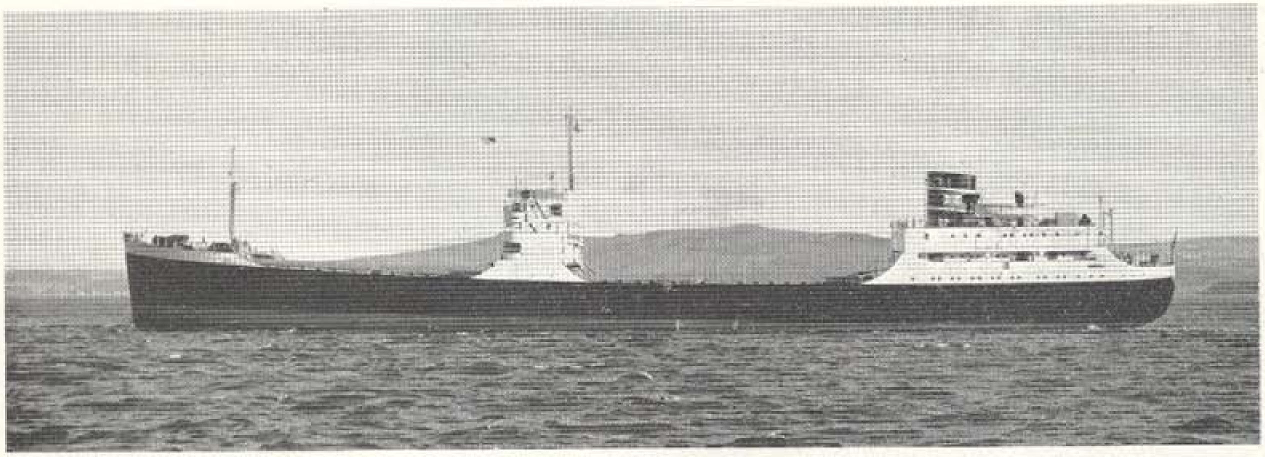


Ore carrier with free-piston machinery

BY OUR SPECIAL CORRESPONDENTS

The "Morar" makes history on the Clyde. First British ship propelled by free-piston gas generator/exhaust-gas turbine machinery undergoes extensive trials. Lithgow Group demonstrate installation with three gasifiers and a prototype turbine designed to prove mechanical reliability

ANOTHER chapter has been made in the history of marine propulsion on the Clyde by the successful completion of the sea trials of the ore carrier *Morar,* which has propelling machinery of a type new to this country. It is also the first time that machinery of this type has been installed in any new oceangoing vessel. The *Morar* is a sister ship to *Ormsary, Gleddoch* and *Arisaig* and, like them, was built by Lithgows, Limited, for Scottish Ore Carriers, Limited, and will be under the management of J. & J. Denholm, Limited, Glasgow.

The principal details are as follows:

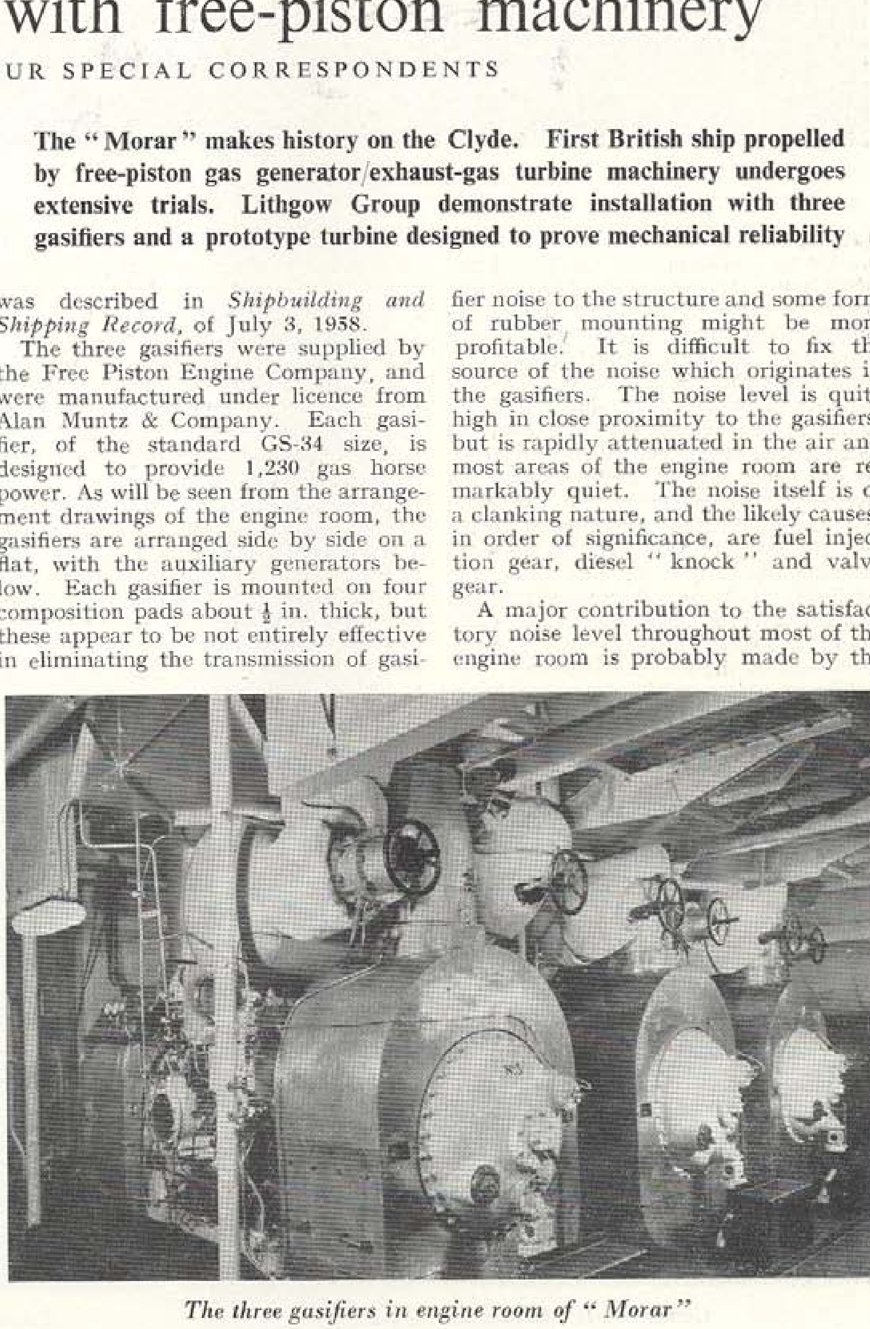
Length overall ..	.. 427 ft. 0 in.
Length b.p. ..	.. 407 ft. 0 in.
Breadth moulded ..	.. 57 ft. 3 in.
Depth moulded ..	.. 32 ft. 3 in.
Draught	.. 25 ft. 3¼ in.
Block coefficient ..	.. 0·77
Gross tonnage ..	.. 6,900 tons
Deadweight ..	.. 9,250 tons
S.H.P., service ..	.. 2,500
Service speed ..	.. 11 knots

As will be seen from the arrangement plans on page 206, the vessel has a continuous upper deck with fo'c'sle and poop. The dimensions are the maximum for a ship calling regularly at Port Talbot. In way of the cargo holds there are two longitudinal bulkheads 17 ft. 6 in. off the centre line, P. and S., forming four holds at the centre and wing side tanks. There is a 7 ft. double bottom below the ore holds for water ballast and oil fuel as well as a deep oil fuel tank amidships. The total water ballast capacity is 6,540 tons, which gives a high ballast rate and corresponds to a mean draught of over 20 ft. The fuel oil capacity is 735 tons.

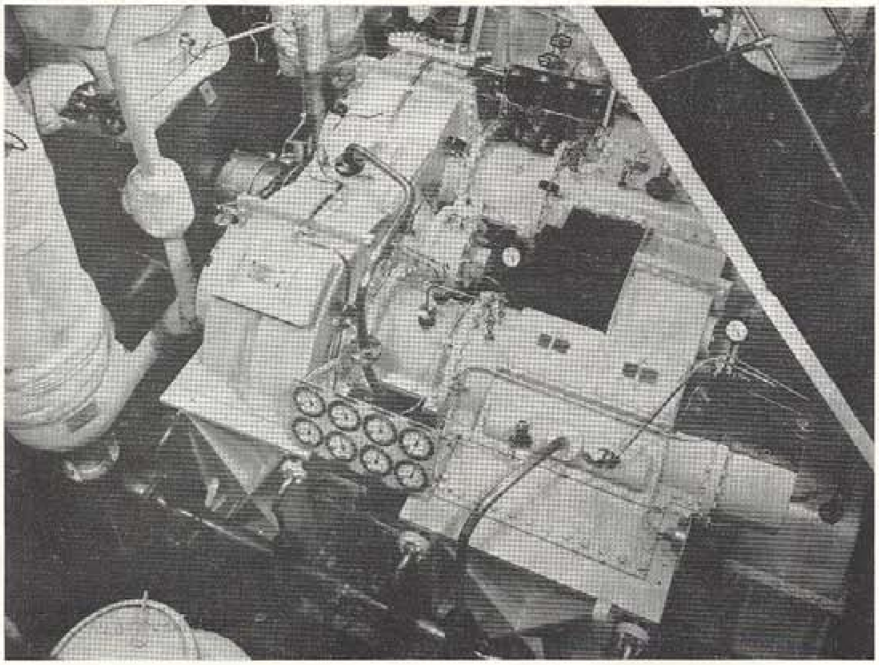
The propelling machinery has been installed by Rankin & Blackmore, Limited, and consists of three free-piston gasifiers supplying gas to a reversing exhaust-gas turbine, geared through normal reduction gearing to the propeller shaft. This machinery was described in *Shipbuilding and Shipping Record,* of July 3, 1958.

The three gasifiers were supplied by the Free Piston Engine Company, and were manufactured under licence from Alan Muntz & Company. Each gasifier, of the standard GS-34 size, is designed to provide 1,230 gas horse power. As will be seen from the arrangement drawings of the engine room, the gasifiers are arranged side by side on a flat, with the auxiliary generators below. Each gasifier is mounted on four composition pads about ½ in. thick, but these appear to be not entirely effective in eliminating the transmission of gasifier noise to the structure and some form of rubber mounting might be more profitable. It is difficult to fix the source of the noise which originates in the gasifiers. The noise level is quite high in close proximity to the gasifiers, but is rapidly attenuated in the air and most areas of the engine room are remarkably quiet. The noise itself is of a clanking nature, and the likely causes, in order of significance, are fuel injection gear, diesel "knock" and valve gear.

A major contribution to the satisfactory noise level throughout most of the engine room is probably made by the



The three gasifiers in engine room of "Morar"



Gas turbine and gear box

ducting of the whole of the combustion air for the gasifiers from the top of the poop house, an arrangement which was probably adopted to allow the incorporation of the filters which are necessary on an ore carrier. It was noted that there was some panel vibration of the walls of these ducts at places where these walls are part of the engine casing; this effect was faintly apparent in the accommodation alleyways. An extensive arrangement of acoustic baffling is provided in the engine room, but its value is doubtful. While considering the subject of noise from the gasifiers, it may be appropriate to observe that the designers of these units could probably help by doing some stiffening of the air intake belts.

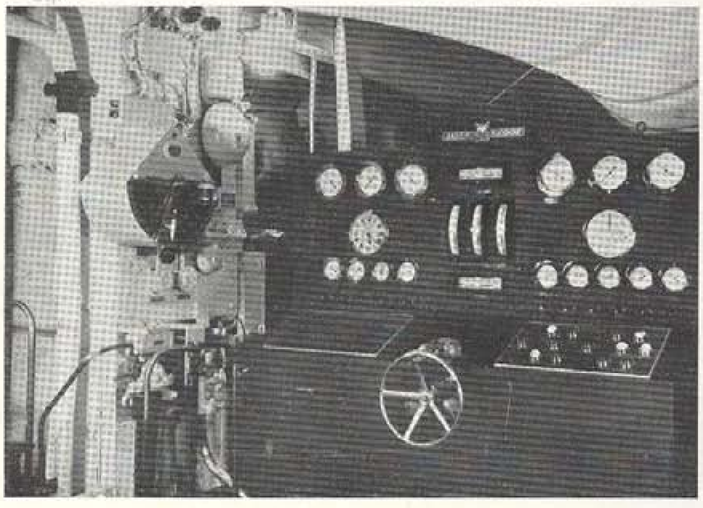
The turbine, built by Rankin & Blackmore, Limited, is the first British-built exhaust-gas reversing turbine to operate in conjunction with free-piston gasifiers. The design is by Power Jets (Research & Development), Limited, and it develops 2,500 S.H.P. at 5,250 r.p.m. Being a reversing turbine, its overall efficiency is considerably reduced because of the astern blade windage losses; unfortunately, also, being a prototype unit, two further losses in efficiency have occurred which have only come to light during testing. Consequently the builders state that they have decided that the present turbine will be withdrawn from service at a suitable opportunity and used by the Lithgow Power Development Company for testbed research. The first fault in the present turbine is that its swallowing capacity is excessive, and the second is that the outlet volume is too restricted. The latter fault arises from the too close proximity of the astern blading. This proximity also introduced a complicated parasitic gas flow, which has been largely overcome by the fitting of a movable mask.

The 5,250 r.p.m. of the turbine is reduced to 115 r.p.m. at the propeller shaft by a double reduction, articulated, locked train reduction gear made by Fairfield. The gearing, which would appear to be lightly loaded, is extremely quiet in operation. The shaft horse power is measured by a Siemens-Ford torsionmeter.

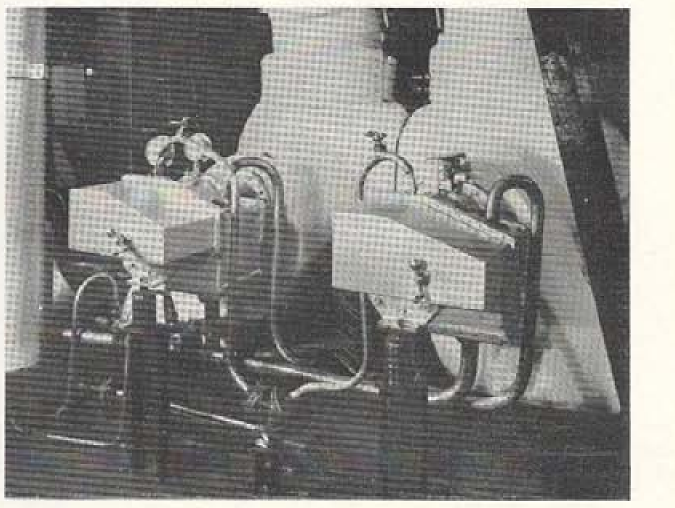
The whole of the machinery is hydraulically controlled from a central point, with an attractive control desk and instrument panel, designed and made by Rankin & Blackmore, Limited. A single control handwheel regulates the load on the gasifiers and at the same time regulates a proportioning valve which allows power gas to enter the ahead or astern sections of the turbine as required. This proportioning valve is also arranged to divert the gas simultaneously in varying proportions to both the ahead and astern turbines, t allowing a very fine adjustment dur..g manoeuvring. During astern and turning trials, the manoeuvring qualities of the machinery were demonstrated by the quick response to orders from the bridge. An alarm device is fitted to indicate when the turbine is running in the opposite direction to a bridge order. This operates, of course, at every change of direction until the shaft has been brought to rest; the choice of the wording " engine wrong " on the alarm light hardly seemed appropriate.

The turbine governor acts in two stages. For a moderate overspeed condition the position of the proportioning valve is altered to correct it. An overspeed trip on the turbine cuts off the gasifier fuel in an emergency, at the same time returning the proportioning valve to a neutral position.

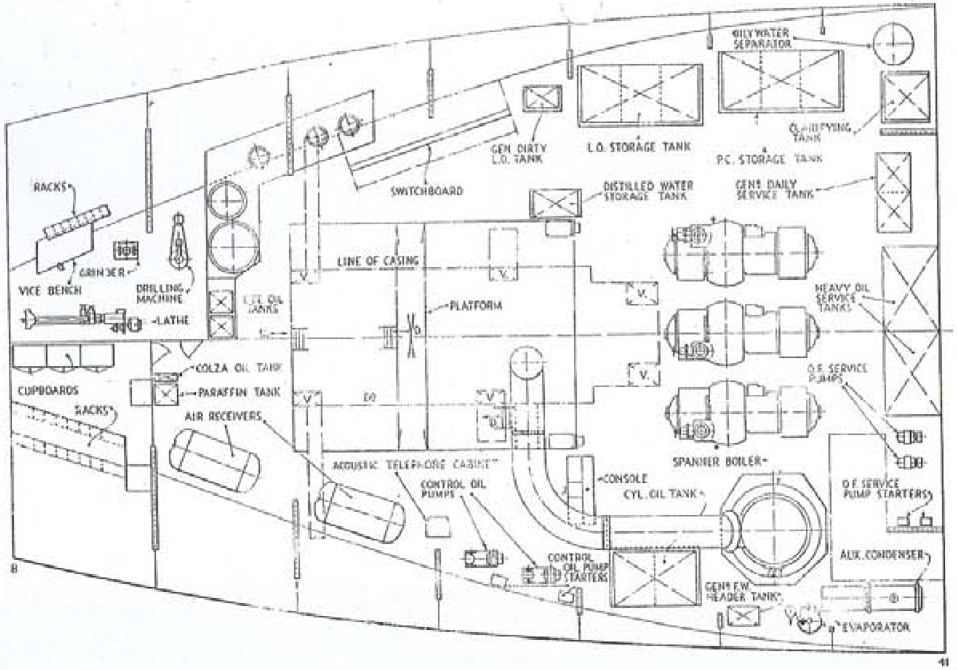
Auxiliary machinery is similar to that usually installed with diesel machinery; there is, however, no waste he boiler, although the exit temperat. of the gases from the turbine is high. Each gasifier has a separate exhaust pipe led up inside the casing to dis-

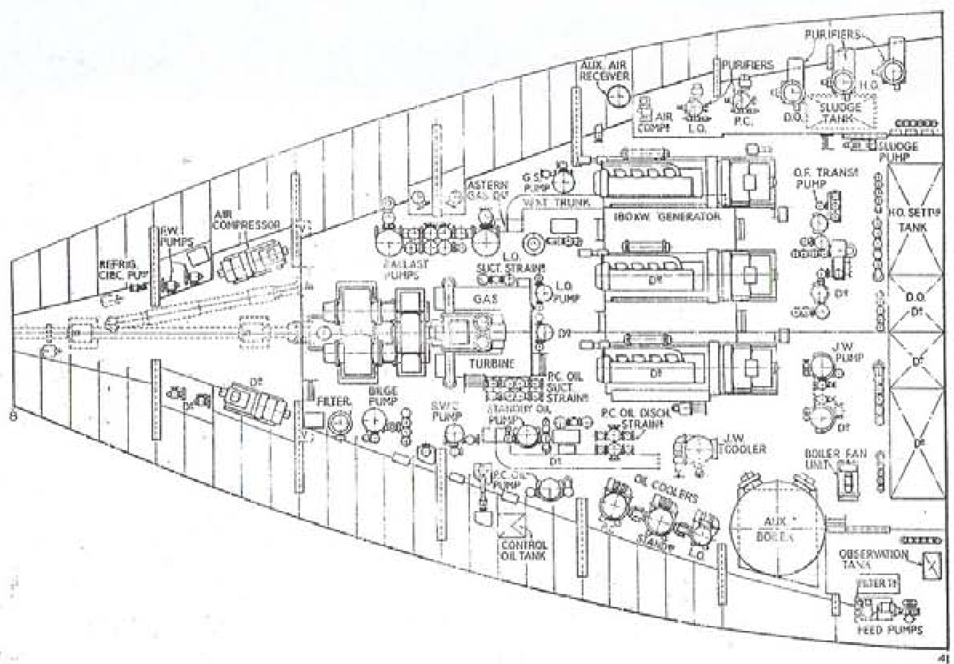


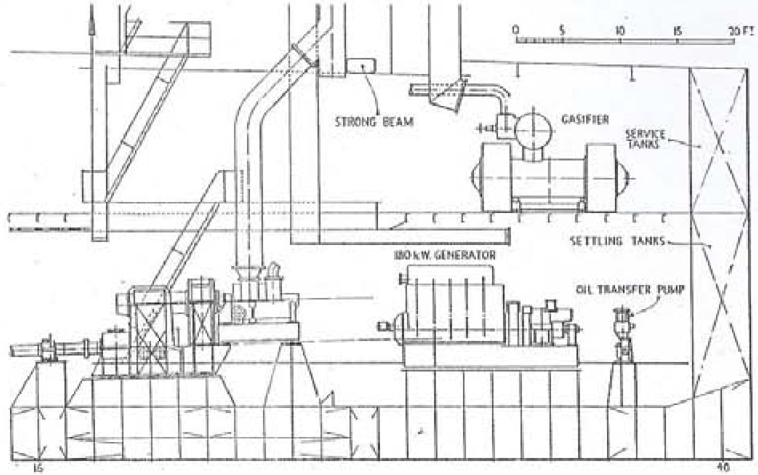
Control desk and instrument panel

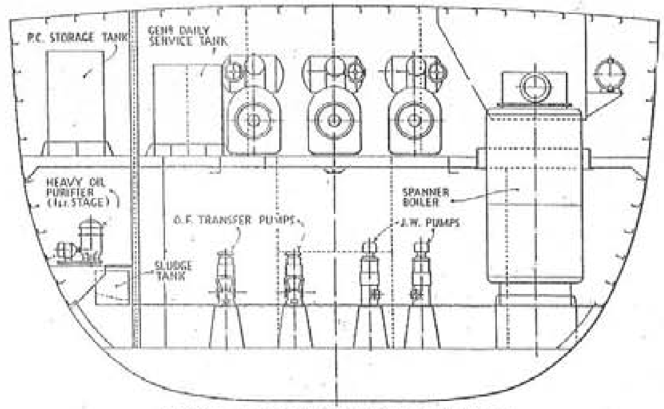


Actuating gear for proportioning valve









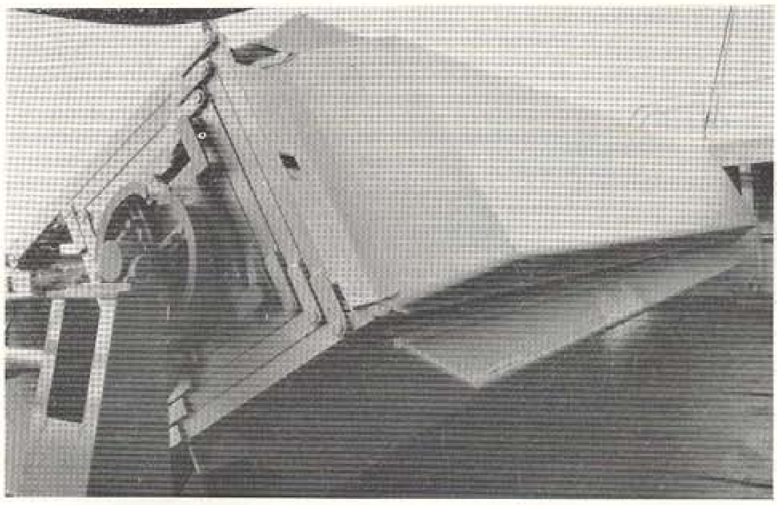
SECTION AT FRAME 36 LOOKING FORWARD

Machinery arrangement of the " Morar " showing, on left, plans of the gasifier flat and engine room platform. On the right appears a longitudinal section of the engine room showing the two levels, together with a cross section at frame 36 charge at the funnel top for use when idling. It would seem that, on an installation with a greater number of gasifiers, this practice would lead to an excessive number of pipes, each having to be lagged. This practice appears to have been adopted on every gasifier built up till now, it being claimed that it has the advantage of allowing a gasifier having combustion trouble to be readily identified, an advantage which would be lost by the use of a common uptake.

There is a fibre glass door on the auxiliary condenser and there are two lengths of fibre glass piping in the engine room in positions where cast iron would normally be used.

Fuel consumption

Fuel consumption is high at 0·49 per lb. per S.H.P. per hr., but this is to be anticipated in view of the turbine faults. With the new turbine now under construction it is hoped to reduce the consumption to 0·42 lb. per S.H.P. per hr. The gasifier consumption has been given as 0·335 lb. per G.H.P. per hr. and, unless this can be improved, it would appear from published data that the best that can be hoped for from a first-class turbine is 0·412 lb. per S.H.P. per hr.



One of the hatch covers rolled up

As the ship is designed for carrying ore, full use could not be made of the maximum reduction in engine room length made possible by the use of this new type of propelling machinery a. consequently, the length of engine room was only reduced by 12 ft. 6 in. although twice that amount could have been saved. The shorter engine room results in an increase of 12,411 cu. ft.

Deck view of "Morar" showing new type of rolling steel hatch covers in bale capacity and also permits of an extra 309 tons of water ballast. The weight of the whole machinery installation is 410 tons as compared with 630 tons in the sister ships so that the extra deadweight carried is 220 tons.

In spite of the shorter poop, the accommodation is spacious. The reduction of 6 ft. in the width of the engine room casing has enabled wash-places, drying rooms, etc., to be arranged alongside the casing and has left the outboard space free for living rooms. As the size of engine room casing only requires to be sufficient to enable removal of relatively small units and as the gasifiers can be distributed where most convenient, this type of machinery appears to offer interesting possibilities.

On deck the sound of the exhaust was a steady purring noise, and in the midship accommodation one could almost forget that there was machinery in operation. The comparative absence of vibration and noise also point to the suitability of this type of propulsion for passenger vessels.

Accommodation for the captain, navigating officers, pilot, radio operator and chief steward is amidships and for the remainder of the crew aft. Everyone has a single cabin and the standard of comfort—that much-abused word "luxury" could be truthfully employed—is high. The public rooms and senior officers' cabins are decorated with polished veneered full-height panelling in oak, sycamore, bird's eye maple and eucalyptus timber. Other officers' rooms are lined with polished veneered oak dado with vynide leathercloth above. Warerite plastic veneers are used for P.O.s', caterers', seamen's and engineroom ratings' accommodation.

Plastic pipes

Innovations in the crew's quarters are that a section of the cold water services in the wash places on the upper deck next to the engine casing has been fitted with plastic pipes for experimental purposes and that a new type of deckhead insulation made of polystyrene foam is being tried out. This insulation is stuck to the underside of the deck plating with a special adhesive; special shapes are available to fit over beams. A special facing material is trowelled over the surface; when painted, the effect is indistinguishable from painted steel. This arrangement, it is hoped, will take the place of wood or composition decking and awaits M.O.T. approval.

The four main cargo hatches are each fitted with Ermans steel rolling hatch covers which have been manufactured and supplied by R. Y. Pickering & Company (an associated company of Lithgows Limited). These hatch covers are arranged to roll themselves on a long electrically rotated winch barrel at each hatch so that separate winches are unnecessary. In the event of electrical failure the barrels can be rotated by hand. The control is by push button and the operation of opening up or closing was carried out quickly, the average time noted at No. 1 hatch being 2½ minutes and no doubt this can be improved upon as the operators get used to the job. As these hatchways were originally designed for covers of another type, the coamings are 18 in. higher than required by Lloyd's.

During a Press conference on board, in which Sir William Lithgow and Mr. James Ferrier took part, several items of interest were mentioned. On the question of price, it was stated that above 3,000 S.H.P. this type of turbine installation would cost less than other types of machinery, while below that figure prices would tend to be higher. As to greater powers, the Lithgow Group have a contract for a ship with a 7,000 S.H.P. gas turbine, taking gas from seven 1,230 G.H.P. GS-34 gasifiers, for the Crest Shipping Company Limited, Nassau, Bahamas. It was emphasised that the free-piston gas-turbine installation in *Morar*, the first new oceangoing ship in the world powered in this way, should not be compared with diesel or steam-turbine machinery. It was a new form of propulsion and much development had to be undertaken, but confidence was felt that it would become established in the range from 3,000 to 15,000 S.H.P. and that it would be a more economic proposition for smaller ships than could be hoped from nuclear energy.

Another advantage claimed is that the building up of engine power by small units which can be easily handled means that maintenance costs will be lower and that ease of replacement will cut down repair time in port.

On trials a speed of 12 knots was achieved. At one point, with only two gasifiers in operation, the speed was only reduced to slightly less than 10 knots. Altogether, the builders of both hull and machinery are to be congratulated on a most successful piece of pioneer work and the performance of the ship in service will be watched with great interest.

An appraisal of "Fuel problems in merchant ships"

BY A CORRESPONDENT

THIS paper by Mr. W. McClimont, of the British Shipbuilding Research Association, presented to the Institute of Fuel last month, is intended as a review of existing knowledge of the problems involved in burning residual fuel oil in modern marine propulsion machinery. It succeeds admirably in its purpose and the author is to be congratulated on his presentation of the subject.

He deals with the water tube boiler, the diesel engine and the open cycle gas turbine. Although he mentions the free-piston gas generator in the introduction, he makes no further reference to it in the text and this is understandable, because experience of burning heavy fuel in this type of machine is only now being gained, and some time must elapse before any conclusions can be drawn.

The paper brings home forcibly the two main problems involved in burning residual fuel, which are firstly, the presence of vanadium and sodium in the ash which gives rise to corrosion and deposition problems at the high temperature end of the cycle and secondly, the sulphur content of the oil and its consequent corrosive effect at the lower end of the cycle. In the case of a steam installation, the first limits the maximum steam temperature, and the second the minimum uptake temperature and hence the boiler efficiency.

The use of additives is discussed at some length, both in connection with the neutralisation of SO_3 and the inhibition of vanadium corrosion and deposition, and the author makes the point that the future of the gas turbine as a marine propulsion unit largely hinges on its ability to burn residual fuel and, for this reason, the search for fuel additives to prevent fouling and corrosion will go on.

The writer feels, however, that one aspect of the burning of residual fuel is somewhat neglected in the search for a method of inhibiting vanadium attack. That is the method of burning the oil. At present spraying is universal, and this means that every droplet contains its share of ash which is carried into the system to do its worst. It might be possible to overcome this problem by burning the oil in such a way that the ash is left behind. The practical difficulties are, of course, enormous, but the fundamental principle is sound and does in fact provide the basis for the standard ash determination test.

Plaque for Esso tanker

At a ceremony aboard the 36,000-ton d.w. supertanker *Esso Durham*, lying in the Tyne, the Mayor of Durham, Councillor J. A. Naylon, presented a plaque in the form of the city's coat of arms to the ship.

Councillor Naylon is a retired staff employee of the Esso Petroleum Company. He served the company for 34 years as a circuit manager at Hull and then Durham. Captain T. R. Rutherford, the ship's master, accepted the plaque.