TECHNICAL ABSTRACTS

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SHIPBUILDING (GENERAL)

British Shipbuilding. *Future*, Overseas Number (1947), p. 11.

Unless anything unforeseen happens, British shipyards, which are at present working to full capacity, will be facing a severe crisis due to an inevitable contraction of demand within from two to five years. Once war-damaged yards have been completely restored, competition from European yards, with low costs and wages and possibly subsidies, is likely to be serious. On a long-term view the speed of air travel will probably be the decisive factor in the competition with the aeroplane, and it is unlikely that any more monster passenger ships will be built except for strategic or prestige reasons. The only type of traffic likely to expand under reasonable conditions of world trade is that catered for by fast cargo or refrigerator ships, with room for a certain number of tourist class passengers. A number of suggestions are put forward for meeting the crisis. These include the introduction of a compulsory " scrap and build " system, worked out to give an even flow of work to shipyards and with the intention of having, say, no ship under the British flag over 15 years old. Yards which for geographical or other reasons cannot be adapted for newer assembly by welding, should be transformed for other types of production, closed down, or amalgamated with adjacent yards. Other industries should be set up in the shipyards and towns in advance to reduce the transitional unemployment to a minimum. No new labour as riveters should be taken on.

From the technical point of view, British shipyards are well served as regards research. Among those engaged in this class of work are a few large firms, the Admiralty, the William Froude Laboratory (part of D.S.I.R.), the British Shipbuilding Research Association, the British Welding Research Association, the British Corporation Register, Lloyd's Register, the Parsons and Marine Engineering Turbine Research and Development Association, the British Internal Combustion Engine Research Association, and the four principal professional organizations of naval architects and marine engineers.

The case for and against both welding and riveting for building ships is stated briefly. It is not possible at present to make any sweeping generalizations on the relative merits of the two methods, but great efforts are being made to solve the technical problems involved in welding, since it is considered by designers that the country which solves them first will gain an enormous advantage over competitors. The drastic reorganization of shipyard and layout is a serious consideration, and the cost would be so great that it would probably have to be met by borrowing capital. The labour question, the length of period of apprenticeship essential under existing conditions if the welder is to rank as a skilled craftsman, and the inducements to become welding supervisors are all problems which must be solved if welding is to replace riveting in the shipyards, as seems certain in the near future.

WELDING AND OTHER METHODS OF CONSTRUCTION

Cold Welding. *Welding*, **16** (1948), p. 193 (May).

It is known that ductile metals can be welded cold by the application of pressure only. Methods have thus been evolved for cold-jointing comparatively thin parts made of aluminium and aluminium alloys ; and this brief article describes research work that has been carried out in the laboratories of one of the leading British companies.

Convenient press tools have been developed to effect cold-welding operations. They have to apply pressure to a relatively small portion of the welding surfaces, which are jointed by a flow of the material similar to that in blacksmithing.

A sufficient reduction of the metal thickness has to take place in cold welding, but it should not be enough to cause unnecessary weakening of the weld. Different techniques are described and illustrated for the production of long straight welds, of circular welds, and of continuous seam welds.

Welding in the Development of Jet Propulsion Engines. LARDGE, H. E. *Trans. Inst. Weld.*, **11** (1948), p. 15 (Feb.).

Fusion and resistance welding are used to a remarkable extent in the fabrication of the combustion and exhaust systems of jet propulsion engines, greatly facilitating the manufacture of this equipment.

The brief description given of engine operation illustrates the severe conditions under which the combustion equipment operates, and information is given on materials, fatigue failures, and fabricating processes, together with some of the problems encountered in the early days of the W.2B. unit.

Nimonic 75, a nickel-chromium alloy in sheet form, has been finally adopted in jet engines where temperatures are highest ; austenitic stainless steel of the weld-decay-free variety are employed for somewhat lower-temperature stressed components ; and, where there is no direct contact with hot gases, mild steel suitably protected from corrosion by aluminium spraying has been found satisfactory.

Generally speaking, pickling of alloy components should be carried out before welding.

Danger of distortion during resistance welding of the corrosion-resistant alloys can be reduced by carrying it out under water or by water-cooling the work during execution, and to this end stitch and seam welding are employed.

Fatigue failures of welded joints caused by pulsations imparted to the air stream were by far the greatest problem in the early development of combustion equipment ; but this has been eradicated in air casings by utilizing a thicker sheet of mild steel, suitably protected from corrosion by aluminium spraying. Seam welding was introduced, planishing of the weld was abandoned, and modifications were made to engine design.

" Direct flow " engines of the " Derwent I," " Nene " and " Derwent V " types employed an improved welding technique, based on experience gained from " reverse flow " engines and the fact that a simpler design of combustion system is possible. Stitch welds on certain joints of the mild steel expansion chambers are fully examined by X-rays, because of the high standard of welding required to meet the adverse physical conditions experienced by these components. Spot-weld failures have also been greatly reduced.

In both " direct " and " reverse-flow " engines, fusion welding by the carbon-arc process is successfully used in the discharge-nozzle bend assembly—a component subjected to severe mechanical and thermal stressing.

In spite of the many problems and failures in welded joints during the earlier stages of jet-engine design, such progress has been made that the Author considers that welding, when done under reasonable technical control, is consistent and safe, and that the number of test or service failures directly attributable to faulty welding is very low indeed.

Review of Flame Cutting Developments Past, Present and Future. DORÉ, R. E. *Trans. Inst. Weld.*, **11** (1948), p. 25 (Feb.).

The paper is a review of the developments and industrial applications of oxygen cutting since its inception some 50 years ago. Manual cutting, factors influencing cutting, oxygen lancing, flame gouging, underwater cutting, cutting of special steels (including stainless), machine and stack cutting, flame conditioning of steel, the cutting of heavy steel sections, future developments, and suggested research are discussed.

It is pointed out that the accurate cutting of steel up to 24 in thick is now frequently undertaken, and while recent developments permit the cutting of steel up to 6 ft or more in thickness, future progress will probably show that there will be no limit to the thickness of steel which can be oxygen cut.

The question of preheat is discussed in relation to surface hardness of the cut edge, and it is recorded that preheat does not become necessary for mild steel less than 8 in thick. For carbon steels, however, preheat is necessary depending upon the mass of metal involved. Various tests have shown that plate edge preparation by machine flame cutting for welding has no adverse effects upon the properties of the welded joint or upon the surface hardness at the cut edge.

Of the various industrial applications of oxygen cutting, underwater cutting is cited as being one of the most important developments, while in the shipbuilding industry machine flame cutting is now in common use for plate edge preparation for welding. The advent of machine profile cutting has effected considerable economy in forging operations by permitting a preliminary rough shaping in steel of any thickness, and in production work " stack cutting " of a number of steel sheets or plates tightly clamped together again effects an economy. Flame conditioning of steel has now become an integral part of the steel rolling process for the purpose of removing surface defects from steel ingots, blooms, billets, and slabs. Although considerable development has taken place in the cutting of extra heavy steel sections, much work has still to be done with regard to the minimum size of nozzle required for the maximum efficiency and economy.

In outlining future developments and suggested lines for research in cutting, the Author emphasizes that in the metallurgical and chemical fields much is still to be learned, especially with regard to the cutting of alloy steels and the design of equipment and practical application ; while probably the most important future development will be the flame cutting of stainless steel, non-ferrous metals, and non-metallic materials.

BOILERS AND STEAM DISTRIBUTION

An Investigation of Boiler-Drum Steel after Forty Years of Service. BLUMBERG, H. S., and SMITH, G. V. *Trans. A.S.M.E.*, **70** (1948), p. 185 (April).

An account is given of the examination of the materials of seven riveted boiler drums, removed from service after forty years' operation at a temperature and pressure of 388° F. and 200 lb/sq. in. There was no evidence of deterioration, caustic embrittlement, any general corrosion, or of strain-ageing as a result of service. This absence of deterioration may be attributed largely, if not entirely, to the careful maintenance programme carried out annually, during which the inner drum surfaces were painted with selected coatings. Before painting, the drums were thoroughly inspected, scraped and brushed surfaces were examined. It should be noted that the feed water was originally untreated, and the rivet holes were punched without subsequent reaming or drilling to remove cold-worked metal. The mechanical properties of the steel compared favourably with those of the steels which would be used for a similar application to-day.

Since neither corrosion, caustic embrittlement, loss of mechanical properties, nor strain-ageing embrittlement was found, it is concluded that, for operation under these particular conditions and with careful inspection and maintenance, the derating of boiler drums is not warranted.

In the discussion that followed, Mr. Rohrig endorsed the view that the suitability of boiler-drum material should be determined by its condition rather than by length of time it had been in service.

MARINE POWER INSTALLATIONS

Machinery of the Cunard White Star Liner " Asia " LOVERIDGE, W. E. *Trans. N.E.C. Inst. E. Shipb., paper read 9th April,* 1948.

The paper describes the machinery of the *Asia*, and gives results of the early passages across the North Atlantic. The principal dimensions of the vessel are $508.79 \times 64.12 \times 27.57$ ft and the design service speed fully loaded is 15 knots. The power of 7,250 s.h.p. required in service is supplied by one high-pressure and one low-pressure turbine which drive the propeller at 116 r.p.m. through a double-reduction gear. Two main boilers of the Foster Wheeler " D " type supply steam at a working pressure of 480 lb/sq. in. and a temperature of about 750° F. at the superheater outlet. A Cochran auxiliary vertical boiler is fitted for a working pressure of 100 lb/sq. in.

Power for the motor-driven auxiliaries and deck machinery is produced by four 205-kW Diesel-driven-generators.

The paper gives many detailed drawings of the machinery, and there are miscellaneous items, such as lists of auxiliaries with their electric loads, detailed weights of machinery, and voyage results given in separate tables. Comparisons are included between the estimated and the actual performance, and indicate satisfactory co-ordination of hull, machinery, and propeller.

The Author suggests that, from the shipowner's point of view, the selected steam conditions represent the best compromise for a vessel of moderate power between first cost, running cost, and reliability.

A Modern Marine Power Plant. WOODS, A. W. *Mar. Engng. Shipp. Rev.*, **53** (1948), p. 61 (April).

The Author describes the salient features of a power plant for a cargo-ship design designated the C-3-S-DB3, and the reasons that led to its selection.

The power plant finally specified is a geared steam turbine of 12,500 s.h.p. normal and 13,750 s.h.p. maximum, with steam conditions of 850 lb/sq. in. and 900° F. at the superheater outlet. Propulsion is by a single screw at 90 r.p.m. Most auxiliaries are motor-driven and three 400-kW turbo-generators are provided.

It is stated that the U.S. Maritime Commission has attempted, in the development of machinery designs, to evaluate the most economic types of equipment, cycle, etc., on a basis of yearly operating cost, which includes first cost of equipment, the annual carrying charges, such as depreciation, interest, and insurance, and the fuel, lubricating oil, and water cost, but excludes wages and maintenance.

This cost analysis is applied to the principal characteristics of different power plants, including the heat cycle, the feed cycle, propulsion turbines, reduction gear, condensers, boilers, electrical plant, feed pumps, and piping.

It is stated that geared turbines were chosen for the design under consideration because of their low first cost. Diesel propulsion plant is more expensive in the U.S.A. than geared turbines and, with the relative prices of bunker and Diesel fuel ruling at present, the Diesel has been unable to overcome this initial handicap.

Potentialities of Marine Steam Turbine Machinery. *Journal of Commerce* (1948), p. 1 (12 Feb.).

This article consists of extracts from a paper entitled Marine Steam Engineering, published in the Annual Review for 1947, issued by the *Journal of Commerce and Shipping Telegraph.* Recent trends in the development of steam turbine machinery are discussed.

For high-speed cargo liners increasing use is being made of a high-pressure impulse turbine and a reaction low-pressure turbine. The first post-war installation of this kind has recently been completed and the trials are reported to have been highly satisfactory. The unit has a service rating of 6,800 s.h.p. at 116 r.p.m. with steam supplied by two Yarrow type water-tube boilers at 450 lb/sq. in. pressure and 750° F. temperature. The gearing is of the articulated type with the high and low pressure primary gears driving their secondary pinions through flexible grill shafts, proper alignment of the pinions and wheels being maintained by means of a fabricated gear case. Regenerative heating of the feedwater is carried out in six stages, the final temperature of the water being 320° F. A number of marine turbine installations of this type are under construction for powers ranging from 5,500 s.h.p. to about 14,000 s.h.p. per shaft.

A number of new steam propelling-machinery installations, operating under medium pressure and temperature conditions, will be fitted with steam auxiliaries, the steam being provided in some cases by an independent auxiliary boiler. The tendency in larger geared-turbine installations now building is towards the use of higher temperatures and pressures. The new Orient liner *Orcades* will be propelled by twin-screw geared turbines working at a steam pressure of 525 lb/sq. in. and a temperature of 850° F.

The possibility of developing a 10,000-h.p. unit at a pressure of 1,200 lb/sq.in. at the turbine inlet, with 1,200° F. steam temperature and 28.5 in condenser vacuum is considered. Steam consumption should amount to about 5 lb/s.h.p. hr, and it should be possible to operate with a boiler-oil consumption of about 0.46 lb/s.h.p. hr. Such machines would have to be uni-directional and the various means for arranging for astern drive are discussed. Of these, a scheme employing a fluid coupling is considered to be the most promising.

LUBRICANTS AND LUBRICATION

Development of Silicone Lubricants. WILLIAMS, A. E. *Power Wks. Engng.*, **43** (1948), p. 138 (May).

Silicone lubricants are now being produced on a large scale in the United States. For general applications they are superior to petroleum oils in many ways ; they have better heat stability and resistance to oxidation, they are non-volatile, and their rate of change of viscosity with temperature is unusually low.

Copper-lead, bronze, commercial brass, babbitt, copper, aluminium, and Alfinalloy are among the bearing metals which have been found promising for use with these lubricants. They are especially effective with chromium-plated high carbon steel journals. Cold-rolled steel bearings operated with copper-plated high-carbon steel journal bearings also show good results. The non-ferrous bearings have been successfully operated at 6,000 lb/sq. in.

For maximum load carrying, the bearings should either be run in slowly or be treated with silicone lacquer before operation. If the slow running-in process is adopted, an organic film containing silicon will form on the bearing. It has been found that the film-coated bearing has a load-carrying capacity comparable with that of artificially silicone-lacquered bearings. Bearing systems of steel on steel and steel on cast iron do not appear to operate satisfactorily with silicone lubricants, but if a very slow running-in process is followed, and the bearings are treated with silicone-lacquer, they will stand up to loads of about 2,000 lb/sq. in. Suitable bearing-lacquer coatings have been formed by completely immersing the bearing in dimethyl silicone polymer fluid having a viscosity at room temperature of 50 to 100 centipoises or more, at a temperature between 300° and 500° F., in the presence of air. Exposures of 100 hours at 300° F. or 24 hours at 500° F. have been found to be satisfactory so far, but the exact time depends upon the metal.

VIBRATION AND SOUND-PROOFING

Vibrations of Steam Turbine Blades. LEVIN, A. V. *Engineers Digest*, 9 (1948), p. 155 (May).

This article was prepared from a number of papers on the " Dynamic Strength of Machine Parts," published by the Academy of Sciences, U.S.S.R., Institute of Mechanical Engineering, Moscow, 1946, p. 25, in which the very considerable stresses that occur in the discs and blades of a turbine rotor operating at speeds up to 3,000 r.p.m. are discussed. Where it is not possible to adjust the natural frequencies of a blade packet to avoid resonance, the stresses in the moving blades are determined on the assumption that they may possibly be working under resonance conditions. In the case of fixed blades, it is important to consider the possibility of changes with age in the strength characteristics of the blades. Experiments being carried out at the Stalin Works have shown that the fatigue limit of blades falls sharply during operation. After 94,000 hours nickel steel blades could only sustain 10 million cycles under a stress of 8.9 tons/sq. in. or less, whereas when new they had a fatigue limit of about 22 tons/sq. in. For blades of untempered steel, the fatigue limit decreased on an average to half the original value after 12,000 hours of service.