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Automatic Combustion Control for Marine Boilers

The author discusses and compares the general characteristics of different systems of automatic combustion control in marine boilers. Such systems may be classified according to the characteristics of the constituent control mechanisms and their interaction. Broadly speaking, there are two classes of boiler control systems, referred to, respectively, as the successive signal control and the parallel signal control systems. In the former, the input signal from the steam pressure regulator causes directly a change in only one of the two variables determining the heat in the furnace (fuel flow and air flow), the change in the other variable following in response to a second signal resulting from the change in the first variable. This system may also be called a " programmed " system and may be subdivided into programmed air supply and programmed fuel supply systems, according to whether the air supply or the fuel supply control is the subordinate (or the programmed) one. It is stated that the programmed air supply system is widely used on Russian ships, while the programmed fuel supply system is common in ships of the U.S., France, and other countries. In systems with parallel signal control, the input signal from the steam pressure regulator actuates the air supply and fuel supply controls simultaneously. This system is theoretically more efficient than the programmed system but in practice it is more complicated and hence less reliable. It seems that the best solution is the programmed air supply system with certain refinements improving its dynamic characteristics. This is briefly described.—*M. Sh. Shifrin, Sudostroenie, 1958; Vol. 24, No. 2, p. 22. Journal, The British Shipbuilding Research Association, November 1958; Vol. 13, Abstract No. 14,736.*

Air Conditioning Unit

A new air conditioned unit which can be used, among other purposes, for the conversion of existing heating and ventilating systems to full air conditioning has been developed by Thermotank, Ltd. Known as Type "C", the new unit enables conversions to be carried out without expensive installation costs and with the minimum of structural alterations. It is intended for mounting on open weather decks, but can be fitted below deck providing that a minimum head clearance of 7ft. 6in. is available for the largest size of unit. The maximum deck space required is 5ft. 6in. by 5ft. 6in. The new units have a cooling capacity ranging from 4 tons to 20 tons of refrigeration, with nominal air circulation of 1,500 cu. ft. per min. for the smallest unit to 5,500 cu. ft. per min. for the largest. The *Burmah Emerald,* owned by the Burmah Oil Co. (Tankers), Ltd., will shortly be fitted with Type "C" units in Calcutta, and the *Tremeadow,* belonging to the Hain Steamship Co., Ltd., will also be converted to full air conditioning at Liverpool towards the end of the year. The main interest for the new units will probably be for conversion work, but they will also be valuable for economical air conditioning of selected groups of spaces on board new ships. The *Esso Canterbury* has three units, each with a refrigerating capacity of 20 tons. These are mounted on the open deck immediately above the existing Thermotank heating and ventilating units, and are connected to the fan inlets by short lengths of ducting. A recirculating duct has also been led from appropriate accommodation to the new units, and this has been arranged as far as possible on the weather decks so as to reduce internal alterations to a minimum. Thermostats sited in the recirculation air inlet at the unit control the operation of the cooling plant. When, in summer conditions, the temperature of the accommodation reaches a predetermined setting, a thermostat actuates the automatic controller in the compressor motor and brings the refrigerating machinery into action. The plant is similarly stopped when the temperature falls below the chosen setting. Type "C" units are capable of maintaining interior conditions of 85 deg. F. dry bulb and 70 deg. F. wet bulb when outside atmospheric conditions are 90 deg. F. dry bulb and 85·5 deg. F. wet bulb. On the *Esso Canterbury,* in order to avoid excessive loss of conditioned air, natural exhaust vents have been closed off and self-closing fittings have been mounted on all doors leading from the accommodation to the outside atmosphere.—*The Shipping World, 26th November 1958; Vol. 139, p. 477.*

Quantitative Wave Study in Model Tank

Many parameters of ship model performance are more profitably studied under the action of waves than in still water. Heretofore, such testing has been accomplished by adapting the traditional long narrow test channel to *wave production;* that is, a wavemaker is installed at one end of the tank and a beach at the other. This, however, leaves something to be desired. Although the long narrow channel is ideal for still-water tests, where ship's heading is of no consequence, it restricts tests in waves to head seas and following seas and to zero speed of advance in beam seas. The desire to conduct model tests in different relative headings of model to waves (that is, oblique seas) has led to the concept of the rectangular tank. This type of facility permits oblique sea testing by two alternative methods: (1) The path of travel of the ship model is restricted to a fixed line with respect to the boundaries of the tank, whereas the direction of wave propagation relative to the same boundaries may be varied in certain ways; or (2) The direction of wave propagation is always the same whereas the path of travel of the ship model along a line may be altered with each test. Implicit in the above is the possibility of embodiment in a particular facility of both methods (1) and (2). Such is the case in the TMB manœuvring basin. One possible disadvantage of the rectangular tank should be noted. Because of the necessity for wavemaking facilities along one or two sides of the tank, it will in general be much shorter than the long narrow channel. There is then the chance that for certain speeds and relative headings a sufficiently long run cannot be made for a reliable test sample. The value of oblique sea testing is that methods exist which enable ship motions, in any degree of freedom, to be computed from such tests. A strong reason for reproducing the seaway in the laboratory is that the model tank can be an analog computer that gives precise answers to ship behaviour problems. Most wavemakers produce, at least in principle, sinusoidal waves. Sinusoidal conditions, although unrealistic, are easily reproducible, and coupled with the fact that the sine wave is a mathematically well behaved forcing function, its desirability as an initial test condition is evident. The sine wave, moreover, is the key to the complexity of the sea surface, for recently it has been proved analytically that the seaway can be considered to be composed of a multiplicity of independent sinusoidal components combined in random phase. The idea of creating an irregular sea surface is not incompatible with known wave-generating techniques. Indeed, at least one institution has conducted extensive tests in long crested irregular seas. The extension of our knowledge on the direction of travel of ocean waves emphasizes the superiority of the rectangular tank for reproducing the seaway in the laboratory; the narrow tank is, of necessity, restricted to propagating waves in one direction. Generally in a rectangular towing facility equipped for generating waves, some of the following phenomena may be produced: (1) long crested oblique regular waves; (2) long crested oblique irregular waves; (3) short crested oblique irregular waves. At this time there are several institutions which have in operation, or are building, rectangular tanks. One such facility is the TMB manœuvring basin; a one-tenth scale model has been successfully operating for over a year. The function of the one-tenth scale model is to provide information on the basic nature of the prototype. It is hoped that extensive tests will demonstrate: how well the facility can produce the wave fields listed above; what, if any, modifications are indicated; how to set up programmes for the propagation of different sea conditions; etc. The investigation of waves in the tenth-scale model will follow the sequence of steps listed below: (1) long crested regular waves; (2) properties of individual wavemakers and simple combinations thereof; (3) long crested irregular waves; (4) short crested waves. This report presents the results of the first part of the investigation, that of long crested regular waves. The eight wavemakers which constitute one short side of the basin were "balanced" to produce uniform sinusoidal waves. The nature of the wave field, in time and space, was investigated for a variety of wave lengths and wave heights. It is demonstrated that a sufficiently large area of the tank remains homogeneously stationary to satisfy most test conditions. The observance of high frequency reradiation from the side walls of the tank is discussed, and remedial measures, based on experimentation, are suggested. It is shown that variable depth and removal of one side barrier do not materially affect wave propagation in the range of wave lengths and wave heights tested. The wave absorbing beach was found to be highly effective.—*W. Marks, David Taylor Model Basin, Report No. 1,192, October 1958.*

Welding of Non-ferrous and Ferrous Tubes to Tube Sheets

During the past decade there has been significant progress in the design and manufacture of heat transfer equipment for steam and atomic power plants, as well as for the chemical, petroleum and other process industries. The demands of these industries for equipment to perform satisfactorily under the ever-increasing temperatures and pressures, as well as safely to conduct lethal and radioactive heat transfer media, has presented a challenge to designers, metallurgists and fabricators. For many years, tubes have been rolled, or expanded, into the tube sheet holes to effect leaktight joints. This procedure is still used extensively on the majority of exchangers. The holding power, or strength, of rolled joints when properly done is still considered adequate for many applications. In recent years, for special service applications, such as high pressure feedwater heaters for power plant applications and for chemical and atomic energy service, the trend has been heavily toward exchangers with tubes welded to the tube sheets. Such joints are categorized as seal welds, or full strength welds, and are most generally made by either the metal arc or inert gas-shielded tungsten arc welding processes. In general, heat transfer equipment is built to meet the requirements of the ASME Code for Unfired Pressure Vessels. This Code is often supplemented by more exacting specifications provided by the customer or government agency for more assurance of a trouble-free service life. For heat exchangers used in atomic energy or chemical plant installations, where tube joint failures could cause excessive damage or loss of life, the joining of tubes to tube sheets must be considered from another standpoint of welding and testing than the generally accepted hydrostatic tests of at least one and one-half times the working pressure specified by the ASME Code. The tube welded joint may be required to withstand completely the operating pressures and temperature cycles with any rolling filling a minor strength role. It is important, therefore, that the designer carefully consider the metallurgical, welding and fabricating problems in order to be assured that the vessel can be built without production delays and that it will completely satisfy the design and operating service conditions. This paper contains a discussion of metallurgical and welding considerations related to the welding of some non-ferrous and ferrous tubes to tube sheets. The term "non-ferrous" is normally restricted to a specific material such as copper, nickel, molybdenum, titanium, etc., or is applied to their many alloys. The scope of this paper, however, is restricted to the joining of Monel, copper, cupro-nickel, copper-zinc alloys and stainless steel tubes to tube sheets of the same metals or carbon steel. The joining would apply to the construction of high pressure feedwater heaters for the steam power industry or special types of heat exchangers used for atomic power and chemical process applications.—*R. W. Bennett, The Welding Journal, November 1958; Vol. 37, pp. 1,071-1,080.*

Costa Propulsion Bulb

The Costa propulsion bulb is a simple yet effective device for recovering energy from the losses behind the propeller. It comprises a streamlined body which is welded to the rudder immediately abaft the propeller boss, having its centre line continuous with the centre line of the shaft. The bulb eliminates the vortices which trail from the propeller boss, tranquilizes the flow of water behind the propeller, prevents its sudden contraction and smooths the wake. Fig. 1 indicates schematically a conventional propeller and rudder arrangement and one fitted with a Costa propulsion bulb. A consequence of the tranquilizing effect on the flow of water behind the propeller is that the bulb eliminates or considerably reduces propeller excited vibrations and improves the steering and manœuvrability of the vessel. Application of the Costa propulsion bulb is not limited to certain types or sizes of ships. Cargo and passenger vessels of every kind, tankers up to the biggest dimensions, coasters, trawlers, tugs and rescue vessels have all been successfully fitted. The installation of Costa propulsion bulbs is essentially limited to single screw vessels. However, in the case of vessels having twin or multiple screws the bulbs can be fitted to the rudders if these are situated behind the propellers and can be supported by fins from the hull structure. The shape, size and position of the Costa bulb for any particular vessel is the result of individual calculation involving the dimensions of propeller, rudder and stern frame aperture and the general characteristics of the vessel's propulsion. In principle there exist two different types of Costa propulsion bulbs. On a balanced rudder and also on special types of rudders such as the Simplex rudder, Star-Contra rudder and others, the bulb consists of two halves which are welded to the rudder. In the case of a rudder with a fixed rudder post the bulb is divided vertically into two parts. The fore part or "head part" of the bulb begins immediately at the roots of the propeller blades and is attached to the fixed rudder post, if necessary by means of supporting fins. The after part or "tail part" of the bulb is welded to the rudder and forms in connexion with the head part a link which makes the turning of the rudder possible without interrupting the continuity of the stream lines. In such a case the bulb consists of four individual shells. The shells consist of steel plates which are suitably stiffened internally; special ice strengthening is provided if the vessel herself is ice strengthened. The particular steel plates are welded together, either lengthwise or in circumferential direction or diagonally. Two or even three of these methods might also be suitably combined. Small bulbs can also be made of wood, e.g. teak or oak. Increased efficiency obtained by fitting the Costa bulb results in an increase of speed of usually 0·2—0·5 knots at the same engine output and fuel consumption as before the installation of the bulb. A reduction of the propulsive power and hence a fuel economy of about 5—12 per cent, and in exceptional cases even more, can be obtained instead of a speed increase, if the same speed is maintained as was general before the installation of the bulb.—*O. Greger, Shipbuilding and Shipping Record, 15th January 1959; Vol. 93, pp. 73-76.*

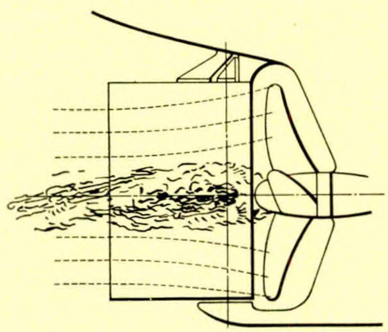


FIG. 1—*Flow of water from conventional propeller and rudder (left) and effect when Costa bulb is fitted (right)*

Study of Tube Expanding Process

This paper deals with certain aspects of the tube expanding process, which have been investigated using the test rig previously developed as part of a research sponsored by the British Shipbuilding Research Association. The factors investigated are (1) retubing, (2) the starting position of the roller cage within the tube, and (3) the initial clearance between tube and seat. A few tests are also reported on the relaxation of the joint with time. In the retubing tests, further tubes were expanded into seat plates used in previous tests, from which the original tube had been removed. The main conclusion was that seat pressures can approach the theoretical maximum in retubing, and that if an extra pass is made to take advantage of the work hardened seat, a stronger joint than in a first expanding results. To study the effect of the starting position of the rollers within the joint, four complete tests were made. The results show conclusively that a much stronger joint is obtained with less work, if the rollers start with their front ends almost at the back of the joint. Tests to study the effect of the initial clearance between tube and seat showed that clearance is not a major factor in joint strength.—*Paper by L. E. Culver and H. Ford, read at a meeting of the Institution of Mechanical Engineers on 20th February 1959.*

Dutch Built Cutter Dredge

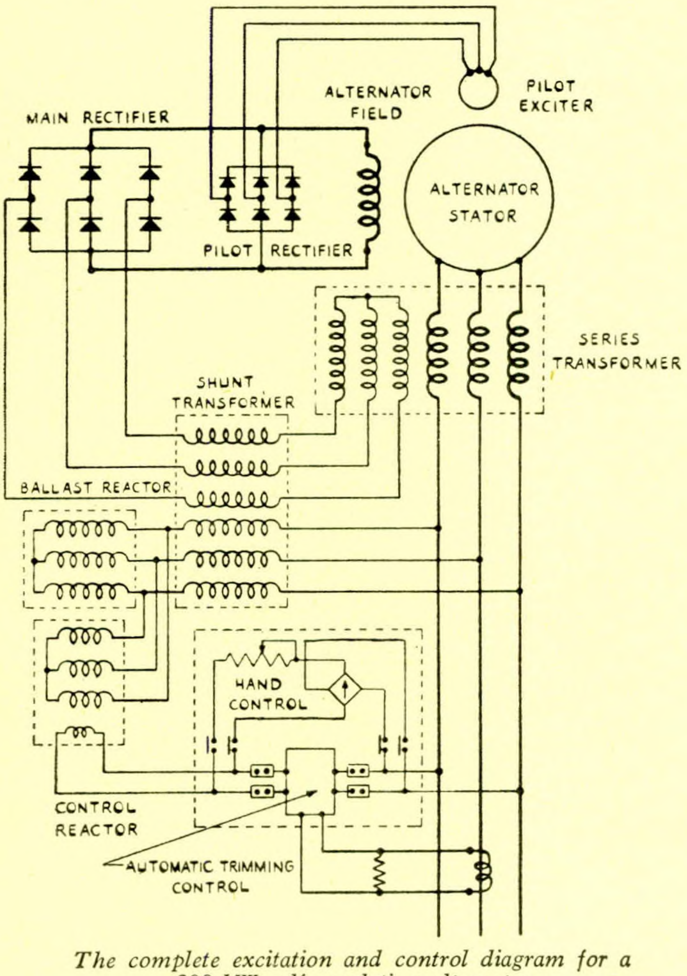
The cutter dredger *Barbados,* constructed by the N.V. Haarlemsche Scheepsbouw Maatschappij, Haarlem, for the Caribbean Dredging Company, Nassau, Bahamas, is the first dredger of typical American design to be constructed in Europe. Designed by the Erickson Engineering Co., Tampa, Florida, the craft is specially constructed for the removal of hard coral rock. The principal dimensions of the vessel are as follows: —

Length	167ft.
Breadth	39ft.
Depth to main deck	11ft.
Depth to superstructure deck ...	24ft.
Length of ladder	80ft.
Diameter suction and discharge pipeline	24ft.
Total installed power	4,000 b.h.p.

The craft has three engine rooms, divided by watertight bulkheads, respectively for the sand pump, the main engines and the auxiliary machinery. The 24-m. sand pump is of special American design and is built for heavy duty service in stone and rocky areas. It is driven by two 6-cylinder M.W.M. Diesel engines each of 1,000/2,000 b.h.p. Both engines drive the pumpshaft by means of hydrostatic torsional vibration damping couplings and a twin reduction gearbox. The hydrostatic couplings are combined with Airflex clutches. This combination by means of automatically operated valve protects the machinery for overloading. Between gearbox and sludge pump there are a geared coupling and a heavy duty thrust block. An Alco Sulzer 900-b.h.p. six-cylinder Diesel generator is installed to supply the d.c. current for the cutter motor. The cutter is driven by a 750-b.h.p. "General Electric" d.c. motor, fitted to the ladder. The revolutions of the cutter can be controlled from the bridge within the range of 0-30 r.p.m. The front winch is of the five-drum type and is of American manufacture. Two drums are for the anchor swing wires; two for anchor lifts and the fifth is for the ladder lift. The winch is driven by a normal 175-h.p. a.c. electromotor with a Heenan Dynamatic coupling and a reduction gearbox. This Dynamatic coupling has an electronic speed governor, which enables the dredging master to control the wire rope speed between 0 and 145ft. per min. This electronic device is only for speed adjustment and consumes current, equivalent to about 1 per cent of the motor power. The cutter is made of cast steel and the teeth are face hardened. The diameter is 6ft. 6in. and the weight is 7·5 tons.—*Holland Shipbuilding, December 1958; Vol. 7, pp. 40-42.*

Self-regulating Marine Alternator

A self-regulating alternator has been developed by W. H. Allen, Sons and Co., Ltd., to meet the shipowners' requirements for a unit capable of accepting the relatively high starting currents of large squirrel cage induction motors without causing a heavy voltage dip over an extended period. Although of conventional construction the alternator is designed to promote the required voltage response characteristics. A major break from conventional design is the replacement of the shunt-wound d.c. exciter by a static excitation system of transformers and rectifiers in which shunt and series elements are combined to produce inherently an alternator field current approximately similar to that required for normal voltage. A static automatic trimming regulator maintains the degree of steady rate associated with marine practice. Basically the operational principle of the alternator is that of phase-compensated, line-current-compounding with static self-excitation, the required excitation power being taken from the output of the alternator. The field winding of the alternator is supplied from a three-phase, full-wave rectifier whose input is derived from the series connected secondary windings of two three-phase transformers. Of these, the hunt transformer has one side of its primary winding connected to the output terminals of the alternator while the neutral side is connected to a ballast winding. Output current from the alternator is carried by the primary winding of the second or series transformer so that the input voltage to the rectifier is the vector sum of the two separate voltages developed in the secondary winding of the two transformers. The output voltage from the shunt transformer is proportional to the alternator terminal voltage, directly opposite to it in phase, and arranged so that acting alone it is sufficient to produce the alternator field current necessary for normal voltage on open circuit. On load, an additional voltage, V_{SE}, lagging on the load current by 90 degrees is developed in the secondary winding of the series transformer. The vector sum, or resultant, V_R, of these two shunt and series produced voltages is applied to the alternator field winding *via* the rectifier. By combining vectorially before rectification the two separate a.c. voltages referred to in the foregoing the required degree of phase-compensated compounding is obtained. Thus, with the suitable co-ordination of the alternator and excitation component design the alternator output voltage can be maintained approximately constant over a satisfactory range of loads and power factors. As a precaution against the possibility of the automatic trimming control sustaining damage, a manual control unit, comprising a small auxiliary rectifier and regulator, is provided, together with an auto/manual changeover switch. —*The Motor Ship, February 1959; Vol. 39, pp. 546-547.*



The complete excitation and control diagram for a 380-kW self-regulating alternator

Tests on Light Alloy Stiffener Sections

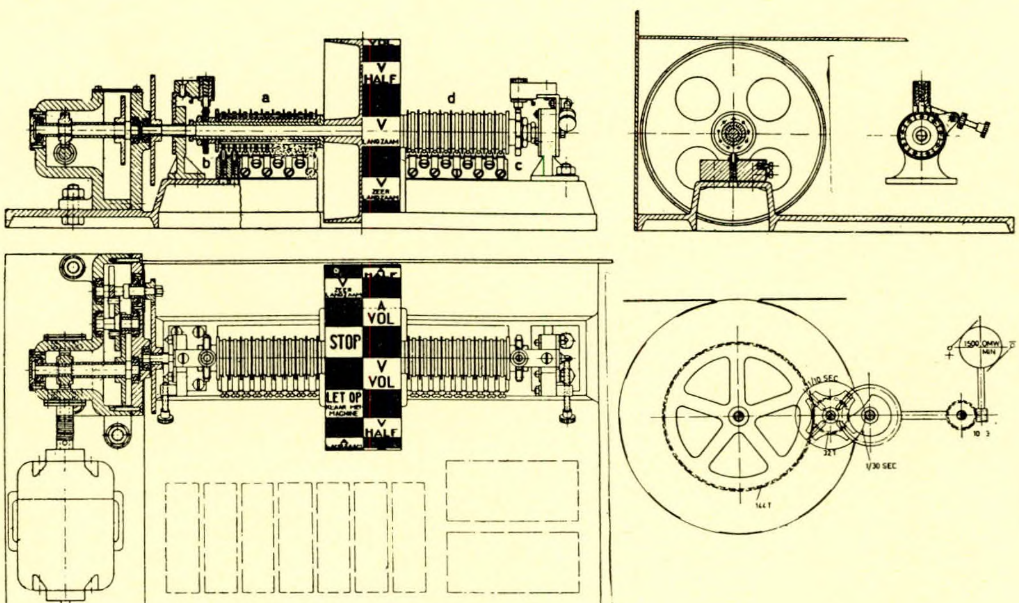
The range of light alloy sections now available for marine purposes has been developed during the past ten years. To expedite this development in the initial stages, the British Shipbuilding Research Association undertook the testing of a series of stiffener sections designed by Dr. W. Muckle. The sections concerned were 9-in. channels and bulb angles, each in a range of web thicknesses. Bars were extruded from both the shipbuilding alloys N.6 and H.30 and two types of test were carried out to determine their suitability for use in shipbuilding: structural tests at Glengarnock, described in Part 1, for which the sections were connected to plating with ¾-in. hot driven aluminium alloy rivets and provided with various forms of end connexion: and shipyard forming tests at the yard of Alexander Stephen and Sons, Ltd., to determine the workability of the material, which are described in Part 2. The Glengarnock test specimens were of 16-ft. span and loaded through the plating. The results show that within the elastic range the deflexions and stresses were for practical purposes proportional to the inertias and section moduli respectively. In tests to destruction carried out on the bracketed specimens with load applied to the clear side of the plating so that the brackets were in compression, failures occurred in the stiffeners themselves only in the section of N.6 alloy with the thinnest webs. In all the specimens in which light alloy angles were used to connect the brackets to the end structures of the machine, these were the first members to fail. When these were replaced by steel connecting bars of the same scantlings, failure occurred at a higher load as the result of buckling of the brackets. The only riveting failures occurred at very high loads and in no case were they the primary failure. The shipyard tests showed that all the sections were suitable for punching, joggling, and bevelling; the N.E.6 and H.E.30 bulb angles could be bent cold to a radius of about 6ft. in a bar bending machine, and the N.E.6 angle could be bent hot on the bending slabs to the same radius; but cold bending of the H.E.30 material on the slabs was possible only when the curvature required was small. The inner flanges of the channels buckled if they were bent by more than a small amount.—*Paper by M. N. Parker and K. V. Taylor, read at a meeting of the North East Coast Institution of Engineers and Shipbuilders on 28th November 1958.*

Photo-recording of Engine Orders and Movements

The Wilton Fijenoord Yard at Schiedam has developed and patented under the name Regitex a method of automatically recording the orders given from the bridge and the engine movements carried out by the engineer officer of the watch. This was devised in an effort to dispense with the time wasting job of entering up the so-called movements book to which, at best, can be attached little judicial value. From the outset the designer intended to avoid the use of a recording stylus on paper strips and to arrange for the recording to be done by photography. This has the inherent advantage of making a number of simultaneous records in a simple manner. For example a clock, with date indicator, may be arranged in the field of view so that the actual time may be recorded photographically. To this may be added the simultaneous readings of the propeller revolutions, the tachometer and even a rudder-angle indication. The orders from the bridge telegraph and the reply signals from the engine room telegraph are introduced into the area of view by means of an order drum. Instead of taking a continuous cinema film, the miniature casette-type camera is set to give a single exposure of the instruments assembled on the panel at each change in position of the telegraph handles. This greatly simplifies the control since, to investigate a specific period in a voyage, one only needs to look for the correct date on the filmstrip and to read the indications by means of the viewer. The negative in question can be produced at material evidence and can be enlarged if need be. The Regitex is fully automatic and is independent of any effort by the operating personnel. No alteration can be made afterwards because the very nature of the exposed filmstrip prevents fraudulent tampering; moreover, each small image is consecutively numbered. The film transport inside the camera is performed electrically, so that no rewinding of a clockwork motion is required. By using a 30-m. length of 16-mm. narrow film, 4,000 orders and replies can be recorded before the camera needs recharging. The orders from the bridge and replies from the engine room are transmitted electrically to the Regitex by means of contacts A and B. The Regitex is a column-shaped cabinet having a withdrawable framework carrying the instrument panel on which is mounted a slave clock, electrically driven by the ship's chronometer, an indicating instrument for the tachometer and the electrical exposure counter. The order and reply drums are also mounted with their relays in this framework. The dials of all these instruments are viewed through an aperture in the upper part of the column. The order drum is set into motion by a worm geared electric motor with an output shaft speed of 7·5 r.p.sec. An intermittent (Maltese Cross) sprocket and a set of reduction wheels between the worm wheel shaft and the order drum give a step by step transmission. The orders and replies are arranged on the circumference of the drum as shown. The left hand column corresponds with the orders from the bridge telegraph and the right hand column with the replies from the engine room telegraph. The indications in these columns are staggered in relation to each other so that at any one position of the order drum only one order/reply signal is visible through the aperture of the instrument panel. The drive to the order drum is such that at one revolution of the worm wheel shaft the order drum is turned through one small division and the indication upon it stands still for 1/10th second before the order drum continues its turning.—*From J. Lammers, Schip en Werft, No. 17, 1958. The Marine Engineer and Naval Architect, February 1959; Vol. 82, pp. 74-76.*

Strength Calculation of Marine Propellers

The development of modern screw theories in the last few years has made possible the determination of dimensions and hydrodynamic properties of marine propellers through calculation. The need to increase the accuracy of the strength calculation of the propeller blade has simultaneously arisen. This is because the optimum efficiency and cavitation properties can only be obtained if the blade sections at every radius are made as thin as possible. The development of the strength calculation should therefore keep pace with the hydrodynamic theory. The theoretical development of the strength calculation, however, encounters serious difficulties as a result of the composite load and the intricate shape of the propeller blade. The method based on the elementary beam theory is still the only one which can be used in practice. The shell theory, introduced by Cohen for the calculation of helicoidal shells, has not yet been prepared for practical application. A survey is now given of the method of strength calculation of the propeller blade, based on the elementary beam theory and of the practical



Details of the recording head and driving mechanism development of this method. The various factors which determine the stress in a section are successively discussed. Several possibilities are given for the standardization of the load, together with indications for the choice of the permissible stress.—*R. Keyser and W. Arnoldus, International Shipbuilding Progress, January 1959; Vol. 6, pp. 20-36.*

Dutch Nuclear Powered Tanker

A plan for the installation of a nuclear reactor for the propulsion by atomic energy of an existing tanker has been announced by the Stichting Kernvoortstuwing Koopvaardijschipen (Foundation Nuclear Propulsion Merchant Ships). This Foundation, in which Netherlands shipowners, shipbuilders, the Technical University, Delft, the Institute T.N.O. and the Reactor Centrum Nederland co-operate, has abandoned earlier plans for the construction of a nuclear powered tanker on account of the high costs. The present plan concerns the use of an existing turbo-electrically driven tanker of a deadweight of either 16,600 or 18,000 tons as a test, research or laboratory vessel by building a reactor of limited output into one of the cargo tanks so that much needed practical experience could be gained. Two types are being considered: (A) A tanker with a single turbogenerator supplying the full power to the propulsion motor; (B) A tanker having two turbogenerators, each supplying 50 per cent of the electricity required for propulsion purposes. It has been considered that the reactor with accessories and shielding—1,100 tons—should be located slightly aft of amidships in the central compartment of one of the original cargo tanks. It is necessary that both the loaded and unloaded vessel—such with a view to the placing in a drydock—obtain a good trim, avoiding an excess of trim by the stern. The location somewhat aft of amidships close to, but not underneath the accommodation, offers advantages with respect to the safety of the crew, while in heavy weather this part of the ship is easily accessible. The instrumentation of the reactor can be located in one of the wing tanks adjoining the central compartment, the turbogenerator and accessories being placed in the other wing tank. The three compartments are separated from the fore and after parts of the vessel by cofferdams. The electricity to be supplied by the turbogenerator is conveyed over the deck to the main switchboard. It has been found that a reactor of one of the existing types which may be considered, having a power up to 4,000-4,500 s.h.p., can be arranged in a central tank compartment. Assuming that a reactor of the pressurized water type is chosen, the installation will comprise: reactor vessel, shielding, heat exchangers, pumps, pressurizer, demineralizer and containment vessel. The principal dimensions of the compartment vessel are as follows:—

External height	10 m.
External diameter	8·25 m.

Steam conditions at the turbine inlet are:—

Pressure	20 atm.
Temperature	238 deg. C.
Superheat	25 deg. C.
Quantity	24 tons/hr.

—*Holland Shipbuilding, December 1958; Vol. 7, pp. 58-59.*

Design of Inflatable Liferafts

The inflatable liferaft is essentially a flat bottomed vessel of shallow draught. It differs from most waterborne craft in that it is affected to a greater extent by movement of the water surface, in the manner of a cork, and tends at all times to align itself to the conformation of the wave surface on which it rests. The primary purpose of such rafts is to provide a haven, for the victims of shipwreck, in comparative warmth and comfort until rescue by other craft. As such it is not usual to provide means of propulsion, though provision may be made for the fitting of outboard engines if desired. On the contrary, it is customary to deploy a sea anchor to reduce drift to a small amount, but, in the event of land being close at hand and with an on-shore wind blowing, the drogue may well be retrieved in order to accelerate the drift ashore; a drift speed of 2 knots will allow the raft to make good roughly 50 miles a day, apart from tidal currents. The buoyancy of a liferaft is generally assumed to be equivalent to the volume of the actual buoyancy tubes, excluding any or all canopy support tubes. In practice the buoyancy is equal to the total weight supported and is due, in relatively small part only, to that portion of the support tubes immersed, the remainder being supplied by that part of the passenger compartment below the water surface. The reserve buoyancy is, in consequence, not easy to define. Both buoyancy and reserve will obviously be affected by the presence of water that may gain entry to the raft. It is highly desirable that the buoyancy system should be so arranged that, in the event of a leak developing, complete deflation shall not take place, and this means that either more than one tube is employed, or one or more baffles, preferably fitted with non-return valves, divide the tube into two or more compartments. A favoured arrangement, which meets these requirements, is the twin buoyancy, or figure-of-eight, system in which two separate tubes are mounted one above the other. In the event of one chamber becoming damaged the second tube is adequate to support the full load complement and there is no loss of usable floor space. The approximate halving of the freeboard might be serious in all but calm water, unless the canopy can be made watertight. Perhaps the optimum arrangement is a compromise between the single and twin buoyancy, consisting of the "double-bubble", in which neither tube is a complete circle and they are joined by a common wall. This arrangement has the advantage of the twin buoyancy, with one chamber out of action, and can be made to show a saving of material, though there is a slight decrease of freeboard.—*Paper by C. H. Latimer-Needham, read at a meeting of the Institution of Naval Architects on 15th January 1959.*

Longitudinal Strength of Tankers

This paper deals with a few of the more important considerations which have to be kept in mind when determining the scantlings and arrangements of the very large tankers which are now being built or which are contemplated; these considerations, however, are of general application to all sizes of tankers, for the design of the oil tanker is not affected greatly by the size. The paper describes the practice adopted by Lloyd's Register for determining the section modulus of large tankers. Account is taken of both the still water bending moment and the wave bending moment and the paper indicates the bases adopted for determining these two components, and the stresses which are associated with them. Some remarks on the effect of design features on the still water bending moments, on the disposition of the material in the midship section, and on the local strength of the main hull girder, are made.—*Paper by J. M. Murray, read at a meeting of the North East Coast Institution of Engineers and Shipbuilders on 14th November 1958.*

Manufacture of Marine Oil Engines

In this paper the author has not attempted to describe all the processes in the manufacture of a Diesel engine: the scope is too wide. It has been necessary to confine the observations to general lines and to emphasize only those principles which appear to open up possibilities of progress and improvements in technique. A good deal of attention is paid to the mechanization of fabrication and the combining of heavy machine tools for their special application to the problem of machining the large components for direct drive Diesel engines. In view of the prime importance of machining processes in the production of marine engines, a large proportion of the paper deals with machine tools. While most of this plant would have a general application in any branch of heavy engineering, its particular suitability for marine engineering is emphasized. —*Paper by J. E. Smith, read at a meeting of the North East Coast Institution of Engineers and Shipbuilders on 13th February 1959.*

Cylinder Wear in Marine Diesel Engines

If in a marine Diesel engine chromium plated liners are used and if this engine runs on a fuel with a high sulphur

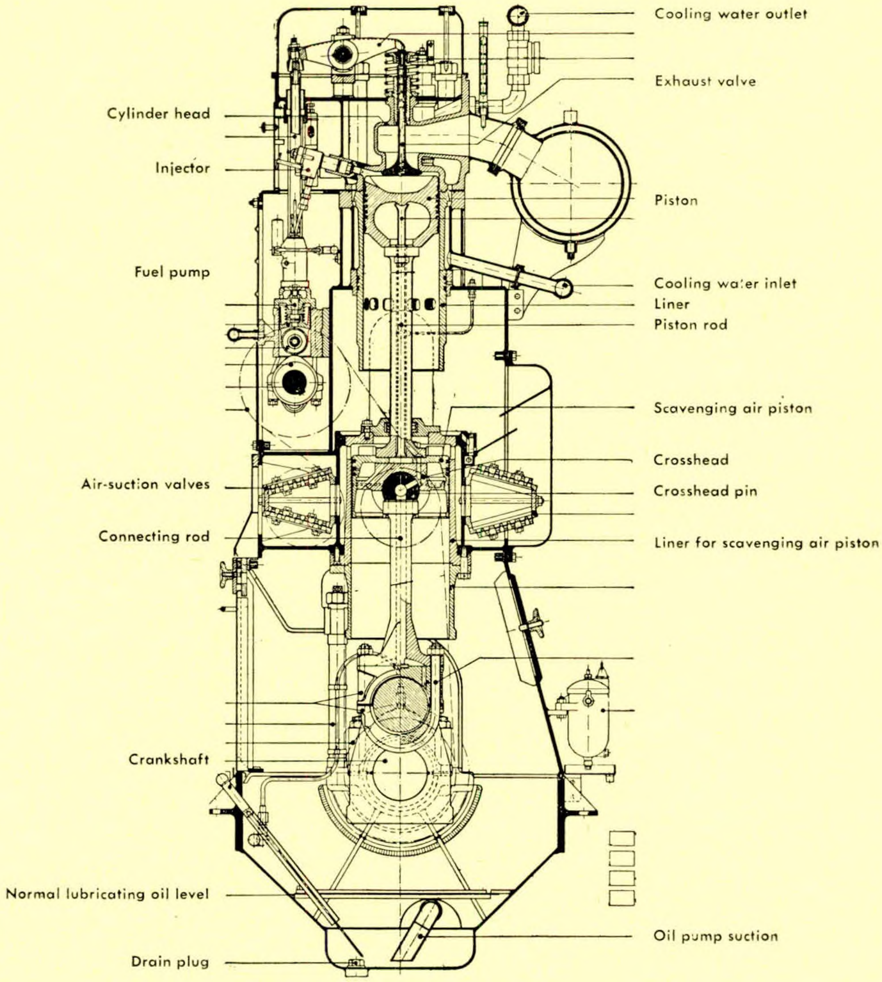


FIG. 4—*Cross section of the Bolnes test engine*

content, a difference in potential between the cylinder wall and the piston can be measured. This potential difference is due to the existence of a galvanic cell formed by the chromium plated wall and the cast iron piston rings with an acid oil film on the wall as electrolyte. From the results on a test engine it could be calculated that an important part of the corrosive wear of the chromium plated liners is due to the action of this cell. The test engine used for these measurements was a stationary two-cylinder, single acting, two-stroke crosshead Bolnes engine with a bore of 190 mm. (Fig. 4). This medium speed engine (430 r.p.m.) with 50 h.p. per cylinder is very suitable for experiments on cylinder wear because of insensitivity to fuel quality and the completely separated cylinder lubrication. As the composition of the oil film on the cylinder wall is important in the study of cylinder wear, drip trays were fixed to the bottom of the liners with drainpipes leading outside the engine. In this way the cylinder oil that runs down from the wall could be collected at regular intervals. The samples were analysed at once on their water and sulphuric acid content. Another modification in the construction of the engine was necessary to make sure that the measured differences in potential originated indeed from the system piston cylinder. Therefore the piston has to be electrically insulated from the piston rod. It was found that as soon as the engine runs under normal conditions of speed, load and cooling water temperature, the cylinder wall is about 300-400 mV negative relative to the piston near T.D.C. and becomes positive at about 100 mm. from the top. Somewhat farther than halfway down the expansion stroke the difference in potential is negligible.—*W. A. Schultze, International Building Progress, December 1958; Vol. 5, pp. 566-576.*

Sea Trials on Passenger Cargo Liner

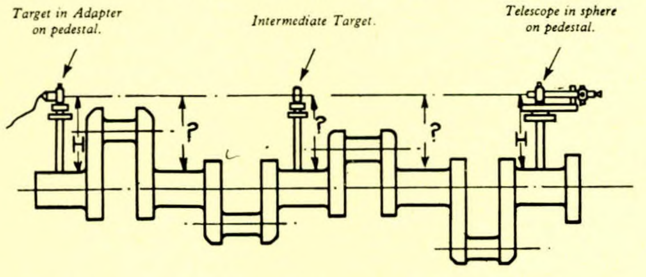
It is now generally recognized that an adequate instrumentation on board is very useful for the analysis of both measured mile and service performance trials. The author attended these trials on two ships of the same service speed, about 16 knots, but with very different block coefficients. One was a passenger cargo liner with a block coefficient of 0·672, the other a large tanker with a block coefficient of 0·770. The ships were equipped with torsionmeter and pitometer log. The results of the analysis of measured mile trials are given and compared with the predicted power derived from tank tests. The effect of fouling and deterioration of the hull as well as the effect of weather on power and speed are established from an analysis of service data. Most of the data were obtained in the nearly fully loaded condition, although a less important number of observations enabled the effect of weather in the medium loaded condition to be fairly well estimated. Information is also given on the power that can be developed in a heavy sea without damage to the ship. In the case of the large tanker, details are given of the velocity distribution within the boundary layer measured by means of the pitometer log.—*Paper by G. Aertssen, read at a meeting of the North East Coast Institution of Engineers and Shipbuilders on 23rd January 1959.*

Abrasion Soldering of Aluminium

Abrasion soldering of aluminium, also called "rub-soldering" and "friction soldering", with high zinc content solders is a very useful and relatively old technique which, until recently, has been used primarily in the filling and sealing of castings. At temperatures above 700 deg. F., the high zinc solders become molten and alloy readily with aluminium when the aluminium surface is subjected to a slight abrading action under the molten solder. Joints can then be made either immediately or at a later time using the zinc coated area as a base. Since the joining temperature is above 700 deg. F., the operation is referred to generically as "hard soldering" in contrast to "soft soldering" which is performed at joining temperatures below 700 deg. F. and usually around 400 or 500 deg. F. This is the conventional lead tin soldering range. On a temperature scale, "hard soldering" is below brazing, which is generally classified as joining at temperatures above 1,000 deg. F. and, like soldering, entails no melting of the base metal. In contrast to brazing, welding processes involve melting of the base metal. In joining aluminium, the filler metals used for brazing and welding consist primarily of aluminium. Aluminium solders contain either minor proportions of aluminium or no aluminium. Therefore, soldered aluminium joints are more dissimilar galvanically than either brazed or welded joints; and, accordingly, soldered joints are inherently the least corrosion resistant of joints prepared by the three joining methods. The advantages of soldering stem from the fact that the operation is performed at relatively low temperatures with comparatively simple equipment. A list of the properties of some high zinc solders is given. After a consideration of these properties, the value of high zinc abrasion soldering as a joining technique for aluminium can then be assessed by considering both the advantages and the disadvantages of the technique.—*O. R. Singleton, Jr., Welding Journal, January 1959; Vol. 38, pp. 34-36.*

Optical Alignment

Taut piano wire has for many years been the usual method of aligning the major components of all types of marine engines and, even today, the "old school" maintain that this method is most satisfactory. Remarkable results have been achieved, it is true, for the machinery of some of the most important ships in the world has been set out in this way. Nevertheless it is a slow method and one calling for considerable experience and an operation which should preferably be performed by one man so that the same "feel" can be applied throughout. Over long distances there is the additional complication of allowing for the sag in the wire. A method which



Diagrammatical principle of checking alignment of crankshaft bearings without dismantling engine

makes use of a fundamental physical law is becoming increasingly popular in many fields of engineering. This is the micron alignment telescope which is proving itself a production tool by cutting the time for the operation in half and by producing a finished result which is more accurate and consistent and is, as far as possible, independent of human errors. The optical axis, or line of sight, of a telescope is arranged so that it is parallel with the outer diameter of a stainless steel, precision ground tube. This accuracy is held to within 0·00025in. and 3 secs. of arc. Integral optical micrometers enable the vertical and horizontal displacement of the target or collinator from the correct line of sight to be read in thousandths of an inch. Readings can be taken at distances as short as desired and can be repeated to within ±0·002 at 100ft. and proportionately for longer or shorter distances. The front cover glass has a graticule which can be used with an auto-reflection attachment for setting-off or checking angles and squares. Considerable use is made of the micro-alignment telescope by the Wallsend Slipway and Engineering Co., Ltd., and John Brown (Shipbuilders), Clydebank, in the erection programme for Doxford type engines. Here the telescope is used to measure and control the alignment of bedplate and crankshaft main bearings during the initial erection in the shop, again during installation on board, and finally after trials. The first stage is to establish a straight datum line between No. 1 bearing and the thrust bearing and to measure the height of all intermediate bearings relative to this datum, which is set above the crankshaft centre line at a height which permits a clear line of sight through the engine, even when all the connecting rods are in position. When only the crankshaft is in position the telescope and adjusting fixture are mounted over No. 1 bearing on a stand having a foot which passes through the oil hole in the bearing cap so that it locates on the crankshaft journal diameter. The datum target in its holder is mounted on a second stand similarly located on the diameter of the thrust bearing. These stands are specially made so that the telescope and target centres are at equal heights above the crankshaft centre line. The telescope micrometers are set at zero, and the adjusting fixture screws are used to aim the telescope on to the datum target so that the target pattern is central with the telescope cross wires. An intermediate target holder, identical to the datum target holder, is now set up on a stand, of equal height to that of the telescope, and located on the diameter of No. 2 bearing. The telescope is refocused on this target and the micrometer is used to measure the vertical displacement of the target centre from the datum line of sight. Slight discrepancies in the radial position of the main bearing cap oil holes make it necessary to slide the intermediate target holder sideways until it is laterally in line with the telescope vertical cross wire. This is done, of course, before the micrometer height reading is taken in order to eliminate errors due to rotating the telescope cross wires. The intermediate target holder is now transferred to No. 3 bearing and the height reading is recorded as before. It was found advisable to recheck the datum line setting between taking readings on the intermediate target. This is simply done by refocusing on to the datum target with the micrometer reset to zero. The adjusting fixture screws are used to correct any error that might be caused by heavy vibration or major redistribution of weights adjacent to the engine. All other intermediate bearings are checked in a similar way. The principle of checking the bearings remains the same except that the telescope mounting is altered slightly in order to allow all adjustment controls to be accessible from the outside of No. 1 column while retaining the location of the No. 1 bearing.—*The Marine Engineer and Naval Architect, February 1959; Vol. 82, pp. 53-56.*

Largest Vessel Built in Belgium

The largest vessel ever built in Belgium was completed last December by Société Anonyme Cockerill-Ougrée, Hoboken, Belgium. This vessel, the *Caltex Cardiff,* is an oil tanker of 31,244 tons d.w., ordered by Overseas Tankship (U.K.), Ltd., London. She is a single-screw vessel powered by geared turbines. During sea trials a speed of 17·36 knots was attained. The propelling machinery was built at the Cockerill-Ougrée engine works at Seraing, Liège. The principal particulars of the *Caltex Cardiff* are as follows:—

Length o.a....	665ft. 6in.
Length b.p....	637ft. 1in.
Breadth, moulded	84ft. 6in.
Depth, moulded to main deck	45ft. 10in.
Draught	34ft. 6¼in.
Deadweight...	31,244 tons
Gross tonnage	21,877 tons
Net tonnage	13,830 tons
Machinery output... ...	15,400 s.h.p.
Service speed	17 knots

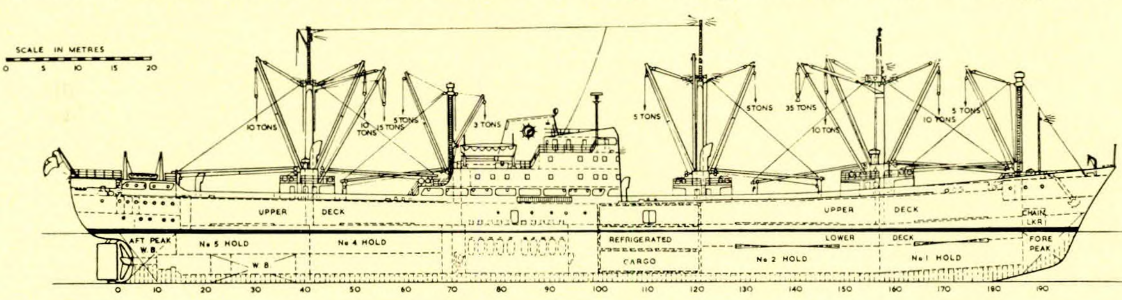
The *Caltex Cardiff* has been built to the classification Lloyd's Register 100 A.1 "for the transport of petroleum in bulk". She is longitudinally framed and has two longitudinal bulkheads, the cargo spaces being divided into 30 tanks, the total capacity of which is 1,536,189 cu. ft. Ten of these tanks are used permanently for water ballast and are protected against corrosion and erosion by the Guardion system patented by F. A. Hughes and Co., Ltd. On deck there are eight steam driven automatic self-tensioning mooring winches, a non-automatic steam driven mooring winch, two steam driven cargo winches, and a steam driven anchor windlass. There are also four 5-ton derricks, one 1-ton derrick and three Schat 1-ton davits for handling stores. Four lifeboats are carried in single pivot gravity davits, two amidships and two aft. All are of glass fibre construction and two of them have Diesel propulsion. The propelling machinery consists of a set of Cockerill-Ougrée-Parsons compound turbines with double reduction gearing. The service output of the machinery is 14,500 s.h.p. at 100 r.p.m. of the propeller, and the maximum output 16,000 s.h.p. at about 103 r.p.m. The propeller is of aluminium bronze with five blades, and has been supplied by Lips N.V. Steam is supplied by two Foster Wheeler D-type watertube boilers having a steam pressure of 750lb. per sq. in. with outlet conditions of 650lb. per sq. in., and a temperature of 875 deg. F. Each boiler has a total heating surface of 12,940 sq. ft. and an output of 85,000lb. of steam per hr. The boilers are equipped with Todd burners, Clyde Electromak automatic soot blowers and Bailey automatic combustion control.—*The Shipping World, 4th February 1959; Vol. 140, pp. 172-173.*

Spanish Built 17-knot Cargo Liners

Spanish shipyards have a larger tonnage of ships on order at present than at any previous time in the history of shipbuilding in Spain, and some are now being built for foreign owners, including British shipping companies. About two years ago the Flota Mercante Grancolombiana, which company has a fleet of about 20 ships, all Diesel driven, and for the most part built since the war, placed an order with the Astilleros de Sevilla for four cargo liners. They were notable for the fact that the speed was higher than previously employed and the ships were designed for 17 knots with full cargo. The first of the vessels to be completed was the *Ciudad de Pasto.* The second, the *Ciudad de Guayaquil,* is also in service, and the third, the *Ciudad de Armenia,* has been launched. In addition, Spanish owners have contracted for two similar ships. The main details of these vessels are as follow:—

Length overall ...	475ft. 0$\frac{7}{8}$in. (148·80 m.)
Length b.p.	439ft. 7$\frac{11}{16}$in. (134·00 m.)
Moulded beam ...	62ft. 1$\frac{1}{8}$in. (18·90 m.)
Depth to shelterdeck...	35ft. 9$\frac{3}{8}$in. (10·90 m.)
Draught	23ft. 9in. (7·26 m.)
Deadweight capacity (without fuel, etc.)...	8,000 tons
Machinery	7,300 b.h.p.
Speed fully laden ...	17 knots

The vessel has five holds, three forward and two aft of the machinery compartment, No. 3 being wholly refrigerated. The total capacity is 402,000 cu. ft. (11,260 cu. m.) for general cargo and 62,000 cu. ft. (1,740 cu. m.) refrigerated cargo. There are 16 electric winches capable of handling 5 tons, the motor in each case being of 50 h.p., and two which can deal with loads up to 8 tons. The windlass is electrically driven, the motor being of 53 h.p. In the refrigerating machinery compartment amidships on the lower deck are four Freon 12 Vizcaino-Worthington compressors driven by 45-h.p. motors and four salt water pumps with a capacity of 33 tons per hr. with motors of 7 h.p. The propelling engine is of the Sulzer type and has 10 cylinders, 720 mm. in diameter, the output of 7,300 b.h.p. being developed at 132 r.p.m. Current is supplied by three Sulzer engined 300-kW d.c. dynamos running at 500 r.p.m. and there is a harbour unit of 60 h.p. coupled to a 35-kW dynamo and to a compressor. The engine auxiliaries include two 225-tons per hr. fresh water pumps and two of 390 tons per hr. for salt water, in addition to two fuel valve cooling pumps.—*The Motor Ship, January 1959; Vol 39, p. 496.*



8,000-ton m.s. Ciudad de Pasto

Dutch Built Motor Trawler for French Owners

The motor trawler *Jean Maurice,* built by Scheepswerf "De Dollard" Landsmeer, is the first of two similar ships to be constructed for French owners. The ship has been designed for deep water fishing in the Atlantic Ocean. The principal dimensions of the ship are as follows:—

Length overall	41·50 m.
Length b.p.	36 m.
Breadth moulded...	7·50 m.

The ship is provided with an insulated fish hold with a capacity of 180 cu. m. The main propulsion machinery consists of a supercharged M.A.N. Diesel engine type G8V 30/45 and developing 1,000 h.p. at 350 r.p.m. This engine drives through a Wulfe flexible coupling the mechanically controllable pitch propeller of the *Bretagne* type. The engine is directly reversible and the propeller pitch setting ranges between the positions "towing" and "running free". The trawl winch, which is of the Robertson type, has a nominal pull of 6 tons with a hauling speed of 70 m./sec. The maximum pull is 10 tons. The trawl winch is driven by a Garbe-Lahmeyer electric motor of 110 h.p. at 220 volts, having an electro-magnetic brake of 150 kg.m., by means of Ward Leonard control.—*Holland Shipbuilding, December 1958; Vol. 7, pp. 37-38.*

Organic Moderated Reactors

The Organic Moderated Reactor Equipment (OMRE) was designed and built by Atomics International as a part of the U.S. Atomic Energy Commission's programme for the development of nuclear power. It began operation in September 1957, and is rated to produce 16,000 thermal kilowatts. This new approach to power from the atom utilizes a high boiling point hydrocarbon as the neutron moderator and reflector and as the heat transfer fluid. This type of reactor has a number of outstanding advantages. It is compact in size, and yet can be designed to attain relatively high temperature operation at a low reactor pressure of only a few atmospheres. There is no chemical reaction between the organic coolant and uranium nor between the coolant and water. Because of the low pressure and the chemical property of the coolant, and because of the inherent safety features of this reactor concept, no special containment building is required, and simple low cost construction is possible with the use of ordinary materials. Furthermore, low induced radioactivity in the organic coolant simplifies maintenance of the entire heat transfer system. Lastly, reasonably efficient operation is attained through the production of superheated steam. A design study was recently completed for the U.S. Maritime Commission and the U.S. Atomic Energy Commission. Results showed that with additional development the OMR plant can become economically competitive with conventional power for the propulsion of tankers.—*The Marine Engineer and Naval Architect, February 1959; Vol. 82, p. 69.*

Heated Bridge Windows

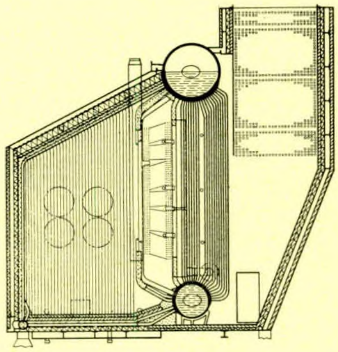
The formation of mist or ice on the navigation bridge windows of ships sailing in sub-zero temperatures can be a serious drawback, and may even bring them to a standstill. Several schemes have been devised to overcome these difficulties, including double glazed windows, the use of hot air and de-icing fluids, and electric heating methods. With the latter method electrical energy may be used to generate heat, and if this heat is distributed uniformly over the window without obstructing vision, an effective method of eliminating both mist and frost may be provided. Two methods of achieving this have been developed, one by means of a fine grid of resistance wires and the other by a transparent film of gold. Triplex laminated glass consists of two or more pieces of glass tightly adhering to plastic interlayers, and is an ideal medium for the incorporation of an electric heating element. With the electrically wired system a close spaced grid of extremely fine wires is embedded in the plastic. These wires are either 0·0008in. or 0·001in. diameter and are spaced at 40, 60 or 80 wires per in., depending upon the power input required and the available voltage. For ships' bridge windows, where the surface area is comparatively large, the heating grid of wires is subdivided into several banks, so that voltages of 110 or 230 may be used directly on a panel. The fine heating wires are invisible by daylight, but although they are oxidized to a dark blue colour, they nevertheless tend to diffract point sources of light. However, this is not sufficient to prevent them from being used for ships' bridge windows. Leads from the heating wires are brought out on one of the vertical sides or the top of the panel so that the condensed moisture does not interfere with the insulation. In order to overcome the diffraction effects referred to above, to provide a heated window with a higher resistance which can be conveniently run off higher voltage supplies and to provide absolutely uniform heating over a given area, the Triplex Safety Glass Co., Ltd., has developed a method of coating glass with a uniform, conductive, transparent gold film. With this method a combined film of gold and metal oxide is deposited electrically on glass in a vacuum chamber. The gold film is only two ten-millionths of an in. thick, is perfectly clear and exhibits a very pale straw colour which only absorbs 5 to 8 per cent of light. Nevertheless, such a film is capable of carrying up to 1,000 watts per sq. ft. if sufficient voltage is supplied. The gold film is applied to the inner face of one glass component so that it is protected from damage as well as being completely insulated in the finished laminated panel. The minimum glass thickness to which gold film can be applied is 5/32in. and to this must be laminated a second glass component so that the minimum total thickness of such a panel is 5/16in. The maximum size of flat glass panels to which this method of heating can be applied is 30in. by 42in. The power requirements for demisting or de-icing ships' bridge windows by this method range from 150 to 250 watts per sq. ft.—*The Shipping World, 4th February 1959; p. 179.*

Turbocharged Opposed Piston Unit

The first of a new Doxford range of marine Diesel engines covering outputs of from 5,800 b.h.p. to 10,800 b.h.p. is expected to run shop trials at the end of this year. This prototype unit will be an exhaust gas pressure charged engine and the series has been designed for higher speeds and greater mean indicated pressures than used in the existing range of Doxford engines. Subsequently, normally aspirated units will be produced, as there remain some owners who will still prefer the non-turbocharged units in the lower power ranges—of 3,000 b.h.p. to 7,000 b.h.p.—because of their simplicity. This new design of engine will be of the opposed piston design, with four cylinders having a bore of 670 mm., and design will commence shortly on an engine with a 800-mm. bore, to develop 9,000-16,000 b.h.p. in service, the latter output being obtained from six cylinders. The crankshaft is much shorter and stiffer than the present design and this has been accomplished by shortening the length of the bearings but increasing the diameters, consequently obtaining a greater overlap of the side crankpin and journals. Spherical bearings as such have been completely eliminated in view of the rigidity of the crankshaft and the short length of the bearings. The cylinder liners are being constructed in two pieces, the upper and lower ends containing the exhaust and inlet ports respectively, and these are clamped by means of the upper and lower jacket to a central cast steel combustion space. The rigid crankshaft with a natural frequency of torsional oscillation more than double that of the present crankshaft and a similar higher frequency of axial vibration should preclude the need of a detuner on engines of less than six cylinders. A pad has been placed on the connecting rod directly under the piston rod, to take some of the load direct and to reduce the loads on the side bearings. It is believed that the direct transmission of the loads will prevent deflexion.—*The Motor Ship, January 1959; Vol. 39, p 461.*

Babcock Boilers for American-built Supertankers

A group of 60,000-ton d.w. tankers, *Sansinena, Torrey Canyon* and *Lake Palourde,* building at the Newport News Shipbuilding and Drydock for the Barracuda Tanker Corporation, for eventual charter to the Union Oil Company of California, are fitted with the latest type of American Babcock and Wilcox two-drum boilers. These are somewhat similar to the



Section through one of the 40-ton boilers

integral furnace type of boiler built by the Babcock Company in this country but, as the accompanying illustration shows, the main generator tube stack is vertical. Two of these boilers per ship will each supply 91,000lb. of steam per hr. at 850lb. per sq. in. and 860 deg. F. to the 25,000 s.h.p. geared turbine set. The boiler efficiency is 88 per cent. As the accompanying drawing shows, the boiler is of all-water wall pattern with a superheater bank after the first group of generator tubes and an economizer in the uptake.—*The Marine Engineer and Naval Architect, February 1959; Vol. 82, p. 84.*

Combined Research on Shipping Reactor

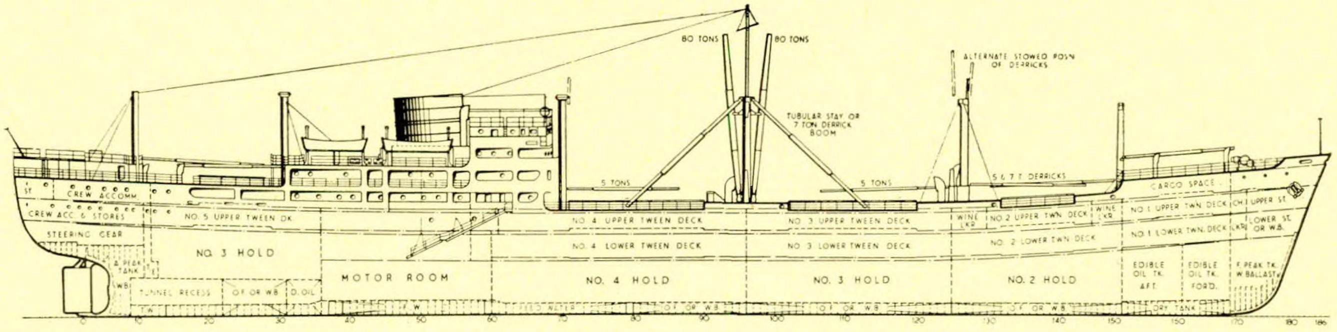
The agreement on nuclear research signed by Britain and 11 other European countries in Paris should have the effect of linking the British nuclear power industry more closely to its potential European markets. This agreement is particularly important in the marine field, as the type of reactor concerned is the high temperature gas cooled reactor which is thought at present to have the best long term prospects as an economic nuclear power unit for merchant ships. The 11 nations comprise the six in Euratom (France, West Germany, Italy, Belgium, Holland and Luxembourg), together with Sweden, Norway, Denmark, Switzerland and Austria. They are to co-operate with Great Britain in a project, to be called "Dragon", for the construction and testing of a high temperature gas cooled reactor at the Atomic Energy Authority's station at Winfrith Heath, Dorset. Great Britain will bear the larger part of the cost of the project, and will retain the reactor at the conclusion of the trials. The Dragon project is stated to be concerned with the development of the high temperature gas cooled reactor for nuclear power station and other applications; but in view of the potential of the reactor for marine use and the fact that eight out of the 11 countries co-operating with Britain have sizable merchant fleets, it seems certain that the shipping application will be kept well in mind. The project will last five years, and work on the construction of the reactor should begin this summer. Before then, the results of some preliminary British work on the subject will be made available to a panel of some 50 scientists from the 11 countries concerned, and they will decide on the design of the Dragon reactor in consultation with their British colleagues.—*The Shipping World, 18th February 1959; Vol. 140, p. 209.*

Cargo Liner of New Design

A cargo liner of new design has been delivered to Clan Line Steamers, Ltd., London. This vessel, the *Clan Maciver,* 9,780 tons d.w., has been built by the Greenock Dockyard Co., Ltd., and is the first of a new class of complete superstructure ships with tonnage openings now under construction for the Clan Line. The engine room is located between Nos. 4 and 5 holds, No. 5 being the aftermost hold, an arrangement which gives the ship an extensive area of clear deck space. The new ship has been equipped with heavy lift derricks, large holds, and tanks for carrying edible oil. Her Barclay Curle-Doxford engine gives her a speed in service of 14 knots. During her sea trials on 12th June a maximum speed of 15½ knots was attained. The principal particulars of the *Clan Maciver* are as follows:—

Length o.a.	502ft. 9in.
Length b.p.	455ft. 0in.
Breadth, moulded	61ft. 6in.
Depth, moulded to upper deck	38ft. 7½in.
Depth, moulded to main deck	30ft. 3¼in.
Draught	26ft. 4in.
Block coefficient	0·718
Deadweight	9,780 tons
Gross tonnage	7,350 tons
Machinery output	5,000 b.h.p.
Service speed	14 knots
Cargo capacity:	
Bale	581,157 cu. ft.
Grain	638,650 cu. ft.
Edible oil	602 tons

The *Clan Maciver* has four complete decks in way of No. 1 hold, three complete decks in Nos. 2, 3 and 4 holds and two in No. 5 hold. She has a raked, soft nose stem, cruiser stern, poop, extended bridge house and long forecastle erections. There are five main cargo compartments, one aft and four forward of the machinery space, with the lower deck continuous from the stem to the after end of No. 4 hold. There are seven main watertight bulkheads as shown on the accompanying drawing, with an additional oiltight bulkhead dividing the edible oil tanks. The double bottom is divided into seven compartments. The forepeak is arranged for the carriage of water ballast. Oil fuel or water ballast is carried in Nos. 2, 3, 4 and 5 double bottom tanks, and the total fuel capacity is about 1,065 tons at 38 cu. ft. per ton. In addition to twelve 5-ton, four 7-ton and two 15-ton derricks, there are two heavy derricks of 80 tons safe working load. These two derricks are supported from a bipod mast fitted between Nos. 3 and 4 hatches. The hatches are 48ft. and 50ft. 8in. long and 21ft. wide respectively. Each 80-ton derrick operates with four sets of guys. For the after derrick two guys are supported from samson posts at the after end of No. 4 hatch and are led to winches adjacent to the samson posts, and two guys supported from guy pillars at frame 96 and led to winches at the fore end of No. 3 hatch. For the forward derrick two guys are supported from guy pillars at frame 96 and led to winches at the after end of No. 4 hatch, and two guys are supported from guy pillars at frame 125 and led to winches at the fore end of No. 2 hatch. The 80-ton derricks are 64ft. long between the centre of the cast steel ball socket heel fitting and the head. For 80-ton lifts no standing rigging is required. The secondary 15-ton and 7-ton derrick tubes at Nos. 3 and 4 hatches are adapted as stays for the bipod mast: the derrick heels can be attached to a swivel at the mast head, and the derrick head attached to eyeplates on deck, thus forming stays. There are 18 electrically driven cargo winches. Twelve of these are standard type for handling general cargo, and four, in addition to normal duties, are also arranged to deal with lifts of 80 tons. Each pair of winches for the heavy lift derricks is mechanically connected by couplings through bevel and spur gearing to a central barrel, one barrel with its winches being used for hoisting, and the other heavy lift barrel with its winches being used for topping. One pair of winches with heavy lift barrel is situated at the port side of the vessel and the other pair of winches with heavy lift barrel at the starboard side. While each winch has its own controller, a selector switch is provided so that the heavy lift barrel can be operated by either of the winch controllers. When the selector switch is moved to either of the heavy lift positions, both winch circuits are prepared for driving in tandem on to the heavy lift barrel and controlled lowering is obtained in the lowering direction. In the event of supply failure or an overload on any one winch, both winches are brought to a standstill by means of the magnetic brakes. The controller is then returned to the "off" position to restore the control circuit feed. There is a position on the selector switch for use when the winches are used independently as ordinary cargo winches, in which case it is necessary to unbolt the heavy lift couplings. The four winches then become independent for working with their own centre barrel and will be individually controlled as 5-ton cargo winches. A switch is provided on each winch to enable



Cargo liner Clan Maciver

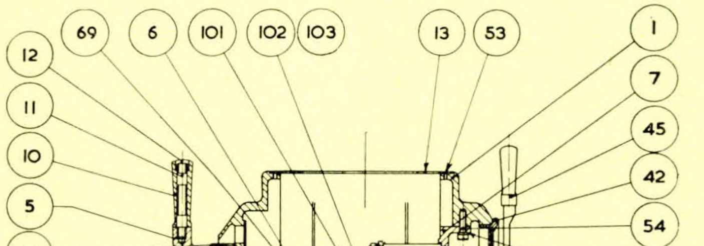
controlled regenerative lowering to be obtained if required. Clarke, Chapman and Co., Ltd., have also supplied two electric combined warping and cargo winches and an electrically driven windlass. The *Clan Maciver* is powered by a five-cylinder Barclay Curle-Doxford oil engine having a bore of 670 mm. and 2,320 mm. combined stroke. This engine develops 5,000 b.h.p. in service at 110 r.p.m. and is capable of a continuous service output of 5,400 b.h.p. Steam for oil fuel heating, domestic heating, oil purification and the oily water separator is obtained at a working pressure of 100lb. per sq. in. from a Cochran composite exhaust gas and oil fired boiler.—*The Shipping World, 28th January 1959; Vol. 140, pp. 151-154.*

British Trawler with Variable Pitch Propeller

Several owners of fishing vessels in the United Kingdom have ordered vessels fitted with variable pitch propellers, and the motor trawler *Kingston Beryl,* built by Cook, Welton and Gemmell, Ltd., Beverley, Yorkshire, for the Kingston Steam Fishing Company and now in service is the first British trawler to be fitted with this design of propeller. As the owners of the *Kingston Beryl* recently took delivery of the *Kingston* Pearl, a vessel of similar design with a fixed propeller, they are in a position to carry out a very close comparison between the two ships on a basis of operational results and maintenance. A trawler with a full catch makes port at the greatest possible speed and there is a tendency to push the main engine to the limit with only a nominal regard for the prevailing weather conditions. If the skipper is provided with a means of obtaining the correct propeller pitch relative to the condition of the sea, the vessel's speed will, within certain limits, be maintained without excessive stress on the main engine. There is another property of the variable pitch propeller which becomes apparent when the blades are in the neutral position, i.e., with the engine running and the vessel stationary when taking in the trawl net. The water from the blades is forced away from the ship's starboard side, and this is particularly helpful in keeping the net clear of the propeller and reducing any danger of fouling. The *Kingston Beryl,* which is built to Lloyd's Register's highest class, has the following main particulars:—

Length, b.p.	176ft. 6in.
Breadth, moulded ...	32ft. 3in.
Draught, mean	17ft. 6in.
Fishroom capacity ...	17,130 cu. ft.
Engine	1,450 b.h.p.
Service speed	13¾ knots

An important feature of the wheelhouse is the telegraph system. The telegraphs, which have been built by C. D. Holmes, Ltd., to the design of the Stone Marine Engineering Company, incorporate Westinghouse pneumatic equipment for operation of the Stone-KaMeWa variable pitch propeller. Each telegraph has two levers, one for normal bridge/engine room signalling and the other for the remote control of the propeller blade



The combined telegraph and propeller pitch control

1) Control head; 2 Control head; 3) Support column; 5) Indicator cover; 6) Cam; 7) Star piece; 8) Pillar; 10) Handle; 11) Spindle; 12) Cap; 13) Instrument panel; 15) Pulley box; 16) Double yoke link; 21) Securing pin; 22) Washer; 23) Bush; 25) Pitch spindle; 26) Air filter; 31) Indicator; 38) Pivot pin; 39) Scale; 42) Dial ring; 45) Handle; 46) Pointer; 47) Dial centre piece; 53) Screw; 54) Screw; 55) Washer; 56) Screw; 59) Lock-nut; 66) Screw; 67) Screw; 68) Screw; 69) Taper pin split; 87) Coupling; 93) Coupling cap; 94) Pin; 101) Pinion; 102) Bearing; 103) Washer.

pitch angle. If required, the propeller pitch may be altered from the engine room using a Bloctube control system. If the exhaust gas temperature of the main engine should rise above a safe level due to overloading, a Teddington Industrial Equipment Company's alarm system operates and draws the skipper's attention to the load on the engine. Propulsion is by a direct coupled, directly reversible, eight-cylinder, four-stroke, turbo-charged Holmes-Werkspoor main engine of the TMABSP-398 type. The rated power at 250 r.p.m. is 1,450 b.h.p., the bore and stroke being 390 mm. and 680 mm. respectively. A specially tuned exhaust system passes the gases to the Napier type MS.400/1 turboblower which, in turn, delivers air *via* a Serck S.W.-cooled cooler to the engine's air inlet valves. At the forward end of the engine room and positioned between two wing fuel bunkers is the 400-b.h.p., five-cylinder, turbo-charged Mirrlees engine driving the 240-kW Laurence Scott winch generator, which receives its excitation from the ship's own electrical system. This generator supplies power direct to the 300-h.p. Ward Leonard-controlled Laurence Scott trawl winch motor, positioned beneath the wheelhouse. Immediately forward of the wheelhouse is the C. D. Holmes trawl winch, with two main barrels fitted with warp spreading gear. All the engine room auxiliaries, with the exception of the boiler feed pump, are electrically driven and power is supplied by two 60-kW 220-volt generators, each driven by a three-cylinder Ruston engine of the VCZ type, the complete electrical wiring system for the ship being supplied by Broady, of Hull. For harbour duty there is a 15-kW generator driven by a three-cylinder Russell Newbery engine. The design of the Stone-KaMeWa propeller, manufactured by the Stone Marine Engineering Co., Ltd., permits the propeller to be removed without dismantling the rudder. This is achieved by withdrawing the cone nut, the propeller and bossing complete, and, finally, the very short tailshaft, which is fitted with a loose coupling on the inboard end. The pressure oil for propeller pitch movements is supplied by two electrically driven Imo pumps located at the after end of the engine room on either side of the shaft. One of these pumps is automatically unloaded when pitch changing has ceased. Both pumps take oil from a common lower tank and an upper tank is fitted so as to maintain a pressure on the system, including the propeller boss, at all times. Particulars of the propeller are as follows:—

Propeller diameter	8ft. $2\frac{7}{16}$in.
Propeller pitch	8ft. 0in.
Propeller blade area ...	22sq. ft.
Propeller material	Stone Novoston Alloy
Propeller boss diameter ...	3ft. 1in.
Propeller weight	3 tons 6 cwt. 2 qtrs.
Number of blades	4 (left handed)

—*The Motor Ship, February 1959; Vol. 39, pp. 514-516.*

Aluminium Alloy Hatch Covers

Hatch covers which can be lifted and carried easily by one man are a feature of the *Enugu Palm,* a motorship owned by the Palm Line, Ltd., of London, and built by Swan, Hunter and Wigham Richardson, Ltd., at their Neptune Shipyard, Walker, Newcastle on Tyne. The hatch covers, which are of all-welded aluminium construction, have been manufactured by Saunders-Roe (Anglesey), Ltd. The design of these covers has received the approval of Lloyd's Register of Shipping and the Ministry of Transport for lengths of up to 6ft., which compares with a maximum length for normal timber boards of 5ft., or 10ft. with an intermediate support. With this intermediate support, the length of the aluminium slab can, of course, be similarly increased. Tests are now being carried out on an 8-ft. slab of similar design for use without an intermediate support, and it is hoped that this increased length will be available in the near future. In the *Enugu Palm,* the hatchway dimensions govern the size of the slabs, but, on average, they have an overall length of 5ft. 6in. and a width of 18in., each slab being supplied as a watertight fabrication with positive buoyancy. Their average weight is 45lb.—roughly, one-third the weight of a wet timber board—and their smooth surfaces enable them to be easily slid into position across the hatches. In tests it was found that, after applying an evenly distributed load of 8 cwt. per sq. ft. to the aluminium alloy slab, which was simply supported at each end, the mean permanent set was 0·04in. Later tests showed that, even after permanent set had occurred, the slab was still able to withstand a maximum sustained load of 16 cwt. per sq. ft. Other tests carried out to prove the slab's resistance to rough handling included dropping it from a height of 10ft. on to concrete, and the dropping of heavy steel weights of various shapes on to the slab from heights of up to 10ft. Even after this severe treatment, the slab was found to be still capable of withstanding a load greatly in excess of the test load of 8 cwt. per sq. ft.—*The Shipbuilder and Marine Engine-Builder, December 1959; Vol. 65, p. 696.*

Salvage Tug for Russia

The salvage tug *Pamir,* first of a series of four similar craft ordered for the Life Saving Service of the U.S.S.R., Leningrad, was handed over by the builders AB. Gävle Vary, Sweden. The vessel is particularly well equipped for her duties as she is provided with a powerful towing winch, a variable pitch propeller, two diving stations, a decompression chamber, underwater welding and cutting equipment and underwater television. She also has facilities for fire fighting and for supplying other ships with fuel oil, lubricating oil and fresh water. The principal particulars are:—

Length overall	238ft. 4in.
Length b.p.	219ft. 7in.
Breadth	38ft. 2in.
Draught	12ft. 2in.
Gross tonnage	1,443 tons
Net tonnage	420 tons
Contract speed	17 knots

A towing winch with a towing capacity of 20 tons at a speed of 8 knots and a maximum towing capacity of 40 tons has been provided. Higher towing capacities were reached on trials. Deck equipment includes one 10-ton and two $1\frac{1}{2}$-ton derricks. For protecting the tug against fire the *Pamir* is fitted with a sprinkler system. Fire extinguishing services to other ships include three water guns and six transportable fire extinguishers. One of the water guns can be replaced with a foam branch pipe. The fire extinguishing equipment is supplied with sea water from a fire pump set consisting of a 560-h.p. Diesel engine driving two pumps with a capacity of 450 tons per hr. at a pressure of 285lb. per sq. in. when working in series, and 900 tons per hr. at a pressure of 145lb. per sq. in. when working in parallel. Salvage pumps comprise two stationary Diesel driven units with a total capacity of 2,600 tons per hr. and nine transportable pumps with a total capacity of 1,650 tons per hr. The *Pamir* is equipped with diving stations suitable for three divers working down to a depth of 130ft. The diving equipment includes a decompression chamber, underwater television and equipment for underwater welding and cutting. Compressed air for blowing pontoons and other services is provided by an electrically driven compressor with a capacity of 28,240 cu. ft. at 225lb. per sq. in. The system is provided with 11 air connexions. Propelling machinery consists of two sets of 10-cylinder M.A.N. four-stroke, single acting, supercharged, non-reversing, Diesel engines, type G1040/60, each developing 2,100 h.p. at 275 r.p.m. The *Pamir* is fitted with KaMeWa variable pitch propellers directly coupled to the engine shafting. Control of the propeller pitch can be effected from the wheelhouse and wheelhouse top.—*Shipbuilding and Shipping Record, 5th February 1959; Vol. 93, pp. 176-177.*

Patent Specifications

Ship's Double Bottom

This invention relates to double bottoms for ships, which are so constructed that pipes which are to be laid in the longitudinal direction of the ship, can be readily accommodated. Referring to Figs. 1 and 2, the double bottom (1, 3) is subdivided in the longitudinal direction by the centre keelson (4) and intercostal girders (5), and in the transverse direction by floor plates (6) and transverse bulkheads (6′). The side bulge (7) of the ship is separated from the double bottom by tank edge plates (7′). The inner bottom (3) has a depression extending inwardly in the form of a trench approximately midway between the ship's centreline and the outer skin of the ship. The plates (8 and 9) of the inner bottom (3) extend downward at an angle as banks of the trench and the plates (8) which lie towards the side of the ship are inclined more steeply than the plates (9). The bottom of the trench between the banks (8 and 9) is formed by plates (10) and is inclined downwardly towards the outer skin of the ship relative to the horizontal. The trench (8, 9 and 10) therefore has its lowest point at (10′). The transition from the bank plates (8 and 9) to the bottom of the trench (10) is advantageously situated where intercostal girders (5) subdivide the double bottom in the longitudinal direction. The pipe trench (8, 9 and 10) is covered by removable planking (11). The remaining part of the inner bottom (3) is covered with floor planking (12).—*British Patent No. 809,733 issued to H. C. Stuelcken Sohn. Complete specification published 4th March 1959.*

Fig. 2

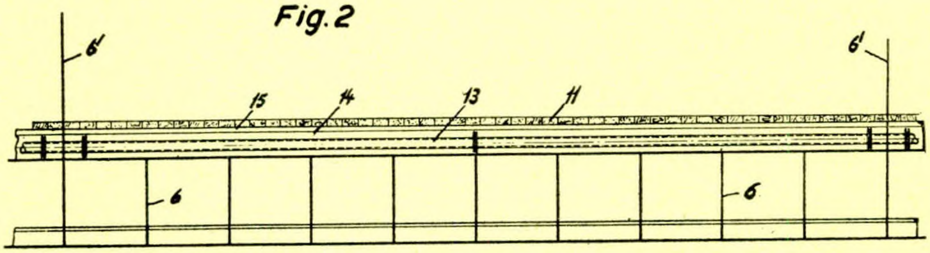
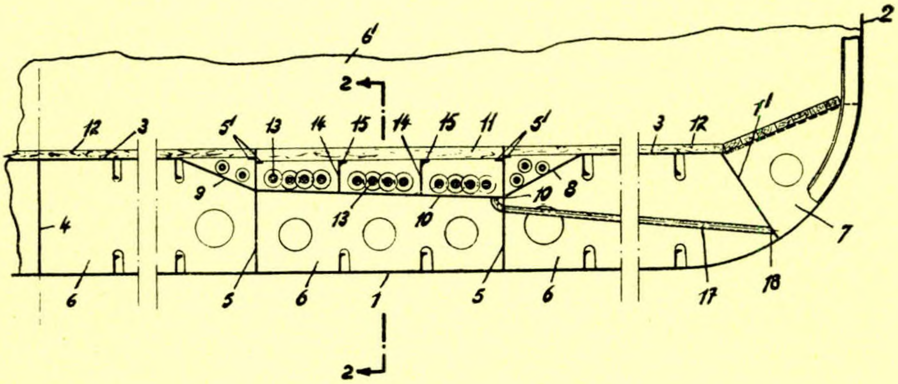
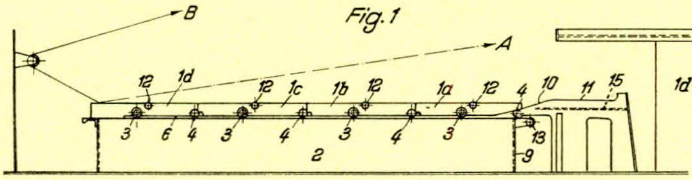


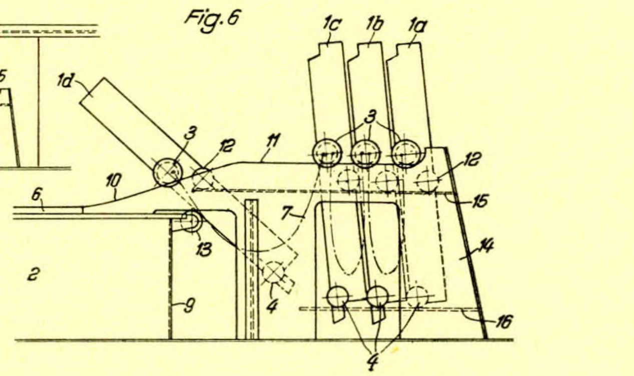
Fig. 1



Hatch Cover

This invention relates to hatch covers and means for moving such hatch covers into an open or closed position. In the example illustrated in Figs. 1 and 6 the hatch cover of a hatch (2) comprises a number of individual cover members (1a, 1b, 1c and 1d), which are furnished with sealing means against the hatch coaming, such as rubber gaskets. The individual cover members, in the closed position, may be lowered into a position of closing, in which an effective sealing of the hatch is achieved. When employing running rollers which may be lowered into slots, the latter may be closed as desired when the cover members are moved into the position of stacking or are again moved out of the stacking position into the close position. If a pulling force is applied to the rearmost cover member (1d) in the direction (A), all cover members (1a-1d) move in a horizontal direction towards the right (Fig. 1) until the front running rollers (4) of the leading cover member (1a) leave the hatch coaming angle member (5). At this moment the lower side of the leading cover member (1a) moves on to the friction rollers (13) mounted on the end of the hatch, and the cover member (1a) continues to roll, with a rocking movement, on these friction rollers and the rear running rollers (3). In the course of further movement the rear running rollers (3) move on to the upwardly inclined guide tracks (10), the cover member, whilst being additionally moved and rolling on the friction rollers (13), being further rocked. At that moment when the axis passing through the centre of





gravity of the cover member is situated about the middle axis of the friction rollers (13), the supporting rollers are caused to move on to the substantially horizontal rails (15). A counter-moment is therefore generated by the bearing points to act against a sudden rocking movement into the vertical position. Upon further movement the cover member then continues to run by means of the supporting rollers (12) on the rails (15) whilst the rear rollers continue to ascend along the guide tracks (10). Owing to the positive horizontal movement of the supporting rollers (12) on the rails (15) and the upward movement of the rear running rollers (3) on the guide tracks (10), a delayed and controlled rocking movement of the cover member up to approximately vertical position is brought about.—*British Patent No. 809,625 issued to Deutsche Werft A.G. Complete specification published 25th February 1959.*

Ship With Air Cushion Below Its Bottom

The invention consists in a ship having an air cushion beneath its bottom for reducing frictional forces during the forward movement of the ship, in which the air cushion is connected at its forward and rear ends into a closed circuit. Thus the air in the air cushion will be moved aft relative to the ship during the forward motion of the ship so that the air pressure will not be increased appreciably in the rearward direction. The air will circulate within the closed circuit, the air velocity increasing with the increasing speed of the ship and being nearly equal to this speed, provided that the air resistance in the circuit is not extraordinarily great. In Fig. 1 the hull of the ship has a bottom (1), the flat part of which is stepped upwardly to form a recess for an air cushion (2). The recess for the cushion can also be formed by attaching strips of Z-shaped cross section to an ordinary flat ship's bottom. From the rear of the air cushion an air duct (3) is led upwardly

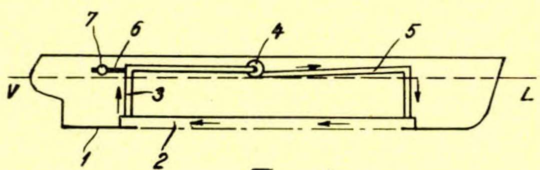


Fig. 1

above the waterline (VL) and thence in a forward direction to the suction side of an air pump or blower (4). From the delivery side of the blower (4) a corresponding air duct (5) is led forward and then down to the forward part of the air cushion (2). When the blower (4) is in operation, an air stream is produced in the closed circuit formed by the cushion (2) and the ducts (3 and 5) having the direction indicated by the arrows. The air in the air cushion (2) should have a velocity astern only a little less than the speed of the ship through the water. The air velocity is so adjusted, for instance, by adjustment of the speed of the blower, that the force which acts upon the air in the air cushion in a rearward direction and which arises from the contact with the water, is equal to the frictional force acting between the air and the ship's bottom. As a consequence the static pressure of the air will be constant over all the length of the air cushion (2).—*British Patent No. 810,769 issued to K. F. Gram. Complete specification published 25th March 1959.*

Anti-pitch Stabilizer

In comparison with the rolling motion, very great forces are involved in the pitching motion and any device to check this motion must be of large area and of great structural strength. A choice for the location between the bow and the stern has to be in favour of the bow because, except for the bow wave, undisturbed water will be met there. A horizontal

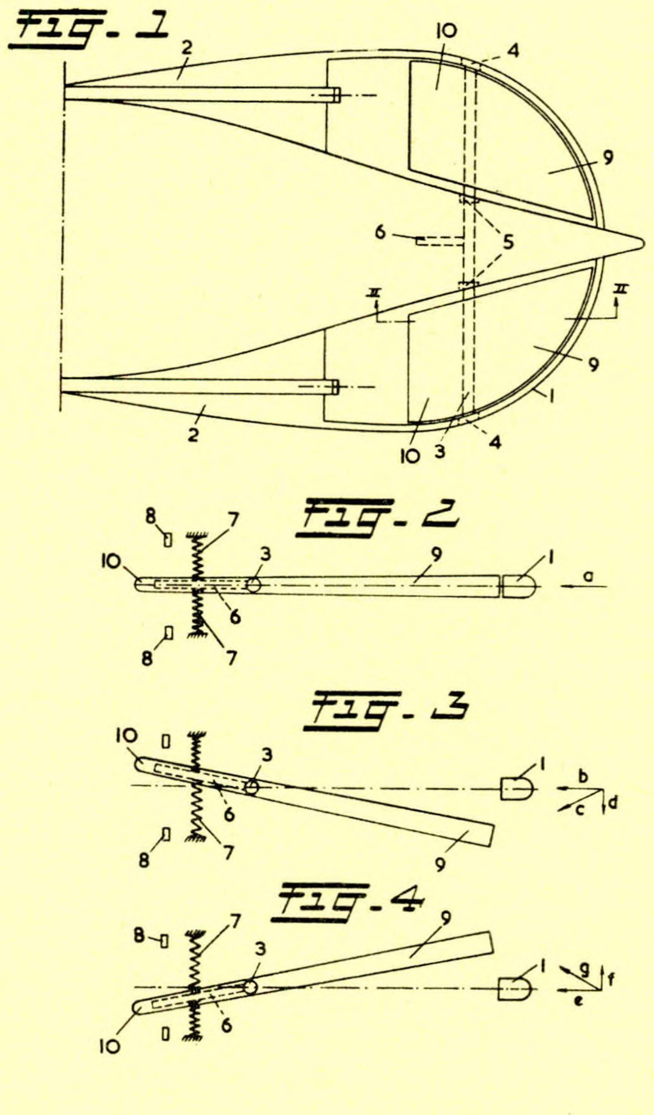


plate on both sides of the bow would be the most simple solution, but its effect on the pitching could only be varied by its area and still not solve the problem. By providing horizontal fins at the bow with a common axis for rotation, a simple means may be obtained for controlling and improving its effect on the damping. In Figs. 1, 2, 3, and 4, numeral 1 denotes a propeller guard, and numerals 2 denote ridges on the outer side of the propeller shaft bossings, which bossings merge into the guard 1, thus protecting the bow screws (not shown) of the ship against damage. The space enclosed by the arc-like part of the guard (1), and the hull of the ship, is eminently suitable for fitting an anti-pitch device, the so-called damper. The damper consists of two equal parts with a part situated on each side of the hull and fixed to a common transverse shaft (3). Each part comprises a foremost part (9) and an after-part (10). The areas of the foremost parts of the damper have a slightly higher movement on the shaft (3) than that of the after-parts (10), when hit by any flow of water. The shaft has four bearing centres, viz. two centres (4) in the guard, and two centres (5) in the hull. The shaft (3) has a lever (6) and it is evident, because of the nearly balanced fore- and after-parts of the damper, that only slight forces have to be used by the lever (6) to control the position of the damper, even at high speeds and in heavy pitching. For the purpose of automatic control, the lever is fitted with two identical springs (7) fixed to the ship, as seen in Figs. 2, 3, and 4. When no force is exerted on the damper, the springs (7) will keep the lever (6) and the damper in their neutral position, as shown in Fig. 2. Figs. 2, 3, and 4 show the position of the shaft (3), the lever (6), and a vertical section of the damper projected on the centre line plane of the ship. In Fig. 2 the ship is assumed to be running in a smooth sea, and the damper, the lever and the springs maintain their neutral position. The direction of the water flow along the damper is indicated by the arrow *a*, representing the fair weather speed. In the Figs. 3 and 4, the springs are alternately under different conditions of tension and compression, depending upon the position of the lever and the damper. Any flow of water of which the direction is oblique relative to the damper will force the damper out of its neutral position. Because of the greater moment of the flow on the foremost parts of the damper, these parts are decisive as regards the position of the damper relative to the direction of the flow. The angle of impact is controlled by the springs and may be regulated in such a way as is most desirable for damping the pitching.—*British Patent No. 811,558 issued to J. de Beurs. Complete specification published 2nd April 1959.*

Ships' Hatches

This invention concerns sliding ships' hatches, constructed as steel covers, fitted with packings, as well as with wheels and guide rails. In Fig. 1 the cover (1) is divided into six sections and each of these sections is fitted with two pairs of wheels (2), of which one pair is mounted near the centre line (3) of the section transversely, and the other pair near the edge facing away from the stacking position (4). Further, the separate sections are connected to each other with the aid of guide rods (5), of which one end is rotatably mounted on wheel axles (8) on the middle wheels (Fig. 2), and the other end is rotatably mounted to the axles of the neighbouring pair of wheels at the edge facing away from the stacking position. Wheels (2) have their guide in a frame (6), which can with the aid of lifting devices be hoisted and lowered in relation to the hatch coaming. This vertical movement is performed with the aid of small hydraulic bidirectional acting lifters (7). This movement can also be performed by way of mechanical or pneumatic methods.—*British Patent No. 808,110 issued to A. Wigeland. Complete specification published 28th January 1959.*

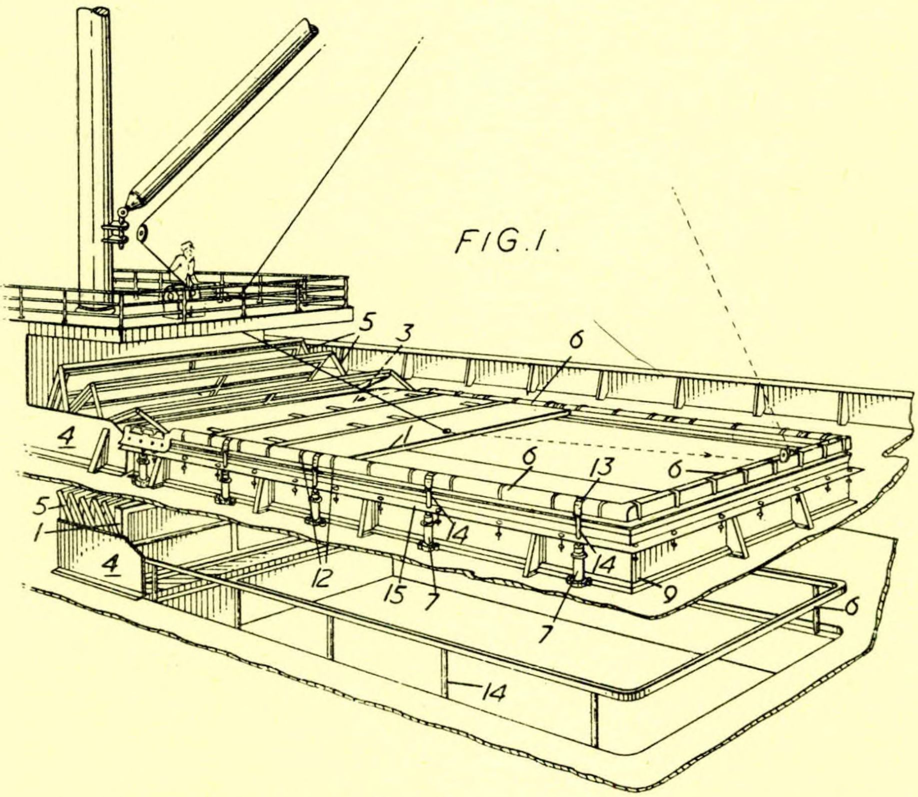
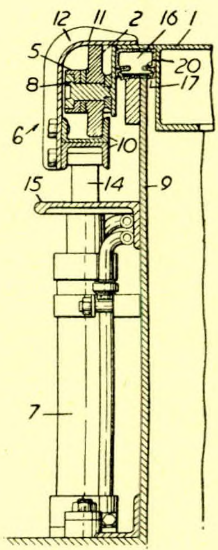


FIG. 2.



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