THE GAS ENGINE: ITS POSSIBLE USE FOR MARINE PROPULSION.

By Capt. Sankey, R.E. (Ret.), M.Inst. C.E.

In his presidential address to the Institution of Civil Engineers, Sir William White said: "the progress made in recent years with gas engines of increasing power naturally raises the question whether they may not take the place of steam engines, even in large ships. It may be that Sir Frederick Bramwell's prediction is correct, and that in less than thirty years the use of gas engines will be almost universal. Enthusiasts dream of a time when gas turbines, instead of reciprocating engines, shall be brought into use. Those more competent to judge than myself appear disposed to think that very serious, if not insuperable, difficulties, lie in the way of this system of utilising power. However this may be, no initial steps seem to have been taken to practically realise the idea."

As though in answer to the last sentence, a small gas engine with producer has been constructed by Messrs. John I. Thornycroft and Co., Limited, and has been fitted to a vessel 60ft. long; the engines are capable of developing 75 b.h.p. at 300 revolutions per minute. Preliminary tests are said to have given satisfactory results, and it is not in the least improbable that extended experience will prove the suitability of such gas plants for somewhat larger sizes. Such success, however, would not justify the conclusion that gas engines were suitable, or even possible, for large ships, if only for the reason that in the small plant referred to above, the producer is arranged to work with anthracite, and before any practical success can be claimed for large marine engines it would be necessary to be able to use bituminous coal. The question has, however, reached a stage in which a short discussion of the matter in general terms, will, we believe, be of interest to Progress readers.

The first question naturally arising is: Why are gas engines desired for this purpose? And the answer is simply the far greater possibilities of economy in coal consumption, approximately in the proportion of 1.8 to 1. It will be agreed that so great a saving is worth striving after. The problem divides itself into two main sections, namely, the gas producer and the gas engine itself. As regards the former, as already stated, and for obvious reasons it must be capable of producing a gas suitable for gas engines from bituminous coals, and it is more than doubtful whether at the present moment such a producer has yet been devised for land work, and, *a fortiori*, for marine work. The difficulty lies in dealing with the tars that result from the distillation of the coal; the bulk can be got rid of either by separating or reburning (" fixing," as it is termed) but the residual tar gets into the gas engine with very injurious results. It is said that the Mond and other similar processes effectually get rid of the tars, and that the by-products are worth as much or more than the coal consumed, so that the user in reality gets his fuel for nothing; it may almost be said that chemical works are established, and that the power produced is, so to speak, the by-product. Such arrangements are, however, inadmissable on board ship owing to the space occupied by the recovery apparatus. The solution of the problem must therefore be sought by " fixing " the tars, that is, by converting them into gas, and although the method is at present not really practically successful there is no reason to suppose that it cannot be made so, possibly at an early date. The space occupied by producers and their accessories, and their weight in comparison with boilers, are matters of great importance—they will probably occupy more room and will weigh more than boilers; but, on the other hand, it must be remembered that less coal would have to be carried for a given voyage, and the saving of space and weight thus effected would compensate for the increased weight and space taken up. Gas producers require a considerable amount of steam, roughly in the proportion of 1lb of steam to 3lb of coal, and this steam must be obtained by evaporating sea water, so that provision will have to be made to deal with the salt that will accumulate on the heating surfaces and render them inoperative. It might mean, for instance, a duplication of the evaporative plant, so that one set might be cleaned whilst the other is at work, or else some form of scrapers, as now used with economisers, might be applied. The weight of salt thus deposited is not considerable, amounting to about one ton per day for engines of 10,000 h.p.; but the important point is that the thickness of the film of salt would increase on the heating surfaces at the rate of about ½in. per day.

The evaporation of the water is usually effected in existing producers by means of a subsidiary boiler, and such an arrangement would obviously cause difficulty in dealing with the salt; but it may not be impossible to utilise the heat in the exhaust of the engine for the purpose, together with that in the jacket water. The amount of heat thus available is amply sufficient, and with suitable fan arrangements the steam can be evaporated at atmospheric pressure.

In many producers a water seal is used around the ashpit, and, obviously, special provisions would have to be made to prevent splashing and breaking of the seal in a sea way. Probably it would be necessary to devise some other form of seal.

Special arrangements will have to be made for thoroughly ventilating the producer's stokehole, to avoid the danger of poisoning by carbonic oxide, especially when battened down in heavy weather. The " poking " of the producers would be more difficult to carry out than on land, owing to the confined space. In this connection it may be stated that fewer men would be needed for attending to the producers than are required for stoking the boilers. On the other hand, the coal would have to be lifted from the bunkers to the top of the producers, and some form of mechanically driven coal-conveyer would have to be schemed for the purpose. The above comprise, so far as is known, the main difficulties to be overcome, and it does not appear that any of them are insurmountable.

We must next deal with the engine. At the present there are many designs of large gas engines, which are running satisfactorily up to 2,000 h.p. or over, and it is understood that the makers are prepared to build up to at least 5,000 h.p. So far, however, all such engines have been of the horizontal type, which is clearly inadmissable for marine work. There is also another important point to be considered, namely, that the majority of these large gas engines are working with blast furnace gas, and it is well understood that the same successful design of engine, when working with producer gas, has given great trouble owing principally to pre-ignitions which are more likely to occur with producer gas than with blast furnace gas. A few vertical gas engines of small power are running satisfactorily, but, so far, no real attempt has been made to build large gas engines of this type. It may be said, therefore, without fear of contradiction, that a great deal remains to be done before it can be hoped to apply the gas engine for the propulsion of even moderate sized ships, let alone really large ones. There is, therefore, no object gained in comparing the present gas engine as regards space occupied and weight with the marine steam engine; the comparison would be entirely in favour of the latter.

As there does not appear to be any gas engine at present suitable, it may be interesting to form some idea of what the marine gas engine may be like, and to state some of the requirements it will have to fulfil. It will clearly have to be of the vertical type, and in order to obviate pre-ignitions, but also, and more particularly, to obtain an even turning effort without the use of a large fly-wheel a great many cylinders would be needed, each working on its own crank. In this way the weight of the moving parts would be reduced, allowing of higher speed, and thus helping to keep the weight of the engine within reasonable limits; the engine, however, would be a very long one. A further advantage of this design would be to materially assist in balancing the engine so as to prevent vibration. In the case of gas engines for driving dynamos, very large fly-wheels are necessary, especially if the dynamo is of the alternating type, and has to run in parallel with others when a coefficient of fluctuation of speed of at least 1/200 is needed. For marine work so small a coefficient is unnecessary; nevertheless, a considerable fly-wheel would be required, even with the large number of cylinders referred to above, and difficulty may be experienced in housing this fly-wheel, and at the same time keep the propeller shaft sufficiently low in the ship. Obviously, also, the presence of a fly-wheel would make it much more difficult to start, stop, and reverse the engine. Possibly some gear may be devised admitting of the engine running constantly in one direction, but it does not follow that it would be reliable when the power to be transmitted is large; and, in any case, such a gear would probably be cumbersome and noisy. It has been suggested, in order to obviate the manœuvring difficulty, to make the gas engine drive a dynamo, which, in its turn, would actuate electric motors coupled to propeller shafts. The engine would run continuously at a constant speed in one direction, but all, or any of the motors can be stopped or reversed by the simple manipulation of a switch. The arrangement is complicated and expensive, but has the merit of great flexibility.

Enough has been said to show that many difficulties will have to be surmounted before the gas engine will be able to compete with the steam engine for the propulsion of ships of any size; none of the difficulties mentioned appear, however, to be insurmountable, but they will have to be conquered step by step, and with much patient effort and the expenditure of large capital. The above remarks refer to reciprocating engines; there is, however, another possibility, namely, the gas turbine. This form of motor is too little advanced to be able to form any opinion, but clearly such a form of engine would obviate many of the greatest difficulties referred to above, and would probably compete favourably with the steam turbine. The producer, also, would be simplified, inasmuch as the presence of tars in the gas would probably not be injurious to a gas turbine.

A promising arrangement is the combination of a water turbine driven by a water jet, produced by continual explosions of a gas mixture in a chamber into which the water is continuously pumped back, in accordance with Mr. Voigt's patent.

Lastly, there is the possibility of using the Diesel engine with coal dust. Such an arrangement would do away with the producer, but there are great practical difficulties to be overcome.

Labour in Germany.

DISPUTES ON THE INCREASE.

German labour statistics for the year 1904, as issued by the imperial statistical office, show that, in all, 2040 strikes and lockouts took place, the trades affected being as follows:—

Buildings	796
Woodworking	417
Metal .	153
Stonemasons and kindred trades	119
Engineering	81
Food (sic)	78
Clothing .	76
Transportation . ..	57
Commerce . .	48
Leather	38
Textiles	31
Chemicals	25
Printing	23
Paper	21
Mining .. .	20
Art trades	4
Soap and candle making	3

Unfortunately, the figures do not give the number of working days lost to the operatives in each trade, nor the number of workmen affected. They do, however, indicate how long the disputes lasted numerically. Thus we are told that—

168 disputes lasted 1 day or less; 687, from 1 to 5 days; 271, from 6 to 10 days; 298, from 11 to 20 days; 185, from 21 to 30 days; 149, from 31 to 50 days; 130, from 51 to 100 days; and 102, over 100 days.

A further analysis of the disputes shows that 1870 were strikes, and 175 lockouts. Of the total, 1457 concerned demands as to wages, 613 related to hours of working, and 884 concerned political and other troubles. The outcome of the 1870 strikes is summarised thus:—

Successful	449
Partly successful ..	688
Unsuccessful	733
.. .. ..	1870

The outcome of the lockout is thus indicated:—

Fully successful .. .	44
Partly successful ..	43
Unsuccessful	44
Unsuccessful	44
Total	175

Comparing the number of disputes in 1904 with those in former years, it is seen that last year's record is the highest since 1899, when the compilation of labour statistics was first undertaken by the German Government:—

1899 ..	1364	1902 ..	1135
1900 ..	1500	1903 ..	1501
1901 ..	1109	1904 ..	2040

The Textile of the Future.

Certain advantages of ramie as the textile of the future are set forth in the *Indian Textile Journal*, which claims that ramie has the following advantages:—that it is many times stronger than cotton, flax, hemp, and the like; that it has a very strong staple, from 3 in. to 9 in.; and that it is easily grown, as it acclimatises itself in almost any zone where agriculture is possible. It crops in some latitudes as many as four times per year. Further, it is beautifully lustrous, more after the nature of silk in appearance, and it does not rot, giving it great advantages for many purposes, such as fishing lines, nets, sail-cloths, boot and saddlery thread, tarpaulins, rick-cloths, tents, hose, shop blinds, boot linings, and other requirements necessitating exposure to damp. It is non-elastic, and therefore is invaluable for machinery tapes; mixed with wool, it imparts non-shrinking possibilities to that article.