Marine Engineering and Shipbuilding Abstracts

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* Patent Specification

East German Train Ferry

The East German Republic has put into service its first contribution to the fleet of train ferries which provide sea connexions between the rail networks of the countries bordering the Baltic. This vessel, the *Sassnitz,* is now engaged on the Sassnitz-Trelleborg crossing which connects East Germany and Sweden. A new Swedish vessel for this service, the *Trelleborg,* entered service last year. The *Sassnitz* is a twin-screw motorship, and has been built at Rostock by the VEB Schiffswerft "Neptun". In her size and leading particulars she is generally similar to the *Trelleborg,* details of the two ships being as follows:

	Sassnitz	*Trelleborg*
Length o.a.	450ft. 0in.	452ft. 5in.
Breadth o.a.	61ft. 8in.	61ft. 8in.
Draught	17ft. 8in.	17ft. 5in.
Displacement ...	7,000 tons	7,000 tons
Machinery output ...	9,600 b.h.p.	10,000 b.h.p.
Service speed ...	18 knots	19 knots

Vessels on this route have four rail tracks, all passing separately over a wide stern to the shore terminals. They must thus always dock stern first, and both the *Sassnitz* and *Trelleborg* have after docking bridges and bow rudders. The bows are in each case of icebreaking type, with the bow rudder set in a forward fin. The *Trelleborg* is equipped with a KaMeWa bow propeller. The *Sassnitz* has an arrangement of German origin, which was developed by Dr. Ing. F. Gutsche, of Berlin. The principle on which the Gutsche propeller works can best be understood by reference to the accompanying diagram. The propeller has its axis vertical, and operates in a vertical tunnel on the centre line of the ship. Water enters the lower end of this tunnel by means of two rectangular openings to port and starboard, and is discharged to one side or other through one or other of a second pair of openings arranged to port and starboard immediately above the inlets. Control of the propulsion jet is effected by directing it to port or starboard, or equally to both sides, by means of a half cylinder which rotates inside the vertical tunnel and blocks one or other outlet. The manner in which it operates is made clear from the diagram. It will be appreciated that as water is drawn equally from both sides of the ship, some propulsive efficiency is lost as compared with the more conventional systems such as the Voith-Schneider, KaMeWa, Pleuger or Jastram designs.—*The Shipping World, 2nd September 1959; Vol. 141, pp. 123-124.*

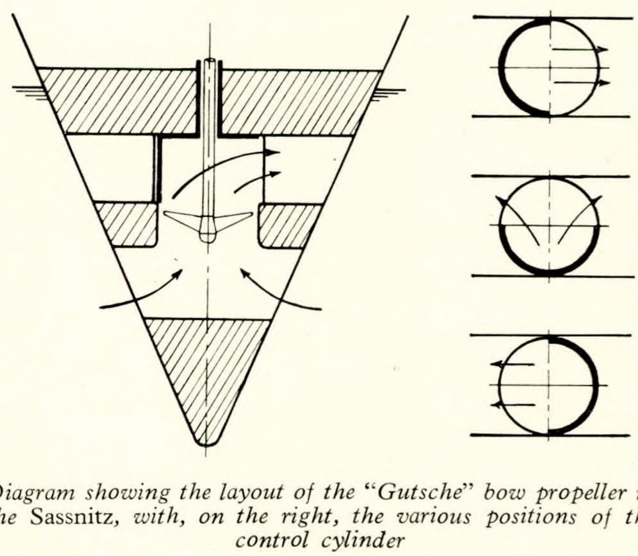
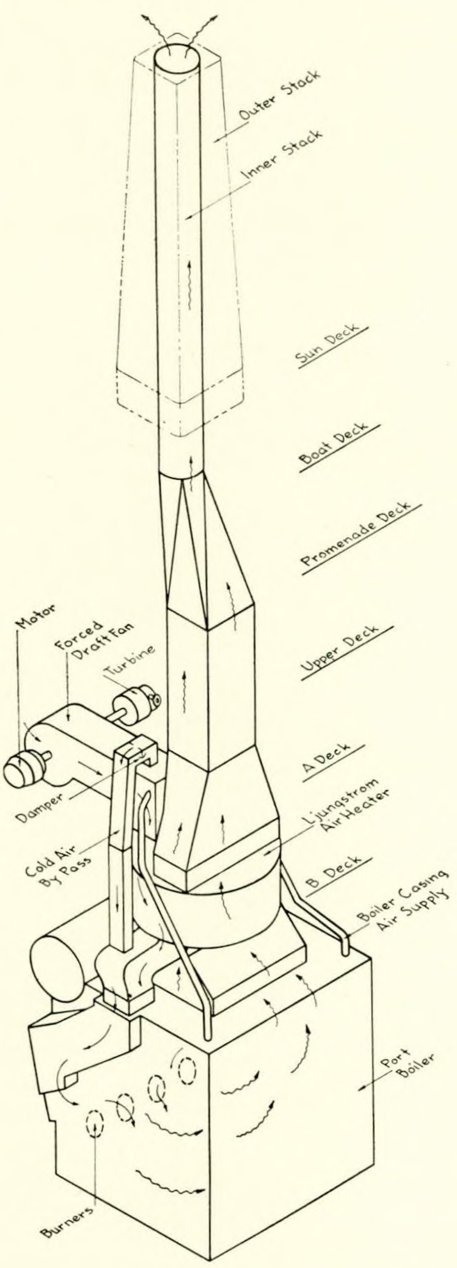


Diagram showing the layout of the "Gutsche" bow propeller in the Sassnitz, *with, on the right, the various positions of the control cylinder*

Rotary Regenerative Air Preheater

Current marine interest in waste heat recovery as a means to improved operating economics is focusing attention on the rotary regenerative air preheater. The basic operating principle of rotary regenerative air preheater is continuous counterflow heat exchange between flue gas and combustion air for a reduction in fuel cost and an increase in boiler efficiency. A heating surface of many thin metal sheets packed in a revolving rotor continuously absorbs heat from flue gases and simultaneously releases it to combustion air. The heat exchange is made as both fluids pass axially along separate paths through the rotor. The rotor which revolves at about 3 r.p.m. is enclosed in a gas tight housing; air and flue gas duct connexions are made at each end of the housings. The rotary regenerative air preheater has a more than 35-year history in stationary installations, where it has developed a high level of performance, reliability and availability. In marine practice, these three factors are of more than ordinary importance. Design and operating features described are applicable to all rotary regenerative air preheaters. They are descriptive of the air preheaters in the *Barrett, Upshur, Geiger* and the *Comet* and the air preheaters which soon will be installed in two cargo ships of the American President Lines and in tankers of Standard Oil Company of California. In addition to providing an enormous amount of heating surface in a minimum of volume, the rotary regenerative preheater design permits flexibility in the number of layers, depth of surface, materials of fabrication and forms of corrugation. Unlimited combinations are possible to meet any known conditions. A rotary regenerative air preheater occupies about one-third of the volume of a tubular type unit of the same capacity and performance. With such a marked difference in volume, it is natural to expect a corresponding reduction in weight. Depending on the size of unit under consideration, the saving in weight with a rotary regenerative air preheater can amount to as much as 15,000lb. per unit.—*J. Waitkus, Marine News, September 1959; Vol. 46, pp. 22-23; p. 68.*



Boiler with rotary regenerative air preheater in Barrett class transports

Liquid Fuel and the Gas Turbine: A Ten-year Review

In many industrial and marine applications the gas turbine must run on residual grades of fuel oil if it is to compete economically with other types of prime mover. The combustion of residual fuels is fairly readily achieved by conventional methods, but difficulty arises from fouling and corrosion of the turbine by inorganic substances present in such fuels, the most troublesome elements being vanadium and sodium. This problem has been tackled along three main lines, namely, combustion control, turbine cleaning, and the use of additives. None of these methods has provided a universal solution, but it is believed that a combination of one or more of them could be successful in most instances, especially where a suitable design of turbine has been adopted in the first instance. *R. F. Darling, Journal of the Institute of Fuel, October 1959; Vol. 32, pp. 475-484.*

Heat Transfer and Draught Loss in Tube Banks of Shell Boilers

The accuracy of established dimensionless equations defining the heat transfer by forced convection from hot gases flowing through water cooled tubes has been investigated. A steaming industrial boiler was used to determine the factors involved in these equations for the particular conditions occurring in the tube banks of tubular shell boilers. The effects of swirl velocities superimposed on the normal turbulent flow pattern are also discussed, and the experiments using promoters of such swirl velocities within the tubes are described. Methods of computing the draught loss in tube banks have also been verified experimentally, and design curves and nomograms are given which enable tube banks to be designed without laborious calculations.—*D. J. I. Roderick, M. V. Murray, and A. G. Wall, Journal of the Institute of Fuel, October 1959; Vol 32, pp. 450-453.*

Injection Equipment for Residual Fuels

The author states that the successful operation of high performance medium and low speed Diesel engines on residual fuels (such as Bunker C) has been made possible by heating and centrifuging the fuel and by modifying the injection equipment. After reviewing the characteristics of residual and other fuel oils, the author briefly describes current practice in centrifuging, filtering, and heating Bunker C oil so that it is delivered in a suitable condition to the injection equipment. The use of light fuel oils for starting and stopping (and for idling and operating at low loads, in the case of locomotive engines) is mentioned. Carbon formation on nozzles, and its causes and effects, are briefly discussed. The higher injection pressures generally used with residual fuels may lead to rapid erosion of certain injection system components, especially if there is any foreign matter in the fuel. Increased clearances may sometimes be necessary. Where a change is made to residual oils in engines designed to run on other fuel oils, the complete injection system should be reviewed. Basically, the injection equipment for residual fuels is the same as that for light fuels, but the author discusses some detail improvements in injection pumps and nozzles to meet the more stringent requirements of the residual fuels. Improved pump features include stronger components to withstand the higher pressures, elimination of gaskets, bottom seating delivery valves with reduced dead fuel volume, hardened baffle rings which are free to turn, and plungers with opposite helices. Adequate nozzle cooling should prevent stuck valves and carbon accumulations on the nozzle tips, although it is questionable whether direct nozzle cooling is always an advantage. Too large a volume in the sac hole between the nozzle valve seat and orifices is an additional cause of carbon formation. Examples of improved pumps and nozzles are shown diagrammatically.—*Paper by P. G. Burman, read at the ASME Semi-Annual Meeting; Paper No. 59-SA-56. Journal, The British Shipbuilding Research Association, August 1959; Vol. 14, Abstract No. 15,644.*

Bolt Fracture by Mercury Penetration

The author describes an investigation into certain fractures which occurred in the threaded sections of bolts fabricated from an austenitic steel (0·4 per cent C, 18 per cent Mn, 3 per cent Cr). The service temperature was about 140 deg. F. The fracture surface differed considerably from that of an ordinary fatigue failure. Although fine grained, it was roughly helicoidal and very uneven, revealing internal fissures. The latter branched irregularly and were intercrystalline. Since the composition and mechanical properties of the material conformed to the specification, it was suspected that the fractures were due to weakening of the grain boundaries by penetration of mercury from the grease used. This grease, known as "blue salve", contains metallic mercury dispersed in minute globules. To confirm the theory, various laboratory tests were carried out. Some tensile-test specimens were fabricated with a central threaded portion and subjected to constant loads at room temperature. If the central part was surrounded by a mercury bath, failure occurred after less than a day at loads just below the elastic limit. The fracture surfaces resembled those of the service failures. With blue salve itself, the test bar was still intact after 280 hours; it is concluded that good metallic contact is a prerequisite for penetration. At the service temperature this condition would be satisfied, because the mercury in the grease conglomerates into relatively large bodies of liquid. Similar tests on a refined (non-austenitic) Cr-Ni-Mo steel gave fractures after 300 to 700 hours at loads above yield point. The fissures ran along the grain boundaries of the original austenite crystals. It therefore appears that steels with an austenitic crystal pattern are more susceptible to penetration than ferritic steels; it is possible that alloying also increases the susceptibility. In view of this phenomenon, and the poisonous nature of mercury, it is recommended that mercurial greases should be dispensed with entirely.—*A. J. Goedkoop, Schip en Werf, 10th July 1959; Vol. 26, pp. 432-435. Journal, The British Shipbuilding Research Association, August 1959; Vol. 14, Abstract No. 15,660.*

Computers for Steam Flow and Heat Balance Computations

Automatic computing machines are now important tools of the designer in making rapid calculations, storing and accumulating data, extrapolating, and otherwise assisting in more thorough steam flow and heat balance calculations and studies. Besides being great time savers, the computers provide a better, safer, and less expensive method for the designers. Among the items suitable for such calculation and investigation are heat balances for variations in ship's speed, for more than one type of cycle (such as bleed, non-bleed, and reheating), and for a given cycle and different machinery combinations (such as steam *versus* electric driven auxiliaries). The computer set-up to be used in such calculations must be versatile enough to permit parameter variations as well as to perform the necessary calculations and balancing. The assimilation of data, such as curves of operation and range of sizes of the various component parts of the system, is itself a formidable task involving assumptions as well as thorough investigation of the many pieces of equipment in the system. This work must be done for the most part without the aid of automatic equipment. A computer can be used to store and accumulate data for use in heat balancing many ships. A computer can also serve to assist in extrapolating these data for future designs. An automatic computing device can be used effectively to make the actual calculations while varying the appropriate parameters, limits, and conditions. The computer saves many man-days of tedious, time consuming calculations, and the design will be better, safer, and less expensive. The many more rapid calculations thus available to the designer will enable him to investigate his design more thoroughly and determine more accurately the operating conditions of the system. Although a computer can in no sense design a system, it can be used to optimize the design by investigating the results of the varying parameters of that system. The experienced designer can thus predict the performance of his design before it is built. Computer results can also be used to change an existing design, and the new design may again be investigated. In this way the computer becomes a powerful tool for the designer.—*Bureau of Ships Journal, September 1959; Vol. 8, p. 39.*

Hydrofoil Seacraft

Grumman Aircraft and its affiliate, Dynamic Development Inc., have studied the feasibility and design of hydrofoil seacraft for fast passenger and cargo transport. They found that such craft can carry payloads 10-60 per cent of their gross weight, operate at greater speeds than fast displacement vessels, and have acceptable passenger comfort in rough seas. They will have an 80-ton vehicle ready for test in mid-1960; are also designing a chemically fuelled prototype craft; and plan to start a hydrofoil boat by 1966. The design and construction of hydrofoil craft must follow aircraft techniques because high strength-weight ratios are required. Design parameters studied include speed (50-200 knots), displacement (100-3,000 tons), range (400-3,600 miles), foil, power plant, and propeller. Two basic types of hydrofoil cross sections—subcavitating and supercavitating—were extensively investigated. Best performance resulted from using subcavitating sections at low speeds (below 70 knots), and supercavitating sections at higher speeds. It was determined by a survey that 90 per cent of the time wave heights are 20ft. or less in the Atlantic Ocean. So, the 20-ft. wave was chosen as the sea state in which the craft should operate while foil-borne without hull wave impact. Basic design considerations were displacement operation, and foil-borne operation with and without wave impact. It was found that the low speed displacement condition, applying conventional marine hull loads, was not critical for the structure. The foil-borne condition without wave impact—which is the normal operating condition—applies the maximum loads to the foils, struts, and attachment structure. Because the condition of foil-borne operation with hull wave impact resembles a seaplane landing in rough water, Navy seaplane hull design specs were used. This method permits local hull bottom pressure to be determined from consideration of hull speed and bottom shape, the point of impact, and mass effects. Using these procedures, the hull weight percentage was found to average 15 per cent, decreasing only slightly with increasing gross weight. This figure is consistent with that for seaplane hulls and light alloy displacement ships. The best material for the structure is weldable aluminium alloy. The nuclear power plant—with relatively high specific weight but negligible fuel consumption—is suitable for hydrofoil craft at extreme ranges. For ranges over 3,000 miles, a closed cycle, gas cooled plant, mounted in an underwater pod, is worthy of development..... Such a plant could be available within ten years. The gas turbine—while a larger weight fraction than the Diesel—provides higher productivity at short ranges. Choice of propulsive devices was narrowed to water or air propellers. In most cases, the water propellers were supercavitating because of their superior performance over subcavitating propellers at the craft speed involved. However, air propellers are best suited to high speed, light displacement craft. For a range of 1,200 nautical miles and 100-knot speed, the optimum craft has a gross weight of 500 tons, uses supercavitating foils, and is powered by gas turbines and driving air propellers. A craft of the same gross weight was designed to perform the same mission using water propellers. This craft is similar in size, also uses supercavitating foils, but requires more gas turbine power. To explore nuclear powered craft, an optimum 1,000-ton craft was designed. It has subcavitating hydrofoils, and an over 50,000-h.p. pod mounted power plant driving one water propeller. The cruise speed is 65 knots.—*D. Lowman, SAE Journal, September 1959; Vol. 67, pp. 42-45.*

Russian Concrete Tankers

It is reported from Varna that the 4,000-ton dwt. motor ship *Fedya Gubanov,* built there at the "Georgi Dimitrov" shipyard, has been handed over to the Soviet Union. She is the first of a series on order for the Soviet Union; the second, *Pamyat 26 Komissarov,* is reported to be approaching completion, and the keel of the third has been laid. Of concrete construction, these ships are larger than any previously built in Bulgaria. Their shallow draught permits, however, of their use either at sea or on rivers, their capacity in the latter case being reduced to 2,000 tons.—*Tanker Times, October 1959; Vol. 6, p. 142.*

Stability of Ships in Rough Seas

This report describes the investigations carried out by the Shipbuilding Research Association of Japan in order to establish a standard for the stability of ships. The first section, which deals with an investigation into the damping coefficient of rolling, is in three parts: the first gives the results of a series of rolling tests conducted on models with and without bilge keels; the second presents a method for estimating the extinction coefficient of rolling;and the third gives the results of a model investigation to determine the resistance to rolling when the ships roll to an angle, causing immersion of the deck edge, the forced rolling method being used. In the second section, the results are presented of a series of wind tunnel tests carried out to study the effect of the heeling moment due to wind pressure. The third section refers to meteorological data of ocean waves and wind obtained in the North Pacific. From these and other data, a simple formula is developed for estimating the magnitude of ocean waves. The fourth section describes observations and trials carried out on actual ships to study the meteorological and oceanographical characteristics of the sea near Japan. Measurements were also made of ship motion, and the rolling angle and the critical heeling angle of the ship in irregular seas were determined. The results are given in tabular and graphical form and discussed. The fifth section presents a statistical analysis of the results of model experiments to investigate the rolling of a ship in irregular seas. In the final section, the factors affecting the stability of ships are considered and the regulation for adequate stability specified by the Japanese Government are discussed. Approximate formulæ are given for assessing stability, and a simple method is outlined for examining the safety criteria in the very early stages of design. The importance of an upper limit to the metacentric height from the viewpoint of acceleration is emphasized.—*Shipbuilding Research Association of Japan, Report No. 25, March 1959; Journal, The British Shipbuilding Research Association, August 1959; Vol. 14, Abstract No. 15,585.*

Organic Reactor for Nuclear Tanker

Interest in the Organic Reactor for marine power was stimulated recently when the Atomic Commission announced its latest study of a 60,000-dwt, nuclear powered T-7 tanker. Applying the most advanced Organic Reactor (OMR) technology to the study, the AEC's contractor, Atomics International, developed the preliminary design for a 30,000-s.h.p. main unit capable of driving the ship at a speed of nearly 18 knots. The study showed the reactor to be well adapted to marine service with respect to weight and space requirements, safety, ease of operation and rapid control. The use of an organic liquid as moderator and heat transfer medium produces a reactor with many attractive features. The high boiling point range (700-800 deg. F.) of the organic reactor permits operation of the nuclear system at a significantly lower pressure (100lb. per sq. in. gauge) than the water systems (1,000-2,000lb. per sq. in. gauge). In addition to the safety resulting from the lower stored energy, low pressure operation allows the use of simpler mechanical components and much lighter reactor vessels, piping, and associated equipment. The non-corrosive character of the organic, even at elevated temperatures, permits the use of low cost, easily fabricated materials in the nuclear system. It is relatively inert to both carbon steel and aluminium, as well as to metallic uranium, and the uranium compounds considered most promising for fuel. This permits savings in construction cost and the use of fuel combinations not practical for water reactors. The organic is only mildly activated by exposure to neutrons in the reactor core. As a result of low induced activity levels in the organic system, much of the nuclear plant equipment is accessible for inspection and maintenance during operation. The preliminary design developed during the recent study confirmed that the OMR is a compact, light weight, relatively simple unit promising ease of operation combined with safety. Fig. 1 is a simplified diagram of the nuclear steam system. The organic

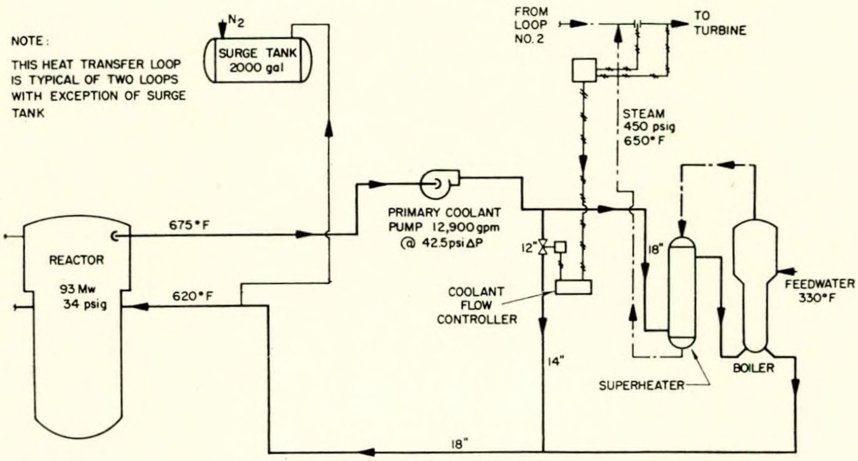


FIG. 1—*Simplified flow diagram of nuclear steam system*

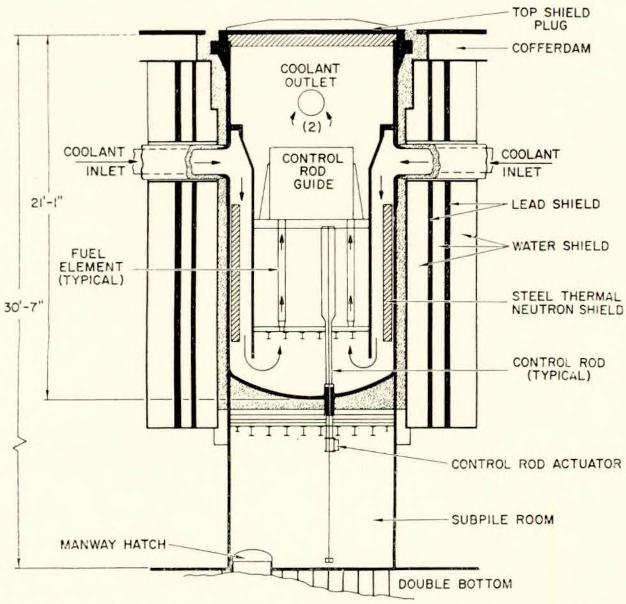


FIG. 2—*Cross section showing low pressure construction of organic reactor*

coolant leaves the reactor at a temperature of 675 deg. F., passes through two steam generators, and returns to the reactor at 620 deg. F. Circulation is maintained by two centrifugal pumps with a total pumping capacity of 26,000 g.p.m. The primary coolant system is designed for 150lb. per sq. in. gauge and operations at 34lb. per sq. in. gauge. Steam at 450lb. per sq. in. gauge and 650 deg. F. is produced at a total rate of 250,000lb./hr. by the two steam generators, each consisting of an evaporator, steam separator and superheater. Details of the reactor vessel and its primary shielding are shown in Fig. 2. The reactor vessel is a vertical cylinder 9·25ft. in diameter and 22ft. high, designed for 350lb. per sq. in. gauge at 750 deg. F. It is closed with a reinforced flat head, bolted to the top flange. The reactor vessel is surrounded by a primary shield composed of several radiation absorbing regions. These include two layers of lead totalling 6in., 3ft. of borated water, and several concentric steel tanks to provide structural support and separation. The diameter of the outermost shield tank is 18ft. 6in. The general arrangement of the ship's nuclear reactor equipment is shown in Fig. 4. The reactor occupies the compartment between the engine room and the cargo pump room. With the reactor operating at low pressure and at a temperature below the atmospheric boiling point of the coolant, containment has been made an inherent part of the reactor compartment design. The complete nuclear steam system, including liquid inventory, weighs only 1,650 tons. Although heavier than conventional boilers of the same power, the nuclear plant frees 5,200 tons of bunker capacity for an appreciable saving in cargo deadweight.—*Marine Engineering/Log, August 1959; Vol. 64, pp. 90-93.*

Propeller Excited Hull Vibrations

There are three distinct types of propeller excited vibration. *Unbalance Vibration* will be generated in the hull by unbalanced forces or moments, irregularities between the blades in the manufacture of the propeller, and imperfections due to bent shafting. Here are included the effects of both mass unbalance and pitch unbalance. These vibrations will all occur at a frequency equal to shaft frequency, and they are not considered in this note. *Blade-Frequency Vibrations* result from the wake distribution into which the propeller is operating and the presence of rigid surfaces in the vicinity of the propeller operating in uniform inflow. *High-Frequency Vibration*—in addition to the foregoing types, cavitation conditions may give rise to an irregular vibration not readily classified on a frequency basis. Additional vibrations may be generated locally in the propeller blades by the hydrodynamic forces. These types of vibration are not discussed in this note. The amplitude of the vibration generated in the hull from blade frequency forces can be approached from several viewpoints. The following are considered: (a) The hydrodynamic conditions of the propeller which induce the blade forces, i.e. forces occurring at a frequency equal to the r.p.m. times the number of blades or their multiple, with a view to determining the hull hydrodynamic characteristics for decreasing these forces. (b) The hull structural characteristics with a view to predicting the frequencies and normal modes. (c) The prediction of the forced response of the hull when subjected to propeller excited forces whose amplitudes are known, either for resonant or non-resonant conditions.—*A. J. Tachmindji and R. T. Goldrick, Journal of Ship Research, June 1959; Vol. 3, pp. 28-35.*

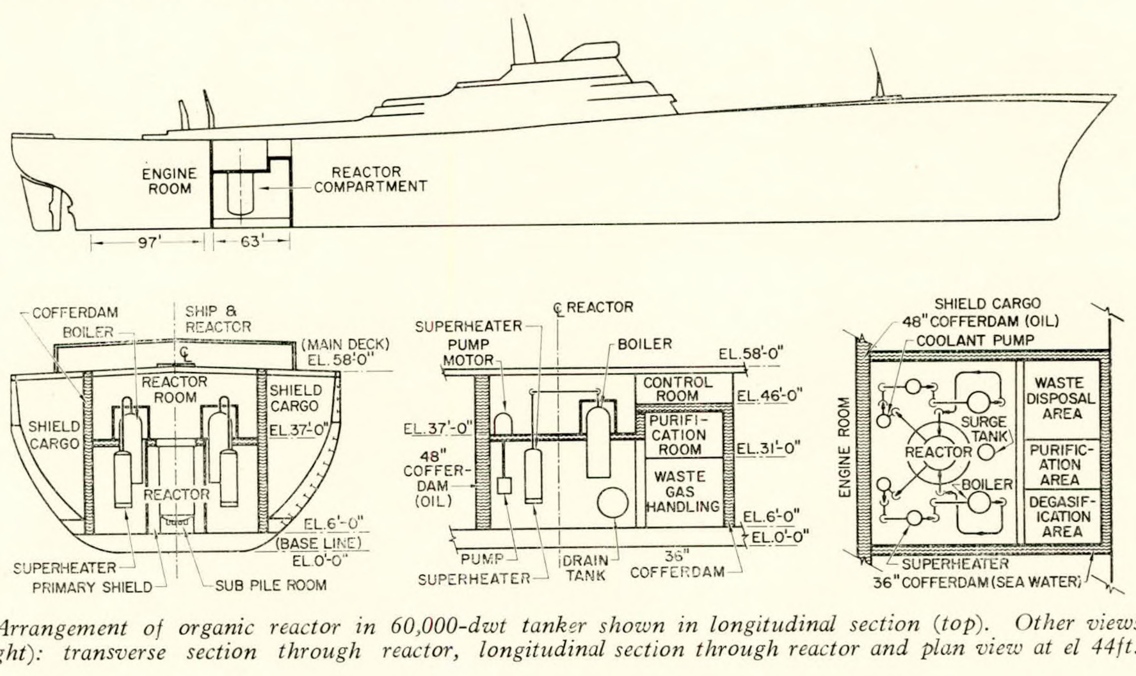


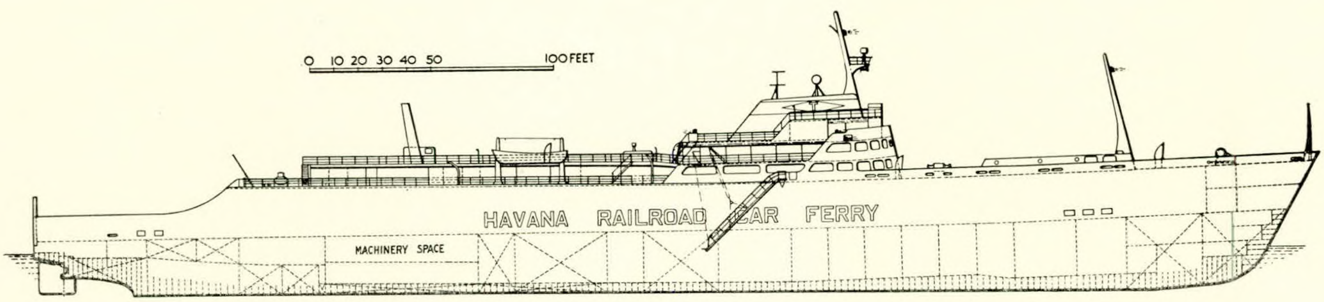
FIG. 4—*Arrangement of organic reactor in 60,000-dwt tanker shown in longitudinal section (top). Other views are (left to right): transverse section through reactor, longitudinal section through reactor and plan view at el 44ft. 0in.*

Japanese-built Train Ferry for American Owners

In July 1958, the keel was laid of the train ferry *City of New Orleans* at the yard of the Kure Shipbuilding and Engineering Company, Kure, Japan, and the vessel began her maiden voyage in August of this year. Built for the West India Fruit and Steamship Company, Inc., of Florida, the vessel is an interesting example in the development of roll-on, roll-off and container ships and has the following leading particulars:

Length overall	520ft. 4in.
Length b.p.	487ft. 6in.
Breadth moulded	70ft. 0in.
Draught designed	17ft. 6in.
Deadweight capacity	6,275 tons
Service speed	18·15 knots

The ferry, which was designed by George G. Sharp Inc., New York, can carry 58 loaded railway wagons on two decks. This was achieved by the use of a large lift 44ft. 6in. by 11ft. 6in., weighing 23 tons and with a capacity of 60 tons. Using the lift, 13 wagons can be placed in the lower hold, the remaining wagons being stowed in the upper hold. When at sea the lift platform is stowed in the lower hold and a steel hatch cover closes the open lift shaft. Electrical hoisting machinery operates both the lift and the cover, the former by means of four cable drums each carrying eight cables. Two sets of eight cables are attached through bridles to each side of the lift platform. The lift motors are designed for full load operation at two speeds, 585 r.p.m. and 230 r.p.m., the respective horse power being 105 and 42. Each motor is coupled to the cable drum by reduction gearing which gives the lift platform a speed of 15ft./min. A 10-h.p. motor operates the lift shaft cover at 7½ft./min. Push buttons control the lift but automatic equipment makes the changeover from low- to high-speed and stops the lift at the end of each run. Main propulsion is by two double-reduction geared steam turbines, each with a normal rating of 4,000 s.h.p. at 165 r.p.m. and driving twin screws. The maximum continuous rating for each turbine is 4,400 s.h.p. at 170·5 r.p.m.—*Shipbuilding and Shipping Record, 1st October 1959; Vol. 94, pp. 237-239.*



Profile of the City of New Orleans *built in Japan for the West India Fruit and Steamship Company*

Submarine Tanker—Utopia or Reality

Some general considerations in the design of submarine tankers, including loading and discharge, are briefly discussed. It is shown that the pressure tight volume should be a quarter of the volume outside the pressure hull. The first submarine tanker will be costly, but if these vessels are built in greater numbers the price will probably approach that of the conventional tanker. However, the submarine tanker will probably always be slightly more costly, perhaps by 10 per cent. Submarine tankers cannot call at the usual harbours on account of their deep draught, and special loading and unloading stations will therefore be necessary. For a surface tanker travelling at normal speeds, 15-17 knots, the frictional resistance is about 65-75 per cent of the total resistance; the corresponding figure for a submarine tanker is estimated to be from 85-90 per cent. Tests are now being carried out in England and the U.S.A. to investigate the most suitable hull form and the influence of submersion depth on resistance. From the results of towing tank tests conducted in England by Mitchell Engineering Ltd. in conjunction with Saunders Roe Ltd., it appears that at large submersion depths the shorter hull with a greater diameter is somewhat more favourable at speeds up to 30-35 knots. A circular cross section is generally to be preferred, except in a few cases at low speeds. 30,000 h.p. is probably the highest power which can be absorbed by a propeller of practicable size at normal speeds of rotation, 100-150 r.p.m. The power can possibly be doubled at speeds of 400-500 r.p.m. A description is given of a Japanese design for a submarine tanker of 30,000 tons d.w., and this is compared with a design developed by Kockums. The principal particulars of the latter are as follows:

Length	502ft.
Diameter, maximum	83·6ft.
Displacement, on load water line	46,000 tons
submerged	50,000 tons
Deadweight	32,000 tons
Submersion depth	490ft.
Machinery output	60,000 h.p.
Speed submerged	28·5 knots

It has a central pressure cylinder, enclosed by a thin outer hull. There is also a smaller pressure cylinder above in which the control room and accommodation are situated. In the lower section there are two additional pressure cylinders which contain a compensating tank and pump room. The cargo is carried in 11 oil tanks, five of which lie in the central pressure cylinder which also contains two reactor compartments and an engine room aft.—*S. Rahmberg and G. Nilsson, Teknisk Tidskrift 1st May 1959; Vol. 89, pp. 465-468. Journal, The British Shipbuilding Research Association, August 1958; Vol. 14, Abstract No. 15,610.*

Pitching Performance of S.S. *Silver Mariner*

The Mariner-type ship is being considered for certain operations which require a substantial reduction of pitching motion from that ordinarily experienced in a particular seaway. As a first step in the investigation of this problem, a model of the Mariner Class, both with and without antipitching fins, was tested at the David Taylor Model Basin. Further experiments were carried out, full scale, on the s.s. *Silver Mariner,* without antipitching fins, to determine her normal pitching performance characteristics. At the conclusion of these trials, a report was issued on the general behaviour of the Silver Mariner with respect to a number of motion parameters. Because the results of the trials were required as soon as possible, the analysis was somewhat primitive and the presentation abbreviated. In this report the results of a more comprehensive analysis of the pitching performance of the Silver Mariner are presented for a variety of speeds and headings in what is usually called a "State 5" sea—or, more precisely, a fully developed sea appropriate to a wind speed of 21 knots. The resultant information was transformed into energy spectra, and a number of statistics that describe the ship's pitching were computed. It is shown that variation of heading is more influential in pitching behaviour than is variation of ship speed. For this ship, bow seas (rather than head seas) and moderately high speeds (18 knots) at this heading are shown to produce maximum pitching. Prediction of maximum pitch angle from the computed spectra agrees well with observed maximum pitch angle.—*W. Marks, David Taylor Model Basin Report 1293, May 1959.*

Strength of Thick Cylinder Subjected to Repeated Internal Pressure

In April 1956 the authors presented to the Institution of Mechanical Engineers a paper entitled "Fatigue under Triaxial Stress: Development of a Testing Machine and Preliminary Results", and in September 1956 a supplementary paper was presented at the International Conference on Fatigue of Metals. In these papers the authors reported tests carried out on cylinders made from a 2½ per cent nickel-chromium-molybdenum steel, which were subjected to (up to) 10 million repetitions of internal oil pressure of (up to) 20 ton/in.^{2}. Since these papers were published, a considerable amount of testing has been carried out on cylinders made from a mild steel, a 3 per cent chromium steel, an austenitic stainless steel, a light alloy, a nearly pure titanium, the nickel-chromium-molybdenum steel in a harder state, and both the nickel-chromium-molybdenum steel and the chromium steel in the nitrided condition. In addition, tests of more academic significance have been carried out on the nickel-chromium-molybdenum steel in an attempt to achieve a better understanding of the extraordinary results which have been obtained. The present paper is concerned mainly with the presentation of results (supported by ancillary tests on each material) which are of importance in design. Points of academic interest are discussed only when they are relevant to the practical problem. To make the paper reasonably self-contained, a brief summary of the previous work has been given.—*Paper by J. L. M. Morrison, B. Crossland, and J. S. C. Parry, read at a meeting of the Institution of Mechanical Engineers on 28th October 1959.*

Dutch-Built Tanker for Brazil

The 33,000-ton steam turbine tanker *Presidente Getulio,* built by Verolme Shipyard Alblasserdam Ltd., Alblasserdam, one of the firms of Verolme United Shipyards, for Messrs. Petróleo Brasileiro S.A. Petrobas, Rio de Janeiro, Brazil, has entered the service of her owners. The principal characteristics of the ship are as follows:

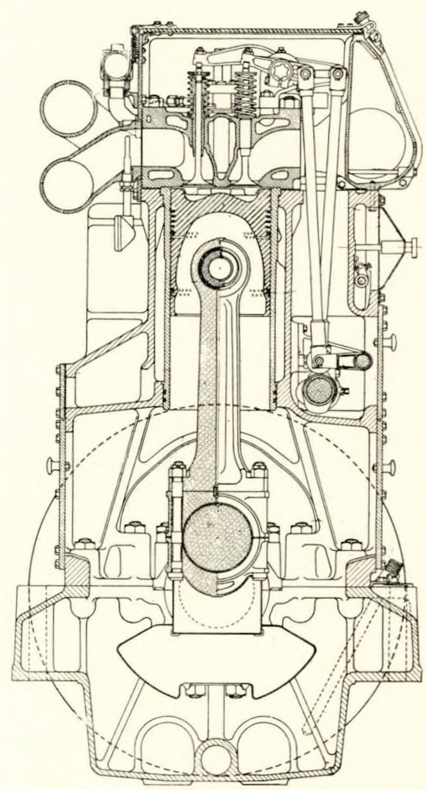
Length overall	664ft. 6in.
Length b.p.	636ft. 5⅞in.
Breadth	85ft. 3⅜in.
Depth to upperdeck ...	46ft. 9in.
Draught ... ... about	34ft. 11in.
Deadweight	33,000 tons
Cargo capacity	1,570,000 cu. ft.

Main propulsion machinery:
"De Schelde"/Parsons steam turbine
installation of 13,750 s.h.p. at 112 r.p.m.

The ship, which has been constructed to Lloyd's Register of Shipping, 100 A1 "carrying petroleum in bulk", carries liquid cargo in 11 triple-tank compartments with a total capacity of 1,570,000 cu. ft. The main pump room and engine room are situated aft of the cargo section. Forward of the cargo section there are a dry cargo hold, two deep tanks suitable for the carriage of fuel oil and an auxiliary engine room and pump room, the latter ventilated by means of axial flow fans which are driven by gastight motors. The cargo section as well as the oil bunkers in the engine room have been constructed in accordance with the longitudinal system of framing, while the normal transverse framing system has been applied in the fore and aftership. The ship is of all-welded construction, except for the stringer angle and the upper and lower edges of the bilge strakes. With a view to achieving strength of construction as well as to save weight, all longitudinal and transverse bulkheads are of the corrugated type, with stringers without stiffeners. The longitudinal bulkheads have horizontal corrugations varying in depth; the transverse bulkheads have vertical corrugations of equal depth. The topdeck is largely constructed of aluminium alloy. The main propulsion machinery consists of a "De Schelde" steam turbine installation of Parsons Marine Turbine Company design, which was delivered and assembled by Verolme Engineering Company, and drives the single propeller through "De Schelde" double-reduction gearing. The installation consists of an h.p. turbine and an l.p. turbine with built-in astern turbine. The normal output of the installation is 13,750 h.p. at 112 r.p.m. of the propeller shaft, the maximum output being 15,100 s.h.p. at 115 r.p.m. The propulsion machinery operates in conjunction with two "De Schelde"-Combustion Engineering steam boilers, fitted with fully automatic Bailey control, including sootblowers, combustion and feedwater controls and panels. The steam pressure at turbine inlet is 42 kg./sq. cm. at a superheater temperature of 425 deg. C. The main condenser is placed under the l.p. turbine; it has a vacuum of 28·5-in. mercury. The boilers have a normal evaporation capacity per boiler of 27,500 kg. of steam per hr. They are provided with flue gas heated and steam heated air heaters. Steam for the auxiliaries obtained from the superheater is passed through a desuperheater in the steam drum on its way to the various reducing groups.—*Holland Shipbuilding, August 1959; Vol. 8, pp. 36-38.*

Diesel Electric Fire Fighting Tug

The advent of the supertanker and the monster tanker has led in some cases to the tug capacity at oil terminals becoming outstripped. The enormous bulk of a laden supertanker requires a very high bollard pull and correspondingly high power. One of the chief oil loading points in Central America is Cardon in Venezuela and the latest tug to enter service at the Shell terminal there is the *Cardon,* recently delivered by Lobnitz and Co. Ltd. of Renfrew. During the course of her normal service at the refinery, this 114ft. craft



Cross section through one of the Mirrlees-JLSSM6 six-cylinder turbocharged engines which form part of the main propelling machinery in tug Cardon may be called upon to act as a fire float. Comprehensive equipment is provided for this purpose, including four Pyrene monitors having a total output of 7,200 gal. per min. These monitors are of dual-purpose design having bypass foam inductors at the base of the pedestals. Operation of a lever selects either foam or water which is projected through 360 degrees. They are supplied by two 225-h.p. motor driven "Pulsometer" fire pumps which can discharge at a rate of 3,300 gal. per min. at 150lb. per sq. in. Over 3,000 gal. of foam compound can be carried. Special attention has been paid to manœuvrability, and, to facilitate this at low speeds, a Pleuger Aktiv rudder is fitted. This is fitted with a 100-h.p. submerged motor and propeller within a streamlined nozzle and can be moved over a sweep of 180 degrees between port and starboard while manœuvring slowly. The thrust developed by this propeller is used to give a powerful steering impulse even when the speed through the water is insufficient for steerage. The Pleuger rudder is also of considerable use in counteracting the side thrust developed when the fire monitors are played on the beam. Power for this motor is derived from a Diesel alternator driven by a Rolls-Royce Diesel engine. The hull is of all-welded construction and is unusual in being fitted throughout its length with a bar keel. The Metropolitan-Vickers constant current Diesel electric power plant enables the *Cardon* to enjoy almost maximum efficiency at the two extremes of tug duty; bollard pull and running free. The propeller speed is independent of the generator speed and so the propeller design need not be a compromise for these conflicting demands as is the case with direct coupled steam or Diesel engines. The propelling machinery consists of two Mirrlees-Metrovick 420-kW. 750-r.p.m. propulsion generators supplying current to a double-armature 1,000-s.h.p. propeller motor. The Mirrlees engines are JLSSM6 six-cylinder turbocharged long stroke versions of the popular 9¾-in. bore model (12½-in. stroke, as against 10½in. of the standard 900 r.p.m. model). They develop 730 b.h.p. and are fitted with Brush turbochargers. They are directly coupled to a single-armature 420-kW. propulsion generator, force ventilated from the engine room supply fans and also coupled in tandem to a 60-kW. 110-volt d.c. constant current generator. The propulsion generators are separately excited by "Metadyne" exciter sets so that a constant current of 700 amps. is developed at all loadings with voltage varying from 0 to 600 dependent upon the load. The Diesel engines and their two tandem driven generators are mounted on a welded underframe. The propelling motor is arranged for a speed of 110 to 140 r.p.m., depending whether the tug is running free or towing. The advantages of a constant current system in this case are threefold: firstly, it enables the propulsion motor to be controlled "ahead" or "astern", simply by varying its field current in strength and direction; secondly, by a suitable circuit arrangement, it is possible to ensure that the propulsion motor will deliver constant power, dependent on the controller position over the speed range from 50 to 100 per cent; thirdly, it is possible both to propel and use the fire pumps with only one main generator in circuit, if necessary. Constant power control is available for both "ahead" and "astern" directions. Control is possible from either the bridge or the engine room, selection being achieved by the bridge/engine room changeover switch situated in the engine room control desk.—*Gas and Oil Power, September 1959; Vol. 54, pp. 242-243.*

Bicera Blade-type Blower

The Bicera blade-type blower is a machine working on an entirely new principle. This was evolved from a study of compression processes and the realization of the need for a better, but not more expensive, machine than the Roots-type blower. When the new and attractive compression cycle was discovered, it was developed in its most elementary form, so that, in addition to being a prototype test machine, it also bore a close resemblance to the possible future commercial machine built to a limited cost. A wide range of design variables exists and it should be recognized that the machine described herewith is not the only form in which the principle can be applied.

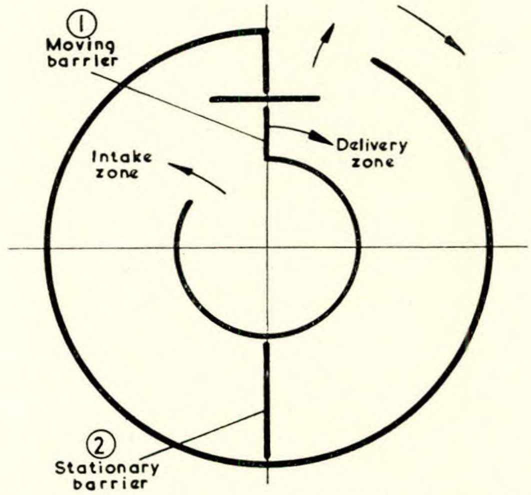


FIG. 1—*Descriptive diagram of mode of operation of Bicera blower*

Continuous inlet and delivery processes at constant velocity and an efficient compression process were the objects of the design. In the interests of low cost and reliability, it was thought necessary to break away from the normal two-rotor type of machine which requires accurate phasing and an attendant expensive gear train. Intake, compression and delivery processes take place in an annular channel formed in a rotor. At all times this channel is divided at two points (1) and (2), as shown in Fig. 1. The division (1) is a local constriction of the channel and the other, (2), a thin blade which can turn on its own stationary axis. When positioned across the channel, this blade forms a blockage; so that the revolving of the constriction acts like a piston, causing an increase in channel volume on the one side and a decrease on the other, giving intake and delivery through ports in the walls of the channel. Before the revolving piston reaches the blade, the latter is turned through 90 deg., so that it is capable of passing through a narrow slot in the piston as it passes over the blade. A sequence of blades gives continuous seals, both in the piston and as partitions dividing the channel, as shown in Fig. 2. During rotation of the one blade relative to the next, the space between them varies, and this feature may be used to obtain internal compression, as is also shown in Fig. 2. Fresh charge taken in at (*a*) is trapped as volume (*b*) and then, by making the channel converge, this space is sealed, and the air can be compressed down to volume (*c*) before this becomes part of the

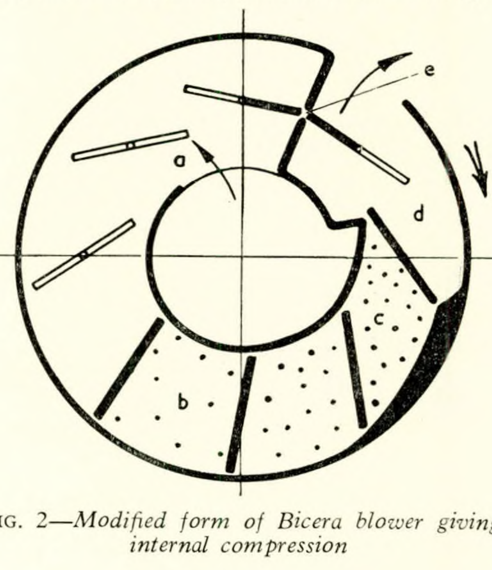


FIG. 2—*Modified form of Bicera blower giving internal compression*

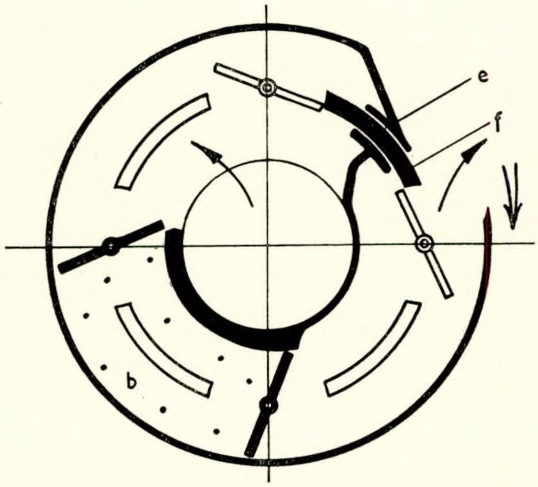


FIG. 3—*Arrangement of Bicera blower, having alternate blades replaced by spacing pieces*

delivery space (*d*). In order to reduce the production costs, the design was modified, as shown in Fig. 3. In this design, alternate blades have been replaced by stationary spacing pieces (*f*), which maintain the seal in slot (*e*).—*The Shipbuilder and Marine Engine-Builder, October 1959; Vol. 66, pp. 585-589.*

The Atomization of Fuel Jets

The efficiency of the working cycle of the Diesel engine depends, to a considerable degree, on the effectiveness of fuel atomization. Afterburning, which frequently occurs, is in most cases due to insufficient atomization or to inadequate mixing of the fuel with air. Smooth and complete combustion is facilitated by providing a mixture with a good macrostructure, i.e. a uniform distribution of fuel with the same fuel/air ratio in all parts of the combustion space, and a good microstructure, i.e. fine and homogeneous atomization. Fineness of atomization is characterized by the mean droplet diameter, and homogeneity by the deviation of the droplet diameters from this mean value. In high speed Diesel engines the amount of time available for mixture formation is very brief (3 to 5 milli-sec), so that the characteristic features of the jet, i.e. its depth of penetration, spray angle, and the distribution of fuel within the jet, are important. These features depend on design factors, such as nozzle design and combustion chamber geometry, and on numerous physical factors, such as the viscosity of the fuel, the injection pressure, the counter pressure of the medium into which the fuel is injected, and air movement. The breaking up of a jet of injected fuel into fine droplets is the result of complicated processes, the mechanism of which is not yet fully clarified. It is known, however, that the jet is acted upon by internal and external forces, which ultimately cause it to disintegrate. As soon as the jet is injected into the combustion chamber, it is subjected to the influence of external aerodynamic forces. Air resistance tries to tear particles out of the liquid and to disrupt the jet surface. This disrupting action increases in intensity when the jet surface is not smooth, i.e. when it contains initial disturbances due to inadequate surface finish of the nozzle, to conditions prevailing at the inlet and outlet edges of the nozzle, and to its length/diameter ratio. The surface tension of the fuel and the cohesive forces between the individual sections of the jet oppose these external forces. In addition, there are internal forces due to turbulent flow conditions, and these are of considerable importance. The velocity vectors have a component perpendicular to the direction of flow, contributing to disintegration. Particles in turbulent and pulsating motion subdivide the jet into sections, and also cause a spreading of the spray proportional to the pulsation velocity. Fig. 1 shows the characteristic forms of jet disintegration. At very low outflow velocities, the jet has a short, compact section, and the droplets break away owing to gravity (Fig. 1(a)). When the velocity is increased, the compact section becomes longer, and symmetrical ripples appear over its length (Fig. 1(b)). With a further increase in velocity, the length of the compact section decreases, and the disturbances become asymmetrical (Fig. 1(c)). Beyond a certain velocity, the jet envelope begins to disintegrate immediately after emerging from the nozzle. A still further increase in velocity increases the quality of atomization and also widens the cone angle (Figs. 1(d) and 1(e)). The velocities at which these characteristic patterns are formed depend on the physical properties (i.e. viscosity, surface tension, etc.) of the fuel; however, the L/D (length/diameter) ratio of the nozzle also has a considerable influence; tests have shown that, with nozzles having a small L/D ratio, the character of the flow depends considerably on the inlet conditions (pintle position, etc.). In this case, the flow characteristics are not fully defined by the Reynolds number. The distribution is non-uniform along the length and throughout the cross section of the jet. In the case of a cylindrical hole, the emerging jet spreads out continuously, as a result of large internal pulsations and also because of the aerodynamic forces acting on its frontal area. The development of the jet probably occurs in the following manner. At the beginning of injection, the velocity of the emerging particles is rapidly reduced by air resistance; at the same time, however, more favourable conditions are created for subsequent particles. At a certain distance the particles situated in front are driven towards the sides by air resistance and are replaced by others which still have sufficient kinetic energy. These, in turn, soon lose most of their energy, and the process repeats itself. The air carried away by the particles on the jet surface also takes part in the atomization process. Moreover, the concentrated, large scale internal turbulence occurring in the vicinity of the surface reduces the compactness of the jet. Thus, a compact central core with considerable energy is formed at the centre of the jet. The particles move round this core and gradually reach the outer surface, decreasing in size and losing their velocity. These small particles are then capable of rapidly adapting themselves to the velocity of the air stream. Thus, good mixing conditions are obtained.—*G. Sitkei, Acta Technica Academiae Scientiarum Hungaricae, 1959; Vol. 25, Nos. 1-2, pp. 87-117. The Engineers' Digest, September 1959; Vol. 20, pp. 363-368.*

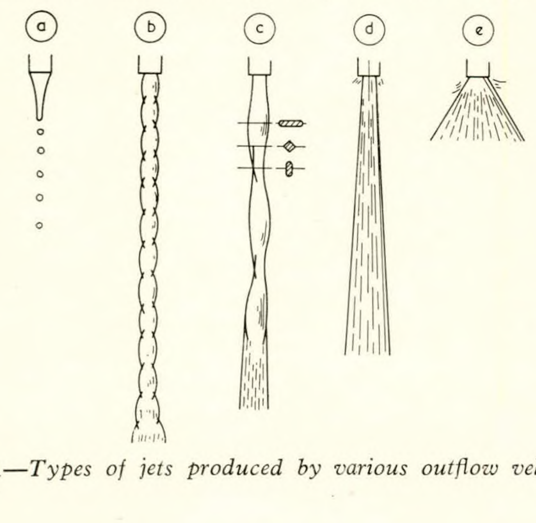


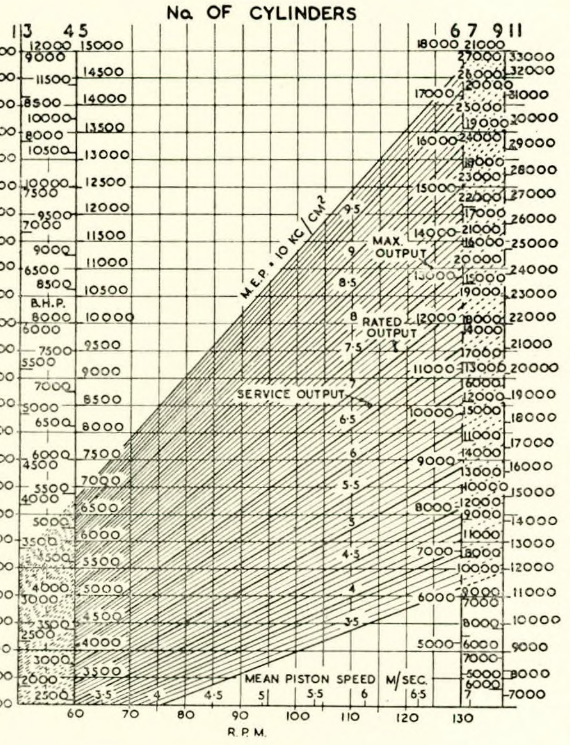
FIG. 1—*Types of jets produced by various outflow velocities*

Hunting of Water Level in Float-controlled Deaerators

Operating difficulties encountered with a deaerating feed heater during full scale test bed trials of a complete prototype main propulsion machinery installation are described, together with the eventual successful remedy. The water level control system of the deaerator is analysed mathematically and a criterion for stable operation established. Comparison of the theoretical and observed behaviour of the deaerator shows reasonable agreement. Practical factors affecting the validity of the theory are examined and suggestions made for improvements in design. Some remarks on common deaerator design practices are made in the light of test bed experience. The example of this deaerator is used to illustrate an introduction to more general analytical methods. The need for these in modern steam plant design work is explained, together with the obstacle to their use imposed by our present ignorance of the kinetic characteristics of common plant items. *—Paper by A. J. Morton, submitted to the Institution of Mechanical Engineers for written discussion, 1959.*

Characteristics of Large-size Fiat Engine

The principal characteristics of the large-size Fiat turbocharged two-stroke engine are reproduced below. This engine has a cylinder bore of 900 mm., a piston stroke of 1,600 mm., and a maximum m.e.p. of 10 kg. per $cm.^2$. It will be seen that the rated output per cylinder is 1,900 b.h.p. and that in the



Principal characteristics of Fiat engine with a 900-mm. bore and piston stroke of 1,600 mm.

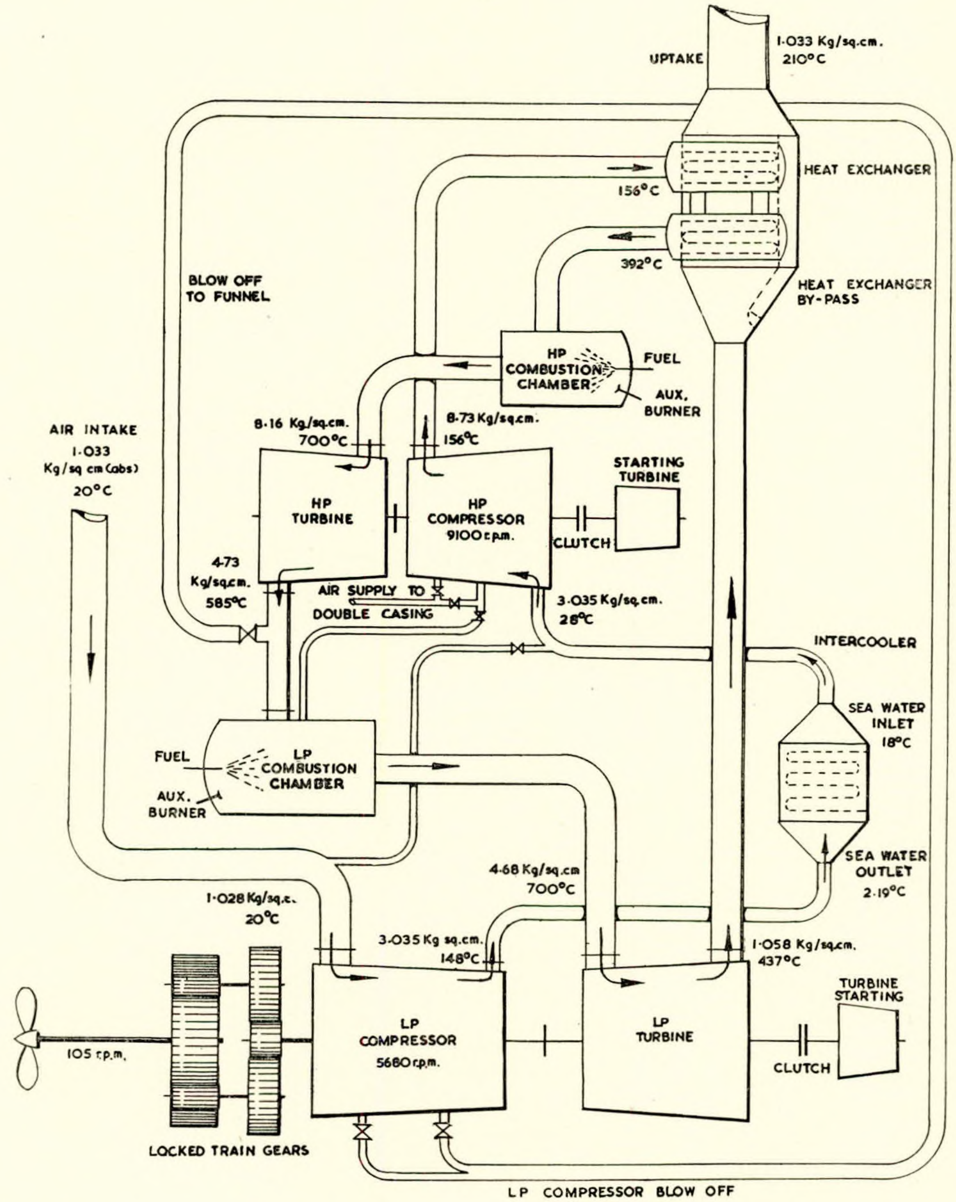
higher power ranges the engine is built with six, seven, nine and eleven cylinders, the latter giving about 21,000 b.h.p. at 118 r.p.m., the mean piston speed being 6·3 m. per sec. A nine-cylinder engine of these dimensions is now being constructed for installation in a 35,000-ton tanker owned by Achille Lauro S.p·A., this having a service rating of 1,700 b.h.p. per cylinder. It will be ready for shop trials by the end of this year.*—The Motor Ship, March 1959; Vol. 39, p. 591.*

Nuclear Ship *Savannah*

The n.s. *Savannah's* pressurized water reactor system is rated at 74 MW (million watts). In addition to the reactor, the system comprises a pressurizer vessel and two primary coolant loops. Each loop contains two canned motor pumps, one heat exchanger, two check and two stop valves. The reactor is moderated and cooled by light water at 1,750lb. per sq. in. abs. It is fuelled with uranium oxide (UO_2) of about 4·4 per cent enrichment in uranium 235, clad in stainless steel rods. The active core is approximately a right circular cylinder with an equivalent diameter of 62in. and a height of 66in. The core is made up of 32 fuel elements (8·5in. sq.), each one consisting of 164 fuel rods 0·5in. diameter. Reactivity control is provided by 21 cruciform shaped control rods, each with an effective length of 66in. The rods are a composite of boron and stainless steel plates, enclosed in stainless steel jackets. Their cruciform shape enables them to move in or out of the fuel mass, actuated by electro-mechanical control. Boron is an element that can restrict the fission process and thereby control the heat release. When the rods are withdrawn, neutrons emitted by the nuclear fuel bombard surrounding fissionable uranium atoms. When a neutron strikes the nucleus of an atom, the atom splits into two or more fission fragments and several neutrons. This change of mass releases energy which produces heat. Since additional free neutrons are released to bombard other nuclei, the process is self-sustainign in the presence of sufficient fissionable material (critical mass). Inversely, by lowering the rods, the fissioning action is reduced proportionately. In the full-down position the chain reaction is shut off completely. The *Savannah's* electro-mechanical rod control drive will be able to insert the rods at a maximum rate of 15in. per minute. However, in case of emergency the reactor safety-monitoring system will automatically initiate a "scram" insertion which will bring the rods to the full-down position in a total elapsed time of only 1·6 seconds. The heat generated by fission in the reactor is absorbed by demineralized water which is circulated through the reactor in two closed loops, each of which has two circulating pumps and a heat exchanger. This is the primary system. The primary loop water is maintained at a constant pressure of 1,750lb. per sq. in. by a pressurized vessel. The latter is fitted with both electrical heaters and spray coolers to maintain automatically the desired operating condition. By keeping the primary loop under high pressure, the primary water can be heated to high temperature without boiling. This heat then is transferred in the heat exchanger to water under much lower pressure (secondary loop) causing it to flash into steam. This is piped to the propulsion turbines, turbogenerators and auxiliary steam lines. With the turbines producing their normal output of 20,000 s.h.p. and the electrical load at 2,200 kW, the reactor powers would be 63·5 MW. This would require 242,200lb./hr. of steam at 490lb. per sq. in. abs. to be generated, of which 186,610lb./hr. would be consumed by the main turbines. (Unlike the conventional high pressure steam plants which produce superheated steam, the *Savannah's* plant produces dry, saturated steam.) At this output the primary coolant flow would be 8,000,000lb./hr. with a mean temperature rise through the reactor of 22·8 deg. F. The feedwater temperature to the steam drum would be 347 deg. F. *Marine Engineering/Log, August 1959; Vol. 64, pp. 75-84.*

Gas Turbine for Liberty Ship

Earlier this year a series of demonstrations took place at the engine works of the Société des Ateliers et Chantiers de Bretagne where a 3,500-s.h.p. marine propulsion gas turbine, ordered by the French Ministry of Merchant Marine and intended for repowering a Liberty ship, was undergoing tests. The designed output of the plant, 3,500 s.h.p. at 105 r.p.m., is intended to give a standard Liberty ship a considerable advantage in speed over the conventional steam machinery, and the open cycle and maximum temperature of 700 deg. C. meet the requirements for long life. The A.C.B.-Rateau gas turbine has been under construction for some considerable time and erection on the test bed was first commenced in 1955. As the accompanying drawing makes plain, it is of two-shaft design. The high pressure set comprises h.p. air compressor, h.p. gas turbine, h.p. combustion chamber and a steam starting turbine. This set is free-running and unconnected to the output shaft. The low-pressure set comprises the l.p. compressor, the l.p. turbine, the l.p. air cooler, the l.p. combustion chamber and, again, a steam starting turbine. This set transmits its output to an A.C.B. variable pitch propeller through double-reduction locked train reduction gears. The heat exchanger is arranged between the h.p. compressor and the h.p. combustion chamber. The gases leaving the l.p. turbine at 420 deg. C. are reduced to about 200 deg. C. while raising the temperature of the air

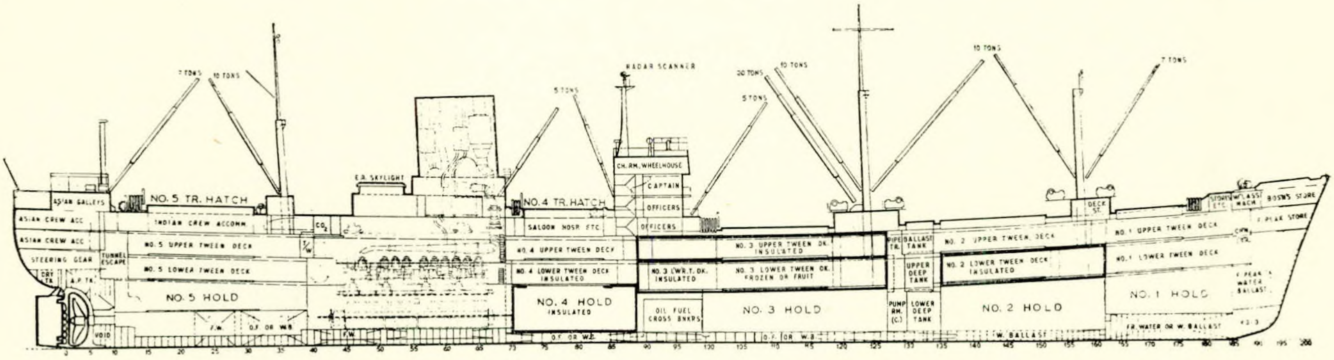


Schematic diagram of cycle with conditions at various stages corresponding to 700 deg. C. maximum. A bypass allows the h.p. compressor to draw air directly from the atmosphere and the h.p. turbine to discharge to the funnel, thus enabling the free running charging set to be started and run independently of the l.p. power turbine set

delivered by the h.p. compressor from about 160 deg. C. to about 378 deg. C. The starting turbines and most of the auxiliaries concerned with this plant are driven by steam in order to utilize to the maximum possible extent those fittings already on the ship. The two axial-flow compressors are of similar general design. They are both of 15 stages and have a pressure ratio of 3 to 1. The casings are entirely welded and the rotor discs are fitted with blades precision-cast by the lost wax process. All the h.p. compressor blades were individually weighed before assembly and the rotors were statically and dynamically balanced.—*The Marine Engineer and Naval Architect, September 1959; Vol. 82, pp. 353-356.*

New Cargo Vessel for Ellerman Lines

The latest ship to be completed by Alexander Stephen and Sons Ltd., Linthouse, is a general and refrigerated single-screw motor cargo vessel, the *City of Melbourne.* Built for Ellerman Lines Ltd., the *City of Melbourne* is a new class of ship specially designed for service between the United Kingdom, Canada and Australia. She has a deadweight of 12,300 tons and a service speed of 17 knots. On September 12, the *City of Melbourne* sailed on her maiden voyage from Liverpool. The *City of Melbourne* is powered by a twelve-cylinder Stephen-Sulzer Diesel engine—one of the most powerful marine Diesel engines in the world. During test bed trials at Linthouse earlier this year the engine developed 18,000 b.h.p.—an output which could probably have been exceeded had the dynamometers been suitable for a higher load. The engine is now rated at 14,000 b.h.p., so it is fairly obvious that much higher speeds than 17 knots could be reached if necessary.



General arrangement of the general and refrigerated cargo vessel City of Melbourne, *12,300 tons d.w., built by Alexander Stephen and Sons Ltd. for Ellerman Lines Ltd.*

The principal particulars of the *City of Melbourne* are as follows:

Length o.a.	545ft. 0in.
Length b.p.	510ft. 0in.
Breadth, moulded	71ft. 0in.
Depth to 2nd deck ...	33ft. 6in.
Draught	28ft. 9¼in.
Deadweight	12,300 tons
Gross tonnage	9,920 tons
Machinery output	14,000 b.h.p.
Service speed	17 knots
Cargo capacity:	
Bale	560,670 cu. ft.
Refrigerated	164,260 cu. ft.

The *City of Melbourne* has been constructed as a complete superstructure vessel with a raked stem, cruiser stern and three raked masts, giving a trim appearance to the superstructure. This is aft of amidships to suit the position of the propelling machinery, which has been arranged between Nos. 4 and 5 holds and aft of amidships. The vessel has been built to Lloyd's Register class 100 A1 with refrigeration. The propelling machinery in the *City of Melbourne* consists of a twelve-cylinder type RSAD 76 Stephen-Sulzer turbocharged two-stroke Diesel engine designed for operation on boiler fuel. The engine has a bore of 760 mm. and 1,500-mm. stroke. As previously mentioned, over 18,000 b.h.p. at 126 r.p.m. was developed while the engine was on the test bed, and the service rating of 14,000 b.h.p. at 114·5 r.p.m. allows plenty of power to be kept in reserve. This is the second engine of this design to be built by Alexander Stephen and Sons Ltd., whose first Sulzer engine of this type was a seven-cylinder unit of 8,750 b.h.p. output installed in the *British Fulmar.* This engine was derated to 7,500 b.h.p. in service. The admission of air into the cylinders is controlled by the top edge of the pistons, and in order to retain sufficient air in the cylinders for combustion the exhaust ports are closed by means of exhaust valves at the end of the scavenging process before the pistons close the scavenge ports. Mechanically operated semi-rotary type exhaust valves are timed to allow after charging. The four turbochargers are of the Sulzer RT.67 type and the engine is turbocharged on the pulse system. Gas leaving the turbines is led into a waste heat boiler to generate steam for ship's services. About 4,200lb. of steam per hr. at 100lb. per sq. in. is produced at normal service power.—*The Shipping World, 7th October 1959; Vol. 141, pp. 219-221.*

Rotatable Funnel for Smoke Deflexion

This article describes a novel means of overcoming the trouble due to smoke driving down on the passenger decks of large liners. It refers particularly to the "Lascroux" type of funnel which has been fitted in a number of French and Italian passenger liners. The boiler uptakes and Diesel engine exhaust are carried through the centre of the funnel, the outer casing of which has a large aperture in the front through which air is forced due to the vessel's forward motion. The duct is swept up just forward of the uptakes, so entraining the funnel gases and carrying them well above the point at which they can descend over the deck. In a powerful cross wind, however, the full effect of these air slots is lost. The proposal is to arrange the upper part of the funnel to be rotatable so that the axis can be trained to the resultant angle of ship velocity and wind speed and direction. The arrangement will be clear from the accompanying sketches, which show that the uptakes remain stationary, suitable seals being

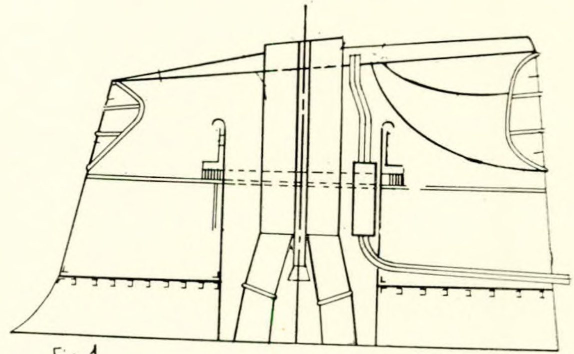


Fig. 1

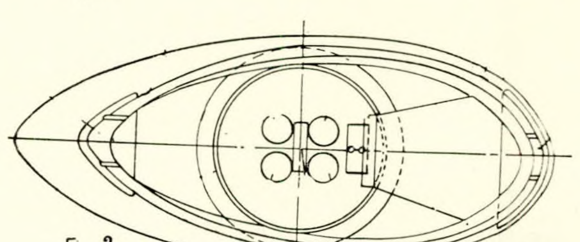


Fig. 2

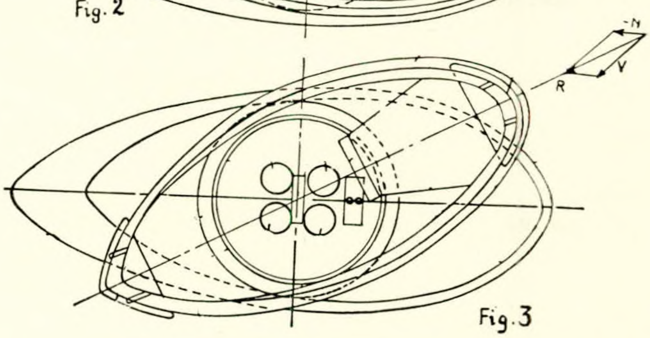
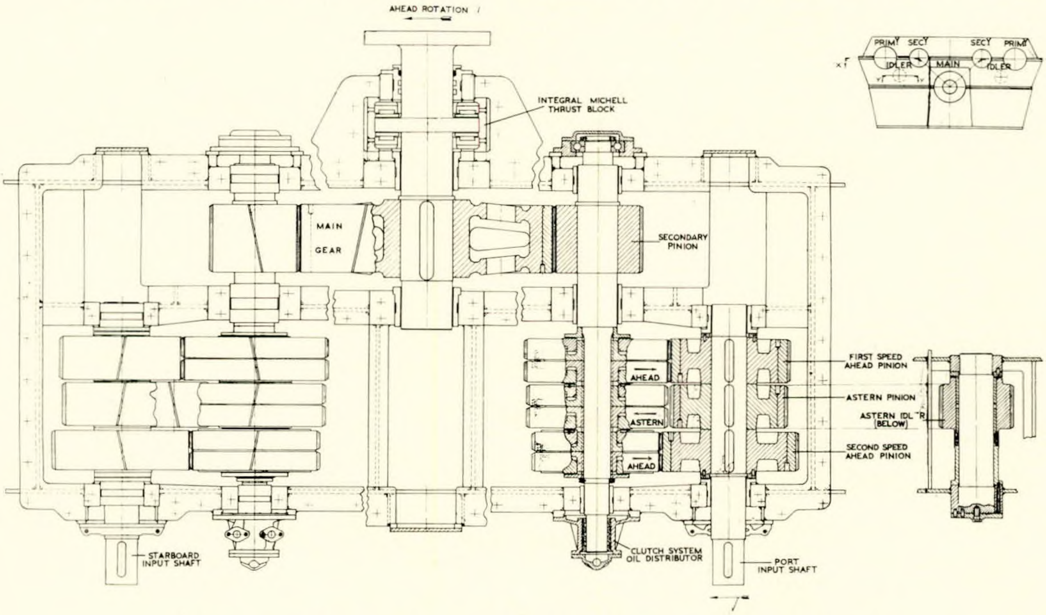


Fig. 3

These three sketches show how the uptakes remain stationary in the centre of the funnel while the upper part of the casing is rotated to resultant of wind and ship motion provided between the moving and static parts. Mario Chiabra, *La Marina Mercantile,* April 1959.—*The Marine Engineer and Naval Architect, September 1959; Vol. 82, p. 363.*

Multi-ratio Reverse Reduction Gears for Tugs and Trawlers

W. J. Yarwood and Co. Ltd. of Northwich have recently launched the motor tug *Sir William Luce* for the Aden Port Trust. The craft is propelled by two Ruston 7VEBXM engines, each rated to develop 630 b.h.p. at 500 r.p.m. and transmitting their combined power to the single-screw through Size 46 type SCD "Fluidrive" couplings and a two-ratio ahead "Hindmarch/MWD" gear unit. The first speed ahead ratio is 3·49 to 1, the second speed ahead ratio is 2·72 to 1 and that for astern is 3·52 to 1. The arrangement of the gears can best be seen from the accompanying illustration. Each of the twin-input shafts carries three pinions which engage with their respective gear wheels within which are the oil operated clutches which, in turn, are keyed to their shaft. At the after end of this secondary shaft is the secondary pinion which engages with the main gear wheel. The reverse train is, of course, taken through the idler. All the shafts are carried in plain white metal lined bearings, lubricating oil being supplied by motor driven independent oil pumps through the necessary strainers, coolers and regulating valves. Control oil pressure is fed through a cock having positions for astern, stop, first speed ahead and second speed ahead. Oil is led to the distributor, whence it passes to the clutch for the particular motion selected. Isolating valves enable either one or the other of the engines to be cut out of service. Most of the control gear is taken to the bridge.—*The Marine Engineer and Naval Architect, September 1959; Vol. 82, p. 362.*



Plan at primary and secondary shaft level of two-speed ahead M.W.D. type 2MWR5 twin-input gear box showing arrangement of first- and second-speed trains

Patent Specifications

Hatch Cover

This hatch cover, as shown in Figs. 1-4, comprises a number of cover members (1), and tilting and sliding yokes (2) provided with pins (3) which are inserted in non-rotatable manner into the end cover member (1a). The latter is tilted about its longitudinal axis up to a certain angle relatively to

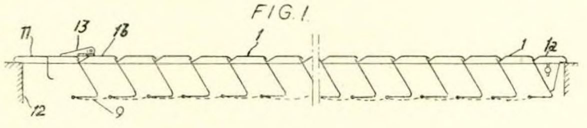


FIG. 1

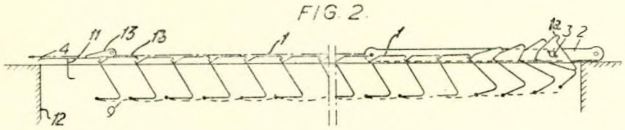


FIG. 2

the slideway (10), and the sliding and tilting yokes (2) are secured to the end cover member on both sides, and so as to be rigid against rotation, by means of the inserted pins (3). Fixed to the sliding and tilting yokes (2) are ropes (4) by means of which the cover members (1) can be pulled together to form a cover member assembly (5). The angle of adjustment of the end cover members (1a) is selected so that the minimum force is required on the rope. By means of the spacers (9) (for example chains) provided on the lower chords of the cover members (1), all the cover members (1) tilt successively, sliding on the slideways (10) about their longitudinal axis, until the closure member (11) bears against the stop (12).

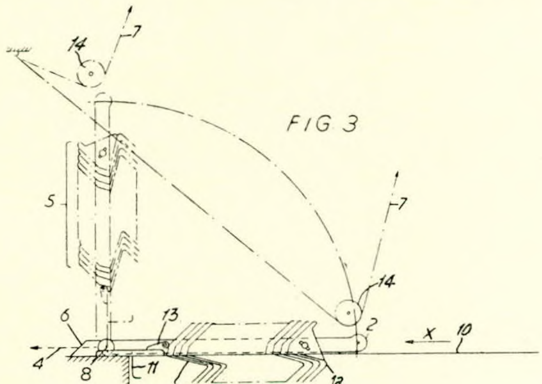


FIG. 3

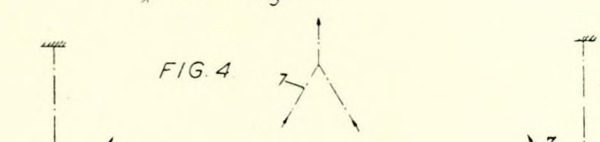
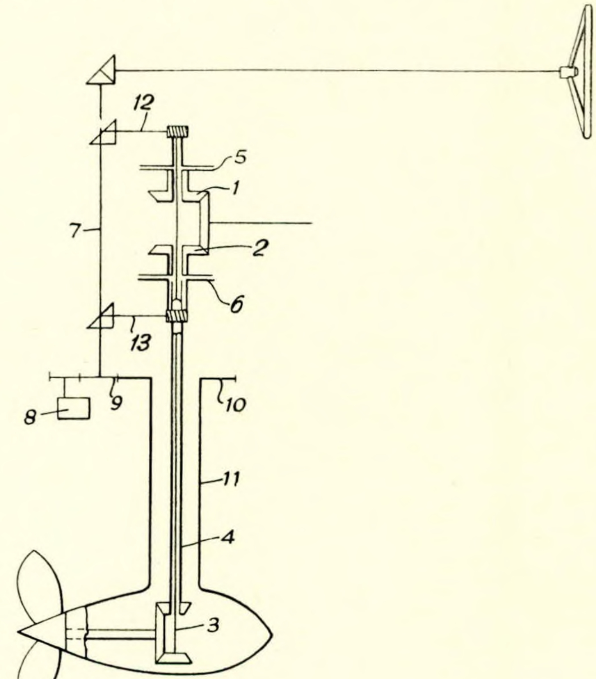


FIG. 4

Subsequently the sliding and tilting yokes (2) bear against the travel limiting means (6) (Fig. 3). The spacing between the stops (12) and the travel limiting means (6) is so selected that the cover member assembly (5) is pressed together. The first cover element (1b) is stopped, for example, by displacement of the hinge bolt (13). With the aid of ropes (7), over pulleys (14), the sliding and tilting yokes (2), with the assembly (5), are swung about the pivots (8) out of the hatch aperture.—*British Patent No. 821,912 issued to VEB Schiffbau, Projekt and Konstruktionsbüro, Berlin. Complete specification published 14th October 1959.*

Steering Control for Marine Craft

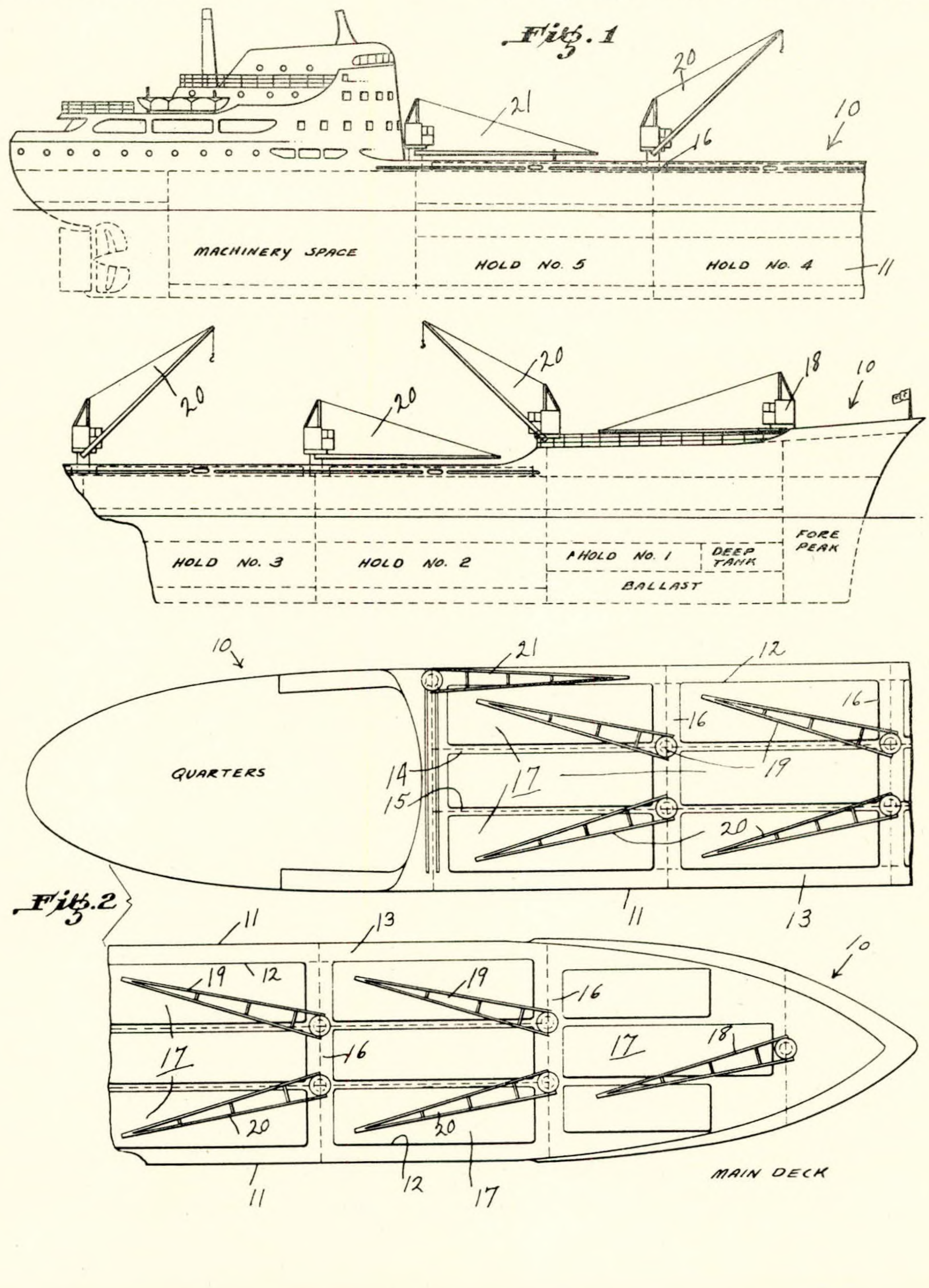
This invention relates to a steering control arrangement for marine craft, the control having oppositely rotating vertical driving shafts. In the device according to the invention one clutch is provided for each driven bevel gear, as shown in the diagrammatic representation. The clutches are placed between the driven bevel gears and the oppositely rotating vertical driving shafts extending to the underwater housing. If one



clutch is partially disengaged, steering is assisted or initiated in the direction of rotation opposite to that of the disengaged clutch. Also, the direction of steer can be changed through 180 degrees, that is, from ahead to astern for instance, by press button circuits having pawl or stop settings. There is no upper limit to the driving power which the steering control will handle reliably, since by means of the servo-effect the engine power is directly used for steering so that an engine power of, for instance, 1,000 h.p. can be controlled very easily. The two driven bevel gears (1, 2) each bear one part of a clutch (5, 6). The other parts of the two clutches are connected to oppositely rotating vertical driving shafts (3, 4), disposed one inside the other. Hence, when the clutches (5, 6) are engaged, the bevel gears (1, 2) are non-positively connected to the driving shafts (3, 4). The clutches are so contrived that their holding torque is slightly greater than the torque to be transmitted. A gear wheel (9) on the steering gear (7) engages with a gear wheel (10) of an underwater housing (11). As the steering gear is turned in one or the other direction, the clutch associated with the shaft rotating in the opposite direction of steer is disengaged through the connexion (12 or 13). Because of the servo-action, the engine drives the underwater housing through the other shaft, which rotates in the same direction as the direction of steer, so that the steering control acts merely as a shift-member and can therefore control a large power very easily. To obviate unequal steering movements, a preferably hydraulic damping member (8) is connected into the steering gear.—*British Patent No. 822,204 issued to VEB Schiffbau, Projekt and Konstruktionsbüro, Berlin. Complete specification published 21st October 1959.*

New Type of General Cargo Ship

This invention embodies a new design of general cargo ship, the hull providing adequate strength and having a multiplicity of hatches of substantially the same area as the symmetrical holds they cover. It also embodies a multiplicity of cranes, or crane lifting devices or cranes on piers or barges, or other shipboard cranes on an equivalent mast-boom-winch system, capable of rotation and of reaching over the side of the ship and dropping general cargo (including conventional containers) into any part of any cargo hold directly. It also embodies the use of hinged between-deck sections in the symmetrical holds of approximately the same area as the main hatches for supporting or arranging the cargo in tiers. Referring to Figs. 1 and 2, the foremost hatch (17) is served by a fore crane (18), while pairs of cranes (19 and 20) are affixed to the transverse beams (16) or other portions of the hull or structure of the ship. These intermediate cranes (19, 20) serve cargo spaces which are between the longitudinal



bulkheads and the inner hulls of the ship. An aft crane (21), shown in Fig. 2, is also used to service the hold (5) in Fig. 1, the after crane (21) being also illustrated in Fig. 1.—*British Patent No. 822,135 issued to Friede and Goldman Inc. Complete specification published 21st October 1959.*

Life Saving Apparatus for Submarine Craft

This invention relates to life saving apparatus for submarine craft and has for its object to provide on the outside of the pressure hull of the craft means for carrying an inflatable dinghy and for conveying the latter to the surface when the craft is submerged, in response to operation of a control inside the pressure hull. A further object is to provide means which will serve as a marker buoy for the craft when submerged and for supporting a telephone cable. In Figs. 1 and 2 the housing for the container (10) of an inflatable dinghy (11) comprises a free flooding cylindrical compartment (12) built into the superstructure (13) of the submarine. The compartment (12) may be closed by a cover (15) hinged at (16). In the base of the compartment (12) a hollow truncated cone of steel (25) is arranged. The space between the side of the cone (25) and the side of the compartment (12) serves as a stowage for coiling down a mooring line (26) for attaching the dinghy container (10) to the hull (14). The mooring line (26) which is preferably of flexible steel rope may incorporate a telephone cable led into the hull *via* a pressure tight cable gland (29). Should the container (10) be released from its compartment (12) in the submarine when submerged, the piston rod (55) will be held in the position shown until the water pressure in the cylinder (57) is insufficient to overcome the effect of spring (59). Thereafter the piston rod (55) will move to the right and the lever (51) will actuate the operating head to release the compressed gas into the dinghy. Under the force exerted by the inflating dinghy the shear pins holding the two hemispheres together will shear and the inflating dinghy will be released from the container, although it will remain attached to it by the painter line (63).—*British Patent No. 819,795 issued to R. F. D. Company Ltd., W. G. A. Jones and K. C. Bowmer. Complete specification published 9th September 1959.*

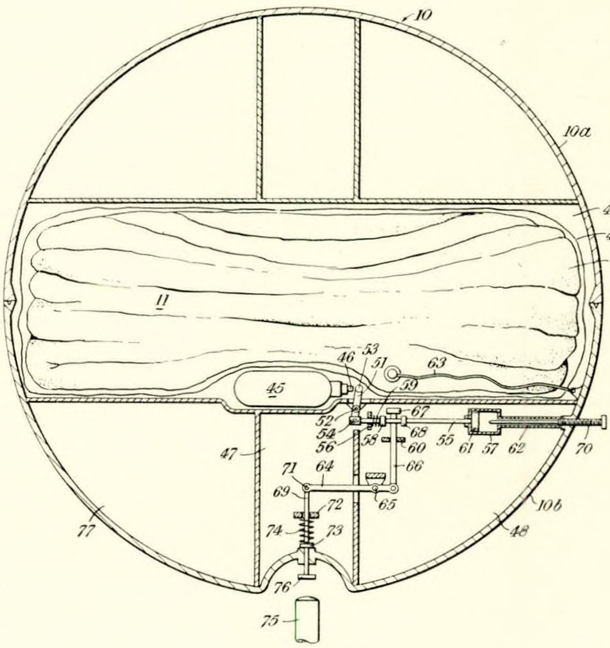


Fig. 2.

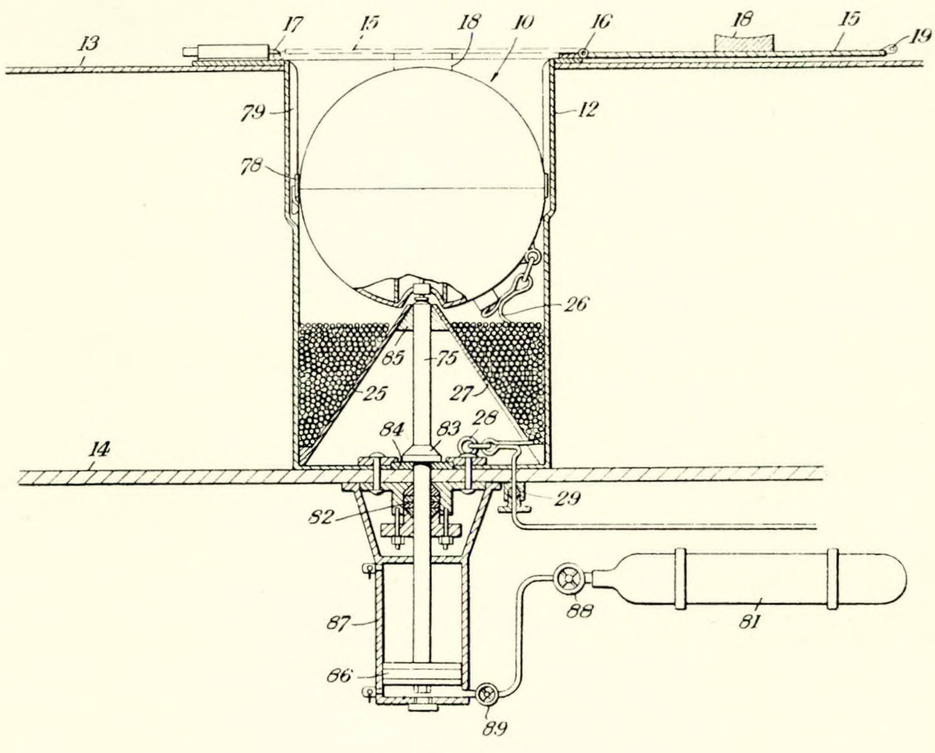


Fig. 1.

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