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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

COMBINED RECIPROCATING AND TURBINE ENGINES.

Unquestionably the greatest defect of the steam turbine, when used for marine work, is the fact that it cannot be reversed. Many attempts have been, and are now being, made to remedy this; but, as far as we know, a practical reversing turbine has yet to be built. The present practice is to provide two reversing turbines of limited power, usually fitted on the same shafts as the low-pressure turbines, which, when the ship is running ahead, revolve idly *in vacuo*. To reverse, the steam is shut off from the ahead turbines and admitted to the auxiliary reversing turbines. This arrangement has the double disadvantage that a portion only of the motive power is available for backing, and a considerable section of the plant is idle for the greater part of the time. Furthermore, the addition of reversing turbines calls for additional longitudinal space in the ship; with the result that the floor space occupied by marine turbine engines is actually greater than that occupied by reciprocating engines of the same horse-power. With a view to obtaining all the advantages of a great range of expansion and a high vacuum, which are marked characteristics of the turbine, the White Star Company has placed an order with Messrs. Harland & Wolff to build the first of two large steamers for the transatlantic trade, which are to be driven by a combined reciprocating and turbine engine plant. Power will be developed on three shafts, the outer two of which will be driven by quadruple-expansion reciprocating engines, and the central shaft by a low-pressure turbine, operated by the exhaust steam from the low-pressure cylinder of the reciprocating engines. For going astern the reciprocating engines will be used, while in ordinary service all three engines will be driven in combination.

Further advantages of this installation are that there will be separate steam connections from the boiler room to each of the three engines, so that in case of disablement, the vessel can be driven under the reciprocating engines or even by one of them alone, or by the steam turbine alone, live steam in this last case being fed direct to the turbine. The range of expansion will be increased, since it will be possible to use a higher pressure steam in the reciprocating engines than is found to be economical for steam turbines; while, on the other hand, the turbine end of the expansion can be carried down very much lower and with a higher vacuum than is possible in the reciprocating engine alone.

UNITED STATES AND BRITISH GUNNERY.

There can be little question that the close attention which has been paid, both in our own and in the British navy, to the improvement of gunnery, has placed these two nations far to the front in accuracy of marksmanship. The remarkable results attained by both navies at the target, as published from time to time, have raised the question as to which navy has achieved the highest record. A daily contemporary recently published some figures from Washington giving a few of the best records obtained in our Atlantic fleet. The most accurate shooting appears to have been done with the 6-inch rapid-fire gun; one gunner on the armored cruiser "Maryland" having made 11 shots and 11 hits in one minute. A gun of the same caliber was fired on the battleship "Ohio" at the rate of 10.8 shots a minute, and made a perfect score. A similar gun on the battleship "Maine" is credited with a perfect score at the rate of 10.4 shots a minute, while the battleship "Missouri's" best record is 10.3 shots a minute. The smaller guns have done even better. A 3-pounder on the battleship "Virginia" fired 20 shots with 20 hits in 75 seconds, while another 3-pounder fired 10 shots with 10 hits in 22½ seconds.

The latest figures available from the British navy are those of results obtained during gunnery practice at Wei-Hai-Wei, China, when three 6-inch guns on the armored cruiser "King Alfred" fired 38 rounds in one minute, scoring 37 hits, of which 28 were bull's eyes. One of these three guns made a bull's eye every time in 11 shots. The same ship made almost as good practice with her two 9.2-inch guns, one of which fired 10 rounds in one minute, making 10 hits with eight bull's eyes, while the other fired 9 rounds in a minute, all of which found a target, and 7 of which were bull's eyes. The range in all cases was approximately one mile. To establish satisfactory comparison between the American and British results, it would be necessary to have more complete data, including the exact range and the speed at which the ship was steaming past the target. In any case, the results are truly surprising. They would have been pronounced impossible only a few years ago.

HEALTH CONDITIONS IN THE SUBWAY.

The investigation conducted for the New York Rapid Transit Commission by Dr. Soper, to determine the sanitary conditions, particularly as regards the effect of the air upon the health of employees, has materialized in two reports, in the first of which the author states that although the Subway air is disagreeable, it is not harmful except for the presence of iron dust. In the second of the two reports, dealing with the effect of iron dust upon the employees, it is stated that a sufficient number of persons were subjected to physical examination to determine the condition of the average employee. A careful search was made for evidences of diseases of the lungs, such as are common among people engaged in occupations where dust is present. An examination of the air showed the presence of a large amount of iron dust, and of various kinds of fragments due to the wear and tear of the Subway and the abrasion of the clothing of the passengers. From the samples taken it was estimated that in every month 25 tons of iron and steel are ground off the rails, brake-shoes, and wheels, on the 21 miles of the Subway. Much of this material is in such large pieces that it falls immediately to the track, and adheres to the surface of the ballast or ties.

Among the conclusions reached by Dr. Soper are the following: The air of the Subway as determined by analysis and careful studies of the health of the men is not injurious, the most objectionable feature being the dust, made up chiefly of angular particles of iron.

The odor and heat of the Subway, although they are disagreeable, are not actually injurious to health, the most objectionable atmospheric conditions, as far as health is concerned, being the strong drafts and changes of temperature which occur at the stations.

The employees submitted by the company for physical examination were a particularly robust lot of men, who had evidently been carefully selected. This was explained by the fact that a large majority of the men had previously been engaged in railroading, where the capacity to do hard manual labor was required. Judging from the accounts given by the men themselves, they have suffered very little sickness during their Subway employment. Most of the men complained of drowsiness, which may be explained by the comparative darkness of the Subway, the monotony of the work, and fatigue to the eye.

Careful physical examination showed that an excessive amount of dry pleurisy without pain or other physical discomfort existed among the men, the proportion being 53 per cent among the employees, as compared with 14½ per cent among persons not engaged in Subway work. Congestion and inflammation of the upper air passages were prevalent.

Among other recommendations made in the report, it was suggested that while the dust does not prove to have produced harmful results, sanitary conditions require that it should be prevented as far as practical from getting into the air. To this end, sand and sawdust should not be scattered for cleaning purposes; sweeping and cleaning should be done in accordance with the recommendations of the Advisory Board of the Department of Health; and investigations should be made to determine whether it is feasible to reduce or collect much of the iron dust. Lastly, the city ordinance against spitting should be enforced to the letter.

FULTON THE FATHER OF COMMERCIAL STEAMBOAT NAVIGATION.

Although the celebration of the centennial of Fulton's successful inauguration of steam navigation will not take place for another year, it is fitting that some anticipatory tribute should at this time be paid to the event, and to the remarkable man to whose faith, farsightedness, and indomitable will that event was due. The claim of Fulton to be considered the father of steam navigation stands or falls with the claims of pretty nearly every inventor of the first rank in his own field of endeavor. The Scientific American has always held that, if some individual must be chosen from among the many who are associated in the development of any great invention, whose name it is to bear in the years to come, the choice should fall upon the man who gathers together the unrelated and more or less fragmentary work of his predecessors, stamps it with his own inventive originality, and gives it to the world in practical working form. It is upon these principles of selection that Bessemer is known as the father of the modern steel industry; Edison, of the electric light; Westinghouse, of the air brake; Marconi, of wireless telegraphy; Sprague, of the trolley car; and Parsons, of the steam turbine.

With equal impartiality, posterity has agreed to name Fulton as the father of modern steamboat navigation. In doing so, there has been no intentional slighting of the work of earlier inventors; of William Henry, who in 1763 was at work on the problem, and actually built a steamboat propelled with paddle wheels; of Fitch and Rumsey, who did excellent work in the last years of the eighteenth century, and last, and by no means least, of Stevens. Indeed, if there is any one inventor in America who, on the strength of his practical achievements, presses Fulton rather closely for the claim to be considered the father of steam navigation, it is Stevens, who in 1804 ran a steam yawl from the Battery to Hoboken, and three years later ran the "Phœnix" to New Brunswick, and in less than a year after the trip of the "Clermont" to Albany and back, sent the same "Phœnix" to Philadelphia by sea, thus securing the credit for inaugurating deep-sea navigation. However, the consensus of opinion on the part of those who have made careful investigation of the historical facts, accords to Robert Fulton the distinction of placing on a regular route, running on schedule, the first practical passenger steamship. The "Clermont" was no mere inventor's model. It was a stanchly-built craft, designed for a special purpose; and at its very first venture, it achieved what, considering all the conditions, must be forever regarded as a brilliant success.

The most authentic record of the "Clermont" is the model which is housed in the National Museum at Washington. Even a cursory inspection is sufficient to show to the naval architect how strong an influence Fulton's craft has had on the subsequent designs of Hudson River steamboats. In it we find the typical flat bottom and shoal hull; the wide guards, and even the system of trussing which has remained as an integral and important structural feature of these boats for nearly half a century. The "hog frame" was present in the "Clermont" in the shape of two trusses extending through the vessel abreast of the boiler, engine, and paddle wheels. According to the figures given by Fulton himself, the vessel was 150 feet long, 13 feet wide, 7 feet deep, and drew 28 inches of water. The plan of accommodation shows a kitchen in the bow, and aft of this the men's room, with a companionway leading to the fore deck. Aft of the boiler room was the gentlemen's cabin; and the extreme after part of the ship was given up to a ladies' cabin, access to the deck from these two cabins being had by means of a companionway situated between them in a separate vestibule, entered by separate doors from the two cabins. It is evident that, even in this pioneer boat, an effort was made to provide suitable privacy, and such conveniences as the limited size of the little craft could afford.

The initial-trip of the "Clermont" was made from Paulus Hook ferry, now known as Barclay Street. That Robert Fulton himself must even at that time have been fully conscious of the historical and commercial importance of the feat which he had at last accomplished, is shown by a letter which he wrote to the editor of the American Citizen, the text of which is as follows: "Sir: I arrived this afternoon, at four o'clock, in the steamboat from Albany. As the success of my experiment gives me great hopes that such boats may be rendered of great importance to my country, to prevent erroneous opinions and give some satisfaction to the friends of useful improvements, you will have the goodness to publish the following statement of facts: I left New York on Monday at one o'clock, and arrived at Clermont, the seat of Chancellor Livingston, at one o'clock on Tuesday—time, twenty-four hours; distance, one hundred and ten miles. On Wednesday, I departed from the Chancellor's at nine in the morning, and arrived at Albany at five in the afternoon—distance, forty miles; time, eight hours. The sum is one hundred and fifty miles in thirty-two hours, equal to near five miles an hour. On Thursday, at nine o'clock in the morning, I left Albany, and arrived at the Chancellor's at six in the evening; I started from thence at seven, and arrived at New York at four in the afternoon, one hundred and fifty miles, equal to five miles an hour. Throughout my whole way, both going and returning, the wind was ahead; no advantage could be derived from my sails: the whole has, therefore, been performed by the power of the steam-engine."