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Conditions to Observe to get High Efficiency from Oil Fuel.

BY ALBERTO KEENES (Member).

READ

On Tuesday, October 10, at 6.30 p.m.

CHAIRMAN: MR. J. CLARK (Chairman of Council).

The CHAIRMAN: As the steamer in which the author is serving has not reached London, to enable him to read his paper to us, the Hon. Secretary will do so for him.

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BEFORE going into the efficient burning of oil fuel it would perhaps be advantageous to show the reasons why the faintest possibilities of increasing the efficiency of our boilers and engines should be grasped and developed as far as possible. Many of our young engineers speak freely of percentages and efficiencies without grasping what stupendous losses really do take place.

Up to the present time, in spite of all our learned men, and in spite of the practical experience at our command, the results, so far as our prime movers are concerned, have ended in great failure if viewed from an economic point of view. The combination of the steam boiler and the reciprocating engine occupies the unique position of being a commercial success, and at the same time an economic failure.

After many years practice we have got reconciled to the tremendous losses that take place, and have had to accept the conditions, for at our present state of learning we do not know of any better method. Even as it stands to-day with all its faults, great strides have been made in its improvement since it was first introduced, and its reliability has assumed an unquestionable position, but still its thermal efficiency is extremely low and we have at the present time many ships sailing successfully and making a dividend whose combined thermal efficiency only amounts to 9 or 10% of the maximum. This great loss is further augumented by the mechanical losses, and the effective thrust to the vessel only amounts to approximately 36% of the indicated horse-power exerted by the engine. This means to say, that taking 100 tons of coal as being burnt, the net returns in effective work only amount to a very small percentage of the energy that we had originally imprisoned in the coal and may be pictured as the contents of the ordinary-sized coal house of the average working man's dwelling.

During late years the Diesel engine has been commercially introduced and the returns for the fuel consumed have been greatly increased. The thermal efficiency of the oil engine has reached the vicinity of 35%. Even this represents a direct loss of approximately 65% of the energy of the fuel. When this 35% is whittled down by mechanical losses, etc., the net returns of work per ton of oil fuel will be represented by the potential energy of about two and a half hundredweights. Although the loss is still tremendous, it is a great advance on the steam engine if viewed from a thermal point of view; the Diesel, semi-Diesel and other heavy oil engines have, up to the present, only made moderate headway in the commercial world, for in spite of their high thermal efficiency the saving by their adoption at present seems to be more apparent than real.

Taking these very great losses into consideration, it is only natural that we should endeavour by all means in our power to increase the efficiency, and in time past, many auxiliaries have been introduced with this object. Up to the present time the progress has been painfully slow and tedious and it would appear that the introduction of auxiliaries, although praiseworthy, does not appear to be attacking the question from the proper direction, and savours a little of the line of least resistance. Although the losses in various directions are so heavy it appears to be a difficult problem to formulate a mode of attack upon these losses and at the present time there does not seem to be any prospect of a material advance.

An item that has gone a long way towards increasing the thermal efficiency (and general efficiency) is the introduction of liquid fuel. Owing to its constant nature and its method of use the adoption of liquid fuel for steam generation lends itself readily for the object that is so much desired. True, even at the most it does not offer any exceptionally great advance but it is a great step in the right direction and the collective results are considerably better than those that could ever be expected from coal.

Many articles have been written from time to time upon the merits or otherwise of coal and oil so that now the methods and conditions (together with the reasons) of extracting the greatest number of heat units for practical work will be dealt with.

Oil fuel will not increase the mechanical efficiency of the engine so that the only two factors that need to be considered are the method of handling the oil and the boilers. The fuel itself may be ignored, for we have no control over its constituent part, and it comes to the engineer in a more or less natural state depending upon the country of origin and to the refinery processes.

To handle the oil efficiently there must be efficient plant. This is where the shipowner must contribute his share toward the desired result. The owner must from personal knowledge, observation and study, choose a system (irrespective of cost) that is in keeping with the general conditions. To choose an oil installation for use on board ship, the following conditions must be observed:—

The system must be in keeping with the peculiar conditions that exist at sea and the burners in particular must be suitable for the boiler construction. There are several systems of burning oil fuel and each system has its own peculiar recommendations. The pressure system appears to be the only type that is really suitable for maritime use, and is the type most generally used. This pressure system uses the least amount of steam of any of the various systems and gives the highest boiler efficiency. The steam used for operating the plant is afterwards fed back to the boilers as fresh feed. There are several Firms that specialise in the pressure system of oil burning for ships. The systems now made by several firms of repute are good—some more so than others. The make chosen must be suitable to the conditions and should embrace the following features:—

The fuel heaters should be at least two in number and of ample size and heating area to maintain a temperature of 350 degrees Fah. on a competitive steam consumption. They should be designed so that they are not liable to be readily choked, and in the event of them being choked they should be easily and quickly cleaned without having to dismantle too many parts. Their construction should be of a robust nature and their reliability unquestionable.

The pumps should be fitted at least in duplicate and should be specially designed for supplying oil to the burners. Their reliability should be 99·9% and the construction such that the possibility of requiring renewals is reduced to a minimum. They should be efficient and economical. The suction and delivery filters should each be fitted in duplicate and as large as conveniently possible, they should be strongly made in order to stand the usage that they are apt to receive by being taken out often for cleaning purposes, and the holes should be of such a size that the possibility of anything large enough passing through to choke the burners is reduced to a minimum.

The burners to be used in a marine multitubular boiler should be chosen with especial care and should embrace the following features:—

They should be capable of producing a short flame and should atomise the oil to a fine degree and in such a manner that the oil offers easy ignition and facilitates the mixture of the air in a thoroughly intimate and regularly proportioned manner. They should not be readily choked, and should be readily and easily cleaned and rapidly fitted into position. All the fittings should be of an interchangable nature.

This covers the particular properties that it is desired for the oil installation to possess. The boilers should also possess several features to facilitate the efficient burning of liquid fuel.

The boilers should be of ample proportions and the combustion chambers of such a capacity with a corresponding smokebox and cross section funnel area, that they are capable of accommodating all the products of combustion without producing smoke, and this condition must be possessed when maintaining the largest amount of steam that will ever be required. The feature of unrestricted combustion space appears to be specially desired in connection with, and to facilitate, the ideal burning of oil fuel. The furnace oil fronts should fit on to—*not into*—the furnace mouths, so that the entire length of the furnace may be utilised. The furnace fronts and oil fittings should, as far as possible, be fool-proof. Unfortunately, making things fool-proof nowadays offers some difficulty, for the fool appears to keep well abreast of the times.

The workmanship of the boilers and the fittings should be of the best and the forced draught air tubes should err on the generous side as regards section area. The boiler shell should be well lagged to prevent radiation.

The plant as it now stands will give all the conditions necessary for the efficient burning of liquid fuel, and it only requires practical experience to get the correct combination of conditions to give the ideal result, and the boilers should be at their maximum efficiency. There are a number of particulars and conditions to observe to maintain this highly efficient state.

The oil should be at a sufficiently high temperature to enable it to flare readily, the temperature and pressure combined should be such that the oil is atomised to a very fine degree. The flame produced should start very near to the nozzle end (about 1 in. away) and extend into a mass of brilliant whiteness. No residue should be formed and there should be no smoke or at least just a faint haze noticeable at the funnel top.

The oil should not be heated to an abnormal temperature, over that which is necessary for the particular class of oil being handled. The heating of the fuel to an unnecessarily high temperature may cause a deposit on the heating surfaces of the heater and thus detract from its efficiency, also, in time, this constant fault tends to choke up the fuel heater altogether.

The air that enters the furnaces, both in the case of forced and natural draught should be very carefully regulated, and no more air should be admitted than that necessary for complete combustion, this condition is recognisable by the very faint darkish haze at the top of the funnel. This indication of the ideal condition is usually resorted to, for very rarely a ship is provided with a CO_2 recorder. Should any excess of air be fed to the furnaces, over and above the quantity necessary for complete combustion (and this takes about 25% more than the theoretical amount) it has a very adverse effect upon the fuel consumption, this effect is even more pronounced than when too little air is supplied to the furnaces.

Every effort should be made to supply the air to the furnaces at the maximum temperature possible. Any improvement of this nature is, as a rule, beyond the efforts of the engineer-in-charge, and is a problem for the designers, however, should it be possible to increase the temperature it would certainly be a step in the right direction, especially so if this effect was obtained by utilising the waste gases of combustion.

It would appear that as the temperature of the air supply is increased, the quantity required for complete combustion is slightly reduced.

When combustion is all that can be desired the funnel and tubes keep remarkably clean and the efficiency of the boilers remains a constant factor. Should the boilers be allowed to smoke, however, this indicates that a certain quantity of heat units are being lost, not only that, but the boiler tubes are being slowly coated with a non-conducting covering of soot, thus doubly creating a lack of efficiency.

With forced draught, when the temperature of the oil and the air pressure have been set to give the desired effect, careful attention must be given to maintain these conditions as regular as possible, for as the oil is of such a constant nature, the chances are that no change will be necessary whilst handling the same class of oil. With natural draught, however, and keeping the oil temperature constant, a slight change of air regulation may be necessary depending upon the atmospheric conditions.

Every effort should be made to keep the burners as clear of obstruction as possible, so that these will not have to be changed any more than necessary. At the same time it is not wise to allow these to go too long without examination. It would appear that over and above all necessary changes all burners should be changed every four hours. This arrangement keeps the operator conversant with the prevailing conditions.

Freedom from choked burners pivots greatly upon the efficiency of the filters and these should be kept in a thoroughly clean condition. Should these filters burst from want of attention, or should any break make itself apparent in the filtering medium this fault should be instantly remedied, thus bringing the changing of the burners down to a minimum. This fault has other disadvantages besides the labour it entails and the reduction of efficiency. The impurities that may pass into the heater are liable to deposit on the heating surfaces with the same effect as pointed out in connection with the over heating of the oil.

With the object of increasing the efficiency it is advisable to fit retarders to the boiler tubes. Should the boilers stand it they should be retarded to the utmost limit.

The furnace and, or, the ashpit doors should never be opened except as a forced measure. Should it be possible to run from docking to docking without having to open these, do so by all means. When the doors are opened and the boilers under action the temperature of the furnace and combustion chamber is rapidly reduced with a consequent loss of efficiency. Not only that, but the cold air striking the extremely hot surfaces of the plates has a very detrimental effect generally, and finally leads to heavy maintenance charges.

Any leakage of oil, however slight, should be instantly attended to, and the glands of pumps, etc., kept oil-tight. The heating coils in the bunker spaces should not be used except as a forced measure. When the oil is kept in double bottom tanks and is of a heavy nature, they are sometimes a necessity. In the average case the want of heating coils is more apparent than real. When thought is given to the subject it will be realised how slowly the oil is really handled. It is a fairly big ship that uses 48 tons per day of oil fuel, even at this consumption the pressure pump only handles about 1·25 cubic feet per minute. The use of the heating coils does not reduce the efficiency of the boilers, but detracts from the ultimate results of the fuel consumed.

In spite of the fact that the boiling point of fresh water is less than that of water that is slightly dense, it is advisable in view of the general conditions to keep the density of the boiler water at from one to two ounces. This density is taken as good practice with the oil fired boiler.

In cases where old boilers are converted to oil burning it is advisable to make a very careful examination of the joint between the boiler and the smokebox to see that this is tight. The base of the funnel and the smokebox doors should also have attention in this direction. If forced draught is fitted, the joints to the boilers and to the smokeboxes must be airtight, also the tubes. The doors that lead from the boiler tops on to the forced draught air tube plate top should also be the object of suspicion, and any leaks that cannot be remedied permanently, can be stopped temporarily by the use of some patent asbestos cement.

It is surprising how prevalent these air leaks really are, and the average engineer appears to be in the dark as to the extent of inconvenience and damage that may be caused by these apparently innocent and small leaks when connected with oil fuel burning.

At times great difficulty is found in preventing smoke and the cause is often very difficult to find. In some cases the furnace and combustion chamber capacities appear to be at fault and will not accommodate the products of combustion. Should all other factors appertaining to smokeless combustion be in order, it sometime occurs that the removal of any brickwork that may be in the furnaces is a step in the right direction. Any alteration of this nature however, must be viewed with a certain amount of suspicion, and no alteration should be made except after due consideration, for whilst trying to cure one fault the foundation may unconsciously be made for a greater fault.

On the surface, these particulars given for observance to enable liquid fuel to be burnt in an efficient manner appear to be very simple and few, and whilst agreeing that under certain conditions it certainly is very easy, there are other conditions in which the smokeless and efficient burning of oil fuel offers great difficulties and taxes the resources of engineers to the utmost.

It is only after long experience that an engineer may reasonably expect to have control over the many and peculiar conditions that may arise, and although the cause of these conditions *may* be simple and easily cured (when one knows how) it requires intimate and personal contact to have the extensive knowledge of oil burning at one's finger tips.

The following contribution was been received from H. S. Sketch, Member:—

How to burn oil fuel efficiently and economically is knowledge common to the majority of sea-going engineers. I think, however, that all these engineers must admit that the methods of raising steam in the first instance with oil fuel are haphazard and highly dangerous to the safety of the ship. Possibly I have been unfortunate, but I am submitting to you my experiences, thinking that if you consider them of sufficient importance they may be inserted in the issue of Transactions, and may lead to a discussion of interest and benefit to members of our profession.

The usual method is to pump the fuel from the settling tank by means of a hand pump through some form of heater, the heat being supplied by paraffin burners, to the fuel burners in the furnace. Providing the hand pump is efficient and not allowed to stop and the heater does not become carbonised, all will be well, and in due course, say ten or twelve hours in the case of an average size Scotch boiler, there will be sufficient steam pressure to start the steam installation. I have seen this system tried on several occasions, both at the ship builders when the installation was new, and after the vessels were under the management of the superintendent engineers, and have never yet seen it successful. To keep the pressure and speed of the oil passing through the heater constant is difficult with a manual pump, and the pipes or coils in the heater and from the heater to the burner become carbonised, and although a sufficient pressure may be maintained at the pump the area of the pipes is so reduced that the supply of oil to the burners is insufficient. With a paraffin burner it is almost impossible to regulate the temperature of the fuel to a nicety. I have discussed this subject with a considerable number of engineers and have not discovered one who has been successful in raising steam by these means. Even though no trouble is encountered I am of opinion that these paraffin burners are undesirable in the stokehold, as the pipes to and from it are only temporary fittings and so placed as to be liable to damage. In the majority of cases that have come under my notice steam has been raised, in the first instance, with wood fuel, the fuel oil in some cases being allowed to play on the wood. This is an expensive method both as regards material and labour, and is dangerous to a degree. In one case a coal fire was lit in one of the furnaces and the oil supply was bye-passed through a U tube into that furnace and on to a burner in the next furnace. This was successful for an hour or so after which the U tube became carbonised and blocked and wood fuel was resorted to until sufficient steam was raised to start the steam plant. The engineer-in-charge fitting a new system of oil fuel burning into a ship recommended me to use a system similar to the last one described, but his idea was to bye-pass the oil through a U tube over a bellows hearth and so to the burners. His faith in his firm's lighting-up system evidently was equal to mine in his U tube over a forge.

The best and safest method I know, is where steam is supplied through the deck or other steam line from some outside source—say from a tug—to work the steam fuel pump and supply steam to the fuel heater. Expense seems to be the only objection to this method, but at least it is safe and positive. Would it not in all cases be more economical and safer if a small water-tube boiler, with a paraffin burner, of sufficient capacity to supply steam to the fuel heater and pump and also its own feed pump were fitted. The boiler should be placed somewhere other than in the main stokehold. In this way the oil temperature and pressure could be accurately regulated. One man could attend to this boiler compared to four men necessary to ensure that the hand pump is never stopped. In many instances it is impossible to get the fuel burners going successfully without an air pressure. This applies particularly where a superheater with elements through the smoke tubes is fitted. In these cases it will be necessary for the auxiliary boiler to be of sufficient capacity to drive the fan engine also. Would the advantage of increased safety and less cost of operating compensate for the original outlay for the boiler and pipes? I am convinced that if engineer managers, superintendent engineers or shipowners had been present on some occasions as I have when raising steam, they would consider very carefully the advisability of insisting on one of the two last methods. The boiler aboard as a means of raising steam has the advantage that it is always available at sea as well as in port.

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DISCUSSION.

The Chairman: You have heard Mr. Keenes' paper and the remarks which Mr. Sketch has contributed towards it; one obvious point to me is that the paper is full of good maxims. At the same time I feel that it is lacking in detail, especially in regard to the author's actual experience of oil-fuel burning. Perhaps the discussion may supply such details, gleaned from the actual experience of those present, and it is to be hoped that a good discussion will follow.

Mr. B. P. Fielden (Vice-Chairman of Council): Mr. Keenes states that "the combination of the steam boiler and the reciprocating engines occupies the unique position of being a gigantic commercial success, and at the same time a gigantic failure," later on he states "True, even at the most it (oil fuel) does not offer any exceptionally great advance, but it is a great step in the right direction, and the collective results are considerably better than those that could ever be expected from coal."

The shipowner wants to carry cargo at the minimum cost and the collective results mean profit or loss, and the question is can the ship pay a dividend with oil at its present price? There is, in my opinion, need for a considerable reduction in the price before that question can be answered in the affirmative.

We householders have our gas charged to us by the therm, and it appears that it would be an advantage to purchase oil according to its heating value. The price of coal to-day in London is round about 36/6 per ton, oil is about 60/- per ton or about 64% dearer than coal. Comparing heat values, a ton of coal contains about 14,500 B.T.U. and a ton of fuel oil about 19,000 B.T.U. We are therefore paying 64% more to gain an advantage of 31%.

I am not a believer in the standardisation of ships or their machinery, but I think ships should be built to suit the trade they are to be employed in. For certain vessels on certain trades I think oil fuel is very suitable, but take the case of a small ship on changing routes where there is only one man maintaining steam; there can be no saving of labour at sea, and the greatest gain by the use of oil would be a small increase in the weight the ship could carry.

In large vessels there are other considerations, saving of labour, steady pressure of steam, therefore increased speed, no ashes, therefore more cleanliness, and rapidity of bunkering, which enables the vessel to be turned round on another voyage more quickly.

Ships that were fitted for burning oil have been converted to burn coal because of the comparative costs of the fuel, others have been converted from coal to oil because the latter was suitable for the particular trades on which the ships are employed, but I am of opinion that the oil companies will have to lower their prices before oil fuel will be economical in the ordinary cargo vessel.

Mr. F. W. Smith: My experience of oil fuel goes back some twenty years. When we started in 1901 we used the low pressure steam spraying system, and I continued with that system in two ships until I left the sea. In 1918 I went back to sea in a Dutch ship fitted with a pressure system. I found a great deal more trouble with the pressure system than with the steam spray. We could set the sprayers when we left Singapore and not touch them till we reached Shanghai, whereas the pressure system required attention several times during a watch. The conditions were rather exceptional as we were in the trade with Sumatra.

Mr. W. McLaren: The short paper, thanks to the author, gives ample time for discussion, to a good deal of which fuel burning is open. I think the author has exaggerated a little in his comparisons between coal and liquid fuel. If we go back to the time of Williams' experiments (C. Wye Williams, A.I.C.E., 1840; also D. K. Clark, C.E., 1878) in steam raising, we do not seem to have got far beyond the results he obtained. What does Mr. Keenes mean by an overall efficiency of 9%? Does he include the engine? I think nearer 12% would be more accurate. Then he says that one should do everything possible to get a short flame. I should recommend the opposite —the longer the flame the better. Briefly, it is my opinion that the boiler of the present day is not suitable for oil fuel. The only boiler I have seen which I consider suitable is one made on the Cochran system. There is not sufficient length in the Scotch type of boiler. The author says rightly that the burner must be fixed outside and not inside. Seeing that no shovels are required to be used, I think it ought to be possible to arrange for part of the oil-burning apparatus to be fixed outside the boiler furnace, that is between the boiler face and bulkhead. Allowing that space to manipulate the burners therefore this extension would act as the oil furnace proper. The author talks about the efficiency of marine boilers, but I do not think we can discuss the efficiency of the average boiler in actual use because we have no means of determining what the true efficiency is. I think oil fuel is perhaps more applicable in the case of water-tube boilers. We have been burning coal for so long, and I feel that we have much to learn yet by experimenting with the burning of coal. There are good reasons for doing so, as oil is admittedly much more adaptable than coal, and much easier to feed into the furnace. The stokehold platform is cleaner, and there are no ashes to contend with. As Mr. Fielden has pointed out, if the price of oil can be reduced, there is a prospect of important advantages being obtained from its use as fuel.

Mr. J. Thom (Member of Council): I have not had any experience of boilers fired with oil, but I am quite sure it is an ideal fuel for use on board ship, particularly passenger ships. This opinion is evidently shared by the owners of many of our large passenger liners, who have equipped their vessels for oil burning. With regard to the contribution of Mr. Sketch, it is obvious that every ship is not suitably arranged for conversion to oil-burning. I am in agreement with the suggestion that steam should be got up in a smaller boiler fired with coal or wood for getting under weigh, although in a big vessel it is exceptional to allow steam to run down in all the boilers. Still, there must be a time when it is necessary to raise steam in the first instance, and this is where the small auxiliary boiler would be an advantage. I am sure there are many men here to-night who have had experience of oil-burning, and we would like to hear their views. I know of instances where the oil-burning apparatus in vessels has given considerably better results after the ships have been in commission for some time, even exceeded the trial trip speed and continued this speed on a voyage of 5,000 miles, which necessitated passing through the Tropics, and I would like to know what has been the experience of experts on this point.

Mr. E. A. Evans, F.C.S., M.I.P.T.: I have only just arrived at this meeting, and am afraid I have missed many points which may have been brought out already in the reading and discussion of the paper. I have come from another meeting which has been considering fuel oils, and one naturally wishes to see how far the two meetings correlate. Presumably the author of this paper is an engineer, and what he says is very sound. It is gratifying to note that, judging by the care and thought which are being devoted to the subject of the burning of oil, which is a comparatively new fuel, we are not going to make the same blunders which were made with coal in the past. The reading and discussion of papers such as this is a move in the right direction. In dealing with the oil as the engineer receives it on the ship, he is taking something for granted. Is the oil he is using the correct one? So far it has been difficult for an engineer to ascertain this. It is suggested in the paper that you must have burners which are easily accessible and which have parts which are easily replaceable. Presumably that is demanded by the abnormal conditions in the fuel itself. If the burner becomes choked it is not the fault of the burner, it is something in the fuel which forms a deposit and chokes the passages, and this question of bituminous matter in the fuel oil is somewhat important. It must be divided into two classes—the soft and the hard. In a paper read recently by Mr. Harold Moore before the Diesel Engine Users' Association he referred to some trouble which occurred at, I think, Messrs. Crossley's Works. He was retained to investigate the problem. He found that it was a different type of bituminous matter which was being formed. They were able to remedy the trouble, and it has not recurred. There is still one other point—that is the examination of the fuel. Besides the bituminous matter the question of water comes in. The Admiralty specification says that you must not have more than $\frac{1}{2}$% of water. The heat of the burner may vaporise the water. Also the inter-facial tension is very great, and in many cases that extinguishes the burner. On one more point—the sulphur content—there has been a great deal of discussion during the past few years as to the quantity of sulphur permissible, and opinions are still sharply divided as to what is desirable. It is well to err on the cautious side until reliable guidance has been obtained from actual investigation. I take it that the reason why the Admiralty keep their sulphur low is that they fear that other difficulties may arise due to a higher sulphur content. Ventilation may not be too good, and passengers may object very strongly to the fumes. The calorific values vary so very little between the various kinds of petroleum as to matter very little. The gross calorific value may be taken as about 19,000 B.T.U.'s. The coal-tar product has a higher calorific value, but that is not used for marine purposes. If you do not watch these points from the start, it is no good taking precautions on the ship, because your efficiency will be lost to begin with.

Mr. Robt. Kingdom: It would be very interesting if the last speaker could tell us whether there is any apparatus which would help the engineer on board ship to get even an approximate idea of the sulphur and other conditions in the fuel he is burning.

Mr. E. A. Evans: I am afraid the simplest way is one which I would commend to you very strongly; there is no method other than that of taking samples and insisting upon the steamship companies testing them.

Mr. B. P. Fielden: We require the companies supplying us with oil to supply a certificate giving the analysis of the oil and its calorific value.

Mr. E. A. Evans: If that is the practice, I think it is a very excellent one. From Mr. Kingdom's remarks I gather that he was not supplied with the information.

Mr. E. C. Broomfield: The oil companies will always give a specification of the oils they are supplying. It will perhaps be of interest to give the approximate specification of the Persian oil which is now being marketed by the company I am attached to.

Specific gravity at 60° F. ...	·897
Flash point	184°F.
Viscosity at 60°F. (Admiralty Viscometer)	40 secs.
Water	·1%
Sulphur (dry oil)	1·42%
Calorific value (dry oil)	18,945 B.T.U.'s per lb.
Sediment on filtration through 100 mesh gauze	A trace.

Regarding Mr. B. P. Fielden's statement that to gain an advantage of 31% in heat values when using oil one has to pay about 64% extra in price, it is hardly fair to judge the suitability of an oil fuel on thermal heat units alone; there are so many other factors to be taken into consideration. For instance, in ship work, especially on liners, the saving due to less number of stokers, time lost in bunkering with coal, also faster time made between ports by oil-fired vessels, all tend to reduce initial cost of oil fuel.

I am not in a position to give you figures giving evaporation per lb. of oil fuel on ships, but with regard to land practice I am daily seeing installations where oil is being used, and the evaporation in many cases has been over 15 lbs. water per lb. of oil (from and at). In some of the places in London using coal to-day, it would not be anything out of the way to say that their average evaporation per lb. of fuel would not be higher than $7\frac{1}{2}$ lbs. (from and at). Comparing this with results obtained on oil (viz., 15 lbs. from and at) we get a ratio of 2—1 showing that the advantage by using oil can be as high as 100% increase due to better combustion; no losses in temperature due to having to open firedoors, for the various operations necessary when coal firing.

The spot price of oil to-day delivered by road tank wagon is 75/- per ton nett. If we take the comparison given, and allowing for cartage of ashes; also labour saving in some cases, together with the convenience of oil, it is not such a high price after all. I have made these remarks as I feel I must speak up for oil fuel, when I hear stated it is only 30% more efficient than coal.

Mr. J. Thom: Are there any boilers with which you come in contact which are anything like a marine boiler?

Mr. W. McLaren: We have got to a debatable point now; may I ask the gentleman who has named over 18,000 B.T.U. as the calorific value of his oil whether he can get 60% of that heating value out of the Scotch marine boiler?

Mr. E. C. Broomfield: I am not in a position to answer that, as I have already stated that I have had no experience with marine boilers and oil burning.

Mr. F. Bradshaw, British Petroleum Co., Ltd.: I think it is quite possible to obtain 60% out of oil fuel containing 19,000 B.T.U.'s.

Mr. T. W. Andrews, South Metropolitan Gas Co.: Referring to a former speaker's statement that he only got 6½% out of steam coal, I consider there was something seriously wrong with the plant.

Mr. E. C. Broomfield: In these different stations they all use varying grades of coal. In many cases they have not the apparatus for determining what evaporation they get, but judging from the enormous quantities of smoke one sees belching forth from the chimneys, we know they cannot be getting good efficiency. From observations I have made I have drawn my own conclusions, and have assumed that they are not getting more than 7½ lbs. (from and at).

Mr. T. W. Andrews: It is extremely difficult to assume any efficiency at all by the condition of one's chimney top. If one said that we were only getting 6½% and then looked at the actual results, it would often be found to be very different.

Mr. E. A. Evans: I addressed a question to Mr. Fielden, which I am afraid he has overlooked.

Mr. B. P. FIELDEN: I am sorry; I thought the reply by another speaker had sufficiently answered the question. My experience is that we never get oil without a specification. Mr. Broomfield has made a similar statement on behalf of one firm of suppliers. I will answer the point raised later about the efficiency. I know of three ships, all of the same dimensions. The first is fired with coal, the second burned oil, the third is a Diesel ship. The oil burner was run for a sufficient time in 1914 to get the necessary figures to determine whether it was wise to continue on oil, and it was found that it was not economical. The displacements of the ships were practically the same—rather in favour of the oil. The revolutions of the engines were increased in the oil-burning ship, being 73·1 as against 63·7 for the coal. The percentage slip of the propeller was nothing to remark about. The average horse-power and speed was slightly in favour of the oil.

The consumptions were:—31·6 tons of oil per day; 42 tons of coal per day; the Diesel ship is running on 11 tons per day.

The figures show that if you use oil you should use it direct;—don't make steam at all.

Mr. BRAND: May I ask whether there is any means of determining the right temperature of the oil before going into the burner? Also when the water goes through the heater, does it pass off in vapour, or is it fresh water in the oil? Some ships, I notice, carry a temperature of 180° to 190° F. We carry 240° F. It is only by guess work; we have no means of finding the right temperature.

Mr. F. BRADSHAW: In determining the right temperature at which oil should be burnt, one must take into consideration the viscosity of the oil at different temperatures. Mexican fuel oil is heavy, the specific gravity being about ·950, and to burn this class of oil satisfactorily with a pressure system of oil burning, it would be necessary to raise the temperature somewhere near 240° F. Persian oil with a specific gravity of approximately ·895 can be burnt at a very much lower temperature, good results being obtained with the oil heated to 130° F.

I was recently present at a test where the pressure system (as fitted to steam vessels) was installed on Galloway type boiler. Persian oil was burnt; at no time did the temperature of oil in heater exceed 105° F., the average temperature for 3-24 hour runs: 100-102-101° F., whilst at the burner the temperature for the same periods averaged 102-97-95° F.

A few figures from the test might interest you; the boiler had two furnaces (one burner to each furnace):—

The average steam pressure was	68 lbs.
The average temperature of	145° F.
The average superheat	360° F.

There was an actual total evaporation of more than 721,000 lbs. of water, giving an average of more than 10,000 lbs. of water per hour. The quantity of oil burnt was over 50,000 lbs. or more than 700 lbs. per hour.

CO_2. We had a CO_2 recorder on for test; the figures for first 24 hours are low owing to defect in pipe; however, good results were obtained, being 9·56-10·72-11·3 respectively, or an average of 10·53 for the full 72 hours.

In order to make the test impartial it was carried out by a firm of consulting engineers, their readings being checked by representatives of the engineering staff of works, where test was carried out. On steamers one could hardly expect to get such a high evaporation, but some years back I was at a test with the Wallsend Pressure System fitted on marine type of boiler, and good results were obtained. The company with which I am connected control very large tonnage of steamers, all of which I believe have oil-burning installations fitted to the boilers. I have no figures of their consumption, but perhaps at a later date could supply Mr. Fielden with this information. In answer to Mr. Brand's question of what happens to water at the heater when it is mixed with the oil, the temperature of oil in heater will govern this. If oil was being heated to high temperature it might form small steam pockets which would give trouble at the burner; the flame would not be steady, but flicker considerably.

Mr. Brand: Does that form a lot of sparks from the burner?

Mr. F. Bradshaw: Yes; you find that happen, especially in systems where a steam blow back cock has been fitted to oil pipe that leads to burner and the cock leaks steam into oil pipe. The best way to avoid water trouble is to put a small water drain cock in bottom of service tank and occasionally test for water.

Mr. F. O. Beckett: Perhaps the foregoing remarks explain why the author says that the heater should be constructed to stand a temperature of 350° F. Should any water be present in the fuel it will be converted into steam. As far as I am concerned, in my experience with oil fuel I have been very unfortunate, and as Mr. Fielden has found about its use at sea, so have I found it on land. I know one man associated with a concern using oil as fuel, and he contends that oil is only second to coal. With regard to Mr. Keenes' recommendations concerning the supply of air and the need for the maximum possible being given to the furnaces, I would like to ask how one would cope with the conditions arising in a ship starting from London in the winter and proceeding to, say, the Red Sea, where the air is rarified and where it would be necessary to augment the supply of air to the burners. On the subject of the testing of oil by the engineer on board ship, we had one meeting here last year where the lecturer, a chemist, had a small laboratory which would go into an engineer's wardrobe. With such an equipment on board, one could test the fuel for, I believe, sulphur, as well as for water, but not for the flash point, as that is somewhat dangerous.

Mr. G. Haly (H.M. Petroleum Dept.): There is one point which has not been touched upon with regard to the conditions included in the specification, namely that some oils, notably those with an asphalte base, become quite solid at the lower temperatures. It is important that provision should be made against that contingency for marine work.

Mr. E. A. Evans: I think I can answer that point. Referring again to the Admiralty specification, which is an excellent one, they take the viscosity not at 60° F., but at 32° F., *i.e.*, at the freezing point of water. I think the figure is 3,600 secs. in the Admiralty pattern viscometer. That definitely fixes the maximum viscosity at the freezing point of water so as to allow the oil to flow in cold weather. I do not think I have seen a specification where the cold test is called for. One oil largely in use is quite thin, but of course that gives no indication as to whether that oil will flow at freezing point. A considerable amount of paraffin wax is found in Persian oils. In any case, when the oil is on the ship you can always heat it to make it flow, but after all, the main reason for heating it is to get better burning. The question of low temperature conditions is not one which worries people; they take it philosophically, and heat the oil as required. The Mexican oil is very thick, and it has to be heated to about 180° F.

Mr. J. Thom: We have heard quite a lot of interesting and useful information for marine engineers, and our experts here have told us that it is possible to get good results from oil-burning in marine boilers. With regard to the suggested auxiliary boiler, it seems wrong to introduce extra units such as this, but it may be a point which the marine engineer will have to observe to get good results. We cannot afford to put Galloway boilers on board a ship at sea. It may be a move in the right direction, before substituting oil for coal, to make some alteration to the Scotch boiler. I think this is a point worth consideration.

The CHAIRMAN: Before formally closing this discussion, there are one or two remarks which I should like to add regarding the paper. The relative merits of coal and oil are still subject to a good deal of contention, but it is certain that those of our big shipping companies who are adopting oil as fuel are not doing so without good reason. As regards the paper to-night, we must remember that it is intended essentially to deal with the conditions to observe to obtain high efficiency from oil-burning; therefore I think it ought to have contained more of the writer's own experience. He does not tell us what his experience has been with the different types of burners he has tried. He recommends a short flame, and that is the extent of his remark. One of the most important points to my mind is the condition inside the furnace. I know that Mr. Keenes can give this information, as he has written papers for the Institute before. There is no doubt that the subject of coal versus oil is one of the great controversial subjects of the day, but the "man in the street" will never be able to come to a decision if he listens to the experts on both sides. If we refer to the tests carried out by the Admiralty in the *Saxonia* with coal as fuel, we see that they obtained 82·3% efficiency from the boilers. Dr. Milton was one of the Committee who were dealing with the matter, and this authority is unquestionable. The figures are published in a Blue Book, so that they are open to anyone to examine. The oil expert can also bring forward figures to prove high efficiency from oil. Mr. Fielden, from his remarks, has tried it out, and from his experience coal is the better to use. Other people have found the reverse.

Mr. F. G. BUTT-GOW: I have pleasure in proposing a vote of thanks to Mr. Keenes for having provided us with this paper.

Mr. F. O. BECKETT: I am pleased to second this vote of thanks. I have no doubt that Mr. Keenes will endeavour to answer some of the questions which have arisen.

Mr. J. Thom: May I ask that members of the audience may write in to the Secretary any remarks which they may feel inclined to contribute to the discussion.

This was agreed, and a vote of thanks to the Chairman concluded the meeting.

The Hon. Secretary: Having been the reader on behalf of the author, I will be pleased to convey to him the vote of thanks for his paper which forms a fitting corollary to his previous one read September 6th, 1921, when he related his experience and gave his convictions as to the possibilities of oil fuel if treated efficiently and economically. Points emphasised have been more or less associated also with coal-fired boilers, *i.e.*, the admission of air to the furnace and the leakages liable to occur at the various doors and joints. More attention has been paid to these details on the part of the constructors than formerly, and smoke-box doors have been improved, but it is well to call the attention of all to what may appear a trivial matter, as when a candle or lamp is held up to indicate to the junior engineer that which is capable of improvement.

The author having detailed his experience in his former paper, has now summed up what he had found, with a view to have the experiences of others attached, so that an all-round discussion may be the outcome for the general good. This is in accord with the advice conveyed by our President in his address, and members can let out from the storehouse of the mind notes based on experience, or place questions on record to which answers from others with wider experience can be given. A simple paper often leads to a profitable discussion. We are out to help one another in the efficient discharge of our daily duties and improve the efficiency of what we are called upon to handle, thus co-operating to maintain and advance the trade and commerce of the Empire, each in his own special environment.

The following have been received by correspondence:—

Mr. D. S. Whiteford, B.Sc.: There are two points in Mr. Keenes' paper which are not altogether clear to me. In the first place the author states, "In spite of the fact that the boiling point of fresh water is less than that of water that is slightly dense, it is advisable in view of the general conditions to keep the density of the boiler water at from one to two ounces. This density is taken as good practice with the oil-fired boiler." One may read into that somewhat unusual statement an implied recommendation that the density of boiler water should be more for oil-firing than with coal-firing, but unfortunately no reasons or explanations are given. Mr. Keenes admits that greater density, with its higher boiling point means, presumably, more fuel for a given evaporation, so that his recommendation is the more difficult to appreciate. Moreover in the case of the water-tube boiler which, although not specifically mentioned, is almost invariably oil-fired at sea, the presence of two ounces of salt per gallon of boiler water, if an advantage for such oil-firing, is certainly not to be recommended. Perhaps Mr. Keenes will make this point clear.

Then again he says, referring to heating coils in double-bottom tanks, "In the average case the want of heating coils is more apparent than real." This is directly opposed to the views which I had formed after some experience in the supervision of American oil-burning tonnage, where the lack of sufficient heating coils led to results which were distinctly "real" and not merely "apparent." Some two-and-half or three years ago there were several hundred ships of the U.S. Shipping Board trading to Europe, and of these ships the great majority were oil-fired. These vessels carried in their double-bottom tanks oil fuel which had a specific gravity of 14° Baumé, or very nearly unity, and as this oil was crude Mexican with a high asphaltum content we had many cases of vessels returning to port during the winter months for a lighter grade oil. In one actual case a ship left Hamburg for New York, met heavy weather in the Channel, and in the general discomfort and confusion the steam pressure gradually dropped, and, finally, with the oil so heavy that the pumps could not handle it, the vessel had to be towed into Southampton. A steam hose was led from the Anglo-American Oil Co.'s barge *Silvertown* to the vessel's pumps and a lighter grade fuel oil was put on board. Some of these ships had merely a heating coil round the suction stream, while others had coils of a capacity of about 0·5 square ft. heating surface per ton of oil in the tank. This was found to be quite inadequate for the heavy grade of fuel carried and the later practice was to fit heating coils to *all* double-bottom tanks giving a heating surface of not less than one sq. ft., and in some cases nearer two sq. ft. per ton of oil carried. Quite fifty of the vessels in the winter North Atlantic trade suffered through lack of adequate heating coils, so that Mr. Keenes' statement would appear to require some qualification.

Mr. R. Kingdom: Mr. Keenes questions the value of heating coils in tanks. With well-filled tanks, and in warm weather, the coils may be of little value, but the following incident which came under my notice proves the necessity of the coils when working on tanks that are nearly empty. An oil-fired vessel was to move to a post some 20 miles away, and 20 tons of heavy oil was available in the cross bunker for the purpose, amounting to about 12ins. over the tank suction. Sufficient steam was available when the vessel left the berth, but through an oversight the settling tanks were nearly empty and the transfer pump had to be started at once. The few heating coils in the tank were close to the suction, and the oil would not flow from the other bays, being cold and too viscous, and it had to be bailed to the settling tanks with buckets. Through lack of steam the vessel had to anchor against the falling tide until by burning all available stage planks and galley coal in one boiler and any oil that could be got to the burners in the other, the steam rose in time to prevent her being left on the mud and enabled the dock to be reached by the aid of a tug. Although such a combination of circumstances might never occur again, the owners have since fitted extra coils in the tanks.

My request to be told of a simple type of testing apparatus for oil was not made because oil suppliers did not supply certificates. During the war none appear to have been issued, and I have had no experience since, one way or the other. I relieved one of our members, Engr.-Lieut. Seaton, in 1917, and one of the duties I took over was the testing of oil fuel for Mudros Base. We were chiefly concerned with finding the flash point, specific gravity, and "freedom from dirt" of the petrol and paraffin supplied for the motor boats and launches, but occasionally heavy fuel samples came along. The viscosity was the only other property we could get of heavy oil, but in a weak moment I tried to find the percentage residue left by heating a sample in an open crucible. The water evidently separated off and collected at the bottom until at about 220° F., it generated steam and blew the oil over my assistant, myself, and all the office. Any member who knows the feeling of hot oil on the face and neck will appreciate why I enquired if there was any simple apparatus for doing the tests safely.

Fred. C. Duxon: Some two years ago I was in charge of one of our Company's steamers, the ss. *Haiching*, of Hongkong.

On being chartered, the boilers—which were then sixteen years old—were re-fitted to burn oil fuel, the system adopted being "steam jet," with firebars, etc., kept in place.

We had considerable trouble with the back ends of tubes leaking, and it became necessary at every port of call—the voyage was to the Persian Gulf— to dismantle the brickwork to get into the back ends and expand all leaky tubes. Naturally these were getting exceedingly thin, and on our arrival in Saigon it was found absolutely compulsory to renew the worst of the tubes, which numbered in the two boilers about 160.

There were on board only nineteen spare tubes, and it was found that only twenty of the sizes required could be obtained in Saigon; the vessel being on charter and time valuable, the impossibility of obtaining new tubes led to the following means being adopted:—

The tubes to be renewed were drawn out and cleaned, and 12 inches of the combustion chamber end was parted off from each of the bad lot in a lathe and the ends chamfered. Then a sufficient number of the spare tubes were cut up into 12in. lengths and one end of each chamfered; the long and short tubes were then placed on a suitable mandril and oxy-acetylene welded, the weld being made by strips cut from the old ends; the idea being to have the same metal as near as possible throughout the tube. The tubes were then cleaned up on an emery wheel and on a hydraulic tests of 360 lbs. per square inch being applied, not one was found to leak. These manipulated tubes were then expanded in position and have been in commission up to now without giving any trouble. The vessel was able to proceed to sea in considerably less time than would have been possible if we had resolved to wait for new tubes to arrive from Hongkong or Singapore. The work was done by the French firm of Dupont Bron and Gregori, with Chinese boilermakers and welders and was found to be very satisfactory to charterers and owners in the saving of time, as well as to those on board.

———o———

Notes.

From the paper by Jas. Richardson, B.Sc., read before the British Association meeting in September, the following quotation is taken, as it bears on oil fuel:—

"The latest official returns show that of all the vessels owned in the world 31·5% are over 20 years old, and more than 20% are over 25 years old. As regards British ships the position is substantially the same. All these factors can only lead to the definite conclusion that there certainly must be a considerable amount of building of new tonnage in the near future. The question, therefore, of the type of ship as denoted by propelling machinery naturally arises, and in this connection a decision must be made regarding the fuel to be used, whether oil or coal. It can now be definitely stated that except in special cases the burning of oil fuel under boilers, with the present prices ruling for coal and oil, is actually uneconomical. The advantages which hold in the case of the Atlantic liner have not now, with reduced wages, sufficient potency with the lesser-powered and slower cargo carrier to warrant the extra first cost of machinery and the higher price for fuel. The subjects of price, distribution and available supplies of oil fuel must be considered. As regards distribution, little difficulty will now be encountered, because oil fuel stations have been provided on all of the principal trade routes, and the case with which this fuel can be accommodated on board ship and the 50% greater heat value per ton, and 65% advantage per cubic foot makes possible for a given ship a very much greater radius of action, without re-bunkering. The price of oil fuel within the last 10 years has keep approximately the same position relative to coal, with an inclination recently to be relatively cheaper. There is no sign of a reduction to such a figure that oil burning under boilers for the average merchantman can compete in with coal, except in very special cases where oil is relatively very cheap and coal dear. There is evidence that there will be available supplies of fuel oil to meet the demand, although the incentive of the high prices obtainable for petrols and lubricating oils will tend to cause producers to distil the crude oils to the maximum possible extent, having the effect of lowering the quality of Diesel and fuel oils coming on the market. Recently a number of tests ashore followed up by actual trials under normal operating conditions at sea, have proved that the Diesel oil engine is not so sensitive to varying qualities of fuel oil, including high asphaltic bunker oils, as was earlier believed to be the case. As to whether the extra overhauling, which the heavier and less easily combustible oils may well demand, counterbalances the savings in fuel costs, will emerge in time, but it is certain that the capacity to burn reasonably satisfactorily almost any grade of fuel oil in the market is unquestionably an added asset of considerable value and will in the future be regarded as a necessity for ocean-going tramps.

"Under such conditions as the foregoing, undoubtedly the Diesel oil engine as the most economical consumer of liquid fuel makes a most compelling appeal, requiring only from one-third to one-fifth the quantity of fuel used by equally-powered steamers."

The remainder of the paper dealt with the construction and development of the internal combustion engine and auxiliaries, the concluding paragraphs comment on future possibilities from these. The following may be quoted:—

"The subjects of personnel and upkeep are interdependent. There is available an increasing number of engineers conversant with the first principles of internal combustion, and most engine builders are only too anxious that their engineers who have worked on the construction of the machinery shall follow it to sea, and form the nucleus of the engine room complements. Under such conditions the fears of excessive upkeep expenses are not well founded. When next marine construction is energetically pursued, as undoubtedly it must be, if we are to maintain our natural and supreme position as a sea-going and trading nation, the motorship will be in the fore-front. To-day at sea the tonnage of motor ships is 6·5 times what it amounted to in 1914, and of the present total, more than one half, or 848,000 tons, represents 149 vessels of over 3,000 tons of ships under construction at the present time, those to be engined with internal combustion machinery form such a proportion as to make the future for this new type appear extremely bright."

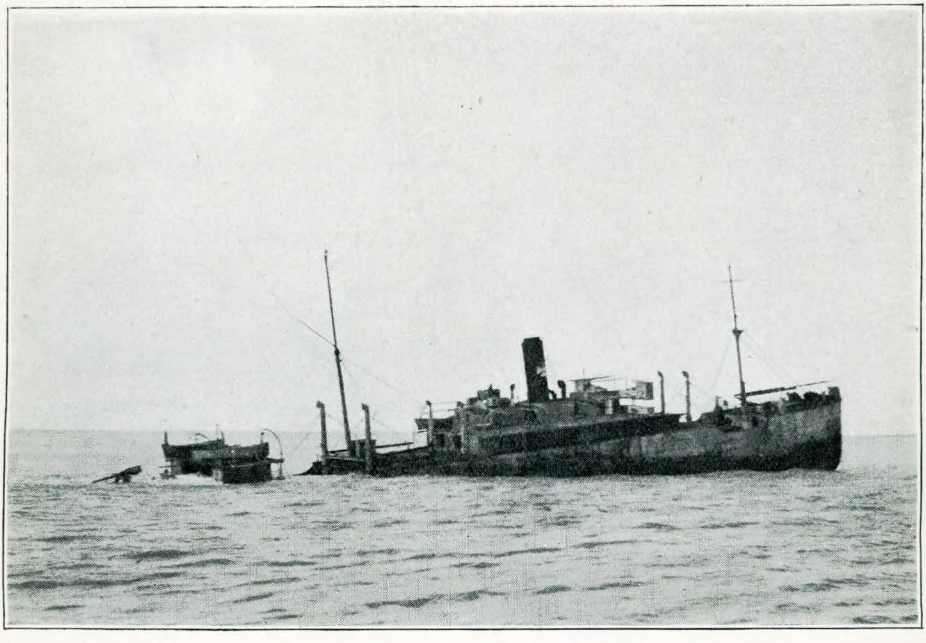
The following interesting communication has been received from Mr. Herbert McLean, one of our members, located at Punta Arenas. To the *Marine Engineer and Naval Architect* we are indebted for the reproduction of the photographs, which are also appearing in their November issue.

"I have pleasure in enclosing a few photos which perhaps will be of interest, and at the same time, will give you an idea of the work I occasionally come up against.

"The ss. *Beacon Grange*, while on a voyage to Rio Gallegos, Argentine Republic, to load frozen mutton, ran ashore on Oliver Bank, at the mouth of the Rio Gallegos, during September, 1921. I was sent up there from Punta Arenas to survey her and see what could be done in the way of salvage. My first visit to the wreck was made partly in a tug, but as the tide was low the tugmaster would not put us alongside, so we embarked in one of the *Beacon Grange's* dinghies, which we had in tow, and finished the voyage in her. We landed on the west side of the bank, and, carrying our provisions, &c., trudged across the loose shingle for about half a mile to where the wreck was lying. There were several ropes dangling over the ship's side, and the captain started to climb up, but when he reached about the Plimsoll mark, the rope broke, and down he came. Fortunately he fell on all-fours, and beyond a rough shaking up, he was none he worse for his drop of 25ft. The next man to make the attempt got up without mishap, and he lowered a ladder for

The "Beacon Grange," high and dry, with salvage steamers "Rio Santa Cruz" forward and "Antartico" aft.

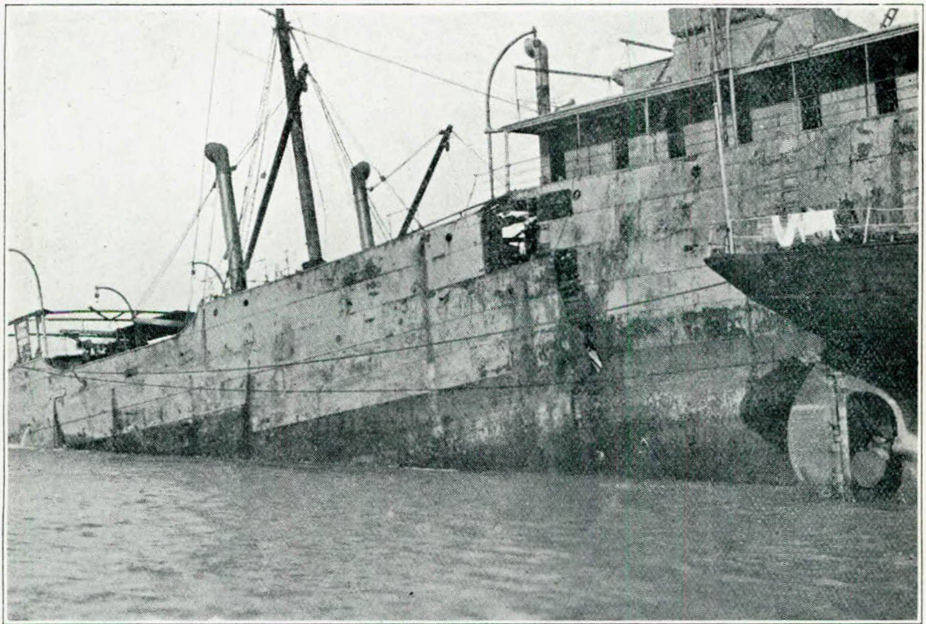
The "Beacon Grange" high and dry on Oliver Bank.



Position of the Vessel as found at High Tide.

the rest of the party. By the time we got up, the tide had turned and was coming in very fast, so we had no time to lose.

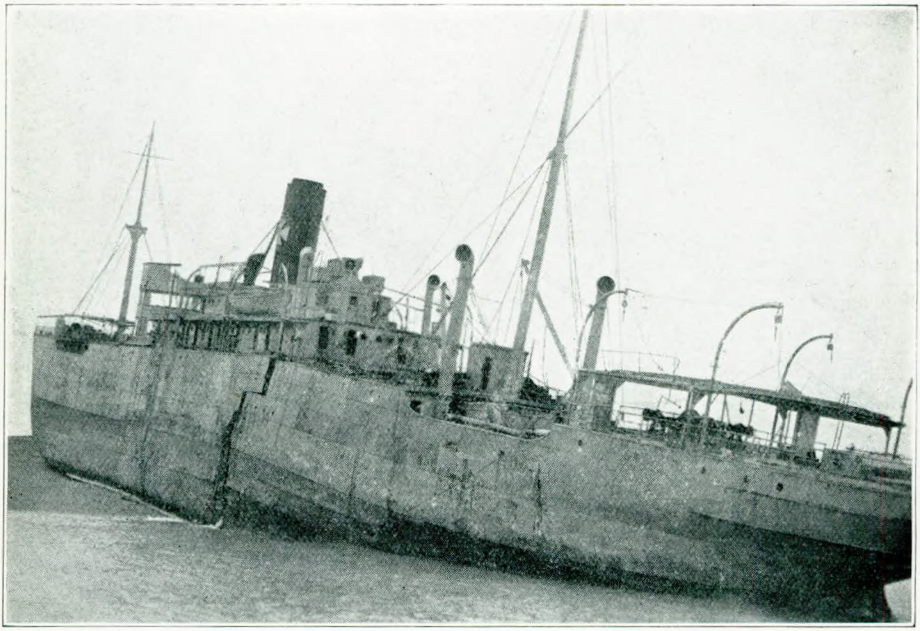
"The *Beacon Grange* was a total loss. She started to break up the same night as she ran ashore, and rivets were bursting and flying about. The wood deck amidships was bursting and tearing away from its fastenings at each end of the deck houses. The ship's sides were bulging in places, and the bottom of the vessel, from the engine room to the No. 2 hold, had come up about 2ft. 6ins., and all the stanchions in the holds were either



Back broken, and S.S "Antartico" grounded alongside.

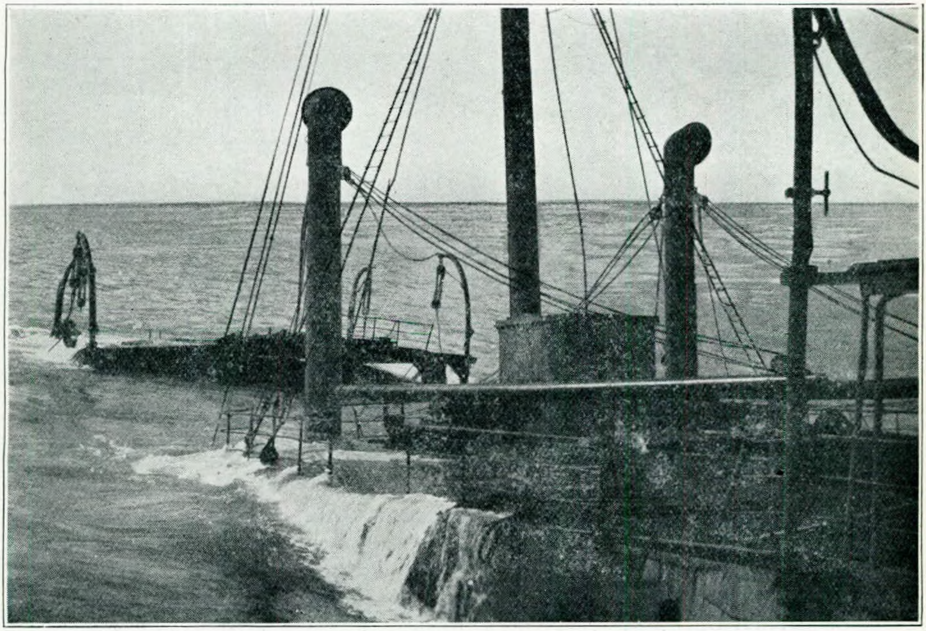
broken or very badly twisted. The boilers had shifted, and the inner funnel was protruding above the outer casing. The main engines had come up, the main stop valve broken off, and all gratings were lying at most awkward angles, so that one had to be very careful in going down the engine room.

"The whole engine room was in a filthy mess. The tide rose to about 6ft. above the cylinder tops, and the oil from the oil tanks, also from the bilges, had naturally floated up, as did also the charcoal insulation, smothering everything. You can imagine the feelings of an engineer accustomed to see a nice clean engine room, and then to witness such a transformation in so short a time. There was about 4in. thickness of this charcoal and grease on the engine room platform when the tide was low. On the tide rising again, the tug came alongside and we returned to Rio Gallegos, a good hour's run. Salvage steamers were sent for, and the Chilian steamers *Lovart*, *Antartico* and *Rio Santa Cruz* were despatched from Punta Arenas, and after the usual formalities were gone through, and permission obtained from the Argentine authorities, work was



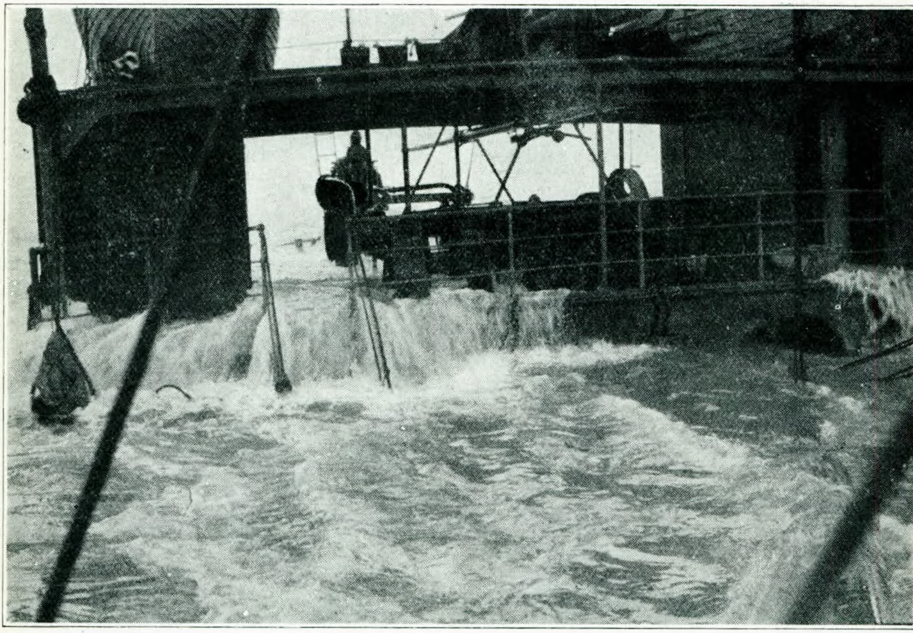
Port Side at Low Tide, showing Fractured Plating.

started. Salvage operations (confined to salving the coal cargo) were very difficult owing to weather and labour conditions, and the exposed condition of the *Beacon Grange*. There was a strike in progress in Punta Arenas, so the ships were manned with a miscellaneous crowd. We endeavoured to collect men in Gallegos, but found that the Federation in Punta Arenas had advised their friends in Gallegos, with the result that we were boycotted. However, we managed to secure the services of the Liga Patriotica, who supplied us with a crowd of free labourers (well armed) to discharge the salved coal on shore. We also arranged to get men to work on the wreck, but they were fired at on their way down to the steamer and two of them were wounded, fortunately only slightly. The others went home, so we started the work of shovelling coal ourselves, short-



After Deck Boats washed away from Poop.

handed at first, but I got my boilermaker and mechanic squad on the job also. The *Beacon Grange's* winches were utilised, steam being supplied through flexible steam pipes, by whichever vessel happened to be alongside. We managed to salve about 2,000 tons of coal, besides a quantity of ship's gear, ropes, derricks, winches, pumps, anchors and chains, brass, copper pipes, &c., and we didn't forget the gun. This gun was landed on condition that it was shipped to England at the first opportunity.

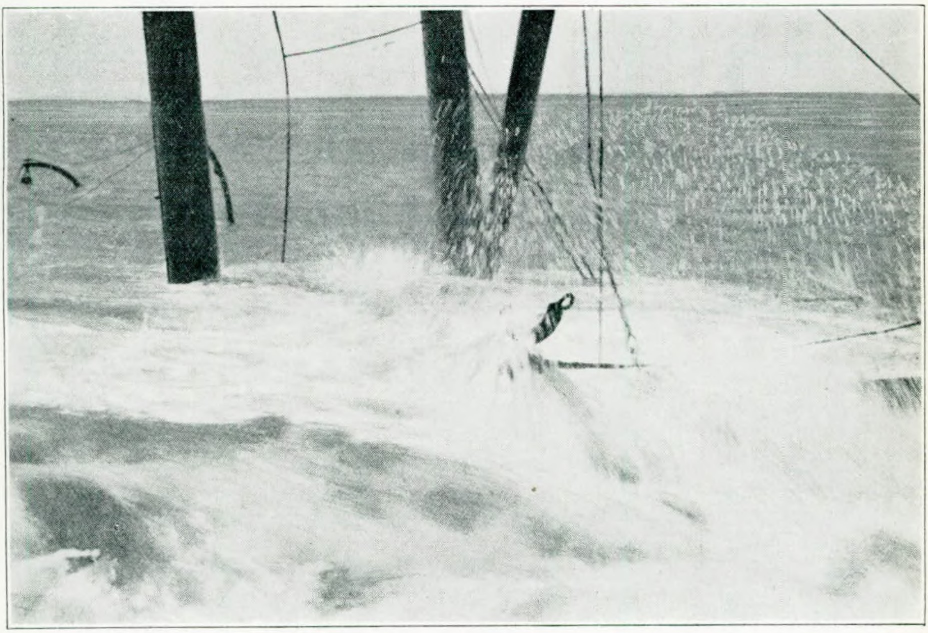


Tide rising over Poop. Well-Deck Submerged.

"The *Lovart* was the first vessel to arrive on the scene. She was very short-handed, but the *Antartico*, which arrived a few days after, was well manned in point of numbers, but they had no one on board who could cook. One of the *Lovart's* firemen, who happened to be a cabinet maker, was transferred to the *Antartico* as a cook. The change was a very fortunate one, as he turned out very well and everyone was satisfied. The *Rio Santa Cruz* was also well manned, so the work went on as well as could be expected under the circumstances. During the six weeks I was up there, I had good opportunities of taking the photos, and was also very interested in watching the destruction of the *Beacon Grange*. When the weather was bad, the after-part of the ship was on the move, and with every wave the torn and broken ironwork would scrape backwards and forwards with shrieks and groans as though in pain. Before I left her the stern had dropped about 25ft., making the work of salvage from No. 4 hold very difficult, and from the No. 5 hold impossible.

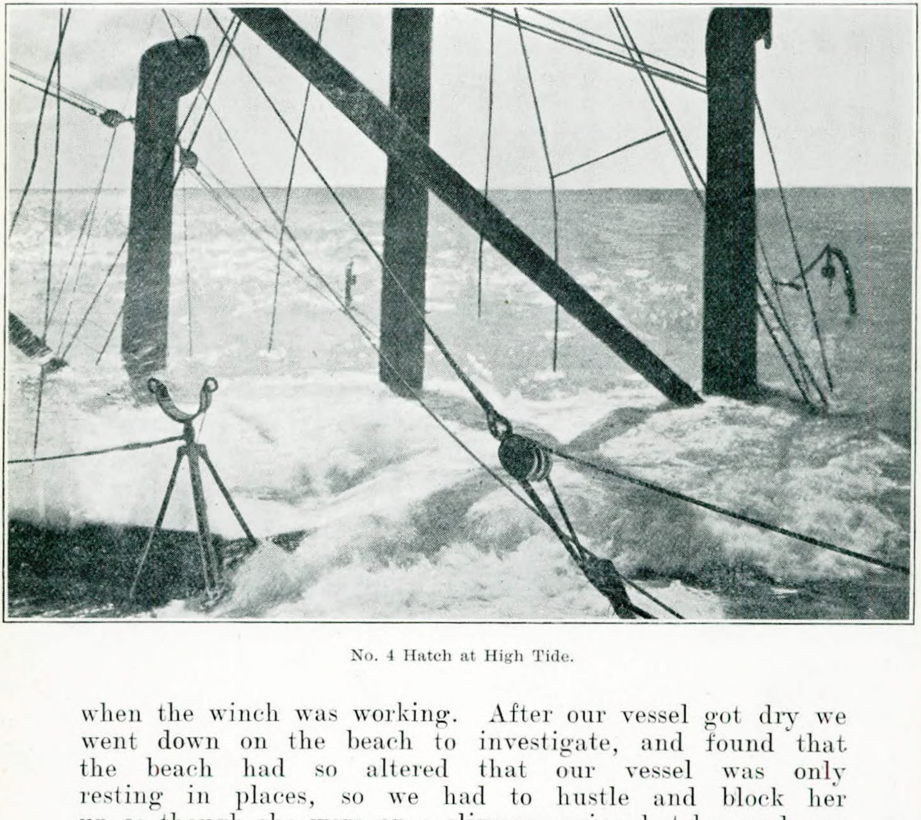
"In the engine room I had great difficulty in getting the pumps and gear out, as when the 'tween decks burst, the coal from the bunkers was washed down the engine room, burying the main engines to the height of the low-pressure cylinder bottom. All the piping was in a fearful tangle, and many of the boiler mountings were broken off the boilers. The screen bulkhead between the engine room and stokehold was very badly buckled, and the gauge columns were lying at an angle of 45° to the vertical, and I was surprised to find that the glasses were not broken. The dynamo was lying up against the ship's side and most of the pumps were broken and standing at different angles.

"On three successive tides I had to dig away a few tons of coal in order to get at the feed pump, which had been buried. The weather conditions were unfavourable most of the time, and when you consider that there is a rise and fall of 36 to 40ft. and an 8 to 10-knot current, you will understand the arduous nature of our work. The beach was nice and flat when we first



No. 4 Hatch Completely Submerged.

arrived, but it very soon altered in shape, making it dangerous for us to beach our vessels alongside the *Beacon Grange*. One morning we were discharging and, as the weather seemed fine, we decided to lie alongside, but when the tide went down and our vessel grounded, we noticed a most pronounced vibration



No. 4 Hatch at High Tide.

when the winch was working. After our vessel got dry we went down on the beach to investigate, and found that the beach had so altered that our vessel was only resting in places, so we had to hustle and block her up as though she were on a slipway, using hatches and any other wood we could lay our hands on. On another occasion, we were lying alongside with a falling tide when the wind changed and we had to try and clear out. On going astern with our engines, our stern was driven unpleasantly close to the wreck, and there was a chance of our little *Rio Santa Cruz* being washed over the well-deck on top of the No. 5 hatch of the *Beacon Grange*.

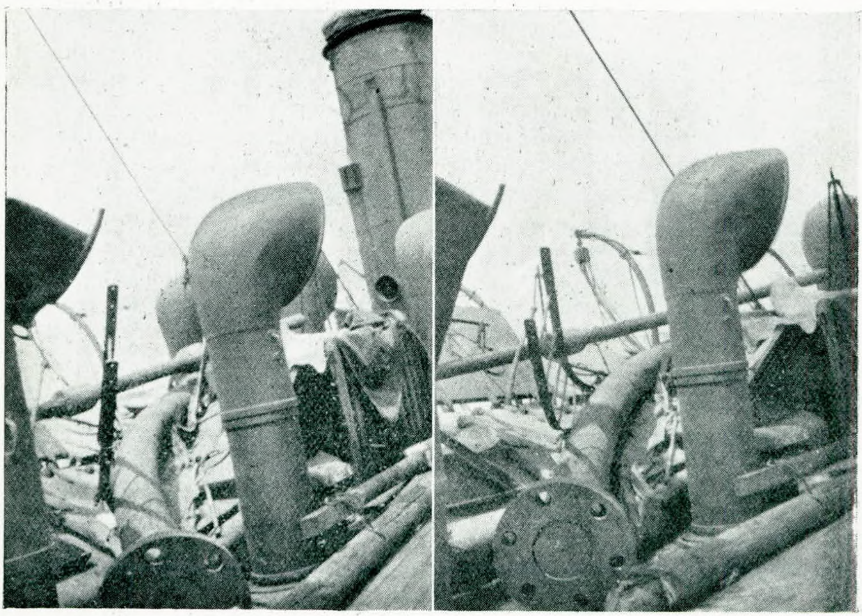
"As the tide was falling rapidly and the wind freshening, we had no alternative but to go full speed ahead and jump the bank, which we succeeded in doing, with only a couple of slight bumps.

"On another occasion we were stuck alongside and couldn't get away. The weather was frightful, so we had to put out extra fenders and extra mooring ropes and wires and hang on all night, with our engines going ahead. In the meantime, we were receiving seas over our decks, and at times, it was impossible to see our fo'c'sle head for spray. The waves and the backwash from the beach made our vessel range backwards and forwards from 10 to 15ft. in spite of the engines going ahead. Several of the mooring ropes snapped (we had four forward and four aft in addition to our anchor and chain), and it was wild work replacing them. We did not sleep that night, and we were all pleased when our vessel started bumping and we knew our watch was over as she would soon be high and dry and ready to receive more cargo. On the whole, our efforts were not very successful, although we were struggling as well as possible to save what we could in as short a time as possible, but the drop in the price of coal reduced the value of our work, and we did not get back to Punta Arenas in a very satisfied frame of mind. However, it was soothing to our feelings to be told in Rio Gallegos that they were surprised we had 'stuck it' so long.

"The expedition was under the command of Captain A. C. Jensen, a Danish captain of great experience, and I often admired the skilful seamanship he displayed in laying his vessels alongside the *Beacon Grange*, with wind and sea and a 10-knot current running broadside on. The captain of the *Antartico*, also a Dane called Jensen, is also a very skilful seaman, and it is a pleasure to work with them. The more difficult the work, the more they rise to the occasion, never beaten. Just as our work on the *Beacon Grange* was drawing to a close, we had news of the stranding of the motor ship *Lima*, on the other side of the continent, and that a salvage expedition had been despatched by our firm. We were, of course, disappointed at not being there, as Captain A. C. Jensen and myself are generally in charge of these expeditions, in the absence of the Marine Superintendent, Captain F. Willumsen. However, we couldn't be in two places at once, so the *Lima* was attended to by others. Should you consider these photos of sufficient interest for publication, I would be very pleased to lend you the films.

"About ten days after my return to Punta Arenas, the *Lima* arrived, and I took charge of the repairs. These were effected on the beach at Punta Delgada, Straits of Magellan, about 60 miles to the North of Punta Arenas, and were of a very arduous and responsible, but interesting nature. I hope to send you a few lines and a number of photos on these repairs, which were unique."

The illustrations show a propeller shaft which was thrown up on deck in the position shown, owing to the steamer being mined at the stern, the force of the explosion was so intense



that the afterpart was broken away, and the spare shaft elevated and landed above. The photographs were taken as relics of his experience during the war, by one of our members, to whom we are indebted for the illustrations.

Books added to Library.

The University of London College Calendar, 1922/3, has been kindly presented by the Provost for the guidance and information of members.

The Transactions of the Institution of Mechanical Engineers, 1922, a copy of which we have received, contains many valuable papers, among which those on "Co-operation between the Engineer and the Chemist," by Mr. G. M. Gill; "Electric Welding for Ship Construction," by Mr. A. T. Wall; and "The Functions and Training of the Mechanical Engineer," by Major F. L. Watson, M.C., T.D., are of special interest.

The Transactions of the North-East Coast Institution of Engineers and Shipbuilders for 1921/22, of which we have received a copy, is full of important and valuable work. The papers on "Maag Gearing," by Engr. Lieut.-Comdr. L. J. le Mesurier, R.N.; "Diesel Engine Flexibility," by W. S. Burn, D.Sc.; and "Some Problems in Marine Diesel Design," by Mr. P. Belgavin, are of great interest at the present time, and all the papers are of interest to Marine Engineers.

Mr. J. B. C. Kershaw's book on "Low Grade and Waste Fuels" has been added by purchase.

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Election of Members.

Names of those elected at Council Meeting of 6th November, 1922:—

Members.

Arthur Boyes, Managing Director, Messrs. Aldous, Ltd., Brightlingsea, Essex.

Peter Jack Cram, North Cliff, Promenade, Egremont, Cheshire.

Alexander Crawford, junr., 57, Regent Street, Greenock, Scotland.

David John Davies, 17, Newry Fawr, Holyhead.

John Maurice Ellison, Major, R.E., Reserve of Officers, Holme Wood, Cockermouth.

James Finch, 46, Norfolk Avenue, London, N.15.

Alexander Gentle, 30, Durham Road, Manor Park, E.12.

Percy Norman Hulme, A.M.I.N.A., 8, Clanricarde Gardens, Notting Hill Gate, W.2.

Stanley Charles Husk, "Westward," Hamilton Road, Wivenhoe, Essex.

Alexander MacKenzie, c/o Messrs. Butterfield and Swire, Ltd., Shanghai, China.

Thomas Pemberton Main, Shanghai Gas Co., Ltd., China.

William James Burridge Mann, 63, St. Chads Road, Derby.

William Alfred Mowat, Woollen Mills, Petone, New Zealand.

David Rankin, Marine and Inspection of Machinery Dept., Napier, New Zealand.

James Riley, 30, Elliott Street, Arbroath, Scotland.

Associate-Members.

Saviour Agius, 26, Tennyson Avenue, East Ham, E.6.

Norman Walter Baker, 15, Calmont Road, Bromley Hill, Kent.

Percival Harold John Higgs, The Lodge H.A.P., Elder Road, West Norwood, S.E.27.

Samuel Leyland, 4, Rue Youssef Eiq Eddine Effendi, Mazarita, Alexandria, Egypt.

Andrew Crichton Lockie, c/o E. H. Cross, Esq., 55, Wroughton Road, Wandsworth Common, S.W.11.

Henry Ramage, 11, Penelope Road, Pendleton, Manchester.

John Smith Winfield, 19, Elphinstone Road, Peverell, Plymouth.

Associates.

Reginald H. Benson, 32, Northbrook Road, Southampton.

Ernest C. Miles, 311, High Street North, East Ham, E.

Edgar James Robertson, 5, Clarence Street, Edinburgh.

Graduates.

David Henry Alexander, 21, Trafalgar Square, Chelsea, S.W.3.

Rowland Hill, 21, Malmesbury Road, South Woodford, E.18.

Student-Graduates.

John Hart Frith, Whittingham, Northumberland.

Frank Gordon Stuart Teunon, 18, Watson Street, Aberdeen.

Transfers :—

From Associate-Member to Member.

E. J. Williams, 5, Corporation Road, Grangetown, Cardiff.

From Associate to Associate-Member.

William T. Greenaway, c/o Asiatic Petroleum Co., St. Helens Court, Singapore.

From Graduate to Student-Graduate.

Percy B. Wells, 47, Thurleigh Road, London, S.W.12.

It is with deep regret we record the death at Glasgow on December 9th of Col. J. M. Denny, and we express our sympathy with Messrs. Denny Bros., of which firm he was Chairman, and with his relatives who mourn his loss.

Col. Denny was President of the Institute in 1900/1, and from his Presidental address delivered on January 21st, 1901, may be quoted words which are of significance to-day, "There is the greatest possible need of commercial ability now-a-days, far more so than in the olden days, for now in the great majority of cases engine building is no longer looked upon as a profession, it is more or less of a manufacture. The utmost must now be taken out of every tool. Every possible scheme for saving money without losing efficiency has to be closely examined. The efficiency of labour assumes a most prominent place."

A son of Peter Denny, LL.D—one of the founders of Denny Bros., and President of the Institute 1891/2—John M. Denny was born in 1858 at Dumbarton, where he received at the academy his rudimentary education. His subsequent studies were planned to embrace a commercial training, leading to a position in the office of the firm at Dumbarton, where he proved his worth and capability, ultimately attaining to the responsible position he held.

His interest was not confined to the shipyard and engine works, as he devoted his youthful energies to training as a Volunteer; also to local societies for social improvement and elevation of the mind, thus rendering himself a power for good.

He was M.P. for Kilmarnock Burghs from 1895 to 1905. By his connection with those employed by the firm, he took a warm interest in their well-being and was highly respected by all. As a member of the Employers' Federation and of the Clyde Shipbuilders' Association he was considerate to all with due regard to the necessities of the day.

By those who knew him personally he was highly esteemed and his friendship valued.

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Past President:—COL. JOHN McAUSLAND DENNY, C.B., D.L.