MINUTES OF PROCEEDINGS,

12TH AUGUST, 1886.

Walter Shellshear, President, in the chair.

The following candidates were balloted for and duly elected:—

MEMBER:

HY. T. VALE.

STUDENT:

ROBT. G. EDGELL.

Alteration of Section V., Clause I., of Rules and By-Laws.

Mr. Key, for Mr. Cruickshank, moved that the annual subscriptions for members be two guineas, instead of one guinea, to take effect from October 1st, 1886; making Section V., Clause I., read—"Each member shall pay two guineas, each associate two guineas, and each student one half-guinea per annum."

Seconded by Mr. Mountain, and carried unanimously.

The following paper was then read:—

ECONOMY IN STEAM NAVIGATION,

BY WM. S. BAILEY.

EVERYONE connected with shipping is aware of the keen and increasing competition between the different steam companies, especially on our own coast. Such being the case, any possible improvement which can be made, either by reducing the working expenses or by the employment of superior machinery, must prove of interest at the present time.

Frequently a steamer does well and realizes a fair amount of profit while kept running; but the long and frequent periods of idleness, which become necessary to keep her in repair, cause such heavy expenses as to eat up the whole of the previous profits.

In this paper some of the causes will be mentioned which have struck the author as usually producing these expenses and interruptions. The delay necessary to repair a steamer proves especially hurtful to a small company, having few boats, and in which a boat must be chartered to take the place of the one laid up.

As a general rule the most fruitful sources of expense in steamers are the engines and boilers. The hull usually costs little for repairs if kept clean and painted thoroughly inside and outside, before rust and scale have commenced to form. The bilges should also be properly cemented, and care taken to replace any cement which may have been removed either by accident or otherwise.

The spars and running gear in a full-powered steamer are, of course, a secondary consideration, and as day by day machinery becomes more improved and reliable, the tendency is to spar steamers even more lightly than has hitherto been done.

It is questionable whether the fitting of sails to steamers is of any real benefit so far as speed is concerned.

Although the speed is undoubtedly increased when sails are used with a fair wind, still the opposite result takes place in even a more marked manner by the influence of a head wind acting on the surfaces exposed to it by the masts, yards and cordage. And this resistance will increase in proportion to the speed at which the vessel is driven.

Sails are usually looked upon more as a means of safety or convenience to the vessel in the event of her engines becoming disabled. The sails and running gear should therefore not be neglected as is too often done, but must be kept in an efficient state of repair, and in such a condition that they may be depended upon at any moment.

Spars are also necessary in steamers to steady them to a certain extent, and their use for this purpose must remain a necessity as long as hulls are built of the present form.

So far as the form of the hull is concerned, the following are the primary considerations which influence the design, namely :—

Speed.
Passenger accommodation.
Carrying capacity.
Handiness in steering.

And that the vessel may be dry and steady in a sea-way—in other words may be a good sea-boat—the proportions which these various conditions bear to each other will vary according to the trade for which the vessel is intended.

For instance, if it be desired to run an ocean trade where great competition exists and in which numbers of people are travelling to and fro, then speed, together with roomy and elegant cabins, becomes an absolute necessity, and must form the chief consideration.

In such a case the carrying capacity will be comparatively low. The ratio of length to beam being greater, the vessel will not answer her helm so quickly, and, as a rule, will pitch more in a sea, owing to the increased fineness of her lines fore and aft.

If on the other hand the vessel be intended for coasting purposes where good inducement is offered for general cargo, then a fair rate of speed, combined with good carrying capacity, will be found most desirable.

If rivers or bars exist the draught of water will also require to be as small as possible.

In this case the proportion of beam to length being greater, the vessel will answer her helm better, and be more easily handled in a river. She will also be drier and steadier in a sea-way, having a better bearing fore and aft.

A decided improvement has lately taken place by the introduction of triple expansion engines in place of the usual two cylinder compounds. Just in the same way as the old low pressure engines were susperseded by the compound principle with steam of 60 lbs., so the introduction of triple expansion marks another era in the history of the marine steam engine.

By the use of these engines, working at a boiler pressure of 120 to 160 lbs. per square inch, the consumption of fuel has been reduced about 20 per cent.

Simultaneously, with the introduction of these engines, we notice the more general use of mild steel for boiler making, and indeed it is chiefly by the substitution of steel for iron in boilers that the high pres ures necessary to obtain this increase of economy are rendered practicable.

Fox's corrugated furnaces are also being generally adopted in place of the ordinary plane ones, experiment having proved them to be twice as strong as plane ones to resist collapsing strain. While acting to a great extent as stays to the boiler ends, they also accommodate themselves to any alteration of form of the boiler due to unequal contraction and expansion; each corrugation acting in the same way as a flexible joint.

The advantages of this triple arrangement of marine engines appear to be,—

1st. Greater economy of fuel owing to increased expansion.

2nd. The cylinders do not require to be so large in proportion to the power developed as they would be if there were only two. More reliable castings are therefore obtained, and the working parts, such as connecting rods, piston rods, valve spindles, top and bottom end brasses, etc., being lighter, are more readily overhauled when necessary for repairs.

3rd. There being three cranks, the crank pin circle may be divided into equal parts, so that the shafting is not subject to such irregular strains as it is when two cranks only are used. For the same reason the engines are much more easily started and reversed, and may be run at a less number of revolutions per minute than is possible with the ordinary two cylinder arrangement. The weight also of the whole structure being more evenly balanced, less trouble is experienced from racing in a heavy sea.

It is also found that the main bearings in these engines, and indeed all the working parts, wear more equally, and give less trouble. This result is no doubt due to the equality of motion imparted by the three cranks.

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In estimating the economy of marine engines, it must be remembered that, as a rule, increased economy is attended by increased weight. Take for instance the S.S. City of Melbourne, whose engines are of the ordinary compound type, of thirty-six inches stroke, and fitted with an independent expansion gear. When driving full speed with Brisbane coal, she burned four pounds per I.H.P. per hour, the expansion valve then cutting off at twenty-six inches. When the expansion cut-off was altered to six inches, the consumption was reduced to less than two pounds per I.H.P. per hour, the power of the engines being also of course much decreased by the alteration in the cut-off. It is therefore evident that when this ship is working at her most economical point, the weight of her machinery is greater in proportion to the power given out than it is when she is driven full speed.

On the other hand, as the weight of a ship's machinery forms a large proportion of her total load, it may pay an owner to drive his vessel full speed, and get as much power as possible out of the weight of machinery in her; although by so doing more coal per horse power may be consumed. Economy of fuel may be attained in compound engines by making the cylinders large, and cutting off at an early part of the stroke, but this economy does not always pay for the increased weight of the engines.

This is probably one reason why so many compound engines of recent construction have no expansion gear, cut off with the slide valve alone. There has also been a constant tendency to increase the boiler pressure; so that whereas sixty pounds was at one time considered high, it is now a common thing to supply two cylinder compound engines with steam of ninety pounds per square inch. Under these circumstances a high degree of economy cannot be expected, but, as before explained, the engines and boilers are lighter, and take up less room in proportion to the power indicated; besides costing less money to build than would be the case if economy of fuel only was considered. Cases sometimes occur in which it becomes necessary to sacrifice economy to lightness of machinery, as for instance in torpedo boats, or in light draught river steamers.

At this point attention might be drawn to the saving which is effected by those coasting steamers whose engines are fitted with an independent expansion gear. In our coasting trade it is often necessary to reduce a steamer's speed to four or five miles an hour, so that her time of arrival may suit the tide at the port to which she is bound, or perhaps she is obliged to run at such a speed all night to enter the harbour at daylight, as it may not be safe or convenient to do so during the night. This is especially the case with those boats running through Torres Straits, and those engaged in the northern trade. These vessels have often to reduce their speed during the night, and when no expansion gear is fitted, are compelled either to lower the boiler pressure, or slow the engines by closing the throttle valve, or to link up by putting the wheel back a turn or two. These expedients are all undesirable, and opposed to economical working. But when expansion gear is fitted a good opportunity is afforded of saving coal, which saving may subsequently become of importance in the event of head winds or accident. In cases where steamers have to make long coasting voyages, every opportunity should be taken advantage of to save coal, as a much higher price must be paid for it at the coaling stations, than is charged in Sydney or Brisbane. In ordinary working also, opportunities often occur for saving more fuel if expansion gear is fitted, as for example when running before a strong fair wind, a slight alteration of the expansion valve will effect a saving in coal without diminishing the ship's speed to any great extent. It sometimes may be desirable to dispense with expansion gear. A ship's speed may be increased by removing the gear, if the boilers are able to supply the additional steam required. Should the boilers not be well able to do this, it will be better not to make the cut-off too late. The best speed is got out of compound engines when the expansion cut-off is just early enough to enable the full boiler pressure to be maintained. It is a mistake to work with so late a cut-off as to lower the boiler pressure.

One of the worst features in the construction of the usual type of compound engines is the arrangement of the valve gear. This generally consists of common slide valves, actuated by eccentrics keyed on the crank shaft, and connected by means of rods to the well known radial link. Valve gear fitted in this way is a constant source of trouble and expense when a high boiler pressure is carried. It may be often observed, that although the low-pressed link motion will run for twelve months or more without repair, the high pressed gear wears slack in a very short time, owing to the pressure of steam upon the back of the high pressed slide valve and forcing it against the cylinder face. So-called improvements are also introduced in the construction of the link motion, by which the bearing surfaces of the link blocks and pins are made ridiculously small in proportion to the weight upon them, and the gear so complicated as to cost a great deal of time and money to repair.

With moderate pressures of steam these defects were not so noticeable, but as the working pressure became higher, the evil so increased, that various expedients have been adopted to relieve the gear of the great strain thrown upon it by the friction of the valve against the cylinder face.

Piston valves have now to a great extent taken the place of common slides for marine engines, and they appear to answer very well. As they work with an equal pressure of steam on each side they are held almost in equilibrium, the only strain on the valve motion and eccentrics being the weight of the gear itself. These valves also cost less for repair, as all the work may be turned out finished from the lathe.

Another very ingenious method is that adopted by Messrs. Key in the steamers built by them. The slide is here made to work between two cast iron cheeks projecting from the cylinder face, and bolted to it, and in which the steam ports are formed. The slide is thus enabled to work almost free from friction, the pressure on each side being equal.

This form of slide has not only stood the test of practice but has given excellent results. In several vessels well known on this coast, these slides are fitted, and have given the greatest satisfaction. Not only do the eccentric straps run perfectly cool, but each time the covers are taken off, the slides are found steam tight, and the faces both of valves and cheeks showing a first-class surface. It may also be seen that should it become necessary to true up the cheek faces, this may be readily done by removing the cheeks and planing them in the machine, instead of the tedious and expensive method of chipping and filing which is usually practiced when the face forms part of the cylinder itself.

The weight and size of the valve in this arrangement is also much less than that of a common slide.

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It is often the practice when comparing the results in economy obtained from different engines, to leave the boiler out of the question altogether; whereas in many cases in which the results are not so good as expected, the boiler power will be found deficient.

For example, in one of our coasting steamers burning Brisbane coal, it was found that when steaming easily, say eight knots an hour, the weight of ashes from the fires formed seven per cent. weight of coal burned; but that when driving full speed (twelve and a half knots) the per centage of ashes and clinker was as much as twenty per cent., thus showing how much of the useful ingredients of the coal is wasted by forcing the fires. So that when a comparison is made between two engines the boilers should always be taken into consideration. Thus, if the results obtained from two sets of engines be compared, and in one instance the boilers be made large enough, and in the other case too small, the worse result will probably be obtained from those engines supplied by the small boiler, although the engines themselves may be really superior to the others in point of economy.

The importance of having boilers made sufficiently large cannot be overrated, and most of our colonial steamers lose far more by insufficient boiler power than in any other way.

This subject seldom appears to receive the attention it deserves. Attempts at economy appear always to be directed to the engines, while the boilers were by far the greater amount of waste takes place are comparatively neglected.

Perhaps this deficiency of boiler power in our colonial steamers is due to the inferiority of our coal as compared with that obtained in Britain; but, however this may be, it is certain that much needless waste takes place through this cause.

Although boilers may give every satisfaction on a trial trip when everything was in first-class order, the tubes and heating surfaces clean and free from scale and soot, it is a very different thing to get steam from the same boilers when the ship has been even 24 hours at sea, and the fires and tubes have become dirty.

Before having been six months out of dock it may be safely stated that it is not an uncommon thing for our coasting steamers to lose a knot an hour in speed through this cause alone; no allowance having been made when designing the boilers for accumulation of scale on the heating surfaces, dirty fires and tubes, inferior coal, for leaks in the boilers, or for engines passing steam by leaking slides, pistons, &c.

It is the usual practice on this coast to clean two fires out of every eight each watch; that is, in a vessel of say 200 nominal horse power having eight fires, two of those fires are drawn completely out every four hours.

This practice is rendered necessary by the accumulation of ash and clinker in the fires, and which can only be got rid of in this way. The ship's speed is of course reduced while the fires are being drawn and made up again.

Two fires out of eight is the usual practice.

In one case within the writer's knowledge four fires out of eight are cleaned every four hours. That is to say, the boilers are so deficient in steaming power, that half the total number of furnaces must be drawn each watch, the cold air meanwhile impinging on the surface plates, combustion chambers and tubes, while the adjacent fires are at the same time worked to their greatest power, to make up, as far as possible, for the loss of heat sustained by drawing their neighbours. The unequal strain thrown on the metal of the boilers by this action is apparent, to say nothing of the shameful waste of fuel, caused by throwing overboard every watch so much useful coal as is contained in four furnaces in active combustion. Under such circumstances as these, it is absurd to expect economy.

On the other hand, where the boilers are made of ample power, the following advantages are gained :—

1st. A considerable decrease in the consumption of fuel, as the fires do not require to be cleaned so often. They do not require so much forcing, so that the coal consumed is better used up instead of being wasted through the bars and out of the funnel, as is done by constantly working the fires. A cheaper quality of coal may also be used, thereby affecting a saving; and the furnace doors not being opened so frequently, less heat is wasted in this direction.

2nd. The boilers not being subject to such sudden and unequal strains are less liable to leaks and cracks, and the heating surfaces and uptakes will not be so rapidly burnt away. The boilers, therefore, last a great deal longer, work more satisfactorily, and cost less for repairs. As a rule, too, a better quality of steam will be supplied to the engines, and having always a good command of it, no necessity will arise for easing them at any time, but they may always be worked to the full extent of their power, thus ensuring quicker and more regular passages.

The internal construction of boilers should also be such as to give ample room for men to work in removing scale from the tubes and backs of the combustion chamber, and from between the furnaces. By making marine boilers in this way, not only is the expense of scaling them from time to time lessened, but a better circulation is obtained, and a better quality of steam is supplied to the engines, the water having less tendency to lift and find its way into the steam pipe.

For the same reason a fair amount of space should be left between the tubes, it not being an uncommon thing to find these spaces so blocked up with scale as to defy all efforts at removal.

Also, if the tubes themselves be made large in diameter they will last longer, less difficulty being experienced in keeping them clean and free from salt in the event of leakage.

Where small tubes are fitted to marine boilers, numbers of them frequently become choked up, thereby reducing the heating surface and efficiency of the boiler, and defeating the very object which led to their adoption.

Another cause of expense and trouble is the practice of fitting marine boilers with what are known as wet uptakes. In this arrangement the uptake itself, which is made circular in form, is carried up from the front of the boiler to the funnel in the usual way, and strengthened by angle irons rivetted round its outside surface. Round this again the superheater is built, it being also circular in form, closed at the top but open to the boiler at the bottom, so that the steam entering the annular space absorbs a great deal of the waste heat ascending from the fires, before it is allowed to pass to the engines.

The disadvantages of this form of uptake are that it adds greatly to the weight and cost of the boilers at first, and is troublesome to keep clean, but the chief objection to it is the rapidity with which the angle irons and surfaces of the uptake are destroyed by the action of the steam on one side, and by that of the fire on the other, and the consequent repairs and expense which after a time become necessary; also, the danger of explosion by collapse of the uptake, it being subject to the same collapsing strain as that of an ordinary furnace tube.

It is surprising how quickly the angle irons are eaten away by the steam impinging upon them in its passage, and as the inner surface of the uptake is also exposed to the action of the fires, the amount of wear is doubled, so that one set of boilers will usually last out two sets of superheaters when fitted in this way. Accidents have also frequently occurred by the uptakes collapsing.

A much better and safer plan is to make the superheater in the form of an ordinary drum or dome, and to place it between the uptakes. By this means the total weight and first cost are lessened, all the parts are easily kept clean, and will last as long as the boiler itself, there being little corrosion going on. There is also no risk of collapse.

Of course, by using the first mentioned kind of superheater the steam is heated to a greater degree, and the waste heat is better used up, but the extra expense and risk involved far exceed any advantage gained in this way.

The second method, namely, that of making the superheater in the form of a drum separate from the rest of the boiler is found in practice to be much better; indeed if the steam pipe be of ordinary length and well lagged, little advantage is gained by carrying superheating to a great extent.

In some instances much injury has been done to slides and cylinder faces, pistons and packing, by using highly superheated steam, and which has been too dry. In the ordinary way of working a quantity of moisture is constantly passing through the engines along with the steam, and may be seen running down the rods when the glands are slack.

There is no doubt that in most marine boilers a kind of slight priming is continually going on, the moisture from which acts as a lubricant to the internal working parts, and preserves the surfaces to a great extent. Of course this moisture in the cylinders may result from condensation of the steam after it leaves the boiler, as, for instance, from the use of long and unprotected steam pipes, and although theoretically speaking any water passing through with the steam is a source of loss, still a slight amount of moisture in the steam is most beneficial to the smooth working of the engines, and where the steam-pipe is of a reasonable length, and protected by felt, the steam is super-heated quite sufficiently by placing the superheater in the uptake as described.

When the steam is moist and care taken to keep the packing glands properly adjusted, the valve spindles and piston rods will run without any other lubricant than that contained in the steam itself. The practice of swabbing the rods may therefore be done away with, so that oil is saved and the engine-room and bilges kept clean.

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It was at one time the custom to inject quantities of oil or tallow into cylinders and boilers, but this practice is now rapidly dying out, experience having proved that it is not only wasteful, but injurious to the metal, and that it also chokes up the boilers, cylinders, and condenser with grease, impairing their efficiency, and increasing the cost of cleaning and repairs.