ENGINEERING ABSTRACTS

Section 3. Shipbuilding and Marine Engineering

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Propeller Characteristics Under Non-axial Flow

This article is accompanied by photographs which demonstrate that cavitation of a screw propeller under non-axial flow varies with blade position and does not remain the same as the blade makes its complete revolution. Therefore, in addition to the generally accepted conditions, the degree of cavitation depends on blade position when the entering flow-lines are not parallel to the propeller axis. The investigation conducted as a result of this observation showed that cavitation occurs earlier (at lower slip) under non-axial flow. Since propeller characteristics are often determined from propeller tunnel tests the discrepancy between predicted and actual starts of cavitation has been a source of concern to propeller and ship designers. A further manifestation of the fundamental nature of this phenomenon has been the disparity between the power absorbed by each propeller of a twin screw vessel having different shaft declivities (and therefore different angularity between flow lines and propeller axis. After the observation of the varying degrees of cavitation with blade position, the investigation was diverted to an analysis of this cavitation phenomenon. It was determined that the reason for the varying degree of cavitation as the blade rotated was the varying angle of attack between the blade section and the entering flow lines.—*Commander C. R. Hirschberger, U.S.N. and Commander F. C. Jones, U.S.N., Journal of the American Society of Naval Engineers, Vol. 60, November 1948, pp. 461-472.*

Oil Operated Clutch

Two trawlers under construction at the Goole Shipbuilding and Repairing Co., Ltd., for the Icelandic Government are each equipped with a Ruston and Hornsby non-reversible Diesel engine of 1,200 b.h.p. continuous rating at 435 r.p.m. or 1,340 b.h.p. on a 12-hour basis. The forward end of this engine drives a generator which can be disconnected from the engine as necessary by an S.L.M. oil-separated isolating clutch. This clutch is designed to transmit 330 b.h.p. at 435 r.p.m., which is equivalent to the input power of the 220 kW. generator. Power for main propulsion is transmitted through S.L.M. oil-operated reverse reduction gears, which have the following characteristics:—

Continuous rating	1,425 b.h.p.
12-hour rating	1,500 b.h.p.
Speed of input shaft	435 r.p.m.
Speed of output shaft	108 r.p.m.
Total reduction ratio	4/1 ahead and astern
Propeller thrust	20 tons

Ahead and astern rotation of the propeller shaft is effected by oil-operated clutches incorporated in the reduction gear train. In the "stop" position, all clutches are disengaged, the final shaft being stationary and therefore minimum frictional losses are encountered. With either the ahead or the astern clutch engaged, no losses whatsoever due to slip take place, but the inherent flexibility of these oil-operated clutches overcomes the disadvantages of the otherwise locked

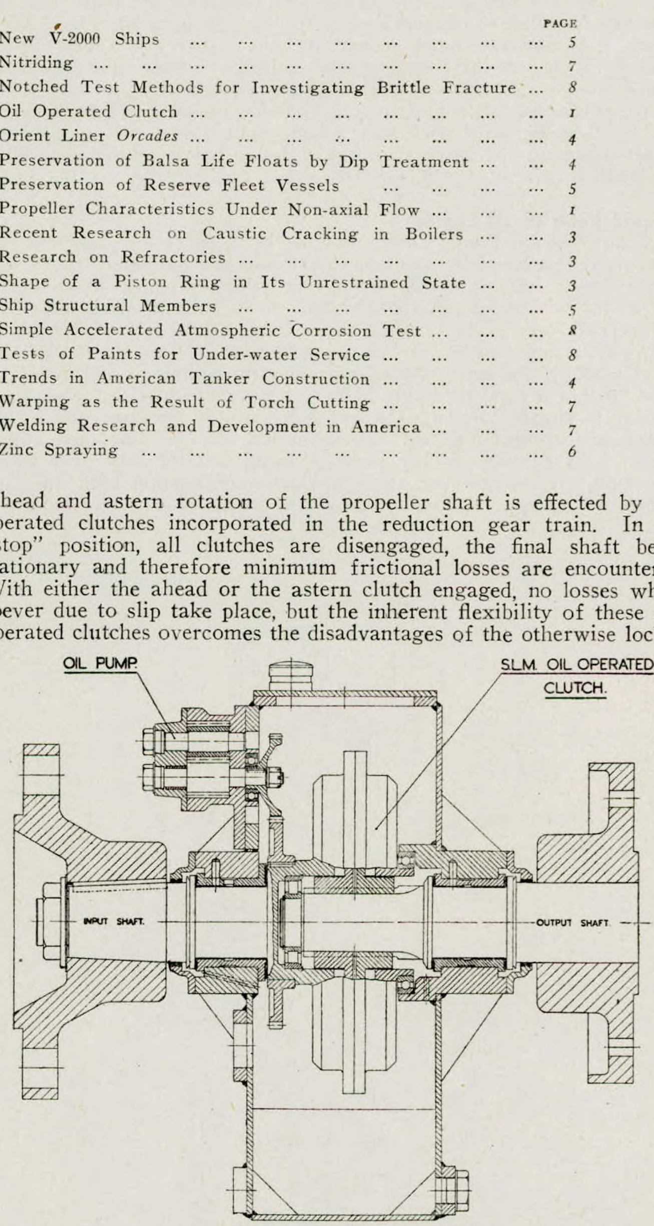


Fig. 2.—*Oil-operated isolating clutch for driving the 220-kW. Ruston generator*

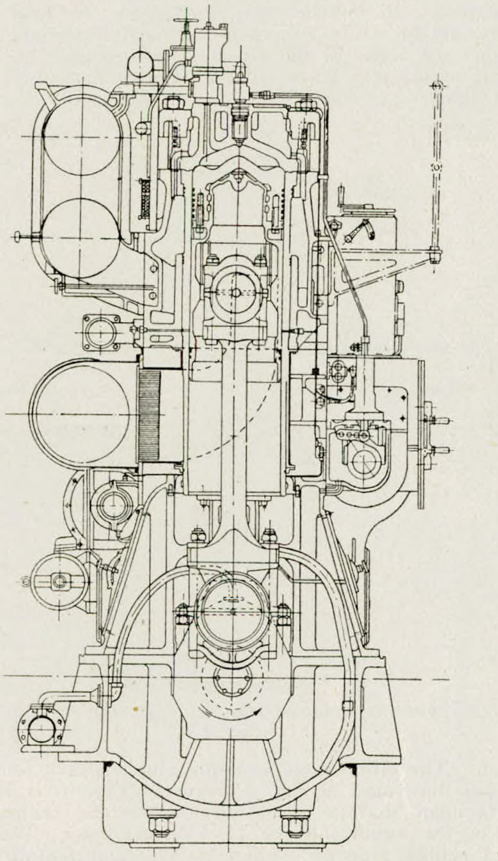
gear train. The oil-operated isolating clutch at the forward end of the engine, illustrated in Fig. 2, forms a completely self-contained unit. Its input shaft is solidly coupled to the engine crankshaft, whereas on the output side the 220 kW. generator is driven through a bonded rubber type of coupling. A special feature of this oil-operated isolating clutch is that it is provided with a special starting and regulating valve which allows for a very gradual speed take-up on the generator.—*The Shipping World, Vol. 119, 22nd December 1948, p. 515.*

Anchor Trials

During the past few years considerable technical research has been undertaken by the Admiralty on the design of anchors. As a first result, one 5½-ton anchor has been designed which is no less than four times as efficient as older types of equivalent weight. As a result of frequent wartime reports that H.M. ships, particularly aircraft carriers, were dragging their anchors and moorings, Sir Charles Lillicrap, Director of Naval Construction and head of the Royal Corps of Naval Constructors, ordered an intensive programme of research whose objects were the designs of a mooring anchor and bower anchor of improved efficiency. Work was begun on full-size anchors at Pwllheli, North Wales, in co-operation with the Air Ministry, and later continued on a testing site at East Fleet, Weymouth. Among the most recent anchors tested are a new 5½-ton mooring anchor of new design, whose design is based on experience gained on previous trials. The old Admiralty mooring anchor would withstand the equivalent of a pull of twice its own weight, whereas the new design will hold more than eight times its own weight before dragging. A further improved design has now been evolved.—*Shipping World, Vol. 119, 8th December 1948, p. 473.*

Kincaid-Polar Diesel Engine

The Kincaid-Polar Diesel engine is a reversible single-acting two-stroke engine with cylinders 500 mm. in diameter, the piston stroke being 700 mm., the output per cylinder being 400 b.h.p. at 250 r.p.m. or 320 b.h.p. at 200 r.p.m. It is built in sizes with four to nine cylinders. The output ranges from 1,000 b.h.p. to 2,600 b.h.p and installations can be constructed with two or four engines driving a single shaft through hydraulic or electric couplings and reduction gear, so that a total of about 14,000 b.h.p. can be attained. Scavenging air is supplied from a blower fitted at the forward end of the engine and comprising two fans mounted side by side on a single shaft. One of these is for running ahead and the other for astern operation. A change-over valve works in conjunction with the fans. When the engine is running ahead the valve blanks off the astern fan, and vice versa. The first engine on trial is a unit of six cylinders developing 1,824 b.h.p. at 190 r.p.m.—*The Motor Ship, Vol. 29, December 1948, p. 346.*



Section through cylinder of the Kincaid-Polar Diesel engine

Compression Shock in Turbine and Compressor Blade Passages

As the author explains, the generalized theory of the plane compression shock has been widely known for some forty years, but only recently has appreciable progress been made in its application to everyday engineering practice. In the fields of ballistics and aircraft engineering, the shock is still generally regarded as a most undesirable phenomenon to be avoided whenever possible. However, in the fluid dynamics of gas-turbine power plant a stage has now been reached at which the shock, far from being regarded as a nuisance, must be considered as a potential aerodynamic tool of considerable consequence. Starting with a brief mention of the isentropic expansion of a compressible fluid and the classical compression-shock theory, the paper introduces some practical definitions and conceptions concerning the description and classification of the various forms of the single shock. The phenomena associated with shock wave reflection and boundary layer interactions are then considered, and finally four examples are given of the occurrence of shocks in practice. Two of the various typical cases considered refer to the gas turbine field.—*Paper by I. M. Davidson, read at an Extra General Meeting of The Institution of Mechanical Engineers, 12th November 1948.*

Frederikshavn Reversing Mechanism

A reversing arrangement in which a single-lever control is employed is illustrated in Fig. 1. The lever may be turned in two different planes, so that in one case the fuel-pump cams and a starting air distributor are adjusted and in the other the starting air supply is opened. When the lever (1) turns the shaft (2), the fork (11) moves the sleeve (14) and the pins (21) on the oblique surface (20) displace the driving plate (30). This driving plate has the effect of adjusting the fuel-pump cams, one of which (31) is partly shown. As the extension (18) turns, it displaces the distributor (19)

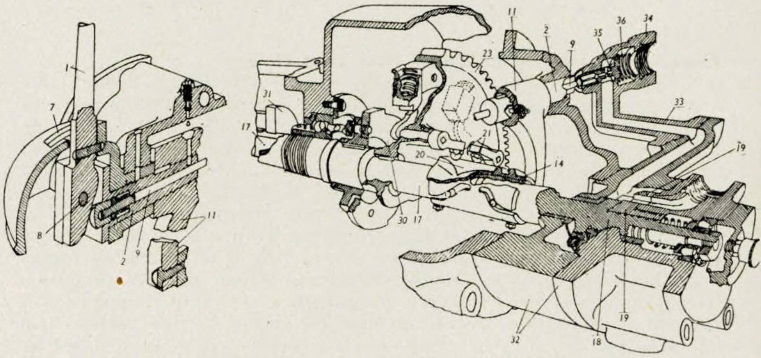


FIG. 1.

which controls the admission of starting air to the cylinders. When the reversing action has taken place, the lever (1) is moved through the slot (7) and turns around the pin (8), so that the spindle (9) moves inwards and opens the starting air valve (35). Air is then supplied from the pipe (34) to the passage (33) and thence to the casing (32) in which the distributor (19) is located. After the engine has started, the lever (1) is moved forward, the valve (35) is closed by the spring (36) and the engine runs normally on fuel. The fuel pump cams are loose on the shaft (17) and are enabled to take up their correct positions ahead and astern, the shaft (17) being driven by a gear wheel (23).—*British Patent No. 602,535, Frederikshavns Jernstoberi and Maskinfabrik. The Motor Ship, Vol. 29, December 1948, p. 362.*

New Diesel Engine

A new Diesel engine applicable to marine propulsion and auxiliary drives has been introduced in the United States by the Hooven, Owens, Rentschler Co. Division of Lima-Hamilton Corporation. With ratings up to 1,200 h.p. the new Hamilton 9-inch bore by 12-inch stroke Diesel engine, described as the heaviest duty Diesel of its kind ever developed in America, is designed for higher working pressures than any now used in comparable engines. Being of a vertical, 4-cycle design, the Hamilton Diesel is built in 6- and 8-cylinder models, normally aspirated or supercharged. Both are of the single acting, solid injection type. Its rating for eight cylinders supercharged at sea level is conservatively set by the manufacturer at 1,200 h.p. It is said that the new Hamilton gives substantially more horse-power per pound of engine weight than any other similar

Diesel now in commercial production. Intercooling is provided on all supercharged models, marking this as the first American Diesel of its type in regular production with intercooling of supercharging air. A Büchi-type turbo-charger is mounted on the free end of the engine and lubricated from the engine lubricating oil system. This turbo-charger, which provides high specific output and operating economy, consists of a turbine wheel driven by the exhaust gas from the engine. The wheel in turn drives the centrifugal air compressor, which supplies air under pressure to the engine intake manifolds. The two intake and two exhaust valves, all of the same size and material, are located in each of the cylinder heads, and the valve gear is so arranged that cylinder heads can be tightened without removal of this valve gear. Individual cylinder liners, of special wear-resistant cast iron are designed as wet type removable sleeves. The bottom seal between the liner and cylinder block is made by use of synthetic rubber rings. Two rings are used at the bottom seal, and a groove is machined in the liner between the two rings. This groove in turn is connected to a drilled passage from the outside edge of the cylinder block. The tell-tale holes enable the operator to determine positively and quickly any seal leaks which may develop.—*Motorship (New York), Vol. 33, November 1948, pp. 41-42.*

Diesel Engines in the U.S. Coast Guard

The present policies of Coast Guard engineering indicate that, in the interests of economy, reliability, and saving of space, Diesel power is being installed where requirements do not exceed 2,000 h.p. This is reflected in a current programme of lightship conversion. The steam plants of many of these vessels, which must be maintained at steaming conditions at all times on station, are being replaced by Diesel engine propulsion and auxiliary machinery. With this installation the main engine room may be secured on station, and with auxiliary machinery furnishing power and air for navigational aids, the necessary boiler and other watches are eliminated.—*Paper read by Captain G. F. Hicks, U.S.C.Q., at the American Merchant Marine Conference, sponsored by the Propeller Club of the United States, held in New York, 13th-15th October 1948.*

Diesel Engines in River Traffic

In the horse-power ranges normally adopted for river towboats, say 1,000 to 2,700 h.p., the fuel economies returnable from steam producing plants are not as favourable as those returnable from large marine or stationary steam power plants. It is now generally accepted in comparing steam and Diesel to allow roughly one pound of Bunker C fuel oil per shaft horse-power for all purposes for the modern steam plant. Diesel powered towboats are usually assessed on an all-purpose allowance of one-half pound of Diesel oil per shaft horse-power. A modern Diesel towboat design frequently incorporates fuel bunkerage approximately one-third of its total displacement. This fact imposes a difficult problem on the designer since the draft aft on the screw propelled boats cannot be permitted to vary more than an inch or two at most. Doubling the deadweight of fuel bunkerage requirement for steam powered plants is beyond the capacity of acceptable hull dimensions. Thus fuel flats are required imposing a loss in revenue equal to the carrying capacity of the fuel flats in addition to the investment burden. This problem of fuel radius, coupled with the further facts that the Diesel engines have been developed to a state of reliability permitting operators to schedule their runs accurately and that a Diesel vessel requires no coal passers, firemen, or water tenders, has all accumulated to the point where there are decided economies in returned costs per ton mile of delivered cargo accruing in favour of the Diesel powered vessel against the steam powered vessel. Fundamentally, there is a direct association between Diesel power and river towing in that river towboats are by necessity problems of restricted propeller diameter. The designer is forced into accepting higher revolutions than he would otherwise normally select were he unhampered by draft restrictions. These higher revolutions, normally running from about 225 to 360 r.p.m., are readily acceptable to both direct connected and reduction geared Diesels. In general, Diesel power installations for river vessels were built up around the direct connected, reversible so-called slow speed Diesel. Progressive changes in materials and design have now permitted acceptance of higher speed non-reversing Diesel engines fitted with reverse and reduction gearing. Such units are assembled with multi-cylinder engines designed to operate with reverse reduction gear units with ratios of from 1½/1 up to as high as 4/1. Units having eight or more cylinders and reduction ratios of 2½/1 or better are particularly attractive. It should be noted that against the handsome return in weight reduction offered by the higher speed reduction geared units one must assess the weight and cost of applying sound deadening linings to engine room walls and overhead. Experience has dictated the installation of such linings in order to reduce the noise level below the point adversely influencing operating efficiency of personnel. In the case of direct connected drive such sound reduction linings are generally considered as optional.—*Paper by A. J. Dawson, read at The American Merchant Marine Conference, sponsored by the Propeller Club of the United States, held in New York, 13th-15th October 1948.*

The Shape of a Piston Ring in Its Unrestrained State

This paper develops, with mathematical means, a general equation between the free shape of a piston ring in its unrestrained state and the consequent radial-pressure pattern against the cylinder wall after its installation. It is up to the designer, first to decide upon the proper pressure distribution for his particular need, and then to use such an equation as a first guide to evaluate the proper free shape of the ring so that it will give him the required radial-pressure pattern after its installation in the cylinder.—*Paper by Che-Tyan Chang, read at the 1948 Annual Meeting of the American Society of Mechanical Engineers, Paper No. 48-A-21.*

Heat Engines

In this paper the author reviews the progress made in the development of heat engines during the last thirty years. Discussing the present position respecting marine applications, he points out that for powers up to 5,000 h.p. there is keen competition between the steam engine with exhaust turbine, the steam turbine, and the oil engine, which enjoys a predominant position. For powers above 10,000 h.p. the steam plant is holding its place, and the tendency towards higher steam conditions is likely to improve its position. The gas turbine will find its place when it has demonstrated a reliability equal to that of existing plant. For large passenger liners the steam turbine is in the most favoured position, but large slow-speed oil engines and medium-speed oil engines, geared or electrically coupled to the propeller shaft, have been used. For fast naval vessels the gas turbine will become a serious competitor to the high-speed oil engine and to the steam plant. Its light weight and smaller space requirement become important factors, and it is in these applications that the gas turbine will find one of its earliest uses.—*Paper by K. Baumann, read at the thirty-fifth Thomas Hawksley Lecture before the Institution of Mechanical Engineers, 19th November 1948.*

Research on Refractories

This article contains a review of representative projects in ceramic research sponsored by the Office of Naval Research in the U.S.A. The author states that at Rutgers University (New Brunswick) a study of slagged boiler refractories is being made to elucidate the physico-chemical processes taking place in a brick during the firing of a boiler. A brick is, from the scientific point of view, an extremely complicated porous structure comprising numerous heterogeneous phases, mixed crystalline and glassy states, and in chemical composition only known to a good degree of approximation. The work in progress at Rutgers has thus far made some important progress in the quantitative study of naval boiler refractories. Formation of mullite during the life of the brick at boiler temperatures has been traced by X-ray diffraction studies. Glass formation has been studied and several crystalline phases have been identified. Typical slags from naval boilers have been studied and correlation of the composition with the fuel oil used in firing the boiler has been attempted. The progress thus far has given clearer definition to the many problems in the physical chemistry of boiler refractories at operating temperatures. Results of this study are immediately applicable to the engineering problems involved in the operation and maintenance of oil-fired, steam-propelled naval vessels.—*R. D. Jackel, Journal of the American Society of Naval Engineers, Vol. 60, November 1948, pp. 552-564.*

Recent Research on Caustic Cracking in Boilers

In this paper the author describes the characteristics of caustic cracking and gives an account of recent research in the laboratory and under operating conditions. He then discusses the various theories which have been advanced from time to time to account for the mechanism of this type of failure. The suggestion is made that some light is perhaps thrown on the whole problem by a simple investigation into the similar type of attack occurring in hot ammonium nitrate solutions recently carried out by the author. In these experiments, U-bend specimens were subjected to the action of ammonium nitrate solutions in the region of the boiling point, provision being made for polarizing the specimens. It was found that unpolarized-specimens and those polarized anodically at a very low current (less than 1 milli-amp) were deeply cracked in the course of a few hours; the cracks were intercrystalline. At higher anodic currents only heavy surface oxidation, accompanied by slight fissuring, was observed. Specimens polarized cathodically at low current densities showed a type of attack similar to that of unpolarized specimens, though in general the cracks were somewhat finer. At current densities sufficiently high to afford apparently complete cathodic protection, shallow and extremely fine surface cracks were produced. It seems probable that, under the circumstances, these latter can only be attributed to the occlusion of hydrogen by the specimens. If the similarity between ammonium nitrate and caustic cracking is accepted as being real and not merely apparent, these results appear to offer a plausible explanation of the mechanism whereby caustic cracks are produced. In the initial stages of the attack of concentrated alkali on steel a non-protective oxide film is formed, the process being accompanied by the formation and partial occlusion of hydrogen. The resultant hydrogen embrittlement of the metal gives rise to fine intergranular surface cracks at severely stressed and distorted areas of the metal surface. Subsequent penetration of these cracks by the alkali results in the beginning of a process of anodic corrosion in the manner envisaged by Evans. The cracks are thus widened and extended, giving rise to the typical intergranular fissures. The corrosion process continuing in the fissure facilitates, in company with the applied stress, its propagation through the distorted and embrittled metal until finally rupture occurs. Thus the occlusion of hydrogen is necessary for the initiation of attack, and accounts for its propagation in an intergranular manner. On the other hand, propagation can only occur under circumstaces which permit the continuance of an anodic corrosion process. As far as attack in sodium hydroxide solutions is concerned, it is to be noted that, while anodic polarization at low current densities does not preclude the possibility of sufficient hydrogen being formed through the medium of local action cells to permit the onset of attack, and will indeed hasten it in its larger stages, cathodic polarization may sufficiently reduce anodic attack to prevent failure altogether.—*Paper by Dr. C. D. Weir, read at a Meeting of The Institution of Engineers and Shipbuilders in Scotland, 30th November 1948.*

Analysis of a Ship's Frame by Superposition

The purpose of this paper is to present a simple and accurate method for calculating the moments, reactions, and thrusts in a multiple deck frame composed of straight or curved members having a constant or non-uniform cross-section. The subject of designing transverse frames, in the wide sense of the term, "design", is not treated; the paper is restricted to the discussion of an example in engineering mechanics of determining stresses under a given condition of loading when all dimensios of the frame are known.—*A. W. Fischer, Journal of the American Society of Naval Engineers, Vol. 60, November 1948, pp. 541-551.*

Preservation of Balsa Life Floats by Dip Treatment

This paper contains a detailed report on a study of the decay of balsa life floats and means of treating the wood with a preservative solution. The report recommends that in the construction of new life floats all pieces of balsa wood incorporated should be given a dip treatment with a 5 per cent solution of chlorinated phenol, this treatment to be carried out prior to any gluing operation. It is further recommended, in view of the rapid deterioration to which balsa life floats are subject, the uncontrollable variability of the wood in specific gravity and other physical properties, and the difficulty of obtaining it in event of war, that a study be made of the possibility of using some synthetic material for float construction, such as a foamed plastic of suitable properties, which would be non absorptive and not subject to decay.—*A. S. Rhodes, Journal of the American Society of Naval Engineers, Vol. 60, November 1948, pp. 568-569.*

Trends in American Tanker Construction

The current programme of seagoing tanker construction in the United States consists of some sixty-four vessels now under contract, totalling over 1,400,000 deadweight tons. These tankers range in size from the 7,800-ton deadweight tanker *Rio Grande,* building for Texas Oil Co. at Ingalls Shipbuilding Corporation at Pascagoula, Miss., to the 30,000-ton deadweight tanker *Bulkpetrol,* launched on 25th September for National Bulk Carriers at Welding Shipyards, Inc., at Norfolk, Va. These tankers may be grouped according to deadweight tonnage as follows:—one vessel of 7,800 tons d.w., four vessels of 16,500 d.w., four vessels of 18,000 tons d.w., twenty-six vessels of approximately 26,000 tons d.w., twenty-four vessels of 28,000 tons d.w., and five vessels of 30,000 tons d.w. each. Except for the relatively small tanker building at Pascagoula, which will have twin-screw unaflow engines, the entire United States tanker programme will be powered with single-screw geared-turbine drive. The 26,000-ton class will have main propulsion units of 12,500 normal s.h.p. at 112 r.p.m. and some of the 28,800-ton vessels will have the same power at 100 r.p.m. Of one of the 30,000-ton tankers it is reported that it will have 16,000 normal s.h.p. Tankers of the National Defence type which will be built in addition to the aforementioned vessels, will be of 29,500 tons d.w. with a maximum of 20,000 s.h.p. giving an estimated speed of 20 knots. In the development of the big tankers, the limit of horse-power per shaft was given consideration. Opinion apparently has been unanimously in favour of single-screw drive. All of the tankers will have two water-tube boilers each except the Defence tankers which have three. The 16,000-ton and the 18,000-ton classes use 450lb. per sq. in. working pressure and 750 deg. F. total temperature, normal. Some of the 26,000 ton tankers have 600lb. per sq. in. and 800 deg. F. with single-stage heating; the others of this size have 850lb. per sq. in. and 850 deg. F. with four-stage heating. All vessels will be equipped with economizers and most of them with air heaters. Steam atomizing oil burners are being adopted to a limited extent.—*R. W. Morrell, Marine Engineering, New York, Vol. 53, November 1948, pp. 59-62.*

Fastest Spanish Ship

The *Explorador Iradier* attained on trials a maximum speed of 19·3 knots and a mean speed of 18·76 knots. The following are the leading particulars of the vessel:—

Length, overall	121·00 m.
Length, b.p.	111·00 m.
Moulded beam	16·70 m.
Depth to main deck	18·85 m.
Draught when loaded	7·25 m.
Total displacement	9,200 tons
Deadweight capacity	4,500 tons
Gross register	6,100 tons
Hold capacity, grain	6,385 cu. m.
Hold capacity, bales	5,960 cu. m.
Refrigerated space	300 cu. m.
Machinery (rated output)	8,500 i.h.p. or 7,000 b.h.p.
Machinery (max. output)	9,000 b.h.p.
Mean speed at 7,000 b.h.p.	18·06 knots

The ship is built with a Maier bow, and the machinery is installed amidships. There are four decks—upper, main, second and third, and a double bottom is arranged throughout the whole length of the vessel. Forward of the engine-room are two holds and five 'tween decks; and aft, two holds and three 'tween decks. Sufficient fuel oil can be carried in the double-bottom tanks for a voyage of 11,000 miles without rebunkering. The propelling machinery was supplied by Burmeister and Wain. There are two seven-cylinder two-stroke B. and W. single-acting engines with a cylinder diameter of 620 mm. and a piston stroke of 1,150 mm. The rated output of each unit is 4,250 i.h.p. or 3,500 b.h.p. at 122 r.p.m., and a maximum output of 4,500 b.h.p. for each engine was attained during the trials. During the first voyage at an average speed of 17½ knots, for a period of over two days, the total daily consumption was 24,660 kg. for all purposes with the engines developing 6,300 b.h.p., corresponding to about 165 r. per b.h.p./hr. At 9·5 knots (58 r.p.m.) the consumption was 5·5 tons per 24 hours.—*The Motor Ship, Vol. 29, December 1948, pp. 334-339.*

The Orient Liner *Orcades*

The new turbine steamship *Orcades,* recently completed at Barrow-in Furness by Vickers-Armstrongs, Ltd., for the Orient Steam Navigation Co., Ltd., is the largest passenger vessel yet built at Barrow. The principal particulars of the *Orcades* are:—

Length, overall	708ft. 8in.
Length, b.p.	668 feet
Breadth moulded to E deck	50 feet
Draught	31 feet
Displacement	32,200 tons
Speed	22 knots
Shaft horse-power	28,164

The *Orcades* is propelled by twin screws, each driven by a set of geared turbines of Parsons' type, designed for a normal shaft horse-power of 34,000, and an overload power of 42,500, at 130 and 139 r.p.m, respectively. The astern turbines are capable of developing not less than 65 per cent of the normal ahead power. Steam is supplied to the turbines at a pressure of 500lb. per sq. in. gauge, and at a temperature of 850 deg. F. The gearing for each h.p. ahead turbine is of the double-reduction type, comprising an independent primary gear driving a secondary pinion engaging with the main wheel. The gearing for the i.p. and l.p. turbines is of the single-reduction type. The h.p. turbines are of the impulse reaction type, each comprising a 2-row impulse wheel forged solid with the rotor, followed by twenty-nine rows of end-tightened reaction blading segmentally fitted, with mild steel packing and Lowmoor iron side locking strips. The i.p. ahead turbines are of the all-reaction type, each having thirty-five rows of blading end-tightened and segmentally fitted to the rotor, which is of hollow forged drum type. The l.p. ahead turbines are of the double-flow type, having hollow forged drums, each half comprising eleven rows of reaction blading segmentally fitted. The astern turbines are of the impulse type, comprising a h.p. astern 3-row impulse wheel of separate construction shrunk on to each i.p. rotor shaft and incorporated in the i.p. turbine casings, and a l.p. astern turbine incorporated in each l.p. ahead turbine casing, consisting of a forged steel 3-row impulse wheel secured to the forward end of the l.p. ahead rotor. All reaction blading is of monel metal, and impulse blading of "Macloy" steel. The casings of the h.p. ahead turbine are manufactured of molybdenum alloy cast steel on account of the high initial steam temperature; the casings of the i.p. turbine are of cast steel, and l.p. ahead turbine casings of cast iron, with astern portion of cast steel. Each turbine is connected to the gearing by a flexible coupling of the claw type. The h.p. turbines run at 3,600 r.p.m. and i.p. and l.p. turbines at 1,931 r.p.m., while the gear ratio is such that with these turbine speeds the propellers run at 140 r.p.m. when the turbines are developing a total of 42,500 s.h.p. Steam is supplied by two large and two smaller water-tube boilers of Foster Wheeler's controlled superheat design, arranged to give a superheat control from 850 deg. F. down to about 600 deg. F. when manœuvring. Steam pressure at the superheater outlet is 525lb. per sq. in. The boilers are arranged for a feed-water inlet temperature of 280 deg. F., and an outlet temperature of about 400 deg. F. Air preheaters of the vertical tubular type are fitted in the uptakes, with by-pass arrangements when steaming at slow speed or in harbour.—*The Shipping World, Vol. 119, 29th December 1948, pp. 533-537.*

The New V-2000 Ships

Three of the five V-2000 ships of the American President Lines, San Francisco, will be built by the New York Shipbuilding Corporation, Camden, N.J. The V-2000 was planned on lines somewhat between the C-3 cargo and passenger vessel and the P-2, best known at present as the *President Cleveland* type, and the ship comes up with the official designation P2-S1-DN1. The principal characteristics are:—

Length, overall, about	536ft. 0in.
Length, b.p.	500ft. 0in.
Breadth, moulded	73ft. 0in.
Draft, maximum moulded	29ft. 6in.
Depth, moulded to upper deck at side ...	49ft. 0in.
Passengers, floor beds, sofas, and upper berths	228
Speed	19 knots, cruising
Crew, approximately	165
General cargo capacity	424,000 bale cu. ft.
Refrigerated cargo capacity	60,000 net cu. ft.
Cargo deep tank capacity	48,000 net cu. ft.
Total capacity	532,000 cu. ft.
Fresh water	206 tons
Fuel oil (98 per cent full)	2,429 tons
Clean salt water ballast	194 tons
Total capacity of tanks	2,829 tons

So far only the main propulsion units such as turbines, boilers and control system have been selected, and contracts for even these are still uncompleted. Commitments have been made for complete General Electric propulsion, Babcock and Wilcox boilers with Ljungstrom air preheaters installed in the uptake of each boiler, Hagan control systems, and Worthington pumps. The ship is to be a steel cargo-passenger vessel with curved stem and cruiser stern. There are to be three complete decks—upper deck, "A" deck and saloon deck—and flats at various levels. A promenade deck is to extend over the upper deck amidships for about one-third of the vessel's length and, above this, shorter officers' and navigating bridge decks. The machinery space which occupies 70 feet of the length is to be located amidships with four holds forward and three aft, arranged for stowage of dry, refrigerated and liquid cargoes. Cargo is to be handled through hatches and side-ports using overhead gear and conveyors. The ship is designed to have a total displacement of about 19,600 tons on a loaded draft of 29ft. 6in. in salt water, and total deadweight of about 10,600 tons of which about 7,800 tons is cargo deadweight. Construction is to be under special survey of the American Bureau. The vessel is to be built on the transverse framing system, of all welded construction except shell seams outside of inner bottom which are to be riveted, with butts welded. It is provided that special care be exercised in welding to avoid notch defects and discontinuities in main structural members attached to same, in general thickened plates rather than doubles to be fitted when required.—*Pacific Marine Review, Vol. 45, November 1948, pp. 36-39.*

Preservation of Reserve Fleet Vessels

By mandate of Congress the United States Maritime Commission is retaining in reserve status large fleets of commercial and military auxiliary-type vessels for use in the event of a national emergency. The method and manner of preservation in effect include proper preparation and treatment of vessel hulls, machinery and equipment which suffered slight to serious corrosion, accumulation of salt deposits and scum coatings during war service. In view of the tremendous area that must be treated within a reasonable time, it has been found advisable to accelerate by manual and mechanical means the removal of scale, salt deposits and scum accumulated during vessel operation from the hull exterior surfaces and vessel equipment prior to preparation for final preservation compound coatings over the rate of removal that could be accomplished by application of a penetrative type compound only. Concurrently with manual and power-tool descaling operations, one fleet conceived and partially developed the idea of utilizing fire pumps and deck stand monitors to descale vessels sides and decks by high-pressure water blasting. Results to date are highly encouraging, indicating immediate large savings in man-hours and overall costs, and producing a surface ideally conditioned for applications of primary preservation treatment. Where water blast descaling is not complete to the extent that final preservation treatment may be applied at once, it greatly speeds the entire preservation programme. Experience to date has shown that water blasting will remove an average of eighty per cent of the scale accumulation from the hulls of all vessels in the fleets and the descaling to that extent is accomplished with approximately thirty per cent of the man-hours that would be expended if the same descaling was done manually and with usual power tools. Water blasting is accomplished by use of approximately 200 gallons per min. at 250lb. sq. in. gauge, using straight bore nozzle throats to obtain a compact discharge stream for maximum impact when operating with the nozzle approximately 12 feet from the surface being blasted. Additional information will be available after further development. The problems brought about by fungi and mould growths are of serious concern, particularly where insulation of electrical equipment and windings must be preserved. The attack on this problem has been twofold: first, a special type insulation quality air drying varnish containing a fungicidal agent is used where needed after all traces of oil, grease or debris have been removed from electrical windings; and second, the Division of Biological Sciences, University of Pittsburgh, is now under contract for the development of a fungicidal compound to kill existing growths and to inhibit new growths for an approximate two-year period.—*Paper by F. E. Hickey, read at the American Merchant Marine Conference sponsored by the Propeller Club of the United States, held in New York, 13th-15th October 1948.*

Ship Structural Members

This paper gives results of tests on (i) girders formed of 6-inch channel, 6-inch bulb angle and 6-inch ordinary angles riveted to plating, (ii) compound girders formed of 6-inch inverted angle, 6-inch bulb plate (cut from 6-inch channel and 6-inch bulb angle respectively) and 6-inch flat bars welding to plating. The amount of plating that contributes to the strength of the girder and the effects of varying the size of end brackets and rigidity of base structure are given. Consideration is also given to the modification of existing standards for scantlings, where the structure is welded, in the light of test results and practical experience to date.—*Part IV of paper read by C. J. G. Jensen at a Meeting of the North-East Coast Institution of Engineers and Shipbuilders, 26th November 1948.*

Demulsification of Sea Water Emulsions in Admiralty Fuel Oil

The problem of emulsification of seawater in Admiralty fuel oil is described, and the deleterious effects of these emulsions in H.M. ships and oil-fuel depots are indicated briefly. The significant properties of the emulsions are discussed, and a theory of emulsion stability is developed and, correspondingly, the conditions for demusification laid down. The emulsifying agent was found to be contained in the whole asphalt fraction of the oil, and proofs were carried out to show that this material is responsible. The mechanism of breaking these emulsions by addition of surface-active agents and by fluxing additives is described, and the conditions for their most efficient and proper use worked out. Successful application to large-scale trials on shore and at sea are recorded; and one semi-large-scale rendering of unpumpable sludge pumpable is reported. A brief discussion indicates that the success of the work and of the theoretical approach upon which it is based challenge several basic conceptions of emulsions and demulsification at present generally accepted. A new sampling pot and a modification of the Dean and Start apparatus designed for use at sea are described.—*A. S. C. Lawrence and W. Kilner, Journal of The Institute of Petroleum, Vol. 34, November 1948, pp. 821-853.*

Colloidal Graphite

When a bearing is lubricated with oil containing colloidal graphite some of the particles are rubbed into intimate contact with the metal, become adsorbed, and constitute what is now known as a graphoid surface. The existence and structure of this graphoid surface has been confirmed by electron diffraction and other methods. It is composed of extremely small, plate-like particles of graphite lying like tiles on the metal surface, and held firmly to the latter by adsorption. Its thickness is a matter of millimicrons and, being held in place by adsorption, it cannot be washed off mechanically by oils or petrol. A considerable amount of research has been carried out on the graphoid surface. The static friction is in the vicinity of 0·12 and the kinetic friction, at high loads, and low running speeds, in the vicinity of 0·06. By way of comparison it might be added that the static value for a mineral oil film would be about 0·15, and kinetic friction under similar loads and speeds, which give boundary conditions, 0·10 or higher. It is evident that such a surface can provide valuable assistance in such conditions, but where fluid film conditions exist the surface would not contribute to a reduction in friction, for obvious reasons. If its main function would appear to be reducing static friction and offsetting the effects of boundary conditions, the relation of the graphoid surface to the oil film is no less interesting. From X-ray diffraction patterns it was found that rapid orientation of stearic acid takes place on polished mild steel on which a graphoid surface has been formed. This adsorptive capacity leads to improved oil-spread over metallic surfaces, particularly on chromium, which is difficult to wet. It also ensures a residual oil film for longer periods on bearing faces which are subject to abnormal conditions of lubrication. Perhaps the most widely known and popular attribute to colloidal graphite is its ability to offset seizure. For this reason it is employed as an additive to lubricating oils in new engines and mechanical equipment. Tests at the National Physical Laboratory in the past have pointed to the elevation of the critical temperature of an oil by colloidal graphite, the increase in maximum permissible loads and the reduction of minimum permissible feeds accompanying its use. It has been amply demonstrated that pure, truly colloidal graphite is quite suitable for ball bearings.—*E. A. Smith, Institute of Petroleum Review, Vol. 2, November 1948, pp. 332-336.*

Flow Meter for Measuring Fuel Consumption of Internal Combustion Engines

In the testing of internal combustion engines very little difficulty is experienced in obtaining accurate measurements of the mean rate of fuel consumption when this measurement can be made over a long period. It is frequently desirable, however, to make accurate determination of the fuel flow rate rapidly. Flow meters whose operation is based on the pressure difference across an orifice have proved unsuitable for use with compression ignition engine fuels, since their calibration is rendered inaccurate by the changes in the viscosity of the oil which result from even small changes in temperature. In the absence of an accurate means of measuring instantaneous rate of flow, it is necessary to measure either the time taken to consume a known quality of fuel or the quantity of fuel used in a fixed time. A simple method commonly employed for this purpose is to supply fuel of measured specific gravity to the engine from a vessel of known volume such as a glass pipette and to time with a stop-watch the passage of the fuel level from a mark near the top of the vessel to a mark near the bottom of the vessel. This method has two serious objections. Since both the specific gravity of the fuel and the volume of the measuring vessel are affected by change of temperature it is essential, if accuracy is required, to determine the temperature of vessel and fuel for each measurement and to make corrections for both variations. The second objection is that the fall in the level of the fuel during the consumption measurement constitutes a change in the pressure acting on the engine fuel system. In the device described in the article the first of these objections has been overcome by the use of a compact form of weighing machine in place of measurement by volume, and the second by arranging that as the fuel flows out of the vessel, the vessel moves upward at such a rate that the level of the fuel and thus the pressure exerted remain constant. Referring to Fig. 1, which shows the arrangement of the apparatus diagramatically, the vessel "a" which contains the fuel to be metered is carried on two light arms "b", attached to a block "c". Also attached to the block at a suitable angle is a rod "f" carrying a counter-balance weight "g". The block is mounted by means of small ball bearings on a fixed shaft "d" which projects from the back plate "e". In preparation for a test, the vessel is filled from the service tank through the pipe "h" which enters the open top. As the vessel is filled, the increase in weight causes the balanced system to rotate. The vessel descends and the weight moves outwards, thus exerting an increasing balancing torque. The reverse process occurs when the meter is connected to the engine system and the service tank is closed. The fuel flows out by syphon action through the pipe "h" and the vessel rises at a rate dependent on the fuel consumption rate of the engine. The movement of the vessel between any two points in its upward travel corresponds to the discharge of a definite weight of fuel. The passage of the vessel past two selected points in its travel is indicated by an optical system, which magnifies the movement of the vessel thirty times approximately.—*W. P. Mansfield, Mechanical World, Vol. 124, 3rd December 1948, pp. 627-629.*

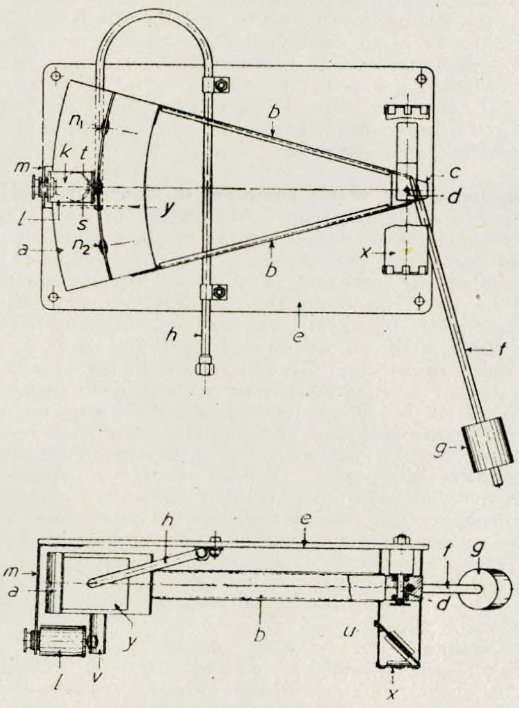


FIG. 1—*Plan and elevation of flow meter*

Liquid Springs

In 1938 G. H. Dowty conceived the idea of using the compressive properties of liquids as a spring and at the same time making the same volume of fluid act as the dashpot medium, where energy absorption in springs was required. Having proved the possibility of fluids as spring medium, the Dowty liquid spring was evolved. This consists of a cylinder filled with oil and containing a piston which carries a valve mechanism. Secured to the piston-head is a rod which emerges from a high-pressure gland. A grease-filled recess in the gland retaining-nut lubricates the piston rod. This is necessary, as although the piston rod is forced into the oil at every stroke, it emerges dry, due to the high efficiency of the gland. When the rod is forced into the cylinder, the oil is compressed, and simultaneously transferred from one side of the piston-head to the other. Valves in the piston-head open fully during compression, but close on the return stroke so that the recoil movement is damped and excellent shock-absorbing qualities are obtained. The cylinders are manufactured in high-tensile steel, and usually embody two filler-plugs to facilitate the filling of the cylinder with oil, and also serving to eliminate trapped air.—*R. H. Bound, De Ingenieur, Vol. 60, 3rd December 1948, pp. L55-L59.*

Zinc Spraying

Zinc spraying has the advantage that the equipment is portable, and sprayed zinc can therefore be applied to steel structures and surfaces even after they have been put into service. Zinc spraying is extensively used for the protection of ships' hulls. Before applying the process the hull is completely cleaned down, any old paints being removed by grit blasting. This prepares the steel surface for the sprayed zinc and incidentally reveals the full extent of any corrosion that may already have occurred. The zinc spraying pistol follows closely behind the shot blasting so that the metal is coated before it has time to tarnish. A coating of 0·004 inch of zinc is usually applied, although in certain circumstances it may be increased to ensure even longer life. The zinc on the ship's hull affords sacrificial protection to any exposed metal work near it and, to prevent it from being removed too quickly in this way, it is common practice to follow the zinc with one or two coatings of anti-corrosion paint. This adheres very satisfactorily to the rough zinc sprayed surface, while the layer of zinc under the paint prevents corrosion from creeping beneath it and so pitting the hull plates. The composite coating of zinc and anti-corrosion paint is then followed by one of the normal anti-fouling compositions used to prevent fouling of the ship's bottom by heavy incrustations of barnacles, calcareous growths and other marine life.—*Zinc Bulletin, No. 5, 1948, p. 8-9.*

Warping as the Result of Torch Cutting

The lengthwise shortening as a result of complete heating of structural members is known to anglesmiths and those who are directly involved in the hot forming of plates and shapes, but is probably not widely known outside that small circle. Possibly the reason why knowledge of this fact has not been widespread is that the heating and formation are the first operations done, and the parts are laid off after the shortening has taken place. However, if for any reason a part had to be heated after it had been cut to length, the shortening would be at once apparent. If a flat plate were to be torch cut along a line, the heating during cutting would cause the main body of the plate and the edge of the strip to expand. When cool, the plate would be found to have shortened on both sids of the torch kerf. Since the heating was local, shortening would occur in the immediate vicinity of the kerf and would not occur where heat had not been applied and the result would be a permanent warp. Warping as the result of torch cutting ordinary structural steels is inevitable. In most instances, particularly in the case of short cuts, the warping which does occur may be so small as to be of no consequence, but the warping is there and precise measurements would disclose it.—*L. Bibber, Pacific Marine Review, Vol. 45, November 1948, pp. 51-53.*

Contact Arc Welding

The contact electrode is claimed to be a completely new type which makes welding not only easier for the operator, but also gives better results. With contact electrodes, which are self-starting and restarting, touch welding is possible in all positions. Touch welding has been known to the welding industry for some while past, but often the welds produced with the older type of touch electrode resting on the workpiece lacked satisfactory mechanical properties and, in addition, considerable skill on the part of the operator was required to prevent the electrode from freezing or sticking to the parent plate. A new type of electrode developed in Holland has half its iron content located in the coating, the outer diameter of which is more than twice that of the core, thus forming a "supercoated" electrode. Freezing does not occur with this kind of electrode, and, when welding, an extremely deep cup is formed by the coating. This deep cup formation is an important factor in the contact welding process. The arc voltage is high and this has a favourable effect upon the depth of penetration. Because of this high arc voltage, combined with the greater current values which can be used for these electrodes, the energy of the arc is also very high, giving a short fusion time. By adjusting the quantity and distribution of the iron in the coating, the arc is made to ignite automatically when the coating touches the joint to be welded; this is the principle of the "self-starting" feature. Re-striking of the arc after an interruption is also automatically achieved whether the interruption is deliberate or because of extinguishing occurring when a welding transformer with a low open-circuit is used.—*Welding, Vol. 16, December 1948, pp. 519-523.*

Nitriding

In the nitriding process the diffusion of nitrogen produces an increase in volume of the outer zone which sets up compression stresses on the outside and tensile stresses inside. The compressive stresses in the nitrided case lead to an increase in fatigue resistance, and this increase rises with the depth of the nitrided layer to a certain maximum for each category of steel, so that there is an optimum ratio (found by trial) between the thickness of the nitrided layer and the cross-section of the work-piece in question. It may not always be possible to attain this optimum, as the nitriding time would be too long. There is no relation between surface hardness after nitriding and fatigue resistance, as the latter depends on the ratio of nitride thickness to cross-section and tensile strength of the core steel. For a part subjected only to alternating stresses, a high surface hardness is not essential. Surface roughness is of no consequence with nitrided steel, although the surface finish is so important with non-nitrided steels. For crankshafts, the greatest increase in endurance is obtained by nitriding all over. If only part-nitriding is done, the radius as well as the pins should be nitrided. Tests have shown that radial engine crankshafts nitrided all over showed a fatigue resistance 15 per cent greater than similar crankshafts which were nitrided on the pins only. Machining of crankshafts to be nitrided all over is less costly than in the case of non-nitrided crankshafts, as the latter must have a very high surface finish to avoid the setting up of fatigue cracks. Similar remarks apply to connecting rods, for which nitrided steel helps to overcome trouble due to fretting corrosion between the bronze bearing and the big end of the rod. A nitrided steel connecting rod under alternating stress tests stood up to 1,560,000 stress reversals as against 39,000 with the non-nitrided steel.—*H. Wiegand, Revue de Metallurgie, Vol. 45, 1948, pp. 105-117. Abstract in Engineers' Digest, Vol. 9, December 1948, pp. 423-424.*

Welding Research and Development in America

Considerable interest is being shown in the U.S.A. in cutting processes for difficult materials. The cutting of stainless steel, copper and nickel can be executed by both the powder method and the flux method. The former injects iron powder into the normal oxy-acetylene flame and the heat of oxidation is adequate to melt the oxide of chromium, which makes the cutting of stainless so difficult. In the flux cutting method, reliance is placed on abrasive and chemical action rather than on the higher temperature. Another interesting development is the fluorine hydrogen torch which so far has not any practical application, but which appears to be particularly suitable for cutting copper. This undoubtedly warrants further investigation, but this is no doubt hindered somewhat by the dangerous nature of the fluorine

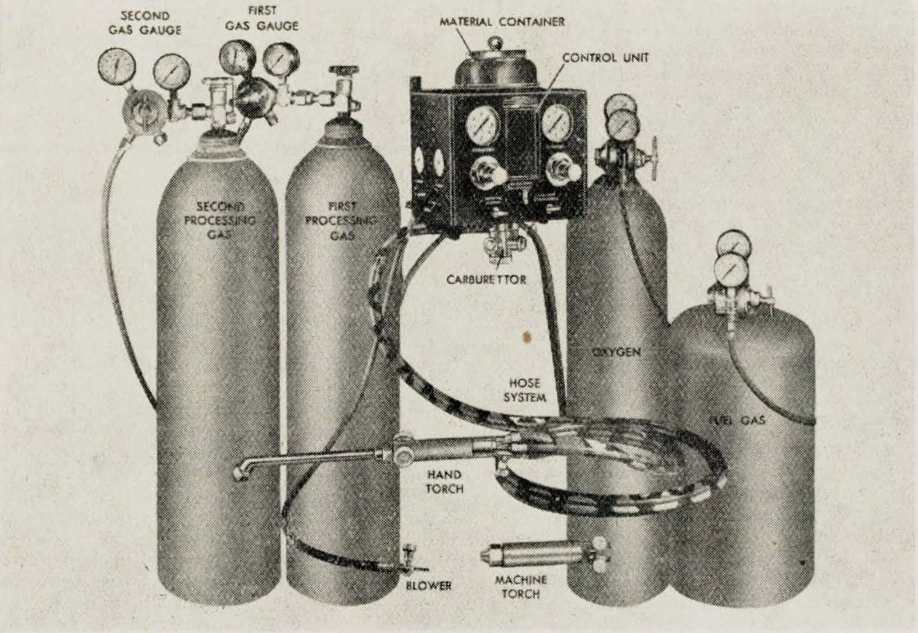


FIG. 6.—*Equipment required for the powder weld process*

Another process is that developed for surfacing one metal with another, but it can also be used for applying ceramic surfaces and for applying rubber to metal. The equipment required for the process is shown in Fig. 6 which shows the torch, the control unit, the fuel gases and the process gases. The material to be applied is contained in the control equipment and is picked up by one of the processing gases in an ingenious form of "carburetter" which permits remarkably accurate control of the amount of powder collected. The powder is conveyed to the centre of the oxy-acetylene flame and is thus spread on to the metal surface, but the heating jet is surrounded by an inert atmosphere so that the surface of the metal may first be cleaned in a reducing atmosphere and the powder then deposited in oxygen-free condition. By this means the powdered metal wets the surface of the base metal, and a satisfactory weld is ensured. The efficiency of this process is much higher than with more normal metal spraying processes, since there is no loss by oxidation, and, as will be readily appreciated, the welding together of the particles of metal is much more satisfactory.—*H. B. G. Taylor, Welding, Vol. 16, December, 1948, pp. 504-510.*

Tests of Paints for Under-water Service

Part I of this paper describes apparatus developed at the Chemical Research Laboratory of the Department of Scientific and Industrial Research for investigating the corrosion of metals exposed to water or aqueous solutions under conditions of rapid movement (comparable with ships' speeds). An ebonite holder carrying suitably prepared metal specimens is rotated at a controlled speed, the nature and amount of corrosion after varying periods of test being estimated by measurements of weight-loss and depth of corrosion penetration, supplemented by visual examination. The apparatus lends itself to modifications for testing specimens of different forms, for example, rings cut from tubing or portions of wire cable. Part II deals with the use of the rotor apparatus in testing a series of typical ships'-bottom compositions. These were applied as three-coat systems to the small rotor specimens by use of special jig, the amount of paint being controlled and measured. Tests were conducted in artificial sea water (similar in composition and *p*H to natural sea water) at speeds of the order of 20 knots for periods up to 50 days. The condition of the paint on each specimen was appraised visually each day; finally weight-loss measurements were made on selected fifty-day specimens. The final qualitative and quantitative results showed good correlation with previous raft tests of the same compositions. The compositions' order of merit in respect of protection against corrosion was very similar in the two series of tests, but the rotor tests gave results in much shorter periods. It was concluded that the rotor tests afforded a rapid and convenient method of assessing the value of paint systems intended for use on submerged metals. Parts III and IV describe the use of apparatus in comparing the merits of several paints formulated by Fancutt and Hudson. Although the order of merit was not identical in all respects, in the laboratory and raft tests, paint No. 32 (pigmented with white lead, basic lead sulphate, and Burntisland red in a modified phenol-formaldehyde resin-oil medium) showed outstanding superiority in both series. Experimental results are given in Part V, showing the acceleration of paint failure and of corrosion of the underlying steel caused by an increase in rate of movement, or by a rise in temperature of the artificial sea water. Part VI deals with methods of assessment of paint failure in rotor tests. Measurements of depth of penetration of corrosion are given for selected paint systems and the results are discussed in relation to the estimates of "useful life" of a paint based on the test-period required to produce loss of adhesion over 10 per cent of the specimen area. The mechanism of blistering, and of paint failure generally, is discussed.—*F. Wormwell, T. J. Nurse and H. C. K. Ison, Journal of The Iron and Steel Institute, Vol. 160, November 1948, pp. 247-260.*

Effect of Inclusions on the Endurance Properties of Steels

U.S. Navy specifications for steel forgings contain a clause that materials shall be free from excessive non-metallic inclusions and segregation. Experience in the field has shown the need for defining the word "excessive" as it applies in this case. Since all steel contains inclusions, it is necessary to establish levels for acceptability depending on a number of factors such as the purpose of the forging, its size, the distribution and form of the non-metallics and the presence of other defects. Ordinarily, Inspectors of Naval Material experience their greatest difficulties when decisions must be made as to whether or not inclusions are excessive in large forgings. A large number of tests have been conducted at the U.S. Naval Engineering Experiment Station on materials rejected because of so-called "excessive" inclusions. Most of the tests were made with specimens removed from heavy forgings, and the principal interest was directed toward an estimation of the serviceability of large machinery components containing unusual amounts of non-metallics. From experimental results and theoretical considerations several general conclusions were drawn regarding the effects of inclusions on the endurance properties of steel, particularly in large forged parts. These conclusions are presented as follows. The inclusions which are most serious in machinery components usually will be those exposed on the surface where stresses are highest and where fatigue failures generally originate. Fortunately, this is the location where inspection procedures are the easiest to perform. Severe inclusions in the surface of a steel part can lower the fatigue resistance considerably. However, if the maximum stress on the surface of the part is not uniform in itself, then the location of the inclusion will determine to a large extent whether or not the part is serviceable. For example, if an inclusion occurs in a fillet, keyway, oil hole or other change of section, it would be more undesirable than for one occurring where stress concentrating conditions do not already exist. A knowledge of the stress conditions which exist in a part at the region of an inclusion would be very helpful in deciding the serviceability of a machinery part. This is particularly true for large forgings such as propulsion shafts. In such shafts the maximum service stresses are relatively low and probably would be below the endurance limit of the steel despite the inclusions. The authors state that not a single case has ever come to the attention of the Station in which inclusions caused the failure of a large propulsion shaft. This is not intended to imply that all shafts with large inclusions should be accepted, and very possibly some of the shafts which have been rejected would have failed had they been used in service. Large forgings usually are made of relatively soft steels. Such materials are expected to be rather insensitive to notch conditions. Hence, inclusions are more serious if they occur in hard steels. The orientation of an inclusion, with respect to the direction of stress, influences to a marked degree the resulting stress concentration. Long narrow inclusions lying in the direction of stress have practically no effect. The same inclusions lying perpendicular to the direction of stress may exert a marked influence. This accounts for the fact that lengthened inclusions running parallel to the axis of a shaft have no significant effect on the flexural properties, but do have an effect on the torsional properties. Globular inclusions cannot be said to have any special orientation with respect to the direction of stress. Such inclusions are the least serious kind, and if not very large can be considered as having little effect on the endurance properties of unhardened steels.—*W. C. Stewart and W. L. Williams, Journal of the American Society of Naval Engineers, Vol. 60, November 1948, pp. 475-504.*

Notched Test Methods for Investigating Brittle Fracture

This paper contains a resumé of investigations conducted in various countries into the problem of brittle fracture of mild steel plates. The research programme drawn up by the Welding Society in the Netherlands in co-operation with the Belgian "Commission Mixte des Aciers" envisages the comparative study of four test methods, namely, the Charpy test, the Schnadt notched bar test, the Campus notched bar tensile test, and the notched bar bending test of von Soete.—*J. A. Haringx, De Ingenieur, Vol. 60, No. 51, 17th December 1948, pp. Mk 141-Mk 148.*

Simple Accelerated Atmospheric Corrosion Test

This paper describes a simple accelerated atmospheric-corrosion test in which specimens are subjected to corrosion in a warm humid atmosphere containing sulphur dioxide. The experimental work was carried out with steam-heated apparatus, since replaced by a thermostatically controlled electrically heated type. The apparatus can be constructed easily from readily procurable materials. The effect of temperature and concentration of sulphur dioxide on rates of corrosion of bare and phosphated steel, with and without paint coverings, have been examined. Corrosion rates increase with rise in temperature and with increase in sulphur-dioxide concentration. In the case of bare steel, corrosion tends to approach a maximum at an initial concentration of sulphur dioxide in the underlying solution of about 0·02g/100 ml., and the rate is approximately seven times that of steel exposed in the local urban atmosphere. Pre-treatment by phosphating improves the corrosion resistance of painted steel, particularly when the paint coating is less than 0·5 millionths of an inch thick. A thick phosphate coating, which does not conduct electricity, and has therefore completely covered the basis steel, showed a resistance in outdoor exposure tests much superior to that of bare steel. A method of determining the spread of rust by measurement of light reflection and effects of artificially damaging paint films are discussed.—*R. St. J. Preston, Journal of The Iron and Steel Institute, Vol. 160, November 1948, pp. 286-294.*