S.M.E. Spring Meeting, Paper No. 50-S-21.*

Modern Marine Gears

The authors point out that a smaller, lighter, more efficient, and lower cost gear can be produced by using a higher gear tooth load K factor. With this in mind a small increase in the K load factor is proposed on the basis that pinion hardness would be increased from the present 200-240 Brinell to 300-350 Brinell. Gear hardness would remain substantially the same as now being used. The authors believe that it would be possible to design highly conservative gear propulsion units with the proposed K load factors. They have had several years' experience of operating hard to medium hard pinions with gears of low hardness. Gears which would pit considerably at 200-400 K factor loads with low hardness pinions, would carry high K factor loads without pitting when operated with the harder pinions. This experience indicates that a considerable increase in load-carrying capacity can be obtained by using pinions which are much harder than the mating gears. To demonstrate this fact, the authors made a special test using materials duplicate of that used in high-speed marine gears. Results of the test as outlined in the paper show a very substantial increase in load capacity when the hard pinion was used. Further justification for increasing K factor ratings lies in the general improvement in present-day gear accuracies and in gear materials. During the past twenty years, great advances have been made in the accuracy and materials of hobs and other gear cutting tools. Today, such hobs can accurately cut harder pinions and gears than was possible years ago. Much progress has also been made in the accuracy of hobbing machines, which produce more accurate tooth spacing, tooth profiles, and concentricity of the gears. Present-day dynamically balanced precision hobbed gears do not have to withstand the dynamic impact loads on the gear teeth. Such impact loads have been a contributing factor to tooth failure in the past years. Present-day materials and methods of gear tooth finishing by lapping, burnishing, or shaving, produce a smoother tooth surface than was possible years ago. Surface finish is important when high pitch line and gear tooth sliding velocities are concerned. The smaller and narrower faced, higher K factor gears will be more conservative as they will have 50 per cent harder material in the pinions than the lower K factor gears. They will take less time to hob, therefore, hobbing errors due to temperature variations during hobbing should be reduced. It should be easier to obtain and maintain full face contact in service on the narrower, higher K factor gears since they will be less affected by the weaving of the gear casing on the ship's foundation. If the present trend in shipbuilding of using larger powers, higher turbine speeds, low propeller speeds is continued, and low K factors are specified, the gears may get so large that it will be impossible to ship them by rail. The present limit is 175 inches in diameter for rail shipment to some of the shipyards. The recommendations in favour of harder pinions and higher K factor are not based on one laboratory test. They are based on various tests and observations over a number of years. Valuable information was obtained in manufacturing the large number of gears during the last war. All of the hundreds of marine gears built by General Electric before and during the last war were tested in the factory at full load and full speed. This gave a good check on the quality of work produced by each hobbing machine and helped establish quality control procedures and manufacturing techniques which produced the desired results. This experience, plus the gear load tests at the Naval Boiler Laboratory and in the G.E. Laboratory, is believed to justify the proposal to increase the allowable K factors on propulsion gears to 120 K on the first reduction and 95 K on the second reduction.—*Paper by J. J. Zrodowski and D. W. Dudley, Bulletin, The Society of Naval Architects and Marine Engineers, Vol. 5, May 1950, pp. 14-15.*

International Research on Flame Radiation

Whilst very little is yet known on the factors affecting flame radiation, this is a matter of great importance in relation to the mechanism of heat transfer in furnaces and boilers. At the end of 1948, therefore it was decided to embark upon a programme of joint international research into the factors affecting luminous flame radiation and the Royal Dutch Steelworks at Ijmuiden, Holland, made available their experimental furnace. This furnace had been built in 1947-48 for the study of the radiation from oil flames. During 1949 three teams were built up in Holland consisting of physicists from the British Iron and Steel Research Association, United Steel Companies and Pilkington's from Great Britain; from IRSID, the Institut du Petrole; Air Liquide and the Laboratoire des Hautes Temperatures from France; and from the Royal Dutch Steelworks and the Royal Dutch Shell Oil Company, who also supplied all the reference oil for the tests. The general plan agreed on for the research was that two kinds of trial should be carried out, termed respectively "engineering" and "scientific" trials. In "engineering" trials a large number of independent variables such as fuel rate, kind of fuel, kind of burner or port, excess air ratio, etc., are altered systematically and a limited number of radiation, temperature and combustion properties of the flame are measured for each flame setting. In "scientific" trials a relatively small number of different flame settings are to be studied in great detail by means of probes so that, for example, the course of combustion of individual droplets, the mechanism of soot formation and the emissivity and temperature of different parts of the flame can be elucidated in detail. It is felt that this more fundamental approach is likely in the long run to lead to results at least as practical as those obtained by the more empirical approach of the engineering trials.—*The Refractories Journal, Vol. 26, May 1950, pp. 185-186.*

Design of Modern Tanker with Special Reference to Machinery

The main purpose of this paper is to show that the major oil companies, when developing a class of vessel for a building programme, must give much consideration to the trade for which the vessels are intended and apply all the results of all collated data in conjunction with the results of experience of the company's technical staff, if the tanker is to be a capable and efficient freighter of the many and varied products of the present-day refineries. The principal factors governing the design are set down firstly and the author endeavours to show, by referring to these factors throughout the paper, the development of a tanker from the initial stages to the completed vessel, giving, as far as the scope of the paper is concerned, the various reasons for the choice of type of main and auxiliary machinery. The paper refers to the fact that a tanker which is capable of carrying and handling all grades of petroleum in a safe and expeditious manner must be capable of producing an abnormal amount of auxiliary steam which must influence an owner seriously to consider steam propulsion.—*Paper by W. Lynn Nelson, O.B.E., Transactions, the Institute of Marine Engineers, Vol. 62, May 1950, pp. 177-208; Discussion and Author's Reply, pp. 209-211.*

Full-scale Trials of Schnitger Propellers

The author reports the results of comparative trials of normal and Schnitger propellers in fishing vessels, a motor tanker, and the emigrant ship *Skaugum*. These trials demonstrate the superiority of the Schnitger propeller over a normal screw. Bollard tests with a single-screw whale catcher at constant revolutions of the propellers and constant power (900 s.h.p.) gave tow-rope pulls of 35·0lb. per s.h.p. and 41·7lb. per s.h.p. for normal and Schnitger propellers respectively. A measured-mile trial was then carried out with the same ship, and here the Schnitger propeller resulted, when run at the same speed as a normal propeller, in an increase of the ship speed by 3 per cent, or at constant ship speed, in a reduction of the propeller revolutions by 3·5 per cent and of the engine power by 10·5 per cent. The time for stopping the vessel was reduced by 17 per cent. Similar experiments were carried out on a twin-screw motor tanker. For constant power, the Schnitger nozzle increased the ship speed by 2·1 per cent and the propeller revolutions by 2·6 per cent. When the ship speed was kept constant, the Schnitger propeller brought about a saving in power of 8·1 per cent. Reversing was made much easier, and for constant stopping time of the ship, the use of the Schnitger propeller increased the speed from which she could be brought to a standstill by 16 per cent. This occurred in 3·56 ship lengths as compared with 4·5 lengths with normal screws. Turning was also facilitated by using Schnitger propellers. The stopping time for the *Skaugum* was similarly shortened by fitting Schnitger nozzles. Other trials on several fishing vessels revealed an increase in the tow-rope pull by 13 per cent to 18 per cent, of the thrust by 11 per cent to 14 per cent, and of the speed of the free-running vessels by 2 per cent to 3 per cent.—*H. Hoppe, Schiff und Hafen, Vol. 1, September 1949, p. 170. Abstract No. 3,625, Journal, The British Shipbuilding Research Association, Vol. 5, May 1950.*

Full-scale Check on Model Tests

The hull of the Clyde paddle steamer *Lucy Ashton,* which was bought by the British Shipbuilding Research Association, will be used for full scale measurements of resistance with a view to checking the predictions of ship resistance that are made from model tests at experimental tanks. The highest degree of accuracy is required as the results to be obtained may well be of vital importance to ship designers. The resistance of a ship's hull at any speed cannot be measured accurately from knowledge of the power developed by its engines since this power is converted to thrust by means of propellers, which involves certain losses. The efficiency of a full size propeller cannot be measured. Moreover, propeller action itself affects the resistance of the hull. An alternative arrangement would be to tow a vessel and measure the pull in the tow rope. Such an arrangement would present many difficulties in any case, and, particularly, at some of the higher speeds at which it is hoped to propel the *Lucy Ashton.* Moreover, the slipstream of the towing vessel or vessels would affect the results. It has therefore been decided to propel the *Lucy Ashton* by means of aircraft jet engines, and four Derwent V engines, manufactured by Rolls-Royce Ltd., have been made available by the Ministry of Supply. They will be mounted in pairs on either side of the hull on a specially constructed frame mounted amidships. They will be so mounted that the actual thrust developed by each engine at any moment can be accurately recorded and controlled.—*The Shipping World, Vol. 122, 7th June 1950, p. 512.*

Catalytic Combustion

It has been shown by experiment that the addition of certain catalysts to fuel oil leads to a far more complete combustion resulting not only in a substantial economy but also in increased cleanliness. Discussing this problem the American journal *Marine News* states that the effect of using a catalyst in the fuel has been tried out in a number of steamships with satisfactory results, higher boiler efficiencies having been obtained over long periods with a fuel saving ranging from six to twelve per cent. There is complete combustion of the fuel which enters the combustion chambers so that no harmful deposits are formed on the walls. Moreover, there is no unburned fuel carried on to the boiler and superheater tube banks to form slag, while fire hazard due to unburned fuel carried on to the air heater and economizer surfaces is eliminated. Furthermore it is claimed that owing to the improved combustion in the flame of the burner and the cleaner tube surfaces, there is a more uniform heat transfer which not only results in a more efficient working of the boiler but leads to a reduction in maintenance costs. The nature of the catalysts is not disclosed, nor is the cost of treating the fuel given, but it is apparent that if this latter is not excessive, the process certainly merits further investigation.—*Shipbuilding and Shipping Record, Vol. 75, 15th June 1950, p. 735.*

Corrosion of Propeller Shafts

This article reviews ways and means of combating propeller shaft damage by corrosion. Special reference is made to the research conducted by C. Manzitti in the years 1933-1936. The latter was in charge of an investigation concerned with the damage by corrosion of the propeller shafts of the quadruple screw motorship *Victoria* owned by the Lloyd Triestino. The remedial measure applied was the rebuilding of the affected parts adjoining the bronze liners by applying a sprayed-on layer of nickel which proved sacrficial in service thus affording protection to the shafting. A potentiometric circuit devised to drain off stray currents from the propeller shafts was also installed.—*L. Fea, G. Guidi and M. Raffo, Rivista Marittima, Vol. 82, June 1950, pp. 558-581.*

Systematic Geometrical Variation of Ship Forms

In connection with the derivation of the lines for a new design from those of a similar basis ship, consideration has been given to the well-known "one minus prismatic" method for correcting the difference in fineness between the two forms, and the limitations inherent in this method have been discussed and enumerated. Principal among these is the fact that the fineness and the extent of the parallel middle body cannot be varied independently. To overcome this and other consequent restrictions more general methods of derivation have been developed which permit independent variation of not only the fineness and l.c.b. position, but also the extent of parallel middle in both the fore and after bodies (or alternatively the lengths of entrance and run). There are limits to which the fineness can be varied by these means, but it is shown that the range is sufficiently wide to cover practical requirements. The methods can be applied to any existing parent form and, apart from the preliminary calculations of the necessary geometrical particulars of the form, they are just as convenient to apply as the usual "one minus prismatic" variation. It is suggested that these more general methods of form deviation might be found useful in connexion with the following: (1) Making systematic variations to parent forms for methodical series of resistance experiments, as there is a free choice of the more important geometrical features likely to influence the resistance. (2) Preparing body sections for new designs and at least for those cases where, for reasons explained in the paper, the usual "one minus prismatic" variations cannot be applied. The methods described have been used to derive the forms for methodical series of resistance experiments on ship models carried out for the British Shipbuilding Research Association.—*Paper by H. Lackenby, submitted for written discussion, Institution of Naval Architects, 1950.*

Electrical Distribution on Shipboard

In the design of an electric shipboard power supply system, there are two basic considerations in selecting and co-ordinating the protective elements. One is the protection of apparatus from failure and the other is the protection of service continuity from failure. It is not possible to obtain the maximum of both of these protective features on the same system at the same time. The relative importance of one as against the other depends upon experience and the comparative risks, hazards, and penalties involved in the event of apparatus or service failures as the case may be. There is a growing trend in the thinking among marine circles that service protection is of considerably more importance than apparatus protection because the hazards are more serious. In other words, good service protection on ships should be achieved, if need be, at the expense of the degree of equipment protection. It should be remembered that service failure may involve also failure of apparatus. On the other hand, apparatus protection simply buys long life and usually appears in the form of devices which interrupt service in the event of excessive temperature or transient over-voltage. Overload protection, often confused with short-circuit protection is precisely what it implies. It protects generators, cables, motors, etc., against overloads whose principal offence is reducing the life of the equipment being protected. Inadequate overload protection, in a rarely few cases, may be the cause of fires. Fires from this presumptive cause, when and if they do occur, actually may be a result of over-aged worn-out apparatus. Overload protection, land or sea, usually appears in the form of a thermal or equivalent mechanical device having the same current characteristic (on the safe side) as the apparatus being protected. All overload protective devices operate as a function of magnitude of current and time-duration of current. Unlike overloads, short circuits usually result in temporary or permanent outages. Short circuits, unless rapidly cleared, can start vicious fires and may do irreparable damage to the electrical apparatus involved as well as adjacent units. There is very little published information on the short-circuit currents available on direct-current generators. At the time the Victory ship programme was getting under way a comprehensive series of short-circuit tests were made by the General Electric Company on a Victory ship service system laid out in exact replica. Two compound-wound, 240/120 direct-current, 300-kW. generators, were driven by large synchronous motors and were connected to the bus through main and equalizer connexion cable. A 100-h.p. motor was connected to the bus to establish the contribution of motor loads to short-circuit currents. Under the direct bus short circuits the tests showed that the available currents at the terminals of many load (moulded case) breakers were far in excess of their interrupting capacities. The current of the bus reached a peak of ten to twenty times generator rating from the generator and from six to twelve times rating from the connected motor load, depending on the length of the feeder circuits.—*Paper by F. M. Starr, Bulletin, The Society of Naval Archtiects and Marine Engineers, Vol. 5, May 1950, p. 17.*

Propelling Machinery for Naval Ships

In view of the need for research in regard to future naval requirements, the Admiralty have placed with Messrs. Yarrow and Co., Ltd., of Scotstoun, Glasgow, a contract to investigate —in association with the English Electric Co., Ltd., of Stafford —in which direction future machinery designs for naval vessels should be developed. The investigation will cover a wide field, and will include a world survey of existing designs. Close co-operation between the Admiralty and Messrs. Yarrow and the English Electric Company will be maintained throughout the work.—*The Shipbuilder and Marine Engine Builder, Vol. 57, June 1950, p. 424.*

Propeller Guards

With the propeller guard shown in Fig. 3, a ring, arranged in halves (10, 11), is provided, and screws (16) for securing the ring to the propeller boss pass through a flange (14), the

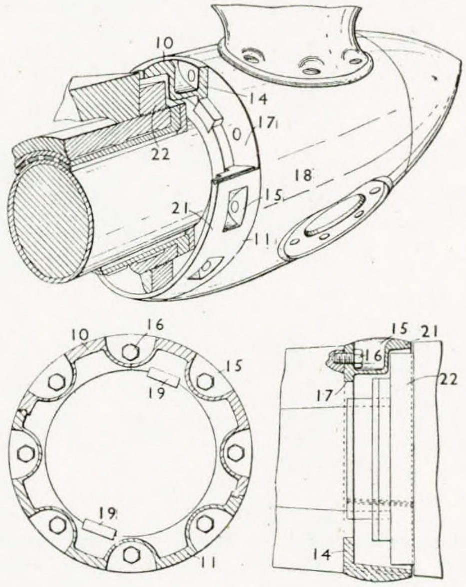


FIG. 3.

screw heads being housed in pockets (15). The flange (14) fits in a recess (17) in the forward end of the boss (18). The edge of the flange and the boss have keys (19) which lock the ring against circumferential movement, so that the screws cannot shear should the guard be fouled by a rope. The ring (21) shields the stern tube nut (22), so that the entry of a rope to the space between the nut and boss is prevented.—*Brit. Patent No. 636,067, issued to D. L. McLean, Liverpool. The Motor Ship, Vol. 31, June 1950, p. 119.*

Mercury Shaft Seal

Seals for relatively large shafting, operating under conditions of high rubbing velocities, present a number of rigid requirements that are regarded as essential for satisfactory performance. These include such factors as high accuracy of manufacture, careful installation, lubrication of surfaces, re-

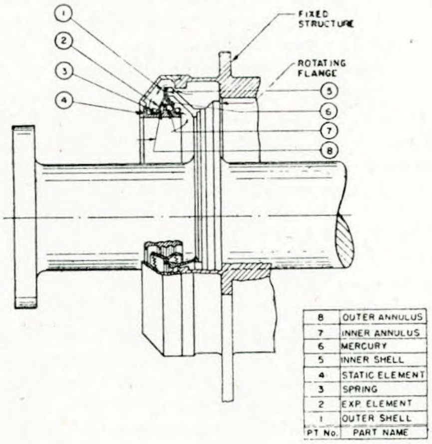
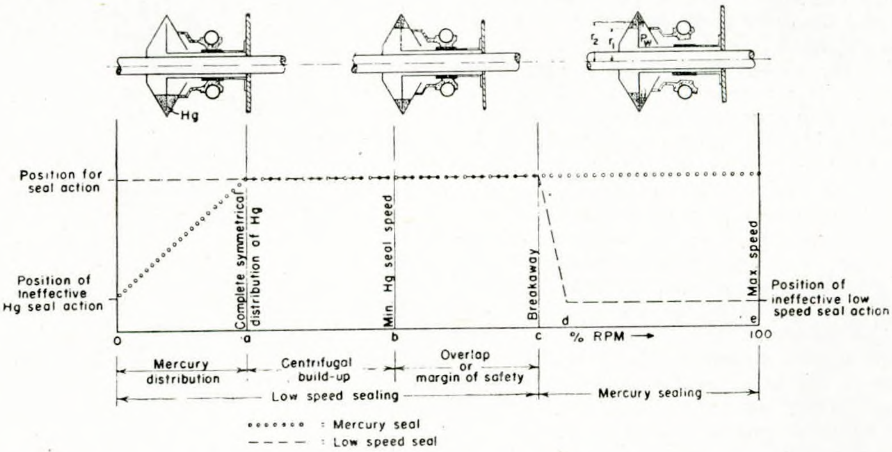


FIG. 1.

duction of heat losses, ease of maintenance, dependability and alignment under operating conditions. During recent studies of a shaft seal problem the use of a mercury seal, supplemented by a rubbing seal, which was to function only at low speeds, was conceived as a possible solution. This seal is schematically illustrated in Fig. 1. The seal consists of four main elements, namely the annular channels (7)-(8), expandable elements (2), static element (4) and the sealing medium (6) which is mercury. The shells bounding the annular channel are secured to the rotatable shaft through suitable means. Expandable elements are attached to and from part of the channel. The static element is fixed to the housing. The sealing medium is mercury and is retained in the annular channel. The steps in the operation of this unit are entirely automatic and do not require the use of any electrical or mechanical actuators. The various elements operate over the desired speed range and are actuated by the centrifugal forces developed by rotation. Under the conditions of zero shaft speed the mercury change remains at the bottom of the annular channel as shown in Fig. 2 position "o". Over the speed range o-c, Fig. 2, the flexible units grip the static element and thus prevent the passage of a medium such as water from one side of the seal to the other. With rotation of the shaft centrifugal force tends to lift the expandable element from contact with the static member. However, the design is such that centrifugal force on the mercury causes it to be uniformly distributed around the annular channel well in advance of the actual break in contact between flexible and static seal elements. This condition is reached at speed position "c", Fig. 2. Therefore, there is a speed range, b-c, relatively narrow, in which there is a double or overlapping seal between the flexible and static elements and by the mercury. This condition, with the double seal existing, is illustrated in the range b-c. As the shaft speed is further increased beyond point "c", the centrifugal force lifts the flexible units from contact with the static member and the seal is then maintained by the mercury through the range c-e. The curve in Fig. 2 indicates the position at which the various elements operate with an increase in shaft speed from zero to maximum. In bringing the shaft from maximum speed to rest, the steps are reversed in order. Therefore a seal is maintained under all operating speeds from zero to maximum. The sealing of line shafting at points of bulkhead penetration appears to be an ideal application of the mercury seal with features incorporated to give maximum flexibility. This flexibility is necessary to assure sealing under severe bulkhead damage and one compartment flooding that might result from a collision. Bulkhead distortions, depending on shaft size and seal dimensions as great as 12 inch are considered feasible without causing the seal to become inoperative. Another application considered in the article is that at the point of entry to a gear case. Foot notes to the article state that a patent is pending and that the development work was conducted by Reed Research Inc. under contract to the U.S. Bureau of Ships, Department of the U.S. Navy.—*J. W. Sawyer and L. Crawford, Journal of the American Society of Naval Engineers, Vol. 62, May 1950, pp. 349-363.*

FIG NO. 2
MERCURY SHAFT SEAL
SCHEMATIC OPERATION



Variation of Propeller Efficiency with Pitch Ratio

Methodical series propeller results cover a range of pitch ratio of about 0·4 to 2·0, and indicate that the peak efficiency increases with pitch ratio, although the increment is small as the pitch ratio approaches 2·0. This report is a theoretical analysis to guide extrapolation to higher pitch ratios. The parent propeller is of three blades and 0·35 blade-area ratio. It is found that the peak efficiency increases from 0·78 at unit pitch ratio to a maximum of 0·85 at 2·4 pitch ratio, and then decreases to 0·68 at 10·0 pitch ratio. The advance coefficient for peak efficiency increases more or less progressively from 0·928 at unit pitch ratio to 8·0 at 10·0 pitch ratio. The theoretical curve shows reasonable agreement with test results over the comparable range of pitch ratio from 1·0 to 2·0. To work at the maximum peak efficiency of 0·85, the propeller r.p.m. would be small, e.g. 130 for a propeller of 10 feed diameter and 24 feet face pitch advancing at 20 knots.—*H. Lerbs, Admiralty Experiment Works Report No. 29/49 (1949), Journal, The British Shipbuilding Research Association, Vol. 5, June 1950, Abstract No. 3,718.*

Controllable Pitch Propeller in Collier

The collier *Wandsworth,* built by the Burntisland Shipbuilding Co., Ltd., for the South Eastern Gas Board, is a collier of 2,825 tons gross, propelled by a reversible eight-cylinder British Polar marine Diesel engine developing 1,250 h.p. at 225 r.p.m. The propeller was manufactured by J. Stone and Co., Ltd., under licence from Karlstads Mekaniska Werkstad. The Stone-Kamewa propeller on the motorship *Wandsworth* has a bronze boss and three bronze blades. Its diameter is 9ft. 4in. and it has a developed surface area of 29 sq. ft. Although the ship can be driven astern by altering the pitch of the propeller blades, the reversing characteristic of the engine is retained. Alterations to the pitch of the propeller blades are made on the bridge from the control pillar. By moving one single operating lever the officer responsible can adjust both engine revolutions and the pitch of the propeller blades, thus achieving the greatest fuel economy for any condition. Movement of this lever is transmitted to the pitch-changing mechanism by means of a pneumatic transmission system. The pitch of the blades can also be altered locally in the engine room and, in an emergency, the engine can be stopped instantaneously from the bridge control pillar.—*The Shipping World, Vol. 122, 21st June 1950, pp. 553-554.*

Torsional Vibrations Caused by Propeller

When investigating the torsional vibrations of a propeller shaft it is usual to take into account only the torque variations caused by the propulsion machinery and to assume that the resisting torque is constant. This is not justified, since the force on a blade element during its rotation through the wake varies considerably, and the deflexion of the blade due to these changing pressures will introduce further irregularities into the resisting torque. The author has attempted to determine approximately the variation of propeller torque due to the wake for three- and four-bladed single and twin screws. He assumed a definite type of flow based on published results and calculated from it the variation of the angle of incidence and then the lift force on the blade for every 15 deg. of shaft rotation. He then subtracted the fundamental component and obtained the harmonics present. The worst result was found in the case of three-bladed single propellers which showed the existence of large third and sixth harmonics. The twin screws showed a fairly strong third harmonic, and the four-bladed screws both had slight fourth harmonics. The author suggests that, by matching the screw with a suitable prime mover (three, four, or six cylinders) at the right angular position, it should be possible to eliminate most of the torsional oscillation.—*G. Rabbeno, Riv. Marittima, Vol. 82. March 1950, p. 551, Journal, The British Shipbuilding Research Association, Vol. 5, June 1950, Abstract No. 3,806.*

German Diesel for Norwegian Vessel

The first large post war Diesel of M.A.N. design built in Germany is now undergoing test bench trials. This engine will be installed in a Norwegian cargo vessel under construction at Trondhjem. The principal data of the vessel are overall length 100 m., breadth moulded 13 m., deadweight 3,600 tons. Speed 14 knots. The M.A.N. engine is of the D 6 Z 60/90 type with six cylinders of 600 mm. diameter and 900 mm. piston stroke, developing 4,000 h.p. maximum at 140 r.p.m. The scavenging pump is of the double-acting single cylinder tandem type.—*Motortechnische Zeitschrift, Vol. 11, No. 2, 1950, p. 52.*

Fiat Geared Diesel Engine Plant

In view of the increasing attention now being paid to the possibilities of geared Diesel propulsion plant, the recent proposals for plants of this type made by the Fiat concern are of considerable interest. This interest is further enhanced by the fact that the designs proposed for a 7,500 s.h.p. and 13,000 s.h.p. plant respectively are purposely made comparable with the British designs of the same powers described and discussed on the occasion of the symposium on "The Engining of Cargo Vessels of High Power", held by the Institute of Marine Engineers in November 1947. Referring to the propulsion plant of 7,500 s.h.p. output, the Fiat engineers propose two alternative special types of medium-speed light engines. The first of these incorporates single-acting cylinders of 19 inch bore with 25·2 inch stroke, rated at 330 b.h.p. at 270 r.p.m., with 68lb. per sq. in. mean effective pressure and a piston speed of 1,140ft. per minute. At full service rating such a cylinder can develop 430 b.h.p. at 300 r.p.m. The second type embodies double-acting cylinders of 19 inch bore with a 25·2 stroke, rated 570 b.h.p. at 270 r.p.m. with a mean effective pressure of 63·5lb. per sq. in. and a piston speed of 1,140ft. per minute. This

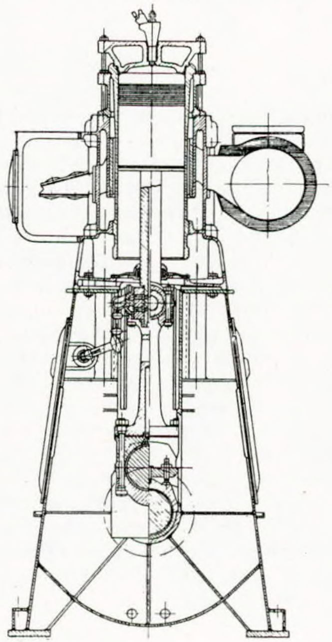


FIG. 1.

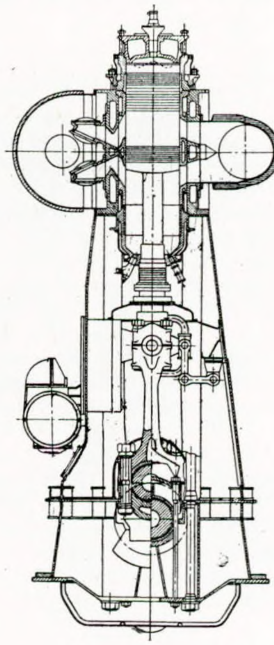


FIG. 2.

cylinder can develop 750 b.h.p. at 300 r.p.m. Cylinder sections of these two types are shown in Figs. 1 and 2 respectively. Bedplate and framing are of welded steel construction, a one-piece design being used for the single-acting type, while a two-part design with the tie rods is seen to be proposed for the double-acting type. Both engines are seen to be of the cross-head type. For engines with up to five or six cylinders, scavenging pumps of the piston type will be used, rotary pumps to be used for larger numbers of cylinders. Fiat proposes the employment of Vulcan hydraulic couplings or of electro-magnetic couplings between engine and reduction gear. Either system will prevent the transmission of torsional vibrations from engine to gearing. First cost, weight, space required and power losses are the same in both cases. The engines will be of the direct reversing type, thus doing away with the need for a reversing gear. The reduction gear causes a total power loss of 5 to 6 per cent, it is stated. However, part of this loss is recovered through the improved propeller efficiency. In order to reduce the length of the engine, scavenging blowers placed above the reduction gear casing have been developed. Elevational views of the proposed layout for the 7,500 s.h.p. plant are included in the article. One illustration shows the installation of four single-acting engines and another outlines that of two double-acting engines. The double-acting engines plant comprises two 7-cylinder engines rated at 4,000 b.h.p. at 270 r.p.m. operating a single screw at 100 r.p.m. The scavenging blowers are arranged above the reduction gear casing. The single-acting installation is composed of four 6-cylinder engines, each rated 2,000 b.h.p. at 270 r.p.m., likewise turning a single screw at 100 r.p.m. In this case the scavenging piston-type pump is direct-operated. Maximum output on trial is estimated at 10,000 b.h.p. Each single acting unit of 2,000 b.h.p. weighs about 80 tons, and each double-acting unit of 4,000 b.h.p. about 115 tons. Total weight of machinery in running conditions is as follows:—

	Double-acting tons	Single-acting tons
Main engines	230	320
Spares	10	10
Reduction gears	40	40
Shafting, including spares	133	133
Auxiliaries	152	152
Piping, ladders, gratings and minor accessories	175	175
Water and oil	28	28
Total ...	768	858

It is expected that the fuel consumption of these engines will be slightly larger than that of a corresponding slow speed Diesel engine. Assuming this increase to amount to some 3 per cent, and taking into account also the power losses due to the employment of a reduction gear, the fuel rate of the geared Diesels may be 4 or 5 per cent more per b.h.p. than that of a slow speed engine of comparable output. Therefore the daily fuel consumption of the plants under consideration will approximate to some 31 to 32 tons, and to this must, of course, be added the fuel requirements of the generating sets. This shows that the geared engine will consume as much normal Diesel fuel in weight as the large engine burns heavy boiler oil. However, the geared Fiat engines are claimed to operate very reliably with fuel oil of density up to 0·94, or even 0·95, provided it is not of too inferior quality. As stated by Dr. R. de Fieri, of the Fiat concern, his firm has not yet sufficient experience to be able to guarantee fully reliable operation of the geared Diesel engines on Bunker "C" oil, as is the case with the large Fiat engines. The lubricating oil consumption for the geared Diesels is estimated as some 150 to 180 kg. per day.—*The Shipping World, Vol. 122, 31st May 1950, pp. 492-493.*

Boiler Oil in American Motor Ships

For two or three months the American motor ship *Del Veinto,* owned by the Mississippi Shipping Co., has been operated on boiler oil with a viscosity S.S.U. at 100 deg. F. of 1,800, a flashpoint of 285 deg. F., a pour point of 15 deg. F., a sulphur content of 0·46 per cent, and a carbon content of 9·3 per cent. The fuel is heated, as in the *Auricula,* to 180 deg. F. The engines installed are of the Nordberg type. So far the results have been satisfactory.—*The Motor Ship, Vol. 31, June 1950, p. 95.*

Large American Diesel Engines

In this summary of curent developments in large Diesel and gas engines the author points out that America has not kept pace with Europe in the application of the Diesel engine to the marine field. Only about four to five million h.p. in marine engines of 8 inch bore or greater, exclusive of navy and army, are in use. There is evidence, however, that this situation is undergoing a change. Fuel economy, space, and weight are forcing modern Diesel machinery into the picture. One American builder of large marine engines uses the Doxford type of design. Geared drives are apparently increasing in favour, and with the development of electric couplings of the eddy-current type, and the electric drive, or a combination of the two, the trend logically points towards more cylinders at higher r.p.m. to gain both space and weight. The piston is the one part of American engines which has received the greatest attention and has undergone the most evolution. Both cast iron and aluminium are used, although within the sizes referred to in the paper, cast iron greatly predominates. The greatest change of thinking in piston design has come about through a better understanding of heat flow. In the design of piston rings, the tendency has been to decrease their width materially. Some manufacturers are using chromium-plated rings, particularly in the top grooves. Others have resorted to the bronze insert ring for the top groove, and report it to be particularly resistant to scuffing. A higher-tension ring with a higher grade of material has become a necessity as engine speeds and ratings have increased. Most of the valves are of welded design, to provide for the best-known material in the valve head and still have a more suitable material in the stem. All American manufacturers are well aware of the necessity for handling fuel oils of less desirable qualities. Definite progress is being made, and there are now authentic reports of the successful handling of very inferior fuels by engines of relatively small bore and high speed. For ocean-going vessels it has always been necessary to employ some form of progressive maintenance. In this system of maintenance, certain parts are removed for inspection and even replaced with spares on certain schedules, whether they need it or not.—*Paper by R. L. Boyer read at the Fourth World Power Conference, London, on 12th July 1950. Section F, Paper No. 2.*

Pilot Fuel Injection System

The fuel injector shown in Fig. 3 provides a charge of pilot fuel at a low rate followed by a charge of main fuel without a break between the two deliveries when fed by a pump discharging fuel at a constant rate throughout the injection period. It is assumed that the internal ducts between the valves (8, 19) and the valves (32, 33) are full of fuel. When pressure is exerted by the fuel pump, the valve (19) seals the hole (18) so that the fuel flows down the passage (21) into the space (23) and thence through the hole (30). The valve (32) opens and fuel passes down the passage (41) to the pilot orifice (43). The cross-sectional area of the orifice (43) is insufficient to pass all the fuel and the excess amount is compressed in the space (23) raising the plunger (2). This compresses the fuel above the plunger in the passages (6), (7), and

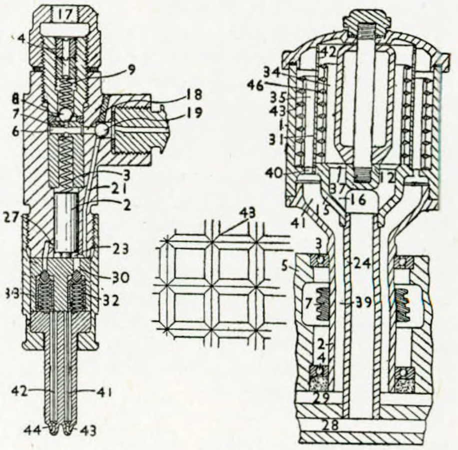


FIG. 3

when the pressure overcomes the strength of the spring (9), the valve (8) is lifted and discharges excess fuel from the space (3) through the hole (14) to the return lead (17). The plunger (2) rises until its lower edge has uncovered the groove (27). Pressure in the space (23) rises and opens the valve (33) so that fuel is discharged through the passage (42) and thence to the main fuel jet (44). Injection through both orifices (43, 44) continues until spill occurs in the fuel pump. *Brit. Patent No. 636,080, issued to Kammer Engines Ltd. and G. S. Kammer.—The Oil Engine and Gas Turbine, Vol. 18, June 1950, p. 81.*

Two-stage Injection

Two kinds of two-stage injection can be effected: (1) Small pilot charge injection ahead of the main charge; this begins to burn and ignites the main charge which enters after an interval; (2) Continuous injection, commencing at a low rate followed by the major phase at a higher rate. The C.A.V. system follows the second method, using a two-stage pump cam, a special delivery valve and a special injector. With this twin-hump cam (Fig. 6) the follower is always rising throughout the delivery stroke—there is no pause. The special delivery valve is planned to give freedom from re-opening of the injector after delivery cut-off; this might otherwise be set up by reflected waves in the pipe acting upon an injector set for low opening pressure. The special injector adopted is rather more complex than usual as it has to provide lower than usual opening pressure but positive closure without fear of gas entry from the engine cylinder (Figs. 7 and 8).—*The Oil Engine and Gas Turbine, Vol. 18, June 1950, pp. 60-63.*

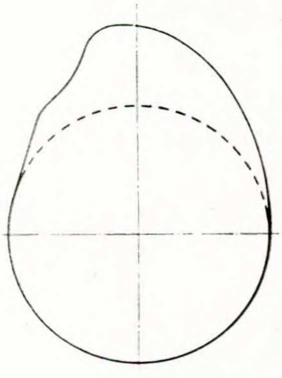


FIG. 6

C.A.V. "two-hump" cam for pilot injection

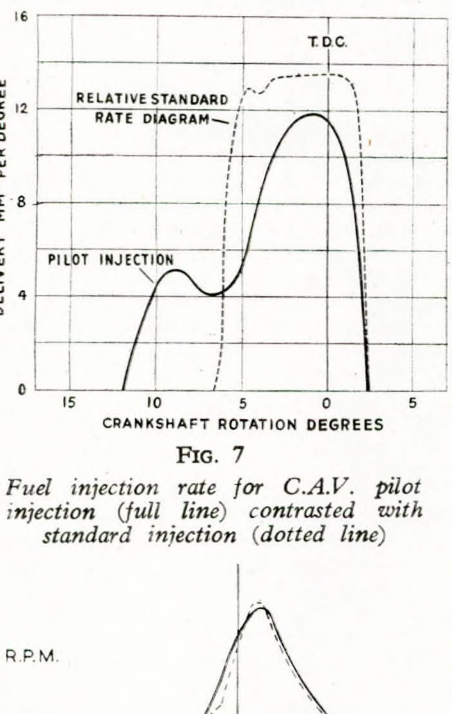


FIG. 7

Fuel injection rate for C.A.V. pilot injection (full line) contrasted with standard injection (dotted line)

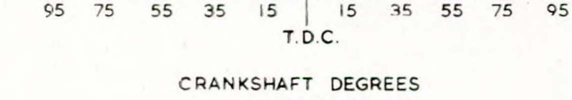


FIG. 8

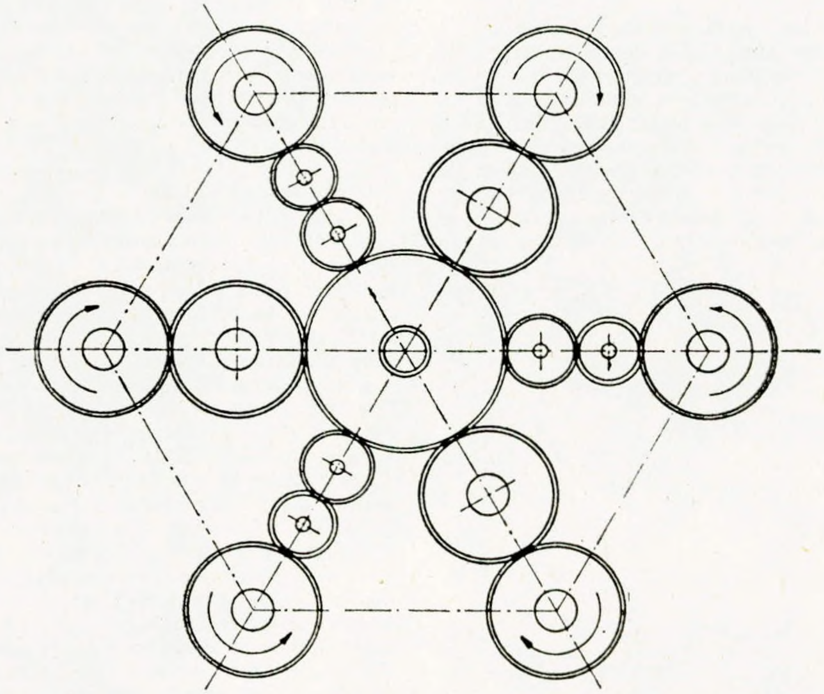
Cylinder pressure diagram with C.A.V. pilot injection (full line) compared with normal system

Oil-fired Marine Boilers

This paper deals with the present state of art of development of marine oil-fired boilers for the British Merchant Service and for ships built in British shipyards during the post-war years. A considerable percentage of the steamships built have adopted the 450lb. per sq. in. 750 deg. F. cycle, a combination which avoids the use of alloy steels in the superheaters. For the higher powers, the 600-650lb. per sq. in. 850 deg. F. cycle has proved its effectiveness in service, the increased first cost of the installation being fully justified by the fuel economy effected. The highest-pressure British-built ships afloat are the post-war *Beavers* of Canadian Pacific Steamships Ltd. These operate at a boiler pressure of 850lb. per sq. in. superheated to 850 deg. F., and the steam is extracted from the turbines at 160lb. per sq. in. pressure and reheated to 850 deg. F. These four ships are, however, propelled by turbo-electric drive and, since they have unidirectional turbines (i.e. no astern turbines to be safeguarded) reheating is a comparatively simple matter. This cycle has not been adopted elsewhere in British ships, and there seems little doubt that for future developments the straight cycle is likely to be adhered to, particularly for all geared turbine vessels. Regarding oil burners, the trend is towards sprayers having a higher output, with a wide range control, to reduce the need for shutting off and lighting up burner units to meet fluctuating steaming requirements when entering and leaving port. The wide-range high-output burner is associated with oil pressures of 300lb. per sq. in. and upwards (as against the older 120-200lb. per sq. in. range) and with correspondingly increased air pressures, the use of which is made possible by the modern system of double-casing the boiler units themselves. The latter arrangement offers the additional advantage of normally dispensing with the necessity for induced draught fans; at the same time leakage of gas into the boiler room is prevented.—*Paper by Captain(E) W. Gregson R.N.R., read at the Fourth World Power Conference, London, on 13th July 1950. Section E2, Paper No. 8.*

First Multiplex Engine

There is nothing new in the idea of placing the cylinders of an internal combustion engine in polygonal arrangement, but that a really promising power unit with cylinders arranged in this manner should be running successfully is definitely novel. This engine, the Multiplex (type Hexa 30) is a 2,100 b.h.p. opposed-piston two-stroke, with 30 cylinders arranged in regular hexagon formation. The bore is 5·11 inch and the total stroke for each pair of opposed pistons 11·8 inch giving a capacity of four litres per cylinder, or 120 litres for the engine. Scavenging air is supplied by two engine-driven centrifugal compressors at 5·68lb. per sq. in. At a power output shaft speed of 1,200 r.p.m. the engine develops 2,400 b.h.p., but the compressors absorb about 300 h.p. of this, so that effective rating is 2,100 b.h.p. Injection equipment is of special design. There are three pumps, each feeding a batch of 10 cylinders. These pumps run on the controlled pressure system, and each has five plungers with variable delivery control. The plungers put the fuel under high pressure in a small accumulator located in the head of the pump, whence it is delivered to the respective cylinders by means of a rotary valve. Fuel pressure is controlled by a bleed, by means of bellows and a counterpressure from the hydraulic governor circuit. Variation of injection advance is effected by axial displacement of the rotary valve, according to the pressure. All three pumps are controlled by the same governor system. B.m.e.p. is 102·4lb. per sq. in. and combustion pressure is 995lb. per sq. in. to 1,024lb. per sq. in. and fuel consumption is 0·418lb. of gas oil per b.h.p. hour. Power is transmitted from the six crank-



How the six crankshafts of a Multiplex hexagonal engine are connected to the central output shaft; three crankshafts revolve clockwise and three anti-clockwise

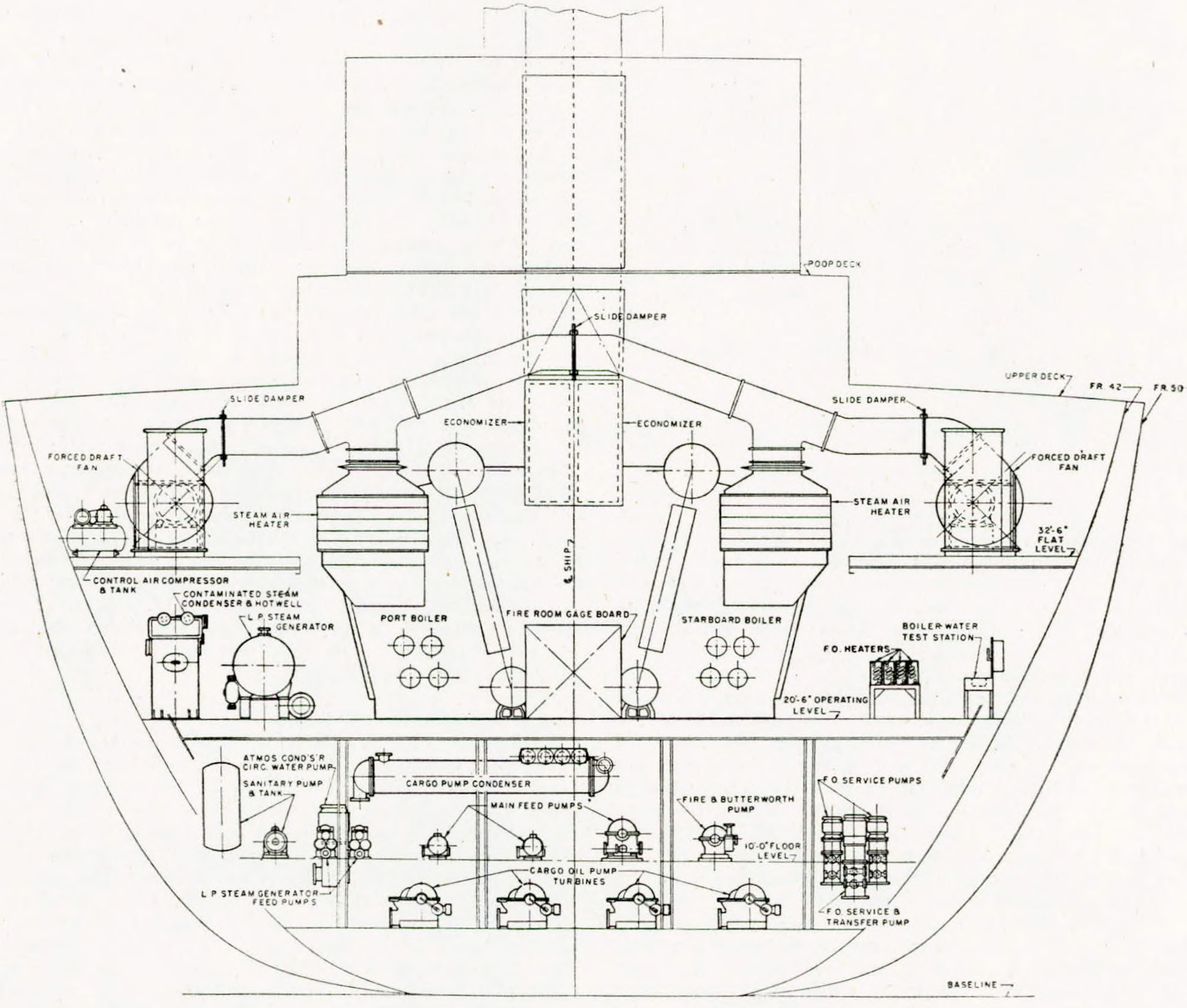
shafts to a central power shaft by gearing as shown in the accompanying drawing. The weight of the prototype engine is given as some 9 tons, or a little less than 10lb. per b.h.p. The speed ratio between the crankshafts and the output shaft varies according to application.—*The Oil Engine and Gas Turbine, Vol. 18, June 1950, pp. 56-57.*

Electrical Power Plant of New American President Liners

This article describes the electrical generating plant and distribution system of the three American President Lines ships, *President Jackson, President Adams,* and *President Hayes,* now under construction at the New York Shipbuilding Corporation, Camden, N.J. When these 536 feet ships are delivered, they will embark upon a round-the-world service which will place a variety of demands on their electrical power plants. The normal supply of electrical power on these vessels is obtained from three 600 kW. turbo-generators, any two of which are capable of carrying the maximum peak load of the ship. In determining the normal and maximum peak load of the vessel several studies were made assuming various conditions of operation; for example, the maximum air conditioning load occurs in the Orient, while the maximum refrigeration load at sea occurs when the ship is one or two days out of New York, after having its reefer boxes loaded. However, two generators will be able to carry the maximum peak load when loaded to 93·2 per cent capacity, which is well within their rating when one considers that each generator is capable of a 25 per cent overload for two hours. The generators are of the shunt-wound 120/240 volt, three-wire direct-current type. The question may arise as to why alternating-current machines were not selected for so modern a ship. The answer is that until a suitable and economical alternating-current winch is developed, in every sense equal to or better than the direct-current type, direct-current supply must continue to be provided for cargo winches, dual capstan-windlasses, and other similar services requiring motors with flexible speed controls and high torques at low speeds. Shunt machines with voltage regulators were selected in lieu of compound machines because they provide better voltage regulation, eliminate equalizer cables, and reduce the size and weight of the circuit breakers and switchboard. On a passenger vessel, it is considered extremely important to have a comparatively flat voltage curve, as even relatively small voltage fluctuations which would cause lights to flicker, would be a source of discomfort to passengers. The operation of cargo winches in particular is apt to cause annoying flickering of the light on ships equipped with generators of less confined voltage characteristics. Another feature of the generators is that each machine is totally enclosed and provided with an air cooler mounted above the generator. The cooling air system is provided with filters to trap the carbon dust from the brushes. The commutator inspection covers are provided with lucite plates so that casual inspection of brush condition and commutation may be made without removing the covers. The author suggests that lucite inspection plates should be made standard on all direct-current generators and motors. By this simple device, every man on the ship will become a part-time electrical inspector, as it is doubted that anyone would pass by a heavily sparking motor without reporting it.—*A. J. Stromsted, Marine Engineering and Shipping Review, Vol. 55. July 1950, pp. 40-44.*

Bethlehem Supertankers

The S.S. *Jahra,* the first vessel to be completed in the extensive shipbuilding programme of the Bethlehem Steel Co. covering the construction of twenty-four 28,000 ton d.w. tankers, has an overall length of 624ft. 9¾in., a cargo capacity of 240,400b.b.l. and a sea speed, loaded, of 16¼ knots. The main propulsion machinery consists of one high pressure and one low pressure turbine of Bethlehem design and manufacture, driving a four-bladed, solid manganese bronze propeller of 22 feet diameter and approximately 27 tons weight through double reduction gears. The unit has a normal rating of 12,500 s.h.p. at 100 r.p.m. Steam is supplied to the throttle at 585lb. per sq. in. and 840 deg. F. with 28½ inch vacuum at the exhaust flange. Steam is supplied by two Foster Wheeler D-type marine steam generators, one left hand and one right hand. A cross-section of the boiler room is given in the accompanying illustration. Each steam generator includes a two-drum bent-tube boiler section, side and rear waterwalls, convection type superheater, and an all-welded extended surface economizer. A de-superheater, which supplies low-temperature steam to auxiliaries, is installed in the steam drum below the



Cross-section of typical Bethlehem supertanker

normal water level. Each boiler is of the single pass design and has a heating surface of 6,710 sq. ft., including waterwalls, while each economizer has 4,970 sq. ft. of heating surface. The boilers are designed for normal continuous evaporation of 47,500lb. of steam per hour at 600 lb. per sq. in. and 865 deg. F. at the superheater outlet, which is in excess of maximum power requirements and is sufficient to permit operation of the tank-cleaning system at full speed. The de-superheater is capable of handling 60,000lb. of superheated steam per hour.—*Heat Engineering, Vol. 25, March 1950, pp. 34-40.*

Dutch Suction Cutter Dredger for France

From a yard at Slikkerveer (province of South Holland) a Diesel-electric suction cutter dredger, which is intended for the Société de Dragage Dérochage et Transports at Paris, has been successfully launched. This dredger is capable of removing some 600 cu.m. of material per hour and discharging it at a distance of several kilometres on land. The dredger is also provided with a plant for emptying hopper barges by suction. The accommodation for the crew conforms to modern requirements and is designed to enable work to be done both in night and day shifts.—*Netherlands Economic Bulletin, No. 59, 1st June 1950.*

New Coastwise Passenger Service

The San Francisco and Los Angeles Navigation Company proposes to establish daily luxury liner passenger service between San Francisco and Long Beach, and has designs for the conversion of two CVE type airplane carriers. Their dimensions, safety characteristics, power, speed, and twin screws for manœuvrability and reserve power, make them suitable for conversion for this service. The conversion plans include the removal of the flight decks and the construction of fireproof accommodations. The ships are 500 feet long, with 65 feet beam and 17 feet draught. The present machinery particulars for the vessels under contemplation include two Skinner Marine Uniflow reciprocating steam engines, of 4,500 h.p. each, with four Babcock and Wilcox two-drum D-type boilers producing an estimated 20-knot speed.—*Pacific Marine Review, Vol 47, May 1950, pp. 29-31.*

Voith Schneider Pusher Unit for Dumb Barges

The author discusses the adaptation of dumb barges to self-propulsion and describes pusher units of the integral low type, which are coupled by push rods with the stern of the barge to be propelled. One such propulsion unit incorporates two 400 h.p. Diesel engines capable of propelling a barge of 1,400 ton d.w. at a speed of 15 km. per hour. With a second barge in tow, a speed of 10-11 km. per hour can be maintained. Fig. 4 shows an alternative layout of the same power but equipped with two Voith Schneider propellers. The superior manœuvring properties of this unit are emphasized.

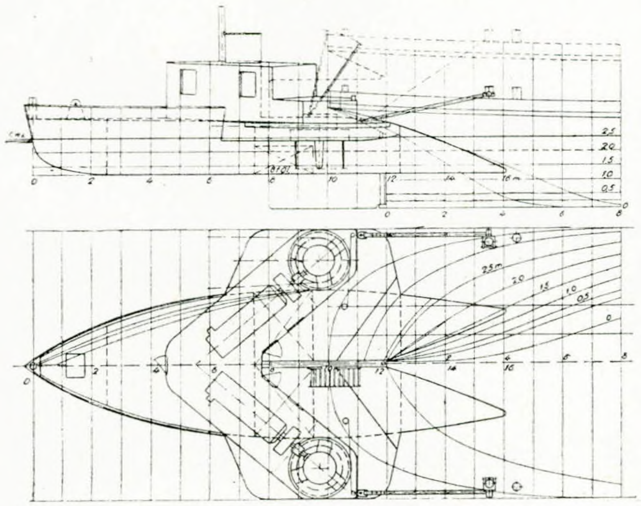


Abb. 4. VSP-Heck, 2×400 PS

Another important advantage of the Voith Schneider propulsion equipment is that it can be operated by remote control from the barge propelled. It is stated that for this system of propulsion a patent has been applied for.—*Vœlker, Schiff und Hafen, Vol. 2, No. 3, 1950, pp. 63-66.*

Resistance-type Strain Gauges

Resistance-type strain gauges made at the National Physical Laboratory have been tested in simple tension, and also under alternating loads having frequencies of 50 and 500 cycles per second. Several different adhesives were used and the superiority of high-solids Durofix over the other adhesives is clearly shown, provided the adhesives are allowed to dry in the air. Stoving would undoubtedly hasten the drying process, and hence the time to attain full sensitivity, but this has not been investigated owing to the impracticability of stoving the specimens when fixed to ship's plating or to large machinery parts. Adhesives of synthetic rubber are unsuitable owing to excessive creep. With a suitable adhesive, the gauges respond accurately at the frequencies tried, and, in the static test, show very little hysteresis as measured by the width of the loop formed during loading and unloading.—*Engineering Laboratory, Royal Naval College, Greenwich, ACSIL/ADM/49/700; Journal, The British Shipbuilding Research Association, Vol. 5, June 1950, Abstract No. 3,796.*

Load Capacity of Lubricants

The demands for lubricants with great chemical stability and resistance to oxidation at high and low temperatures, low volatility, and high viscosity index have been met by solvent-refined oils which have qualities formerly only possessed by the paraffinic oils of the eastern U.S. This improvement in the standard of oils has allowed engine builders to obtain higher b.m.e.p.'s and to produce hotter, more highly stressed, and more efficient power units than formerly. The same oils have, therefore, been called upon to endure the greater severity of loading conditions especially manifest in components such as gears and cams. Oils are now critical to sliding conditions between such members, and their essential lubricating value is the predominant property called into play. Solvent-refined mineral oils, without additives, are often found deficient in this property, with the result that "scuffing" occurs, a form of welding and surface damage which produces rapid deterioration of moving parts. Unfortunately, the ability of an oil to lubricate to prevent "scuffing" is most difficult to measure. Whereas chemical stability can to a large extent be covered by precise specifications, the most intrinsic property of oils, their ability to lubricate, still remains undefined and there is not even a proper name for it. Such things as corrosion, gumming, etc., are all well understood, in principle if not in detail, but no general mechanism has been revealed which can explain why one liquid remains trapped between moving surfaces, whilst another fluid with similar physical properties is squeezed out and allows them to scuff or to seize. "Lubricating value", "film strength", "oiliness", etc., all synonymous terms, must therefore be assessed directly by squeezing the lubricant between loaded surfaces in relative motion and determining how much of this treatment each lubricant can stand without the metals being damaged. Many testing machines have been evolved to rate lubricants in this manner, notably the types in which a flat metal surface is pressed on to the periphery of a rotating disk. Quite considerable instability seems to be the feature of such tests, which embody a condition never occurring in practice, namely pure sliding motion with line or point contact. It follows that a feature most desirable in an oil-testing machine is the combination of rolling motion with sliding. If the aforementioned type of test machine, in which a rotating disk rubs against a stationary plate, is modified and a rolling motion imparted to the system, the action between gears and cams is simulated, and the rubbing action distributed over a wide area of both surfaces as the point of contact now moves relatively to both. The actions are therefore not concentrated at one line of contact (or indeed one point of contact as is the case in test machines in which steel balls rub together). In the Roll-Slide machine described by the author, this aim is achieved by using a design in which a plate bears against a disk which rotates and oscillates at the same time. The plate is loaded against the disk by means of a self-aligning feature, allowing the test surface to be unaffected by deflexions in the machine. —*V. H. Brix, Journal of The Institute of Petroleum, Vol. 36, May 1950, pp. 295-302.*

Danish Cross-Channel Motorship

The motorship *Jens Bang* is the first of two 20½ knot cross-Channel motorships for the Copenhagen-Aalborg service of the United Steamship Co., Ltd., built by the Elsinore Shipbuilding and Engineering Company. The route taken between Copenhagen and Aalborg lies in very shallow water, the depth varying between 23 and 100 feet, and the design has been specially considered from this point of view. The reduction in speed due to passage through shallow water has been the subject of model tests, a number of which were run under conditions corresponding to 40 feet depth. The results of these tests show that in water with a depth of as much as 100 feet a reduction in speed amounting to 0·2 knots is experienced. In water 50 feet deep the maximum speed of the *Jens Bang* will be 19 knots while in 33 feet this is reduced to 17 knots. The principal dimensions of the new ship are as follows:—

Overall length	341 feet
Length between perpendiculars	310 feet
Breadth moulded	48ft. 9in.
Depth to main deck	25ft. 9in.
Draught loaded	16ft. 0⅝in.
Displacement	3,420 tons
Deadweight capacity	900 „
Gross tonnage	3,155 „
Passengers (first class) ...	86
„ (second class) ...	224
„ (third „ ...	800 (night service)
„ „ „ ...	1,200 (day service)
Main machinery output ...	7,600 i.h.p.
Speed	20½ knots

The two main engines, which have been built under licence by the Elsinore Shipbuilding Co., are of Burmeister and Wain 950-VF-90 type with nine cylinders 500 mm. bore and 900 mm. stroke, and are designed to develop 3,800 i.h.p. each at 165 r.p.m. They are uniflow-scavenged, single-acting, two-stroke, poppet-valve engines. The scavenge blowers installed in the *Jens Bang* are of the horizontal six-stage axial flow type and have a combined maxmimum capacity, corresponding to the full output of the main engines, of 23,000 cu. ft. per min. at 4,500 r.p.m. Each blower is driven by a 250 b.h.p. variable-speed electric motor through 4 to 1 speed-increasing gears.—*The Marine Engineer and Naval Architect, Vol. 73, June 1950, pp. 225-228.*