OUR COLONIAL-BUILT HARBOUR STEAMERS.

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In bringing this subject before the association the author desires chiefly to consider what progress has been made during the last twenty years in the construction of our harbour steamers, and to suggest in what direction there is room for further improvements which would render them more suitable for modern requirements. To do this it will not be necessary in the scope of this paper to enter into detailed calculations, but simply to look at the benefits derived from the improvements of the past, and see how they may be advantageously applied to our own steamers.

This subject opens up such a wide field, containing as it does so many and various matters affecting it, that the author feels he cannot give the numerous points the individual attention they deserve, but, being aware that many of our members are conversant with its various aspects, hopes that it will evoke a good discussion, which may prove beneficial.

Our newest paddle ferry steamers are not what they ought to be. Their machinery is bad in principle and unsuited for the work required of them. In endeavouring to prove this, the writer believes that although he may meet with some opposition, he will no doubt have a counterbalancing amount of support before being called upon to reply to any criticisms.

About 25 years ago there were only six or seven ferry steamers—all paddle boats—running on the waters of Port Jackson, the two of most improved construction at that time being the "Alma" and "Herald." The former, which was built of wood, till about six months ago was running successfully on the Hawkesbury River. The latter was an iron boat, imported and put together here. They both steamed from 8 to 9 knots an hour, and had diagonal high-pressure engines exhausting up the funnel. They had circular boilers, with through tubes, and carried a pressure of about 50lbs per square inch.

Let us now look at the progress we have made in the models of steamers since these vessels were built. From what we see of the old boats, it appears to have been supposed that a good floor was essential, and, as speed was necessary, the vessels were made narrow, with the ends sharpened off, producing a good wedge-shape. This rendered them very unstable, and they had a strong inclination to remain anything but perpendicular with even a small load of passengers on deck. This model is gradually going out, and it is being realised that to insure a staunch boat the displacement must take place further from the ship's centre when she is listed, or, to take a common illustration, the difference in section is as that between a square box and a basin. In the one case the metacentre is almost stationary under all conditions, while in the other it moves from side to side as the vessel lists, and gives the long end of the lever to the high side. This improvement has to some extent been brought about by scientific knowledge, but chiefly from the increased facilities for practical experience, and there is reason to believe that our modern built screw steamers will bear comparison with those in any part of the world. It is now understood that a waterman's skiff has more stability, more room, and is altogether better adapted for our requirements than anything in the shape of a small ship. Here it may be stated that the author has long been of opinion that the day will come when our ocean steamers will be more of this form, and he considers it would be preferable to the square wall-sided tanks that it is now the practice to build. Even with the weight of their engines and boilers to balance them they now require a second bottom some feet above the proper one, and the intermediate space filled with water to make them stand upright, although their top weight, in the shape of spars and rigging, is comparatively a trifle. To propose constructing a large steamer more after the shape of a skiff would no doubt give rise to all sorts of imaginary obstacles, such as the awkward shape for internal accommodation for passengers and cargo, or for convenience for berthing at a wharf. Such objections could probably soon be overcome, and it appears that a vessel with fine symmetrical curved lines would be a much stronger structure than the present ocean waggons. It has taken us since the days of Nelson to bring ship's sides from falling inwards to being almost perpendicular, and a much shorter time will probably see them inclining outwards, and our modern box-girders with pointed ends will appear as antiquated as the old "Dreadnought."

Let us now turn to the various merits of wood, iron, and the composite system for the construction of our harbour steamers, from which it seems that iron and steel are not used to such an extent as their present low prices and superior suitability jutifies us in expecting. Hard wood crooks are naturally becoming scarce near at hand, and the necessity of going further into the bush to obtain them renders them more expensive, while on the other hand the price of metal has been steadily falling. Our slips and docks are getting more numerous, and are likely to continue doing so, which will tend to reduce the cost of keeping iron bottoms clean. Constant experimenting is going on with a view to getting a better anti-fouling paint than the orthodox "Peacock," and it is to be hoped that they may result in success. Iron and steel have the great advantage of not becoming sodden and heavy in the vessel's bottom, and dried up and open on the top sides, which is a great point in their favour compared with wood. Those conversant with the subject must have noticed that excessive corrosion, either internally or externally, is in nearly all cases due to sheer neglect or parsimony on the part of owners. Corrosion always takes place where the metal is boxed in with wood, which retains the damp, and, as in ferry boats, the space below deck is seldom used except for engine and boiler, there is no reason for closing in the sides. It is a noticeable fact that where there is a free current of air under cover there is little or no rust, and also that when the bottom inside is well covered with cement and the outside properly painted before rust has commenced, the plates will last an indefinite time. The writer has seen cement taken off the inside of a ship's bottom at the end of twelve years which disclosed the original "bloom" still on the iron, and on scraping the outside of the vessel the original paint marks on the plates became visible. Wooden frames steamed and bent are much used at present in the construction of the smaller class of our harbour steamers, but it is questionable if this mode of construction could be utilised for steamers of the size likely to be required in the future. Several vessels have been recently built on the composite principle, which have proved light in construction and satisfactory in many respects. Wood and iron, however, are bad partners under water, and contact is invariably formed between them and the sheathing metal, which soon results in the total destruction of the iron where that is the case. A coppered bottom is nevertheless necessary where the bottom cannot be got at to be cleaned, but any-one planking iron frames now, where a dock is available, will, there is good reason to believe, regret before many years that he did not plate them.

Passing on to the design and construction of our modern boilers, we see that our screw steamers, which have practically come into general use during the last twenty years, have boilers of a shape suited to them. These boilers are nearly all circular, with circular furnaces, wet combustion chambers and return tubes. Their total length is about eight or nine feet, and working pressure from 60 to 120 lbs. However, as we are dealing chiefly with paddle steamers, as the most suited for harbour ferry service, we may write down the improvements in their boilers as a cypher. No doubt they are larger and stronger than formerly, carrying an increased pressure up to 90 lbs. per sq. inch, and modern appliances enable the constructor to put in better work. But placing the boiler of 20 years ago and our present one side by side, the only apparent difference is that the latter has double rivetted longitudinal seams, spring safety valves, and is generally constructed of steel. Perhaps we could not have done better, but it is a remarkable fact that in the design of boilers for ferry steamers we have stood still for many years.

We now come to engines. As our screw steamers are now gradually being constructed with double cylinder, surface condensing engines, which, being economical and effective do all that is required of them, we may pass them by and come at once to paddle engines.

If anyone asked why we have single cylinder engines in all our ferry boats, the most honest answer would be that the old "Alma" had a single diagonal engine, and that being a success in its day, we have been blindly following and enlarging on the same pattern ever since. It is a fact that during the last two years several ferry steamers have been built with a common diagonal high-pressure engine, exhausting up the funnel, similar in every respect to one built on Peacock's Point, Balmain, 30 years ago, except that the cylinder has been increased in diameter from 13 to 19 inches, the stroke from 2 to 4 feet, and the pressure from 40 to 80 lbs., the boat being about eight times the size. It is true that in some of our paddle engines the tandem system has been adopted, a high-pressure cylinder being put at the back of a low-pressure cylinder. A surface condenser has in some cases been added, and these improvements are gratifying, as showing that modern mechanical civilisation has in some instances pierced with a ray of light the darkness in which so many steamboat men are content to dwell. The fact, however, remains, that in our harbour, with a constantly increasing traffic, and steamers continually crossing and coming nearly in contact with one another, not one of them can reverse their engines at once, but must stop and wait till the way is about half off the vessel before they can go astern. Contrast this with a screw steamer the author tried some time ago. She was 100 feet long, steaming 12 knots an hour, and was brought to a standstill and went astern in about 180 feet. She had a pair of compound condensing engines capable of being started and stopped by a boy, and did not require a man to pump at a heavy starting lever for every half stroke made.

A mechanical success, however great, often remains unappreciated by the general public, even though it be also a financial one, on account of its higher first cost. As an instance we may call to mind the bronze propellers introduced about three years ago, and acknowledged beyond doubt in three of our large ocean going steamers to increase the speed a knot an hour, or give a saving of 15 to 20 per cent in fuel, and yet they have not been adopted except in a few rare cases, the first cost frightening shipowners.

The compound principle has now so thoroughly established itself all over the world, and the relation of first cost and after expenses is so well understood, that one can hardly understand an engine for commercial purposes being made in such a primitive form as is adhered to in this colony, save on the ground that there is a certain feeling of security in employing something similar to what one has been accustomed to. But such is a poor reason for declining to adopt changes which have proved a marked success elsewhere.

In the construction of an engine, we, as engineers, know that one of the principal objects is to get the greatest effective power for propulsion, and that all unnecessary weight in the moving parts is robbing one all the time the machinery is in motion. Speed, consumption of fuel, and the comfort of passengers, all require great consideration, while the cost of repairs, and time lost in effecting them, are very important items. Some of the above points appear to have been much ignored in the construction of our paddle steamers, and we will now endeavour to see in what way.

A single engine, as we are aware, exerts its greatest power when the crank is almost at right angles to the piston rod, the power gradually diminishing towards the ends of the stroke where the momentum of the paddle wheels carries the crank over the dead centres. By substituting a pair of engines with cranks at right angles, the strain on the shaft would be nearly equalised and approximately continuous throughout the whole revolution. In the latter case a much lighter shaft would be sufficiently strong and safe on account of not having to stand the intermittent strain which takes place twice in every revolution of a single engine. The paddle wheels also for a single engine have to be much stronger to allow for the variable power applied to them, and, in addition, are frequently thrown out of balance by heavy cast iron floats intended to reduce the chance of the engine sticking on the dead centre. In boats fitted with a single engine the time lost in coming alongside a wharf is very considerable, but cannot be avoided, as the driver must make sure of his engine going astern when required. This materially increases the time of transit, and, with two or three wharves to call at, causes considerable delay. This loss of time may some day prove fatal in the event of a collision; a contingency which is daily becoming more probable from our fast increasing traffic and higher speeds.

It appears to be the impression with some engineers that slip in a paddle wheel is not all loss of power, for not long since a firm in this city reduced the size of the floats on a pair of paddle wheels to enable the engine to get away faster and develop more power, on the supposition that greater speed would be attained. This seems contrary to mechanical principles in anything like reasonably proportioned wheels. The crank, crankshaft and paddle wheel form a circular or continuous lever, the crank pin being the power end, the crank-shaft bearings the connection with the weight to be moved—that is, the boat—and the water the fulcrum against which the long end of the lever in this case acts. The average thrust exerted on the boat is arrived at by multiplying the pressure on the piston by twice the length of stroke, and dividing by the circumference of the wheel at about the centre of the floats. Anything like an equal thrust, however, is only due to the weight of the wheels and their velocity. If another engine of equal power were added, with the cranks at right angles, the power would be doubled, while the strain on the crankshaft would be about the same as before, owing to its being continuous. Supposing a cogged wheel working in a rack took the place of the paddle wheels and water on which they act, we should then have the whole power of the engine, minus the friction exerted on the boat, as our fulcum would be solid. With water, however, we have a yielding body to deal with as a fulcrum, and the smaller we make the floats the more slip there is, which, in the vessels we are considering, amounts to from 30 to 40 per cent. under the most favourable circumstances. This lost power is exerted in giving a backward velocity to the water in contact with the ship's side through which the after part of the vessel is passing, and this considerably increases the frictional resistance of the vessel. There is also another way of looking at the loss or slip when experimenting in cutting down floats under the impression that more revolutions will give increased speed, and that is, the greater the velocity of the piston the more steam will be used, and consequently a lesser pressure will be obtained, which will give a reduced thrust on the paddle shaft bearings to propel the vessel.

Considering the size of the paddle wheels themselves, to which no doubt is attributable a great loss of power, we find they have been made small in diameter in order that passengers may not be inconvenienced by the shaft coming above the deck, while in some instances it is only a little above the deck line, and the wheels are all too narrow to obtain a fair amount of float surface. Some recently constructed are notable for this defect, which is probably due to a desire to keep down the width of the boat over all, for convenience when alongside a wharf. These specimens of modern steamboat construction may be seen any day with their floats entering and leaving the water at an angle of about 45 degrees; the entering floats tending to lift the vessel, while the emerging floats tend to depress her in the water, thereby wasting a large amount of power. In the endeavour to obtain resistance so many floats are put in these wheels that none of them get solid water to act on, each being in the broken backwater of the preceding one. When anything like full speed is put on, they may be seen splashing round in a manner which gives one the impression that they were specially designed to knock the water about, instead of to get a solid hold and propel the boat. We can imagine what would be the result if our champion sculler were to reduce the blades of his sculls to three inches wide, and compare such a supposition with the paddle wheels referred to.

The two methods adopted elsewhere to prevent loss of power have been entirely ignored on our ferry steamers, viz., increasing the diameter of the paddle wheels and using feathering floats. The first of these plans is chiefly employed in America. There the diameter of the wheels is so great that passengers on the main deck walk under the paddle shaft. This allows the floats to enter and leave the water nearer the vertical position, and puts so many floats in immersion that the loss of power is very much reduced. It may be pointed out that these American boats are very fast and have single cylinder engines, but we must bear in mind the altered condition under which they work.

It is the writer's opinion that the loss of power in our paddle boats may safely be put down at about 40 to 50 per cent. as compared with our screw steamers. The maximum speed of the former seldom reaches 10 knots under the most favourable circumstances, while 7 to 8 knots on the ferries is certainly quite as much as they average, although they are all built for speed, and may be considered full powered. With our screw boats of the same size it is no uncommon thing to average 11 knots all the year round, which gives about 40 to 50 per cent. loss for paddle steamers as compared with the screw.

It is difficult to understand why none of our boats are fitted with feathering paddles, unless we accept the conclusion that it is simply because the old boats were without them, and their example has been blindly adhered to. Every engineer knows that feathering paddles are undoubtedly the best, and our steamers have reached such a size to justify their use in almost every instance. Some may say that they would be liable to damage by bumping at the wharves, but it is not necessary for the feathering gear to be connected at the paddle-boxes as it may be on the side of the wheel next the hull.

When we see one company sending home for new feathering wheels for an old boat that had worn hers out after about 25 years' service, and other companies still constructing larger steamers with wheels of the old type, we are struck with the difficulty of getting people to make a change from what they have been accustomed to.

It occurred to the writer when thinking of paddle wheels to see what Seaton had to say on the subject in his manual of Marine Engineering, and one cannot do better than quote from him. He says: "Paddle wheels with radial floats are now but seldom employed, and only in tugs where prime cost is a paramount consideration, or in small river steamers, having comparatively large diameter of wheels and a small amount of dip, or for service in barbarous countries, where simplicity and a minimum risk of derangement is a necessity." Another authority, Sennet, in his work on the marine steam engine, published in 1885, when speaking of radial paddle wheels states: "The extreme width of the floats should not exceed one-half the width of the vessel, so that the combined width of the two paddle wheels should not be greater than the width of the ship. In sea-going steamers the width of the float does not generally exceed one third the width of the vessel. In still water the greater the width of the float the more effective the wheel, as the required area of race can be obtained with less immersion, and the loss from oblique action is thereby reduced." As a contrast to the foregoing, the following are the dimensions of the latest colonial production: Beam of boat, 18ft.; width of each float, 42in. by a depth of 18in."

It may be as well mentioned that the owners are in no way indebted to any engineering skill for this particular part of the work, but have grown into it from their own knowledge and experience.

It must not be imagined from the foregoing remarks that all our colonial built paddle steamers are equally mechanical failures, for, as has been already pointed out, a few have shown an advance in the right direction, but the majority are of the most primitive description, with no evidence of progress or improvement about them.

It is astonishing how the possession of a few shares in a steamboat company seems to make people consider themselves qualified to give opinions on the best design and proportions for the construction of a steamer. The employment of professional men, who start and get out all their proportions from a basis, and furnish a set of drawings, with weights, displacement, &c., carefully calculated, is ignored by such an individual. When he is looking after the construction he tries to get the information he does not possess by fossicking among people who he imagines know more than himself, and it is hardly necessary to say that the information so obtained is generally about the same value as the price paid for it. As orders are given on specifications which contain few details, and as the lowest tender is accepted, old patterns, cast iron cranks, and many other things that destroy the mechanical beauty and efficiency of the engine are used

It reflects very little to our credit that a rule and sketch book on board another steamer seem to have often played a prominent part in the design of some of our steamboat engines, professional etiquette having been at even a lower ebb than mechanical skill. The author could point to engines, made by different firms, in boats on Sydney harbour that are a great deal too like one another to be above suspicion, and if one is not a direct copy there must have been a wonderful similarity of ideas on the part of the designers. With one exception, all our paddle steamers are fitted with cast iron framing to their engines, which in itself is not up to the standard of engines afloat in other countries; cast iron being avoided as much as possible in high-class machinery. We have good specimens of diagonal engines afloat on the harbour, but these are not copied, as the first cost seems to be the main consideration with some people, who cannot see that what they get cheap is not always profitable.

In conclusion, seeing that our ferries have no opposition, the writer is of opinion that the travelling public are entitled to more security from accident than is given by an engine that will not reverse and a hull without watertight compartments, which only requires to be pierced in one place to let the vessel fill fore and aft and sink.