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*MARINE BOILERS.

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Because of the importance of weight in a ship, when designing marine boilers, emphasis is always placed on making a unit as light as possible consistent with the requirements of the service, type of feedwater to be anticipated, accessibility for cleaning and repairs, and continuity of service. When a ship is at sea, the boilers should at all times be available, and both the design and operation should be such as to assure this result. Unlike the average stationary boiler, all marine boilers are supported from below and never suspended from above. This is to save weight, and also to assure proper stability when a ship is pitching and rolling in a seaway. Before taking up design characteristics of marine boilers and the trend that has been taking place in them, it will be interesting to review just what must be done by equipment of this kind in generating steam from the fuel and water brought to it.

Assume that a cubic foot of fuel oil is burned efficiently and all of the available B.Th.U. (1,136,000) are utilized in generating steam from water at 250° F. Table 1 shows the volumes of water and steam that would be handled under these conditions.

Table 1.

Steam conditions.	Cubic feet of feedwater at 250° F.	Cubic feet of steam.
300 psi; 500° F.; 80 deg. superheat	18·6	1,834
400 psi; 700° F.; 250 deg. superheat	16·9	1,579
600 psi; 850° F.; 360 deg. superheat	15·9	1,135
1,200 psi; 900° F.; 320 deg. superheat	15·8	574

If the products of combustion are cooled to approximately 350° F., the gases formed by burning 1 cu. ft. of oil would occupy a volume of approximately 20,000 cu. ft.

The effect of pressure and temperature upon the quantity and distribution of heat required to produce 1lb. of steam from water at 250° F. is outlined in Table 2.

Table 2.

Steam Pressure, psi.	Steam Temp. °F.	Sensible heat to water. B.Th.U.	Sensible heat to water. Per cent.	Latent heat. B.Th.U.	Latent heat. Per cent.	Superheat. B.Th.U.	Superheat. Per cent.
300	500	180·3	17·4	804·4	77·5	52·6	5·1
400	700	209·6	18·3	776·5	67·9	157·3	13·8
600	850	256·2	21·1	728·3	59·9	231·6	19·0
1,200	900	355·3	29·1	608·9	49·8	257·5	21·1

As may be noted from Table 2, as the pressures and temperatures increase, the percentage of latent heat decreases, and both the heat of the liquid and the heat used for superheating the steam increase. These thermal characteristics of steam at different pressures and temperatures have their logical effect upon boiler design to meet these different requirements, the duty of the boiler surface becoming proportionately less and that of the superheater and economizer (or feedwater heater) surfaces becoming correspondingly greater with increasing steam pressures and temperatures.

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The pressure and the temperature of the steam generated by a marine boiler are determined by the requirements of the propulsion machinery. As knowledge of the art of designing and building steam machinery has progressed, the design and manufacture of boilers has kept pace, resulting in improved thermal efficiency and better operating economy of the ship. Table 3 gives the approximate over-all performances that may be expected from marine installations, utilizing the steam conditions specified.

Table 3.

Steam conditions. Pressure, psi.	Steam conditions. Temp., °F.	Pounds of 18,500 B.Th.U. oil per hour per shaft horsepower (all purposes).
300	500	0·80
400	700	0·62
600	850	0·57
1,200	900	0·50

It is because of the trend, shown in Table 3, that steam pressures and temperatures have been gradually increasing in steam-driven ships, moving up as rapidly as progress in the art of building the propulsion machinery has justified such increases commercially.

Boiler Units.

Marine boilers and furnaces and supplementary heat-absorbing equipment such as superheaters, air heaters, and economizers, when used with them, are so closely associated that any such combination is referred to as a boiler unit.

Scotch Boilers.

Until about fifty years ago, practically all steam used for propulsion of ships was generated in fire-tube boilers (gases inside the tubes), the Scotch boiler being the most popular type of such units for both naval and Merchant Marine service. Fig. 1 shows the essential characteristics of a Scotch boiler equipped to burn oil fuel and fitted with a small air heater. Because of the necessity of using relatively heavy shell plates, with suitably stayed flat heads, a Scotch boiler is a heavy and inflexible structure for the purpose intended, and is seldom built for operating pressures in excess of 250 psi. Scotch boilers, without water, weigh in the neighbourhood of 50lb. per sq. ft. of boiler heating surface; the water at steaming level and temperature weighs approximately 20lb. per sq. ft., making a total of 70lb. per sq. ft. of boiler heating surface. Because of its inflexible construction and relatively poor circulation characteristics, it is not usual to "force" boilers of this type, with the result that from 10 to 15lb. of boiler are required per pound of equivalent evaporation per hour at full power.

At about the turn of the century, active steps were taken in both the Navy and Merchant Marine to explore the possibilities of water-tube boilers. The lack of proper knowledge of feedwater conditioning made early progress with water-tube boilers in the marine field somewhat slow, but their inherent advantages for this duty (reduction in weight and ability to "force" them when necessary) gradually overcame the resistance to their use, so that to-day their acceptance is almost universal in new American-built steam-driven tonnage.

Three-pass Header-type Boilers.

Because of the necessity for frequent manual cleaning of the water surfaces in the early days of water-tube boilers, the use of

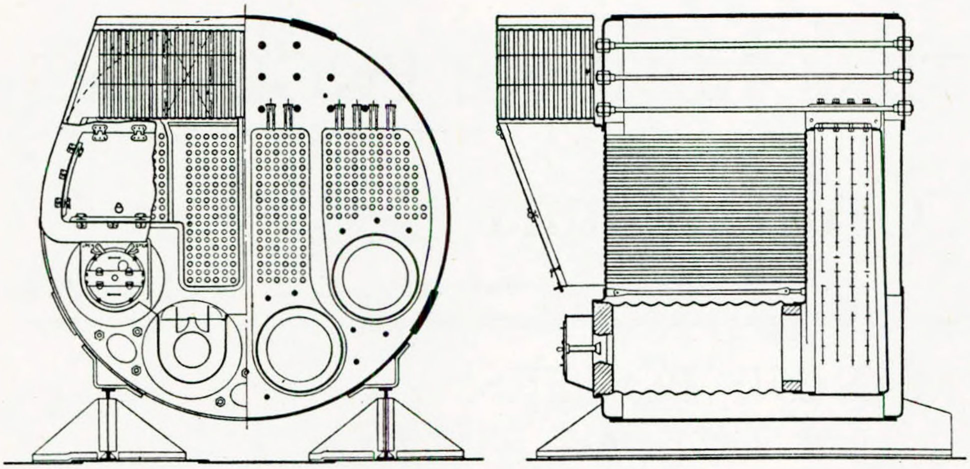

FIG. 1.—*Scotch boiler.*

straight and readily accessible tubes was emphasized. A boiler of this type which enjoyed wide popularity is shown in Fig. 2, where 4-in. tubes were used throughout the boiler surfaces; the superheater, which is located at the top of the first and second passes of the boiler, being made of 2-in. tubes. These 4-in. tube units, with water at steaming level and temperature, weigh approximately 40lb. per sq. ft. of boiler heating surface, and 7lb. per pound of equivalent evaporation per hour at full power, which is an appreciable saving compared to Scotch boilers of similar capacity.

The extensive operation in the Merchant Marine of boilers of this general type during and following the last war gave a great number of marine engineers, who up to that time had never handled anything but fire-tube boilers, an opportunity to become familiar with marine water-tube boilers and their advantages.

Although the 4-in. tube header-type boiler, as shown in Fig. 2, was a decided improvement over the Scotch-type boiler from a weight and accessibility point of view, appreciable improvement in the way of further weight reduction and saving of space in the fireroom could be made by using tubes of smaller diameter. Fig. 3 shows tube groupings that have been used in header-type marine boilers, the reduction in diameter of the tubing used, and its more compact arrangement appreciably affecting the weight characteristics of a boiler unit of this type. Table 4 shows the essential effects

TABLE 4.

Size of tubes, in.	4	2	1¼	1
Gauge of tubes, No....	6	10	13	13
Tubes per handhole fitting	1	4	9	14
Heating surface per handhole fitting (tubes 10ft. long), sq. ft. ...	10	20	28	35
Weight per square foot of heating surface, lb.	9·34	6·04	4·25	4·15
Weight of water at 400lb. per sq. ft. of heating surface, lb.	3·52	1·61	0·96	0·69
Weight of water and steel per sq. ft. of heating surface, lb.	12·86	7·65	5·21	4·84

of the progressive reduction in tube diameter, utilizing the tube arrangements shown in Fig. 3, assuming average Merchant Marine steam pressures in the neighbourhood of 400 to 500 psi.

Fig. 4 shows the 2-in. tube header-type boiler that was installed in many of the Merchant Marine ships built during the last war, these being known as the "535's" or "State Ships". These boilers were designed to operate at 265 psi, with approximately 50 deg. superheat in the steam at the superheater outlet, the superheater being located at the top of the first and second passes of the boiler. The weight per square foot of boiler heating surface of one of these units is 26lb. and the weight per pound of equivalent evaporation at full power is 4·7lb., both of these being on the assumption that the boiler was under steaming conditions with water at the centre of the gauge glass. It will be noted how appreciable is the reduction in weight in going from the 4-in. tube boiler to the 2-in. tube construction, all other essentials of the unit, such as rating, location and type of superheater, setting height, etc., remaining approximately the same for both installations.

When it became desirable to build new steam-driven tonnage in the 1920's, more attention was given to operating economy, which resulted in higher steam pressures and temperatures (up to this time 300 psi pressure and 75° F. superheat were the highest values used) and in the more general application of supplementary heat-absorbing equipment, such as air heaters. Fig. 5 shows a typical three-pass header-type boiler of this era as used in the Merchant Marine, the steam pressure being 400 psi, and the steam temperature 650° F. Tubes of 2in. diam. were still used for the boiler generating surfaces, but to obtain the higher steam temperature which was desirable with the higher steam pressure, the superheater was moved from the over-deck position at the top of the first and second passes to an interdeck position in the first pass, where the products of combustion were hot enough to give the desired steam temperature with a superheater of moderate size. The horizontal-tube air heater had the air flowing through the tubes, the products of combustion flowing three times across the outside of the tubes. Boiler units of this type, complete with air heater, and with water, weigh

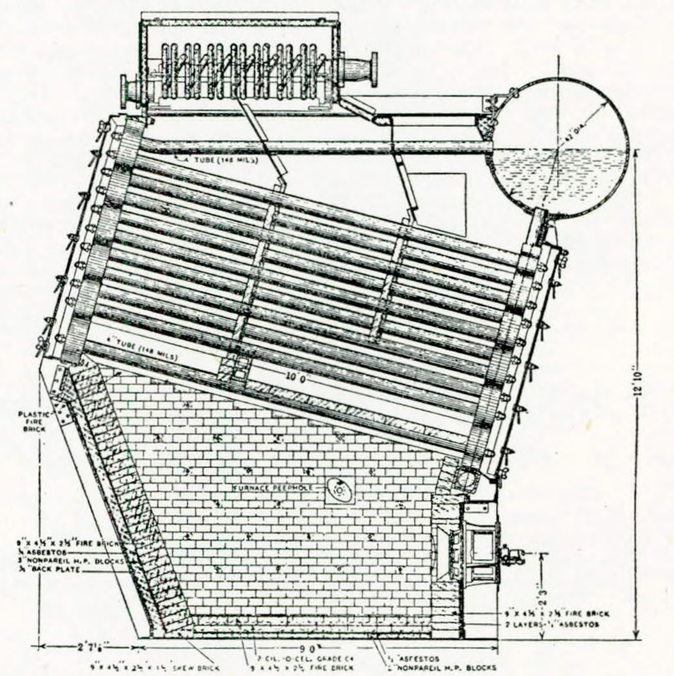

FIG. 2.—*Longitudinal section of 4-in. tube header-type boiler with superheater.*

approximately 40lb. per sq. ft. of boiler heating surface, and the corresponding weight per pound of equivalent evaporation at full power is 7lb.

Single-pass Header-type Boilers.

The increased use of cracked oil residue as fuel led to combustible and corrosive deposits lodging on any shelves which existed in the gas stream. Thus, it became desirable to eliminate, as far as possible, such ledges where deposits could lodge. This, together with the saving in weight involved, led to the use of the single-pass type of header boiler, using tubes 1¼ or 1in. diam., grouped as indicated in Fig. 3. Because of the improvement which had taken place in the art of feedwater conditioning, the use of tubes smaller in diameter than 2in. was entirely feasible.

Fig. 6 shows the longitudinal and front-view sections of a single-pass header-type oil-burning boiler fitted with 1¼-in. tubes, interdeck superheater, and air heater, designed for operation at 625 psi pressure, and 900° F. total steam temperature. Units of this general type have been extensively installed in modern tankers and in cargo ships built and building for the United States Maritime Commission. The front view section clearly illustrates the stud-tube construction of the water-cooled side walls of the furnace, and the design and method of supporting the superheater tubes with 3¼-in. diam. boiler tubes. To assure a constant steam temperature

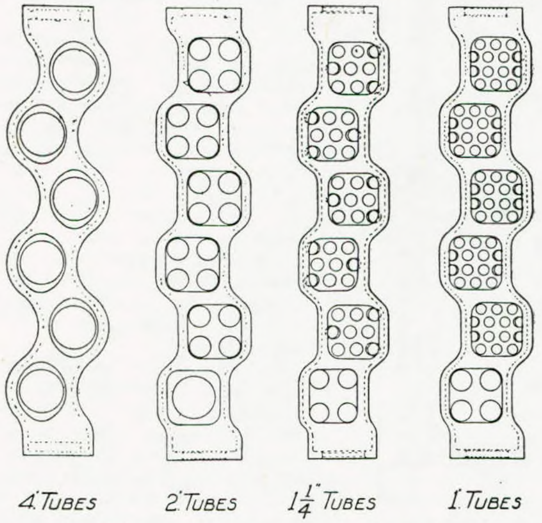

FIG. 3.—*Tube groupings used in header-type boilers.*

of approximately 900° F. at the superheater outlet under all normal rates of operation, automatic superheat control is employed with this unit, utilizing an attemperator or desuperheater of the submerged coil type, located in the steam drum as shown. The wet weight of this type of 1¼-in. tube boiler unit is approximately 38lb. per sq. ft. of boiler heating surface, and the weight of the unit per pound of equivalent evaporation at full power is 4·5lb.

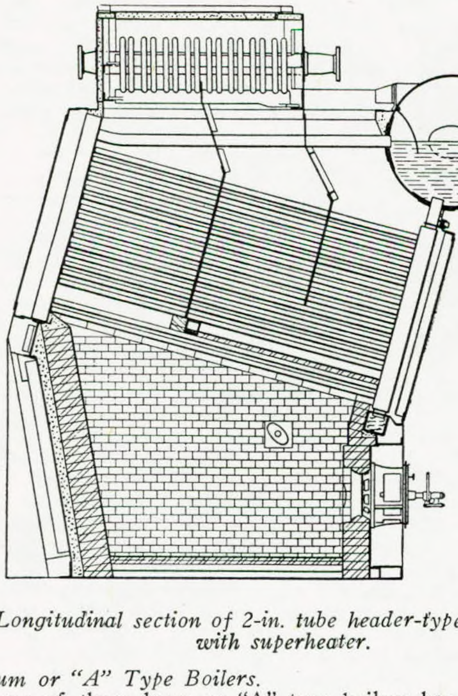

FIG. 4.—*Longitudinal section of 2-in. tube header-type marine boiler with superheater.*

Three-drum or "A" Type Boilers.

The use of three-drum or "A" type boilers has been very extensive in Navy combat ships for a great many years, principally because of their light weight per pound of steam generated, and their compactness. In the Merchant Marine, their use has been confined to the larger passenger ships almost exclusively, because of the fact that relatively large steam demands per boiler are desirable to justify the use of boilers of this type, compared to the header or two-drum designs. Fig. 7 shows the front-view section of a double air-cased three-drum oil-burning boiler, fitted with a superheater in one bank and an air heater in each of the two uptakes, which was installed in the fireroom of one of the largest passenger ships built in this country for transatlantic service. This unit is designed to operate at 450 psi pressure and a steam temperature of 725 °F. The gases pass straight through the air heater, across the outside of the tubes, while the air makes two passes counterflow inside of the tubes. This boiler unit complete, with water, under steaming conditions weighs 18·5lb. per sq. ft. of boiler surface, and the wet weight per pound of equivalent evaporation at full power is 3·2lb.

At this point it may be of interest to note that three-drum boilers fitted with economizers, as used in Navy combat ships, are operated at appreciably higher rates under full-power conditions than is customary when using similar types of boilers in the Merchant Marine, the Navy ratings being anywhere from 3 to 5 times as great per square foot of boiler heating surface. Accordingly, although the steaming weight of a modern Navy boiler unit usually averages between 20 and 25lb. per sq. ft. of boiler heating surface, the corresponding weight of one of these units per pound of equivalent steam generated at full power is usually between 0·75 and 0·9lb. Boilers in the Merchant Marine are usually designed to generate from 6 to 10lb. of equivalent steam per square foot of boiler heating surface per hour at the full-power condition, whereas, in Navy combat ships, the corresponding generating range at full power is in the neighbourhood of 30 to 35lb. In a somewhat similar manner,

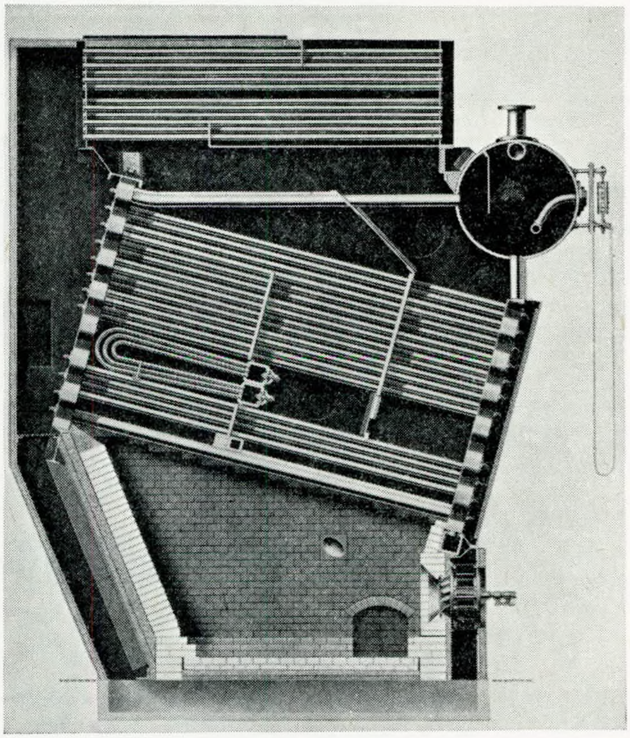

FIG. 5.—*Longitudinal section of 2-in. tube header-type boiler with interdeck superheater and air heater.*

the B.Th.U. release rate in the furnaces of the Merchant Marine boilers is usually between 75,000 and 110,000 B.Th.U. per hr. per cu. ft., whereas in modern Navy combat ships the full-power designed condition usually calls for a release per cubic foot of furnace volume of between 250,000 and 300,000 B.Th.U. From the foregoing, it may be noted that the difference in weight of three-drum boiler units, as used in the Merchant Marine compared to Navy combat ships, is largely a matter of difference in rating employed when doing full power, rather than a difference in details of construction of the units.

Two-drum Boilers.

The use of two-drum boilers has shown an increase in the Merchant Marine field the last few years, their relatively light weight and low cost being important factors in their favour for installation in ships of moderate power, in spite of their comparative inaccessibility for quick internal cleaning and repairing. To do any such work on boilers of this type, it is generally necessary for a man to enter the steam drum, and it usually takes an appreciable time interval for such a drum to cool sufficiently to permit this. If a ship has

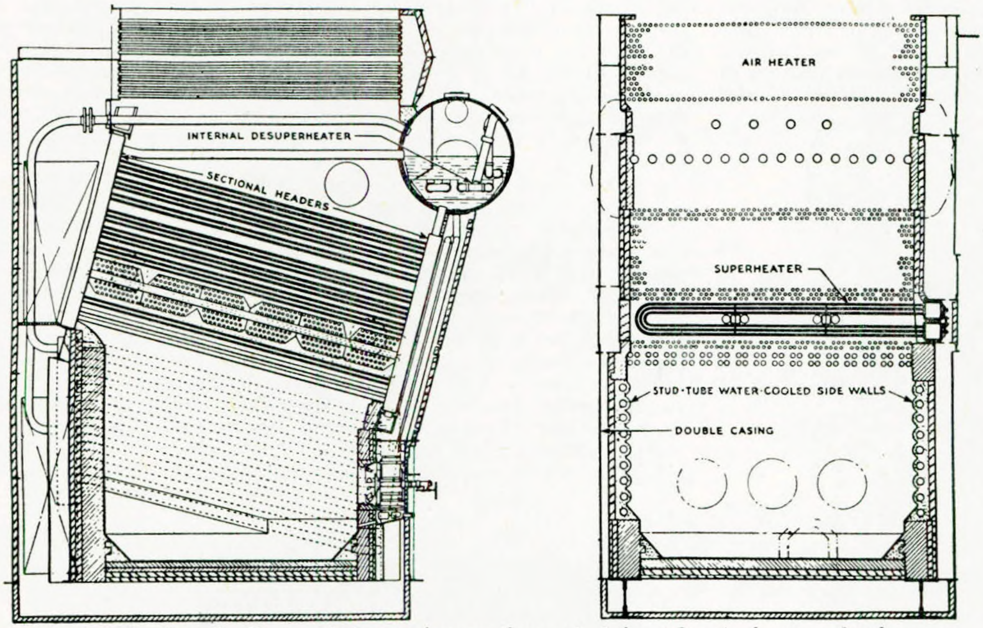

FIG. 6.—*Longitudinal and front view sections of ½-in. tube single pass, header-type boiler with interdeck superheater and air heater.*

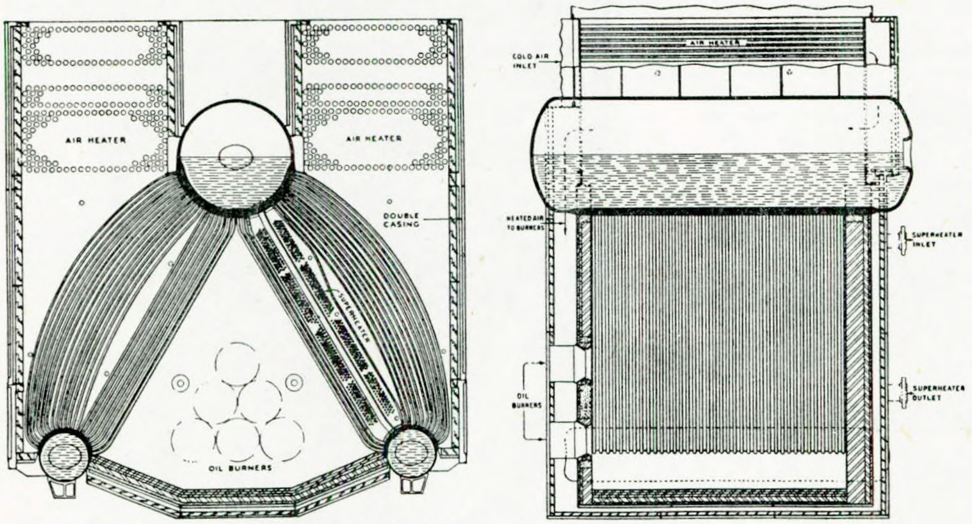

FIG. 7.—*Front view and longitudinal sections of three drum boiler with superheater and air heater.*

only two boilers and is on a fairly quick turnaround schedule, excellent care should be taken of boilers of the two-drum type, to avoid the possibility of tube losses or the necessity for frequent internal cleanings.

Fig. 8 shows a two-drum inclined-tube-bank marine boiler fitted with superheater and economizer, as installed in some of the modern merchant ships. There are no gas baffles whatever in this unit, the gases flowing horizontally through the water screen, superheater, and the boiler bank, then turning vertically upward through the economizer. The side wall of the furnace is fully water-cooled by means of stud tubes, while the front and rear walls have partial cooling by means of 2-in. bare tubes in front of regular refractory linings. The unit shown is designed to operate at 450 psi pressure and 750° F. total steam temperature. The wet weight of one of these units per square foot of boiler heating surface is 25lb., and the weight per pound of equivalent evaporation at full power is 2·7lb.

Steam-temperature Control.

As the steam temperatures have increased in marine service, proper control of these temperatures has become more desirable, and in some cases essential. When manœuvring a ship which is not fitted with means for controlling the steam temperature, relatively wide fluctuations are liable to occur because of the rapid changes in firing rate. Another reason for the increasing application of means for controlling steam temperatures afloat is that, in geared-turbine installations, designed for high steam temperatures, it is usually customary to lower this temperature to the zone of 700° to 750° F. when admitting steam to the backing turbines.

Steam temperatures have been controlled in marine installations by the various methods familiar in stationary practice such as (*a*) dampers so located in the gas stream that their movement diverts more or less of the gases over the superheating surfaces; (*b*) attemperators or desuperheaters located in the steam path approximately half way through the superheating surfaces, and (*c*) controlling the percentage of the gases flowing over the superheating surfaces by varying the quantities of the fuel fired in the two furnaces of a "divided-furnace" boiler.

An interesting application of the (*c*) method of steam-temperature control is illustrated in Fig. 9. This unit is employed to deliver steam to a turbine using a reheat cycle, the operating steam pressure in the boiler drum being 1,270 psi, and the temperature of both the high-pressure and reheat steam being approximately 750° F.

Under "ahead" operating conditions, the saturated high-pressure steam enters the primary superheater, crosses over to the secondary superheater, and then passes to the high-pressure turbine. The steam from the turbine is sent through the reheater to bring its temperature back to 750° F., after which it is returned to the low-pressure stages of the turbine. When using the astern turbine, there is no steam to the reheater, so the burners on that side of the boiler unit are shut off, and all the steam necessary for backing is obtained by firing the fuel in the furnace under the secondary superheater. When operating under full-power-astern conditions, the oil burned on that side of the unit is appreciably greater than is burned there when going full power ahead, with the result that the temperature of the steam heated in the secondary superheater alone, under these conditions, is approximately 750° F.

The boiler is provided with a complete double air casing. The section of this casing at the boiler front is subdivided by a partition from top to bottom, so that the burners for the reheat furnace are isolated from the burners for the other furnace. The oil burners are fitted with wide-range atomizers of the plunger type, automatically controlled to the reheat furnace, in order to maintain a constant temperature of 750° F. in the reheat steam, and to the other furnace, to maintain the proper operating steam pressure.

Because of the relatively small proportion of boiler generating surface in this unit, and the required strength of the pressure parts, the steaming weight per square foot of boiler surface is 72lb. The weight per pound of equivalent evaporation at full power is 5lb. This installation emphasizes the fact that as the pressures, temperatures, and boiler efficiencies have been increasing, the weights per square foot of boiler surface have risen steadily, because the percentage of boiler generating surface grew appreciably less compared to the total surface in the unit. The weight of unit per pound of equivalent steam generated has, if anything, been gradually reduced, and this weight of boiler unit per pound of equivalent steam generated is the important one in designing a ship.

QUALITY OF STEAM.

One of the important developments that has kept pace with the increasing steam pressures and boiler ratings has been the improvement in the quality of steam coming from the boiler drums. Improved steam-drum baffling has made possible the strides that

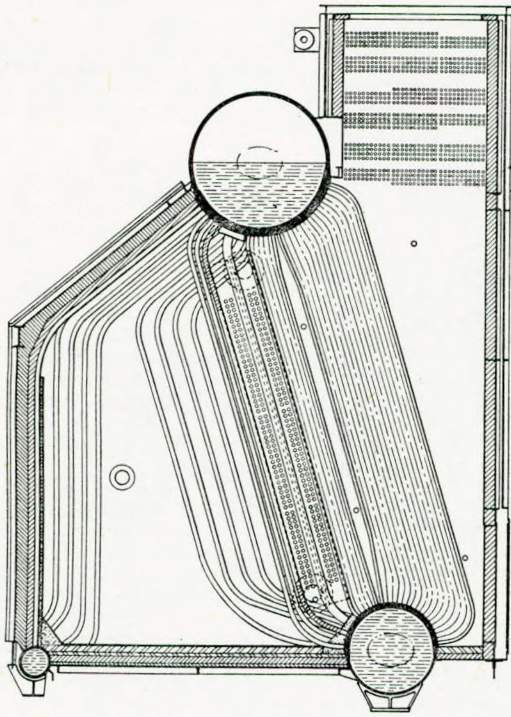

FIG. 8.—*Front view section of two drum boiler with superheater and economizer.*

have taken place in other directions in the development of marine boilers. This is done with plate baffling, sometimes submerged and sometimes in the steam space, or by means of centrifugal separators. Fig. 10 illustrates a baffle of the latter type which is finding wide application in the marine field at the present time, especially in ships that are designed to employ high boiler ratings at full power. This construction has assured remarkably dry steam with relatively high boiler-water concentrations over wide ranges of water level in the

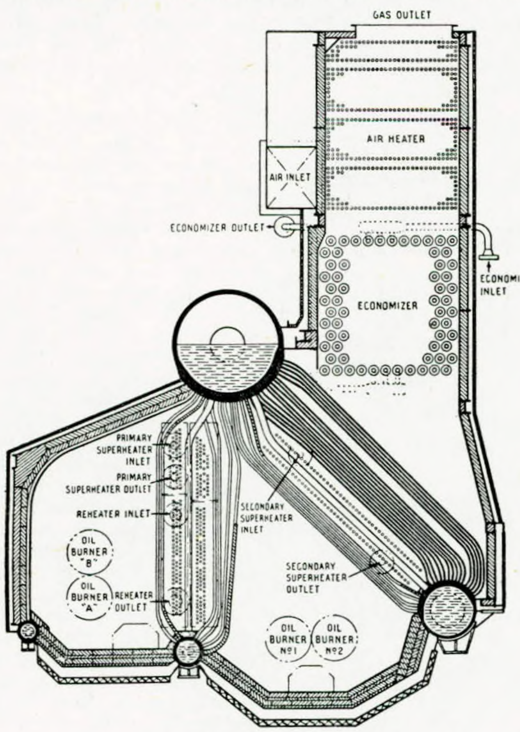

FIG. 9.—*Front view section of 2-furnace, single uptake, high pressure, reheat boiler with economizer and air heater.*

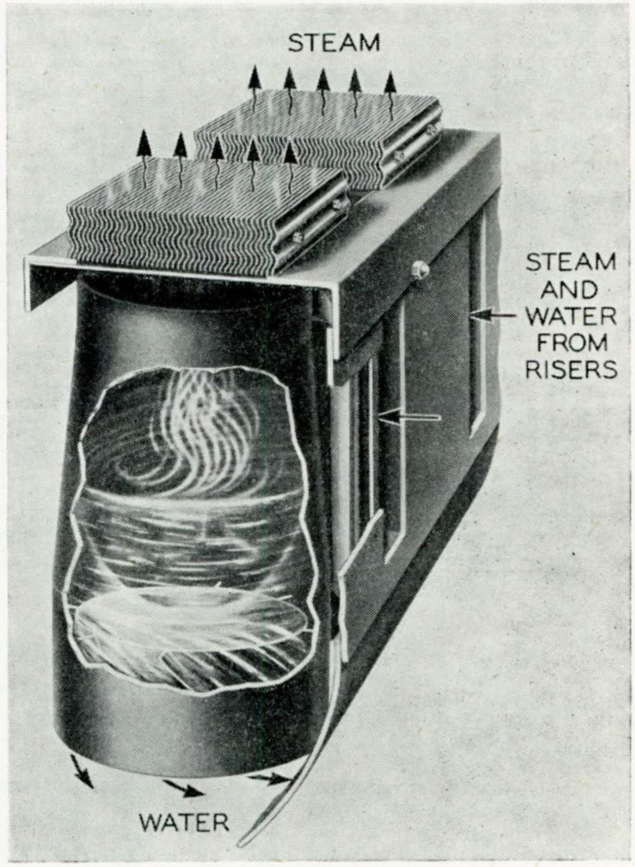

FIG. 10.—*Cyclone steam separator.*

steam drum, an extremely important item when a ship is rolling or pitching in a seaway.

OIL BURNERS.

When oil is used as a fuel under marine boilers, it is usually discharged into the furnaces in the form of a fine conical spray from one or more mechanical atomizers located in the centre of circular oil-burner registers. Steam atomizing is not used to any extent in marine work at the present time because of the loss of fresh water its use entails.

Because of the limited operating range possible with atomizers of the standard mechanical type (approximately 2 to 1, without shutting off burners), there is a growing demand for atomizers which have wider-operating-range characteristics. There are now on the market several wide-range mechanical atomizers such as those of the return-flow type or those of the plunger type, which are being installed aboard ships to an increasing extent, especially where auto-

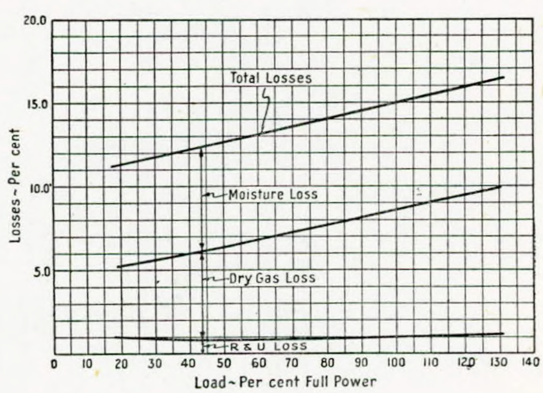

FIG. 11.—*Curves showing typical losses to be expected from combustion of oil under marine boilers.*

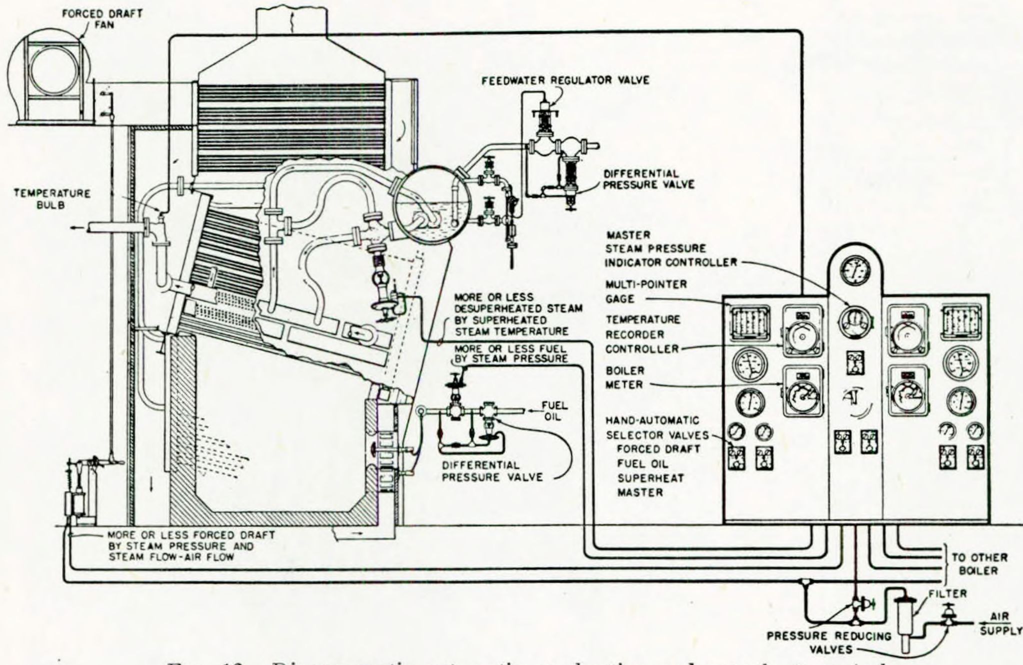

FIG. 12.—*Diagrammatic automatic combustion and superheat control.*

matic combustion control is employed.

Fig. 11 shows in curve form the typical losses to be expected from an efficiently handled oil-fired marine boiler. Where the total losses are 15 per cent., the boiler efficiency would be 85 per cent. These curves show that the percentage moisture loss and percentage radiation and unaccounted-for loss are fairly constant over a relatively wide range of operation, the major cause of increasing uptake losses with increasing boiler ratings being in the heat carried away in the dry gases.

SOOT BLOWERS.

Keeping the external surfaces of a boiler unit clean is essential if consistently high efficiency results are to be secured. Originally, the only method used for cleaning the external surfaces of a boiler unit was hand lancing with steam. To-day, it is very exceptional to install a boiler unit in a ship without equipping it with automatic soot blowers.

The use of steam for soot blowing naturally causes an appreciable loss of fresh water from the ship's supply. To eliminate this loss automatic soot blowers using compressed air have been developed and are being increasingly applied in modern steam-driven tonnage.

AUTOMATIC CONTROLS.

Feedwater Regulators.

Feedwater regulators are almost universally used in modern Merchant Marine installations. During the era of moderate steam pressures, regulators actuated by floats in the steam drum were frequently employed, but with the advent of pressures between 400 and 600 psi, this type is seldom used, the thermo-hydraulic type being more generally accepted for this duty. In Fig. 12 is shown a typical regulator of this design, attached to a boiler drum.

In order to secure the most satisfactory results from any type of automatic feedwater regulator, a differential valve should be placed in the water line ahead of the regulator valve, as shown in Fig. 12, to maintain a constant pressure differential across the regulator valve, regardless of fluctuations that may occur in the steam pressure or in the water at the feed-pump discharge. This is to ensure consistent water flow to the boiler at all times, for a given position of the regulator valve. If this is not done, relatively wide fluctuations in water level may occur in the boiler drum.

Combustion Control.

Until a few years ago, automatic combustion control was seldom used aboard ship, but during the last few years, with a wider appreciation of its advantages and with direct savings in assuring consistent combustion efficiency, its application in modern steam tonnage of the Merchant Marine is almost universal. Fig. 12 shows the essentials of such an installation. The steam pressure is maintained at its desired value by the master steam-pressure indicator-controller actuating the equipment controlling the air supply from the forced-draught fan and the oil supply to the burners. The control of the air supply to the unit may be had either by the use of dampers, as shown in Fig. 12, or by directly controlling the speed of the fan, or both.

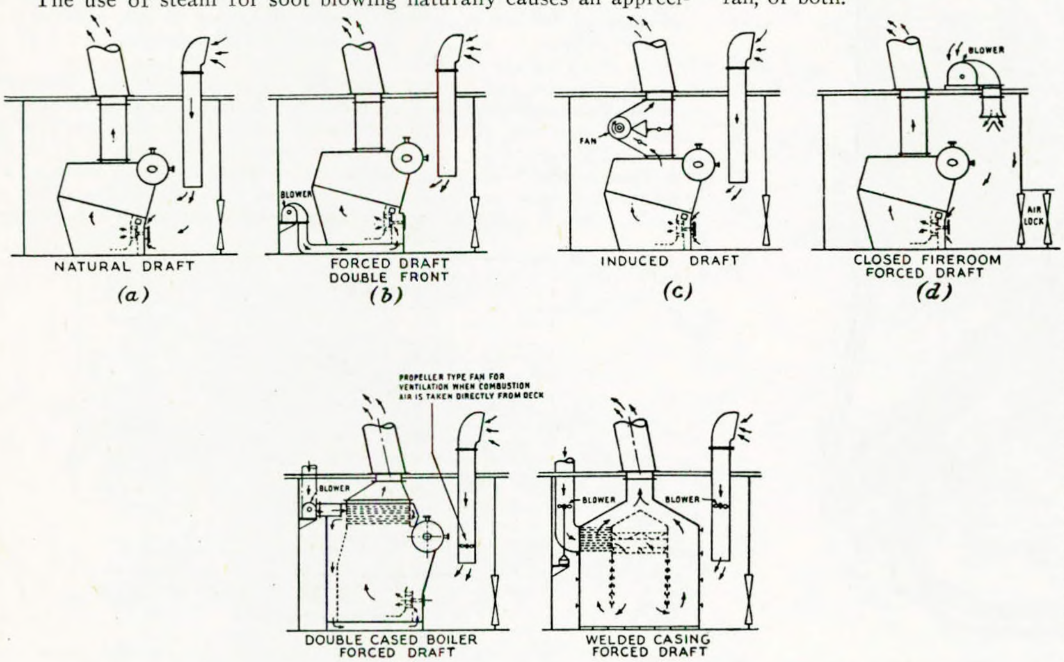

FIG. 13.—*Diagrams illustrating various methods of supplying combustion air to marine boilers.*

Superheat Control.

Fig. 12 also shows a method of automatic superheat control which has proved very satisfactory in marine service. All the steam from the steam drum enters the superheater at the upper end of the top box and, after making three passes through the first half of the superheater, is taken either to the attemperator in the steam drum or directly back to the fourth pass of the superheater, the quantity of steam going to each being controlled by the position of the three-way valve attached to the boiler drum as shown. The steam that goes through the attemperator returns to the three-way valve, joining the steam that was not desuperheated, the mixture going through the remaining three passes in the last half of the superheater. A temperature bulb is located in the steam piping from the superheater, this bulb serving to actuate the position of the three-way valve by means of the temperature-recorder (or indicator) controller.

If the steam temperature is controlled by means of dampers located in the gas stream, then they are actuated by means of the temperature-recorder (or indicator) controller in a manner similar to that shown for controlling the position of the three-way valve in Fig. 12. In the case of automatic steam-temperature control, applied to divided-furnace boilers, the air and oil supply to the burners on the superheater side of the unit are actuated by a temperature recorder (or indicator) controller, while the air and oil to the burners under the saturated side of the boiler are actuated by the master steam-pressure indicator controller.

For an installation as shown in Fig. 12, filtered compressed air at approximately 35 psi pressure is the medium used to actuate the differential oil valves, three-way steam valves, and air-control-damper mechanism, under the direction of the controllers located on the central control board.

SYSTEMS FOR SUPPLYING COMBUSTION AIR TO MARINE BOILERS.

Fig. 13 shows six methods that have been used to supply combustion air to marine boilers. Natural draught (*a*) is seldom used in modern ships, because of the impossibility of securing sufficient boiler rating with it, unless excessively high funnels are used. When natural draught was found too limited, the next step was to use the "double-front forced-draught" construction (*b*), the blower providing sufficient air pressure to overcome the resistance through the oil burners or bed of coal on the grates, the natural draught of the funnel being more than ample to take care of the gas resistance through the boiler unit, leaving a slight suction in the furnace.

Some induced-draught (*c*) installations were made, but this method of supplying combustion air was never extensively employed, as the volume of gases handled by the fan was nearly double that of the atmospheric air supplied to the unit, requiring increased fan power. Also, because of the hot gases, the fan bearings had to be water-cooled, an awkward complication in a piece of auxiliary equipment located at the top of the boiler room of a ship.

The closed-fireroom forced-draught (*d*) type of installation was extensively used in the older Navy combat ships and in a few Merchant Marine installations, where boiler ratings in excess of those possible with the double-front forced-draught (*b*) construction were required. Because of the hazards to the personnel involved in case of a gas attack, and the complication of the air locks, this system of supplying combustion air to the boilers is no longer being installed in ships of either the Navy or Merchant Marine.

The double-cased forced-draught (*e*) type of installation is the most generally used method of supplying combustion air to boilers in modern ships of both the Navy and Merchant Marine. It permits high boiler ratings without the possibility of the gases of combustion leaking into the firerooms, and at the same time allows the use of "open" firerooms; *i.e.* without air locks. The fan supplying ventilation air may be shut down during gas attacks.

The single welded-casing (*f*) installation may be operated at high rates without the possibility of gases leaking into the fireroom. This makes the lightest and most compact casing for use on boilers to be operated at high rates in an "open" fireroom.

TREND.

The trend that has been taking place in the distribution of heat absorbed in marine-boiler units, as steam pressures and temperatures increased, is illustrated in Fig. 14, which graphically compares the boiler unit shown in Fig. 2, which was installed in the ships of the Emergency Fleet during the 1918-1919 period and operates at 200 psi

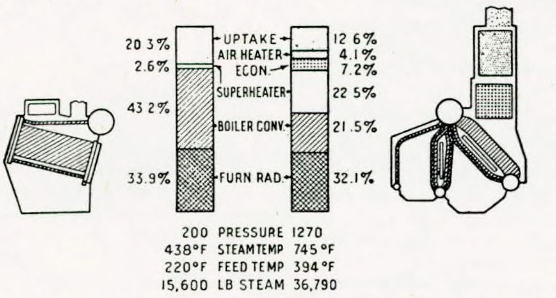

FIG. 14.—*Diagram showing distribution of heat absorption in various positions of boiler units, as shown in Fig. 2 and Fig. 9 respectively.*

pressure and 50° F. superheat, with the modern high-pressure (1,270-psi) reheat unit, shown in Fig. 9. The percentage of the heat absorbed by furnace radiation remains about the same for both units, but the heat absorbed in the boiler-tube banks of the modern unit is only one half of that absorbed in the boiler-tube bank of the low-pressure unit. The percentage of the heat absorbed in the superheater of the modern unit is nearly nine times greater than that in the older installation. The economizer and air heater in the high-pressure unit are responsible for giving it an efficiency approximately 8 per cent. higher than that of the older unit, with both operating at designed full power. Reference to Table 2 shows how this trend in boiler-unit design has been keeping pace with the change that occurs in the thermal characteristics of steam, in going from the lower pressures and temperatures to the higher pressures and temperatures.

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THE INSTITUTE OF MARINE ENGINEERS GUILD OF BENEVOLENCE.

Donation of the John Silley Memorial Fund.

At a special meeting of the General Committee of The Institute of Marine Engineers Guild of Benevolence on the 28th October, Engineer Vice-Admiral Sir George Preece, The President of The Institute, reported having received a letter in the following terms from Mr. H. A. J. Silley, the Chairman and Managing Director of Messrs. R. & H. Green and Silley Weir, Limited, the well-known London firm of ship repairers :—

21st October, 1943.

Dear Sir George,

My brother and I have been considering for some time how best we might create a memorial in some tangible form to our late father, Mr. John Silley. His interest in The Institute of Marine Engineers and, in particular, his efforts in connection with the Guild of Benevolence during his term of office as President are, of course, well known to you. You will recall that when he made his special appeal on behalf of the Guild Funds he set himself a target figure of £50,000. Unfortunately, ill-health intervened, both during his term of office and after, and this I am sure prevented his carrying his wishes into effect.

In view of the foregoing, my brother and I can think of no more fitting memorial than to help in attaining the objective which our father set himself. We have therefore decided to donate to the Guild under a covenant for seven years such sums as will in process of time aggregate to approximately £20,000. When our intention became known to my Board they expressed the wish that the Firm should also contribute to the Guild in memory of my father, the late Chairman of our Company, and I am extremely happy to inform you that at a recent meeting of our Board the Directors unanimously resolved to donate the sum of £10,000 to the Guild of Benevolence.

You can imagine, as Chairman and Managing Director of Green and Silley Weir, the pleasure it gives me to convey the news to you.

My colleagues on the Board, together with my brother and I feel that we should like these donations allocated to a special fund, to bear the name of "The John Silley Memorial Fund". This fund, would, of course, be administered under the same rules and conditions as other monies already subscribed to the Guild of Benevolence.

I take this opportunity of conveying to The Institute and the Guild under your Presidency our best wishes for the future.

Believe me,

Yours sincerely,

(signed) H. A. J. Silley.

The Commitee recorded their profound gratitude for these generous donations, and passed a unanimous vote of thanks to each of the three donors. Arrangements were made for the investment of these funds, and for the distribution of the income in accordance with the wishes expressed in Mr. Silley's letter.

The Institute is already deeply indebted to the late Mr. John Silley for his outstanding part in the founding of the Guild of Benevolence—an event which will always be associated with his year of office as President. He was justifiably proud of his distinction as the first President of The Institute to have attained that high office by successive advancement from junior membership, and the inspiration which he has thereby afforded to coming generations of young marine engineers will be considerably enhanced by this permanent memorial to his personality and achievements.

The newly augmented Capital Funds of the Guild will enable the Committee to extend materially its good work in alleviating cases of hardship among marine engineers, their widows and dependants. As such cases will inevitably continue to increase in the coming years, it may be hoped that other potential donors may be inspired by the actions of Mr. Silley and his brother, and of the Firm with which they are associated, to bear in mind the Guild of Benevolence as being worthy of all possible assistance.

ADDITIONS TO THE LIBRARY.

Presented by the Publishers.

British Standard Specification No. 1131-1943 for Bronze Oil Retaining Bearings.

A Concise Engineering Course. By Percy H. Miller, A.M.I.Mech.E. Isaac Pitman & Sons, Ltd., 1943, 169 pp., 63 illus., price 7s. 6d.

This book has been especially written for the benefit of apprentices and trainees in the engineering industry and covers a very wide field in a very brief survey. The author has endeavoured to present in simple language some of the fundamentals which he considers should be acquired by the newcomer to engineering before he can be expected to make a close study of the various complementary subjects in the vast field of engineering.

This preliminary survey is divided into ten sections under the headings Elementary Draughtsmanship, The Pattern Shop, The Foundry, The Smithy, Sheet Metal Work, Oxy-Acetylene Welding, Electric Welding (including some remarks on the welding of Brass, Bronze, Aluminium, Nickel Cast Irons and Stainless Steels), The Fitter, The Machine Shop, and The Inspection Department.

The illustrations, which are mostly photographs taken from makers' catalogues, convey a regrettably small amount of information. Unfortunately, in the all too brief section on machine drawing, the reference to the use of cross-hatching to represent different metals is now quite obsolete.

Bearing in mind the purpose for which the book was written, the trainee should find in it much to stimulate his interest in engineering processes, presented in a compact, if somewhat superficial form.

MEMBERSHIP ELECTIONS.

Date of Election, October 28th, 1943.

Members.

Robert Francis Allen.
Alexander Brown Edmond.
Cyril Llewellyn Evans, Eng. Lieut., S.A.N.F.
Harry Godfree.
Alcwyn Morgan Jones.
Alexander Kari.
Horace Noel Morgan.
Theodore Hugh Noel.
William Arthur Richardson, Lieut.(E.), E.M.S.
David Gilbert Rorison.
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Francis Leslie Tewkesbury, Lt.-Com'r.(E.), R.N.
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Harold Norman Elliott Whiteside.
Isaac Lewis Williams.
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Peter Johnston.
Stephen Marmaduke Mattison.
William Purdy, Temp. Lt.(E.), R.N.R.
Douglas Rhodes West.
Cyril Henry Williams.
William Wilson.

Student.

Wilfred Fitzgerald Ratcliffe.

Transfer from Associate to Member.

Gilbert Armstrong Kerr, Lieut.(E.), R.N.R.

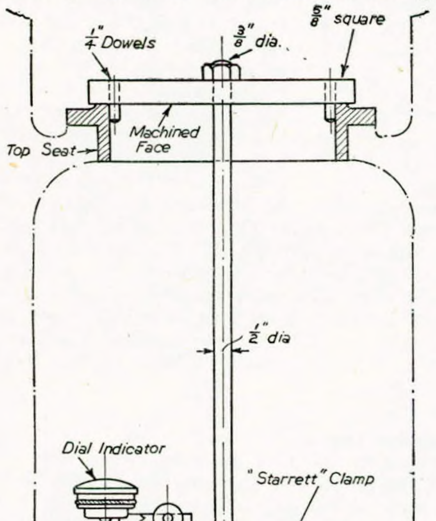
Abstracts of the Technical Press

Air-screw Propulsion for Danube Barges.

The Budapest German-Hungarian Chamber of Commerce recently published some particulars of the experimental work carried out with air-screw propulsion applied to river barges on the Danube. Last September a series of successful tests were made with a shallow-draught barge fitted with an Asboth unit consisting of a 10-ft. air-screw driven by a 30-h.p. petrol engine, and after these trials a syndicate was formed to develop this form of propulsion. The first of a series of five craft equipped with Asboth air-screw motors was recently completed in a Hungarian shipyard. The vessel is about 92½ft. in length and 18ft. in breadth, and is able to carry 50 tons of cargo on a draught of only 1ft. 8in. The engine, which can be run either on petrol or producer gas, is installed aft on a tower which can be revolved, permitting movement of the vessel in any desired direction. Thus, by turning the tower 90° the craft can be made to move sideways, while a further turn of 90° gives the air-screw a tractor, instead of pusher, effect, driving the craft astern. This easy manœuvrability makes the new system of propulsion especially convenient in narrow waterways. On trials the craft attained a speed of over 6·8 m.p.h. The vessel is equipped with an electric crane having a lifting capacity of half a ton at a radius of 30ft.—*"Lloyd's List and Shipping Gazette", No. 40,132, 7th July, 1943, p. 7.*

Testing Parallelism of Valve Seats.

The arrangement shown in the accompanying sketch was devised by the writer as a means of testing the two valve seats of a ship's double-beat regulating valve for parallelism. The nickel-chrome valve seats were "bought in" finish machined, whereas the cast-steel valve chest had to be machined on the premises. The impressions made by the two valves mounted on a common spindle on the valve seats gave rise to some doubts concerning the parallelism of the latter, and the writer therefore devised suitable means for checking it. A mild steel bar of ⅝in. square section machined flat on one side and made long enough to subtend the valve seats, carries a length of ½-in. diameter mild steel bar to which is clamped a test dial indicator. The long square bar has a ⅜-in. hole at its centre and two ¼-in. holes pitched equidistant from the latter, the distance between the centres of these ¼-holes being ¼in. less than the bore of the valve seats. Dowels are driven into the square bar to enable the apparatus to be rotated freely in the bore of the seats. In operation, the bar is slowly rotated and any variation in the parallelism of the faces of the valve seats is immediately shown on the dial indicator.—*C. Mathieson, "Practical Engineering", Vol. 8, No. 191, 17th September, 1943, p. 221.*



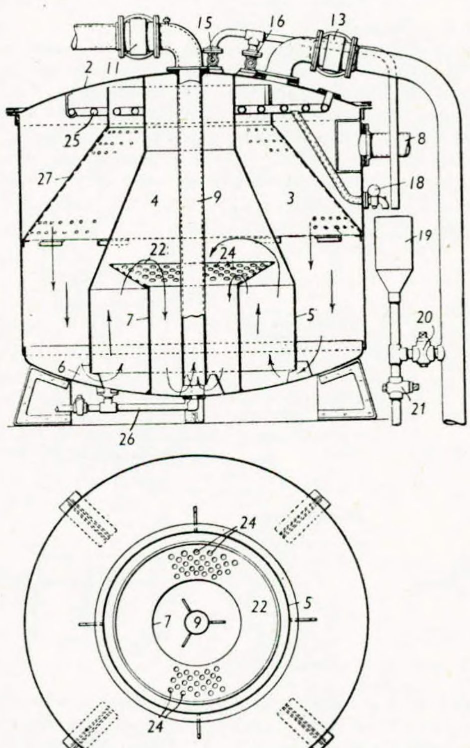
Testing parallelism of valve seats.

Detachable-blade Screws.

In recent years the once-popular type of propeller having bronze blades bolted to a separate boss has fallen out of favour, due to the greater efficiency of integral cast screws with their somewhat smaller bosses. Nevertheless, it is probable that the shape of the boss is, within certain limits, of greater importance than its actual diameter and advantages are sometimes claimed for a well-streamlined boss of relatively large size, alone or in association with other stern features. Built-up propellers may be advantageous for high-speed work because they lend themselves to dynamic balancing, and greater manufacturing tolerances on pitch are feasible in view of the possibility of adjustment in place. A single blade design can therefore be standardised for a given diameter over a wide range of pitch, whilst the war-time advantages are that wider manufacturing facilities are available for making blades alone, together with the fact that the most readily available material may be chosen for the boss, which need not be of bronze.—*"Shipbuilding and Shipping Record", Vol. LXII, No. 6, 5th August, 1943, p. 123.*

An Improved Oily Water Separator.

An improved type of separator for the removal of oil from bilge water, in which a special method of secondary separation is adopted, forms the subject of a recent British patent. The construction of such a separator is shown in the accompanying sectional elevation and plan. Contaminated bilge water enters the separator through an inlet (*8*) located somewhat below the level of the cover (*2*), while the outlet for the treated water consists of a central pipe (*9*). A discharge control valve (*11*) is provided. The oil collected in the upper part of the chamber (*3*) is removed through a pipe with a regulating valve (*13*). The two separating chambers (*3, 4*) are divided by a tubular casing (*5*) which rests on supports (*6*). Inside is another tube (*7*) sealed to the bottom of the separator. Test cocks (*15, 16*) are provided in order to ascertain the presence of oil and scum or air and oil in the chambers (*3, 4*), and a cock (*8*) enables tests to be made of the depth of oil accumulated in the upper part of the chamber (*3*). There is a drainage funnel (*19*) which communicates with the oil discharge pipe through a cock (*20*) or allows the fluid to return to the bilge through a cock (*21*). A steam coil (*25*) is fitted in the separator near the top to heat the oil, and at the bottom there is a drain pipe (*26*). Within the separator is a perforated cone (*27*) to distribute the bilge water evenly across the transverse area of the chamber (*3*) where the primary separation takes place. The water, still containing some oil, passes below the bottom of the tube (*5*) into the chamber (*4*), where the secondary separation is carried out. An important feature of the construction is the provision of a distributing plate (*22*) having a truncated conical shape, with a large number of holes (*24*). The effective area of the distributing plate



Sectional elevation and plan of oily bilge water separator.

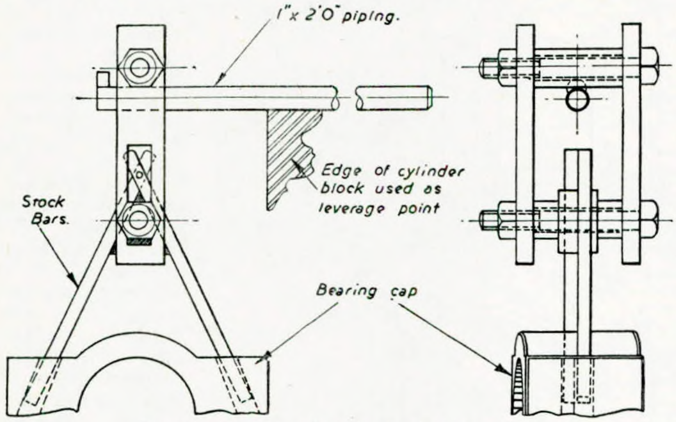
surface (the total area minus the aggregate area of the holes) is about one-half of the area of the upflow passage between the tubes (*5, 7*). By the use of this distributing plate the turbulence of the stream where the direction of flow changes from up to down is rectified. The smooth flow obtained allows the oil globules to acquire a velocity in relation to the water, thus enabling them to pass into the upper part of the chamber (*4*). Otherwise, the globules of oil would be entrained with the water in the down flow around the lower part of the centre pipe of the separator.—*"The Motor Ship", Vol. XXIV, No. 284, September, 1943, p. 195.*

Remote-reading Depth Indicator.

An improved type of depth indicator with a remote-reading gauge for use with oil, water or fuel tanks which are so placed as to make it difficult to fit them with depth indicators which are easily visible from the E.R. starting platform, has been put on the market by a well-known North Country engineering firm. The actuating unit is an air bell which rests on the bottom of the tank and is connected to the recording gauge by ¼-in. bore piping. To make up for any leakage of air in the system a small pump is provided immediately below the gauge. The latter can be fitted in any convenient position, without regard to its relation to the location of the tank. The system comprises a minimum of working parts and operates on the principle that the head of liquid in the tank expels the air from the submerged bell through the connecting pipe at a pressure proportional to the depth of liquid. The recording gauge is calibrated to suit the depth of the tank and the specific gravity of the liquid it contains.—*"The Oil Engine", Vol. XI, No. 124, August, 1943, p. 112.*

Packard Marine Bearing Cap Removal.

Difficulty is sometimes experienced in removing the main bearing caps of Packard marine engines of the type used for sea rescue launches. The difficulty is due to the fact that the crankshaft is so deeply embedded in the bearing supports that the bearing caps are hard to release. This difficulty was overcome by a pull-out device, designed and constructed by the writer, which consisted of two lengths of ½-in. bar connected to a square holder into which was inserted a bar made of 1-in. tubing, about 2ft. long. By using the



Packard marine bearing cap removal.

edge of the cylinder block as a leverage point it is possible to release the bearing caps quite easily. The construction of the pull-out device is shown in the accompanying sketches.—*H. L. Fuller, "Practical Engineering", Vol. 8, No. 187, 20th August, 1943, p. 121.*

Eliminating Erosion in Continuously Operating Turbines.

A turbine rated at 23,000 kW. of the straight condensing type designed for operation with steam at a pressure of about 530lb./in.^{2} and temperature of 800° F., was put into operation some years ago and was recently opened up for examination after approximately 36,000 hours' running. According to the *Brown, Boveri Review* (August, 1942), the only defects found were of a trivial nature, a few small parts and minor auxiliaries having to be renewed or adjusted and the nozzle valves having to be ground in. Apart from this, general cleaning was all that was required. The turbine blading proved to be in excellent condition, the inlet edges of the blades, which are commonly subject to the erosive effect of water droplets, being unimpaired. Working records showed that for three summer months the mean temperature of the condenser circulating water was 73° F. and for three winter months, 53° F., these limits resulting in steam of relatively high wetness. The condition of this turbine confirms earlier experience, *i.e.*, that with high outputs and a high degree of wetness of the exhaust steam concomitant with a good vacuum and high efficiencies, reaction blading is no more subject to erosion than impulse blading.—*"Mechanical World", Vol. 114, No. 2,958, 10th September, 1943, p. 304.*

Davey, Paxman Emergency Devices for Inoperative Cylinders.

An emergency device for use with oil engines to enable these to be run with a cylinder cut out of action, has been developed by Davey, Paxman & Co., Ltd., and is covered by a British patent. The device, which is illustrated in Fig. 1, comprises a balance weight for attachment to the crankpin of the inoperative cylinder, and mechanism to be substituted for the valve-actuating push-rods, so that the valves remain closed until the cylinder is ready for normal operation. The balance weight (A), intended to take the place of the big-end bearing, can be readily assembled around the crankpin ((E) by means of bolts, (B) having heads which lie in recesses (D). It is claimed that the use of this fitting makes it possible to maintain the correct balance of the engine with one cylinder, or one pair of cylinders on a V-type unit, out of service. To prevent damage to the valve gear which might occur with the engine running at a high speed, telescopic push-rods, which are spring-loaded, replace the ordinary rods that normally transmit motion from the camshaft (F) to the valve lever (G). Each push-rod of the emergency fitting has a head (J) engaging a stud (K). A sleeve (L) is secured to the head and the bottom of the rod consists of a pin (M) with studs (N) moving in slots (P). The sleeve (L) serves to enclose a spring (R). This arrangement ensures that pressure is always maintained between the rocking lever (S) and the valve lever (G). The valve remains closed, as the working of the cam merely produces a reciprocating movement of the pin (M) in the sleeve (L) of the push-rod against the light pressure of the spring (R).—*"The Oil Engine", Vol. XI, No. 125, September, 1943, p. 137.*

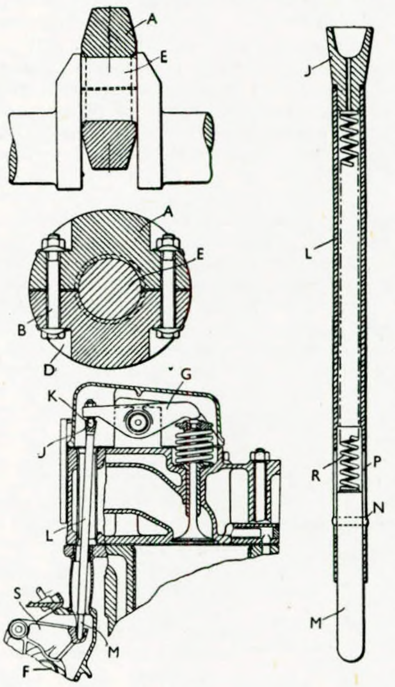


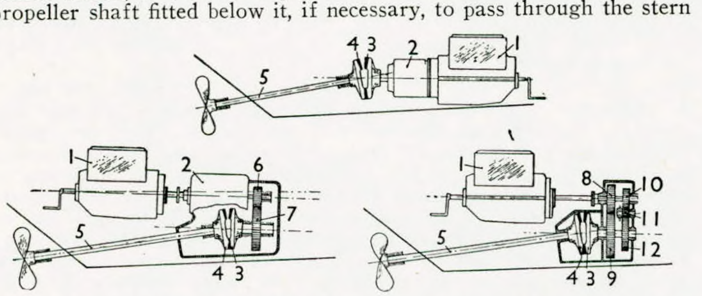
FIG. 1.

High-speed Light-weight Marine Engines.

Some further particulars of the new type of two-stroke oil engine developed by the General Motors Corporation for the propulsion of the 110-ft. U.S. submarine chasers (*see abstract on p. 124 of* TRANSACTIONS, *December, 1942*) were given in a paper entitled "Development of a Light-weight Diesel Engine" which was recently read before a meeting of the Society of Automotive Engineers by J. C. Fetters. The main feature of this engine is the arrangement of its 16 cylinders in four radial banks above the gearbox, the speed reduction being obtained through a pinion and ring gear in a right-angle drive to the variable-pitch reversible propeller. The output of the engine is 1,200 b.h.p. at 1,800 r.p.m., and the weight, based on this power, is 4lb./b.h.p. This is claimed to be only 20 to 25 per cent. the weight of any other marine engine of corresponding output now in large-scale production, whilst the space occupied is about one-third of that required for the normal type of engine. The push-rods for the cylinder valves are arranged in rows along each bank of cylinders and are operated by a single camshaft located in the V of each pair of cylinder banks, so that only two camshafts are needed for the 16 cylinders. A slipper-type arrangement of connecting rods is employed, there being four connecting rods bearing directly around each of the four crankpins. As the rods are articulated, the arc which can be subtended by each rod pad is only 66°. This results in a very high loading. There is a 2 to 1 reduction in the gearbox. Port or starboard propeller-shaft rotation may be determined according to whether the gear ring is on one side of the pinion or the other. The crankcase is a welded single-piece structure built up in layers of four-cylinder radial elements at a time, the main stress members being alloy-steel X-shaped plates in a horizontal plane spaced apart by hexagonal-shaped plates. These constitute the main stress members in this sectioned crankcase. The crankcase assembly has to be fed into one end of the case. The main bearings are housed in forged-steel X-shaped members made in halves and assembled on to the main journals before the shaft is lowered into place. Four spokes pilot into the crankcase and bolt on to four lugs which project inward from the main stress bulkheads, the latter being cut away between the lugs to permit the shaft to be lowered into place. When it is in position, each bearing carrier is indexed around 45° until the lugs of the case line up with the spokes of the carrier. Scavenging air enters the cylinders through ports in the bottom, whilst the exhaust gases are discharged through two exhaust valves in each cylinder, actuated by push rods. The cylinder barrels and the port rings are made from steel tubing, the inlet ports being cut out of both the barrel and the port ring. The cylinder heads are steel forgings to which light steel water jackets are welded. The upper parts of the heads are formed by separate forgings, each of which has a flat disc welded on the under side to form the water passage. A steel tube through the middle of each of these welded sub-assemblies ties them together. The port ring, lower water jacket and lower cylinder flange are all hydrogen brazed in place. The top of the barrel has an external thread, and the cylinder-head forging has an internal thread. When assembling, the upper water jacket is slipped down over the barrel until it seats tightly against a copper-plated steel gasket, whereupon the water jacket is welded to the port ring and to the cylinder head. The entire assembly only weighs about 30lb., in spite of the fact that it is constructed of steel throughout. The complete cylinder assemblies with the pistons and connecting rods inserted into them, are guided into the crankcase until the lower flange of each cylinder rests against the edge of the crankcase. After the four cylinders which make up each bank have been fitted in place, a casting termed an exhaust housing is slipped over all four cylinder heads and bolted to the crankcase by a row of studs around each cylinder. The explosion load is therefore taken directly from the cylinder at this point and transferred through the exhaust housing to the crankcase via the securing studs. The pistons consist of a forged-steel head and a skirt made from steel tubing, welded together just above the ring belt. The pistons are cooled by jets of oil. There are no wrist-pin holes through the piston skirt. Two forged-steel trunnions are arranged on each side of the connecting rod and are bolted directly to the head forging. A silver-plated floating bushing is used between the connecting rod and the wrist-pin. The centrifugal blower is driven from the top end of the crankshaft through a spring coupling, the drive ratio being 10 to 1, so that the impeller speed is 18,000 r.p.m. at the rated output of the engine. Air passes from the inlet at the centre out radially through the impeller blades, through the diffuser, and into the discharge scrolls. Each discharge scroll leads to an air passage in the crankcase which is common to two banks of cylinders. The rated output of the blower is approximately 4,000 cu. ft./min. at a pressure of 6lb./in.^{2}. The complete assembly of the blower and drive weighs about 100lb.—*"The Motor Ship", Vol. XXIV, No. 283, August, 1943, pp. 144-145.*

Novel Angle Drive for Motor Boats.

In order to obtain an angle drive, generally in conjunction with a return shaft arrangement, it has been the practice to employ conical pinion wheels, so that the engine can be installed horizontally and the propeller shaft fitted below it, if necessary, to pass through the stern



tube at the required depth. The pitch cone of these pinions has what is termed an acute opening angle, and the machining of the teeth is a somewhat difficult operation. The Swiss Locomotive and Machine Works, Winterthur, have recently developed and patented a form of angle drive using bevel-wheel teeth with a very obtuse angle opening, which are relatively simple to machine. It is also claimed that a greater number of teeth can be made to engage each other than with a conical pinion drive, so that the tooth pressures are reduced and the transmission is smoother, the bevel-gear angle being determined by that of the propeller shaft in relation to the more or less horizontal line of the engine crankshaft. Three forms of this new S.L.M. inclined shaft drive are illustrated in the accompanying diagrams. The upper view shows a plain angle drive from the engine (*1*) through the reverse gearbox (*2*) and the bevel wheels (*3, 4*) to the propeller shaft (*5*). In the lay-out shown in the lower left-hand diagram the reverse gear (*2*) is arranged in front of the engine (*1*), with a spur-wheel reduction gear (*6, 7*) forward of it. In the lower right-hand diagram the arrangement shown eliminates the usual reverse gearbox, the spur wheels (*8, 9*) taking the ahead drive and giving the propeller shaft a reduced speed, while the astern drive is taken through a separate set of spur wheels (*10, 11, 12*). It will be apparent that the distance of the point of application of the twisting moment from the centres of the crankshaft or transmission shaft and the propeller shaft has to be borne in mind when designing the bearings for the latter.—*"The Motor Boat", Vol. LXXVI, No. 1,911, September, 1943, p. 235.*

Multiple Opposed-piston Engine Drive for Propeller Shafts.

A new method of using a number of opposed-piston Diesel engines for driving a single propeller shaft has been developed in the U.S. and forms the subject of a recent British patent. Referring to the accompanying diagrams (Fig. 1), the power units (E) are provided with clutches (C) by means of which any engine can be disconnected or reversed. The two crankshafts (*19*) of each engine have pinions (*20*) which engage the gear-wheel (*21*), so that the propeller-shaft gearing keeps the crankshafts in synchronization. The construction of the clutches (C) is shown sectionally in detail. The hub (*26*) is free to rotate on the shaft (*1*). Discs (*32*) are welded to the hub and to an external connecting ring (*25*), whilst the hub is extended to form clutch dogs (*33*). The pistons (*39*) are forced by hydraulic pressure inwardly away from the enclosure (*17*) so as to move the friction blocks (*37*) against the outer surface of the pulley (*34*). When this pulley is running at the same speed as the enclosure (*17*), the control lever (*50*) is released in order to engage the dogs (*41*) with the clutch dogs (*33*). Thus, the shaft (*1*) becomes positively engaged with the hub (*26*) of the gear-wheel (*21*). The control of the hydraulic pistons (*39*) is effected through passages (*2, 3, 4*) in the shaft (*1*), which are connected by a hydraulic "commutator" (*5*) to pipes (*6, 7, 8*) fitted with control valves (*10, 11, 12*) through which oil under pressure may be admitted from the pipe line (*13*) and high-pressure pump (*14*).—*"The Motor Ship", Vol. XXIV, No. 284, September, 1943, p. 202.*

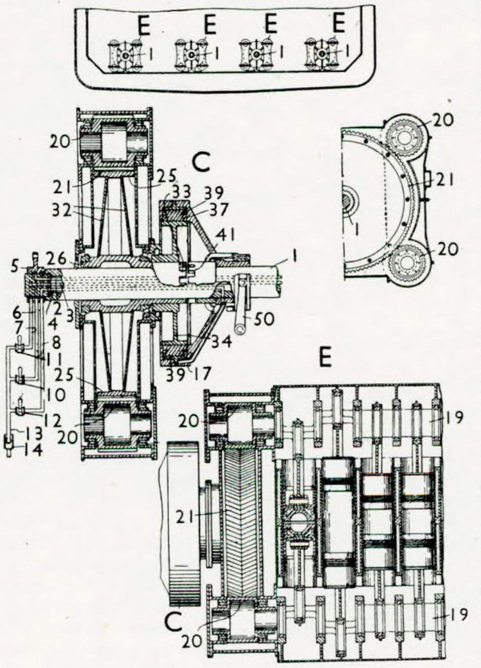


Fig. 1.

Precautions to be Taken with Producer-gas Installations.

According to the *Journal de la Marine Marchande*, gas producers have been installed in several small French ships, on account of the shortage of oil. It appears that a number of precautions have to be taken when operating these installations. The volume of gas produced has to be very large in order to obtain results which compare with oil or petrol, and as the gas is heavier than air and noxious, special care has to be taken to ensure that the engine room is adequately ventilated and that the number of pipe joints is reduced to a minimum. It would also appear that, in general, it is advantageous to have two generators, as the plant has to be stopped from time to time for repairs, cleaning and de-coking. If gas is to be used extensively in a proportion of small coasting vessels, it is probable that a more promising line of development will lie in the use of cheap gas stored under pressure in containers and supplied by the local gas works, rather than in the way of producers installed on board.—*"Fairplay", Vol. CLXI, No. 3,143, 5th August, 1943, p. 222.*

Doxford Pressure Alarm.

Three types of Doxford pressure alarm, as recently patented in this country, are shown in Fig. 3. In each case there is a chamber (*2*) supplied with air at a constant pressure. This is set slightly higher than that existing in the fluid system when the device is required to operate. For example, if the pressure in the system is 25lb./in.^{2} and an alarm is needed when it drops to 20lb./in.^{2}, the air pressure in the chamber (*2*) is adjusted to 21-22lb./in.^{2}. When the working pressure in the chamber (*1*) drops to 20lb./in.^{2}, the excess pressure in the chamber (*2*) moves a diaphragm which causes a valve (*7*) to open, thereby allowing air under pressure to flow into the cylinder (*9*) and causing the piston inside the latter to operate an alarm or a visible signal. The top left-hand diagram shows a simple form of the device. If the pressure in the chamber (*1*) which is to be safeguarded is lower than the air pressure for the alarm, a spring (*3*), shown in the top right-hand diagram, is provided for the operation of the diaphragm by the application of the necessary additional loading pressure. In the case of the third arrangement, shown in the centre, it is assumed that the pressure in the chamber (*1*) is higher than that available from a constant-pressure supply. A tension spring (*6*) operates on the diaphragm against the pressure existing in the chamber (*1*), so that this pressure is balanced by the combined effects of the constant air pressure in the chamber (*2*), and the tension of the spring. The lower diagram shows how these devices can be arranged to safeguard a number of systems with widely differing pressures. Each of the pipes (*28, 29, 30*) has a pressure-safeguarding apparatus (*31, 32, 33*) of any of the forms described, but the constant air pressure is derived from a single source. The different pressures are balanced by adjustments of the compression or tension springs, as the case may be. Separate reducing valves (*35, 36, 37*) are provided in order to obtain a convenient range.—*"The Motor Ship", Vol. XXIV, No. 284, September, 1943, p. 202.*

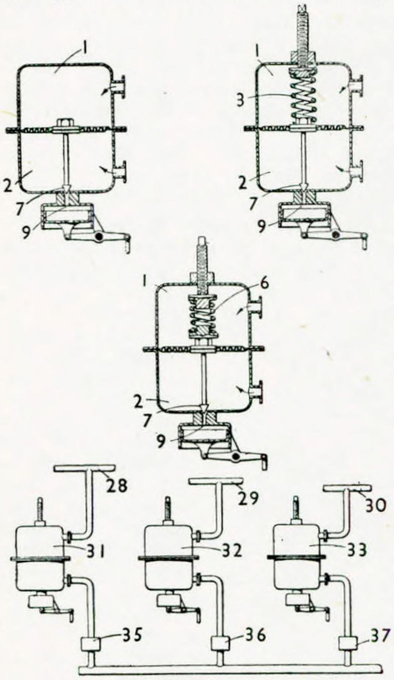


FIG. 3.

Latest Krupp Two-stroke Engine.

Some particulars were recently published in Germany of the modifications which have now been effected in the design of the two-stroke Krupp marine Diesel engine first introduced in 1937. The latest engine of this type to be built is a 7,000-b.h.p. single-acting unit designed to run at 120 r.p.m., and has 10 cylinders of 740 mm. diameter with a piston stroke of 1,300 mm. The b.m.e.p. at full power is 66·8lb./in.^{2} The cylinders have ports for the admission of scavenging air and the discharge of exhaust gases, but above the inlet ports —which are lower than the exhaust ports—is a series of small suction ports in direct communication with the exhaust manifold. It is claimed that these suction ports prevent the formation of eddies in the cylinder resulting in imperfect filling of the latter with scavenging air. Piston-type blowers at the back of five of the 10 cylinders supply the scavenging air, the drive being taken from the crossheads of the main pistons. The Archaouloff injection system, originally used for the conversion of air-injection engines, has now been adopted for new engines. The injection pumps are actuated by the pressure within the main working cylinders and are screwed into the pressure rings of the cylinder covers. The injection pumps are in effect water-cooled gas cylinders connected by means of steel pipes with the cylinder combustion chambers. The fuel is delivered from the pump to the injection valve by a very short pipe. The suction valve of the pump is regulated from a horizontal control shaft at the front of the engine, and the rotation of this shaft advances or retards the opening of the valve, thus increasing or reducing the amount of fuel supplied. This action is effected automatically according to the engine load, so that no camshaft is required for the actuation of the fuel pumps. A vertical camshaft driven from the crankshaft is, however, provided for operating the air distributor valves by means of which the engine is started and reversed. Although the full pressure of the starting air (about 200lb./in.^{2}) is maintained at the starting valves during the whole period of manœuvring, the valves themselves are only open through the intermediary of pilot valves for a short time when starting. The valves cannot be opened unless the pressure in the cylinders is below that of the starting air. Fuel can be injected into the cylinders at the same time as the starting air. Unlike the original Krupp engine which was manœuvred by means of a reversing wheel and two levers for fuel and starting air respectively, the new engine is controlled bv two levers only. Fuel injection occurs at the top dead-centre, so that no change in timing is needed for reversing, the latter process being effected by the control of the air distributing valves. Sea-water cooling is employed for the pistons and cylinder covers, the latter being in two parts, one of which comprises the water-cooled section in contact with the combustion chamber, and the other the pressure ring which holds down the water-cooled part. The telescopic pipes for the piston-cooling water are fitted with air vessels. The scavenging-air pressure is 1·4lb./in.^{2} and the amount of scavenging air supplied is 35 per cent. greater than the swept cylinder volume. The pressure-feed type lubricating-oil system for the main bearings and crankheads is maintained at about 20lb./in.^{2}, but oil at a pressure of up to 300lb./in.^{2} can be supplied to the crosshead bearings by means of separate oil pumps having their plungers reciprocated by the angular movements of the connecting rods.—*"The Motor Ship", Vol. XXIV, No. 283, August, 1943, pp. 142-143.*

Steam Superheater for Scotch Boilers.

An improved design of superheater for use in boilers of the Scotch and similar return smoke-tube type has recently been developed and patented by the Superheater Company. With the usual arrangement of relatively small smoke tubes of 2¼in. to 3½in. external diameter, the superheater surface which it is possible to locate in these tubes is so limited that only a moderate degree of superheat is obtainable, so that in order to give higher steam temperatures it is sometimes necessary to extend the superheater elements into the combustion chamber. In these cases the heating surfaces are exposed to gas temperatures higher than those obtaining with the usual type of smoke-tube superheater, and they are therefore more vulnerable. This disadvantage is claimed to have been overcome in the improved form of construction illustrated in the accompanying diagrams. Two pairs of superheater headers are mounted in the usual positions in the smokebox, one pair (*5, 6*) being shown in Figs. 1 and 2. The flue tubes (*3*) are distributed over the whole of the usual tube spaces of the boiler and are interspersed among the stay tubes (*4*). There are fewer flue tubes, but due to the difference in diameter, the total heating surface of these is substantially greater than that of the stay tubes. The superheater elements are U-shaped at (*8*) and are connected by inlets and outlets (*9, 10*) to the headers (*5, 6*), respectively. Each flue tube accommodates three element loops (*8*), as shown in Fig 1, most of the superheater elements consisting of six loops. The loops (*8*) of an element are arranged inside the adjacent flue tubes (*3*) of the same horizontal row, but where the horizontal rows of flue tubes in the centre or either of the wing nests contain an odd number of tubes, one of the elements in a row consists of only three U-loops and all the loops are disposed in one flue tube. The sizes of the flue and stay tubes can be varied to suit the tube-plate lay-out of any particular boiler, but generally the cross-sectional

Fig.1.

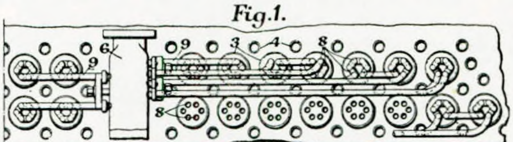
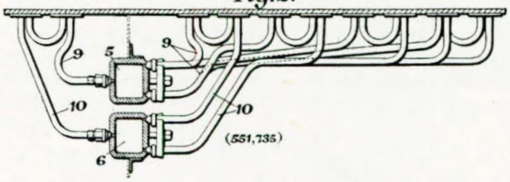


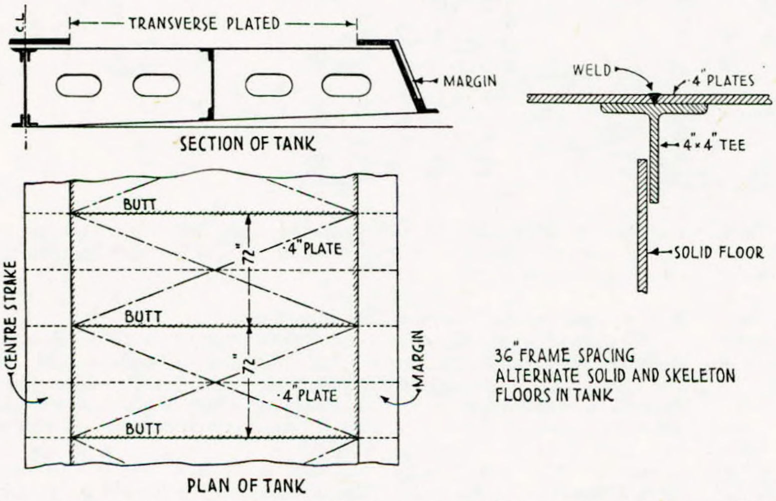
Fig.2.



area of a flue tube will be at least 50 per cent. greater than that of the smoke tubes normally fitted in such a boiler. Similarly, the stay tubes will be smaller than normal and almost the whole of the furnace gases will be forced to pass over the superheater surfaces. For instance, where the flue tubes are $5\frac{1}{2}$in. outside diameter with a wall thickness of $\frac{3}{16}$in., the small stay tubes have an outside diameter of 2in. with walls $\frac{1}{4}$in. thick. With flue tubes of this diameter it is possible to employ superheater elements composed of 1-in. outside diameter tubing in each flue tube. The headers occupy the usual positions in the smokebox opposite the spaces between the tube nests, the number of headers depending on the number of furnaces in the boiler. Thus, two sets of headers are fitted in a three- or four-furnace boiler, whilst in the case of a two-furnace boiler only a single set of headers is required, mounted, as usual, opposite the space between the two nests of return tubes. The elements are shown connected to the wrought-steel headers (*5, 6*) by so-called ball joints in which a spherical end of the tube seats in a coned hole in the wall of the header and an annular abutment is formed on the tube with a spherical surface concentric with the end surface and on which a conical collar is seated. The two elements are secured in place by means of a central stud and clamp.—*"Engineering", Vol. 156, No. 4,052, 10th September, 1943, p. 220.*

Electric Welding of Tank Plating.

The accompanying illustrations show what is claimed to be an improved method of plating a double-bottom tank by the use of electric welding, whereby the fitting of the plating at the ends of the tank is simplified. Furthermore, this method of plating is claimed to be more economical. It may be seen that the plating is fitted transversely instead of longitudinally. the marginal plate flange extending inboard by 12in. and forming a stringer, while the centre



strake is fitted fore and aft. A T-bar is secured to the top of the solid floors to take the butt welding of the plates. The tank-top plates are two frame spaces wide, and the intermediate skeleton floor reverse is welded to the top plate.—*"Shipbuilding and Shipping Record", Vol. LXII, No. 10, 2nd September, 1943, p. 224.*

Big Mileage by Tanker.

The British Tanker Co.'s tanker "British Confidence" has set up what is claimed to be a record for a British merchant vessel, by covering nearly 243,000 sea miles since the beginning of the war. She is a motorship of 8,250 gross tons with a d.w. capacity of 12,250 tons, built in 1936 by Cammell Laird & Co., Ltd., and is propelled by a 4-cylr. Doxford engine of 2,850 b.h.p., giving her a service speed of about $11\frac{1}{2}$ knots. The "British Confidence" has been employed in the carriage of aviation and pool petrol, of which she has already transported a quarter of a million tons—sufficient to provide for 75 large-scale raids on Berlin. The vessel is commanded by Capt. E. C. Evans, O.B.E., and her chief engineer is Mr. W. C. Leete, of South Shields.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,062, 9th September, 1943, p. 8.*

Swedish Motor Schooner Converted to Producer Gas Propulsion.

The motor schooner "Gärd", of Kalmar, has just been fitted with a producer gas installation. She is a vessel with a d.w. capacity of 490 tons and is stated to be the largest Swedish producer gas ship employed in foreign trade. The application of producer gas to her two-cylinder 2-stroke Skandia oil engine of 160 h.p. marks a milestone in the development of producer gas systems for marine propulsion. The "Gärd" is about ten years old and is equipped with a reversible-blade propeller. Her producer gas plant, which operates on the Johansson system, includes an automatic diaphragm pump connected with the crankcase, for pumping in the gas. The latter is generated in two parallel-coupled Hesselman generators, each with a capacity of about 12·3 cu. ft., and fitted with a galvanized cooling and cleaning system. The power developed by the engine when running on producer gas is said to be about the same as when operating on fuel oil, the consumption of wood fuel being about 14·2 cu. ft./hr. —*"Lloyd's List and Shipping Gazette", No. 40,185, 8th September, 1943, p. 7.*

Feed Water Treatment.

In a paper entitled "Determination of Total Solids in Boiler Water from Alkalinity and Chlorinity", contributed to a recent issue of the *Journal of the American Society of Naval Engineers*, by R. S. Kaufman, the author puts forward an empirical formula from which, having measured the alkalinity and making two measurements of chlorinity, the total solids in the water can be determined. The formula, which has been found accurate to ± 5 per cent., is represented by the equation: $S=2{\cdot}01B+KC$ where S is the required total solids in parts per millions, B is the phenolphthalene alkalinity of the boiler water in parts per million, K is the ratio of total solids in the condenser water to its chlorinity, and C is the chlorinity in parts per million of the boiler water. In U.S. naval practice 100 per cent. distilled water is used in conjunction with a compound made up of 44 per cent. soda ash, 47 per cent. di-sodium phosphate and 9 per cent. starch, but the author suggests that similar equations for other values of the coefficient B could readily be derived from any different percentages making up the boiler compound employed.—*"Shipbuilding and Shipping Record", Vol. LXII, No. 7, 12th August, 1943, p. 148.*

Sidelights on the Liberty Ship Programme.

Reference to the origin of the Liberty ship design was made in an address recently given at an informal meeting of Philadelphia engineers and shipbuilders by Mr. Henry Meyer, chief engineer of Gibbs & Cox, the well-known New York naval architects employed by the British Government for the construction of the 60 "Ocean" type cargo steamers which were built in American yards in 1941. The design of the Liberty ships follows closely that of the British vessels, and the speaker praised the wisdom and foresight of the British authorities in adopting triple-expansion engines and Scotch boilers in spite of the criticisms to which they were subjected. The American Liberty ships differ from their British counterparts, however, in having oil-fired water-tube boilers instead of coal-burning Scotch boilers and air ejectors and condensate pumps for maintaining a vacuum instead of air pumps driven by levers from the L.P. crossheads of the main engines. In the American ships, moreover, the multi-vane forced-draught fan is driven by a single-cylinder steam engine which is interchangable with that used for driving the main circulating pump.—*"The Marine Engineer", Vol. 66, No. 793, August, 1943, p. 178.*

Copper for Ships' Bottoms.

Research work carried out in America has shown that pigments containing metallic copper provide an effective means of protecting the under-water plating of steel ships (*see abstract on p. 106 of* TRANSACTIONS, *October, 1942*). It is reported that an anti-fouling paint containing 3lb. of copper bronze pigment per gallon has given very satisfactory results in actual service on the hull of a cargo vessel in service between North and South American and West Indian ports. The bottom of the ship was first sand-blasted and then given three coats of red-lead priming followed by two coats of the copper anti-fouling composition which gave the appearance of a brilliant sheet of copper. After five months the vessel was again dry-docked, when the hull was found to be in perfect condition with no sign of fouling of any kind. According to a report made six months later, the ship was still in service without any increase in fuel consumption for the maintenance of her usual speed.—*"Shipbuilding and Shipping Record", Vol. LXII, No. 2, 8th July, 1943, p. 27.*

Cargo Steamer Rebuilt After Being Sunk.

A North-East Coast firm of ship repairers have completed a notable job of work by making fit for further service the 3,900-ton cargo steamer "Stakesby" which, after being torpedoed and partly gutted by fire, had lain on the bottom of the sea for 16 months. The vessel was struck by a torpedo on the S. bow while crossing the

Atlantic. Her cargo of pit props caught fire and after being abandoned by her crew, the "Stakesby" was towed by rescue vessels to near the west coast of Scotland, where it was intended to sink her in order to put out the fire. Unfortunately the ship sank in too shallow water and the flames burnt right through the lower decks, gutting the upper deck completely. Eventually, after she had broken away from her moorings in a storm, the "Stakesby" slid into deeper water, where she remained submerged for 16 months before being raised. An examination of her machinery and boilers having indicated that these could be made serviceable, the hull was patched up sufficiently for the vessel to be towed round the coast to a N.-E. Coast repair yard, where she was taken in hand for reconditioning. This work took many months and involved the construction of a complete new fore-end. Except for the funnel, nearly everything above the water-line had to be rebuilt, tons of plates damaged by the fire having to be cut away and renewed. The flames had "drawn" the hull up to such an extent as to cause misalignment of the main shafting, and the stern frame was pulled up 11½in. off the blocks. The extensive repairs made necessary almost amounted to the building of a new ship, and now the "Stakesby", under a new name, is once more in service.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,014, 15th July, 1943, p. 2.*

Salvage of Sunken Ships.

A recently patented method of raising the hulls of sunken vessels is shown in Fig. 2, in which the example taken is that of a submarine. Four salvage craft are employed in the first instance, the procedure

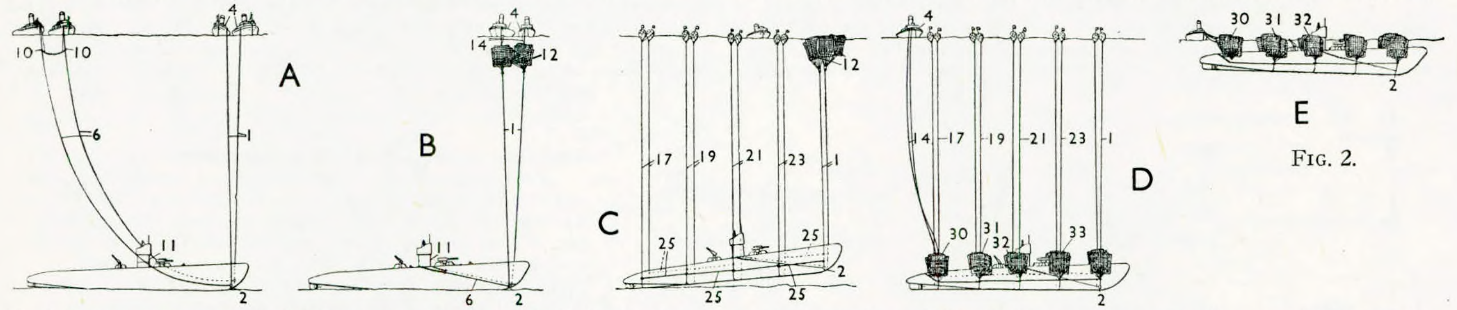


FIG. 2.

(A) being to pay out cable (*1*) from two of the craft (*4*) in the form of a loop (*2*). A pair of auxiliary cables (*6*) slide down the lifting cables (*1*) and a locking chain (*10*) slides down the auxiliary cables and engages part of the superstructure (*11*) in a manner shown in the second stage (B) of the operation. The auxiliary cables are there shown detached at a point above the securing chain. Two groups of deflated floats (*12*) are then secured to the lifting cables (*1*) at about 15ft. below the surface and these floats are then inflated by air tubes (*14*). Each float comprises a container holding a flexible bag, the whole being enveloped in 78-mesh steel-wire netting. When the bag is fully inflated it measures 8ft. by 8ft. (the depth being comparatively shallow) and the lifting capacity is 12 tons. When the bow rises (stage C) four supplementary cables (*17, 18, 21, 23*) forming loops are passed under the hull by divers, and to ensure that the loops shall remain in their adjusted positions, spacer bars (*25*) are run down the cables, so that the vessel is held in a cradle. The cables are buoyed so that the number of salvage craft can be reduced to a minimum. The floats (*12*) are then deflated and the vessel again rests on an even keel. In the next stage (D) additional floats (*30, 31, 32, 33*) in a deflated condition are slid down the supplementary cables and secured in place. The floats at the bow and stern are then inflated, the others being supplied with air progressively towards amidships. In the final stage (E) the vessel is shown raised by the floats towards the surface. The construction of the various parts of the salvage equipment used in the operation is described in detail in the patent specification.—*"The Motor Ship", Vol. XXIV, No. 284, September, 1943, p. 202.*

Tonnage Output and Tonnage Definition.

The U.S. Maritime Commission reported that the June output of American merchant ships was 1,676,500 tons deadweight, thus bringing the total production for the first half of 1943 to just over 8,800,000 tons d.w., or nearly 6,000,000 tons gross. The output for the whole of 1942 was about 5,000,000 tons gross. Although American statistics are given in tons d.w. whilst those issued in this country are in tons gross, it should be noted that in order to avoid confusion in announcing production and losses, the British and American authorities are endeavouring to arrive at a common basis for computing tonnage. However, the generally accepted factors employed for converting one tonnage to another may sometimes give erroneous results, since the characteristics of ships, even of the same type, vary from yard to yard. In the case of an open shelter decker of the type built before the war, the deadweight was, on the average, 1·9 times the gross tonnage, and the net tonnage 0·62 times the gross. Since the beginning of the war, however, these relations have not applied, for, in general, permissible draughts have been increased, more especially in the case of shelter deckers built during the last three years. For such vessels a draught of 18in. in excess of that normally associated with this type of ship has been adopted, the tonnage openings being closed and the scantlings increased. As a result the gross tonnage has been greatly augmented, and the deadweight is only 1·45 times the gross tonnage. Thus, an open shelter decker, 425ft. by 57ft. by 37ft. 9in. to the shelter deck, carried 9,400 tons d.w. on a draught of 25ft. 10in., but as a closed shelter-deck vessel she can carry 10,200 tons d.w. on a draught of 27ft. 4in. In the first case the gross tonnage is 4,870 tons and in the second 7,000 tons, so that the relations between the deadweight and the gross tonnage are 1·93 and 1·45 respectively. In the case of the American "Liberty" ships the gross tonnage is about 7,200 and the d.w. tonnage 10,700, so that the relation here is 1·5. As most of the ships being built in America are vessels of this type, it is possible to convert the American statistics given in terms of deadweight to gross tons with a fair degree of accuracy. The other type of tonnage generally being produced at the present time is the oil tanker. In this case the deadweight varies from 1·45 to 1·55 times the gross tonnage, although, due to the relaxations allowed by defence regulations, these figures can be increased. The net tonnage relation remains constant at about 0·60 of the gross tonnage for practically all the above types of vessels.—*"Fairplay", Vol. CLXI, No. 3,140, 15th July, 1943, pp. 136 and 138.*

Recent Addition to Ellerman City Line Fleet.

The twin-screw passenger and cargo steamer "City of Bristol", built last year by Swan, Hunter and Wigham Richardson, Ltd., for the Ellerman Lines' service between this country and Indian ports, recently completed her first round voyage. She is a vessel of 8,424 gross tons and 10,960 tons d.w., with accommodation for 12 passengers and a cargo capacity of 517,180 cu. ft. (bale). The ship's fuel tanks will hold 1,737 tons of oil fuel, whilst the fresh-water tanks have a capacity of 461 tons. The ballast tanks will hold up to 1,439 tons of water ballast. The accommodation provided for the deck and engineer officers, as well as that for the European petty officers and Indian crew of 80, is claimed to be unusually spacious and well equipped. The cargo-handling equipment includes a 50-ton derrick for No. 2 hold and a 30-ton derrick for No. 4 hold. All the cargo winches are for either 5- or 7-ton lifts. The propelling machinery comprises two sets of geared turbines, the propeller shafts being driven through D.R. gearing on the H.P. turbines and S.R. gearing on the I.P. and L.P. turbines. Steam at a pressure of 400lb./in.^{2} superheated to 750° F. is provided by three oil-fired Babcock & Wilcox watertube boilers operating on the Wallsend-Howden system of forced draught and with Weir closed feed. Two Scotch boilers are installed to provide steam for auxiliary purposes. Electric current is supplied by three steam-driven generating sets.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,038, 12th August, 1943, p. 2.*

Chrysler Corporation's "Sea Mule".

The Chrysler Corporation recently disclosed some particulars of their "sea mule", a portable propulsive unit for attachment to barges and other non-propelled craft. Hundreds of these units have, it is stated, already been shipped to various war areas. The 8-cylr. engine of the unit is enclosed in a welded watertight compartment above which is a steering wheel and a sort of turret containing the various controls and indicating instruments. The forward end of the unit is shaped to fit flush against the stern of the craft to be propelled, whilst the after end is fitted with a propeller and rudder, both of which can be lowered or raised as necessary. The total length of the entire pusher unit is 20ft. and the width about 6ft., so that it takes up less space than a ship's lifeboat. The makers therefore suggest that one or more pushers could be carried on board the average cargo vessel. Only one man is required to work the pusher unit, which is designed to operate as an independent boat, although when made fast to a barge it becomes almost an integral part of the latter. The maintenance costs of an entire fleet of the new units are substantially lower than those of a single tug.—*"Lloyd's List and Shipping Gazette", No. 40,109, 9th June, 1943, p. 7.*

Heat Removal.

A British patent relating to improvements in vapour-compression refrigerating systems was recently granted to a well-known marine engineer in this country. The refrigerating effect of such systems, more especially when the refrigerant is CO_2, falls as the temperature of the cooling water circulated through the condenser rises. Where the temperature of the cooling water varies, the capacity of the refrigerating plant has to be made sufficiently great to obtain the required refrigerating effect with the cooling water at maximum temperature, even though such conditions may only prevail during relatively short periods. The object of the invention covered by the patent is to enable the refrigerating effect of the plant to be maintained at such times as the circulating-water temperature is high in an economical manner without undue complication of the plant. In order to achieve this result, the compressed-vapour pipe of the refrigerating system includes a coil contained inside the "flash" chamber of a vacuum refrigerating apparatus which can be used wholly or partially for other purposes when not required for boosting the capacity of the vapour-compression plant. In the case of ships' refrigerating installations, the vacuum apparatus could be used for air conditioning, cooling drinking water or similar purposes and, although its size might have to be greater than that necessary for these services alone, to enable it to maintain the requisite refrigerating effect of the vapour-compression plant for the refrigerated-hold spaces, the apparatus would be economical as regards first cost and maintenance. A high degree of economy in operation could be achieved by the employment of steam-jet vapour pumps or thermo-compressors using exhaust steam, "bled" steam or steam from a Diesel exhaust gas-fired boiler. The accompanying drawings show two diagrammatic arrangements of such apparatus, *A* being the compressor of the vapour-compression system, *B* the cooling coil, *E* the expansion valve, *F* the evaporator coil in the evaporator or brine tank, *G*, through which and the cold chamber cooling pipes, *H*, brine is circulated by the pump *J*. The compressed-vapour coil *B* is contained within the "flash" chamber *K* of the vacuum-refrigerating apparatus; *L* is the steam-jet or centrifugal exhauster delivering vapour from the chamber *K* into the vapour condenser *M* connected to the air pump or ejector *O*, and *P* is the pump for removing the condensate from the condenser *M*. *N* is the pump for circulating water from the bottom of the "flash" chamber *K* back to the spray pipes *R* of the "flash" chamber direct or through the coil *V* for air conditioning or other purposes. *T* are valves in the circuits to distribute the flow of chilled water from the chamber *K* through the coil *V* as may be required. Fig. 2 represents a modified arrangement in which the compressed vapour, after being partially cooled in the coil *B* of a condenser *C* by sea water circulated by a pump *D*, is passed through a coil B^1 in the "flash" chamber *K* of the vacuum apparatus.—*"Modern Refrigeration", Vol. XLVI, No. 545, August, 1943, pp. 196-197.*

FIG. 1

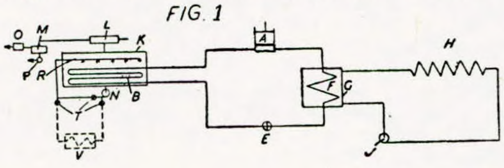
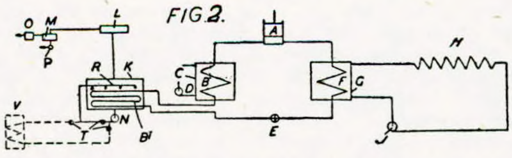


FIG. 2



American Classification Society's New Symbol for Ships.

Mr. J. L. Luckenbach, president of the American Bureau of Shipping, has stated that in the 1943 issue of the register issued by his society—restricted to subscribers under war-time regulations—the names of ships equipped with mechanically-controlled ventilating and dehumidification systems are distinguished by a special symbol —VDS. This abbreviation appears in an appropriate column opposite the vessel's name and is followed by a figure corresponding to the number of cubic feet of conditioned space. Thus, if a ship appears with the symbol VDS 372M., it means that 372,000 cu. ft. of cargo space in the holds and 'tween decks are equipped with mechanically-controlled ventilating and dehumidification systems.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,002, 1st July, 1943, p. 7.*

Salvage of Ships Sunk in Pearl Harbour.

No fewer than 14 of the 19 ships sunk or damaged in the Japanese attack on Pearl Harbour on the 7th December, 1941, have now been raised, repaired and reconditioned. Among them are the battleships "Nevada", "California" and "West Virginia", which have again joined the fleet as effective fighting vessels. The battleship "Oklahoma" and the target ship "Utah", which capsized, have also been raised and are now undergoing repair in readiness for further service. Only the battleship "Arizona" and the destroyers "Cassin" and "Downes" are considered to be beyond economical repair. The whole of the "Arizona's" guns have, however, been recovered, as well as practically all the guns from the two destroyers. About 50 per cent. of the main and auxiliary machinery of the "Cassin" and "Downes" has been salved and reconditioned for use in other destroyers. Large quantities of ammunition have also been recovered from several of the stricken ships. There are still 1,509 men missing as a result of the attack. This total includes 381 lost on board the "Oklahoma", 1,071 in the "Arizona" and 57 in the "Utah". In addition to these, 50 bodies have been recovered from these three ships. The salvage operations were carried out by personnel of the U.S. Navy with civilian assistance, under the direction of Rear-Admiral W. R. Furlong, commandant of the Pearl Harbour Navy Yard.—*"Marine Engineering and Shipping Review", Vol. XIVIII, No. 6, June, 1943, pp. 179-187.*

An Aircraft Delivery Vessel.

In a paper presented at a meeting of the Philadelphia Section of the Society of Naval Architects and Marine Engineers on the 21st May, Mr. J. C. Lord described how the hull of a cargo liner of the C-3 type could be adapted for war-time service as an aircraft delivery vessel. The general characteristics of these ships are a length b.p. of 465ft., a beam of 69½ft., and a depth of 42½ft. There are five cargo holds and two tiers of 'tween decks, in addition to deep tanks for the transport of oil cargoes, etc., in Nos. 3 and 4 holds. The conversion envisaged by the author provides for the carriage of some 87 fighter aircraft of about 42-ft. wing space, 30-ft. length and 13-ft. height, together with spares, supplies and aircraft equipment amounting to 1,527 tons and 1,500 tons of aviation spirit and lubricating oil, exclusive of the ship's own supplies of fuel oil (1,300 tons) and stores (100 tons). There is also accommodation for the necessary additional personnel and a large assembly space forward where five aircraft at a time can be prepared for flying off from catapults on the flight deck above.—*"Marine Engineering and Shipping Review", Vol. XLVIII, No. 6, June, 1943, pp. 209-212.*

De-icing for North Russian Ports.

The three main adaptations which are made to British merchant ships to meet war conditions are the provision of gun stiffening for the carrying of defensive armament; de-gaussing to give protection against magnetic mines; and the so-called "de-icing" of vessels bound for North Russia. The last-named adaptation includes strengthening of the hull against ice, and the lagging of steam and exhaust pipes and tanks in exposed positions to prevent freezing up. Additional heating arrangements are installed in all living spaces, and auxiliary heating appliances, such as bogey stoves, are provided for use in case the steam heating breaks down. All exposed piping is thoroughly lagged, and drain cocks are fitted where-ever necessary. Steam coils for heating the stern tube are installed, and steam jets are arranged to keep the inlets and discharges in the ship's side free from ice. Special attention is given to the lagging of deck winches, and a generous supply of spare gear for them is carried. Blank flanges for isolating deck steam pipes are also fitted where necessary. As the customary sanitary arrangements can hardly be expected to function at 85° to 90° of frost, dry chemical closets are installed. Special steam hoses, with connections fitted at convenient points on the deck steam system, are supplied to enable steam jets to be used on any part of the deck. To counteract the excessive condensation in the accommodation, all exposed steelwork in the latter is lined throughout and coated with an anti-condensation composition, the space between the plating and the wood lining being packed with an insulating material. Special Arctic clothing is also provided for all officers and men.—*"Shipping", Vol. XXXI, No. 271, June, 1943, p. 32.*

Amphibian Jeeps.

The amphibian version of the ubiquitous Jeeps is built by the Ford Motor Company, at Detroit, and is a vehicle which can carry five men and is able to perform on land every task done by the ordinary type of Jeep. In addition, it can cross rivers and lakes and operate in seas that any boat of comparable size can navigate. The amphibian is, in effect, an ordinary Jeep, around which is placed a complete and independently-built lightweight welded hull. A new frame or hull can be fitted in the same manner as a new body is put on a chassis. Special protection for the engine is provided to safeguard it from the effects of water breaking over the bow of the "craft". The controls are identical with those of the ordinary land version and no steering change-over is required from land to water operation. A power-driven capstan is fitted forward to enable the vehicle to pull itself up a steep river bank or sea shore, and the equipment includes a lightweight self-priming bilge pump with conveniently located controls.—*"The Shipping World", Vol. CVIII, No. 2,607, 2nd June, 1943, pp. 523-524.*

Congress Committee Investigates Structural Failure of Ships.

A sub-committee of the Merchant Marine Committee of the U.S. House of Representatives, under the chairmanship of Representative Jackson, recently completed the first phase of its investigations of several cases of structural failure in the Maritime Commission's ships built during the war. Only two out of over 1,000 Liberty ships have been lost as the result of such failures, these being the "J.L.M. Curry", built by the Alabama Dry Dock & Shipbuilding Corporation, Mobile, which developed structural defects at sea in enemy waters on 6th March last and had to be sunk by gunfire to prevent her falling into enemy hands, and the "Thomas Hooker", built by the South Portland, Me., Shipbuilding Corporation, which was lost on the same day, when she came apart and had to be abandoned at sea. In neither case were any lives lost. Apart from these two cases, there have been a number of minor failures and a few major ones necessitating dry-docking. The defects were invariably due to faulty welding practices and no evidence was found of any case in which defective material was the direct cause of subsequent failure. Speed of construction appears to have nothing to do with the incidence of defects, and a vessel launched from one of the Kaiser yards in a little over four days and at sea in just over seven, has had no trouble. The yard with the highest percentage of structural failures is one on the Gulf Coast. Much of the trouble can be traced to the lack of trained supervisory personnel both in welding and other phases of ship construction, brought about by the endeavour to keep pace with the tremendous expansion of the shipbuilding industry. The immense output of new ships must inevitably give rise to some structural defects, but the percentage of these is no higher than in any other industry.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,044, 19th August, 1943, p. 8.*

New Type Life-saving Raft.

An improved type of life-saving raft, recently built in a Swedish shipyard to the design of Mr. Rolf Cervin, chief inspector of the Trelleborg Shipping Company, is now carried on board that firm's oil tanker "Falsterbohus". The raft, which is constructed of 2-mm. steel plate, has the shape of an oversized, oblong life-buoy, the open space in the centre of which is decked. The length is about 18ft. and the breadth about 10ft. 4in., with a height of 4ft. 7in. and it is all-welded. With 20 persons on board and full stores the draught is under 2ft. and the freeboard about 2ft. 7½in., but if necessary the raft can carry 50 passengers. It is of the same shape on both sides and is divided into 16 watertight compartments, all of which are accessible from both ends, so that when launched from a roller-way on deck it is immaterial which side comes uppermost. A hand-rail can be put up round the upper edge. The interior of the raft contains storage lockers with sufficient provisions to last 20 persons 25 days, in addition to tanks holding about half-a-ton of fresh water. Ten men can sleep at a time, five in real berths and five on the floor.—*"Fairplay", Vol. CLXI, No. 3,149, 16th September, 1943, p. 376.*

New Standard Fast Passenger and Cargo Liners.

The first of a new series of fast passenger and cargo liners built to Admiralty design, which combines normal commercial practice with special war-service requirements, was recently inspected by representatives of the Press. The ship is described as a twin-screw shelter-deck steamer with upper and lower 'tween decks, of 12,000 tons d.w. capacity, with a hull of riveted construction, although a considerable amount of welding was used for the construction of the deck-houses, etc., some of which were pre-fabricated and erected in large sections. The six cargo hatches and holds are of exceptional size to facilitate the carriage of cargoes such as locomotives, boilers, and similar heavy plant and machinery. The cargo-handling equipment comprises 18 derricks of from 5 to 10 tons and three of from 30 to 80 tons lifting capacity, served by 19 electric winches. Where these are intended to operate the heavy derricks, they are coupled together in pairs and work centrally-arranged drums. The ship's rudder is of the streamlined type, and is worked by hydro-electric gear driven by a pair of 35-h.p. motors. A two-tier deck-house amidships provides roomy and well-appointed accommodation for the officers and passengers, there being 12 two-berthed staterooms for the latter. The crew are berthed aft under the poop. Mechanical ventilation, giving warm or cold air, is provided for all the accommodation except the crew space aft, which is steam heated with natural ventilation. The propelling machinery is located between Nos. 4 and 5 holds, *i.e.,* well aft of amidships, and consists of two sets of D.R. geared turbines supplied with steam at a pressure of 450lb./in.^{2} and temperature of 750° F. by two Foster Wheeler watertube boilers arranged in the same compartment as the turbines. The whole of the ship's auxiliary and deck machinery is electrically driven and no steam is normally used while in port, an oil-fired vertical boiler being installed for domestic heating. Electric current is provided by three 6-cylr. Diesel generator sets, each of 175kW. output, located on the starboard side of the engine room. There is also a 10-kW. Diesel generator set for emergency purposes. The service speed of the ship is stated to be over 15 knots.—*"Shipbuilding and Shipping Record", Vol. LXII, No. 13, 23rd September, 1943, p. 295.*

Fleet Tenders from America.

Among the miscellaneous small craft built for the Royal Navy in American yards are a number of "F.Ts." or fleet tenders. They are sturdy single-screw vessels with wooden hulls of an o.a. length of 103ft., a beam of 21ft., and a draught of 11ft. 3in. on a displacement of 238 tons. They are equipped with single Diesel engines built by General Motors, the Atlas Co., and the Superior Diesel Engine Co. The G.M. engines have reduction gears, whereas the remainder drive the propeller direct. These tenders can carry over 25 tons of fuel oil, which suffices to give them a cruising radius of 2,000 sea miles at 10 knots. Their economical speed is 9 knots, but they are capable of 10½ knots, if necessary. The vessels are armed with heavy and light machine guns and are normally manned by a crew of three officers and 14 ratings, but there is also accommodation for troops to the extent of two officers and 60 men. The fresh-water tanks have a capacity of over 12 tons. The first four of these fleet tenders recently sailed from U.S. ports, three being bound for the Mediterranean, and one for Icelandic waters. Under arrangements made by the Director of the Small Vessels Pools, they were manned by volunteers ranging in age from 45 years to 72 years.—*"The Motor Boat", Vol. LXXVI, No. 1,911, September, 1943, p. 232.*

Ship Repairing in South Africa.

A good many repairs to ships are being carried out at the Cape with the assistance of certain Dutch marine engineers and other overseas experts. In some cases underwater hull repairs are being effected by trimming the ship to make the damaged area of the plating accessible from pontoons alongside. This expedient saves time by eliminating dry-docking whenever possible. A number of ships damaged by enemy action have, it is stated, thus either been rendered sufficiently seaworthy to return to a port in the U.S. or Great Britain for more permanent repair, or for ordinary sea service.—*"The Engineer", Vol. CLXXVI, No. 4,576, 24th September, 1943, p. 256.*

Salvage of s.s. "John Cadwallader".

An exceptionally difficult salvage operation was recently completed in Philadelphia in connection with the raising of the s.s. "John Cadwallader". She was a single-screw inland passenger and cargo vessel of 1,478 gross tons with reciprocating engines and oil-fired watertube boilers, built in 1926 and requisitioned by the U.S. War Shipping Administration for delivery to the British Ministry of War Transport under the Lease-Lend Act. On 29th August, 1942, the ship was lying alongside a pier in Philadelphia, after having undergone an extensive refit, when she caught fire from unknown causes and sank in 35ft. of water on the night prior to scheduled departure. The job of raising her was then entrusted to the Philadelphia Derrick and Salvage Corporation, who succeeded in doing so after overcoming a number of very great difficulties. The operation involved the removal of the entire deck superstructure, together with a large amount of debris, from the upper deck by means of underwater burning and the use of grabs from derricks alongside. It was then found that the decks were badly warped and that the state of the hull rendered it impracticable to make any attempt to raise it by means of compressed air. The close proximity of the underpinning of the concrete pier and the fact that the outlets of the city's sewage system were adjacent to the pier, precluded the use of dynamite for blowing the sunken ship to pieces, whilst cutting up the hull with burning torches into sections small enough to be handled by the derricks available was ruled out because of the time the pier would be out of service and the urgent need of the port derricks for cargo-handling duties. It was therefore decided to utilise cofferdams and pumps, despite the awkward position of the hull and shortage of the materials required for the work involved. Two large cofferdams of about 30×35×60ft. and 30×35×65ft. were eventually constructed entirely of wood with the exception of steel straps and lifting grips. These cofferdams were then lowered on to the deck of the vessel and secured in place with anchor chains and turnbuckles. Eight centrifugal pumps driven by petrol engines were installed on the top of the cofferdams with their suction hoses led down inside the latter. The pumps had to be lowered as the hull rose to meet the additional suction head. Three separate attempts were made to raise the ship before the job was completed, the mud proving to be the most serious obstacle, as it was packed so solidly inside the hull that it was necessary to employ high-pressure air and water jets to remove it. This proved to be a long and tedious undertaking, which was further complicated by an 8-ft. deposit of mud and sewage on the decks that had to be reduced and constantly agitated to overcome the continuous deposit caused by the flow of sewage from the adjacent outlets, the stench of which was obnoxious. The hull was eventually raised on 20th May and cleared of mud sufficiently for a survey two days later.—*D. S. Brierley, "Marine Engineering and Shipping Review", Vol. XLVIII, No. 7, July, 1943, pp. 183-187.*

The World Oil Situation.

Some interesting facts concerning the world coal and oil situation were recently given at a conference by Mr. J. G. Bennett, director of the British Coal Utilisation Research Association. The *proved* reserves of petroleum vertified by actual drilling are sufficient at the present world rate of consumption for only 12 years, but the world's *ultimate* reserves are very much greater; they may be as much as 5,000 million tons, of which quantity perhaps 85 per cent. can be economically worked. The present annual world consumption of petroleum is about 400 million tons, but this figure is gradually increasing, and, although the consumption is unlikely to attain the figure of 11 gall. per head of population which obtains in America, it is fairly safe to say that the present average of one gallon per head for the whole world will be increased. On these assumptions, the world's oil supplies may last for 60 to 100 years, according to the rate at which consumption grows. These supplies, however, do *not* include the potential supplies obtainable from the shales and oil sands throughout the world, which are not economic to exploit at the present time (*see abstract on p. 18 of* TRANSACTIONS, *March, 1942*). Even so, there is grave danger of an oil famine long before the world's petroleum reserves begin to run low unless the amount of prospecting is substantially increased beyond what is being done at the present time. In the U.S.A., where the drilling of new wells is undertaken with a greater intensity than anywhere else in the world, the present situation is that while the output of coal to reserves is as 1 to 4,000, that of petroleum is 1 to 14, and additions to the proved reserves of petroleum during the past few years have only been one-third of the annual consumption. In view of the prospects of a possible world shortage of oil, therefore, it would seem that more attention may have to be given to the methods of distilling oil from coal, and that it may even become necessary for countries such as the United States, which are well endowed with petroleum resources, to embark on ventures of this kind. In its present state of development, however, the distillation of oil from coal is an expensive process; therefore, the prospects for the coal industry may become more favourable than the present tendency towards oil fuel leads us to believe.—*"Fairplay", Vol. CLXI, No. 3,141, 22nd July, 1943, p. 163.*

Stud Locking System.

According to *Iron Age,* a stud locking system which can be adapted to any function performed by ordinary studs or by threaded inserts in soft materials such as the light alloys or wood, has been developed in California, where units incorporating this system are already being manufactured. A simple ring with internal and external serrations is forced into place over interlocking serrations made in the head of the stud, the ring being flush with the surface of the material in which it is used and fitting tightly into the latter. The stud differs from an ordinary stud in that it has a central collar equipped with teeth. It is screwed in until the top flange of the serrated collar is flush with, or slightly below, the surface of the material. The ring then falls into place and with a special tool or a short length of bar steel bored to clear the stud, the operator drives the ring into the countersunk hole prepared to receive it. The purpose of the serrated ring is to prevent the stud or insert from turning in its location, and to ensure this V-shaped splines are formed on the outer periphery of the ring. When seated in either hard or soft material, these splines, by broaching their way into the material, hold the ring, and through the interlocking arrangement with the mating part, anchor the insert or stud firmly in place. The latter is, in the first instance, put in by means of a threaded tool and lock-nut after which a driving tool is used to force the serrated ring in place.—*"The Machinery Market", No. 2,228, 16th July, 1943, p. 14.*

Hydraulic Pressure Intensifiers for Obtaining Extra Energy From Lower Pressure Water.

A hydraulic intensifier is in effect a direct-acting booster pump which can be operated by steam or water pressure produced externally, its function being the delivery of a supply of water at a pressure above that of the supply used for operating the intensifier itself. The machine consists essentially of a lower fixed cylinder containing a ram (the larger ram), this ram being in itself a cylinder which works over a fixed ram (the smaller ram) attached to an upper crosshead. The cylinder formed by the moving ram delivers water through a central waterway in the smaller fixed ram. The boosted or intensified pressure produced by the machine depends upon the relative areas of the larger and smaller rams, with an allowance for frictional losses, whilst the output of intensified-pressure water depends upon the diameter of the intensifier and the stroke of the machine, as well as on its rate of stroking. The energy stored in the water at the intensified pressure is obtained directly from the water at the lower pressure, and the hydraulic intensifier is thus distinct from the differential hydraulic accumulator (a very similar machine), in which the higher water pressure is produced directly by external pumps and stored under a pressure load at a lower potential. In a small self-acting hydraulic pressure intensifier manufactured by a well-known British firm of hydraulic engineers, the larger ram is 9¼in. in diameter and the smaller ram 6¾in., whilst the stroke is 16in. The machine is capable of boosting a hydraulic pressure of 1,680lb./in.^{2} to 2,800lb./in.^{2}.—*"Industrial Power and Production", Vol. 19, No. 214, August, 1943, p. 185.*

Portable Hydraulic Tube Bender.

A portable bending device for tubes, pipes and flat strip, known as the "Staffa" hydraulic tube bender, has recently been put on the British market. Its total weight is only 80lb., and it can be operated with little physical effort. By its use tubes and pipes from ⅜in. to 2in. bore can be bent cold to angles up to 90°, whilst bends up to 180° can be made with the aid of an extension arm. The device can also be used for bending lengths of thin conduit and flat strip up to 4in. by ½in. section. The ram dimensions and leverage make it possible to exert, by means of the comparatively short hand lever, a pressure of up to 5,000lb./in.^{2} The makers of this tube bender have also developed a simpler and smaller machine for bench mounting, without the hydraulic feature. This little hand-bender can bend tubes and rods up to ¾in. and strips 1¼in. by ⅜in. in the cold state.—*"The Power and Works Engineer", Vol. XXXVIII, No. 445, July, 1943, p. 166.*

Heat Pumps.

A writer in a technical periodical has put forward a suggestion for a type of heating apparatus which he terms a heat pump, and which, if not absolutely novel, does not yet appear to have received any wide application. It may be described as a refrigerator in reverse, mechanical energy being supplied to drive a compressor, with the difference that the cooling effect is exerted upon the outside atmosphere and the heat generated in the compressor utilised. Theoretically, for a small range of temperature, an indefinitely high efficiency measured by the ratio of available heat to mechanical input should be attainable, and even for quite practical ranges the ideal efficiency is of the order of five or more. Taking into account compressor and other losses reduces this figure substantially, but actual realised efficiency values exceeding 200 per cent. do not seem out of the question. The explanation of the apparent paradox of an efficiency greater than unity is that a substantial part of the heat is merely transferred from the cooling medium—air or water—by the action of the apparatus, and only the remainder has to be supplied by the drive in the form of electrical or other power; the classical equation for the efficiency of an ideal heat engine working on the Carnot cycle being, in fact, applicable in the reciprocal form. It remains to be demonstrated whether it will prove feasible to make the same apparatus serve as a heater in winter and as a refrigerator in summer by a simple reversal.—*"Shipbuilding and Shipping Record", Vol. LXI, No. 22, 3rd June, 1943, p. 495.*

Fibrous Glass Electrical Insulation.

The first part of the paper comprises a short survey of the history and development of glass fibres. Glassmaking procedure and present-day methods of producing "staple" and "continuous" fibres are outlined and information is given on the system of numbering fibrous glass yarns in comparison with other textiles. The features of glass textile insulation are then discussed in detail, and brief references are made of the various electrical and non-electrical uses of glass fibres in types other than those employed for electrical insulation purposes. The health aspect of the handling of these fine inorganic fibres is considered and the paper concludes with a brief survey of the rôle played by glass textiles in enhancing the reliability of electrical plant.—*Paper by A. M. Robertson, B.Sc., "Transactions of the Institution of Marine Engineers", Vol. LV, No. 5, June, 1943, pp. 87-96.*

De-magnetizing Ships' Hulls in Sweden.

The well-known Swedish electrical engineering concern known as the A.S.E.A. have developed a means of de-magnetizing ships' hulls in order to render the vessels immune from danger from magnetic mines. One de-magnetization station has already been put into operation and others are shortly to be opened on the south and west coasts. The necessary personnel is being provided by the Government, and the de-magnetization service is at the disposal of all shipowners who are desirous of taking advantage of it. The procedure involved requires the ship to be placed in an artificial magnetic field, opposed to the terrestrial field, which it nullifies. This enables the self-magnetism of the hull to be measured and provides other necessary data. The hull is then electrified in such a way that it is rendered immune to future action of magnetic fields. Finally, the ship's self-magnetism is destroyed by moving the hull through a high-tension magnetic field. This de-magnetization is controlled according to the relevant data obtained during the first part of the process. After the magnetism of the hull is destroyed, the slight effects of induction due to terrestrial magnetism remain to be dealt with. These are overcome by running a certain number of turns of cable round the hull through which passes a current inducing a magnetic field suited to the characteristics of the hull. Tests have indicated that although this form of protection does not confer complete immunity from the danger of magnetic mines, it renders a vessel safe against mines located at a depth of 33 to 50ft., since they are insensitive at any distance exceeding 16ft. from the hull. The total charge per ship varies from £300 to £600, this covering the cost of the cable and the towing work involved.—*"The Motor Ship", Vol. XXIV, No. 282, July, 1943, p. 123.*

Topping Units.

In order to increase the output and efficiency of existing electrical generating stations on land, it is becoming the practice, particularly in the U.S.A., to install so-called "topping units". These units, which are not unknown in marine engineering practice, comprise a high-pressure boiler supplying steam to a turbo-generator the exhaust from which is usually re-heated to the same pressure and temperature as the steam from the main boiler plant, so that it can be supplied to the main turbines. In a typical installation of this kind recently put into service in America, a single La Mont boiler with a steam output of 650,000lb./hr. at a pressure of 1,825lb./in.^{2} with a superheat temperature of 950° F., is employed to operate a turbo-alternator of 25,000 kW. capacity exhausting at a pressure of 400lb./in.^{2}. The exhaust steam is reheated to 760° F. and is then utilised for the existing machinery. Although equipment of such a capacity could not be installed on board ship, it has been suggested that the employment of topping units of this type might, in some cases, prove suitable for increasing the speed of existing ships after the war. By using a high-pressure forced-circulation boiler it should be possible to provide the necessary amount of steam in the minimum of space, and the power of the turbine which formed part of the topping unit could be applied to the propeller shaft by any of the methods which are already being employed with exhaust steam turbines.—*"Shipbuilding and Shipping Record", Vol. LXI, No. 23, 10th June, 1943, p. 519.*

Electrically-propelled Lifeboats.

It is reported that arrangements are being made to fit a certain number of ships' lifeboats, more especially those of tankers, with small battery-driven electric motors. These motors, of about 2 h.p., drive a 17-in. propeller through a 10-1 reduction gear, and it is stated that during recent trials made with a 24-ft. lifeboat equipped in this manner, a speed of over 5 m.p.h. was obtained. The electric motors are not intended for continuous operation, but to ensure escape from burning oil by facilitating a quick get-away of the boat from the ship's side.—*"The Motor Boat", Vol. LXXVI, No. 1,911, September, 1943, p. 249.*

Day Classes for Marine Engineers at Stow College.

An important development at the School of Engineering in Stow College, Glasgow, is the provision of day classes for marine engineers. Part-time courses of instruction in the form of evening classes have been provided by the Education Committee of the Corporation for marine engineer apprentices for some time past, and the additional facilities now available will ensure that a complete course of technical instruction will be at the disposal of the apprentice from the day he begins his workshop training until he finally presents hmself for examination for a certificate of competency. The complexity of the main and auxiliary machinery in a modern ship calls for a far higher standard of technical education for the sea-going engineer, and the new department of the college has been established to meet this situation. Despite war-time difficulties of supply, the Education Committee have succeeded in equipping it with the necessary machinery and apparatus, whilst local employers have presented various items of machinery to be used for practical demonstration and instruction in the heat laboratory. The Ministry of War Transport have recognised the school as an officially approved centre for the training of marine engineers, the time spent there by students being accepted, up to a stipulated maximum, by the Ministry in lieu of actual sea service. The teaching staff are themselves holders of the highest grade of certificate, and have had many years of sea-going experience in steam and motor vessels.—*"The Journal of Commerce" (Shipbuilding and Engineering Edition), No. 36,002, 1st July, 1943, p. 2.*

Annual Report of the Officers' (Merchant Navy) Federation for 1942-43.

Among the matters dealt with in the *Annual Report of the Officers' (Merchant Navy) Federation, Ltd., for the Year ended 30th June, 1943,* is the entry and training of engineer officers. The Council of the Federation has set up a sub-committee of engineer officers to consider possible improvements and developments of the present system of training. It is realised that under peace-time conditions, serving engineer officers can be divided into two main groups, *i.e.,* those who are attracted by the sea and are resolved to make service in the Merchant Navy as an engineer officer their chosen career, and those who with deliberation elect to serve at sea merely for the purpose of acquiring the necessary qualifications for a chosen shore career. The Council of the Federation is mainly concerned with the first-named group, and suggests that any revised system of training might well include facilities for the entry of a certain number of engineer midshipmen, who would be afforded an early initiation to sea life and traditions before completing their drawing-office and workshop training ashore, prior to resuming their chosen career at sea. In the view of the Council, another desideratum is that the training scheme for both navigating and engineer officers should "dovetail" to the extent that at some period of their respective training facilities should be provided at a shore college to enable young officers of both departments to undergo joint training in common subjects and under a common discipline and community life.—*"The Journal of Commerce and Shipping Telegraph", No. 36,020, 22nd July, 1943.*

Lumsden Pipe-flange Grinder.

The Lumsden pipe-flange grinder is a machine which has been designed to eliminate the laborious task of facing up the flanges of steam pipes by hand before making metal-to-metal joints. The machine can be operated by semi-skilled labour and is able to produce a dependable metal-to-metal joint capable of withstanding a hydraulic test of 2,000lb./in.^{2} in a fraction of the time of hand scraping. The actual grinding time is short, but the setting has to be carefully done. The total time taken to set up and grind the flanges of a 12-in. to 15-in. steam pipe is, however, only about 30 minutes. A machine of this kind designed to grind flanges up to 24in. in diameter, but able to deal with 30-in. flanges by the removal of a small detachable plate, weighs 8 tons and takes up a floor space of about 12ft.×9ft. The actual grinding is done by a 16-in. periphery wheel, ⅜in. wide, and mounted on a motor-driven, totally-enclosed spindle carried by a radial slide attached to a circular face plate. This face plate revolves, producing the circular grind, while the head automatically traverses in and out radially a pre-determined amount according to the width of the flange face. The whole revolving face-plate and grinding wheel can be fed forward to put the grinding cut on, whilst the pipe is securely held in a vice attachment to a T-slotted table which is capable of being traversed across, raised up and down, or swivelled, for the purpose of aligning the pipe correctly. In the case of long pipes, some form of gantry must be employed to steady the outer end. The table is 24in.×45in., has 18in. vertical adjustment, swivels 10° each way, and has 12in. traverse. These movements are all controlled by hand. The face plate is driven by multi-V ropes from a two-speed electric motor, whilst the traverse feed is obtained from an infinitely-variable-speed motor controlled by a small self-contained Ward Leonard set. An automatic switch with adjustable tappets reverses the traverse, and a rheostat controls the speed from 2in. to 15in. per minute. Push buttons are provided for controlling the motors. The grinding is done dry, but the electric wiring is completely protected from dust, while a powerful fan prevents even the smallest spark from reaching the operator. The surrounding guard is fitted with a Triplex glass window. The faces are not ground flat but are slightly crowned, so that when the flanges are tightened a heavy sealing pressure is applied between the two pipe faces at a ring close to the pipe bore. The outer edge of the flange is normally ground below the inner edge to the extent of about 0·0005in. per inch of flange width, but this taper may be varied to suit conditions by swivelling the face plate on its spindle by means of fine adjusting screws which serve to throw the traverse slightly out of a true plate at right angles to the axis.—*"The Marine Engineer", Vol. 66, No. 789, April, 1943, pp. 81-82.*

Heroism of Engineer of American Tanker.

The President of the United States recently conferred the Merchant Marine Distinguished Service Medal on Second Assistant Engineer Geo. Thornwaite for his heroic conduct on board a torpedoed tanker. He was on watch, in the early morning hours, when the ship was struck by an enemy torpedo, the resulting explosion wrecking the dynamos and extinguishing the lights. Mr. Thornwaite ordered all the men in the engine room and boiler room up on deck and, with the aid of a hand torch, reversed the engines to take way off the ship in order that the lifeboats might be launched. While thus engaged he heard a fireman calling for help from between the boilers. The man was rapidly losing consciouness as Mr. Thornwaite dragged him through the engine room, which, by this time, was blazing with oil from the damaged fuel tanks. Reaching the ladder, he hauled the fireman to the first grating, where he was forced to drop him in order to beat out the flames from his own clothing. The fireman fell back to the blazing floor plates and Mr. Thornwaite again went below and succeeded in dragging the man to the comparative safety of the upper deck. Upon abandoning the sinking ship, the lifeboat carrying Mr. Thornwaite and 21 other survivors was thrown against the burning ship's side and into the path of oil burning on the water. Some of the men in the boat became panic-stricken, but the engineer's coolness, courage and presence of mind enabled him to allay the panic and encouraged the men to pull out of the blazing area to open water and ultimate rescue.—*"Motorship", Vol. XXVIII, No 4, April, 1943, pp. 305-306.*

Engine-room Personnel.

Some interesting suggestions for desirable post-war developments in machinery installations have recently been made in Germany, and it would appear that a reduction in the number of the E.R. personnel required to operate the machinery is an important feature of the various schemes envisaged. These include the possible use of gas engines, as well as different types of steam and Diesel engines for various classes of ships, and although the primary aims are improved fuel consumption and reduced machinery weight and space, a decrease in the numerical strength of the E.R. staff is likewise provided for. The present tendency towards a more general use of automatic combustion control, automatic feed-water control and so on, should obviously lighten the burden imposed on the engineering staff of the vessels so equipped, whilst the high degree of reliability of the present-day electric motor used to drive deck and E.R. auxiliary machinery will do much to reduce the maintenance work devolving on the personnel in charge of such plant. The German proposals referred to include schemes for a single-screw geared-turbine installation having high-pressure oil-fired boilers, and all auxiliaries, except the feed pumps, driven by electric motors. Under normal operating conditions, the ships concerned would only require one watchkeeping engineer, one assistant engineer and one fireman on duty in the machinery compartment. For a vessel of 5,000 s.h.p., such an economy of personnel might be considered undesirable and almost dangerous; but it should be remembered, that with the boilers and engines located in a single compartment, and with geared turbines or main engines of the totally-enclosed and automatically-lubricated type, the engineer on watch and his assistant would, normally, have to undertake little supervision of the main machinery. The provision of reliable aural alarm systems to give warning of any derangement in the lubricating-oil or cooling-water installations, etc., and of reliable electric motors for driving the auxiliary machinery, coupled with careful attention to design and arrangement in the general lay-out of the installation, might result in making the reduction of the engine-room staff suggested by the German sponsors of these schemes a practicable proposition.—*"The Shipbuilder", Vol. L, No. 408, May, 1943, pp. 177-178.*

Growing Shortage of Sea-going Engineers in America.

As it takes nearly four times as long to train a marine engineer as it does to build a Liberty ship, the new Victory Fleet is faced with the problem of providing engineer officers of all ranks for these vessels. To meet this acute situation, a special recruiting campaign is being launched by the War Shipping Administration in the states of Illinois, Indiana, Wisconsin, Minnesota, Iowa, Nebraska, N. Dakota and S. Dakota. Certificated marine engineers who have left the sea are offered immediate employment, those whose certificates have expired being given refresher courses of one to four months' duration. During the training they receive pay at the rate of $126 per month, plus subsistence and uniform allowance. Suitably qualified mechanical engineers with no sea-going experience are also eligible for appointment as Unlicensed Third Assistant Engineers after undergoing a special course of one month's duration. The pay during this training is $126 per month plus subsistence. At sea, these officers draw monthly pay at the basic rate of $155 to $185 plus overtime plus voyage bonuses on certain routes of 40 to 100 per cent., in addition to port bonuses of from $40 to $125. After three to six months' sea service they may be examined for a Third Assistant Engineer's certificate. The basic pay for engineer officers in American merchant ships is stated to be 25 per cent. higher at the present time than it has ever been in the history of the U.S. merchant marine. Third Assistants get from $165 to $224 per month; Second Assistants, $180 to $253; and First Assistants, $200 to $316. These rates of pay are exclusive of overtime payments and bonuses.—*"Motorship", Vol. XXVIII, No. 4, April, 1943, pp. 304-305.*

Merchant Navy Honours.

Among the names of members of the Merchant Navy mentioned in a recent issue of the *London Gazette* who have been awarded decorations for gallant conduct at sea, are those of four engineer officers, Messrs. S. J. M. Tyson, D. G. MacKenzie, G. MacDonald and W. Sutton, who have received the M.B.E. The three first-named officers were serving in a passenger vessel which was torpedoed, and joined a party of volunteers who returned to the ship after she had been abandoned in order to make an attempt to save her. They relit the furnaces and proceeded to pump out two of the cargo tanks. They also worked the engines as required by the captain in his attempt to place the vessel in a favourable weather position, but conditions made this impossible and it was therefore decided to try to pump out another tank, in spite of the increasing leakage into the engine room. It was only after the rising water had extinguished the fires and had attained a height of 16ft. in the engine room, that these officers relinquished their efforts and finally abandoned the sinking ship. Mr. Sutton was third engineer of a ship in which the magazine blew up as the result of a torpedo explosion, the poop becoming a mass of wreckage. The third engineer immediately went to the engine room, stopped the engines and closed the W.T. door to the tunnel, afterwards remaining in the engine room until ordered to abandon ship. Reaching the deck, he heard an officer calling for help from the poop. He went aft and carried three injured gunners one by one to the boats. On making a fourth journey he found that the officer had been able to crawl forward with the help of another member of the crew, so Mr. Sutton made a further search among the debris to make sure that there were no others requiring help before he left the ship. After abandonment he returned on board with the captain and other members of the crew in order to make an effort to save the vessel, but she was found to be sinking rapidly and had to be finally abandoned. But for the gallantry of the third engineer officer it is probable that more lives would have been lost. In addition to these awards of decorations, the list of those honoured contains the names of four more engineer officers commended for their brave conduct when their ships encountered enemy ships, submarines, aircraft or mines.—*"Lloyd's List and Shipping Gazette", No. 40,097, 26th May, 1943, p. 2.*

Proper Care Can Double Service Life of Rubber Hose.

An article by E. Sterrett in *Oil Weekly* deals with the care and maintenance of the rubber hoses used in the oil industry. The author states that not one hose in ten actually wears out through carrying fluids, including gases and steam. The wear and tear to which the average rubber hose is subjected is accentuated by the effects of external heat, light, acids and gases, abuse and unnecessary abrasion, but the greatest factor in hose deterioration is abuse. The amount of rubber in a rubber-lined canvas fire hose is relatively small, whilst the percentage of the same material in a rotary hose may be high, but in either instance failure of the sealing material—the rubber—renders the hose unfit for further service. The author enumerates the following precautions to be taken to obtain maximum service from rubber hoses: Handle with care and avoid kinking when uncoiling. Let the hose untwist when pulling it from the coil, and avoid stretching. When filled to working pressure a length of rubber hose tends to shorten, and fastening both ends rigidly when it is fully extended imposes severe strains on the fabric. Do not walk on hose, nor roll heavy objects over even a wire-reinforced hose. If once deformed, do not attempt to hammer a flattened hose back to round again; if the application of internal pressure does not restore the shape of the deformed section, cut out the damaged length and splice with rigid couplings. Avoid sharp bends and kinks, as hoses are designed to carry equal stresses all round the circumference. In a kink the outside is overloaded, whilst the crimp carries no pressure. Hose is manufactured with a factor of safety of 4, and if the operating conditions do not maintain this factor of safety the life of the hose will be shortened due to excessive fatigue. Do not expect a hose to span wide gaps and carry load; a plank spanning the gap will support the hose and prevent overstressing. Make certain that the hose is used for the purpose for which it was made; suction hoses are not designed to withstand internal pressure, nor pressure hoses to withstand collapse. Never pass steam through a water hose. Hoses not in use should be carefully drained, then coiled and stored flat in a cool, dark place away from sunlight, oil, acid and fumes.—*Abstract No. 547, "Journal of the Institute of Petroleum", Vol. 29, No. 234, June, 1943, pp. 215A-216A.*

Weld or Rivet?

Many factors have to be considered before any definite decision concerning the employment of welding or riveting for certain parts of the hull of a ship under construction. The preparation of plates intended to be welded together requires to be more accurate than if they were riveted, because there is more edge-to-edge fitting and less overlapping of the plates. Expansion and contraction must also be allowed for in plates intended to be welded. Expansion and contraction takes place on the work concentrically with the arc, as it moves along during the welding. There is a great need for a standardised system of testing actual welds. The quality of a weld depends upon the human factor, and skilled supervision is essential. Specimens tested by X-ray or other methods cannot be compared with tests made by the actual weld, and the recent mishap to the all-welded American tanker "Schenectady" showed how urgent this need for an effective system of testing welded joints is at the present time. The question of the relative costs of welded and riveted structures cannot be accurately assessed in general terms because the price of electric current varies in different districts. It is said that hand electric welding is more costly than riveting, but that automatic machine welding will cost less. Machine welding can only be used for certain portions of an erected hull structure, but it is the ideal system for welding work finished on the ground. The climatic conditions in this country call for as much preconstruction to be done under cover as possible, but in many British shipyards there is insufficient space for fabricating large portions of the hull structure, and the lifting appliances are not suitable for handling and erecting such heavy weights. A laminated plate attached by a welded connection is more likely to fail than a riveted one, for which reason the actual process of manufacturing steel to be used for welding must receive special attention. In some welded ships small cracks have recently become visible on the decks close to hatch corners at some distance from the weld. This may be due to the excessive heat set up during the welding process. An electric-welded ship will carry more d.w. tons than a riveted one of the same dimensions, and shipowners will have to decide whether the commercial value of the increased deadweight will balance the increased cost of the upkeep repairs. Rapidity of construction and saving of steel weight are desirable, but it is more important that a ship should prove satisfactory under all conditions of service. When repairing a riveted ship, the rivets are cut or burned out, and a large proportion of the material can be used again, but in a welded vessel the damaged material must, in most cases, be replaced by new material, because the plate to be repaired has to be burned off. The use of the old material when repairing a vessel hastens the progress of the repair and is economical. The inside of double-bottom tanks are more suitable for riveting than welding, but if these tanks were framed longitudinally instead of transversely they would be better suited for welding. There would then be fewer confined spaces, and it is not so difficult to make efficient welds when there is sufficient operating space. It is probable that in the future a combination of riveting and welding will be adopted for ships' hulls. Although much has been done in practice and research, it is not yet possible to visualise the ultimate development of electric welding, whereas riveting has successfully stood the test of years. Electric welding is still in the development stage, and satisfactory results can only be achieved if all the operations involved are carried out by the proper methods under proper conditions.—*"The Shipping World", Vol. CVIII, No. 2,611, 30th June, 1943, p. 639.*

Welding in British Shipyards.

In the course of an address recently delivered in Glasgow by Mr. R. B. Shepheard, Superintendent of Welding Development (Merchant Shipbuilding), Admiralty, the speaker pointed out that in the lay-out of the American shipyards which have attained such an extraordinarily rapid output of all-welded cargo vessels, provision had been made for extensive areas and depths of spaces above the head of the berths. In a typical instance material was routed by overhead cranes from stock racks to bays in the fabricating shops, each bay being reserved for special operations. Fabricated components were transported to large covered sub-assembly spaces arranged across the lower ends of the fabricating shop bays and served by 10-ton overhead cranes, where such items as floor stiffeners, girders and shaft tunnels, etc., were assembled by welding. Full use was made of mobile cranes and motor haulage over paved roadways throughout the yards. Accurate loft work and templating were recognised as essential to successful production, and a large mould loft and template store were situated close to the fabrication shops. Those British shipyards which have ample space available are fortunately placed for welding work, but the majority of our yards have little space to spare, and because of this complicated problems of space utilisation are likely to face many British shipbuilders. The different conditions in each yard would have to be taken carefully into account, but the speaker ventured to put forward a few suggestions which might be applied in varying degree, as circumstances permitted, to individual lay-outs. Where possible, space should be cleared and made available for welded fabrication and the storage of units adjacent to the berths, and, as welding increases, the present number of existing heavy machine tools for riveted work will become redundant, and the remainder should be rearranged in a such a manner as to save space. The area needed for the blacksmith's shop might, in many cases, be reduced, since smithwork is now being increasingly superseded by gas-cutting. Ultimately, it is also probable that frame furnaces will become unnecessary through the fabrication of framing from deep sections of flanged plates flame-cut to shape, while the potentialities of welded fabrication to obviate furnaced plates should likewise be borne in mind. Of course, a reduction in the number of berths would make valuable additional space immediately available, but there is also the question of new equipment, including travelling cranes to serve the assembly spaces and the berths for prefabrication, which should be sufficiently powerful to handle large units. For some time to come it is probable that riveting and welding are likely to be utilised in the same yards, although the scope for welding will be increased as time goes on. The occasional difficulties which have been experienced with all-welded hulls must be regarded as teething troubles of the kind which have usually arisen during the development of comparatively new processes, and there is every reason to believe that they will be overcome as more experience is gained of the stresses to which welded joints are exposed under sea conditions.—*"The Times", No. 49,576*, 19th June, 1943, p. 7.*