TECHNICAL ABSTRACTS

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SHIP RESISTANCE AND FLUID MOTION

The Determination of the Power Required for the Propulsion of Small and Medium-Size Ships (French). DERVIN, H. *Bulletin Technique du Bureau Veritas*, **32** (1950), p. 163 (July).

The Author presents a new method of estimating rapidly the horsepower or speed of a ship for layout purposes, if speed or power respectively are given. The method uses two diagrams in metric units and does not require any cumbersome calculations. The Author has studied the application of the most popular empirical formulae for the assessment of the power (Admiralty, Ljungberg, Colinet, Le Besnerais, Skene), but has not found them adequate. The empirical curves given by Skene in English units are in the Author's opinion the most reliable, and he therefore used them for the construction of his own graphs which are specially adapted to vessels of small and medium dimensions (up to about 160 ft. length). The new method obviously gives approximate values, and is suitable for ships of normal design and with normal propulsion plants only. It is based on overall efficiencies of the machinery, whose average values are tabulated for a number of ship types.

The Author shows how he derived his two diagrams with the aid of an empirical formulae which he developed from earlier empirical curves constructed with Skene's values, and the results of many tests. In the main chart of the new method, the 7/6 power of a power coefficient is plotted against speed-length ratio and length-displacement ratio. The power coefficient is the ratio of actual effective horsepower to basic horsepower. The latter is the effective power divided by the basic displacement, basic displacement being equal to $(0.112\ L)^3$, where L is the ship length. The Author's second diagram gives the power coefficient and its 7/6 power as a function of the ship's length.

The Author shows how his method is used to solve two problems. In the first, the power is to be calculated, ship length, displacement, speed, and overall efficiency of the propulsion plant being given. In the second, length, displacement, power, and efficiency are known, and the ship's speed is wanted. The Author has checked the reliability of the method by comparing his results for 44 different vessels with full-scale data, and it can be seen from the comparative tabulation of the figures that the agreement is very close.

PROPELLERS AND PROPULSION

Controllable Reversible Propellers compared with Fixed Blade Propellers. ENGLESSON, E. *Motorship*, **35** (1950), p. 30 (Aug.).

This article is compiled from a paper read at the 22nd Oil and Gas Power Conference of the A.S.M.E. in June 1950.

The Author describes briefly the construction and operation of a Kamewa variable-pitch propeller. He then gives curves of r.p.m. plotted against speed for various pitches, and shows how propeller pitch should be adjusted to give best fuel economy. One of the main applications of a variable pitch propeller is in craft in which the resistance varies, such as tugs, trawlers, etc. If a fixed-pitch propeller is designed for the free-running condition, it will be too large when towing and the engine will be incapable of running up to full speed, with a consequent loss of output. The Author gives curves which show that a variable-pitch propeller can be adjusted to give results which, over the entire range of speed, are superior to those obtained with a fixed-pitch propeller designed for any one towing condition.

Other curves show how a controllable-pitch propeller enables an engine to be operated at higher speeds without increase in mean cylinder pressure, which makes a greater output of power available. The Author concludes by showing how the installation of these propellers would simplify the engine rooms of certain types of ship, and finally suggests that they are ideal for gas-turbine drive, since this type of machinery cannot be reversed.

Variable-Pitch Propellers (German). *Hansa*, **87** (1950), p. 1099 (9 Sept.).

Variable-pitch propellers were originally introduced some thirty years ago to provide a reverse motion when the engines themselves could not be readily reversed. The improvement of efficiency by alteration of the pitch to suit different working conditions was not a primary object of these early propellers. A number of difficulties were met with in operating them, and once direct-reversing engines or reverse gears became popular, the variable-pitch propeller found application only in small sizes for sailing craft fitted with auxiliary engines, where it was desirable to be able to feather the propeller.

Variable-pitch propellers for higher powers have however been developed by a number of firms in the past decade or so, and by the beginning of 1949 some 230 sets had been delivered of which the largest were a pair of propellers of 17-ft. diameter, to transmit 7,000 h.p. each. Large propellers of this type are adjusted by hydraulic means. The most efficient use of a variable-pitch propeller occurs when it is applied to craft in which the resistance varies considerably, such as tugs and trawlers. A German manufacturer is producing variable-pitch propellers suitable for small fishing craft, in which the motor is non-reversible and the full power is required whether towing or running free. A diagram and description of the mechanism, which is hand operated, is given. This type of mechanism would be suitable for powers up to 120–150 h.p. For higher powers, a hydraulic pitch-adjusting mechanism would be necessary.

The Schelde Controllable-Pitch Propeller. *Nautical Gazette*, **144** (1950), p. 42 (Sept.).

It is stated that the Schelde controllable-pitch propeller offers all the advantages of a Diesel-electric coupling without being subject to its approximately 20% loss of power due to electrical losses in the generator and driving motor. Reversing can be achieved without changing the direction of rotation of the propeller. Four blades are arranged in a pair of tandems, with the shanks of opposite blades built within each other. This tandem arrangement enables a boss to be used no larger than that of a comparable fixed-pitch propeller.

Operating experience with the ferry *Queen Juliana* is quoted as satisfactory. This vessel has a 2,500-b.h.p. Diesel engine driving two identical Schelde propellers, one forward and the other aft.

WELDING AND OTHER METHODS OF CONSTRUCTION

Welding in Boilers. Griffiths, S. H. *Transactions, Institute of Welding*, **13** (1950), p. 95 (June).

The Author describes how the use of specialised welding processes in the construction of various types of boilers and their components has affected their design and development, and economy of material. The use of metallic-arc and submerged-arc welding for fabrication of Lancashire boilers and water-tube boiler drums is mentioned, and an account is given of an investigation carried out on riveted and welded Lancashire boilers. Observations made during cold hydraulic-pressure tests showed that the completely welded boiler strained in a uniform manner. The riveted boiler twisted considerably, particularly in so far as the shell was concerned.

It is stated that troubles due to chemical corrosion, such as caustic cracking, cannot occur in welded shell boilers or drums. The economy in materials made possible by the higher efficiency of the welded joint, as well as that due to the absence of butt straps, overlaps, and rivet heads, is demonstrated. The advantages of replacing heavy forged flanges in pipelines by welded butt joints are discussed. The use of Gamma radiography is recommended for non-destructive examination of pipe joints.

Stud welding has replaced the older methods of drilling, tapping, and screwing in of studs. In addition to the saving in time, there is the advantage that the thickness of the plate is not reduced or penetrated at any point with the resulting local weakness.

The use of flat-topped projection welding machines for the production of industrial flooring is described briefly.

Welding in the Construction of Marine Diesel Engines (French). *Revue Générale de Mécanique*, **34** (1950), p. 310 (Aug.).

This article describes the manner in which the crankcases and frames of two types of Diesel engine, one of 6,000 h.p. and the other of 3,250 h.p., have been built up of welded parts instead of the more normal castings. This has the advantages firstly of cutting down weight, since the individual components need be designed only to withstand the stresses to which they will be subjected, and there is not the objection to sudden changes of section associated with foundry technique ; and secondly the elimination of flaws, such as blow holes, in the way of machined surfaces.

Engine Component Repairs by Welding. *Oil Engine and Gas Turbine*, **18** (1950), p. 136 (Aug.).

A description is given of the way in which broken castings, or new castings in which machining has exposed porosity, can be repaired by oxy-acetylene welding. The damaged material is " veed out " by chipping, and the area then gently raised to a red heat. With a specially-prepared flux and a cast-iron filler rod to hand, the torch is played on the bottom of the veed crack until a small pool of molten metal is formed. The filler rod is dipped in flux and brought into the flame of the torch held just above this pool. The end of the filler rod is heated until almost melted and then gently inserted into the liquid iron to melt. Gently stirring the pool, the welder progressively adds filler rod by melting the sides of the vee and the rod, dipping the filler into flux from time to time to prevent oxidation. This simple method may have to be modified when more complicated repairs are required, but the procedure remains virtually the same.

Building-up Worn Parts by Welding. *Engineers' Digest*, **11** (1950), p. 264 (Aug.).

Indiscriminate application of the recently developed method of repairing worn or corroded steel surfaces of machinery parts by " building-up " or " pad " welding, may have serious consequences. In general, it seems that the method is suitable when the stress loading of the part concerned is predominantly static, or when compression stresses are mainly involved, e.g. in the repair of cavitation and corrosion damage on ships' propellers, pump impellers, wheels of water turbines, etc. But repairs by this method of shafts and similar parts subjected to stress reversal have often led to complete breakdown by fatigue failure.

With present-day welding techniques it is impossible to avoid the production of residual stresses and also of a certain notch effect, when building up worn surfaces. This is the main cause of fatigue failure after a comparatively short time of operation. The loss in fatigue strength caused by residual stresses cannot be recovered by stress-relieving heat treatment of the weld, and even normalising has proved to be useless.

SHIPBUILDING (GENERAL)

Presidential Address. STEPHEN, SIR A. MURRAY. *Transactions, Institute of Marine Engineers, address delivered* 28 Sept. 1950.

After stressing the need for reliability in marine machinery, the President stated that, in view of the considerable progress made in the past, further improvements had become more and more difficult, and their cost might rise to the point where the first charge outweighed any savings. One matter in which the President did not consider progress had been made was the design of funnels : the tall, thin funnel of fifty years ago had great advantages over the modern streamlined funnel in preventing flue gases from descending on the decks. The streamlining of houses and other erections caused them to be more expensive to build, and less economical of space ; and, as the chances of a side wind were greater than those of a headwind, streamlining might, in fact, not present any great advantage.

Considering the question of engines, the President suggested that in the future Diesels might all burn cheaper boiler fuels, and that the power might be increased by gearing twin engines to one shaft. It might be that in time the Diesel and the steam turbine would be ousted by the gas turbine or the atomic energy machine. One of the main advantages of the gas turbine—that of reduced size—is still neutralized by the tonnage laws, which put a virtual prohibition on making engine rooms less than 13% of the ship's gross tonnage.

The development of welding is likely to increase the tendency in all forms of machinery to substitute fabrications for castings : and there is a parallel tendency towards increasing the use of welding in the hulls of ships. One reason for this is the likelihood of a distinct dearth of riveters in the future. It is too early to give a definite answer as to whether welding really is cheaper than riveting. It has cheapened a number of fittings, but the process of making large welded sections of a ship and assembling them on the berth is not easy and often involves much expensive fitting. The cost of ships is often stated to be so many per cent. greater than that of a similar ship pre-war. The President pointed out that the specifications of ships have altered to such an extent that a true comparison is not possible.

Finally, the President mentioned the research being carried out by B.S.R.A., and Pametrada.

MATERIALS : STRENGTH, TESTING, AND USE

Effects of Grinding and Other Finishing Processes on the Fatigue Strength of Hardened Steel. TARASOV, L. P., and GROVER, H. J. *American Society for Testing Materials, paper read at Annual Meeting*, 26–30 June, 1950.

This paper presents the results of an investigation carried out on a ball-bearing type of steel, using two heat treatments to give two different hardnesses, Rockwell C 45 and C 59. All specimens were ground, and in some cases the grinding was followed by other finishing processes. Grinding was carried out in the axial direction so that the scratch direction was always parallel to that of the applied stress.

Reversed-bending tests of flat bars showed: (*a*) gentle grinding gave endurance limits as high as gentle grinding followed by careful polishing; (*b*) severe grinding reduced the endurance limits by about 20 to 25%; and (*c*) tumbling or shot peening after grinding greatly increased the endurance limits. A partial explanation of the results is given in terms of residual surface stresses on the basis of an assumed Goodman-type diagram.

Rotating-bending tests of round bars gave endurance limits about twice as high as reversed bending of flat bars of corresponding hardness. The effects of surface processing on the round-bar endurance limits were less pronounced than for the flat bars, and seemed generally inconsistent for the two hardness levels.

In no case did gentle grinding prove detrimental to the fatigue properties.

Speculations on the possible origin of the scatter of points in S–N curves suggest the significance of studying the surface conditions of the specimen.

There is a bibliography.

Thermal Cracks in Turbine and Generator Rotor Forgings. RANKIN, A. W., BOYLE, C. J., MORIARTY, C. D., and SEGUIN, B. R. *Mechanical Engineering*, **72** (1950), p. 559 (July).

A general review is given of the results of ultrasonic testing of large forgings during a period in which considerable trouble was experienced in ensuring that the forgings used for large turbine and generator rotors were free from thermal cracks. The results on the first three rotors tested are examined in detail. The practical details of ultrasonic testing of large rotor forgings are discussed, with special emphasis on the need for careful interpretation of the results of such an investigation. The metallurgical investigations on particular rotors are described, and some general identifying characteristics of thermal cracks and non-metallic inclusions are tabulated. A description is given of the spin tests which were made to determine the reduction in the bursting speed of a rotor resulting from thermal cracks of the size and distribution found in this investigation.

Naval Uses for Glued Laminated Timber. MOURER, P. W., JR. *Journal o American Society of Naval Engineers*, **62** (1950), p. 621 (Aug.).

Laminated timbers are built up from multiple thicknesses of lumber, bonded together with synthetic-resin adhesives of phenolic type to form an integral whole. They are not only stronger but far more durable than solid wood, and can be used for aprons, deck beams, binding strakes, booms, capping, deadwood, frames, counter timbers, keels, keelsons, knees, mast-stepping, risers, side fenders, stems, stern-posts, strakes, stringers, towposts, transoms, decking, bulwark stringers, ladder rails, gun platforms and gang planks. Glued laminated members, prefabricated to exact requirements, compare favourably with other materials, having more than 10% of the strength of steel and $7\frac{1}{2}$% of its weight.

Dredge spuds, range markers, spar buoys, boat booms, and similar gear admit of economical fabrication with greater strength and durability through the use of glued laminated timber.

Novel Wear-Resistant Aluminium Coating. *Engineers' Digest,* **11** (1950), p. 298 (Sept.).

A new scratch and wear-resistant hard coating may make it possible to use aluminium more widely for articles that until now have been made of steel. This coating is applied to aluminium and aluminium alloys by an electrochemical process, which creates a non-metallic, file-hard, highly heat-refractive surface strongly bonded to the base metal. The coating has high resistance to atmospheric and salt-water corrosion and is said to be superior to conventional anodised surfaces. Coating thicknesses range from 0·001 to 0·006 in, 0·002 in being generally used for abrasion resistance. Successful applications include gears, pinions, turbine-impeller blades, hand tools, swivel joints, etc.

Carbon as an Engineering Material. WILLIAMS, A. E. *Engineering and Boiler House Review,* **65** (1950), p. 314 (Oct.).

The Author reviews the new types of carbons now available for the construction of different components formerly made of metal. Advantages of carbon include its self-lubricating properties, high thermal conductivity, and chemical inertness. It can be machined to tolerances as fine as 0.001 in. Required characteristics can be emphasised by judicious blending of selected varieties. Carbon may be produced to give a low coefficient of friction and to sustain very heavy loads. In the presence of air, it successfully withstands a temperature as high as 650° F. It will not melt and sublimes only at temperatures above 5,400° F. For the electrical industry, carbons can be produced with a conductivity as high as that of brass, or with a very high electrical resistance.

Among the applications of carbon discussed are bearings, sealing of pumps, heat exchangers, tower packing, lining of containers, piston rings, and carbon vanes for use in air or gas compressors and liquid rotary pumps.

See also Abstract No. 1544 (Feb. 1948).

Investigation of Bearing Materials under Various Degrees of Lubrication in the Low-Speed Range. NOWELL, L. A., JR. *Bulletin, American Society for Testing Materials, No.* 168 (1950), p. 47 (Sept.).

This is the first progress report of an investigation to measure the differences in several bearing materials under various conditions of lubrication. The report is concerned with the steps taken to adapt an Amsler wear-testing machine to this purpose. From the results, the Author concludes that with certain modifications, which he describes, the Amsler machine can be used successfully.

It is possible to obtain reasonably accurate data on oil film and bearing-alloy temperatures, rate of oil flow through the bearing, journal speed, total load, frictional torque, and electronic indication of oil film continuity. The Amsler machine is adaptable for testing a variety of bearing and journal materials, including plastics.

A list of references is given.

BOILERS AND STEAM DISTRIBUTION

Ultrasonic Boiler Scale Suppressor. *Engineers' Digest,* **11** (1950), p. 233 (July).

An ultrasonic water-treatment plant of particularly simple design has been developed in Switzerland for the prevention of scale formation in boilers.

The apparatus incorporates a mercury switch alternately charging and discharging a condenser ; the condenser discharge passes through the coil of the oscillator, which is in contact with the water to be treated. Energised by the discharges of the condenser, the ferro-magnetic core of this oscillator vibrates at the rate of some 27,000 c.p.s.

Brickseal Refractory Coatings. *Shipbuilding and Shipping Record*, **76** (1950), p. 111 (27 July).

The article outlines the properties required of refractory coatings, and the effects of alkalis, salts, and the gases of combustion on firebricks.

The use of " Brickseal " as a bond allows the bricks freedom to move as they expand or contract. At high temperatures this product is viscous. One of its most recent applications is to the furnace brickwork of the cross-channel steamer *Brighton.*

Investigation of Steam Separation in Boiler Drums through Studies on a Model. FARBER, E. A. *American Society of Mechanical Engineers, Paper 50-F-25, read at Fall Meeting, Worcester, Mass.*, 19–21 Sept. 1950.

A method by which the processes that occur inside steam-boiler drums can be compared and predicted is described. The method is based on tests carried out with a model filled with Freon 12 as liquid and vapour, and gives the same density ratio between liquid and vapour that exists in the boiler. When the velocity of the liquid-vapour mixture in the model drum is adjusted to the proper value, the separation forces in the model and boiler are the same. Freon 12 was selected after unsuccessful tests with water and air had been made.

The experiments were performed at different loads, pressures, and liquid levels in the drum. Several different drum internal arrangements were tested, and results and conclusions based on these tests are reported. An increase in load, with pressure and liquid level constant, and an increase in pressure, with load and liquid level constant, both had the effect of increasing the amount of carry-over and entrainment. An increase in liquid level, with load and pressure constant, increased carry-over and decreased entrainment. Changes in load and liquid level had a much greater effect on carry-over and entrainment than pressure changes. Any condition that reduced the difference between liquid and vapour density would make the separation more difficult. An increase of velocity in the separators or a decrease in diameter increased the separation forces and caused more complete separation.

GAS TURBINES

Marine Unit Designed for Long Life. *Oil Engine and Gas Turbine*, **18** (1950), p. 102 (July).

A description is given of the first British long-life marine gas turbine, the preliminary tests on which have begun at the Pametrada Research Station, Wallsend. The plant, which is of 3,500 s.h.p. and the open-cycle type, has been manufactured by member firms of the Parsons and Marine Engineering Turbine Research and Development Association.

The primary factors influencing the design and choice of cycle were complete reliability, long life, and long periods between overhauls, and the ability to use fuels from a variety of sources. The efficiency had to be higher than the 23–26 % obtained from steam turbines burning various grades of under-boiler oil.

After allowing for all transmission losses at 85 r.p.m. of the propeller shaft, the thermal efficiency is expected to be some 28%.

There are two axial compressors on a common shaft driven at 4,500 r.p.m. by the H.P. turbine. Between the compressors is an intercooler designed to cool a mass flow of 50 lb of air per sec from 230° F. to 80° F., using 2,200 gallons of seawater per min at 60° F. Air leaves the H.P. compressor at about 81 lb/sq in abs., the overall compression ratio being 5·5.

From the compressors, the air is carried to the top of the heat exchanger, a tubular recuperative unit designed to give a thermal ratio of about 80%. The air makes a single pass from top to bottom, and the gas flows across the tubes in four passes. Air temperature at inlet is about 300° F. and at outlet about 860° F. This exchanger weighs 30 tons, and the complete weight of the plant is about 160 tons. The omission of the recuperator would increase the fuel consumption by 30% at full load, and more at part load.

From the main combustion chamber, the gases flow to the H.P. turbine, through twin reheat chambers to the L.P. turbine, and thence through the heat exchanger to exhaust.

The H.P. and L.P. turbines are similar in form, both being double-flow reaction turbines. The casing in each is a light structure, and the load is carried by the cast stainless-steel inner cylinder.

The transmission system has not yet been fitted to the turbine, although it has been built and is being tested separately. The requirements of ahead and astern running have been met by the provision of an ahead hydraulic coupling of 98% efficiency, and an astern torque converter, both fixed to a shaft driven by the unidirectional turbine. Two astern couplings are under development, and it is hoped to bring the efficiency up to 70% at full load. The double-reduction gears reduce the 3,080 r.p.m. of the power turbine to 85 r.p.m. on the propeller shaft.

It is hoped ultimately to instal the plant in a merchant ship for sea trials.

The Advantages of Combining Gas Turbines with Steam Turbines (French). CHAMBADAL, P. *Technique Moderne*, **42** (1950), p. 277 (Sept.).

The Author considers the advantages of combining these two types of machine from the point of view of fuel consumption.

He first studies the heat cycles of a condensing steam turbine and a gas turbine. Then he points out that the output of a steam turbine consists partly of mechanical energy and partly of heat energy. If both types of energy are taken into account, it is not sufficient in determining the efficiency merely to express them in the same units, but a coefficient must be included which takes account of the fact that about three heat calories are necessary to produce one work calorie, while a work calorie cannot be entirely converted into heat. This coefficient consists of the ratio of the efficiency of production of mechanical energy alone to that of the production of heat energy alone, and will vary from case to case. It will still be necessary to determine the minimum fuel consumption, since this may not be at the maximum efficiency.

The Author then describes various proposed combinations, and shows that they are of particular value when a back-pressure steam turbine is used, although in certain cases the arrangement can be justified for a condensing turbine. The Author shows that, although an economy in fuel consumption is to be expected from this type of combustion, many factors such as initial cost and maintenance must be considered to ensure that the installation as a whole shows a saving.

DIESEL AND OTHER I.C. ENGINES

Recent Trends in Engine Valve Design and Maintenance. HOERTZ, N., and ROGERS, R. M. *Transactions, Society of Automotive Engineers*, **4** (1950), p. 347 (July).

Problems of valve material and valve design are reviewed. An analysis of materials used for exhaust valves shows that they fall into three categories, the ferritic group, the austenitic group, and the sigma precipitate group. Field tests are the final determining factor in evaluating valve steels. The advantages of hard facing and sodium-cooling of valves are discussed. Fits and clearances which have been found conducive to good valve performance are given, and methods of correcting or preventing sticking and burning are suggested. The Authors consider that valve rotation has a number of important advantages and will improve valve performance substantially. Two types of rotating valves have been developed, the Rotovalve and the Rotocap.

There is a bibliography.

Valve Problems in Diesel Engines. AYRES, V. *Diesel Power and Diesel Transportation*, **28** (1950), p. 62 (July).

The Author discusses valve problems in Diesel engines and suggests possible solutions. Valve breakage may be caused by high loading of the valve, or by weakness due to faulty design or poor material. A number of recommendations are made based on a study of successful designs. Valve materials may be selected on the basis of strength and hardness at the operating temperature and resistance to environment. The causes of seat wear are incompatible materials, high unit loading, and material inadequate at the operating temperatures. If distortion is found to be the cause, the use of other materials or a change in the cylinder head sections surrounding the valve may result in reduced wear. The use of a different material combination has so far been the most successful means of reducing wear. A valve material selected for its resistance to environment is recommended to prevent face guttering, and in this connection rotation has proved of benefit in keeping temperatures, deposits, and leakage under control. The most effective factor in avoiding stem and guide wear is adequate lubrication, although proper geometry of the valve train and correct materials and surface finish must also be considered. Sticking is caused by stem and guide deposits resulting from too high a temperature for the oil, scanty oil supply, and excessive stem-to-guide clearance. Rotation of the valve, and the use of oils with reduced tendency to form a deposit, are suggested as remedies for this problem.

Methods used in the Study of Internal Combustion Engines. MANSFIELD, W. P. *Engineering*, **169** (1950), p. 658 (9 June), p. 672 (16 June), and p. 695 (23 June).

The Author describes the apparatus and methods used in the study of piston-type internal-combustion engines under running conditions. An important requirement of any method used to examine a process is that the introduction and operation of the necessary apparatus shall have either a negligible effect on the process or a known effect for which due allowance can be made. The measurement of the air flow to an internal-combustion engine and the determination of fuel-flow rate are described as examples of the care required to avoid false results. A fuel flowmeter giving a measurement directly in terms of weight is described and illustrated. The Author discusses the fitting and use of thermocouples for temperature measurement of both stationary and moving parts of the engine structure.

The application of electronic equipment to engine studies is considered in some detail. Electronics have been used to indicate the pressure changes that the gases undergo in their passage through the engine, and several types of indicator are described. An important development in the measurement of strain has been the introduction and extensive application of resistance-wire strain gauges. Two methods of studying vibration are described, namely the indication of surface strain and the indication of movement of a part of the engine structure relative to another part of the engine or relative to a stationary point. Equipment is now available for the study of engine noise, and several types of noise analysers are described.

In the study of the combustion process, a direct indication of the combustion period may be obtained by means of equipment comprising a combustion-chamber window, a photocell and amplifier, and a cathode-ray oscillograph. Diagrams obtained by these means provide a comparative measure of the period of major heat release, give some indication of changes in the light intensity during the combustion period, and show the extent of any irregularity between successive cycles.

MACHINE PARTS

Seals for Rotating Shafts (Dutch). Boon, E. F. *Ingenieur ('s Graverhage, Holland)*, **62** (1950), p. Ch. 43 (21 July).

The design of mechanical seals for rotating shafts is discussed for different working conditions (high pressures, high temperatures, low viscosity of the fluids, corrosive or rubbing media, intermittent service, etc.). The Author shows how seals can be made with a minimum of leakage and wear of the shaft, and how they can be so designed that they follow deflections of the shaft and avoid increased shaft clearance and leakage. The principal mistakes in design are discussed. It is wrong, for instance, to over-tighten stuffing-boxes : packing glands should be elastically compressed by interposing springs between the plunger and the packing rings. The ideal conditions for a perfect seal are a perfectly round and smooth shaft, an elastic, non-permeable packing material, a pressure of the packing on the shaft higher than the fluid pressure, and a minimum radial movement of the shaft.

To prevent seizing of the shaft at high temperature and pressure, normal stuffing-boxes are often allowed to leak slightly, the leaking fluid being used as a lubricant. The ideal is, however, to have a snugly-fitting packing gland which will seal tightly ; this requires highly finished sealing surfaces. A simple way of causing the fluid to press the gland sufficiently against the shaft is to give it the shape of a cup, cone, etc. New sealing devices under review include the Stork-Pacific hot-oil gland and the mechanical seal of Flexibox, Ltd.

LUBRICANTS AND LUBRICATION

Lubrication of Marine Turbine Propulsion Equipment. Jones, F. S. *American Society for Testing Materials, paper read* 12th Oct. 1949.

The design, manufacture, installation, and operating factors of the lubrication system of marine turbine propulsion equipment are reviewed.

Three common and acceptable lubrication systems are described and their fundamental design practices outlined.

The elimination of possible contamination in marine turbines, the venting of reduction gears, the oiling systems of electric generators and motors, and the common practices adopted for the care of marine propulsion equipment during manufacture, shipment, and installation are discussed.

A description is given of cleaning procedures for new marine turbine installations. It is concluded that if oiling systems are correctly designed, properly installed, and carefully operated by properly-trained personnel, marine-turbine propulsion equipment should give little trouble in operation.

A Review of the Factors to be Considered in the Selection and Maintenance of Diesel Engine Lubricating Oils. RAWLINS, E. B. *American Society of Mechanical Engineers, Paper* 50 *PET* 12, 1950.

Factors to be considered in the selection of Diesel-engine lubricants include the various crudes and their refining methods ; blending and compounding ; engine type, service, condition, and maintenance ; type of lubricating oil ; operating temperature ; filtration and maintenance ; and kind of fuel used. These factors are discussed, and a number of recommendations are made. The oils selected should be treated to withstand the heat and deposits common to all Diesel engines ; other requirements are a high viscosity index for low oil consumption and greater stability, and the proper viscosity for Diesel-engine service. Detergent oils designed to keep the engine clean are recommended, and they should be compounded of high-grade stocks with low carbon content. High-output engines require oils of heavier viscosities, high viscosity index, higher additive concentration, and highest quality. Operating temperatures should be increased to enable the detergents to operate efficiently and reduce the chance of contamination by water condensate. Adequate filtering must be provided for the oil.

HEAT TRANSFER AND INSULATION

The Theory and Practice of Thermal Insulation. LAING, G. *Transactions, Institution of Engineers and Shipbuilders in Scotland, paper read* 24 Oct. 1950.

A short survey of heat-transfer data, with particular reference to insulation problems, is followed by an analysis of heat transmission through insulated steelwork forming refrigerated spaces, including a graph giving coefficients for various structures. A proposal is made for evaluating insulation thickness on an economic basis, and suggestions are put forward for overcoming condensation and moisture penetration.

Properties of materials for both heat and refrigeration insulation are discussed. The various methods of specifying insulation thickness for marine boiler and pipe work are analysed, and a chart gives economic thicknesses for temperatures up to 1,000° F. Finally, recommended thicknesses of insulation for structural insulation are given, together with a table of temperature drop in ventilation ducts.

There is a bibliography.

AIR CONDITIONING, VENTILATION, AND REFRIGERATION

The Evolution of a New Refrigerant. PENNINGTON, W. A., and REED, W. H. *Modern Refrigeration,* **53** (1950), p. 123 (May), p. 154 (June), and p. 184 (July).

A new refrigerant has been developed, consisting of an azeotropic mixture of Freon-12 and 1·1-difluorethane ; it is called " Carrene-7." As compared with Freon-12, it produces lower temperatures and has a higher refrigerating capacity (by about 20%) at the same compressor speed ; it has the same refrigerating capacity as Freon-12 when used in compressors run at lower speed (i.e., compressor motor supplied with a 50-cycle current instead of 60 cycles). Its use should simplify existing refrigerating machinery. It is non-inflammable. Graphical illustrations of its properties are included.

There is a bibliography.

CORROSION, FOULING, AND PREVENTION

Vinyl Protection for Ships' Hulls. *British Plastics*, **23** (1950), p. 68 (Aug.).

A new primer, Wash Primer No. 1, for the underwater protective coating of ships' hulls has been developed, having a basis of polyvinyl butyral resins, and serving both as an adhesive and anti-corrosive agent for the metal. The new primer gives excellent adhesion to a wide range of metals, including aluminium, anodized aluminium, steels, zinc and galvanized iron, cadmium, chromium, nickel, copper, and magnesium. It may be used with conventional finishing coats.

A complete underwater protective system for naval craft has been developed, which is based entirely on vinyl resins, and in which the application of the primer coating is followed by an anti-corrosive undercoat and an anti-fouling top coat, all three coatings being applied by spraying. Photographs illustrate its protective action on steel plates.

Corrosion and Related Problems in Sea-Water Cooling and Pipe Systems in H.M. Ships. SLATER, I. G., KENWORTHY, L., and MAY, R. *Journal of Institute of Metals*, **77** (1950), p. 309 (June).

A study is presented of corrosion and related problems that were encountered in sea-water cooling systems during war-time service. Details are given of the deterioration liable to occur in the component parts of the system, such as inlets, valves, gratings, pumps, trunking, condenser doors, tube-plates, ferrules, condenser tubes, and piping. Impingement attack and deposit attack were the two most prominent types of corrosion encountered. It is shown that the main factors which influence these are water speeds with related eddies and turbulence, entangled air bubbles, tube obstructions, and contamination of the water. Remedial and palliative measures are discussed in relation to the corrosion-resistance of the materials and protective coatings available ; the use of different alloys in the same system ; modifications of design for minimizing the severity of the conditions ; and the importance of maintenance routines.

Laboratory tests, and especially the jet-impingement apparatus, are shown to be of great value in indicating the probable service behaviour of materials, provided certain precautions are observed.

There is a list of references.

The Jet-Impingement Apparatus for the Assessment of Corrosion by Moving Sea Water. MAY, R., and STACPOOLE, R. W. DE VERE. *Journal of Institute of Metals*, **77** (1950), p. 331 (June).

Failure of condenser-tubes and sea-water pipes occurs largely as a result of the corrosive-erosive action of impingement air bubbles carried in the water stream. A jet-impingement apparatus which reproduces the condition favourable for this type of attack is described. The construction of the apparatus, running of tests, and the assessment of the results are discussed.

There is a list of references.

Corrosion of Bare Iron or Steel in Sea Water. HUDSON, J. C. *Journal of Iron and Steel Institute*, **166** (1950), p. 123 (Oct.).

The results so far obtained in the course of the Corrosion Committee's work relating to the corrosion of structural irons and steels when immersed in sea water are presented and critically examined.

The presence of mill-scale on the iron or steel is shown to promote serious pitting in sea water. The rate of general corrosion of mild steel, when immersed in British waters after removal of the mill-scale, is found to be approx. 3–5 mils/yr. There is little, if any, difference in the corrosion rates, under these conditions, of ordinary, unalloyed, ferrous materials such as mild steel, ingot iron, or wrought iron.

Of a wide range of alloying elements incorporated in a series of low-alloy steels, only two, chromium and nickel, are shown to have any significant effect in reducing the corrosion rate. Steels containing 2–3% of chromium were found to corrode at one-half or one-third of the rate of unalloyed steels of the same carbon content. The effect of nickel additions was less marked.

No significant difference has been observed in the behaviour of ordinary and of copper-bearing steels when totally immersed in water.

There is a list of references.

The Influence of Stress on Corrosion. HARWOOD, J. J. *Corrosion*, **6** (1950), p. 249 (Aug.), and p. 290 (Sept.).

The effect of stress on the internal structure and energy characteristics of metals are discussed in relation to their influence on corrosion reactions. The nature and importance of residual stresses and the non-homogeneity of worked metals are emphasized. Recent concepts of the nature of grain boundaries are reviewed and their importance in reactions where stress and corrosion act together is described. A review of the literature reveals that stresses, either due to applied loads or of a residual nature, may influence the nature, rate, and distribution of corrosion reactions in several ways : by increasing the internal energy level of the metal system and causing a possible shift of electro-chemical potential in a more active direction ; by causing an intrinsic increase in the rate of corrosion ; by damaging protective surface films ; by influencing polarization reactions ; by changing the metallurgical characteristics of the metal system in promoting phase transformations, precipitation, etc. ; or by accelerating the rate of corrosion by purely mechanical effects. The exact influence of stress on rates of general corrosion is still questionable, but does not appear to be of major consequence. The most serious effects of stress are in localized corrosion phenomena such as stress-corrosion and corrosion-fatigue. Stress-corrosion of alloys, and the influences of metal composition and structure, environment, and state and degree of stress, are discussed. Practically all known alloy systems can be made to crack from stress-corrosion in appropriate environments. The oxide-film, mechanical, and electro-chemical theories of stress-corrosion cracking are reviewed and it is shown that the experimental evidence favours an electro-chemical mechanism. However, the exact mechanism of cracking may vary from one metal system to another, and no theory presented thus far is adequate to account for all observed phenomena. Stress-corrosion cracking of alpha brass, stainless steels, and magnesium alloys is still not understood clearly. Methods of protection against stress-corrosion cracking are reviewed briefly.

A list of references is given.

OPERATION AND MAINTENANCE

Scale Prevention for Low Pressure Evaporators. *Marine News*, **37** (1950), p. 29 (July).

The main difficulty in the production of fresh water from salt-water evaporators has hitherto been the formation of hard scale in the units, which reduces their efficiency and makes frequent shut-downs for cleaning necessary.

Attempts to reduce scale formation have met with varying success in the past, one of the most useful methods being the injection of dilute corn-starch solution. This method and others similar had, however, several drawbacks. A proprietary substance has now been developed which is said to inhibit scale formation completely. The result is that an evaporator will produce up to 130% of its rated capacity, the temperatures and pressures remaining the same. Although it is not possible to analyse the steam consumption with absolute accuracy, it appears that the increase in water production from an evaporator while the steam consumption remains much the same would imply a saving of about 1 ton of fuel for every 400 tons of fresh water produced.