TECHNICAL ABSTRACTS

The following abstracts are reproduced from the 'Journal of the British Shipbuilding Research Association,' Vol. 9, Nos. 9, 10, 11.

SHIPYARDS AND DOCKS

Treatment of Compressed-Air Machinery. *Power and Works Engineering*, **49** (1954), p. 199 (June).

Compressed air has a number of advantages as a form of power distribution. The motor portion of a pneumatic machine cannot be damaged by over-loading; power can be easily regulated; stopping and starting are almost instantaneous; and this method is considered the safest for transmitting power to portable tools.

When possible, pneumatic tools should be the responsibility of a competent maintenance fitter, who should keep the tools in repair and advise on handling and general treatment during use. The attitude of the individual workman largely determines the treatment a tool will receive, and for this reason tools that are too heavy should be avoided, since they might cause fatigue and carelessness. Correct lubrication is important for machinery powered by compressed air, and the use of dry air is essential. A water trap between air receiver and tools is required to remove moisture. Compressors fitted with aftercoolers are most efficient in this respect. Excess oil may also cause trouble in this type of machinery.

MATERIALS : STRENGTH, TESTING AND USE

Portable Magnetic Crack-Detector. *Power and Works Engineering*, **49** (1954), p. 259 (July).

The magnetic crack detector, Mageo, made by the Magnetic Equipment Co. Ltd., is designed to enable flaws in any direction to be detected. For this purpose a magnetic field in two directions must be applied. This is done by first using a magnetizing unit, and then passing a heavy current through the work to produce a magnetic flux at right angles to the first. The new equipment has a very light control box, and a magnetizing magnet with adjustable legs, which enables almost any shape of workpiece to be inspected. The control box provides complete regulation of the magnetizing current, and is available for A.C. or D.C. supplies, or in a universal form applicable to both.

Material for Gas Turbines. SUTTON, H. *Metallurgia*, **50** (1954), p. 131 (Sept.).

This paper was read at the Production Exhibition and Conference organized by the Institution of Production Engineers and held at Olympia.

The parts of the gas turbine that have presented the main problems for the metallurgist are the rotor blades of the turbine, the rotor disk or drum, the nozzle guide vanes and stationary blades, and the combustion chamber and discharge arms. The first objective, as far as service aircraft were concerned was to develop materials that would at least satisfy the following requirements : the alloy must not give an extension of more than 0·1 per cent in 300 hours under a stress of 3 tons sq in at 750° C (1380° F), and must have the highest possible resistance to oxidation and other corrosive attack at this temperature ; the alloy must be sufficiently workable for rather complicated forgings to be produced in it without excessive difficulty.

The quest for hollow blades for application of cooling and also for light-weight stiff stator blades has stimulated development of blades by powder metallurgy, by casting techniques, in solid wrought forms, and by fabrication from sheet, strip, tubes, etc. There is great interest in porous materials prepared by sintering and other techniques for transpiration cooling, and it is to be expected that, with increasing experience, these materials will find useful application in turbine engines. Cladding techniques have been developed and clad steels and copper have been produced. By these means, layers of more resistant materials can be applied to one or both sides of sheets of less expensive material.

Titanium-rich alloys seem likely to have advantages in compressors of gas turbines if the working temperature reaches 400° C (750° F).

GAS TURBINES

Gas Turbines for Ships' Emergency Generator Drive. *Engineering*, **177** (1954), p. 637 (14 May).

W. H. Allen, Sons & Co. Ltd., have built a small lightweight emergency gas-turbine-driven generator for naval requirements. As only limited spells of running time were envisaged, fuel consumption and long life were relatively unimportant considerations, and so the design adopted was a simple-cycle single-shaft type of engine. For simplicity, the unit comprises a single-stage centrifugal compressor, a single combustion chamber, and plain bearings. The compression ratio was limited to 2·5 to 1 to permit the use of a single-stage turbine, the rotor of which runs at a speed of 23,000 r.p.m. through an Allen-Stoeckicht epicyclic gear.

The first attempt to run the engine through its critical speed of 7,000 r.p.m. proved abortive owing to the severe whirling of the overhung rotor. It was therefore decided to change to the present design with a bearing on either side of the rotor, with the result that the engine now runs well below its critical speed in all conditions.

A radial-flow turbine was chosen, since it was thought that this might give higher efficiency than an axial turbine in such small size ; but the efficiency of the turbine actually attained—86 per cent—is not superior to that of an axial turbine of the same size.

The measured performance at full load is as follows : air inlet temperature 60° F ; turbine inlet temperature 1,435° F ; mass flow 5·1 lb/sec ; pressure ratio 2·4 to 1 ; thermal efficiency (high-speed coupling) $8\frac{3}{4}$ per cent ; output 200 h.p. ; specific fuel consumption 1·6 lb/hr.

The overall dimensions of the engine are approximately 50 in high, 39 in long, and 34 in wide. The weight, including reduction gear and all auxiliaries, is 600 lb. The engine is mounted on the base plate of the generator which it drives.

POWER TRANSMISSION

Surface Failure of Gears. CAMERON, A. *Journal Institution of Petroleum*, **40** (1954), p. 191 (July).

Lubrication theory requires film thickness to vary directly with speed at any given load. But experimental work has demonstrated the failure of the classical theory, since a complete oil film is formed at very low speeds. If this could be explained, the lubrication of gears would be better understood.

The suggestion is made that scuffing is a type of ' cold ' pressure welding. In gears the sequence of events may be as follows :

The local temperature rises to 250° C (482° F), and this causes the surface to soften; the consequent yielding will rupture the oxide film present on it. The two metal surfaces will then weld together as the result of the pressure exerted between them.

Pitting commonly occurs with marine gears but is not regarded as being very serious. Cracks are formed in both the addendum and dedendum, but only those in the dedendum extend to form pits. It is usual for the crack to extend to a depth two or three times that of the pit. Cracks are always oriented away from the pitch line in a driven gear, and towards it when the gear is driving.

References are given.

LUBRICANTS AND LUBRICATION

Oil Film Whirl. An Investigation of Disturbances Due to Oil Films in Journal Bearings. NEWKIRK, B. L., and LEWIS, J. F. *American Society of Mechanical Engineers Paper No. 54–LUB–4, read at First Annual A.S.M.E.–A.S.L.E. Lubrication Conference, Baltimore, Maryland*, 18–20 Oct. 1954.

Tests were run, using oil at various viscosities, with three rotors and five bearings, to determine conditions of stable operation with cylindrical journal bearings at speeds above twice critical speed. It appears from these tests that short bearings, rather large clearance ratios, and moderate bearing pressures favour a wide range of stable operation, up to more than five times critical speed. A slight misalignment resulted in a remarkable increase of the range. It is suggested by the Authors that apparently two basically different phenomena are involved, to which the terms ' oil whip ' and ' oil-film whirl ' have been applied indiscriminately.

It was noticed that in many runs at light loads or no load, as in guide bearings of vertical shafts, a shaft vibration of frequency at half the running speed occurred at a running speed well above twice critical speed. These disturbances were easily damped out. There is a more severe disturbance that builds up in the natural frequency of the shaft for transverse vibration.

Results of a large number of runs under which the whirl was impending—the border line of instability—are presented in two tables.

AUXILIARY EQUIPMENT AND MACHINERY

Water Purification Plant for Ships. *Marine Engineer and Naval Architect*, **77** (1954), p. 227 (June).

All natural waters require a certain amount of chlorine to oxidize completely the nitrogenous matter present. The point of complete oxidation is known as the 'break point'. Because of the difficulties of determining the break point on board ship, it is the usual practice to over-chlorinate to ensure that the water is sterile. The surplus chlorine and chlorinous compounds then have to be removed before drinking.

In the water-purification plant developed by Sutcliffe, Speakman & Co. Ltd., which has been designed to deal with varying amounts of chlorine residual, the water is passed through a bed of activated carbon, giving a sterile water free from unpleasant odour and taste. The active-carbon dechlorinator unit is preceded by a sand filter, which removes any solid matter and can be cleaned simply by reversing the water flow. All operations are controlled by a single selector valve. When it is necessary to sterilize the pipelines throughout the ship, the dechlorinator is by-passed and chlorinated water allowed to flow through the system.

Separating Oil from Bilge Water. *Motor Ship*, **35** (1954), p. 191 (Aug.).

A device for the separation of oil from oily bilge water was recently demonstrated. This separator, designed by Holford Processes Ltd., London, has a capacity of 10–15 tons per hour and weighs about 17 cwt ; its diameter is 3 ft 6 in and height 7 ft 6 in. The oily bilge water is pumped into the lower end of the separator, where it is distributed by means of a perforated injection pipe arranged centrally in a rotating conical baffle. Above this, in the main body of the vessel, there is a series of baffle plates having staggered holes, so that in its passage through the apparatus the mixture is broken up. On the top of the separator, there is an automatic float-operated oil-discharge valve. The separated effluent water can be discharged either overboard, or through a filter chamber. The separator is fitted with steam heating coils, or, alternatively, an electric immersion element can be used.

In addition to the size demonstrated, the separator can be supplied in three other sizes, the largest having a rated capacity of 40–50 tons per hour.

CORROSION, FOULING, AND PREVENTION

Corrosion Damage in Marine Engines. BERGENHEIM, H. *Motor Ship*, **35** (1954), p. 168 (July).

Serious corrosion damage has been observed for several years in two-stroke marine Diesel engines. Investigations have shown that the main causes of this are probably (*a*) Diesel oils with high cetane numbers, and (*b*) electric plant with low insulation-resistance. As regards cause (*a*), the high cetane numbers seem to affect only slow running engines, and so far no correlation between cetane number and the wear of high speed engines (ships' auxiliaries, for example) has been found. Increased cetane number seems to be associated with a higher concentration of such oxidation products as peroxides and aldehydes which are able to initiate detonation in cylinders, with resulting high temperatures. At these high temperatures the piston, the oil film, and the cylinder walls are probably subjected to a destructive action which increases wear.

As regards cause (*b*), the investigations have shown that electrical phenomena arise in connexion with the combustion inside the cylinder, in consequence of which the cylinder becomes negative and the piston positive. The difference of potential drives a current through the circuit formed by the engine frame, cylinder, crankshaft, connecting rod, and piston. When the current passes through an oil film, an electrolytic oxidation of the oil takes place, simultaneously with electrolytic action on the metals. The products of oxidation contribute to increasing the violence of the next combustion, which again leads to higher combustion temperatures and increased wear.

In crankshaft bearings and main bearings, where the oil stream is copious, the corrosion should be considerable. This has, in fact, been found. In lubricating-oil purifier bowls, the oil stream is forced to pass between the metal surfaces of the discs, and again the corrosive action is extensive.

The investigations have proved an immediate increase of material damage when the insulation resistance of the ship's electrical installation is low. The stray currents in the hull, piping, and engines start an electrolytic action, and the potentials initiate oxidation in which the metal ions act as catalysts.

To counteract the electric currents causing corrosion, a compensating apparatus has been developed and patented by the Bröstrom concern in several countries. The apparatus consists of a converter for transforming the voltage of the ship's network to the required figure, starting and stopping gear, automatic switches, a regulating device, and indicating instruments. The first trial apparatus of this type, installed in 1951, was followed by further five installations in various Bröstrom ships. The results are said to be very satisfactory.

See also Abstracts No. 3434 and 3435 (March 1950).