SESSION, 1891-92.

TWENTY-FIFTH PAPER

(OF TRANSACTIONS)

ON

SOME IMPROVEMENTS

IN

ENGINE ROOM PRACTICE

BY

MR. W. W. WILSON

(MEMBER OF COUNCIL.)

Read (Stratford) Tuesday, Feb. 10th, 1891,

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PREFACE.

A Meeting of the Institute of Marine Engineers was held here on Tuesday, 10th February, persided over by Mr. J. McFarlane Gray, when Mr. W. W. Wilson read a Paper on "Some Improvements in Engine Room Practice."

A Meeting was also held in Cardiff, by the Members resident on the Bristol Channel, on the 18th March, when the Paper was again read. The chair was occupied by Prof. Elliott, the Paper was read by the Honorary Local Secretary.

The Paper was prepared under circumstances explained by Mr. Wilson, and which may serve as an example to Members, to take notes and treasure them up in order to provide for similar emergencies.

The discussion was somewhat briefer than should have been expected on such a Paper, but the remarks which have been made will be found following the Paper itself, and probably will be found sufficiently suggestive for other Papers dealing with subjects well worthy of further consideration and discussion.

JAS. ADAMSON,

Honorary Secretary.

SOME IMPROVEMENTS

IN

ENGINE ROOM PRACTICE.

In introducing this subject to you to-night, I take the liberty of briefly mentioning under what circumstances I do so. At our meeting here a fortnight ago it was announced that in all probability the paper to be read here to-night would be that by Mr. Green, "On the application of Zinc to Boilers," which has been in the hands of the Papers' Committee for some time back. When Mr. Green was communicated with he desired to be excused, owing to indisposition, and wished the reading put off for a fortnight at least. As there was but little time to arrange anything further, I volunteered at last Council Meeting to do my best to lay a short paper before you founded on a few notes which I had taken about eighteen months ago, which, at that time, were intended to form the nucleus of what I have now tasked myself with.

Although, after considerable thought I had abandoned the idea of being able to arrange a paper which would be of any value to the Members of this Institute, still, under the circumstances, I decided that, possibly, if these notes were collected and put before you in the way I purpose to-night, there might be found in them something that might have the effect of raising discussion which might prove of benefit to all of us. I, however, crave your indulgence, as it has been hastily written and may contain inaccuracies which might have been avoided had I had longer time.

When I first formed the idea of preparing anything to lay before this Institute it struck me that if I could

collect a few of the minor details in Engine Room Practice which I have occasionally had brought before my notice, for the most part made and fitted by Engineers in out-ports, or by Junior Engineers while at sea, the aim of which was to economize labour or material, if I brought little hints to many I would perhaps, in return receive more than I could give. I addition, I have since thought that I might also draw your attention to some of the improvements which have been effected in recent years having the same end in view.

It is, therefore, on these lines I intend to proceed to-night, and I hope that any Member, whose ideas I endeavour to lay before you, will not be in any way offended, as I do not expect that anything I may mention is really private property, or, if so, it is already properly protected.

When we look back on the marine engine as it existed about twenty years ago (which is as far back as I can go in marine engineering) and compare it with that of to-day, we cannot but be struck with the enormous advances which have been made in design and general development, and when we look at the amount of additional machinery now placed under the charge of the marine engineer, I think it may well cause us to wonder how it comes that in the large passenger ships of the present day the small complement of crews which are allowed are enabled to keep the machinery so well in hand and in good repair.

About twenty years ago, ships having engines indicating from 1,200 to 1,500 horse-power had engine-room crews (of course I only mean engineers) numbering at least three-fourths of those now allowed for ships whose engines indicate three or four times the horse-power. In these olden days the whole amount of machinery to be looked after comprised the main engines, and, possibly a couple of donkey pumps—one for the engine-room, and one for the deck boiler—also with, perhaps, a couple of winches or so. Now, in addition to the main engines, we have steam steering

gear, electric lights, refrigerators, and no end of auxiliary engines of all descriptions and for all purposes, both below and on deck, thrown into the charge of the engineer, and yet with the very small percentage of extra assistance, as already indicated. Some may say, "Well, I expect the engineers of those days must have been well off, and had splendid times of it." I say "No," and I think that all our older members will willingly acquiesce. The old engineers had, I say, harder work to perform to keep everything going right than those of to-day, so far as manual labour is concerned, and the cause of this change is nothing more than the many and great improvements in the details of construction, arrangement and management which have been made during the interval of years.

I shall now draw your attention to a few of these, and will commence with the piston.

In the discussion on the paper read by Mr. Brett last year, on "Friction," the subject of the piston was brought prominently into notice, and the merits of several of the systems of packing rings were duly commented upon. At that time I spoke particularly on the old D springs which were universally in use in the early days of my experience, and which at that time were applied in such a haphazard way that really I do believe that but very few indeed ever gave a thought as to the amount of pressure they were putting on the walls of the cylinder, all the aim being to make sure that it was perfectly steam-tight. Not only was this abnormal pressure the cause of a considerable waste of power in friction, but the system caused an almost incessant overhauling of pistons to keep them working—I was going to say properly, but I am afraid it should be improperly—as there was a constant heavy wear on the cylinders and rings, they getting much cut and torn. Then there was also the breaking of the springs, which caused an almost deafening rattle at the termination of each stroke, and which of course wound up with the overhaul of the piston at the very first opportunity. It was, therefore, a decided improvement in this line

when the floating packing ring, in its various forms, was introduced. Unfortunately, each of these has also had its faults, and I am inclined to think they too are gradually losing ground in favour of the old Ramsbottom ring, which, although so long known, has only within the last few years been utilised for marine engines. This is now very successfully applied, and, I believe, is the best ring for pistons, at least up to 50 in. to 60 in. cylinders, and I do not see why it might not be applied to larger diameters by a slight increase in the section. In low-pressure pistons these, however, have not yet been quite so effective, but I think that a series of light spiral springs in the bottoms of the recesses would enable them to be used there as well. These springs would help to keep the ring out to the cylinder walls better, and all the tension that would be required on them would be what was sufficient to overcome the effect of the vacuum on the inside of the ring, which has the tendency of drawing it off the cylinder in the same way that steam getting at the back has the tendency to push it out. That these Ramsbottom rings have been a very decided improvement in labour, is generally admitted, and, there is but little doubt, in material and stores as well. With them there is but very little necessity for the annoying overhaul of pistons that used to be in intermediate ports, or in the Suez Canal, and it is quite as fully acknowledged that, if need be, pistons so fitted could with safety be run without the slightest necessity for being looked at for several voyages. I have a recollection of a certain vessel, not so far back as twenty years, where it was the rule, that upon no account was the Suez Canal to be passed without—while hauled up between night and morning—either one or both pistons being examined, even although on many occasions the same operation had been gone through within the previous ten or twelve days, and, even after that, I have known one of the pistons to be done again at least once before arrival in England. And I know that this was not the only ship in which this was the rule.

With regard to valves, I shall not occupy your attention much, merely mentioning the introduction of

better balanced slide valves, amongst which may be cited Mr. Church's, which was also spoken about in the paper already referred to. There is also the piston valve, which I believe to be a very great step in the improvement of this portion of the marine engine. I look back on the immense amount of labour, &c., which formerly was expended on the overhaul of the valves and faces, on the amount of scraping and filing which was necessary to keep the surfaces in good order and free from that cutting and cording which was too often found on them. No doubt the better system of lubrication now used has a good deal to do with this improvement, in addition to the better designs and better management which now exists.

This now brings me to mention the introduction of the now universally adopted sight feed for internal lubrication. To the best of my knowledge (and here I am willing to be corrected), the earliest specimen of this invaluable little attachment to the marine engine introduced into England, was the one which was brought out by an American named Phillips, and was, I believe, put into the English market by Mr. Axford, one of our members. No sooner, however, had its merits been recognised than it was altered and arranged in many different ways and into many forms by almost all the brass finishers of the country. Its value can only be measured by comparison with the older styles of impermeators, which, after having been filled and duly set to give a gradual feed as intended, were often found at the end of the twelve hours—during which the supply of oil was supposed to last—to be still filled with the oil which had been originally put in, not a drop having got away, or, if gone, the engineer was left in blissful ignorance as to whether it had just been finished, or had made its exit within the first quarter of an hour after filling, as was too often the case. It is very doubtful which of the two ways, viz., want of lubrication altogether, or its getting it all in large doses at long intervals, was the best for the engines. On the whole, however, these old lubricators were very unsatisfactory, and the introduction of the sight feed was indeed a great improvement. With it the con-

sumption of oil can be so beautifully adjusted that any quantity per day can be used and at any moment the engineer can satisfy himself that that is being carried on with regularity. I may here mention that, in my opinion, the arrangement of the force pump lubricator worked by a ratchet from some part of the engine, and having the sight feed attachment, which I see has been recently added to this form, seems to me to be one which ought to commend itself, as it only works while the machinery is in motion, even although the steam remains open to the engines. The displacement system of lubricator continues to work, as you are all aware, so long as the valves on it are open, consequently, by a slight oversight the whole of the oil in the lubricator may be used when the engines are at rest and be thus wasted, doing nothing.

While on lubrication of internal surfaces, I cannot but draw your attention to the introduction of mineral oils for this purpose. I often look into cylinders now and admire the cleanliness which is visible as compared with the old state of matters. When I first went to sea I remember the first thing to be done, as a rule, on opening up a cylinder for overhaul, was to have a couple of firemen with scrapers, a bucket, and an armfulof waste, if it could be got, to clear the way for the engineer getting to work, and on many occasions a whole day was wasted making the top of the piston in a fit state for the junk ring to be got up, and even when up, the interior of the piston was often found in the same dirty, filthy condition, the springs being literally embedded in grease, especially if the piston was not in the very best condition. I have seen a week spent in overhauling and thoroughly cleaning two such pistons, whereas, at the present time—when no other work interferes—it is quite competent for an engineer to do the same work easily in two days, and that with considerably more comfort to himself.

What is the cause of all this difference ? Why, just what I have been trying to explain in the foregoing. First there is the better designs of valves and pistons and their better management, less pressure being now put on them, consequently causing less friction and cutting and

tearing of surfaces; then there is the better system of lubrication, causing considerably less oil to be used, and, lastly, there is the use of mineral oil in the place of the old animal or vegetable oils which formerly could not be done without.

We shall now proceed to the shafting. Mr. Manuel in his paper on this subject, treated it so fully that really there is now but little left for me to say; still I feel that I cannot pass it without some little notice. In his paper he explained the various improvements that had been made on shaftings and bearings, such as improved design in the latter, giving more solidity, also the increased surface now given, and, besides, the introduction and extended use of white metal. The latter, in my opinion, is of itself a decided improvement, and, I think, ought to be accorded a very great percentage of the success in the running of heavy shafts in the present day. The changes enumerated have all tended to the abolition of water on bearings, which was so prevalent a few years back. Water I consider to be the bane of a Marine Engineer's existence. None can appreciate the comfort of the generality of the engine-rooms now-a-days, except those who have had to go through the mill—I am afraid it was a water-mill—with some of the older jobs, when, to see the water hose coiled up snugly in the corner, was the exception and not the rule. I have some very painful recollections of many good drenchings got in this way. But, happily, all this is now changed, and, thanks to the improvements named, and others, there is now but very little necessity for carrying any hose in the engine-room.

The value of the suppression of water from shafting must not be measured only by the greater comfort of the engineer on watch or his ability to keep the engine-room in a tidier state. There are other far more important points in connection with it. My belief is, that, to a very great extent, water on bearings had a great deal to do with the broken crank-shafts which used to trouble us so much, or of which we so often heard. Now, in steamers properly looked after and cared for,

we very seldom hear of a broken shaft. A vessel detained in an intermediate port for the fitting of a new shaft is now rare, and certainly occurs very much less often than formerly. I remember the case of a steamer which was so detained, and in speaking to one of the engine-room staff some little time after, regarding the shortness of the detention, I expressed some surprise that the work had been done so quickly, when he said something like the following: "Well you see," "we have done the job so often now, that we know every little obstruction that stands in the way, even to an inch stud, and we are now so well up to doing the job that we found it no trouble to get it done in the time." I may say that he had been in the ship for about five years, and in that time had seen no fewer than seven crank-shafts put in. I do not think that many ships could surpass that number.

Not only do these improvements give comfort, but, as you will see from the foregoing, the amount of labour saved must be considerable, and now, with water gone and improved lubrication, there is very much less tear and wear on bearings, consequently there is a saving of labour. There is little need now for one or two bearings to be lifted in intermediate ports to make good, defects caused by overheating. The engineer can now pretty well feel satisfied that when he leaves London, he can safely go to the other end of the world without further troubling himself as to the efficiency of his shaft or bearings, that is, of course, always provided that due care is properly exercised by those on watch below.

Before leaving the crank-shaft, I would mention the eccentrics—not having any experience with radial valve gear, I cannot speak about it. It seems to me that, as a general rule, the eccentric has too little surface for the work it has to perform, and the consequence is that there is a very considerable amount of tear and wear on it, and there is great risk of overheating if it is not very closely attended to. To keep it running cool and anything like well I find that it has,at almost all times,to be

run with more or less water. In fact, when I interrogate any of the engineers with whom I come in contact, whether they use water on the shafting at all, the usual answer I get is, "Not a drop, except on the eccentrics, which will not run without it." Now I don't see why these should not be provided with sufficient surfaces to allow them to run without water, but as this, as a rule, is not easily accomplished in the generally accepted designs, I will now draw your attention to a means which has been adopted in a number of ships for removing the difficulty. This is the providing of a trough below the eccentrics into which they dip every revolution. This trough is usually filled with a mixture of fresh water and oil, which as a rule is replenished by the water, which, escaping from the valve spindle glands, runs down the rods and so into the trough, whilst the oil which is fed from the cups in the usual way with syphons also finds its way into the same receptacle. A small tap on the side near the bottom can easily be fitted which will let off any surplus water that may accumulate, or when the trough gets too full that it splashes out on the footplates. An arrangement of this kind has been found a certain cure for many bad running eccentrics that I know, and the little fresh water which is used does no harm to the bearings.

Turning now to the thrust shaft and bearing, we find that here also a considerable improvement has been effected in the same lines as on the other portions of the shafting, viz., by the provision of increased bearing surfaces, as well as in better material. Great improvement was certainly effected when some years ago there was introduced that form of thrust which is generally known as the "horse-shoe" style. There is little doubt but that it has a good many advantages, notably that of the engineer being able, at any time, to so adjust each ring that it takes its full share of the pressure, and also the fact that in the event of anything going wrong with any one ring it can be removed and refitted with metal or otherwise renewed just as may be required without the necessity for taking the shaft away to get at the delinquent collar. It appears to me, however, that this

system is not quite what is wanted, for in it the whole of the thrust comes on the nuts of the adjusting screws at the sides on the centre horizontal line of shafting, which, in my opinion, is not so good as the old system of complete rings, as in a good solid bearing. The thrust which is now most in use in the ships which come under my notice is one of the latter type, but instead of having removable brass rings, these are solid cast iron, but lined on both sides, as well as on top and bottom of collars with white metal in recesses. A gutter-way is formed along the bottom of the lower half of the block, not extending, however, right through from end to end. This gutter generally lies full of oil, and also any sediment or foreign substance which happens to get in on the bearing, as a rule lodges here, but by unscrewing a plug at either end of the block below the shaft all this can be drawn off at any time, and the inside of the bearing thoroughly cleared out. The top half of the bearing is to a great extent open, so that the hand can be put in and any single ring felt all over, which gives the same advantage as in the horse-shoe system, in that,the engineer can pick out any single collar which may be inclined to give trouble, and direct his whole attention to it if necessary. The block is, moreover, fitted with lubrication boxes as usual, besides being provided with water service circulating through it, it being cast hollow for the purpose, in the usual way.

Since the introduction of the improved block just described (which I consider far superior to the horse-shoe, as the pressure is very much better on the rings and on the bearing), I find that there have not been lacking some improvements thereon, introduced by various engineers on board, which tend to a considerable amouut of saving in cost of lubrication, not to mention the removal of a great amount of anxiety and trouble to the engineer on watch.

One of these improvements is the fitting of a shallow packing gland on each end of the block. The top half of the block is jointed with a lamp wick or other joint to its lower portion, and this gland, also in halves, but

having a turn or two of packing inserted, makes the interior of the block an oil-tight box, thus causing the shaft to run in an oil bath, and, so long as this oil is kept in a fluid state, there is but little fear of much going wrong with the thrust. The earliest specimen of this style that has come to my notice was fixed by a member of this Institute to the block in the ship in which he was then serving. It consisted of a light angle iron ring bent to suit, with lugs on it to take the studs, which inclosed the necessary packing. This is running very successfully now. Recently constructed thrusts, however, have had a properly fitted gland fixed, which is, perhaps, more satisfactory.

Another system which often comes under my notice now, having similar aims to the one just mentioned, is the fixing at each end of the block of a trough on the bottom half, and reaching up to the centre of the shaft. On the outside edge of this a light brass strip is fixed bearing lightly on the shaft, but forming a joint half way round and so preventing the oil from escaping. From the side of the forward trough, about 2 in. from the top, a pipe is carried round the front of the block into the after trough as near the bottom as possible, so as to have as great a droop in the pipe as can be obtained. By this means the interior of the block is in the same state as in the former, namely, an oil bath, but in this case the oil, after working through the block and reaching the forward trough, is sent back through the pipe by gravitation to the after one, and entering there finds its way back into the interior. And so the cycle of operations goes on as long as the shaft keeps revolving. To those who may not have observed it, I may say that in a thrust bearing the oil always keeps travelling to the forward end. The system of lubrication just described is, I think, the one to be preferred, as it seems to me the one which gives the better circulation.

One other little device I would mention before leaving the thrust, and which, I think, was also introduced by another of our members. It is a very simple thing, and consists of a slight brass feather fitted to the top

half of the block over the two outside rings and just on the top of the collar when the top half is screwed down in its place.

The feather is placed at an angle to the line of shafting running from the outside to the inside in the direction of its revolution when going ahead. The action of this simple attachment will be easily understood. When the after trough has oil enough inside, the after collar takes up a little on its outer surface, and carries it round with it until it meets the obstructing feather. This being at an angle in the direction of the revolution, as stated, the oil is scraped off the surface of the collar and forced into the interior of the block, and so travels gradually forward, till, reaching the surface of the forward collar, it again encounters the other feather. This one being placed at the same angle as the other, the tendency is to throw the oil back into the inside. Of course a certain amount always escapes into the troughs, but they, being fitted with a connecting pipe as before, it flows back again to the after end and repeats the operation. In connection with this, there are a variety of ideas for fixing small pieces of brass, so as to form scrapers for sending the oil back into the troughs so that as little oil sa possible is allowed to escape.

But why is all this trouble taken ? you may ask ; well, when I tell you that I am assured by nearly all who use these systems that a pair of engines indicating say 3,000 to 4,000 horse-power will require only about five gallons of oil, costing about 10s., on a thrust bearing on a round voyage from London to Australia and back, you will easily understand the benefit, and, besides, there is the comfort and assurance felt that there is much less danger of anything going wrong when the bearings are properly attended to in this manner. I may say that the usual oil boxes with syphon feeds are, as a rule, never used at all in the ships fitted as described, although they are always retained in place.

One great disadvantage about the style of thrust I now advocate is, that to get at the bottom half of the bearing

it is necessary to lift the shaft which, to say the least of it, is too often far from a desirable job. We all know that it is a good—I might almost say necessary—thing to be able to scrape up the rings a little so that the bearing may be better distributed over all the collars, and although this is easily and often done on the top half, still, as a rule, it is impossible to get at the bottom. With this object in view, a suggestion was made to me by yet another of our members, which I think a very good one, and, to my idea, a very practical one. This was the construction of the bottom half of the block in two pieces, they being bolted together longitudinally below the shaft. For myself, I do not see why it should not be done, but I would like to hear the opinions of others on the subject.

Whilst speaking about the tunnel; or, as often called, the screw alley, a thought strikes me that this is one of the parts of a ship which is, I am afraid, too often in a sad plight for want of proper ventilation, and for some time I have had an idea that it should not be so, as there are surely better means of effecting this than are now usually employed. I sometimes enter tunnels which it certainly is a great pity to see in the state they are, the plates pouring with water, and, in fact, rendering the place simply impossible to be kept anything like as neat and tidy as it ought to be, and all for the want of good ventilation. It strikes me that a small water-tight grating door, opening from the hold into the tunnel at the after end, or as near there as possible and close to the floor, would be the cure. This door need not be direct into the hold, but into the space occupied by the ship's fresh water tanks, which are generally placed aft at that place.

I have found when a manhole door was removed from a tunnel floor for the purpose of getting at the holding-down bolts of the after bearings, even although the holds were full of cargo, but with the hatches off, that a considerable current of cold air rushed in through the opening and thence out at the door into the engine room.

Now I do not see why a proper door for the purpose could not be provided, and with good results. This I should also like to hear discussed. I have seen in a number of vessels a small fan fitted for the purpose, with varied results, although generally it has done fairly well.

When I commenced this paper I intended to have drawn your attention to a few more items connected with various portions of the engines not yet touched upon, but I am afraid that by doing so I shall take up too much time. I cannot, however, conclude without taking you into the stokehole just for a little to bring to your notice the very great improvements which have been made in boiler mountings within the last few years. When first I went to sea the overhaul of these fittings was a continual job for at least one of the engineers in every terminal port; every cock and valve had to be gone over as regularly as the voyage was completed, and yet it seemed as if they always leaked as badly as ever. The old dead weight safety valve, with its too often unnecessarily broad mitre seating, was constantly under examination, and the gauge glass cocks and connections were a continual source of trouble and annoyance. When we think of it now it seems a wonder that so few accidents occurred in view of the unsatisfactory state of the connections as they then existed. Thanks to Messrs. Adams, Cockburn, and others, with their spring loaded safety valves, and to Messrs. Dewrance and Co. with their asbestos packed cocks, there is now very little necessity for much labour being expended on these portions of the mountings, and, in fact, I consider that the introduction into the stokehole of these two articles alone, is equal to one engineer at any time.

I do not know that I need mention the introduction of the evaporators, feed heaters, and feed pumps, of Messrs. Weir and others, as they are somewhat out of the scope of my intentions in this paper, nor is there use of mentioning forced draught; but I might suggest that I consider it would be advisable in our large passenger steam vessels that an independent condenser, having auxiliary air, circulating, and feed pumps attached, should

be fitted in the engine-room, and that all steam used by winches and other auxiliary engines should be there condensed and returned to the boiler. That the latter would be very much benefited I am sure there can be no doubt.

Might I also further suggest that the time is fast approaching when the stoking on board a ship will be accomplished by mechanical means.

Before concluding I should like to say, that it would be greatly to the advantage of large steamship companies were they to encourage and recognise any little efforts the engineers in their employ make to increase the economy or efficiency of the machinery placed in their charge. In March last, when Mr. Manuel was elected President of the Institute, he truly remarked that although by the introduction of the surface condenser and the compound engine, and now triple and quadruple-expansion, we had, in the past, been able to make very decided advances in the reduction of the cost of running our ships, still it was patent to all that the same rate of improvement could not be continued, and the engineer of the future must be contented with very small increments of gain, for only by careful attention to minor details, and by taking advantage of every little improvement, can he hope to be able to effect further economy. It is for that reason I say that were a system of awards instituted by large companies, similar to that now in operation in the establishment of Messrs. Denny and Co., in Dumbarton, I think it would be a decided advantage to the shipowner, and there is no doubt that it would be appreciated by the marine engineer.

The HONORARY SECRETARY.

In reference to various points touched upon by Mr. Wilson, and which are suggestive of many more, according to the intention of the writer, many ideas arise naturally in connection with the ordinary routine of the engine-room, which it may be well to consider and discuss.

In large passenger steamers where there are so many auxiliary engines, and consequently much steam used in addition to the requirements of the main engines, it is important that strict attention should be paid to the exhaust steam and the fresh water from drains. The exhaust pipes should all be led into the condenser, so also the drains, provision being made to circulate through the condenser and at the same time pump the fresh water into the boilers when laying in port under banked fires. By using the circulating discharge water for the bath-rooms, scullery, and washing purposes, much steam, which otherwise is lost, with its equivalent in fresh water, might be saved. In many cases the loss due to steam being used to heat up baths, and for other purposes in connection with the saloon department, is very considerable in the course of a voyage, and when there is no necessity for using the steam in direct contact with water it becomes a duty to save it by the introduction of coils for the heating apparatus, and by utilising the hot circulating discharge water for baths or pantry. The introduction of an independent condenser, into which all the exhaust and drain pipes may be led, with a connection to the donkey and feed pumps, would be an improvement, in that it would save all the fresh water, and form a reservoir for much heat and water, frequently lost in the bilges.

The Ramsbottom piston rings, referred to by Mr. Wilson, seem to have given good results in very many cases. I am aware of several engines where their success has been assured. Attention has been called to the eccentrics as a too frequent source of trouble, and especially where the slide valves are very heavy and badly balanced, no doubt they are all that is laid to their charge. The introduction of the balanced valve referred to in the paper is a good corrective, not only for troublesome slide valves but also for valve gear, including the eccentrics.

In a previous paper it was pointed out that the steam pipes, cylinders and receivers should be covered with a good non-conductor, to prevent radiation, and

that the engine-room should be kept as cool as possible, so also the tunnel, that the lubricants may have a better chance of keeping the bearings in order with the least possible expenditure of stores, and it may be well to refer to it again as an important factor in the economy of engine-room practice.

Mr. JOHN TAIT.

(VICE-PRESIDENT).

Referring to some recent improvements in engine-room practice, I may make some brief remarks on a few points which have been raised in the course of the discussion. Although I have had no experience with evaporators such as are now fitted in nearly all recently built steamers, especially those with boilers over 100 lbs. pressure, I am convinced that the evaporator is a good addition to the outfit of an engine room, as the use of sea water for the purpose of making up the feed water is an undesirable method, if it can be avoided. In some cases, a portion of the engine-room bilge is made into a tank with a connection to the condenser, so that fresh water may be carried to make up for the losses caused by the usual drains upon the steam supply, such as occur in all steamers, especially passenger steamers, this is a good device as it obviates, to a certain extent the need for supplementing from the sea. My experience of the total loss per 24 hours of fresh water for all purposes, gives about 750 gals. in ordinary circumstances, including the Suez Canal. Working in port when the donkey boiler is unfit for the full working of cargo, refrigerator, &c., of course, the loss is very much greater, probably amounting then to over 2,000 gals. in the 24 hours. I am now speaking of a steamer of about 2,500 indicated horse-power. I cannot say I see much, if any, advantage is gained by a feed heater using boiler steam to heat the feed water. I work the feed water under ordinary circumstances at from 126° to 130° with feed pumps discharging direct to the boilers. This is about as high as the rubber valves will stand, but with metallic valves, which I understand have given excellent results in several steamers so fitted, the temperature could be raised with advantage.

Mr. R. LESLIE

(HONORARY TREASURER).

I have listened with much pleasure to Mr. Wilson while he read his paper on engine-room practice, and I think he has opened a wide and extensive subject for discussion, and also for special hints on improvements in modern machinery. This is of great importance, and all true-born engineers, and by this term I mean engineers who take so great a pride and interest in their profession as to study minutely the smallest details about machinery, and who earnestly look into every part of a machine with one grand object in view, namely—the general improvement of that machine, no matter whether it be a donkey pump or a 7,000 horse-power marine engine, and I feel I am saying what is right when I say that all commercial men who study marine engineering financially, must know that the nearer their machinery is to perfection, the nearer they draw towards the greatly desired goal of highest economy; and I think that it is incumbent on all owners of costly machinery to encourage the young as well as the old engineer to obtain the best results with the least expenditure; and this I maintain can only be done by improvements in everything in connection with marine engineering. I may be allowed to mention one case where the necessity of great attention to small matters as well as large ones was fully demonstrated. The case I refer to happened in one of the Atlantic liners, where a careless junior engineer, in fixing on the main engine connecting rod oil cups, made them fast with a badly fitting $\frac{1}{4}$ in. bolt and nut; the engines were racing, and first the nut slackened back and dropped into the crank pit, then the oil pipe became loose and got out of place, the consequence was the crank pin heated; when, too late, the cold water hose was applied, and the mischief was done. A crank shaft, worth £500, had to be removed on the ship's arrival in port, all through the lack of the requisite attention to a few small matters. Mr. Wilson has kindly referred to me in his mention of thrust blocks, and many a weary hour have I spent with them, and that is the reason why the thought struck me that there was great room for improvements in thrust bearings.

Some time ago I designed a thrust which would have the bottom half in two pieces, so that each half of the lower part could be removed for inspection and renewal, if required, without disturbing the thrust shaft in any way. This thrust block had a stuffing box at each end so as to retain all the oil round the shaft. I will now give some other members a chance to speak on the subject of engine practice.

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*Mr. CHARLES ELMS, (Cardiff)

(MEMBER).

Most of the previous speakers have alluded to the fact that the paper opens a wide field for discussion, although the facts contained therein, are, for the most part, well known, they having dealt with the shafting, thrust block, and cylinders generally. I would like to say a few words on some of the constantly increasing number of auxiliary engines now met with in the engine-room of a modern merchant steamer, but before doing so I would like, just for a moment, to follow Mr. Hardy on the subject of piston rings, a great number of which have appeared on the market with more or less success during the past few years.

†I was recently invited to inspect a new patent piston ring that had been tried, with splendid results, for two voyages in a steamer. Steam is, in the case referred to, admitted on both sides of the ring, thus ensuring a minimum of friction. This is the first piston ring introduced to my notice having a pressure inside and out, or, in other words, having a perfect steam balance. It is so constructed that the pressure on the inside of the ring, being just sufficient in excess of the pressure on the outside to keep the ring tight with a minimum amount of friction. It is perfectly simple, easily applied to any piston without the slightest alteration to the piston itself, having only to be dropped into its place, and the

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*Since deceased.

†Probably the Piston Rings referred are Twigden's.—J.A.

junk ring put on and screwed down, and it is then ready for use. There are none of the usual complications of setting the springs and then altering them if too light, and as it is a somewhat novel departure, I look upon it with some amount of interest.

Returning to the subject of auxiliary engines, Mr. Edminston referred to the number of these on the Transatlantic mail steamers from Liverpool. I know of a case where thirty-one engines are working independent of the main engines, and on the occasion of my last inspecting this particular vessel, I happened to take part in a discussion as to the benefits derived from using fresh water evaporators, when considerable differences of opinion were expressed, and several of the engineers questioned the utility of evaporators. Personally, I am of opinion that every steamer should have one. In those we have fitted, the salt water is boiled under a vacuum in the evaporator at a temperature of about 170° Fahr. We take the water from the main condenser discharge, which is usually about 100°, so that it only has to be raised 70° to produce vapour. There is no pump, the water supplying the evaporator being admitted through an automatic valve, the vacuum drawing the water in and the valve closing when the proper water level is attained. We have never experienced any trouble whatever with them. For each 1lb. of steam taken from the boiler, I have computed that 1½ to 2lbs. are returned to it. For steamers in the coasting trade, constantly under banked fires, I consider them invaluable. I may mention, by the way, that one of the engineers who condemned evaporators had met with a serious accident through the machine he had filling with water when steam was shut off, but this is impossible with those I have referred to.

I should like to hear the opinions of some of the members, having long runs to the East and China, on this subject, and I hope another night may be arranged for extending the discussion further on the excellent paper given by Mr. Wilson.

Mr. THOMAS DREWRY

(MEMBER).

I am glad to notice that Mr. Wilson mentions Mr. Phillips in connection with the sight feed lubricator. In March, 1881, when in Boston, U.S.A., I accompanied Mr. Phillips to see some of his sight feed lubricators at work on shore engines. They were working in a very steady and reliable manner. During that same month they were introduced into the Wilson Line steamers (Hull). I regret that Mr. Phillips has not reaped a fair reward for his invention.

I quite agree with Mr. Wilson, that, not only have great strides been made in the design and construction of machinery, but also in engine-room practice. However good the design and construction, if the engine room practice is at fault, failure is certain. On the other hand, how many ships and engines, faulty in design, and faulty in construction, have been run for years successfully, entirely through superior engine-room practice.

Mr. Wilson awakens old memories when he talks about the large quantities of dirt and grease that we used to find in the cylinders and pistons, notwithstanding that each cylinder oil maker claimed that his oil removed all dirt and grease. Then, what quantities of grease we used to find in the boilers, and do yet in many cases; but the boiler grease is following the cylinder grease into the past, and with modern engine-room practice the boilers open up now quite free from grease, even after the longest voyage and the usual expenditure of cylinder oil.

In nothing is modern practice more successful than in heating up or cooling down engines and boilers, when we consider the high pressures that are carried now, the number of accidents due to sudden heating or cooling is very small.

I agree with the author, that now is the time for builders to look to and try to perfect the minor details of their designs. At present, all the well-known builders

have some special feature in their engines or boilers of which they are justly proud ; but, at the same time, they also have some special feature which is very troublesome to the engineers in charge. In the case of one builder, the air pumps are noticed for their small clearance and bad gratings, in another, the feed pumps give a lot of trouble ; and when a number of engineers meet it is nothing uncommon to hear them expressing dislike for So and So's pumps, or So and So's thrust, etc. etc , for the fault shown in one engine seems to be repeated in almost every engine built by that maker.

I went to sea when the " Water Mill " period had not quite died out, and I have a profound respect for the old school engineers. The men who could do the work they did, with the material they had to work with, were well worth the name, for in those days it took a very courageous man indeed to be a marine engineer.

I think this paper very instructive, and I congratulate Mr. Wilson on the very successful result of his effort to fill in an otherwise blank night.

Mr. CHARLES A. NEWBY

(MEMBER OF COUNCIL).

I congratulate the author of this paper for the masterly manner in which he has introduced his subject. Taking us back through a period of twenty years and reviewing some of the difficulties which Marine Engineers had to contend with in the early seventies.

The improved packing rings with their diminished lateral pressure and a better distribution of the load upon the bearing surfaces. The improved balancing of the moving parts of the machine—here I refer particularly to the three-crank engine, in its turn transmitting a more uniform motion to the propeller—have undoubtedly contributed largely to the advancement in engine-room practice.

With regard to lubricants I am of opinion that there has been and is still used an amount of oil internally much in excess of the requirements, and the formation of acids by some of the commoner oils used, accounts for a great amount of the mischief done inside the boilers.

With the water tube boiler where foreign matter of any description would be fatal to its proper working, a most ingenious and effective method is adopted to obviate the use of cylinder oils. The pistons of these engines working with initial pressure of 400 lbs to the square inch are fitted with a series of Ramsbottom metal rings composed of copper and tin in the ratio of 16 to 5 and, after running for some years, the walls of these cylinders have been found beautifully polished without any apparent wear, the wear being entirely on the rings, notwithstanding the hardness of this metal, which requires no lubricating unguent. It has been adopted by other engineers with marked success, especially in high speed engines using the loco'type of boiler and forced draught.

My experience with evaporators, similar to those referred to by the late Mr. Charles Elms, was attended with very satisfactory results. I cannot speak too highly of their simplicity and efficiency in dealing with what I may term the bane of an engineer's life—the waste of fresh water.

In those vessels unprovided with a more elaborate form of apparatus I would recommend a trial of this one, which could be rapidly fitted up on board by the engineers themselves; it consists simply of a cylindrical vessel fitted with a steam coil, a guage glass and, preferably, though not absolutely necessary, an automatic valve for salt water supply, otherwise there is just the possibility, through oversight, of carrying over into the condenser the undistilled water and thereby frustrating the object.

A separate condenser with accessories, specially for auxiliary engines is suggested in the paper as a remedy

for this waste of water but I think the benefit would not be commensurate with the outlay and cost of maintenance.

I may be departing from the subject before the Institute, but I would like to state my belief that distilled salt water contains impurities which cannot be removed by any process of distillation at present in use, which in time imparts injury by corrosion to the boiler if *un*protected by a slight *film of scale*.

Mr. F. COOPER
(MEMBER).

It is a pleasure in these days, when the sea-going engineer is having so much more put on his shoulders in the shape of care and responsibility, if not in manual labour, to hear the profession recognised in such a straightforward manner as "improvers." I have often thought - with Mr. Wilson—that a great many of the large shipping companies are too callous in the matter of receiving suggestions from their engineers, more especially their junior engineers. This Institute has already opened the eyes of a good many to the fact that even junior engineers sometimes "strike ile" in their ideas of improving the marine engine.

Mr. Seaton, in a paper read last year before the "Iron and Steel Institute," Pittsburg, N. S. speaks of "the progress that has been made by the marine engineer in the design and manufacture of machinery, whereby the engine of to-day, notwithstanding that it is lighter and even cheaper than fifteen years ago, is worked with less wear and tear and fewer accidents." All the credit for improved running, and increased length of life to both engines and boilers goes to the builder and designer. To the sea-going engineer he will admit *no* credit—*he* has not advanced with the times—nor indeed is he in this regard such a skilful man as he used to be; for Mr. Seaton's words are "Although, from the tremendous demand made for sea-going engineers (so that the supply has not been all that could be desired) the marine

machinery of to-day is probably not in the hands of such experienced and skilful men as then, it does not suffer thereby, while at the end of twelve months' work it is in better order now than was the case fifteen years ago. I do not wish to disparage, by any means, the skill and ability of our sea-going engineers, but I think that I shall be supported when I say that younger faces are to be seen in the engine-room, taking important positions there,than was the case fifteen years ago; that, whereas, then a natural taste and aptitude was a *sine qua non* for entrance into it, it is now flooded to a great extent by young men who simply look on it as being more lucrative than some other professions and trades, to which admittance is easy, have now become."

I do not know from whom Mr. Seaton expects his support in this opinion, I do not suppose it will come from the marine engineer, and I should at least hope it cannot conscientiously come from the shipowner. That there are younger men in charge in the engine-room we do not deny—we should rather proudly admit. The same assertion would be equally true of most other professions, and of the same profession on shore. This is only a natural consequence of the high speed and pressure we live at. At all events we are glad to see that Mr. Wilson does not hold this pessimistic view, for he evidently thinks the sea-going engineer is a greater "improver" than he gets credit for. The system of awards he speaks of is an excellent suggestion, and one that would very soon pay the promoters on pecuniary grounds. It would be eminently fitted to develope the "skill and ability" of marine engineers, and perhaps prove the injustice of such disparaging remarks as Mr. Seaton's. We point to the "Institute of Marine Engineers" as the best possible reply to "Ichabod! Ichabod."

Mr. H. CHISHOLM

(MEMBER).

I have read with interest Mr. Wilson's paper on engine-room practice. And as I am not able to refute

anything contained therein, I will content myself with mentioning that, by the courtesy of a brother engineer, I had the satisfaction of seeing one of the suggested auxiliary condensers at work. The chief engineer assured me that he could run his donkey boiler for a month without the necessity of cleaning it, and at a great deal less cost to the owners than he was able to do before, so I think that speaks for itself. By way of satisfying me he said, "take a look round and see if you can find any indication of waste of exhaust steam." I could not, as it all went back into the donkey boiler, hence a low density and clean boiler, meaning less coal and a saving of labour in boiler cleaning.

I should also say that the circulating water passed through the supply tank, always insuring a good flush in the w.c.'s, etc., in harbour, a very important sanitary advantage at no cost at all.

Mr. Wilson states (and very truly) that water is the bane of an engineer's existence in the engine-room. I feel sorry he did not give us his opinion about water in the stokehole. The hose is often used to wash down the stokehole, as well as to wash out the boilers. In my opinion, wherever a dry brush can be used to get rid of dirt it ought to be used, whether inside or outside the boilers. Water used on iron, coupled with the influence of the atmosphere, especially where the skin of the iron is broken, is sure to augment corrosion.

Another item I would like to hear an opinion on, is whether, with metalic valves in the air pump, it would not be judicious to drain, continuously, all water from the L. P. casing to the hot well to heat the feed water. With metallic valves no injury could be done in the air pump by the high temperature.

Mr. DAVID PHILLIPS
(MEMBER).

Being, I confess, but indifferently acquainted with the engine room practices and improvements of the

present day, there is, consequently, very little in Mr. Wilson's interesting paper that I can offer any remarks upon. Of the suggestions contained in the last paragraph, two are well worth considering, both by the engineers and their employers and I venture to say, should be adopted, perhaps, in a modified form in all vessels having multifarious auxiliary engines and a boiler to supply them with steam in harbour. Whether the steam be obtained from this boiler or the main boilers, the exhaust steam from *all* sources and at *all* times (except the whistle) should be taken care of, and the products—from condensation—returned to the boilers.

When I wrote the circular on the "Protection and Treatment of Boilers," in 1877, I had this very question in view, though I did not go into details as to carrying it out, except verbally; as the following extract will show, viz. : "I would strongly recommend that the boilers, when idle, be kept as far as may be practicable, *full* of water, and the water changed in them, when at work, as little and as seldom as possible, providing the density be not allowed to exceed $\frac{5 \text{ or } 6}{32}$*; for which purpose and also of preventing, as far as practicable, the deposition of scale on the heating surfaces, the *waste from all sources should be reduced to a minimum*," and, of course returned to the boilers, How far this recommendation was carried out, I am not in a position to say; but the late Mr. Malcolm Campbell and Mr. Cameron, Hull, said at the time that should the fresh water system of filling the boilers and discontinuing "blowing off" proved successful, they would consider the question of leading the exhaust steam from the winches, steering engines, &c., to the condenser.

If an independent condenser were supplied, I doubt the necessity of an air pump. A small cock, or automatic valve, to admit of sufficient air into the condenser to destroy the vacuum and a small tank to receive the condensed water, would, perhaps, answer the purpose in

* $\frac{1}{32}$ being considered as equivalent to sea water density of about 5oz. to the gallon.

harbour ; while the donkey bilge pump having a branch suction pipe to the sea and its feed pump (already fitted) might perform the rest of the duties (circulating and feeding).

However, it is obvious that contrivances,such as the author suggests, would go a long way towards keeping down the thickness of sale on the heating surfaces, economizing fuel and preserving the boiler,and I believe, would soon pay for the expense.