# Marine Engineering and Shipbuilding Abstracts

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### Flexible Oil Barge

Progress is being made with the British project to develop flexible oil barges of "sausage skin" type, and the stage has now been reached where a barge of commercial size has been made and tested. This barge, 100ft. in length and with a capacity of 40 tons of petroleum products, was demonstrated in Southampton Water. The first model made, of 9in. diameter and 16ft. long, was tested in a towing tank at the National Physical Laboratory to determine its drag and observe its behaviour. If no special precautions are taken, a long barge may snake in the water in the same way that a flag waves in the wind. On the other hand it has lower skin stresses and is more convenient to handle. In the spring of 1957, a larger model, of 3ft. diameter and 67ft. long, with a capacity of 10 tons, was tested on the Great Ouse. Good results were obtained and a development company, Dracone Developments, Ltd., was formed with the support and financial backing of the National Research Development Corporation. The name Dracone is derived from the Greek δράκων, a serpent, and the barges are now being described as Dracones. Further testing of the 10-ton model was carried out in Harwich harbour and the North Sea under conditions ranging from calm to a gale. Under all these conditions, the model behaved as predicted and the practical experience gained has enabled still larger sizes to be designed and developed. During these tests, means of preventing yawing and snaking were further developed. Various experimental techniques were tested and it was found that the model Dracone could be towed straight at the cost of a small increase in drag. The model could ram a river bank at a speed of 5ft. per sec. without any harm, the nose taking the shock and transferring it to the fluid. It was also found that the model could be turned in much less than its own length by allowing it to form a fold which travelled from end to end. Further experiments and investigations into possible materials and improved methods of construction have led to the building of the first operational Dracone, of 5ft. diameter and 100ft. long, with a capacity of 10,000 gallons or about 40 tons of oil. This model is made of woven nylon fabric with synthetic rubber coatings capable of resisting petrol or fuel oil on the inside and sea water and sunlight on the outside. A "stressed skin" construction is used for the barge. The skin of the Dracone contains just over 200lb. of nylon, which gives it high mechanical strength. Its total weight is 2,300lb.; most of the weight is in the rubber which has to seal the fabric and provide abrasion resistance. Eyes are fitted at nose and stern for attaching ropes for towing and mooring, for buoys and floats with flags and navigation lights. At the stern there is an Avery Hardoll self-sealing quick acting hose connexion for emptying and filling through a 4-in. hose. Connexions for measuring internal pressure are also provided. A special stabilizing device in the form of a drogue has been attached to the stern. Without this device the barge would snake and yaw from side to side. The drogue increases the drag of the barge by about one-third, but will probably be superseded in later models by a more refined method of achieving stabilization now under development.—*The Shipping World, 24th September 1958; Vol. 139, p. 278.*

### Nuclear Powered Submarine Tanker

The author gives an account of the studies carried out at Kobe by Mitsubishi Heavy Industries, Reorganised, Ltd. A submarine submerged to sufficient depth has zero wave making resistance. At low speeds the frictional resistance is greater than that of a comparable surface vessel, but above a certain critical speed (about 19 knots for ships of 30,000 tons d.w.) the difference in total resistances strongly favours the submarine. Also, a surface ship expends extra power owing to wind and wave effects. Nuclear power allows a submarine to remain submerged for practically the whole voyage; hence, the longitudinal bending moments assumed for the hull design can be much smaller. General cargo submarines would need large pressure hulls and pressure tight hatches; also, trim and stability would present difficult problems. A crude oil tanker, however, appears promising. The pressure resisting structure can be limited to the reactor, machinery and accommodation spaces, together with a few oil tanks to be left empty when the craft is in ballast. These spaces occupy only a fraction of the volume enclosed by the lightly built outer shell. The rest can be subdivided into tanks which are always filled, either with cargo or sea water ballast. The cargo handling equipment comprises pumps plus pipelines and valves, which can be readily adapted for adjusting the trim. Moreover, for deadweights above 25,000 tons, the total steel weight of the submarine would be less than that of a surface tanker. The advantage amounts to about 10 per cent at 30,000 t.d.w., and more at higher values. Also, any increment in size leads to a diminution of the ratio between submarine steel weight and deadweight capacity. This is due to the relatively small dimensions of the pressure hull, together with the minor nature of the dynamic bending stresses imposed on the outer shell. On this basis, Mitsubishi have prepared a specific design, of which a detailed description is given. The principal particulars are as follows:—

| | |
|---|---|
| Length, o.a. ... ... ... | 590·6ft. |
| Breadth, maximum ... ... | 78·7ft. |
| Depth, amidships ... ... | 78·7ft. |
| Mean draught ... ... ... | 55·8ft. |
| Normal displacement ... ... | 48,200 tons |
| Cargo deadweight ... ... | 30,000 tons |
| Total steel weight ... ... | 6,600 tons |
| Safe submersion depth ... | 330ft. |
| Cruising speed (submerged) ... | 22 knots |

The hull form is a streamlined body of revolution, with a length-diameter ratio of 7·5. The pressure hull, located axially and designed for collapse by yielding, is in three sections. The forward part is formed by vertical spectacle frames (33ft. diameter intersecting cylinder with strength deck across intersection). The lower section is devoted to cargo-or-buoyancy tanks, the upper to control room and accommodation for a crew of 50, with one tank forward. Aft of this is an independent cylindrical compartment, 32·7ft. in diameter and length, which serves as containment vessel for the 180 MW (heat) pressurized water reactor and the twin vertical steam generators. This compartment is surrounded by secondary shielding, of steel and heavy concrete. Aft again, a section 72·2ft. in length is formed by horizontal spectacle frames, the cylinders being 37·7ft. in diameter. The lobes accommodate two cross compound turbine sets with double reduction gearing to the twin shafts. Each set develops 20,000 s.h.p. at 160 r.p.m.; the inlet steam conditions are 560lb. per sq. in. and 480 deg. F. (saturated). In addition, the starboard lobe contains the main generators, switchboard, and associated equipment, which are balanced by the salt-water distilling plant, deærator, main feed pumps and reactor control room on the port side. Access to the machinery section is by a port side passage trunk above the reactor; on the other side are three openings for refuelling (at two-year intervals) and maintenance operations. The turbine driven cargo pumps are located aft of the main turbines. The lower part of the outer shell is reinforced to support heavy concentrated forces when in dry dock, especially in way of the reactor and machinery compartments.—*Paper by M. Shigemitsu, read at Second United Nations International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958. Journal, The British Shipbuilding Research Association, October 1958; Vol. 13. Abstract No. 14,615.*

#### Notes on the Jerk System of Fuel Injection

The paper aims at drawing attention to certain features of the injection of fuel into the cylinders of compression ignition engines. It is in effect a continuation of that contributed to the Institution of Mechanical Engineers by one of the authors in 1940. Since then data have been accumulated and certain new facts have come to light. As in that paper, attention is confined to the jerk system of fuel injection employing independent pumps and injectors. The authors refer therefore in the first place to the effect on the injection process of details of the design of the nozzle valve (differential needle). They deal secondly with the effect of the elasticity of the fuel trapped between the pump delivery valve and the nozzle needle valve. From this they build up calculated indicator diagrams for the fuel delivery pipe and then arrive at figures for calculated injection period under various conditions. In these calculations consideration of pipe surges is omitted. They then go on to recommend a procedure for determining the most favourable particulars and dimensions of the fuel injection equipment in any particular engine. In the course of the paper a number of numerical calculations are made to illustrate the influence of the several variables on the injection process. They are based on certain simplifying assumptions made to reduce the calculations to manageable proportions. It is stressed therefore that the numerical results derived are indicative of trends and cannot be accepted as representing actual facts.—*Paper by W. A. Green and G. R. Green, read at the General Meeting of the Diesel Engineers and Users Association, 20th November 1958.*

#### German Reactor Project

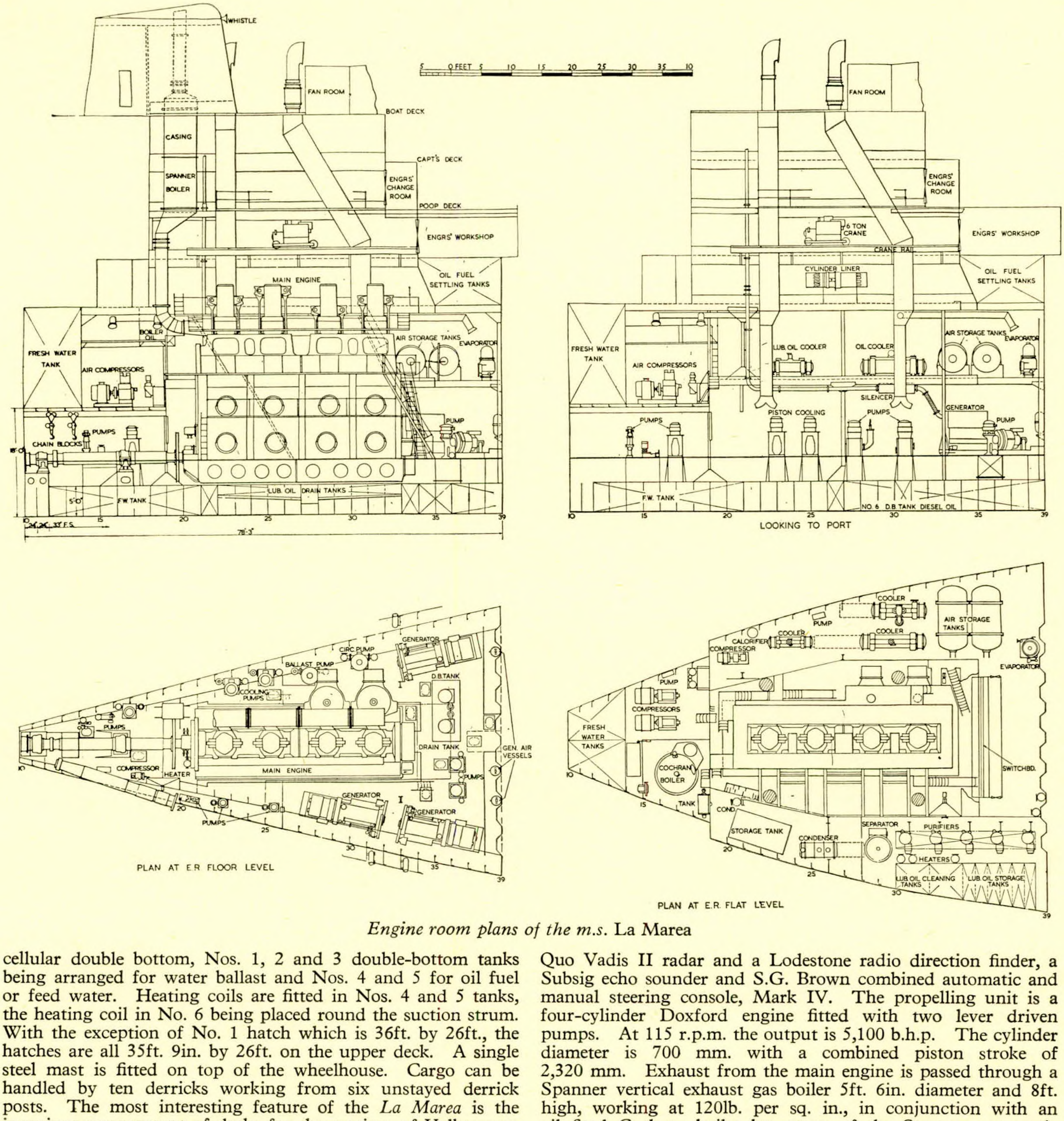
In April 1956 various North German shipyards, shipowners, and industrial undertakings formed an Association for the Application of Nuclear Energy to Ships. The purpose of this organization is the development of ship propulsion on the basis of nuclear energy. It is intended that this should be carried out in a three-stage programme, the first stage being the construction of a research reactor. After extensive study of various models, a swimming pool reactor was chosen on account of its high neutron flux and versatility. The ease with which its internal parts may be inspected and the mobility of the reactor core afford many possibilities for teaching and research purposes. The reactor is designed for a maximum output of 5 MW; there are 32 fuel elements, each containing 0·35lb. of U 235 in the form of a 20 per cent enriched $UAl_4$ alloy rolled in between aluminium plates. The future programme of the Association provides for the construction in the next few years of a first experimental reactor which is to be run on land under conditions simulating those experienced on board ship. It is then planned to install an actual ship reactor for the propulsion of an experimental vessel.—*E. Bagge, Atomkernenergie, May 1958; Vol. 3, pp. 169-175. Journal, The British Shipbuilding Research Association, October 1958; Vol. 13, Abstract No. 14,616.*

#### Automobile Carrier

A major problem in the transport of cars by sea is the poor stowage rate and the large amount of cubic space required for a small deadweight. This difficulty has been successfully overcome by Buries Marks, Ltd., London, in their new ship *La Marea,* built by Bartrams, Ltd., Sunderland, and now on a five-year charter to Volkswagen G.m.b.H., the West German motorcar manufacturers, with the option of a further five years. The vessel is the first to be designed and built in the United Kingdom with special decks for the carriage of motorcars and she will be followed, in March 1959, by *La Loma,* due to be launched by Bartrams at the end of 1958. The leading particulars are:

| | |
|---|---|
| Length, b.p. ... ... ... | 465ft. 0in. |
| Breadth ... ... ... | 63ft. 3in. |
| Depth, moulded to upper deck | 41ft. 6in. |
| Depth, moulded to second deck | 32ft. 0in. |
| Draught ... ... ... | 30ft. 0¼in. |
| Block coefficient ... ... | 0·760 |
| Machinery ... ... ... | 5,100 b.h.p. |
| Speed in service ... ... | 14·0 knots |
| Deadweight ... ... ... | 14,500 tons |

The *La Marea* is of the closed shelterdeck type with a cruiser stern, a raked, round soft-nosed stem and a short forecastle, the vessel being built to Lloyd's Register highest class. Welding is used extensively in the construction of the hull, the exceptions being the riveted frames, tank longitudinals and the bilge keel where the bulb flat is riveted to the flat bar. Certain deck girders are riveted to bulkheads and deck longitudinals to hatches and beams. There are seven compartments in the




*Engine room plans of the m.s.* La Marea

cellular double bottom, Nos. 1, 2 and 3 double-bottom tanks being arranged for water ballast and Nos. 4 and 5 for oil fuel or feed water. Heating coils are fitted in Nos. 4 and 5 tanks, the heating coil in No. 6 being placed round the suction strum. With the exception of No. 1 hatch which is 36ft. by 26ft., the hatches are all 35ft. 9in. by 26ft. on the upper deck. A single steel mast is fitted on top of the wheelhouse. Cargo can be handled by ten derricks working from six unstayed derrick posts. The most interesting feature of the *La Marea* is the ingenious arrangement of decks for the carriage of Volkswagen cars. These decks are in centre hold No. 3 and in holds Nos. 1, 2, 4 and 5. There are five decks for car stowage; Nos. 2, 3 and 4 are slung from chains and when not required are raised up so as to be lashed to the underside of what may be termed the 'tweendecks. The centre portions of the portable decks are designed as long pontoons and these may be fitted straight out of the hatch and stowed on special stools placed on the weather deck so that when carrying grain or other bulk cargoes the holds are virtually clear spaces. The machinery and the accommodation are placed aft, making a composite structure with a very clear view forward from the combined wheelhouse and chartroom. Navigational equipment includes a Marconi Quo Vadis II radar and a Lodestone radio direction finder, a Subsig echo sounder and S.G. Brown combined automatic and manual steering console, Mark IV. The propelling unit is a four-cylinder Doxford engine fitted with two lever driven pumps. At 115 r.p.m. the output is 5,100 b.h.p. The cylinder diameter is 700 mm. with a combined piston stroke of 2,320 mm. Exhaust from the main engine is passed through a Spanner vertical exhaust gas boiler 5ft. 6in. diameter and 8ft. high, working at 120lb. per sq. in., in conjunction with an oil fired Cochran boiler by means of the Spanner automatic feed system. The main engine operates on heavy fuel oil having a viscosity of 1,500 sec. Redwood No. I at 100 deg. F. Crankcase diaphragms are fitted to all cylinders and the lower pistons are oil cooled. Distilled water cooling is used for the upper pistons. Each scavenge pump has a diameter of 1,700 mm. with a stroke of 563 mm. A four-bladed Stone Novoston propeller is fitted.—*The Motor Ship, November 1958; Vol. 39, pp. 346-348.*

**Amber Light Operates with Ship's Whistle**

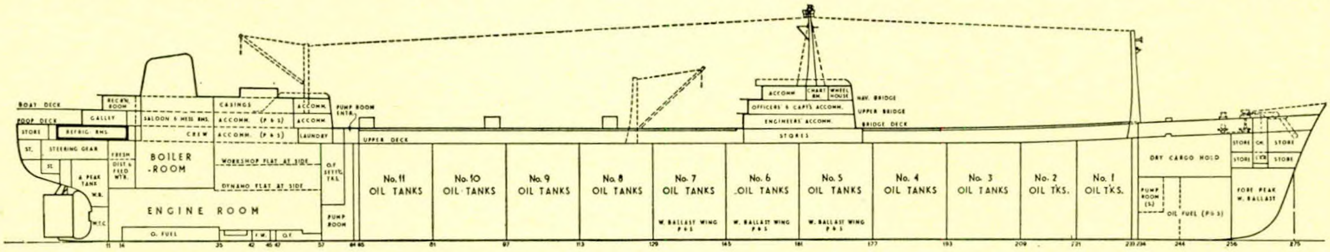
A visible signal to synchronize with a ship's audible whistle signals has been developed. The new device is said to be the first such signal to reach the manufacturing stage. It consists of a specially designed marine light which projects an amber beam vertically, multiple amber beams at an upward angle of approximately 45 degrees, and horizontal rays all around the horizon. The signal is provided with a super-powerful light source of 110,000 candle power. It is rated at 500 watts with a burning time of 2,000 hr. The light unit is connected electrically to operate exactly synchronously with the intermittent whistle signals. The visible signals created, according to the manufacturer, are so different in appearance that they cannot be confused with any other lights afloat or ashore.—*Marine Engineering/Log, September 1958; Vol. 63, p. 130.*

**Large British Tanker**

The first of the 42,000-ton d.w. oil tankers being built for the BP Tanker Co., Ltd., ran sea trials on 1st October 1958. This vessel, the *British Duchess*, has been built by John Brown and Co. (Clydebank), Ltd., and is the largest tanker so far built in Great Britain for a British owner. The *British Duchess* is powered by steam turbines which gave her a maximum speed over the measured mile off the Isle of Arran of 17·23 knots at 109·2 r.p.m. propeller speed. The mean speed was 17·06 knots at 109 r.p.m. Instead of the two longitudinal bulkheads in some tankers the *British Duchess* has three bulkheads, dividing the cargo space into 44 tanks. The principal particulars of the *British Duchess* are as follows:—

| | |
|---|---|
| Length o.a. ... ... ... | 710ft. 0in. |
| Length b.p. ... ... ... | 665ft. 0in. |
| Breadth, moulded ... ... | 95ft. 0in. |
| Depth, moulded ... ... | 51ft. 0in. |
| Deadweight ... ... ... | 42,116 tons |
| Draught ... ... ... | 38ft. 8in. |
| Machinery output, service ... | 16,000 s.h.p. |
| Speed in service ... ... | 16 knots |
| Cargo capacity, cu. ft. | |
| Oil cargo ... ... ... | 1,823,000 |
| Dry cargo ... ... | 67,300 |

The *British Duchess* has longitudinal framing. Three of the wing tanks on either side amidships have been arranged solely for the carriage of water ballast, the remaining 22 centre and 16 wing tanks having a total capacity of 1,823,000 cu. ft. A dry cargo hold having a capacity of 67,300 cu. ft. has been arranged forward. Some of the cargo tanks have been equipped with cathodic protection. The oil cargo is handled by three turbine driven pumps made by Drysdale and Co., Ltd. These are of the horizontal centrifugal two-stage type, each having a capacity of 1,000 tons of water per hour. There is a water ballast pump of the same type and capacity. There are also three horizontal duplex 14-in. by 12½-in. by 15-in. stripping pumps and a similar pump for water ballast. A 6-in. by 6-in. by 6-in. steam driven vertical duplex bilge pump has also been fitted. The forward pump room contains one horizontal duplex steam driven ballast pump, and one oil fuel transfer pump of the same size and type. The propelling machinery in the *British Duchess* consists of a set of geared steam turbines of Pametrada design built by John Brown and Co. (Clydebank), Ltd. The turbines drive a single screw and are capable of developing a service power of 16,000 s.h.p. at 105 r.p.m. of the propeller and a maximum power of 17,600 s.h.p. at 108 r.p.m. Steam is supplied at 600lb. per sq. in. pressure and superheated to 850 deg. F. Steam is obtained from two Foster Wheeler E.S.D. type watertube boilers arranged for oil firing. The air heaters, which use bled steam as the heating medium, supply air at a temperature of 235 deg. F. to the boilers, each of which is a two-drum boiler with economizer, superheater, air attemperator, and internal desuperheater.—*The Shipping World, 29th October 1958; Vol. 139, pp. 388-391.*

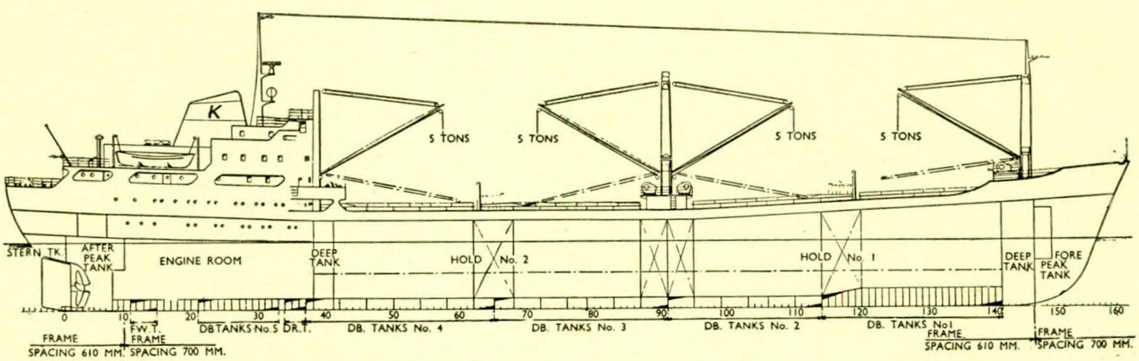



*The oil tanker* British Duchess

**Swedish Cargo Ship**

The recently completed motor ship *Ingerseks,* built at A/B Ekenbergs Varv., Stockholm, is another example of a cargo vessel with the machinery as well as the accommodation aft, and in which all auxiliaries are operated by a.c. motors. She has been built to the order of A/S Inge, Bergen (Jacob Kjode A/S Bergen, managers), to Det Norske Veritas Class 100 1A1 Ice. The following are the main characteristics:—

| | |
|---|---|
| Length, overall ... ... | 387ft. 5in. |
| Length, b.p. ... ... ... | 355ft. 6in. |
| Breadth, moulded ... ... | 52ft. 6in. |
| Depth to main deck ... | 31ft. 0in. |
| Draught, on summer load line | 24ft. 10in. |
| Corresponding deadweight ... | 7,420 tons |
| Cargo capacity, about ... | 320,500 cu. ft. grain |
| Machinery ... ... ... | 3,450 b.h.p. |
| Speed ... ... ... | 13½ knots |




*M.S.* Ingerseks

The propelling machinery comprises a six-cylinder Burmeister and Wain turbocharged engine of 3,450 b.h.p. at 170 r.p.m. Forward of the engine room is the deep tank, forward of which are the four cargo holds, fitted with MacGregor steel hatch covers and served by eight 5-ton derricks, with two self-staying masts and two stump masts. The a.c. winches, the windlass and capstan are of Siemens manufacture whilst the steering gear is of the Hastie type. There are three 208-kVA 400-volt 60-cycle Diesel driven Siemens alternators, in addition to a harbour set of 62 kVA. A composite oil fired boiler is installed, having an output of 1,100-1,350 kg. of steam per hr. The *Ingerseks* is equipped with a gyro compass with auto-pilot, radar, SAL log and echo-sounding apparatus.—*The Motor Ship, November 1958; Vol. 39, p. 382.*

**Torque and Thrust Measuring System**

A measuring system is described which has been developed at the David Taylor Model Basin for use in model and full-scale ship testing. The system utilizes transducers of the differential air gap type, special designs of which permit measurement of torque or thrust in rotating shafts without the use of slip rings. The system includes instrumentation for direct recording and for visual or automatic digital read-out. Accuracies of $\pm\frac{1}{2}$ per cent or better are obtainable. The torque transducer (Magnitorque) is shown in Fig. 2. Two necked-down sections of the shaft (A and $A^1$), having the same diameter and length, form the flexural elements. Three rings made of magnetic material are fastened to the shaft over these flexural elements; one ring (B) is fastened to the land between the flexure sections, and the other two rings (C and D) are fastened to the shaft at the ends of the flexures. The rings are made so that a series of air gaps are formed between the centre ring and the two end rings. With no torque applied to the shaft, the active gaps (E and F) are equal and the impedance of each winding is the same. When a clockwise torque is applied, as shown, the flexural elements twist, resulting in air gaps F increasing and gaps E decreasing. This causes the impedance of one winding to increase and the other to decrease proportionally to applied torque. The shaft is made from a non-magnetic spring material such as beryllium copper or K-monel to avoid short circuiting the magnetic flux. The thrust transducer (Magnithrust) is shown in Fig. 3. The flexural element consists of an annular section of the shaft in which a series of slots is cut perpendicular to the shaft, forming a type of compression spring. The shaft extension on one side of the flexure carries a ring A. This ring is centred between two similar rings (B and C) which are secured to sleeve S, which is fastened to the shaft on the opposite side of the flexure. With no thrust applied to the shaft, the active air gaps (D and E) are equal and the impedance of each winding is the same. When a positive thrust is applied as shown, the spring is compressed, thereby moving ring A to the left. This movement decreases air gap D and increases gap E, resulting in a differential impedance change and a corresponding output voltage proportional to load. Fig. 4 shows a simplified diagram of the circuitry used. It will be noted that the gauge signal is converted to direct current before balancing against the feedback potentiometer. This eliminates the need for phasing adjustment. Controls are provided for span adjustment, for gauge zeroing, and for filtering or smoothing the signal output. Silicon diodes provide noise-free stable rectification of the reference and signal voltages.—*M. W. Wilson, Applications and Industry, September 1958; No. 38, pp. 245-249.*

**Brittle Fracture Initiation**

Static fractures which are brittle from the start are evidence of lack of ductility at the point of crack initiation and occur at low average net stress. Past static tests, in failing generally to reproduce the phenomenon of brittle fracture initiation, showed that undamaged steel plate under adverse notch conditions has sufficient ductility to allow general yielding before fracturing. Static initiation of brittle fracture can

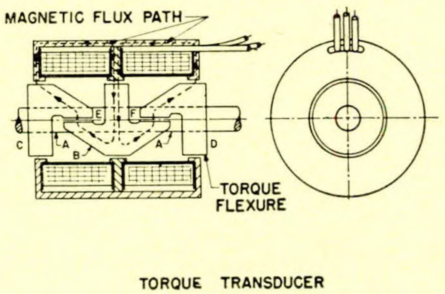



FIG. 2—*David Taylor Model Basin Magnitorque*

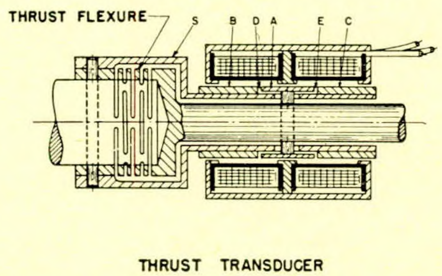



FIG. 3—*David Taylor Model Basin Magnithrust*

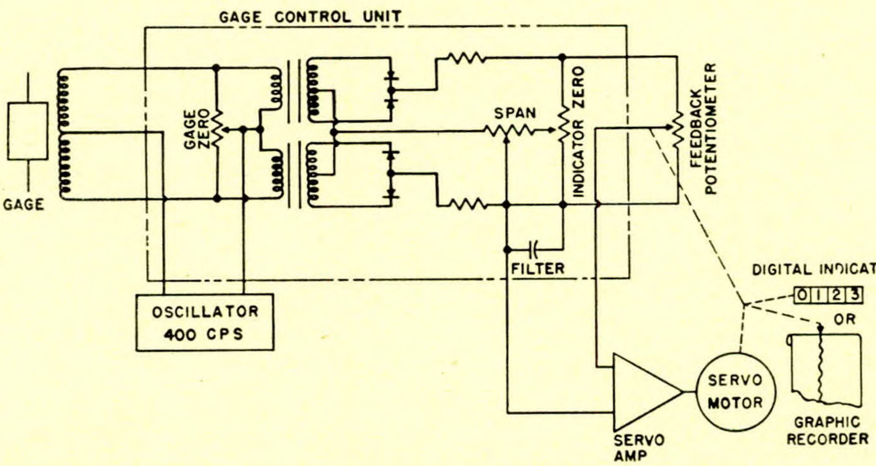
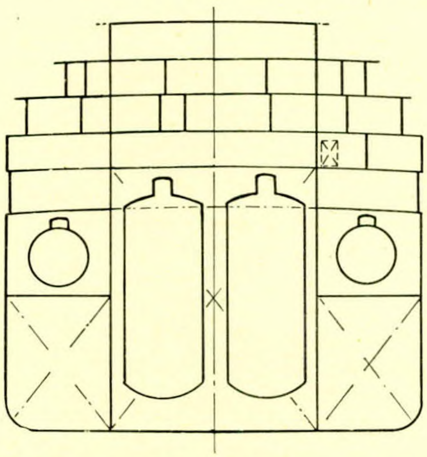



FIG. 4—*Schematic circuit diagram, differential reluctance measuring system*

be achieved by an additional exhaustion of ductility. For this purpose, a steel of high transition temperature was subjected to various types of prestraining. The best results were achieved by precompressing ¾-in. thick, 10-in. square plates with machined notches so as to produce large plastic strains at the notch roots. When tested in central static tension at a temperature below the transition range, these plates fractured at average net stresses well below yield level. The lowest average stress at fracture was 36 per cent of virgin yield. Thus, for the first time, brittle fracture of unwelded steel plate has been initiated in the laboratory under controlled conditions at such low stress. The conditions at fracture indicate that energy theories are useless or inapplicable in the problem of fracture initiation. Finally, residual stresses are shown to be of little importance when ductility is ample. When embrittlement is excessive, they only hasten a fracture which would have occurred at low applied stress in the absence of residual stress. —*C. Mylonas, D. C. Drucker and J. D. Brunton, The Welding Journal, October 1958; Vol. 37, pp. 473s-479s.*

#### Combined L.P.G. Carrier and Tanker

One of the twelve super tankers ordered from Cantieri Riuniti dell'Adriatico, Trieste, by the Esso group of companies, the *Esso Puerto Rico,* has been specially designed by the technical staff of the Esso Shipping Company as a combination liquefied petroleum gas/bulk oil carrier. While retaining the length, breadth and depth of her eleven sister ships, the *Esso Puerto Rico* differs in having a centre line trunk extending fore



*Section showing storage of vertical and horizontal gas cylinders; the crossed spaces are the cargo oil tanks*

and aft on the upper deck between the forecastle and poop. There are only two types of this kind of vessel in service at present; ships carrying liquefied petroleum gas only, ranging from lighters to ships of up to 7,000 gross tons, and ships of very limited capacity for combined transport of bulk oil and/or liquefied petroleum gas. The *Esso Puerto Rico* is being built under the survey of the American Bureau of Shipping and has principal characteristics as follows:—

| | |
|---|---|
| Length overall ... ... | 690ft. 0in. |
| Length between perpendiculars | 600ft. 0in. |
| Moulded breadth ... ... | 90ft. 0in. |
| Moulded depth to upper deck at side ... ... ... | 47ft. 0in. |
| Deadweight ... ... ... | 32,300 tons |
| Total displacement ... ... | 48,940 tons |
| Machinery output (at 100 r.p.m.) ... ... ... | 16,000 s.h.p. |
| Corresponding trial-speed ... | 17 knots |

The tanks and attendant systems are designed for an L.P.G. pressure of 150lb. per sq. in. and the loading and unloading system consists of two identical groups installed in separate pump rooms. The propelling machinery consists of a two-casing cross compound set of double reduction turbines built by the San Andrea Engine Works of Cantieri Riuniti dell'Adriatico, under licence from the De Laval Steam Turbine Co. of Trenton, N.J. The first of these turbine units was installed in a recent tanker delivered by Cantieri Riuniti dell'Adriatico and afforded excellent results, an exceptionally low fuel consumption rate having been recorded at speeds of over 17 knots in fully loaded conditions. Others are being installed in the Ansaldo and CRDA-built vessels of the British Tanker Co., Ltd.—*The Marine Engineer and Naval Architect, November 1958; Vol. 81, pp. 435-436.*

#### Training in the Use of Shipborne Radar

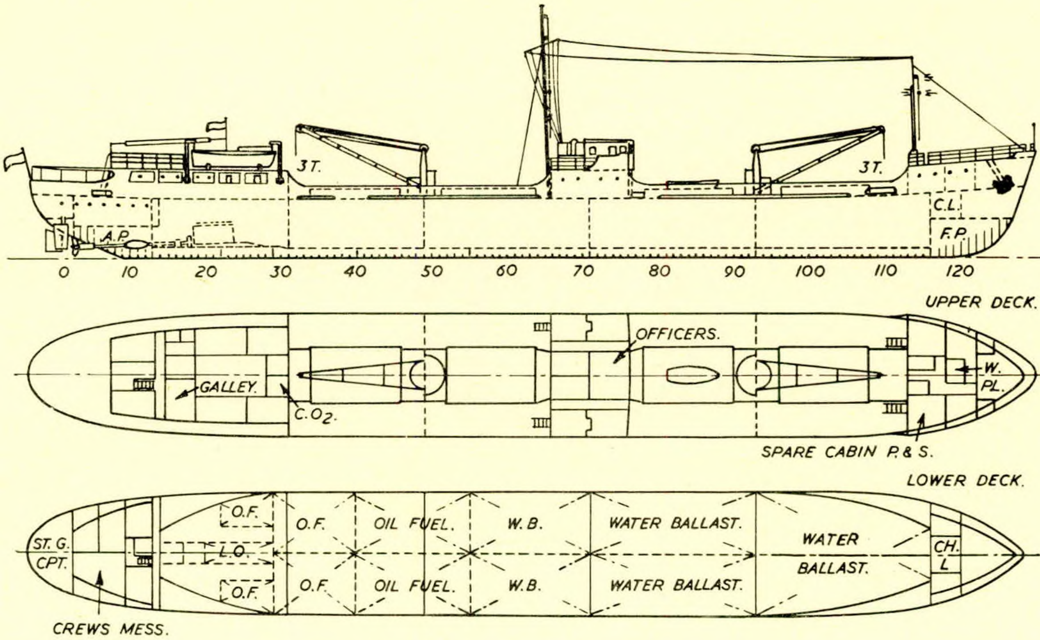
Many of the problems arising out of the use of radar in poor visibility can be laid at the door of "incorrect appreciation" of the information available on the PPI, coupled with the lack of timely action to avoid, if possible, a close-quarter situation. To this must be added the over-confident ship handler who has never yet been faced with a collision situation in poor visibility and who may be complacent until too late. The solution to these problems lies in adequate training for radar observers. Many shipping companies arrange for practical radar training in their ships at sea and this is invaluable, but such matters as alteration of course or speed by own ship to illustrate problems which may so easily arise in poor visibility is not always practicable, while similar alterations by other ships and therefore in the movement of their echoes on the PPI cannot be achieved. For this reason simulators installed at appropriate places ashore would be of great practical value. One of the difficulties is to find a balance between this practical value of the equipment and the technical complications in order to keep the cost within reasonable limits. Two separate PPI displays are required, one for the instructor and one for the pupil, on each of which can be displayed the echoes of ships, each separately controlled in respect of course and speed by the instructor. These displays should be of a standard marine radar design capable of orientation "ships head-up" or "north-upwards". Facilities should be available for the pupil to control the course and speed of his own ship which will be integrated with the course and speed of the ship echoes under the control of the instructor so that the echoes will display relative motion on the PPI's. It would obviously be an advantage if facilities were also available for true motion presentation.—*R. G. Swallow, The Journal of The Institute of Navigation, October 1958; Vol. 11, pp. 369-371.*

#### Metallurgical Properties of Steel Plates from Fractured Ships

Structural failures involving extensive fractures in the hull plating of welded ships were investigated to determine causes of individual failures and to obtain data for evaluation of metallurgical and other factors that contributed to the origin and propagation of the fractures. Fracture initiation resulted from the coincidence of a notch or point of stress concentration and a plate that was abnormally notch sensitive at the operating temperature. Propagation or ending of a fracture was also related to the combined effects of stress and notch sensitivity of the steel. Relations between notch sensitivity, as measured by V-notch Charpy energy criteria, service performance, and chemical composition and grain size or plate thickness of the steel, were determined by statistical analyses of the accumulated data for 149 plates.—*M. L. Williams, The Welding Journal, October 1958; Vol. 37, pp. 445s-454s.*

#### Jugoslav Danube-sea Ships

The Jugoslav River Shipping Company of Belgrade operates a regular service in vessels between that city, other Danubian towns and ports on the Black Sea and Eastern Mediterranean. It has recently taken delivery of a group of new motorships from Tito's Shipyard, Kraljevica, on the Adriatic coast of Jugoslavia. Danube-sea ships are highly specialized, for not only are they subject to severe draught limitations due to the wide variations in depth but the maximum height of fixed deck erections is restricted by the bridges




*River-sea cargo vessel* Kolubara

beneath which they have to pass. Steering and manœuvrability are also important in those stretches of the river where the flow is particularly rapid, as for instance at Djerdap and Turnu Severin where the Danube breaks through the Transylvanian Alps. The vessels are single deckers with a raised fo'c'sle and bridge house aft above the machinery. They are of all-welded construction and have been built to Bureau Veritas Class for limited service in the Mediterranean. The new ships, which are named *Kolubara, Mlava* and *Tamnava,* have the following principal particulars:—

| | |
|---|---|
| Length overall ... ... | 261ft. 0in. |
| Length between perpendiculars | 248ft. 0in. |
| Moulded breadth ... ... | 32ft. $9\frac{1}{2}$in. |
| Moulded depth ... ... | 15ft. 0in. |
| Maximum draught ... ... | 3ft. 1in. |
| Maximum air draught from keel ... ... ... | 30ft. 4in. |
| Displacement ... ... ... | 1,700 tons |
| Gross tonnage ... ... | 1,027 tons |
| Net tonnage ... ... ... | 544 tons |
| Deadweight ... ... ... | 1,100 tons |
| Grain capacity ... ... | 61,800 cu. ft. |

The four holds and large hatches are served by two 3-ton Boka electric luffing cranes having a working radius of 30ft. These cranes and the other deck machinery, comprising an electric anchor windlass and a towing winch aft were made by the Vulcan Company of Rijeka. Electro-hydraulic/hand-hydraulic steering gear supplied by Atlas-Werke of Bremen controls the three spade type suspended rudders. The main machinery consists of two six-cylinder M.W.M. RH348 SU engines of $12\frac{1}{2}$-in. bore by 19-in. stroke, each developing 500 b.h.p. at 375 r.p.m. These are directly coupled to 5ft. $5\frac{1}{2}$in.-diameter Zeise propellers specially designed for shallow water operation.—*The Marine Engineer and Naval Architect, November 1958; Vol. 81, pp. 430-432.*

**Toughness of Welds**

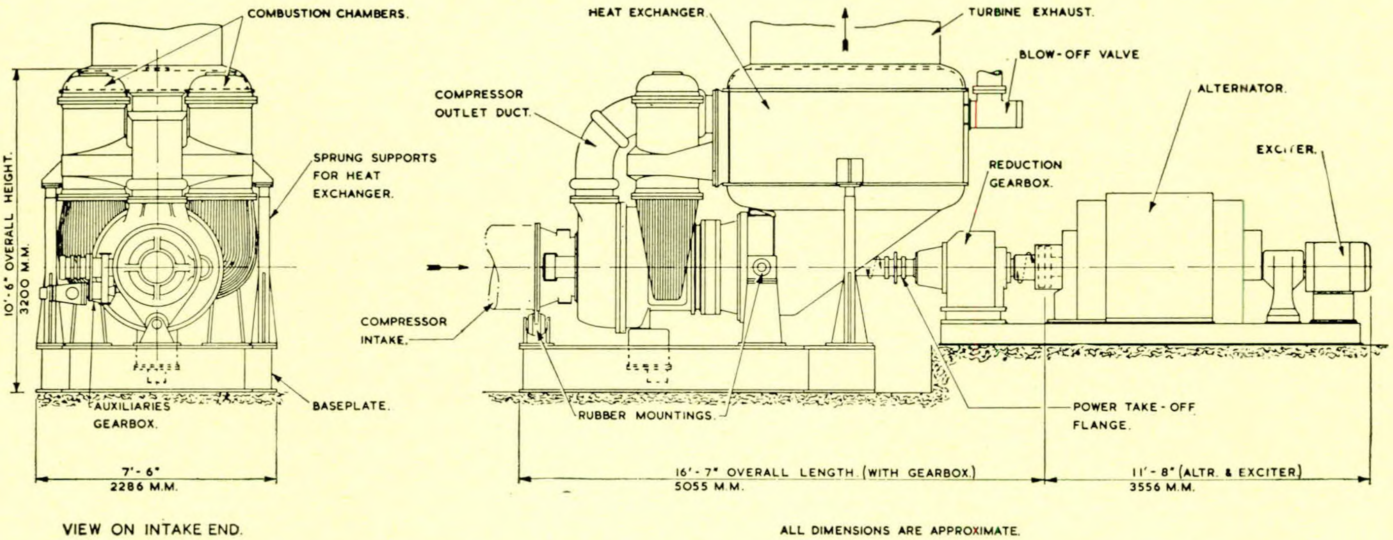
The Watertown Arsenal Laboratories composite test utilizes a V-notched Charpy impact specimen with approximately equal areas of weld metal and heat affected base metal in the cross section under the notch. Because a definite relationship exists between lateral expansion occurring at the base of the Charpy specimen and the energy absorbed in fracturing the specimen, it is possible to substitute lateral expansion for energy in plotting transition curves. Thus, separate measurements of lateral expansion at the weld and heat affected base metal sides of the test specimen provide two distinct transition curves from a single set of specimens. The objective of this investigation was to obtain further information on the significance of composite Charpy-impact tests by comparing transition curves of weld and heat affected base metals tested separately and in combination. The findings confirm the validity and usefulness of the composite deformation-temperature transition curves for evaluating the relative toughness of weld and heat affected base metal structures. Moreover, the composite test method is versatile in that it permits the testing of a range of welding techniques (from stringer beads to multipass weaving in a V groove), and is economical in that it permits simultaneous evaluation of the notch toughness of weld metal and heat affected base metal from one series of test bars.—*W. P. Hatch and C. E. Hartbower, The Welding Journal, October 1958; Vol. 37, pp. 455s-462s.*

**Determination of Initial Stresses in Steel Plates**

A non-destructive method for the determination of the direction and magnitude of the principal stresses at any location in a structure, such as a ship or a bridge, has been investigated and developed as reported here, in an effort to overcome the generally destructive and costly methods presently available. This non-destructive method consists of attaching electric-wire strain gauges around the point at which the stress is to be measured and then drilling a hole ($1\frac{1}{8}$in. to 1in. diameter) at that point. The gauge reading before and after the drilling of the hole are used to determine the stress. Known stress values up to 15,000lb. per sq. in. were applied to test plates, and measurements were made by the hole relaxation method. When corrected for the stresses initially contained in the plates, this hole relaxation method checked the known applied stresses to within 1,000lb. per sq. in. The holes are easily and economically repaired.—*C. Riparbelli, E. W. Suppiger, and E. R. Ward, Ship Structure Committee, Publication SSC-42, 1958.*

**Gas Turbine Auxiliaries**

The steady progress being made in improving the efficiency and reliability of the smaller types of gas turbine is making the use of these machines as auxiliary prime movers increasingly attractive. The main advantages of the gas turbine over reciprocating internal combustion engine plant are that it is very much lighter and more compact for the same power and,




*The English Electric EM-27P 2,700 h.p. gas turbine with heat exchanger—turbo alternator set*

by virtue of its simple construction and absence of wearing parts, more easily maintained. As compared with steam driven machinery, they have the advantage that, being independent of a steam supply range, they are unaffected by defects or breakdowns in the boiler rooms and can be sited anywhere in the ship without complication. The main applications of gas turbines as marine auxiliaries lie in the generation of electrical power and raising steam. Normally, the marine installation utilizing a gas turbine is so arranged to take advantage of the heat produced by the turbine's exhaust gases and thus improve the efficiency of the gas turbine installation. The economic operation of a gas turbine installation is dependent upon the exhaust heat conversion factor. In cargo vessels the gas turbine plant can meet the electrical requirements during cargo loading and discharging, while at the same time the exhaust gases are being used in the vessel's exhaust gas boiler to produce all the ship's steam requirements. This method of operation can show considerable economies since it obviates the necessity for additional steam raising plant when the ship is loading or unloading. Fuel consumption of a gas turbine in an installation of this type is comparable to the combined consumptions of a Diesel generator of corresponding rating and the oil firing for an auxiliary boiler. In this way, the gas turbine proves itself a better proposition than the more conventional systems on account of the efficient utilization of fuel and savings in space and maintenance. Gas turbines are particularly suited to functions where an occasional supply of power is required either in emergency or under special circumstances. In these cases, as the running time envisaged is comparatively short, the question of thermal efficiency or fuel economy is relatively unimportant, a simplified plant of low capital cost is most suitable. The chief requirement is an ample supply of power at short notice from a plant occupying the minimum space when not in use. Emergency and peak load generators for all the larger types of vessel, ballast or cargo discharge pumps, high capacity rotary air compressors, particularly for salvage purposes, and hull and fire pumps for fire fighting and damage control purposes fall into this category. Portable fire and salvage pumps powered by small gas turbines, which are considerably lighter and easier to handle than Diesel or electric pumps of similar capacity, have also been designed for marine use. The power range of the machines available for fixed or portable auxiliary applications in the marine field runs from 40/60 h.p. for the lightest types, to 2,750 h.p. for the heavy generator engines. Larger designs, of 5,000 s.h.p. and more, are in production for main propulsion. The smaller types, especially when not fitted with a heat exchanger, are particularly light weight, for example the 45/60 h.p. Budworth, complete with 15:1 reduction gear, weighs 80lb. At the other end of the scale, the English Electric EM-27P of 2,750 h.p. weighs 30,000lb. complete with heat exchangers.—*Shipbuilding Equipment, November 1958; Vol. 1, pp. 10-11.*

### Structural Analysis and Design Integration

This paper is an attempt to set forth a design method for the longitudinally continuous structural elements for the midship section of transversely framed ships. The material on which it is based is taken from the "Rules for Building and Classing Steel Vessels" of the American Bureau of Shipping. The assumption is that such "Rules" represent the most comprehensive body of data available which is reasonably representative of the lower limits of merchant ships' structural adequacy as demonstrated by service experience. The technique presented has several advantages of flexibility owing to its reliance on basic concepts of structural mechanics once a few criteria are established. It should provide the means of structural design for vessels of considerably greater or smaller size and different proportions than are now included in rule tables. Quite different internal arrangements, structural arrangements and framing systems can be accommodated. Additional service experience and an advancing state of analytical knowledge can be incorporated readily in design through its use. Materials of differing properties can be evaluated for structural purposes in a direct way. The general procedure is first to determine the minimum thickness of individual shell, inner bottom, and deck plating panels, using both stress and instability criteria. An explanation of the concepts employed is included. The reasoning behind the choice of each recommended criterion or qualifying constant is developed and the data leading to their selection are presented. With all such elements determined to meet panel or local requirements, the assemblage of them comprising the ship hull girder can be checked for its section modulus and modifications made as necessary for optimum structural efficiency. An example is worked out to illustrate the method and refined methods of analysis are indicated for use in the final adjustment of scantlings.—*Paper by J. H. Evans, read at the Annual Meeting of the Society of Naval Architects and Marine Engineers, New York, 13-14th November 1958.*

### Explosives Carrier

A small cargo vessel for the carriage of explosives has been built by Ardrossan Dockyard, Ltd., for the Nobel Division of Imperial Chemical Industries, Ltd. This ship, the *Lady Roslin,* is a motor vessel of some 700 tons gross, with a speed of 12 knots. She is a single-deck ship with machinery aft. The principal particulars of the ship are:—

| | |
|---|---|
| Length o.a. ... ... ... | 174ft. 5¼in. |
| Length b.p. ... ... ... | 164ft. 0in. |
| Breadth ... ... ... | 30ft. 6in. |
| Depth moulded ... ... | 16ft. 0in. |
| Tonnage: | |
| Gross ... ... ... | 708 tons |
| Deadweight ... ... | 544 tons |

The vessel has been built under the survey of Lloyd's Register of Shipping for the classification ✠ 100 A1. A combination of riveting and electric arc welding has been employed, the arrangement being intended to facilitate construction and also to keep down corrosion replacement and repair cost. The shell plating has welded butts in conjunction with riveted seams. The construction is based on the transverse deep frame principle, with bulb angle sections being used for the side frames. The deck beams are of ordinary angles bracketed to the main frames by beam knees and lugged to the hatch side girders. The cellular double bottom extends from the collision bulkhead to well beyond the machinery bulkhead, solid floors being

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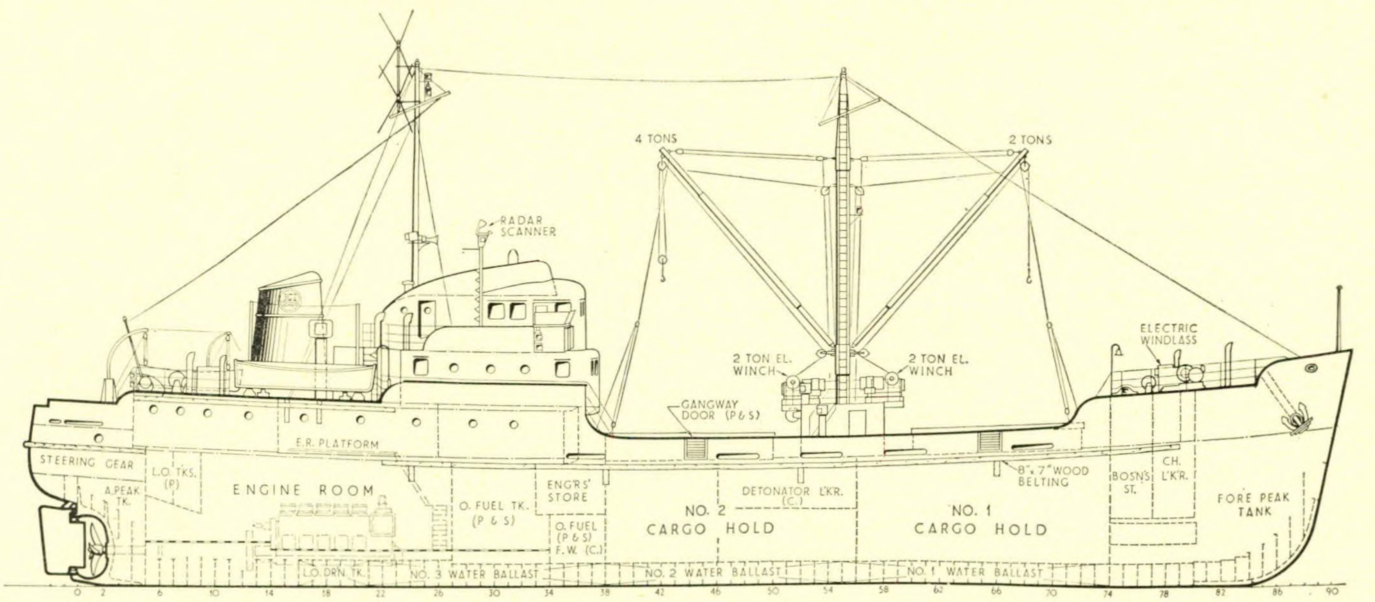


*Explosives carrier* Lady Roslin

arranged at every frame. The two-tier aluminium bridge deckhouse is a prominent feature of the ship, with its well streamlined curves. The funnel is also of aluminium, and the total weight of light alloy employed is 8 tons. Explosives are carried in Nos. 1 and 2 holds, the detonators being stowed in a specially designed locker situated on the centre of No. 2 hold, the locker being served by a portion of No. 2 hatch. The holds, detonator locker, hatches and hatch beams are completely sheathed with white pine. The forward hold is served by a 2-ton tubular steel derrick, while a 4-ton derrick serves the fter hold and the detonator locker. The derricks are operated two 2-ton electric cargo winches. Fuel oil is carried in two ker tanks built into the ship's side at the forward end of ngine room, settling tanks being arranged adjacent to the r tanks. The fresh water storage tank is arranged on the at the forward end of the engine room, this tank supply- domestic pressure system. The spaces allocated for ge of water ballast are Nos. 1, 2 and 3 double bottom fore and after peak tanks. A total of 48¾ tons of arried, while the total water ballast capacity is 266 vessel is propelled by a type M45M five-cylinder Diesel engine designed to develop 850 b.h.p. at *he Shipping World, 12th November 1958; Vol.*

results are adequate for predicting design lift and drag coefficients, although they may be conservative at high rudder angles and high speed. 4. Model tests appear to give torque coefficients that are lower than those observed on these full scale trials. 5. Joessel's formulas are adequate for predicting normal forces but not for predicting torques. 6. The value of 0·6 for the reduction coefficient is adequate for predicting design forces for this type of ship. 7. The type of zigzag turns run on these tests are no more detrimental to the rudder system than are ordinary turns.—*Paper by L. A. Becker and J. S. Brock, read at the Annual Meeting of The Society of Naval Architects and Marine Engineers, New York, 13th-14th November 1958.*

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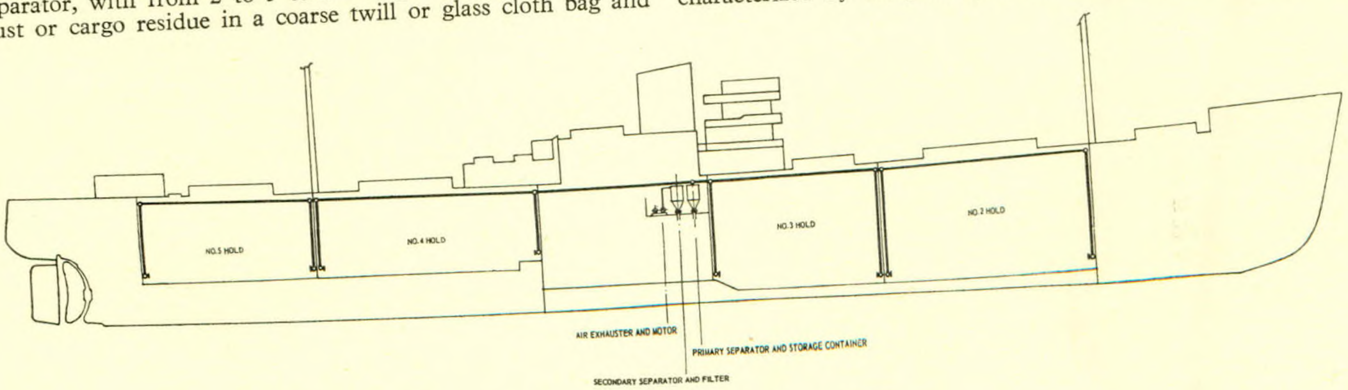
For over twenty years both naval and merchant ships have been fitted with vacuum soot removal plant for use when boiler cleaning; now permanent installations of much the same basic type have been developed to deal with the problems of cleaning holds and passenger accommodation. Of particular interest is the idea of providing each hold of cargo vessels with large bore suction connexions which will enable ships' staff to remove the residue of loose, dusty cargoes quickly and efficiently without having to rely on local port facilities. It is

… clean the holds of a cargo … loose or dusty cargo can be … uum process. Particularly in … inating the new cargo by the … rough cleaning mandatory, this … ubstantially increase the speed of … advantage of this alone could go … ng the capital cost of the plant. … used to recover the loose remainder … hich make this a worth while pro- … hemicals, ores and grain would come … e plant is also particularly suited to … with… …y remnants of such consignments as the remova… … the less valuable ores, as refuse. The coal, copra, sulphu… … plant consists basically of a turbine-type air exhauster working in conjunction with a separation unit and a suction main. The air exhauster, powered by a 25 to 35 h.p. motor, draws a vacuum of some 10 inches Hg in the separators. The primary separator, with from 2 to 3 tons storage capacity, collects the dust or cargo residue in a coarse twill or glass cloth bag and discharges it downwards into a hopper. As the latter fills it can be discharged into bins or sacks or, alternatively, overboard through ejectors by operating the shutter and rotary discharge valves which close its lower end. A bag-shaker lever is fitted to prevent the porous bag from becoming clogged, and a compressed air valve is provided for cleaning the hopper pneumatically in the event of choking. A secondary filter separator is employed to cleanse the air before discharge to atmosphere. The suction main, which should be designed with as straight a run as possible, is a 3- to 5-in. pipe system with branch connexion points at each end of the holds. Flexible suction hoses of a bore suitable to the job in hand connect these to the portable cleaning nozzles. This arrangement permits of several operators working simultaneously and can handle particles ranging from fine dust to pieces somewhat larger than a coffee bean. The occasional lump of considerably greater size (up to one-third the diameter of the pipe) can be dealt with, but for bulk removal of heavier grade material a specially designed system would be necessary.—*Shipbuilding Equipment, October 1958; Vol. 1, p. 7.*




*Suggested layout for hold cleaning installation*

#### Full-scale Ship Structural Tests

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| | |
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| Length, overall ... ... | 504ft. 11⅛in. |
| Length, b.p. ... ... ... | 480ft. 7⅞in. |
| Breadth ... ... ... | 68ft. 11in. |
| Depth ... ... ... | 37ft. 4⅞in. |
| Draught ... ... ... | 27ft. 6in. |
| Deadweight ... ... ... | 16,099 tons |
| Gross tonnage ... ... | 10,497·77 R.T. |
| Net tonnage ... ... ... | 6,200·24 R.T. |
| Main propelling machinery: One M.A.N. Diesel engine of 4,670 h.p. at 125 r.p.m. | |
| Speed ... ... ... ... | 13·5 knots |

The ship is of largely welded construction, except for the side framing and a number of seams. The bottom, the tank top and the main deck are constructed with longitudinal framing and girders. A complete floor is placed at every other frame in the double bottom below the cargo section. A web frame is placed at every fourth frame in the wing tanks on either side of the cargo section; between there is a high floor at every second frame. The stem is constructed of plate steel and half round. The stern is made up of cast steel elements with plate connexions. A simplex balance rudder is fitted. Aluminium has been applied in the construction of the wheelhouse, the top deck and radar mast. The wheelhouse was constructed as a complete section. The main propelling engine is a seven-cylinder, single-acting, M.A.N. Diesel engine of the crosshead type. Each of the cylinders has a bore of 700 mm and a stroke of 1,200 mm. The engine has an output of 4,670 h.p. at 125 r.p.m. and drives a manganese bronze Li… propeller. Electricity is supplied by two Diesel generator se… each consisting of a four-cylinder, four-stroke superchar…

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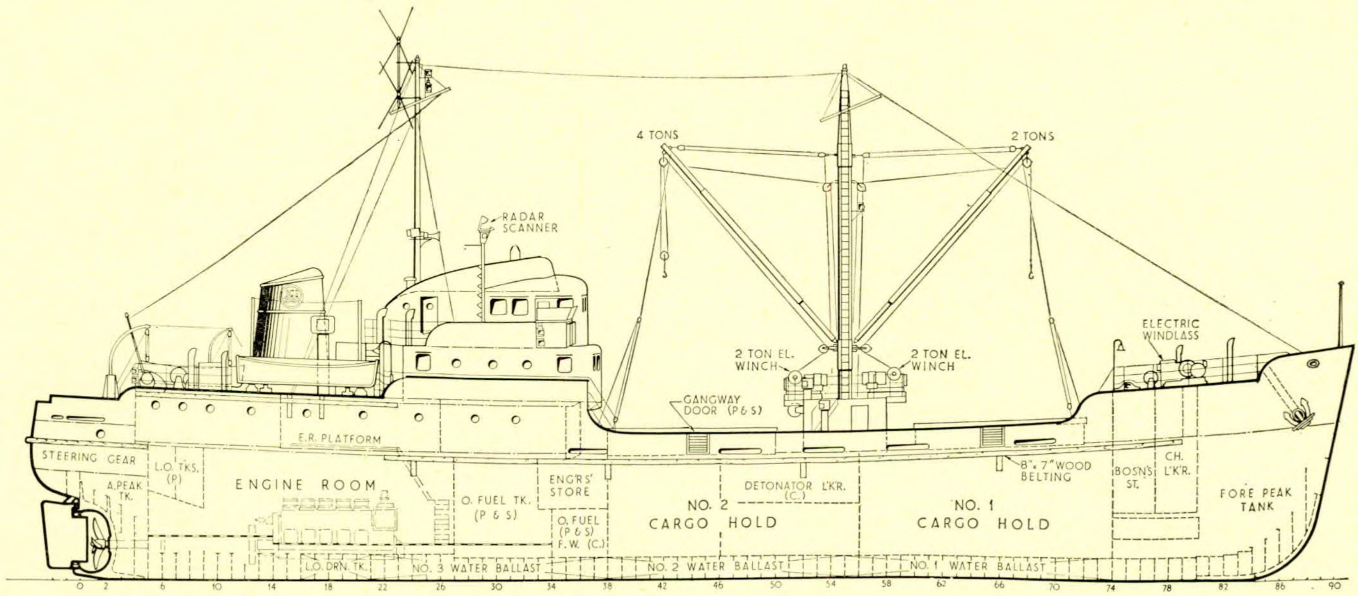


*Explosives carrier* Lady Roslin

**Experimental Determination of Rudder Forces**

Full scale rudder forces and rudder stock torques and bending moments were measured during underway trials of USS *Norfolk*. A maximum force of 563 kips (563,000lb.) was recorded during these underway trials. A maximum torque of 601 kip-ft. also was recorded. In addition, rudder rates and ram pressures were determined. The results of the full scale tests are compared to results obtained from model studies and also from calculations. The forces compared very well but there is considerable difference between the torques. Based on these tests, the following conclusions are drawn: 1. It is possible to determine the full scale magnitude, direction, and point of application of the force acting on a spade rudder supported by spherical roller bearings. However, it is necessary to drydock the ship prior to the underway tests in order to calibrate the structure against known loads. 2. The rudder stock torque can be determined by means of strain gauges mounted on the stock, and also by measuring ram pressures; however, the two results are not consistent. Because of the complexity of the steering system, torques obtained from the rudder stock strain gauges are taken as correct. 3. Model test results are adequate for predicting design lift and drag coefficients, although they may be conservative at high rudder angles and high speed. 4. Model tests appear to give torque coefficients that are lower than those observed on these full scale trials. 5. Joessel's formulas are adequate for predicting normal forces but not for predicting torques. 6. The value of 0·6 for the reduction coefficient is adequate for predicting design forces for this type of ship. 7. The type of zigzag turns run on these tests are no more detrimental to the rudder system than are ordinary turns.—*Paper by L. A. Becker and J. S. Brock, read at the Annual Meeting of The Society of Naval Architects and Marine Engineers, New York, 13th-14th November 1958.*

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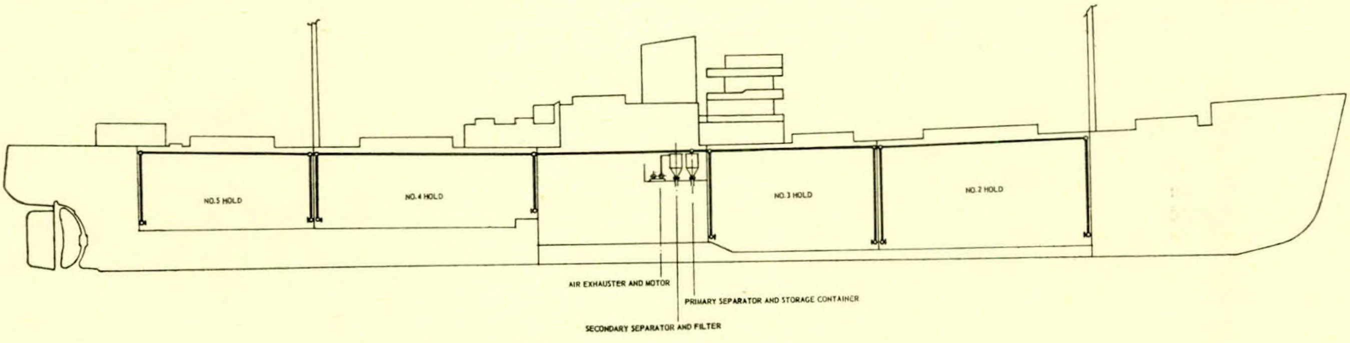


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Moss Diesel engine with an output of 360 h.p. at 450 r.p.m. and driving a NEBB generator of 300 kVA, supplying 3-phase a.c. at 440 volts, 60 cycles.—*Holland Shipbuilding, September 1958; Vol. 7, pp. 38-44.*

**Helical Heating Coils**

An entirely new design of heating coil for the cargo tanks of oil tankers has been developed by the Shell group. Coils to this design are at present being constructed by Colvin-Smith, Ltd., for two bitumen tankers building at the Hamburg yard of Deutsche Werft for Shell Tankers, Ltd. Instead of being arranged in a grid over the bottom of the tank in the normal manner, these coils have the form of a vertical helix, or spiral, which can be introduced into the tank through the deck hatch. They are thus very much simpler to construct and to install than the normal type of coil. For bitumen tankers such as those now being built in Germany, the new helical coils would be used in conjunction with a normal bottom grid of coils, replacing the coils which normally line the lower part of the tank sides. For a vessel carrying crude oil, however, it should be possible to dispense entirely with the normal bottom grid. The bitumen tankers will have four helical coils in each centre tank and two in each wing tank: for a crude oil carrier it is possible that two units in each tank would be sufficient. The spreading of the heat through the tanks will, of course, be dependent on the maintenance of satisfactory convection currents in the crude oil. The new helical coils are being manufactured under licence from Shell by several British manufacturers of heating coils; they are Colvin-Smith, Ltd., Steels Engineering Installations, Ltd., Charlton Weddell and Co., Ltd., Archibald Low and Sons, Ltd., and Munro and Miller, Ltd. Each coil consists of a helical coil made from 291ft. of 1½-in. bore, 14-s.w.g. aluminium brass tube. For rigidity the coil is clamped to an angle bar tripod frame. The exhaust riser passes up the centre of the tripod from a P-bend trap to ensure efficient ejection of the water condensate. For installation in the vessel the units are clamped to the bottom bar of the ship's longitudinals, and, of course, secured at the top. By using breakable steam and exhaust connexions, the units may easily be fitted or dismantled, while it is a simple matter to vary the heating surface by reducing or increasing the number of units per tank. The coils can easily be removed to speed up tank cleaning.—*The Shipping World, 22nd October 1958; Vol. 139, p. 365.*

**Automatic Synchronizer**

Alternating current systems installed on board ship are invariably supplied by more than one alternator set, the number of machines connected to the busbars being adjusted to suit the electrical load on the network. Alternators can only be satisfactorily paralleled if the voltage, phasing, phase sequence and frequency of the machines correspond exactly. If these conditions are fulfilled, the machines can be connected without any current surges. Of the four factors mentioned, the phase sequence is a fundamental matter concerned with the initial connecting up of the machines and switchgear, but the others must be sensed by some means before the machine may be safely paralleled. This "sensing" is usually carried out by a skilled switchboard watchkeeper with the aid of voltmeter, synchroscope, and frequency meter. The Austinlite synchronizer is arranged to detect when the voltage, phase and frequency are within sale limits for successful paralleling. When fitted in unattended power stations it is switched on automatically by means of a suitable relay but where the station is manned as would be the case at sea, alternators can be paralleled by a semi-skilled attendant without the possibility of incorrect operation. When it is necessary for the alternator to be paralleled with the existing supply the watchkeeper selects the incoming machine with the synchroscope selector switch in the usual way and then, observing the synchroscope, varies the engine speed by adjusting the speeder gear. When he considers the two machines are in synchronism he will then attempt to close the circuit breaker. The automatic synchronizer (now called the Check Synchronizer) is connected in series with his push button or manually closed circuit breaker. If the correct moment of synchronism has arrived when the attendant operates his equipment, then the circuit breaker will close, but if the operator has made a mistake the Check Synchronizer circuit will be open and thus prevent the circuit breaker closing. The equipment is fitted with a frequency sensitivity control which can be pre-set by means of a screwdriver when it is decided how closely conditions must be to perfection before the circuit breaker is allowed to close.—*The Marine Engineer and Naval Architect, October 1958; Vol. 81, pp. 395-396.*

**German-built Bauxite Carrier**

The first of three bauxite carriers ordered from Deutsche Werft, Hamburg, has been delivered to her owners, Thorvald Klaveness, Oslo. This vessel, the *Baumare,* 34,970 tons d.w., is of similar dimensions and has the same type of propelling machinery as the *Rio Orinoco,* built at the same shipyard in 1957. In appearance she differs very little from the *Rio Orinoco,* the main difference being in the sub-division of the hull and the fact that hatch covers of a new design have been fitted. A sister ship, the *Baune,* has also been launched from the Deutsche Werft yard. During the next few years the *Baumare* will be used exclusively in service between Port Kaiser in Jamaica and Baton Rouge in Louisiana, a distance of about 1,200 miles, which the ship covers in about 3½ days. It was to make full use of the cargo loading and unloading facilities at the terminal ports that the owners specified unusually large hatches which had to open and close both rapidly and easily. This presented problems which resulted in the design of a new type of cover. The principal particulars of the *Baumare* are as follows: —

| | |
|---|---|
| Length o.a. ... ... ... | 657ft. 4in. |
| Length b.p. ... ... ... | 625ft. 0in. |
| Breadth, moulded ... ... | 87ft. 0in. |
| Depth ... ... ... | 46ft. 0in. |
| Draught, summer freeboard... | 35ft. 1in. |
| Deadweight ... ... ... | 34,970 tons |
| Gross tonnage ... ... | 24,035 tons |
| Net tonnage ... ... ... | 14,172 tons |
| Speed ... ... ... | 14½ knots |
| Machinery output ... ... | 9,000 s.h.p. |

The *Baumare* is a single-screw vessel built to the highest classification of the American Bureau of Ships ✠ A1 (E) "Ore Carriers" AMS, EAC, with the engine room and most of her accommodation aft. Bauxite, at 30 cu. ft. per ton, is carried in nine cargo holds having a total capacity of 1,176,840 cu. ft. There are twelve wing tanks on either side of the cargo holds, which are used mainly for ballast. The total amount of fuel oil carried is 3,700 tons (metric) which gives the ship a range of about 21,000 nautical miles. As regards the hatch, the sections, which travel on rollers, are pulled sideways by a winch. When the hatch is fully uncovered, the sections are stowed on the deck areas alongside the longitudinal hatch coamings, with the two inner sections placed on top of the two outer sections. The hatch is closed by pulling the sections back towards the centre line of the ship. These operations are carried out by means of four electro-hydraulic reversible winches of 5-tons pull, manufactured by W. Baensch, Hamburg, which are positioned as follows: one winch between Nos. 1 and 2 hatches; one between Nos. 3 and 4; one between Nos. 5 and 6, and one between Nos. 8 and 9. This last winch serves three hatches, while the other three winches serve two hatches each. The covers are of welded construction. Each resembles a long flat box and is made from ½-in. steel plating with four longitudinal stiffeners about 17in. deep and three lighter intermediate stiffeners. To ensure dust and water tightness, the sections are provided with rubber seals.—*The Shipping World, 1st October 1958; Vol. 139, pp. 299-300.*

**Welded Aluminium Hatch Covers**

Complete sets of MacGregor welded aluminium, insulated, 'tweendeck covers are to be fitted in three ships for the Royal Mail Lines, Ltd., now being built at Belfast by Harland and Wolff, Ltd. In the construction of hatch covers, the weight saving made possible by the use of aluminium can have a dual advantage, for it both increases the deadweight capacity of the ship and, at the same time, facilitates easy handling. The corrosion resistance of the material and a consequent reduction in maintenance can also be taken into account, and all these factors together can more than outweigh the increased first cost of aluminium covers. A very good case for aluminium construction is also offered by the heavy insulated covers of refrigerated ships, the handling of which, particularly in the lower 'tweendecks, can prove to be a difficult operation. Until the comparatively recent introduction into general use of the inert-gas consumable-electrode welding process (known in the United Kingdom under the trade name of Sigma or Argonaut), the development of aluminium covers was delayed by the impossibility of designing riveted structures to compete economically with welded steel structures. In 1954, however, the first MacGregor aluminium hatch covers were fitted experimentally in the ore-carrier *Sunbrayton,* built by the Burntisland Shipbuilding Co., Ltd., of Burntisland, for Saguenay Terminals, Ltd. (now Saguenay Shipping, Ltd.), of Montreal, P.Q., and although these were of riveted construction, they have provided valuable service data. The *Sunbrayton,* of 7,850 tons deadweight on a draught of 20ft., is designed to carry bauxite from Mackenzie on the Demerara River, British Guiana, where the deeper draught ships cannot profitably operate, to stockpiles accumulated at Trinidad. The vessel has one hold, extending the full length of the cargo space and served by five hatchways fitted with MacGregor single-pull covers. Three of these covers are of steel, but No. 1 and No. 5 hatchways, which have dimensions of 18ft. by 20ft. and 30ft. by 50ft., respectively, are fitted with aluminium covers of equivalent design. The scantlings of the covers thus tested had been selected on the basis that strength and deflexion were to be comparable with the equivalent steel covers, and the same principle has been followed with later designs. On this basis, the proportion of weight saved by using aluminium with welded construction is about 50 per cent. The owners of the *Sunbrayton* report that, after four years in a particularly rigorous service, the aluminium covers are in very good condition, comparing favourably with the steel covers. This report is the more interesting in view of the fact that it was, in this instance, necessary to use for the aluminium covers the same type of standard steel fittings as for the steel covers. These were attached with steel rivets, a chromated packing being placed between the faying surfaces, and in no case is there evidence of galvanic action on the surrounding aluminium plate. As a result of successful experience in the *Sunbrayton,* Saguenay Shipping, Ltd., have now had complete sets of MacGregor welded aluminium covers fitted in each of two new bauxite-carriers recently completed—the *Sunhenderson,* built by the Hamburg firm of H. C. Stülcken Sohn, and the *Sunwalker,* built by the Uraga Dock Co., Ltd., at Yokosuka; both of these ships are designed to operate in the same restricted conditions.—*The Shipbuilder and Marine Engine-Builder, October 1958; Vol. 65, pp. 583-584.*

**Flexible Pipe Couplings for Ships**

In the construction of a ship, considerable effort is devoted to control or cater for the movement within the ship structure, but, until recently, all pipework has been strapped or clipped to the same structure regardless of the movements, with the result that the stresses are transferred to the pipes. Some of these stresses in the pipe are longitudinal and can be relieved by expansion joints, which will allow axial movement. Quite often, however, the strain is lateral to the pipe, which means there will be shear strain on the pipe between two supports, and should there be a joint at this position, then it is withstanding a load for which it may not have been designed. Flexible joints can be used to relieve these stresses, but, first of all, the function of various joints, in relation to the movements they are designed to accommodate, should be given consideration. In an expansion joint of the stuffing-box type, the sliding piece is ground to a very smooth finish and, when lubricated, will allow "x" of axial movement (according to specification). It can take a wide range of temperature and other service conditions, but will not take angular or lateral displacement. It is made for fitting between flanged pipes. The bellows joint, which is fitted between flanged pipes, is usually made from steel, stainless steel, copper, etc., and will allow axial and angular movement but very little lateral displacement. The amount of movement depends on the number and diameter of the corrugations. A later version, made of rubber composition and sometimes reinforced with canvas, will allow axial, lateral and angular displacements, according to specification, but may have limits on service conditions. Victaulic joints, with rubber-composition self-sealing rings in a steel or malleable cast iron housing, will allow ⅛in. axial movement on sizes up to 12in. in diameter for steel pipe, or $\frac{3}{16}$in. axial movement on sizes up to 8in. in diameter for cast iron pipes. These increase slightly with the diameter. The angular deflexion varies inversely with the diameter; e.g. 2-in. n.b. steel, 1 in 21; 6-in. n.b. steel, 1 in 55; and 12-in. n.b. steel, 1 in 104. Singly, they will not take lateral displacement, but will take end load up to the test pressure of the pipes. When used in pairs, they will allow lateral displacement, depending on the length of the pipe between them. The temperature limit is 150 deg. F. The pipes have to be prepared at the ends, shouldered or grooved. The Viking-Johnson coupling is a sleeve type of joint, with two rubber-composition rings and two compression flanges. They allow 1in. of axial movement and 6 deg. angular deflexion, but no lateral displacement, unless used in pairs. The pipes must be anchored against end load. Plain ended pipes can be cut to length, provided they are round, within a tolerance of plus or minus $\frac{1}{16}$in. in diameter for steel and 0·08in. for cast iron. The Viking-Johnson flange adaptor is constructed like half of a coupling plus a pipe flange. It will take the same axial and angular deflexion and connects flanged pipe or can be fitted to plain ended pipe. The possible advantage is that it is positively located to the mating flange.—*The Shipbuilder and Marine Engine-Builder, October 1958; Vol. 65, p. 586.*

**Preparation and Maintenance of Handhole Fittings and Openings**

The sea landing of a handhole fitting and handhole opening must be perfectly clean, true, and free of defects to obtain a satisfactory gasketed seal. It would seem obvious, therefore, that to assure absolute tightness, any pits, indentations or scars would need to be removed by accurate surface grinding or refacing. In most instances such reconditioning is not necessary. However, a cleaning to remove all surface deposits

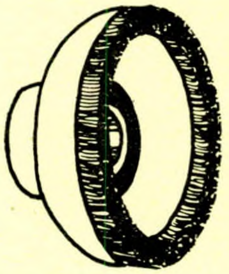


FIG. 2—*Cup wire brush for cleaning handhole opening*

(products of corrosion and gasket fillers), to assure that all mating surfaces are perfectly clean, is necessary. A tight joint cannot be obtained if surface deposits of any sort are not completely removed, not only from the seat landing surfaces but also from the corners of the handhole and fitting. Power driven wire brush wheels can be used to good advantage in cleaning up seats which have surface deposits. Only cup and circular wire brushes should be used for external cleaning; scraper type tools must not be used. A circular wire brush can be used to clean the handhole plate effectively. A cup wire brush (Fig. 2) does an excellent cleaning job in the manner shown in Fig. 4. Any power tools, either electrical or air driven, can be used, with mountings for holding the wire brushes.—*Bureau of Ships Journal, September 1958; Vol. 7, pp. 17-18.*

**Electrically Heated Glass**

A new type of heated glass uses a two ten-millionths of an inch electrically deposited film of gold and metal oxide as a uniform heating element between laminations. This film, which gives the glass a very pale straw colour, absorbs only 5-8 per cent of light and is capable of carrying a current of up to 1,000 watts per sq. ft. Its advantages over the wire grid heated panel are that point sources of light are not diffracted and a higher voltage power supply can be used to provide absolutely uniform heating. The gold film is applied to the inner face of the one glass component so that it is protected from damage and completely insulated in the finished laminated panel. The power supply—from 24 to 240 volts—is applied to busbars at opposite edges of the heated area, the dimensions of which determine the resistance. Where necessary, the area can be divided into banks connected in series to increase the resistance for use with the higher voltages. The maximum size of flat glass panels is 30in. by 42in. and the minimum thickness of $\frac{5}{16}$in. for the larger sizes. Curved panels with a camber not exceeding 1in. can be produced for special requirements. This product is suitable for bridge windows of ships which may encounter conditions of extreme cold. The power input for this application is 150-250 watts per sq. ft. Temperature control is achieved by means of a sensing element embedded within the panel in such a way as to be insulated electrically from the heating film; this operates a relay controlling the main heating element and maintains a steady temperature in the laminated panel.—*Shipbuilding Equipment, October 1958; Vol. 1, p. 16.*

**The "Helitube" Heat Exchanger**

What is claimed to be an entirely new type of heat exchanger has been developed by British Boiler Accessories, Ltd. The outer casing consists of a fabricated steel jacket, and the nest of tubes can be either of copper, steel, aluminium or stainless steel. The "Helitube" heat exchanger surfaces consist of narrow tubes tightly coiled into a helical shape and housed in an external jacket. High quality seamless tubes are used, and these are secured in the tube plates by means of a tightly fitting ferrule, which beds the tube into grooves in order to effect a perfect seal. If steel tubes are used, they are welded into the tube plates. Both methods of fixing the tube ends ensure a completely tight seal. The tube plates are rigidly fixed in the tube jacket, without the necessity for expansion plates or floating heads. Any vibration, expansion or contraction caused by high variations in temperature are taken up in the light, springy action of the tubes, and no stress is put on them. High overall heat transfer is achieved, since the tubes are of small bore—normally not more than $\frac{1}{2}$in. in diameter—which ensures intimate contact of all the liquid with the heat-transfer surfaces, and, at the same time, turbulence is maintained. The flow of the liquid in the jacket runs almost at right angles to the helical coils, and inwards and outwards over the surface of the tubes, ensuring the greatest percentage of surface coverage.—*The Shipbuilder and Marine Engine-Builder, October 1958; Vol. 65, pp. 596-597.*

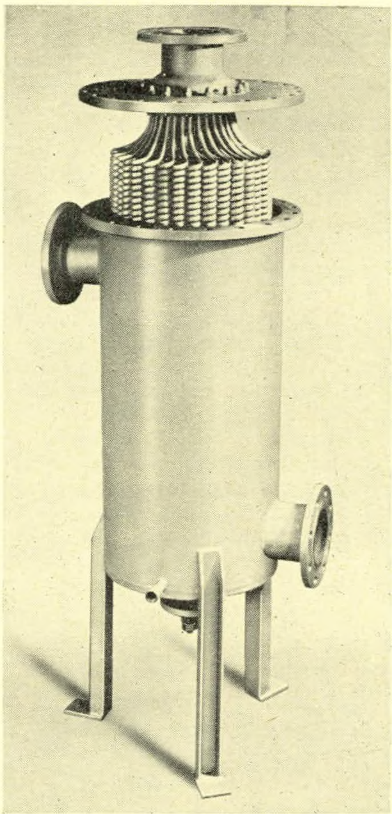


FIG. 1—*The B B.A. "Helitube" heat exchanger*

*Compiled and published by the Institute of Marine Engineers*

# Patent Specifications

### Ship with Liquid Cargo Container

The object of this invention is so to secure the containers for liquefied gases and media to the ships that the forces arising are fully transmitted without the conduction of heat, and the containers are free to move in any direction under the action of temperature changes. For this purpose the containers to be fixed in the hold for the purpose of receiving liquefied gas are provided with a well which is preferably central and which is penetrated by a supporting structure connected to the ship. The supporting structure takes up the forces arising and transmits them to the body of the ship, and serves at the same time to strengthen the ship. Further anchorage points for fixing the containers in the hold are not necessary, so that they are free to move in all directions in response to temperature changes. Referring to Figs. 1 and 2, the container (1) of rectangular section has side walls (2), a base (3) and a cover (4), these parts being reinforced by stiffening members (5 and 6). At the intersection of the

Fig. 1.

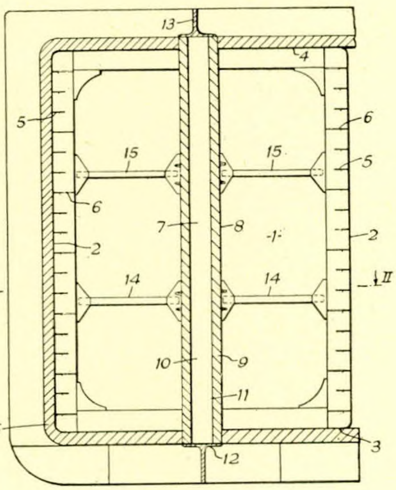
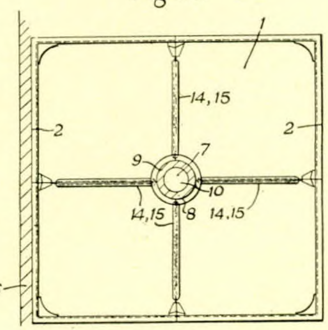



Fig. 2.




diagonals (Fig. 2) is provided a well (7) which, throughout its whole height, is separated from the container by the cylindrical sheet metal tube (8). In the well (7) is provided heat insulation (9) which has a bore (10) through which the supporting column (11) extends. The supporting column (11) is anchored to the ship *via* a lower support (12) and an upper support (13). Naturally the insulation (9) can be omitted, but in this case the supporting column (11) must be insulated from the members 12 and 13. In order to stiffen the side walls (2) with respect to the inner well (8) of the container there are provided struts (14 and 15) by which the forces arising are transmitted to the supporting column (11). The hold of the ship is provided with heat insulation 16; in the space thus insulated are mounted the non-insulated containers (1). It will be appreciated that the containers (1) which are connected to the ship solely by the central supporting column (11) can execute any movement of contraction or expansion under the action of temperature changes.—*British Patent No. 801,507, issued to Aktien-Gesellschaft Weser. Complete specification published 17th September 1958.*

### Improvements in Propelling and Steering Ships

Experiments in the cavitation tank with pear shaped displacement bodies which are arranged in extension of the propeller shaft axis behind the screw, known as "Costa pears" or "Costa bulbs" have shown that the removal of the contraction of the emerging screw stream is actually attained by the bulb as foreseen by its originator. The effects which are initiated by the propulsion bulb are manifold; nevertheless the damming effect is the most important, particularly for overcoming the stream contraction. In the forms of bulbs made hitherto, the damming effect occurs only once at the front end of the bulb head. According to the invention, especially for fitting the propulsion bulb to ships of higher Froude numbers, where the stream contraction is much more extensive in an aft direction, the propulsion bulb is provided with two or more damming steps aft of the propeller hub. By such an arrangement the first damming effect occurs on the actual head of the bulb. As soon as this effect fades out, a further step of suitable shape and size is inserted, which again induces the damming effect. Finally, aft of this second step another can follow which utilizes the final eddy energy still contained in the emerging propeller stream for the final

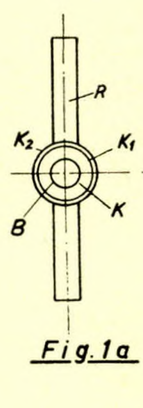



Fig. 1a

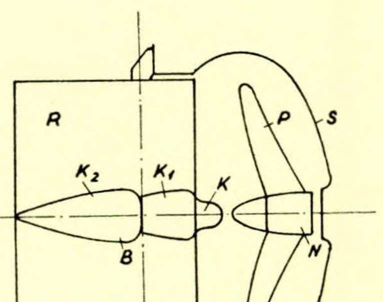



Fig. 1.

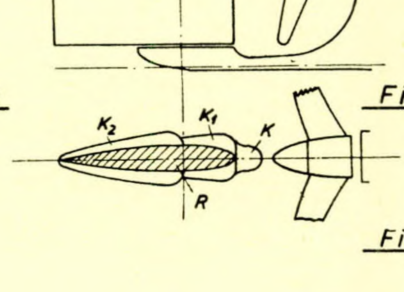



Fig. 2.

damming effect. These repeated damming effects favourably influence the propulsion of the ship to a still higher degree than in the case of the hitherto known constructional forms of the bulb. Likewise the ease of steering is increased. In Figs. 1, 1a and 2, S denotes the stern post, P the propeller, N the propeller hub, R the balanced rudder and B the propulsion bulb, carried by the rudder blade R, the bulb head K being rotationally symmetrical, which constitutes the first damming stage, and e.g. two subsequent damming stages K1 and K2. Even with the rudder deflected, the bulb in consequence of its shape retains high effectiveness.—*British Patent No. 800,917, issued to L. Costa and E. Maier. Complete specification published 3rd September 1958.*

**Method for Securing an Oil-bath Stern Tube**

This invention relates to a method for securing an oil-bath stern tube in a ship. It is known and common practice to support stern tubes substantially along their entire length with a fit in a stern ring or similar part of the ship, and then to align the propeller shaft axis, and by a machining operation inside the ship to turn out the stern tube accurately, concentrically about the propeller shaft axis, in order that it may receive and support the propeller shaft in the right position. It is also possible to cut out accurately the stern ring after it has been mounted inside the ship, and then to insert the stern tube without any further operations. The invention has for its object to obviate altogether the machining or working of parts inside the ship, which is a difficult and troublesome operation, and in general to simplify the securing of the stern tube to or in the ship. In Figs. 1 and 2 a propeller shaft (1) is shown, on which is mounted a propeller with a boss (2). A stern tube (3) has been designed as a simple tube, which in the centre of the bushing leaves a space (4), which serves as oil chamber. The method for building in this stern tube is carried out as follows. The stern ring (9) is accurately adjusted about the aligned propeller shaft axis and fitted in the ship. In the plating section (16), about the aligned propeller shaft axis, is made a concentric opening, which need not be machined very accurately, but could for example be made by flame cutting, and which is conveniently somewhat larger than the ring (14), to allow radial adjustment. The stern tube (3), along with the bushes (5 and 12), and

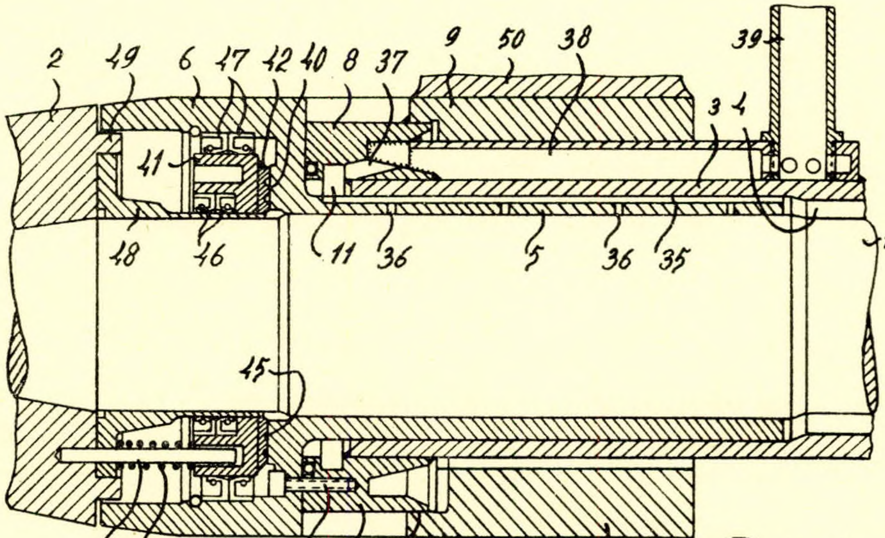



Fig. 1

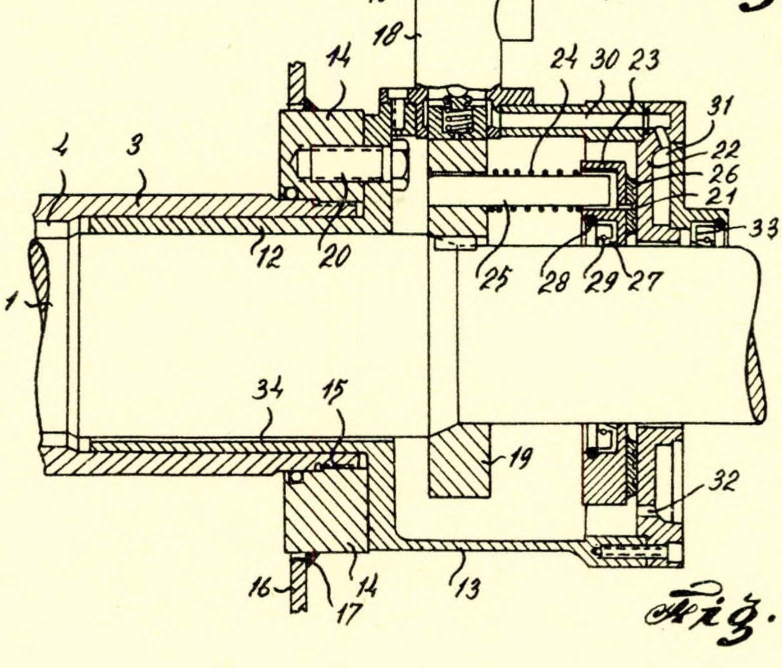



Fig. 2

the rigs (8 and 14), is machined in the workshop and completely finished, with mutual adjustment of the parts. The ring (8) is then welded to the tube (3), upon which this aggregate may be finished and modified further. The tube is subsequently introduced into the ship, which is done after the ring (14) has been unscrewed from the tube (3) and after bush (12) has been removed. This tube can thus be pushed into the ship from the outboard side until the outer leg of the ring (8) fits along a short distance within the fitting surface (10) of the stern ring. Then from the inboard side of the ring (14) is screwed on to the tube again and the bush (12) is mounted. Dependent on the accuracy with which the opening in the plating (16) has been machined, the ring (14) can now be welded to the plating (16) at once, if the aperture in it is the correct size and correctly positioned. Or the stern tube can first be aligned relative to the correct propeller shaft axis, upon which, after removal of the ring (14), the opening can be enlarged or modified so that the ring (14) and with it the tube (3) can be placed slightly differently in radial direction in the plating (16). Since the fitting surface (10) is short and the stern tube long, while owing to its U-shape the ring (8) is somewhat elastic, this can readily be done. The ring (14) is subsequently welded to the plating (16). The bush (12) is bolted by bolts (20) to the ring (14), and the relative part of the propeller shaft can now be inserted. *—British Patent No. 806,386, issued to M. C. Pieterse. Complete specification published 23rd December 1958.*

**Water Jet Propulsion**

The object of this invention is to provide a propelling device of the water jet type capable of generating a considerable propelling force with high efficiency and with simple and cheap construction. Referring to Fig. 1, a combustion chamber (13) is formed by a piston (11) and a cylinder cover (12) of the gasoline engine of which other parts are not shown. The combustion gas in the chamber (13) is discharged into the exhaust pipe (15) when an exhaust valve (14) in pipe (15) opens and then enters the water jet pipe (A) through a cock (16), the end portion (10) of the exhaust pipe (15) and the gas jet pipe (1), whereby water in the water jet pipe (A) is forcibly ejected from the nozzle pipe (6). The water in the jet pipe (A) can generate a large thrust when it is impelled by gas pressure because of a remarkable variation of the momentum in the water. During the period in which the water is impelled by gas pressure, the water sucking holes (8 and 8a) are maintained closed by the valves (7 and 7a), so that the jet pipe (A) acts as if it were a single closed pipe and water ejection is completely carried out. After almost all the water contained in the cage pipe (5) has been ejected and the gas in the water jet pipe has sufficiently expanded, the gas pressure in the water jet pipe (A) becomes a negative pressure. Accordingly, the valves (7 and 7a) are opened due to the water pressure from outside so that water is sucked rapidly into the jet pipe (A). The exhaust valve (14) is closed at a suitable moment during the above-mentioned process and suction, compression and combustion of the gas in the next cycle of the engine are carried out. In the case of a high speed internal combustion engine, the period of time for drawing water into the jet pipe is very short, so that when only the inlet ports (8) are provided at the front cover (2), the suction area is insufficient to obtain a large thrust. However, the jet pipe (A) consists of the cage cylinder (3), the cage pipe (5), the throat pipe (4) and the nozzle pipe (6), the cylinder (3) and pipe (5) being provided with a number of water inlet ports, so that the total suction area is very large, whereby the water suction in the jet pipe is rendered effective. *—British Patent No. 803,851, issued to Hiroshi Idemitsu. Complete specification published 5th November 1958.*

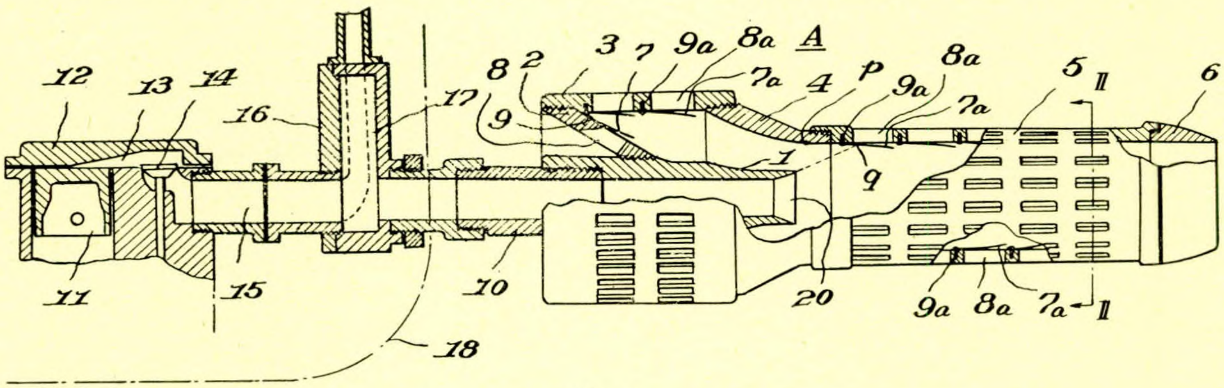



FIG. 1

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