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Major-General P. K. M. Skinner C.B.

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discussion has been to-night, it must be attended with advantage. Different views are put forward, and being discussed in a friendly spirit, the result must be advantageous to the Naval service as well as to the country. It is with this special object that the Council invite gentlemen to lecture in the theatre of this Institution. I have now to ask General Skinner to explain the principle of his propeller.

ON A CYLINDRICAL PROPELLER, WORKING ON A VERTICAL SHAFT IN THE MID-SHIP SECTION OF A SHIP.

By Major-General P. K. M. SKINNER, C.B.

MR. CHAIRMAN, LADIES AND GENTLEMEN,

I WOULD invite your attention for a few moments, while I do myself the honour of offering some remarks on Steam-ship Propellers, and of submitting to your criticism models, which incorporate an idea that is destined, I believe, to effect a great improvement in the propulsion of steam-vessels.

I present to your notice a new description of propeller—I say new, because it is my own invention. I have searched diligently to discover whether I have been treading in the footsteps of others, or infringing rights to which I have no manner of claim, and I am happy to declare that I can discover no description of propeller similar in form or action to the one I have the pleasure of making known to you this evening.

All propellers hitherto designed, depend on the horizontal principle of action, excepting, perhaps, Ruthven's hydraulic propeller, of which I have no information; all are fixed on a horizontal main shaft. This, although the plan that first suggests itself, involves, in practice, many difficulties and much loss of power.

With the ordinary paddle-wheel, there is loss of power, and a tremor caused through the ship as each float strikes the water; the corresponding loss of power as each float resumes the horizontal position on emerging; the impossibility of keeping the vessel in such good trim, that both paddle-wheels shall take sufficient water, and no more, too deep an immersion wasting the engine power, and too little merely throwing up the water without driving the ship—these are matters that I need not enlarge on; they are difficulties inherent in the construction of paddle-wheels, and which have been only partially overcome by feathering paddles and similar expedients.

We may state, then, that for all sea-going vessels, where economy of fuel must be considered, and the combination of sail and steam maintained, the screw-propeller has superseded the paddle-wheel. The screw propeller does not, however, convey to our minds the idea of a perfect machine. It is placed at the end of a long shaft, resting on bearings, which, to ensure the correct working of shaft and screw, must always remain true; and it is known that on several occasions the screw, or boss with its fans, has been broken off and fallen into the sea, leaving the ship unable to pursue her course, as far as steam power is concerned. The shaft passes through a water-tight (or sup-

posed water-tight) stuffing-box, and may, in case of strain or fracture, so injure or enlarge the aperture in which it works as to endanger the safety of the ship; or it may possibly be removed from its place by fracture, and thus leave a large opening for the sea to rush in; and, in the twin screw-ship this danger is doubled. It is not improbable that several of the screw-propelled ships that have gone on distant voyages, and have not since been heard of, have been lost in this way.

When a screw-propelled ship pitches in a heavy sea, it not unfrequently happens that the screw is lifted clear of the water, so that the faus spin round with great rapidity, and then comes a terrific check to the engine as the screw plunges deep into the sea, and receives a shock tending to injure the machinery and strain the shaft. Again, the action of the screw in the same water as that acted on by the rudder, makes steering sluggish: nor is the reverse action of screw propellers satisfactory.

In a ship rolling heavily, the paddle-wheel proves a very defective propeller. At one time lifted entirely out of water, and at another almost submerged, the wonder is, how the vessel advances. In my propeller, under all circumstances the blades are constantly immersed, either partially or entirely, so that all liability of the racing of the engine, as it is technically termed, is in consequence avoided; and when the blades are totally submerged, the action of the propeller is increased; nor is any leakage to be apprehended from this cause, for no water can find its way into the hull of the ship by the aperture through which the main shaft works, no matter how large it may become, for it is placed high above the water line.

I claim, then, for my propeller the advantage which the paddle has over the screw, in being placed in the best part of the ship, where both the vessel is strongest, and where the propeller imparts motion to the ship at the best advantage; where, in fact, by propelling on one side, and reversing on the other, the ship will be turned in her own length. In reversing, the action of my propeller is just as immediate as that of the paddle, and far better than that of the screw.

I claim over the ordinary paddle the advantage of not losing the power it does in the immersion and emersion of its floats. I retain the advantage which the screw has over the paddle in fixing its blades under sail, with the additional advantage that the blades of my propeller can be fixed fore and aft on a line parallel with that of the keel—a position that offers no resistance whatever to the impulse obtained from the sails, and, finally, I lay claim for my propellers to an immense advantage over both screw and paddle, namely, that if one is disabled or injured, it can be hoisted on deck, repaired and replaced at sea, the ship continuing her course in the meantime with the other, by the aid of the rudder.

The propeller which I shall now describe consists of a drum or cylinder, placed on each side of the ship in a vertical position, with a wheel on the head of a shaft, driven by a wheel, attached to the main shaft, which may either be horizontal or vertical, according to the description of engine and driving gear employed. (In my models and diagram the main shaft is horizontal.) And here I shall remark that it is

not necessary that the main shaft should be placed directly athwart the vessel, as required in a paddle ship, nor directly fore and aft, as required with a screw, but in whatever direction it may be convenient to

place them to suit the engine. The working models before you have their main shafts oblique to the keel of the vessel.

In the drum and passing transversely through its centre and throughout its whole depth, is a traversing blade or fan, the ends of which are so guided by an oval rib or guide, that in every revolution of the drum each end is alternately pushed out and brought back in such a manner that it is pushed furthest into the water at the point of the revolution where it acts most favourably for driving the ship forward.

To overcome the friction of the lower edge of the blade, due to its weight, I sling it from the top, so that horizontal motion is perfectly free, and to remove any side friction there may be against the sides of the slot I place friction rollers at top and bottom.

This model is on a scale of half-an-inch to a foot, so that, in reality, this drum represents a drum 10 feet high, and 6 feet in diameter, and the width of the fan or blade 4 feet, which would give an area of 10 feet by 4 for the blade, when acting at its best.

With regard to speed, as each revolution of the drum is equivalent to a forward motion of 24 feet, and as there would be no difficulty in giving the drum a velocity of 60 revolutions to a minute, a speed of 15 miles an hour may be counted on, for I do not see how any appreciable slip will arise.

As this model has been tried in the water on several occasions, and, though moving rapidly, the water has been but slightly agitated by the propellers, I might suggest the adoption of this description of propeller for ships navigating the Suez Canal, where water much agitated has a tendency to destroy the banks.

I would only say in conclusion, that each point connected with this invention has been the consideration of many years, indeed, far more carefully considered than this meagre description would lead you to suppose, and many trials have been made of working models during that time, and up to the period of the completion of these now presented to your notice. These models give every promise of the sufficiency of the design, and have suggested no difficulty.

Admiral INGLEFIELD : How far below the water would the top of the aperture for the propeller be ?

General SKINNER : It would be 2 feet below water. But if I were to build a vessel, I would make it still lower, and would make the propeller smaller. It does not require so large a propeller as that, and then the propeller would be much more under water. The ship would draw 18 feet of water.

Admiral INGLEFIELD : I asked the question, because a man-of-war in rolling always exposes the paddle. What would be the effect of shot striking your propeller ?

General SKINNER : I would place the propellers much lower. I think the propellers are too long. You would have one advantage by having them not so long that you might have them continually under water. But this is not intended for a man-of-war alone : it is intended for merchant ships.

Captain HEATHORN, h.p. R.A. : Could you not multiply the propelling power of that blade or fan by which you propel the ship, by increasing the number of drums, if necessary ? If you wished to reduce the drums in depth, could you not get the same power by increasing their number ?

General SKINNER : You might do that, but I think it would take up too much of the vessel to put a drum here and a drum there.

Captain HEATHORN : But it might be done in order to do away with the difficulty of bringing the top out of the water, and so exposing the propeller to shot.

Mr. STERLING LACON : Can you give us the result of any experiments on a larger scale than those made with the models on the table ; because there is a vast difference between theory and practice ?

General SKINNER : No, I am unable at present. I am now building a boat 12 feet long. I can only say I have had the model of a twin-screw propeller that I built 13 years ago, and it did not go faster than this, although it went very rapidly indeed. The model is now in the South Kensington Museum, I sent it to the Admiralty, and the Admiralty kept it about two years, and then said it was useless.

Mr. MACKIE, C.E., asked if the inventor had estimated the amount of floatation power lost in the vessel by taking the slice out of her midship area for the access of water to the propellers ?

General SKINNER : There has been no calculation made of that nature. But then you give a ship of this kind great breadth of beam. The length is a little more than four times the breadth. This model would represent a ship of 176 feet long by 42 broad ; and this form of the vessel would be an impediment to her rolling.

Admiral INGLEFIELD : Is it imperative that the apertures should be exposed ? Could not the propeller be protected by armour plating outside ?

General SKINNER : I have had one that was protected, but it was too much enclosed. The fans would not have free access to the water if they were enclosed.

Admiral INGLEFIELD : But if there was a channel through which the water could pass.

General SKINNER : I scarcely think it would answer.

Admiral INGLEFIELD : It is suggested that by armour-plating the propeller might be protected.

Captain SELWYN, R.N. : There are several engineers present ; there are also a good many naval architects ; and I have waited in the hope of hearing some refutation from my brother officers of what, I for one must say to General Skinner, requires very deep consideration. I am afraid it should go out from this meeting of our Institute, that we encourage an inventor to come forward and to propound to us what the shipbuilders, engineers, and naval Officers who are conversant with steam, must know is a proposition to retrograde, exactly in defiance of all our laws of mechanics, of everything that we have done yet, and go back to a bad implement, badly placed, worse-placed than ever it was before—and to sacrifice for the sake of doing so a large proportion of the tonnage of the ship, to sacrifice for the sake of doing so all possibility, at high speeds, of the water ever getting to the motor at all. We cannot for an instant suppose that this is a thing which has not been considered before, because all of us here know very well that such ideas have been before the world many times. I am most reluctant to be obliged to say what I have, but I should also be very sorry that the sanction of this Institution should in any way be given to what I am afraid we must pronounce a great fallacy.

Captain HEATHORN: May I be so bold, as a soldier against a sailor, to ask on what grounds Captain Selwyn pronounces that this is so heavy a failure. We are ignorant, and would like to know. There is no doubt of this, that it has an advantage over the old paddle-wheel, in this respect, that after it has given the blow it has not to strike the water down. Again, as regards other propellers being fixed in the sponsons of ships in this way, the first screw propeller that ever came out, which answered very well in model, (for it has never come to the front,) was a vessel with screw-propellers put in the sponsons, very much where paddle-wheels are now placed. They worked independently, and vertically on each side, and they answered exceedingly well in the model. Therefore, vertical machinery to work a vessel has not altogether failed. This is a paddle-wheel (as far as I can see) which does not possess some of the demerits of the ordinary paddle-wheel. And the fact of your being able to repair it and refit it under certain circumstances appears to me very practicable. But before a gentleman of such great experience as Captain Selwyn completely runs it down before this audience—for I am sure there are many soldiers in the Army who do not know anything about ships—I think he ought to explain to us a little more what its demerits are.

Captain SELWYN: If the Chairman and the meeting are of opinion that I should proceed to explain the reasons why the thing cannot operate properly, I shall be most happy to do so.

The CHAIRMAN: I am afraid that if we begin to discuss the merits and demerits of every statement that Captain Selwyn has made, we shall be a long time in coming to a conclusion. If the Board of Admiralty took two years to decide upon the merits of General Skinner's other invention, I am afraid that at this late hour of the night we shall scarcely be able to come to a satisfactory decision. Questions of this kind, when carefully examined, raise very intricate points, both theoretical and practical; and I think, in justice to General Skinner himself, it would be almost impossible to discuss the question so thoroughly as to decide whether his is a practicable invention. These inventions can only be tested on a large scale; to test them by models is only likely to mislead. Therefore, unless the meeting earnestly desire it, I propose now to conclude with a vote of thanks to General Skinner, and to express a hope that when his larger vessel has been thoroughly tried, he will be good enough to give us the result of those trials.

Admiral Sir EDWARD BELCHER: I wish to make one or two remarks. This is a very pretty model, and a very pretty idea. But as far back as the year 1818 I tried something in a similar way between two keels, with the paddles passing over the bows between two stems and keels coming up above, horizontal between two rudders, to destroy the undulation, it being intended for use in towing barges on the Runcom Canal. However, the question before us now is, whether this invention is fitted for Her Majesty's Service. Having taken very great interest in the turbine, I can only say that the turbine, of which this seems to be a variation, has been proved. The Admiralty has constructed a vessel on that system, and the turbine, although primarily supposed to give 8½ knots, actually on trial gave 10. The trial between Mr. Reed's "Viper" and "Vixen," and the "Waterwitch," resulted, to tell the truth, in a victory for the "Waterwitch." Now, as the turbine works out of water, or under water, or indeed under any difficulties, and gives all the velocity that we require; as it is perfectly protected from shot, and as it possesses one other extraordinary advantage, which is, that it will overcome the flow of water from any sized shot hole, however large, that is, provided it is not so large as the opening behind you (four feet square), and considering that the turbine of the "Waterwitch" will throw 1,000 tons of water per minute, the turbine would take the wind out of the sails of this very pretty thing. I admire the thing very much, and I like the idea. But we should lose an immense amount of tonnage by that slice cut out of the ship fore and aft; further, every time the ship rolled, the enemy would take quiet aim and destroy the exposed machinery, therefore, I do not see that the invention is applicable to the Royal Navy. As to a boat on a canal, or a yacht, or a merchant vessel, I have no doubt it would prove useful.

The CHAIRMAN: I will intrude by again thanking General Skinner for the trouble he has taken in bringing this invention forward.