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Sediment in Marine Boilers, its bearing on Furnace Collapse.

BY MR. W. R. AUSTIN (Member).

READ

Tuesday, September 10, *at* 6 *p.m.*

CHAIRMAN: MR. B. P. FIELDEN (Vice-President).

The CHAIRMAN: I welcome you to this our first meeting on the re-opening of the Session, and it is a pleasure to have with us the author of the paper on the subject we have met to consider; the presence of Mr. Austin, who has come from a distance (Newcastle) enhances its value, and I have much pleasure in now calling upon him to read his paper.

ENGINEERS in charge of Multitubular Boilers will agree that sediment in such boilers is most objectionable, and anyone called to survey them looks with suspicion when he sees it present in abnormal quantity on its removal from the boilers.

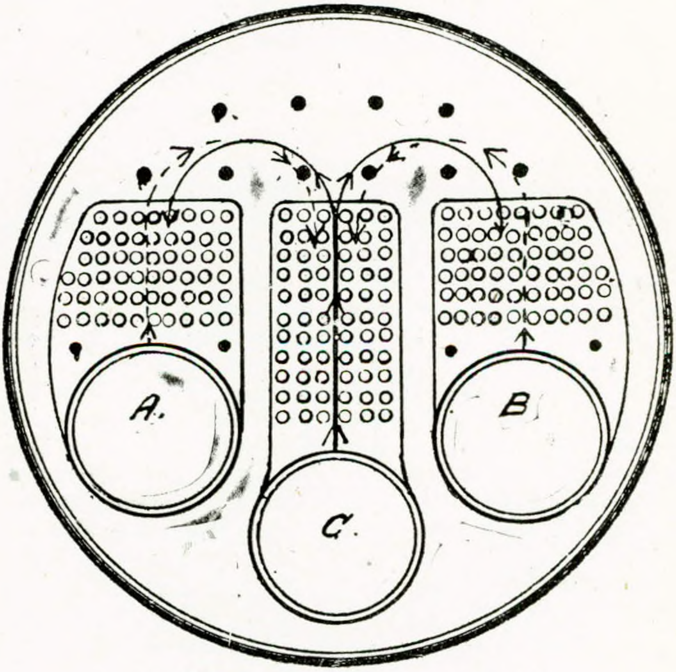
It not infrequently happens that furnaces become distorted without the cause or the occasion being known, and observations lead to the belief that not a few accidents of this kind are attributable to the presence of sediment. As enquiries have revealed the fact that many watch keeping engineers are but imperfectly aware of the dangers arising from its presence in the boilers, these lines are written to point out where the risk of accident generally arises.

If a vessel's boilers were always filled by hose from the shore the quantity of sediment found at the time of cleaning would be very much less. It is, however, not always possible to obtain such water owing to the absence of facilities, while occasionally one hears of an objection on account of the expense. "Needs must when the de'il drives." The ship must sail, so the engineer is obliged to fill his boilers from the dock or river in which his ship is then lying.

At such a time the water may appear quite clear as viewed from the deck, but appearances are deceptive. As an example, some double bottom tanks were filled with water from the St. Lawrence River as the ship was proceeding to sea. The water appeared to be clear, yet when the tanks were opened on this side several inches of silt were found on the tank bottoms. It must have come from the river, as when previously filled the tanks had contained sea water.

Blow-off cocks are placed so low down on the ship's bilge that in many docks they are in the immediate vicinity of the mud of the dock bottom, and boilers filled in this way always get with the water a certain amount of sediment. The engineer may have used every means in cleaning the boilers to ensure safety in working, but by filling them as indicated he nullifies to a great extent all his care, and admits a most insidious enemy. Once in the boilers sediment becomes a source of danger while they remain under steam. It settles down over the surface of the boiler bottom and its removal by blowing off from the bottom is not very effective, only that portion being ejected which lies within the stream lines of the flowing water close to the mouth of the blow-off pipe.

The first occasion I would mention where risk arises from the presence of sediment is in the act of raising steam. In this operation time is essential. The danger from racking strains caused by unequal expansion is so generally recognised that very few new boilers are now installed which have not the means of circulating the water within when raising steam. The danger to the shell is one which looms largely in the eye of the engineer, and ofttimes it is feared to the exclusion of another which he has overlooked. He circulates to save the boiler shell from undue strain, but in doing so brings into existence conditions which are detrimental to the furnaces. The movements due to the circulation of the water within the boiler disturb the sediment. It is thrown into circulation and flows with the water currents, whose course is liable to change with any local change of temperature. It thus becomes a menace owing to the variable temperature of the furnaces at such a time.



Sketch showing the flow of the water currents.

A specific instance of this is shown by the practice of many engineers who, when raising steam, light up the lower furnaces of a set of boilers before the wing furnaces; by this course avoiding as far as it is possible any inequality of temperature in the structure of the boiler shell. If the centre furnace only is lit when the circulation of the water begins, the water rises by convection from the furnace C as shown by the full lines on the sketch, and returns to the lower parts of the boiler via the wing furnaces. The comparatively cool surfaces of the nests of tubes in each of these furnaces assist in smoothing the path of least resistance for the falling currents of water. The sediment is carried by the water and a part of it falling between the tubes is deposited on the wing furnace crowns A and B. It lies there, and when these furnaces are lit up and generate heat, all the elements necessary to produce collapse of the crown plates are present.

In some cases a furnace so injured may remain unnoticed until it is subsequently examined. Then, on a search being made no trace of the cause of collapse can be found, as the sediment was thrown off when the plate became distorted.

To prevent injury in these circumstances, uniformity of temperature in each furnace is required, and it is suggested that the circulation of the water within the boilers should not begin until all the furnaces are lit and uniformly burning, as thereby the risk of sediment settling on the furnace crown plates would be minimized.

The next occasion on which sediment becomes a menace arises after the ship has put to sea. If rough weather be then experienced those who at such a time have blown through a gauge glass must have noticed that the water after blowing through is much discoloured. It resembles in many instances coffee "grounds." This is an indication of the state of the water in the boiler. The rolling of the ship has put the sediment from the bottom of the boiler into circulation, and its presence should be a warning to those in charge. Danger is not likely to arise while all the furnaces are uniformly generating steam, but when the time of cleaning fires comes round then care should be exercised.

Suppose that a centre fire is to be cleaned. The operation is a warm one and firemen delight in having the fire burned well down to the bars. If such an one has his way when the gauge glass indicates the presence of sediment, then the furnace crown, always at such a time comparatively cool, becomes a dangerous cooling surface. Hitherto the water and steam had been rising from the crown plate C. Now its course is reversed as shown by the dotted lines on the sketch. The wing furnaces A and B are generating steam rapidly and the water currents rise from them and then fall with corresponding speed on the furnace crown plate C, bringing with them in their descent the sediment in circulation.

The water currents with their burden of sediment always come down heavily over a furnace being cleaned if it has ceased to generate steam, and if the time taken in cleaning a fire is unduly prolonged the accumulation of sediment which settles on the crown plate may easily be such that on the fire becoming thoroughly alight overheating of the plate will take place.

When viewed from this standpoint the operation of cleaning a fire at sea is a most important one and should have close attention from those in charge. It should at the moment of cleaning be kept so bright and alive that it will generate steam, otherwise a critical situation is produced.

It will be evident that these remarks apply to all boilers of the multitubular type no matter what kind of fuel is used to generate steam. The course of the water currents within the boiler being determined by the temperature at which any one, or any combination of the furnaces is worked.

In the case of boilers using oil fuel, the oil is injected to the furnace through a burner or burners fitted to the furnace door. Where a single burner is used and this becomes choked or requires renewal the generation of steam in that particular furnace is temporarily stopped. The conditions then produced are in every way similar to those which obtain when cleaning a coal fire which has been burned down too low. The active heating surfaces become cooling surfaces producing within the boiler an alteration in the direction of the water currents, sediment when shewing will fall on the crown plate while the burner is being overhauled with every prospect of damage to the crown plate when it is again lit and commences to generate heat.

In vessels using oil fuel and running as at present under convoy, varying speeds are required and often called for. The engineer in the stokehold to save time and suit the steam production to the requirements of the engines frequently shuts off one or more burners to prevent the steam from blowing off. This method of regulating the steam supply, in view of what has been said, is a most reprehensible one and should be strictly prohibited. A uniform heat should be maintained in each furnace by regulating the supply of oil fuel from each burner as may be required for the lessened need of the engines. This course is absolutely essential where single burners are fitted. In cases where twin burners are fitted to each furnace then one of these may be shut off on all furnaces in a case of urgency; but the better course is to regulate the valves which control the fuel supply to the burners. By doing so uniformity of steam production in each furnace is maintained. Evaporation will be reduced, and the risk avoided which is always attendant on shutting off the entire oil fuel supply from any individual furnace.

A third instance where sediment may give trouble occurs when a vessel after rough weather arrives at an anchorage and the boiler fires are banked. The rolling of the ship has ceased, but the sediment is still in suspension in the water. If all he stop valves are then closed the tendency is to stop the circulation and check the rise of steam from the heating surfaces. With banked fires the furnace temperature has fallen considerably, the upward movements of the steam grow more sluggish, and one can conceive a point being reached when steam may be generated on a furnace crown plate and remain there because of the insufficiency of heat necessary to throw it off, backed by the lack of movement in the water. In such circumstances the sediment in suspension falls on the crown plate and becomes a menace. Instances have occurred where loud reports were heard in boilers lying under banked fires, and after the report there was heard gurgling up to the steam space a considerable volume of steam. One can only speculate on what caused the report. It may have been due to a sudden inrush of water on a part of the crown plate which was slighly overheated. As the crown plate was not distorted one naturally asks what could have disturbed the sediment. The probability is that owing to the conditions of temperature existing at the moment, steam may have been generated but had not left the surface of the plate, and over this had fallen a slight coating of sediment arresting it and causing the steam to be isolated and insulated. As it absorbs more heat it ultimately bursts the enveloping sediment, thus admitting the water to the overheated surface and causing the report. The writer has frequently heard such reports when boilers were under banked fires. The boiler pressure was 90lbs. and in no instance was damage found in the furnace at that pressure. With higher pressures and greater density and temperature of steam accidents have occurred while lying under banked fires, and for this reason the danger is pointed out.

As a means of avoiding the risk of accident while lying under banked fires, steam should be used for a considerable time after banking has taken place. By doing so, steam generated is drawn to the steam space and the water is kept in circulation until such time as the sediment has settled on the boiler botton. Fires should always be banked at the front. If banked at the back, a large part of the surface of the furnace crown plate is exposed to the cold air and thereby downward currents are induced in the water within the boilers which may lead to a deposit of sediment on the crown plate.

It is worthy of note that distortion occurs more frequently to furnaces of extreme than to those of small diameter. As the plate thickness is determined in the patent types of furnace by the diameter, and the rule used gives an ample factor of safety having been fixed after exhaustive hydraulic tests, it follows that the question of strength does not here arise. Furnaces of all diameters are equally liable to collapse if solid saline matter is found abnormally thick on the plate. That furnaces of extreme diameter suffer more than those of small diameter when no scale is present, appears to be induced by their form. They have a broader back and falling sediment will settle and remain with greater certainty, until disturbed, on such a crown plate than it will on one of small diameter. Given similar working conditions in boilers fitted respectively with small and extreme diameters of furnace, any other deleterious matter present would affect the smaller diameter equally with the extreme diameter, and the predominance of accidents with furnaces of extreme type is a proof that the cause of accident is a movable one and produced by a change of temperature at the sources of heat. This causes a deposit of sediment on the crown plate, and on a restoration of normal working conditions the plate becomes overheated.

As already stated, a knowledge of the action of water within the boilers when at work is not generally known, nor are the dangers fully appreciated. The subject might well form part of the viva voce examination held by the Board of Trade when granting engineers certificates. This would lead to a general consideration of the subject and bear fruit (if one may say so) in reducing the number of such accidents.

Furnace troubles are like a disease, contracted by defective arrangements and lack of care. It is present and demands attention but prevention is the better way. Exclude the sediment from the boilers and the trouble will not arise. It is even now entirely a question of ways and means and the exercising of reasonable care.

In existing vessels it is suggested that a test cock should be fitted at the blow off cock level. By using this, water drawn off in a glass would shew if the water outside the ship was such as could be used for filling the boilers. If mud is present then the means of filtering could be improvised as the water was being pumped into the boilers through the upper manhole.

In new vessels the following suggestions if adopted would eliminate the risk arising from the presence of sediment.

The blow-off pipe should only be used for blowing off and not for filling the boilers. This can be done by fitting a non-return valve on the blow-off pipe permitting the water to be ejected from the boiler, but preventing its admission through this pipe.

Water for feeding or filling the boilers in port or when the water is muddy should be filtered. This can be attained by a filter (with a locked by-pass for use at sea) being fitted between the donkey pump sea cock and its suction valve chest. If more than one pump can feed the boilers each should draw from a tee piece on the bottom of the filter.

From the boiler circulating valve on the donkey pump suction chest the circulating pipe should be connected to the blow-off pipe between the non-return valve above mentioned and the blow-off valve on the boiler. Through this pipe the boilers can be filled by running up from the sea via the filter, or the water in them can be circulated when raising steam as may be desired.

This paper had its inception in observations on furnace accidents extending over a considerable period of time in various districts. To the individual marine engineer these accidents may not appear of much importance, but when viewed collectively by the underwriter's surveyor or the surveyor for classification they become of very great importance, and the cost of renewing and setting up furnaces damaged by overheating, combined with the loss of ship's time, amounts, at a low estimate, to a national loss of a serious nature, and one which demands consideration. There is no body which can so well give this consideration as the Institute of Marine Engineers. They are directly interested in the subject, and as the theory put forth in the paper bears directly on the question of the overheating of furnaces, it is hoped that the discussion will be such as to demonstrate wherein the danger lies, disseminate a knowledge thereof amongst sea-going engineers, and thus minimise the number of such accidents, thereby averting from the country as a whole what is now a serious national loss.

The Chairman: We are indebted to Mr. Austin for an interesting paper on the above subject, and the thanks of the Institute are due to him for writing it.

Sediment in boilers is a subject which our sea-going members will be interested in and know something of, and I think some of them would like to contribute to the discussion of the paper. I therefore suggest that some time be allowed to elapse before the discussion is closed, and I have no doubt that our Hon. Secretary could arrange for this.

The Hon. Secretary: Certainly. The paper will be published in the Transactions as soon as can be arranged, with part of the discussion, and contributions afterwards received from members may be included in later issues. I have contributions to read from two members who are unable to be with us to-night, Mr. Jas. M. Dewar and Mr. J. Paterson.

Mr. Jas. M. Dewar: I am sorry I will not be able to get to Tuesday night's meeting. I should have liked to have been present at the opening of the session. I have read Mr. Austin's paper with much interest, and must confess I had no idea that so many dangers confronted the Marine Engineer from sediment in his boilers. I take it, however, that it is only in cases of abnormal deposit on heating surfaces that such dangers arise, and one would expect in these days of high pressure that the sludgecock was used only for blowing down, and not running up. Fortunately, in my time at sea we were always provided with fresh water by hose from shore when in port, or by water-boat during voyages to the East, so our anxiety regarding foul heating surfaces from outside matter was thus prevented as far as humanly possible; in fact, I have no recollection of outside water being admitted to the boilers from any other source except a small quantity of salt water on one or two occasions. Mr. Austin does not deal with water tube boilers, but I recollect on one occasion a vessel fitted with Belleville boilers, after running her trials, went to load at Newcastle.

Evidently, water for boilers could not be supplied from shore where she was lying. The boilers were pumped up from the river, but unfortunately the bilge of the ship was on the mud, unknown to the engineers. Upon setting the fires away little or no steam was forthcoming, and could not be raised at any cost of fuel. The reason for this was afterwards discovered, being that the tubes were solid with mud, and what moisture there had been with it was rapidly evaporated. Nothing happened, however, but it took some 14 days to bore the deposit out of the tubes! I hope you will have a very successful meeting.

Mr. Jas. Paterson: We have to thank the author for a very interesting paper. My experience of marine boilers is that it is impossible to keep them clear of sediment—it gets in somehow, be as careful as you like. I have never seen a filter that prevented oil getting in to some extent. I used to run boilers for six months at a time, and on opening up regularly found a thick sediment round the shell at water-line. I am a great believer in filling a new boiler up with salt water; after that supplement with distilled water for the rest of the voyage. The salt water closes up the shell seams if they are inclined to leak. There is no doubt that a lot of damage is done to a boiler on the trial trip—everything is over-strained. I have known a new boiler filled up with dirty river water, and after the trial trip sent on a voyage. The chief engineer afterwards gets the blame if anything goes wrong. I have re-filled a boiler after cleaning, with clean, fresh water, then kept it supplemented with distilled water. The next time I opened the boiler I found the furnace crowns red with rust. A little sediment is better than rust. A boiler should always have some density; a thin scale on the furnace crown prevents rust and pitting. When I first went to sea we had boilers of 50 lbs. pressure, and after cleaning the boilers we used to wash the furnace crowns with thin Portland cement, so as to prevent pitting and rust.

Mr. Robt. Balfour: This paper is on a subject which is of great importance to Marine Engineers, and I am afraid the matter has not received the consideration it deserves—particularly on vessels engaged in trading to ports situated on river banks where the river water contains vegetable and other matter, and is frequently used for filling the boilers and double-bottom tank, some of the water in the latter being subsequently used to make up feed for the boilers during the voyage. The mud found in the double-bottom tanks when examined proves the dirty condition of the water; it is true that in some instances precautionary measures are taken by keeping the auxiliary feed pump suctions well above the bottom of the tank, but the rolling and pitching of the vessel mixes any sediment with the water. Many years ago at Calcutta it was the practice to filter the river water in a specially constructed barge before pumping it into the boilers; the chief trouble in connection with this operation was to see that there was no by-passing of the untreated river water into the feed. In connection with this, I think a quantity of alum was mixed with the water. I agree with the author's remarks with reference to blow-off cocks and their position, also with the suggestion at the end of the paper that a non-return valve should be fitted to prevent filling the boilers through this source. In all cases where clean water is not obtainable it should be passed through a gravitation or other filter before being pumped into the boilers.

The author, in his remarks on water circulation, touches on "the practice of many engineers who, when raising steam, light up the lower furnaces of a set of boilers before the wing furnaces." This old idea or practice is, in my opinion, an objectionable one, as it must tend to set up an undue strain on the front end plates. The sketch showing the flow of the water currents by convection is in accord with the author's description of the action of the water under certain conditions, but, of course, does not represent its course under normal work, the downward currents then being chiefly by the wide water spaces next the shell and between the next of tubes.

The application and regulation of heat in the furnaces is important, as is also the reference to the risk of trouble occurring when boilers are under banked fires, precipitation of any matter held in suspension in the water then takes place, a quantity of which will lodge on the furnace crowns, and when the fires are again set away the furnace crowns under these conditions are apt to become overheated and result in distortion before circulation of the water takes place. With reference to banking of fires, opinions differ. I believe in banking at the front both with natural and forced draught systems; in the former, close-fitting ash-pit doors are necessary, and in the latter the valves should be made as air-tight as possible. Too much attention cannot be given to the fit of these valves.

The suggestions offered by the author in his closing remarks are valuable. I thank Mr. Austin for his interesting paper.

Mr. James Shanks: I am sorry I did not take the same trouble as Mr. Balfour in jotting down my impressions of the subject before us, as I believe it is the best plan. I have often found furnaces distorted without any internal evidence in the boilers to show the cause. In his paper Mr. Austin has given an explanation for many of these mysterious distortions, and has recalled to me an experience I had of a steamer which had discharged at a Continental port where the boilers had been cleaned and examined, and no defects were then revealed. On the vessel's arrival in London I was called upon to survey her, and on examining the boilers, much to the surprise of all concerned, every furnace was found to be deflected, and there was no evidence as to the cause, the internal surfaces all being clean and in good condition. On inquiry it was found that the boilers had been filled from one of the ballast tanks which was supposed to contain clean water, the chief engineer being dissatisfied with the river water. To discover the source of the trouble, we made an internal examination of the ballast tank from which the boilers were filled, and found a heavy deposit of sediment in the bottom, proving that the boilers had been filled with water containing a large percentage of sediment, which had acted detrimentally on the furnaces during the short voyage to London. That is one instance of deflection of furnaces by sediment, and illustrates the danger of using water from ballast tanks the quality of which has not been tested. I agree that it is dangerous to fill up boilers by the blow-off cocks, and there should be means to prevent this being done.

The author does not deal with density, but I may relate an experience I had in my earlier years at sea. The chief engineer was a great believer in never blowing down the boilers to reduce the density, even when it exceeded 4/33rds, and I have seen the salinometer almost jump out of the pot. This was before the days of evaporators, when the only make-up feed was from the sea. He rightly held the view that the less salt water passed through the boilers the less the scale on the heating surfaces. He, however, always took precautionary measures as soon as steady steaming ceased, and consequently circulation of water in the boilers, to reduce the density to prevent any deposit of salt on the heating surfaces. The result was very slight scale on the heating surfaces, although the density of the water was very high. On one occasion, however, on a voyage from India the boilers had been filled on the Madras coast with pure sea water, and during the voyage to the Suez Canal the blow down had never been touched. The ship was delayed several days in the Canal, and the water in the boilers was not changed. On arrival in London the boilers were opened up for survey, when it was found that all the furnaces were deflected on account of a heavy salt deposit on the crowns, but the scale was not excessive. This is an experience I had nearly 40 years ago, and illustrates the danger of sediment in boiler water. There are many points in the paper which deserve the consideration of all Marine Engineers. It is a well-known fact that furnaces of large diameter are more liable to deflect than smaller ones, and the author's explanation as to the cause is reasonable. In large furnaces, however, better combustion is always obtained, and the more intense heat in the fire may tend to make the furnace more liable to yield.

Mr. S. G. Martlew: Taking the broadest view of our subject, one may say that "Sediment is the matter which subsides to the bottom of water or any other liquid." I hold, therefore, that sediment comprises not only solid impurities, such as sand, but scaly or chemical matter of any description, including heavy grease. Except when freshly distilled, all water contains sediment of some kind, and should hence be dealt with before entering the boiler. Apart from electrical or chemical means, the best way of effecting this, in my own practice, is by passing it through a quartz sand filter, which can frequently be cleaned by reversing the current. Owing to weight and bulk of such an apparatus it is rarely adopted on shipboard, where impurities are in evidence in the feed-water filters such as we generally carry in the engine room when we change the cloths or other straining medium.

The worst experience I have had with sediment in marine work arose out of an order given to fill up tanks, etc., from the turbid Mississippi River, in which the vessel was then lying. I was junior engineer at the time, and was surprised that no attempt was made to prevent the entrance of silt. Fed from such a source, the boilers steamed many thousands of miles, and some furnaces collapsed. Too much oil for internal lubrication was used, and I am persuaded that this, in conjunction with the river deposit while standing under banked fires for several days, had collected on the crowns and brought about their failure.

In the Far East years ago I was called in to survey a boiler which the native owners complained "would not go." I found that salting up had occurred to such an extent as to fill up practically all space between the individual tubes; and enquiry elicited that sea water had always been pumped in, and the blow-off cock never used, until steam could no longer be generated.

More recently, among the appliances under my charge were some Ross-Hotchkiss circulators, each fitted to a large horizontal land boiler; these are having much success also in marine installations, as sediment is thereby collected in a spherical vessel from which it is discharged at suitable times, thus saving the heating surfaces from harmful deposit. This apparatus is *external* to the boiler; for collecting impurities *inside* I have successfully tried pans or troughs over which the feed water passes on entering, and a great deal of the danger pointed out by the author in his valuable paper has thus been avoided.

By having tubes in *water-tube boilers* as nearly vertical as possible, sediment or any scale-forming matter tends to slip down easily to settle in the bottom headers instead of as in the more horizontal type, stopping in the tubes and causing bulging, or "bagging," as the Americans call it. Prevention of admission to such boilers of any deleterious matter is naturally of considerable importance, but, despite every care, in very few cases are they absolutely free from sediment.

Mr. Wm. McLaren: I am pleased to see the paper is short and crisp, and I am also pleased to see so many members of Council here to-night, including the Chairman. But to come to the paper: the first thing that strikes me is the reference to the supply of shore water; next, the water tube boiler has been brought into the discussion. It is a great temptation for the chief engineer, when fresh water is not obtainable except by water-boats, involving cost and delay, while lying in river, to fill up with the river water when discharging and loading with quick despatch. Drastic measures are also necessary to get the boilers cleaned to keep to time. Of course, the boiler water under such conditions suffers owing to mud and dirt accumulating. Take, for instance, a fruit carrier, with a day here and a day there. Unless the chief engineer has more than one boiler to change over to allow the chance of cleaning the boilers out alternately, say, in a six weeks' run, there is no reasonable time for opening up to clean and examine boilers. Therefore, one can sympathise with any engineer who has to run a steamer in such a trade. The water of some rivers in the north of Spain, though tainted with copper and iron ores, has been found to be good for boiler water. While a junior I had the pleasure of being with a chief who made a particular study to test the water daily from the Tyne to Spain, and on one particular Sunday we drew fresh water in the Bay 18 ft. below the water line. He wrote a pamphlet on his experiences —Mr. Fothergill it was, who afterwards became Superintendent of this company on the North-East Coast. In regard to the circulation of water, while raising steam in boilers, I prefer to use a pump to circulate the water, taking it from the bottom of boiler and through the feed check valve, and have found it a complete success. The author recommends that the fires should be banked in the front of the furnaces; I cannot agree with him. I should say "bank up to the bridge; keep the brick bridge as hot as possible." Any air that enters the furnaces gets heated, therefore the tube plates are kept at the best possible heat, while there are few leaky tubes. As to the burning of fires, say we have a four-furnace boiler; set the two bottom fires away, then circulate with the feed pump, drawing from bottom of boiler and pumping through feed check valve. This method has given every success, preventing any undue strain from cold bottoms and hot tops while raising steam.

The firing of boilers is a hot job, and I sympathise with the firemen to a considerable extent when doing their best to get the steam, which we have to use to the best advantage. In my first examination before the Board of Trade, Mr. Lewis, the examiner, brought out a bottle of salt taken from a ship's boiler to show me what the neglect of not blowing down did cause; so that proved to me you can "salt up"; but please note it is not "scaling up," as the two conditions are quite different, though both injurious in boiler treatment. Even well water in the South of London is from 25 to 30 degrees of hardness, and in the North 5 degrees of hardness, on which latter we can run a large Lancashire boiler for twelve months, and one man can clean it out in three hours; the former would take six men twenty hours, and if the water was left in the boiler for six months, without work, it would bore holes through the plates; this water leaves very little scale behind.

Mr. Shanks: Great care must always be taken in the use of dock water, no matter how good it may be supposed to be. I have found the water in the Victoria and Albert Docks good at light draughts, but dangerous to use in a laden ship from deposits in the dock bottom. These remarks apply only to feeding the boiler in use while in dock. Good clean fresh water from shore should, however, always be used in filling the boilers for the voyages, and no other water should be used as a feed after they are filled.

Mr. G. Jas. Wells: I cannot approve of questions set in examinations for B. of T. Certificates upon matters of opinion, except possibly in the highest grade. In adjudicating upon answers to such questions, the personal views of the examiner may lead to bias in favour of a certain school of thought rather than an independent examination of the problem from all points of view.

As pointed out by Mr. Martlew, there are two classes of sediment to be considered—*i.e.* (*a*) mechanical and (*b*) chemical. With regard to the former, if the source of water supply contained sand, etc., in suspension, then if possible an opportunity should be given for settlement by gravitation and subsequent filtration. The secret of success in the elimination of the precipitate by gravitation is to arrange matters so that there is time for it to take place. The velocity of the current should be as small as possible; settling tanks should be provided if possible, so that there is no current. Similarly with filters, the rate of flow is frequently accelerated in order that the capacity may be increased with a resultant loss of efficiency.

The chemical deposits, however, are the more serious from the boiler superintendent's point of view. As is now well known, it is simply a question of temperature where the impurities are thrown out of solution if the water is fed into the boiler without previous treatment.

Almost every engineer has at one time or other had the matter forced upon his attention in the form of internal feed pipes becoming choked with deposit or by an abnormal amount of scale in boiler near the feed inlet.

To avoid the trouble, it is necessary to treat the water chemically and removing the scale-forming matter before it is fed into the boiler, or so arranging the feed water scheme that it is raised to a temperature of 212 degrees on its way to the steam boiler, so that all the scale-forming matter may fall out of solution before the boiler is reached.

Arrangements have been used in land boilers, so that the feed is introduced into the steam space and falls into a tray from which it overflows into a second tray; and thence into a third tray; finally it falls into the water. In each cascade it takes up heat from the steam and deposits any precipitate in each of the trays as it is formed. But at sea the motion of the ship and the longer periods of steaming customary would probably prevent any such scheme succeeding. But possibly the introduction of the feed into the steam space in the form of a very fine spray without the trays would tend to remove the local cooling effect due to internal feed pipes. On the Great Western Railway, where softened water is freely used, this system of feed is in general use.

The circulation of the water in boilers is very important, and the more rapid motion of the water tends to sweep clean the boiler surfaces and promote evaporation. The author calls attention to this point, and Mr. Churchward has also pointed out that a change in the method of firing may *reverse* the direction of the circulation in the locomotive boiler. The experiments in circulation by Yarrow, Thornycroft, Prof. Watkinson and others are very suggestive to the student of boiler working, and although they refer to water-tube boilers, they illustrate the principles and laws of circulation, which are universal in their application.

The CHAIRMAN: Mr. Austin is undoubtedly aware of what Marine Engineers are doing at the present time, and that it is impossible for the majority of our members to attend the meetings to hear the papers read, but I can assure him that his paper will be discussed by them when they are off watch or temporarily released from the great work upon which they are at present engaged, namely—the saving of the British Empire.

I think it is one of an engineer's principal duties to see that the water which is put into the boilers is good and clean. It was a surprise to me to hear that boilers were at the present time filled through a blow-off cock, and it appears to me to be absolutely wrong to do so, because the engineer does not know what is going into the boilers. I was under the impression that all ships were fitted with a pump which could either put water into the boilers or on deck, and if river or dock water was to be used for filling the boilers after they were scaled the water could be pumped on deck first, when it could be examined for its suitability for use in the boilers. In my opinion it is false economy to use dock and river water for boilers. The cleaning and repair costs are thereby increased, the boilers have to be opened more frequently, and there is a higher consumption of coal, due to inefficient heating surfaces.

Prevention is better than cure, and the prudent shipowner pays for proper water and fits evaporators and filters in his vessels.

With the best arrangements that can be provided, some solid matter deposits itself in the boilers, as condensers will sometimes leak or evaporators will occasionally prime, and fresh water invariably contains some solid matter. I have personally found it an advantage to filter the fresh water both at sea and in port before allowing it to enter the boilers, and on several ships had two filters, one of the gravitation type on the suction side of the pumps, and the other of the pressure type between the pumps and the boilers, and I think that both were good investments and justified their installation by catching oil and sediment.

I think it is wrong to light one of several furnaces in a boiler when raising steam, because of the strains thereby set up through unequal expansion.

In regard to the deflection of furnaces, I am of the opinion that there are causes other than that suggested in the paper. The difference in the temperature above and below the firebars must cause the top half to expand more than the bottom half in a fore and aft, as well as in a circumferential direction. The load due to expansion is resisted by the back tube plate and front end plate. Supposing the plates are so stiff that they do not alter shape, then the increased length of the furnace must be absorbed by the corrugations. It is my opinion that the corrugations do alter shape, and continue to do so without any ill results until the metal becomes fatigued, when gradual deflection begins. Many cases have been known of furnaces being deflected or out of circularity, and remaining in that condition. Does this not prove that the furnaces had taken a shape which they were forced into and which allowed them some freedom? My experience is that the nearer the tubes are to the furnaces the more trouble there is with the latter, either by deflection or by cracking at the place where there is the most stretching of the material.

Furnaces have a great amount of work to perform under the best of conditions and have to withstand rough usage when fires are being cleaned, also when raising and lowering steam, and in my opinion should be given a fair chance by being kept as clean as possible, and by every care being taken that the water used is good and pure.

I have great pleasure in proposing a vote of thanks to Mr. Austin.

BY CORRESPONDENCE.

Mr. J. B. Harvey: Mr. Austin, in his paper on Sediment in Marine Boilers, has given engineers who are in charge of boilers a good reminder of troubles that are likely to be caused through not sufficient attention being given to the water with which he is filling his boilers and using for feed after they are working.

The author mentions in his paper that boilers are often filled through the blow-off cock; I was not aware that this was ever the practice. Anyone doing this is only looking for trouble, and deserves all the trouble he gets, as there must be other means by which he can fill his boilers without the possibility of filling them with a mixture of mud and water. If the owner will not allow fresh water to be used, and will not provide means by which mud and water can be prevented from entering the boilers, the folly of his ways should be pointed out to him by those responsible, so that he may be saved the risk of having to renew the furnaces before they are any age. The majority of ships, I think, are fitted with evaporators; why not use this means of filling boilers if fresh water is unobtainable? It would be an easy matter to have the evaporator cleaned again ready for use at sea while steam is being raised; the result would be that you are starting the voyage with perfect water in your boilers without any fear of sediment falling on the heating surfaces whilst raising steam, and the extra feed required can be usually kept up by using the evaporator, that is, if the engineer is careful about stopping all the small leaks which are likely to occur at all times in the engine-room and other parts of the ship.

When ships are fitted with means of circulating the boilers and have a feed heater, it should be arranged that the water can be put through it before the fires are lighted; the water in the boilers can then be brought to a temperature sufficiently hot to prevent any undue strain being caused by unequal expansion, and the practice of some engineers of lighting the low furnaces first need not have any consideration; all fires should be lighted at one time and allowed to go very slowly until the boilers have at least 50 per cent. of the working pressure on them.

I quite agree with the author that cleaning a fire at sea is not always supervised, as it should be, not so much that the fire is burnt down too low, but because cold air is allowed to continue blowing down a ventilator in the vicinity of the fire which is being cleaned. All stokehold ventilators should be fitted with a damper that can be shut from the stokehold plates, so that they can be shut before starting to clean any fire, thereby preventing cold air rushing into the furnace and combustion chamber. I do not agree with the author that furnace trouble is all caused through the sediment collecting on the furnaces; it is often caused through faulty design.

Mr. AUSTIN's reply: Mr. Chairman and Gentlemen,—I beg to thank you for the kind reception you have given to the paper. As the discussion is not to be closed at this sitting, I would ask Mr. Adamson to be so good as to send me any further criticism which may come to hand, and I will reply thereto at a later stage.

So far as the discussion has gone, the impression conveyed to my mind is that accidents to furnaces are much more numerous than is generally known. Most of the gentlemen who have spoken have gained their experience from liner vessels, well fitted, and trading between ports where ample facilities exist for obtaining supplies of fresh water for their vessel's main boilers.

Even so, the boiler furnaces of liner vessels are not exempt from accidents to the furnace crowns caused by overheating, and it is obvious that if the furnaces of such vessels suffer, other vessels of the Mercantile Marine—generally designated tramp steamers—gathering their freights in the by-ways of the sea, must be more liable to such accidents when trading to ports where facilities do not exist for obtaining pure fresh water.

The Chairman, in his criticism, remarked that the difference of temperature of the furnace above and below the bars was a cause of deflection in many cases. Corrugated furnaces having, as most have, a large and easy radius at the flange connecting them to the back tube plate, should easily take up the movement indicated by the difference of temperature and the linear co-efficient of expansion. If this were a cause of collapse all the furnaces of a given set of boilers would suffer from it, but it is shown from experience that we may have distortion on only three furnace crowns, while the other six furnaces in the set of boilers remain unimpaired. If difference of temperature is the cause of such accidents, why are the uninjured furnaces not affected, seeing they are working under the same conditions as those which were damaged? It is obvious from this that the cause of collapse is a variable one, not inherent in the furnace itself, but arising from the conditions under which it has been worked.

The question of density in relation to such accidents has been mentioned. To the credit of the engineers of the Merchant Navy let it be said that accidents to furnaces arising from excessive scale deposit are not now numerous. When they do occur the evidence is always left behind to show that cleaning had been neglected. Personally, I am in favour of using a little salt water in marine boilers. In my opinion, it has a more intimate touch with the active heating surfaces than distilled water, or water in which large quantities of soda have been dissolved.

Mr. Shanks, in his remarks, shows the nature of the accidents to which the paper draws attention, and the case he quotes is a typical one of many which are constantly occurring, and which can only be explained by a variable temperature in the furnaces combined with the presence of sediment in circulation with the water of the boilers acting as shown in the sketch attached to the paper.

Mr. Wells, in his remarks, is very dogmatic in regard to the suggestion made that engineer candidates' knowledge should be tested at his examination. At the conclusion of his remarks he states that the principles and laws of circulation are universal in their application. If this is so, why should he object to a candidate for a certificate of competency being examined thereon? The examiner is dealing with facts, not with fads. It is absolutely necessary, if the evils of furnace collapse are to be overcome, that every engineer should, even where the action is unseen, as in a main boiler, be able to realise that a given *cause*, such as burning down too low when cleaning a fire, or shutting off the oil fuel supply from one furnace and leaving it on others, will produce a change in the currents of circulation within the boiler; and if sediment is present it will be deposited on the furnace crown plate and produce the undesirable *effect* of distortion by overheating.

With reference to the remarks on feed water, I cannot see how chemical appliances could be installed on board ship for its treatment. Ships are built and run to earn money. Such an installation would be costly, occupy valuable space, and in probably unexperienced hands give negative results. The only satisfactory method of purifying feed or sea water for boiler use is by separation and/or filtration.

Mr. Harvey, in his remarks, suggests that where fresh water is not obtainable from the shore the boilers should be filled from the evaporator. This course would necessitate the fitting of a condensing plant, and rather neglects consideration of the question of time. If only a 20-ton evaporator is fitted on a large steamer and 120 tons of water are wanted to fill the boilers it would involve a serious delay, even where a large donkey boiler was fitted on board to generate the required vapour.

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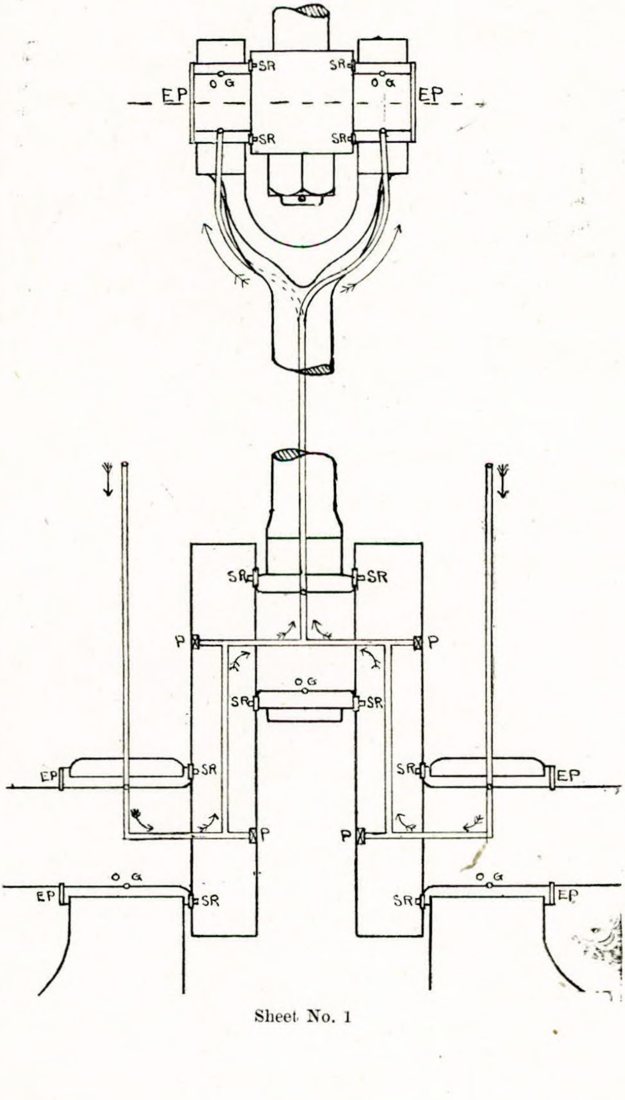
Oiling System and Bearing Designs.

By Engr.-Lieut. A. E. WINDRAM (Member).

This subject is introduced to bring before the members the very bad practice that still prevails in our drawing offices among the designers of the present day modern type of bearing —inefficient designing. Bad practice can be traced to our poor system of education, meaning that practical and theoretical training must be combined in the members of the drawing office staff, so that the draughtsman knows at once whether it is possible to machine, assemble, etc., the particular detail he is committing to paper.

The writer has picked out this detail during his observations while on duty in the engine room as an illustration of where the designer ashore pays too little attention as to the design of main bearings, crank pins, brasses and crosshead brasses. How many of these bearings are so designed that if an egg-cup of engine oil be placed in the oil pipes or boxes leading to these bearings the oil will remain in the bearings? Is it not the case that the oil oozes out through the sides, and so goes to waste, without having done its proper duty, viz., to lubricate the bearing? We may say not many seconds, because the bearings will not retain the oil, and consequently more oil is used than what is actually required to lubricate these bearings; therefore, all surplus oil goes to waste into the crank pits, etc. Thus do we progress! The writer has noticed no sign of improvement in this respect since making his first voyage to sea in 1907-8, and yet has made several voyages on up-to-date passenger liners, and of recent construction.

The thought has occurred many a time when watching the greasers oiling round, "When to goodness will somebody design a set of reciprocating marine engines where the greasers will cease to try and catch the speed of the crosshead bearing oil boxes and bottom end bearing oil boxes adjoining, in their endeavour to drop a quantity of oil into each when they imagine the oil boxes to be on top centre." As a rule, the oil starts its downward path either just before or just after the crosshead reaches top centre; if before, the oil is buffeted all over the place by the oil cup or tray smacking the oil severely; if after the crosshead has passed the top centre the oil does its best to race after the receding oil cup, and is assisted by the partial vacuum created around the oil cup by its sudden downward passage, so again the oil is sprayed all over the place by the sudden downward swoop of the crosshead. This is where the oil comes from that is found burnt on to the bottoms of the cylinders, hanging on and dimming the electric lights situated by the crossheads and fixed to the middle gratings; also the oil dripping off the bars of the middle gratings on to the bottom platform, and running down the connecting rods, eccentric rods and columns, passing finally around the bed plate into the bilges. This oil, anywhere between 30 per cent.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Sheet No. 1

and 50 per cent. of the allowance, has never had the remotest chance of getting into a bearing, but has simply been brushed or swept to one side, and so wasted, through the lack of a little foresight in the drawing office when the bearing was designed. Such questions as, "Will the bearing be a good oil container?" and "What is the best way to put the oil, or get the oil into the bearing?" seem never to have been considered, nor the unnecessary trouble and care caused by want of practical consideration.

The design where the oil cup is made to come in contact with a well oiled worsted is a fairly good positive idea of putting oil into a bearing, provided the worsteds always touch the oil cups: but do they? is a pertinent question enough to make the designer provoked. If the worsted is perfect and the oil finds its way into the bearing it is intended for, will the oil stay in the bearing and do its work properly, or gradually find its way to the side and ooze out into the open? More than likely only about half is used probably; this is another question for the drawing office to consider. There should never be any "buts" or "ifs" in our drawing offices. A machine is either designed correctly or it is not; there is far too much of "That is near enough," or "This will do; it has stood up so far," yet there is that feeling of doubt, "It will do, or it will not do," should always be the answer, and the practical men must see and stop being let down by evasions and urge the designers to pay plenty of attention to details, and not go by the general look of things, or use and wont.

The writer by a few rough sketches indicates an idea how it is easy to make the majority of existing main bearings, crank pins, bearings and crosshead bearing brasses, oil-tight, on nearly any reciprocating engine, or, in fact, any bearing that requires to have good, careful oiling, by means of drilling crank webs into oil rings or grooves turned round the centre of journal, and corresponding oil ring or groove in centre of brasses connected with pipes from brasses to brasses, which are made oil-tight by sealing rings on ends of brasses.

The first sketch on Sheet No. 1 shows the general outline of an oiling system and bearings that will retain the oil by means of sealing rings (S.R.) and end plates (E.P.), shown in sketch. The bearing journals have oil grooves (OG) turned in centre of journals, as indicated by small circles, half-circle groove in journal and corresponding half-circle groove in bearing. The main bearing and crank bearing journals are drilled from oil grooves to centre of shaft, and the shaft drilled longitudinally to meet vertical hole in journals; the centre holes in shaft have the ends plugged (P).

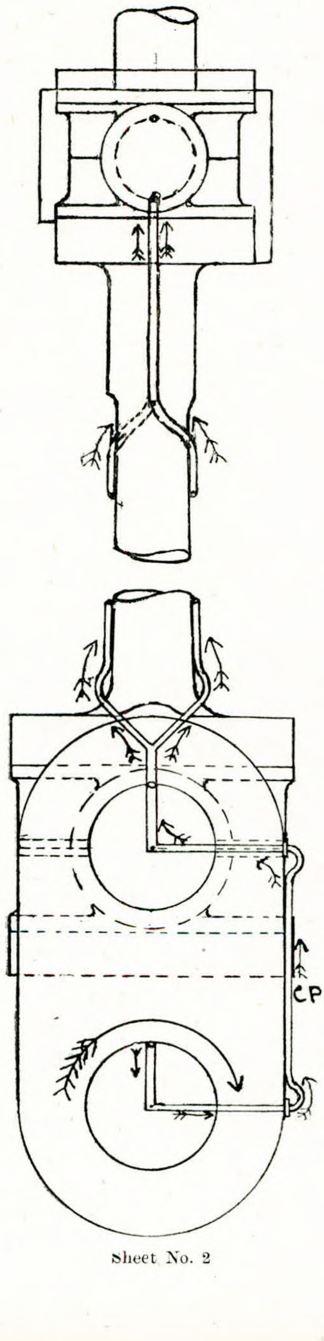
Then on Sketch No. 2 the crank webs are shown drilled horizontally from edge of web to centre; the main bearing oil hole is put into connection with the crank pin oil hole by means of a connecting pipe (CP), which is bolted to the outside of crank web; as the process of drilling through the crank web from the crank pin down to the main bearing journal oil hole is more difficult, therefore the pipe (CP) is used as shown. Also the large arrow of rotation from left to right shows the pipe (CP) as leading the crank when running, so that any centrifugal effect will cause the oil to flow towards the crank journal.

The sealing rings (SR), as shown on Sheet No. 1, are let into grooves turned in the sides of the crank webs, also holes are drilled in centre of the grooves to receive the pegs at the backs of the sealing rings, so that the rings cannot turn round with the brasses, but act as scrapers; having slight springs on the pegs at the back, just forcing the rings on to sides of the brasses, a slight recess is turned on the sides of the brasses for the rings to run in, thus attempting to make a good running joint and stop all leakage of oil.

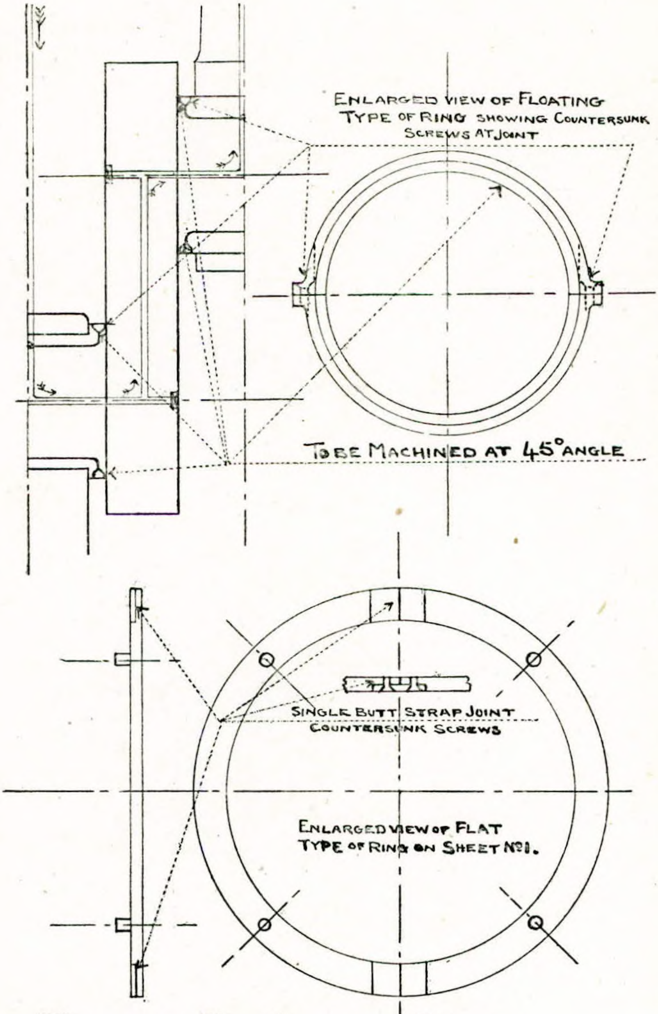
A larger view of a sealing ring is shown on Sheet No. 3, termed a flat type of ring, showing the ring built up in halves with two flush joints, also four pegs to keep ring in position. On Sheet No. 3 is another view of a floating type of ring showing a V section sitting in a groove, one side running on the journal and the other on the brass, built in halves, and can be fitted and adjusted, yet free to float round either with the journal or brasses, and keep oil tight.

Referring again to Sheet No. 1, it will be noticed that the main bearings have an end plate (EP) fitted that sits in a small groove or recess in the shaft and bolted on to end of brass, thus sealing up the oil and stopping any leakage along the shaft, then if found necessary a ring could be fixed to the shaft just touching and jointing with the fixed ring on end of brass; in fact, there are innumerable ways of sealing up the ends of the main bearing brasses. The crosshead brasses have end plates bolted on, and so seal up the bearing round the pin.

Looking at Sheet No. 1, the flow of oil is easily imaginable. Entering the pipes leading through the main bearing cups into the oil groove circle round the shaft, the oil is free to travel all round the bearing by suitable channels in the brasses; at



Sheet No. 2



TWO TYPES OF OIL SEALING RINGS FOR MAIN BEARING, CRANK PIN & CROSSHEAD BRASSES

Sheet No. 3.

the same time travel into the hole drilled to the centre of the shaft, and along longitudinally to the crank webs, and then at right angles from the centre to the outside of the crank webs (Sheet No. 2). The oil next travels through the pipe (CP) towards the crank journal from the outside edge of crank webs to centre of crank pin shaft, then at right angles along to centre of crank journal and up to oil groove circle turned round centre of pin and brasses, so that the whole of the "bottom end" brasses are floating round the crank journal in oil through suitable channels in the brasses. The foot of the connecting rod (Sheet No. 2) is shown drilled like a Y, because two pipes are required to run up the connecting rod so that the oil can be conveyed through the crank pin brasses up through the foot of the connecting rod and out into the two pipes up to the crosshead brasses. The two pipes are fitted round the fork end of the connecting rod and up through the bottom brass into the oil groove circle turned round the crosshead journal pins; thus the crosshead brasses are kept floating in oil.

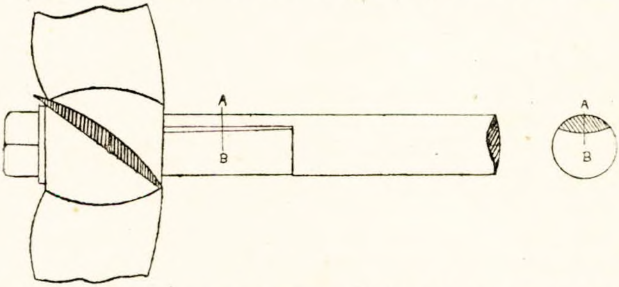
The pipes leading into the main bearings (Sheet No. 1) can be led to a height—say, the oil reservoirs may be placed above the cylinder covers, so that if gravity led, the oil is bound to go up the pipes, up the connecting rods to lubricate the crosshead bearings, or the pipes leading into the main bearings can be connected to small hand pumps, so that oil can easily be pumped through the system, say a pump and strainer similar to Hall's refrigerating engine gland pump, although not more than 5 or 8 lbs. square inch pressure would ever be required to reach any crosshead bearing.

The success of this system of oil-tight and oil-retaining bearings will be the good workmanship and attention paid to fitting of same.

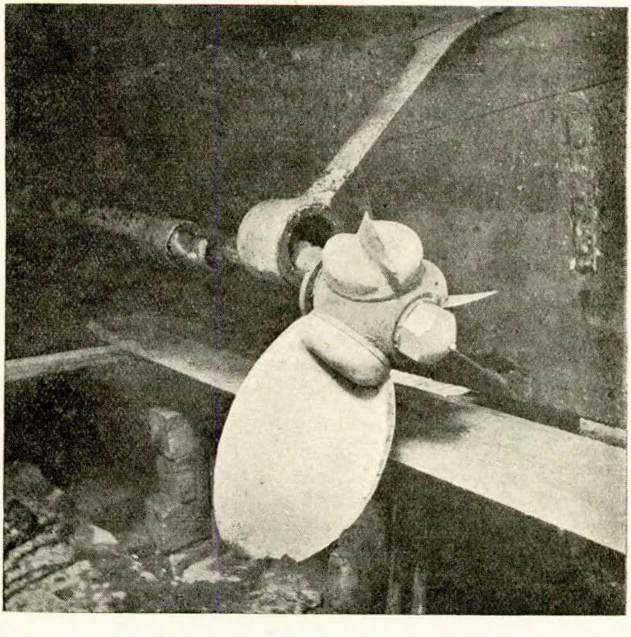
The old method of putting tins into bearings so that "you can just hear her knock," and filing away the sides of the brasses so that the only touching place is the crown of the brass are practices that should be stopped, and good machined brasses and journals let together just a fine working fit, otherwise if the journals are to continue to flap about inside the brasses no oil will ever remain in the bearings. A true pin and a true brass will run quite finely adjusted, providing the oil is sure of getting to the rubbing surfaces, and the oiling system proposed, with proper workmanship, appears to the writer well adapted for the purpose designed.

SEDIMENT IN RIVER WATERS.—The photograph and sketch reproduced were kindly forwarded by one of our members, Mr. J. S. Ryan, to whom we are also indebted for an account of the circumstances which led to the accident:—

The illustrations show an experience with a propeller and shaft due to working amid water mingled with sand under



The vertical line AB indicates the position of the outer bearing, and the wear of the shaft due to the sand. The three upper lines fore and aft show the portion of the shaft that remained; the lower line, continued from the boss, represents the original part of the shaft which wore away; the cross section AB shows the area of the wear and the amount left when examined in dry dock.



Photograph taken in dry dock to show broken propeller blades of cast iron, and buckled gun-metal blade, also more especially to illustrate the unique experience of a propeller shaft working for many hours in sanded water, yet with less than one-third of the original diameter left the propeller boss remained on the outer end.

the following circumstances:—The steamer was trading between Monte Video and Paraguay, and in the course of the voyage up river she fouled a sand bank; the engines were kept moving to get the vessel off. The chief engineer, finding the engines to be increasing unduly in speed, reduced the steam inlet, but after some eighteen hours' work they pulled up. When the vessel was brought into dock for examination it was found that the shaft, the original diameter of which was $6\frac{3}{8}$ ins., was reduced to $1\frac{3}{4}$ ins., thus giving a play of $4\frac{3}{4}$ ins. in the outer bearing bracket, while two of the propeller blades, which were of cast iron, were broken, and the other blade, of gun-metal, was buckled at the tip.

The shaft was lined with gun-metal, and the stern bush was similarly lined. The vessel has twin screws, and the illustrations show the port propeller shaft. The propeller is three-bladed, and at this period of its history was fitted with two cast-iron blades and one of gun-metal.

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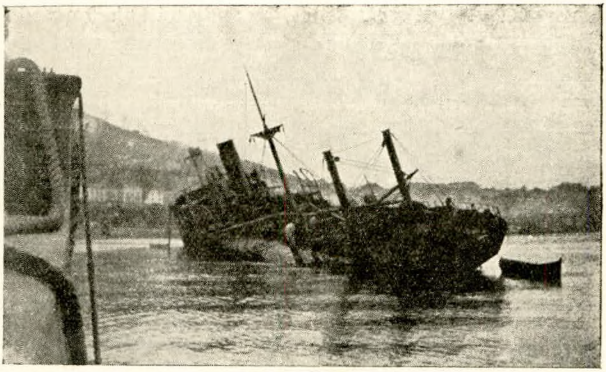
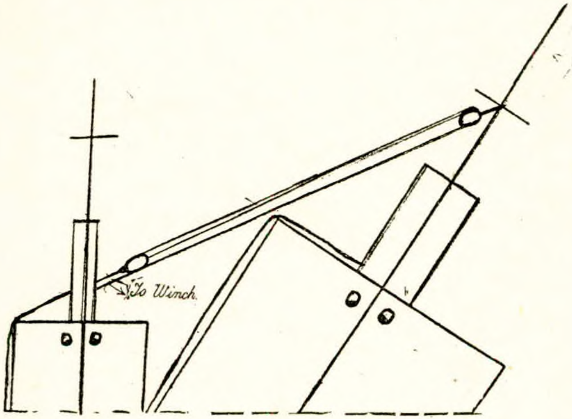
The following has been received from one of our members—who was engaged in the salvage operations of the vessel—Engr.-Lieut. Frank A. T. Wheeler, R.N.R. (Member), who writes as follows:—I am forwarding the attached article, thinking that it might be of interest, it being an account of the salving of the SS. "—————," which had been torpedoed, and had grounded on a bank while being towed in, and had taken a dangerous list. I enclose a small photograph showing the vessel. I have read with considerable interest the discussions on "Aids to Prevent a Ship from Sinking," and judging from what I have seen, the principal item, is a strong bulkhead that won't collapse, and it should be double riveted to tank top, not single riveted, as in numerous cases that have come under our notice:

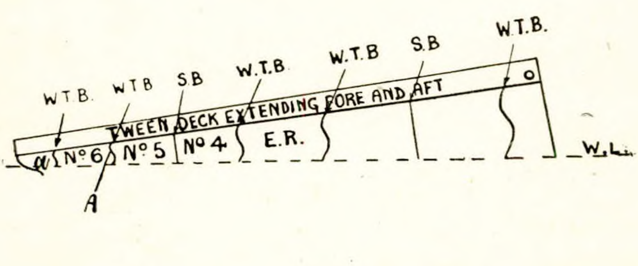
Salving of the SS. "—————."—This vessel was a hurricane decked steamer having a 'tween deck extending fore and aft, the midship portion of which was used as bunker space. The watertight bulkheads extended as far as this 'tween deck, and not to the upper deck, the bulkheads being of the corrugated type. The number of bulkheads, that is, watertight, abaft the engine-room were two, one on the after end of No. 6 hold, and the other between Nos. 4 and 5 holds, holds 4 and 5 being divided by a wooden bulkhead.

The torpedo struck the vessel on her port side in No. 5 hold, causing extensive damage, holes being blown in her 'tween deck and in her starboard side. The tunnel being damaged, considerable quantities of water leaked through the door, making it imperative to shore-up the door to prevent it from bursting. The watertight bulkhead at after end of engine room also leaked badly, and eventually flooded the engine room. The vessel having a dangerous list, it was feared that she might fall right over, and the steps taken to prevent it were as follows:—The salvage vessel was brought alongside, and a 6 in. wire was passed under her and fastened to the bollards and lower part of the mast of the torpedoed vessel, from the end of the wire on the salvage vessel a 25-ton tackle was made fast, led to the steamer's mast cross trees and the fall of the tackle hove taut by winches, as in Fig. 1. To prevent water flowing along the 'tween deck into No. 6 hold, a bulkhead was erected across the ship, and the seams of same caulked-up at position "A." The stern of the vessel and up to the position "A" midships was covered with water at high tide (Fig. 2). An electric submersible pump, capable of delivering 350 tons per hour, was lowered into the engine room and started, the current being supplied from the alternator on the salvage vessel; the engine room was pumped, but this had no apparent effect on the list of the ship. This pump was used intermittently to keep the engine-room dry, but fears were again entertained that the vessel was going over, and wires were led out from starboard bow and starboard quarter to the shore and hove taut; these means not proving sufficient, a lighter was brought alongside and made fast forward of the bridge, the lighter having tanks that could be flooded to sink her about 4 ft. A 9 in. wire was passed round her, the two ends being clamped together with a Bullivant's "Bulldog Grip" clamp, a tackle was made fast to the wire, and the other end to the ship's foremast cross-trees, the fall being taken to the ship's winch, and steam supplied to the deck steam pipe line, with flexible steam pipes from the salvage vessel.

Three hundred tons of coal were discharged from port 'tween deck bunker. The hatches were put on Nos. 4 and 5 holds, and the seams caulked and shored down, from the hatch beams above. The water in the after-peak tank was blown out with compressed air by fitting a connection to the tank air pipe, water emerging through the sounding pipe. An 8 in. pump was put into No. 6 hold, and a 4 in. submersible pump, the pumps being started as the tide commenced flowing, large quantities of water leaking through the tunnel into No. 6 hold, the vessel gradually righted herself and floated with a list to port of five degrees; the ship was then towed in and beached in 10 ft. of water low tide. It may be noted that a 4 in. submersible pump delivers 100 tons per hour.







Notes.

Electric Welding—Referring to the remarks by Mr. Thom in connection with the very interesting and instructive paper on electric welding by Mr. Kennedy, Mr. George Hast (Member), New Zealand, writes:—

> "It may interest Mr. Thom to know I had some electric welding carried out in October, 1917, to the boiler of the pilot tug *Theresa Ward*, the nature of the work being to weld the landing edges of wrapper plate seams in combustion chamber, and they seem to be quite good; it is my intention to have same continued farther along in October, 1918. The work was carried out by Messrs. Steresson and Cook, Port Chalmers, N.Z., who had a plant installed some time ago, and have carried out quite a lot of boiler repair jobs, which they formerly dealt with by oxy-acetylene welding. This may interest members to know that we in New Zealand are trying to keep up with the times. Best wishes to the Institute and kind regards to yourself."

OIL MOTOR FUEL.—An article contributed to the *Electrical Review* in September describes a car motor engine trials using oil extracted from tar, and indicates how this oil can be used with economical results for stationary engines for power production, electric light and auxiliary plant. During the distance trials, it is stated that the amount of tar oil used was about the same as the more expensive petrol, another advantage being that the former was a home-made product, a most desirable aim to keep in view.

The practical results gave the following details:—

	Sp. gr.	Flash point Fah.	Cost of Fuel per gal.	Miles per Gallon.	Cost per Mile in pence.
Petrol	·745	—	3/9	19·01	2·29
Paraffin	·810	—	1/9	18·76	1·12
Tar Oil	1·015	184°	5d.	18·33	0·27
Tar Oil	1·040	180/190°	5d.	19·18	0·26

It is further stated that the car on which the trials were made weighs 26 cwt., and has run 7,000 miles for two years on paraffin and for three months on tar oil.

A summary of the article is given in *Page's Engineering Magazine* of October.

His Majesty the King has graciously consented to become the Patron of the Institute. This announcement will be received with pleasure by the membership.

Redemption Assurance Policy.—A policy of £10,000 has been completed with the Royal Exchange Assurance Company for the redemption of the cost of our new premises at the expiry of the 99 years' lease.

Trustees.—The Lord Pirrie, Lord Weir and Jas. Denny, Esq., have kindly consented to act as Trustees of the Capital Funds of the Institute.

"'Leinster' Disaster Fund."—A donation of £10 10s. from the *Titanic* Engineers' Staff Memorial Fund was given to this fund for the relief of the dependents of the engineers who were killed when the steamer was so shamefully torpedoed.

Lord Mayor's Appeal on behalf of the Red Cross.—Intimation has been received that the fund in connection with this appeal is being kept open till the end of November. We have received donations from members amounting to £15.

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*Patents Law Amendment Act.—As a result of careful consideration of the present Act, with its various claims and provisions, a deputation consisting of representatives of the engineering and industrial societies—including the Institute of Marine Engineers, represented by Mr. Jas. Keith and the Hon. Secretary—who have been meeting in conference for some time past, met on October 10th at Whitehall Gardens, to place before the President of the Board of Trade a summary of their views, in order that the new Act, which is in course of preparation, might embody what is deemed to be the most fitting and appropriate provisions in the interests of all concerned, emphasis being laid on the fact that the highest interests of the Empire are involved therein, as in giving every encouragement to the inventive faculty in connection with progressive industrial undertakings these would be very materially helped towards the consummation of the hope that all hands will unite

* Quoted from *The Marine Engineer and Naval Architect.*

in doing their utmost towards increasing trade and commerce, as upon such well directed efforts will depend the money necessary to recuperate the country and pay the monetary obligations which are now being laid upon us, and the pinch of which has not yet been felt to the extent it will be.

The deputation was introduced by Mr. Longridge (President Inst. Mech. Engineers), who stated that various important details would be indicated by different speakers, who would voice the collective views of the representatives in accordance with a programme which had been prepared. Dr. Ferranti dealt with the question of moratorium for patents; Mr. Horatio Ballantine, F.I.C., importance of protection for inventions relating to food, medicinal, or surgical products, importance of product claims to chemical and other industries; Mr. W. M. Mordey, extension of (*a*) the term of patents, (*b*) period of provisional protection, (*c*) period for acceptance of the complete specification, reduction of patent fees; Sir Geo. Croydon Marks, protection of patentees in relation to utilisation of their inventions by the State; Mr. M. Atkinson Adam, limitations of provisions for revocation of patents, safeguarding patents of addition; Sir Robert Hadfield, F.R.S., suggestions for a special tribunal to deal with patent cases. Emphasis was also laid upon the desirability of the new Act being framed to embrace the British Empire in its provisions. The presence of representatives from beyond the seas would facilitate arrangements being made in this direction.

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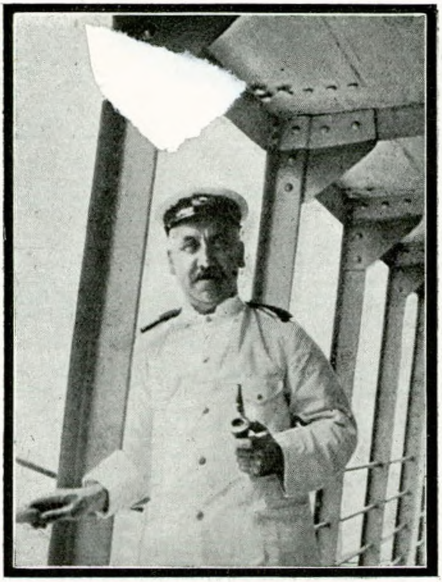
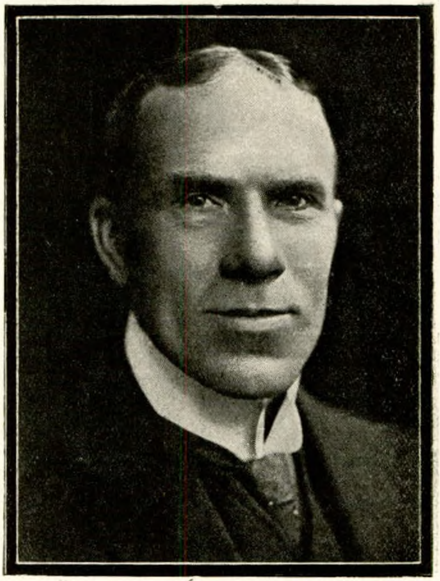


JOHN HAMILTON.

Our sympathy has been keenly aroused towards Mrs. Hamilton, who by the death of her husband, owing to the dastardly act of the enemy, has been left with seven children to face the future. Mr. Hamilton was of Scotch parentage, and was born in Bermondsey, London, S.E. Shortly afterwards his parents removed to Liverpool, where John was educated in Dr. Carmichael's School, and served his apprenticeship with Messrs. A. B. Fraser and Co., Regent Road, Liverpool. He first went to sea in the Harrison Line, then transferred to the Red Cross Line. He received his promotion to Chief Engineer of the *Pawnee* when 30 years of age. After a short spell on shore he joined the Ellerman Line, and for eight years served in one or other of their steamers. In October, 1917, he had an attack of malarial fever, which necessitated leave from his appointment. On his recovery he worked on shore for a time, and then received the appointment of chief engineer of the *Trinidad* (Cunard Line). He was 50 years of age when he met with his death. His ship sank quickly, and all the engineers were lost. Mr. Hamilton was a Member of the Institute of Marine Engineers; genial and pleasant in disposition, he was popular in his circle of friends, and in his family circle his home-coming was a season of sweet reunion—now, alas, of saddened memories.



JOHN H. KNOWLES

We looked forward with pleasant anticipation to a visit from John H. Knowles from New Zealand, but, alas, our hopes were doomed to disappointment, and with sorrow and regret we record the loss of another member of our fine body of marine engineers. We tender our regrets and sympathy to his mother and relatives at Port Chalmers, New Zealand. John H. Knowles was born at Wellington, New Zealand, in 1875, and served his apprenticeship with Messrs. W. Gardiner & Co., Port Chalmers. In 1896 he came to the Homeland for a wider experience, and served in the workshops of Messrs. Fleming and Ferguson, and Muir and Houston. In 1898 he went to sea as Ref. Engineer in the *Duke of Norfolk*; the following year he joined the SS. *Osborne* as 4th engineer, and was soon promoted to 3rd, remaining in this ship till November, 1902. He then had a spell on shore in the works of Messrs. Lobnitz and Co., Renfrew, and in 1904 he joined the dredger *Whakariri* as 2nd engineer, bound for Wellington Harbour Board; soon after arrival he was promoted to chief engineer and dredger master to the Imaru Harbour Board, and left in 1907 for a chief engineer's appointment to sail on the New Zealand coast. In December, 1907, he was appointed to the dredger *Moribiku*, at the Bluff, New Zealand, and in 1909 he left for Britain in order to sit for examination as extra chief, and then was appointed to supervise the building of the dredger *Parituta*, at Messrs. Fleming and Ferguson's. On her completion he left as chief engineer, and on arrival in New Zealand he remained as dredger master till completion of the guarantee, after which he was appointed to the *Ceretodus* at Bundaberg, Australia, and in 1912 he received a Government appointment as Inspector of Machinery for New Zealand.

After the outbreak of war, and the call for experienced marine engineers, he offered his serviecs to the Admiralty, and when the *Aurora*, after the Sir E. Shackleton's expedition, was taken over, Mr. Knowles joined her to proceed to Britain, as did other volunteers, one of whom, the chief mate, had already served in the Army, and was wounded at Gallipoli, invalided home to Australia, and was returning to marry a nurse who had attended him when in hospital in England. The *Aurora* sailed from Sydney on June 22nd, 1917, and has not since been heard of. The relatives of those on board have clung to the hope that at least some, if not all, of the members of the crew of the missing ship may have been saved, but the lapse of time has gradually obliterated expectation of news. Mr. Knowles was a Member of the Institute of Marine Engineers.

HERBERT G. MITCHELL.

Within a short run of his homeland, Mr. H. G. Mitchell lost his life while engaged in carrying on his peaceful duties as chief engineer of the steamer, which was sunk by the dastardly act of the enemy of law and order, two only of the crew being saved. To his widowed mother and relatives our deep sympathy is extended. His father was a master mariner, and died at Port Said in 1895. Born at Poplar, where his parents had removed from Teignmouth, Mr. Mitchell was educated at Tarrance Street School, and served his apprenticeship with Messrs. Caird and Rayner. Soon after completion of his time he went to sea in the SS. *Picton*, August, 1905, as a junior engineer. The following year he joined the *Annapolis* as 4th engineer, being subsequently promoted to 3rd; he also served in the *Lomas*, the *George Fleming* and the *Uranium*, receiving his promotion to 2nd engineer of this steamer in April, 1910, and to chief in July, 1910. He passed for his second certificate in 1907, and for chief in 1910. He also served in the *Glenturret*, *Quito*, *Inveric*, and then joined the *Avanti* is chief engineer in March, 1917. His elder brother is a deck department officer, and his younger brother is serving on the battle front in France. Mr. Mitchell was elected a Member of the Institute of Marine Engineers in 1905.

LIEUT. A. BARCLAY MOYES.

It is with great regret we note the death of Lieut. A. Barclay Moyes, and with much sympathy for his father in the loss of his bright and promising son. The younger son, Mr. Wm. Young Moyes, was senior 6th engineer in the *Titanic*, when she was lost in 1912. A. Barclay Moyes was born in 1885, and was educated at the High School, Stirling, where his father was headmaster of the Primary High School for nearly 39 years. His uncle was Mr. R. P. Hewit, of Manchester. His engineering apprenticeship was served with Messrs. Muir and Houston, Glasgow. He then went to sea in the Direct Line SS. *Torgorm* as 3rd engineer, subsequently being transferred to the *Crown of Grenada*, trading to the West Indies. On obtaining his chief engineer's certificate he joined the *Kirklee*, in the East Indian trade. His next appointment was in one of the Castle Line steamers, and while in the *Sabine* the vain search was made in the southern seas for the *Warratah*. He left the sea service in 1912, on obtaining an appointment as engineer surveyor for the Yorkshire Insurance Company, at Manchester.

On the outbreak of war he offered his services in the national cause; having been a member of the 3rd Lanark Volunteers, he was qualified as a good rifle and revolver shot. He joined the Manchester Universities and Public Schools Battalion, and was afterwards gazetted to the Cheshire Regiment. He served as captain and assistant adjutant in the second line battalion. By his special desire he was transferred to the first line, and left for the seat of war as lieutenant, and was killed during the defensive operations about the end of March, 1918. He was held in high esteem by his commanding officer. He was elected an Associate of the Institute of Marine Engineers in 1906.

LIEUT. CHAS. OVERTON, R.E. (Naval Division).

We record with regret that Chas. Overton, of Edgley Cleadon, near Sunderland, has lost his life while on national duty, the vessel on which he was serving having been reported as "missing." He was born at South Shields in 1888; his father was Samuel Overton, a ship-master. Educated at the High School, Shields, he served his apprenticeship with Messrs. Dickinson and Son, Sunderland, and continued in their works until, in December, 1910, he went to sea as a junior engineer in the American Line SS. *Philadelphia*. His subsequent sea service was in the White Star Line SS. *Olympic* and in the Royal Mail Line *Arato*. Obtaining his second-class certificate early in 1912, his chief's in 1914, he came home from the West Indies to sit for the extra chief's certificate in September, 1916, but having offered his services to the Naval Division of the Royal Engineers, he was called away and given a commission before the examination took place, and entered upon his duties as chief engineer of a vessel in the East, during which period he was at the siege of Bagdad.

Great sympathy is extended towards his invalid sister, whom he supported with kindly and brotherly help. Mr. Overton was elected a Member of the Institute of Marine Engineers in 1916.

LIEUT. DAVID PALMER, R.E.

Our sympathy goes forth anew to Mrs. Palmer as we pen these lines to place on record the following biographical sketch of the life of her husband, David Palmer, who was chief engineer of a steamer which was last sighted in the Mediterranean Sea, on February 26th, and is given up for lost.

Born at Nigg, in the North of Scotland, in 1874, son of David and Margaret Palmer, of "Altens," Nigg, he was educated at Nigg Public School and Robert Gordon's College, Aberdeen.

After serving his engineering apprenticeship with Messrs. J. Blaikie and Sons, Aberdeen, he was employed at the works of Messrs. Simons, Renfrew, gaining further experience of marine engineering before going to sea in 1896, as third engineer of the *Grandholm*, of Aberdeen. Obtaining his Board of Trade second engineer certificate in 1897, he was promoted to second engineer, and remained in the *Grandholm* till 1899, when he obtained his chief's certificate. He then joined the Red Star liner *Vaderland* as fourth engineer, being afterwards promoted to third, and to second in 1902; subsequently he joined the *Ilaro* (Elder Dempster Line) as second, in 1904, and was promoted to chief after four or five voyages. He also served as chief engineer of the *Herminius*, *Harmonides*, and the *R. P. Houston*, of Liverpool.

On December 29th, 1917, he joined a steamer in Glasgow as chief engineer for employment on national service, in the Inland Water Transport Department, with a commission as Engineer-Lieut., R.E., and sailed for a port in the East (Mesopotamia), and while serving in the steamer referred to he was lost to sight, but hope remained for many months that he might have been saved. The hope has not been fulfilled, and memories of the departed alone remain to dwell upon by his widow and friends. David Palmer was elected a Member of the Institute of Marine Engineers in 1912.