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72.—REPORT ON THE WORKING OF THE BOILERS AND ENGINE OF THE UNITED STATES FISH COMMISSION STEAMER ALBATROSS.

By Passed Assistant Engineer G. W. BAIRD, U. S. N.

[From his report for the quarter ending June 30, 1883.]

Though the ship has been in commission about seven months there has been no opportunity to make a continuous voyage of any considerable length with the vessel at or near her load draft of water, under conditions of weather which would not influence the speed. The voyage from New York to Washington, just after the vessel had been docked, cleaned, and painted, offered a tolerably good opportunity, as the sea was smooth, but the wind, which was light, was ahead. The coal used was the anthracite supplied to the Navy, and it contained a considerable quantity of ash, clinker, and slate. The boilers, which have never been tight, leaked less than ever before, which permitted us to carry more pressure. The quality of the oil used was bad, and the warming of the journals prevented us from urging the engines. The voyage was a fair average one, on the whole, in point of speed, as it is our object to make economical rather than speedy voyages.

The following results must not, therefore, be considered as for the maximum performance of the vessel, but for the conditions of ordinary cruising. This, however, does not impair the deductions for scientific purposes:

Duration of voyage		42 hours 9 minutes
Total distance, in geographical miles, of 6,086 feet		423
Mean number of geographical miles per hour		10.03
Total number of revolutions, starboard engine		200,197
Total number of revolutions, port engine		200,411
Mean number of revolutions per minute, starboard engine		79.05
Mean number of revolutions per minute, port engine		79.06
Slip of the starboard screw in per cent. of its speed		14.74
Slip of the port screw in per cent. of its speed		14.75
Mean steam pressure in boilers, in pounds, above the atmosphere		60.05
Mean pressure in starboard receiver above zero		25.53
Mean pressure in port receiver above zero		23.78
Mean position of (both) throttle valves, in eighths		7.20
Mean vacuum in condenser in inches of mercury		24.46
Mean height of barometer in inches of mercury		30.09
Mean point of cutting off in starboard high pressure cylinder	inches	26.333
Mean point of cutting off in starboard low pressure cylinder	inches	14.032
Mean point of cutting off in port high pressure cylinder	inches	19.780
Mean point of cutting off in port low pressure cylinder	inches	17.831
Total number of pounds of anthracite coal consumed		42,865
Total number of pounds of ashes, clinker, &c		8,353

Total number of pounds of combustible	34,512
Mean number of pounds of coal per hour	1,016.97
Mean number of pounds of combustible per hour	818.79
Percentage of refuse in coal	19.40
Mean number of pounds of coal per hour per square foot of grate surface	10.667
Mean number of pounds of coal consumed per hour per square foot of heating surface	0.4103
Mean number of pounds of combustible per hour per square foot of grate surface	8.589
Mean number of pounds of combustible consumed per hour per square foot of heating surface	0.3303
Mean number of strokes per minute of circulating pump	80
Temperature of the air on deck	73.73
Temperature of the injection water	65.73
Temperature of the discharge water	93.78
Temperature of the feed water	76.39
Temperature of the engine-room	119.10

HORSES-POWER.

Indicated horses-power developed in the starboard H. P. cylinder	93.460
Indicated horses-power developed in the starboard L. P. cylinder	122.240
Indicated horses-power developed in the port H. P. cylinder	110.224
Indicated horses-power developed in the port L. P. cylinder	131.602
Aggregate indicated horses-power developed in the starboard engine	215.700
Aggregate indicated horses-power developed in the port engine	241.826
Horses-power required to work the starboard engine	22.116
Horses-power required to work the port engine	22.118
Net horses-power applied to the starboard shaft	193.584
Net horses-power applied to the port shaft	219.708
Horses-power absorbed in friction of the load on the starboard engine	14.5188
Horses-power absorbed in friction of the load on the port engine	16.4781
Horses-power expended in the slip of the starboard screw	23.278
Horses-power expended in the slip of the port screw	26.838
Horses-power expended in friction of the starboard screw-blades and shaft on the water	21.278
Horses-power expended in friction of the port screw-blades and shaft on the water	21.279
Net horses-power applied to the propulsion of the hull	289.642

DISTRIBUTION OF THE POWER.

Percentage of the net power applied to the shaft absorbed in friction of the load	7.500
Percentage of the net power applied to the shaft absorbed in friction of the screw-blades, hubs, and shafts on the water	10.297
Percentage of the net power applied to the shafts absorbed in the slip of the screws	12.122
Percentage of the net power applied to the shafts utilized in the propulsion of the hull	70.081

ECONOMIC RESULTS.

Pounds of coal consumed per indicated horses-power per hour	2.222
Pounds of coal consumed per net horse-power per hour	3.246
Pounds of combustible consumed per indicated horse-power per hour	1.789
Pounds of combustible consumed per net horse-power per hour	2.613
Pounds of coal consumed per mile	101.336
Pounds of combustible consumed per mile	81.588

THRUST OF THE SCREWS.

The net power applied to the propulsion of the hull by the two propellers being 289.642 horses is equal to $(289.642 \times 33,000 =)$ 9,558,186 foot pounds of work per minute, and the speed being 10.03 knots per hour is equal to $\left(\frac{10.03 \times 6086}{60} =\right)$ 1017.376 feet per minute; therefore the resistance of the hull and the equivalent thrust of the screws at that speeed was $\left(\frac{9558186}{1017.376} =\right)$ 9395 pounds. The thrust per indicated horse-power at that speed was $\left(\frac{9395}{457.526} =\right)$ 20.31 pounds, and per pound of coal per hour it was $\left(\frac{9395}{1016.97} =\right)$ 9.23 pounds.

POWER ABSORBED BY THE FRICTION OF THE WETTED SURFACE OF THE HULL AGAINST THE WATER.

Taking the resistance of the water to a square foot of smoothly painted iron of the surfaces of the hull moving at a velocity of 10 feet per second to be 0.45 of a pound, and (according to the method of Chief Engineer Isherwood, United States Navy) deducing from the speed of the vessel the mean speed of its immersed surfaces due to the inclination of the water lines there results a speed of 16.35076 feet per second, and a consequent surface resistance of $(10^2 : 0.45 :: 16.35076^2 :)$ 1.203063 pounds per square foot at that velocity. The aggregate wetted surface during the above-mentioned voyage was 7,350.44 square feet, and the power expended in this resistance was $\left(\frac{7350.44 \times 1.203063 \times 16.35070 \times 60}{33.000} =\right)$ 262.893 horses; consequently of the 289.642 horses power required to propel the hull $\left(\frac{262.893 \times 100}{289.642} =\right)$ 90.73 per cent. was expended in overcoming the friction of the hull on the water, and the remaining 9.27 per cent was expended in displacing the water and overcoming the pressure of the wind against the upper part of the hull, the spars, and the rigging.

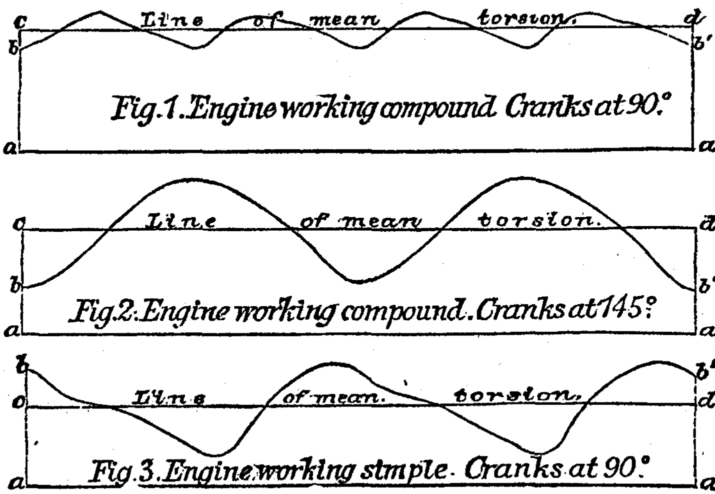
THE CHANGE IN THE CRANK-ANGLE.

The cranks, as originally arranged, at 145 degrees, diminished, to a small extent, the friction on the center main bearings by the almost opposite position, and almost opposite crank effort. The indicator diagrams taken from the high-pressure cylinders bear a very near resemblance to each other, with the cranks at either angle, but in the low-pressure diagrams the difference is marked.

Fig. 6 is from the starboard low-pressure cylinder with the cranks at 145 degrees.

Fig. 5 is from the same cylinder, with the cranks at 90 degrees, but with the receiver enlarged from $1\frac{6}{10}$ to $2\frac{6}{10}$, the volume swept by the high-pressure piston.

TORSIAN DIAGRAMS.



INDICATOR DIAGRAMS.

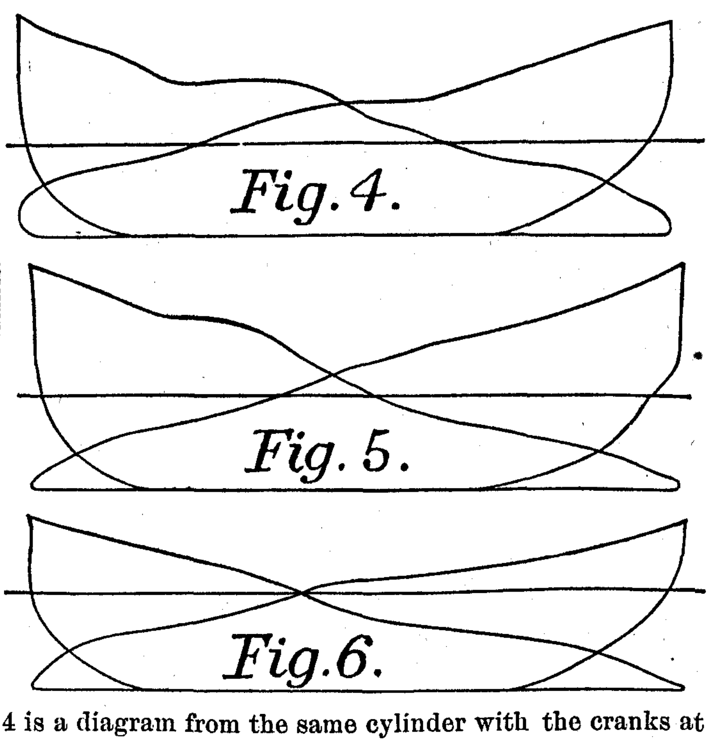


Fig. 4 is a diagram from the same cylinder with the cranks at 90 degrees, but with the original volume of receiver, namely, $1\frac{6}{10}$, the volume swept by the high-pressure piston.

The relative contours of these diagrams and their variance from the hypothetically perfect diagram is marked, and if an engineer is willing to accept them as the *ultima thule* he will doubtless decide in favor of that produced by the engines as originally arranged, namely, at 145 degrees crank angle.

The indicator is the stethoscope of the steam cylinder only; it fails to give any indication of the work, either utilized or wasted, beyond the steam cylinder.

It is manifest that a crank turned by a uniform moment is revolved with less labor and less injury to its journals than if turned by an intermittent force; by blows for example. Uniformity of torsion on the shaft is one of the great objects sought. This torsion may be demonstrated, graphically, by constructing diagrams whose abscissa is referred to the length of the path of the turning force, and the ordinates to the moments of torsion. In Figs. 1, 2, and 3, the ordinates are calculated for the combined moments of the two cranks, the same units being used for each. The lines *c d*, in these figures, refer to the path described by the combined effort of the two cranks, and the ordinates, commencing with *a b*, and ending with *a' b'*, represent the moments of torsion. The curved lines represent the variation in the torsion, and the superiority of these torsion curves is in their nearer approach to the straight line *c d*.

This graphic method might be pursued still further by applying a dynamometer to the screw shaft, which would indicate the thrust of the screw, wherein every increment or diminution in that force would correspond with those in the torsion diagram, but would be greatly reduced in extent owing to the weight and consequent inertia of the heavy working parts.

In changing the crank angle from 145 to 90 degrees the eccentrics were not disturbed; the cushioning, lead, and release are the same in both cases; the same boiler-pressure and mean back-pressures are maintained, and the same number of expansions are employed; consequently there can be no physical advantage in the original over the present crank angle. The mechanical saving in the minute amount of friction eliminated in a single journal of each engine is much more than compensated for by the saving of friction on the screw blades alone, by their more uniform velocity.

The Katzenstein packing on the piston rods has worked so well that I feel it merits a special mention. I respectfully recommend it be placed on the H. P. valve stems. The Baird distilling apparatus has produced 5,883 gallons of water during the quarter, steam being used from the main boilers, the ship being at sea under steam, and cylinder oil (a compound of petroleum) being used in the cylinders; the water was good. The anemometer used in measuring the air currents in our ventilating tubes broke down, but the makers replaced it with a new one, since which time I have been recording air velocities, and hope, at the end of the next quarter, to be able to report on the ventilation of the ship.

The electrical apparatus continues to give satisfaction; the dynamo has been in operation three hundred and twenty-three hours and nine minutes during the last quarter. Four 3-light safety plugs have been melted out, and one key socket broken, all of which I promptly replaced. I tapped the engine-room circuit and placed a lamp over the circulating pump, which was very much needed.

Advantage was taken of the ship being docked, at New York, to overhaul the sea valves, screw propellers, shafts, and stuffing boxes. We found it necessary to entirely replace the packing of our stern bearings. There was some corrosion in the shafts near the brass jackets, all of which were carefully scraped and painted.

The steam windlass, never having given any trouble, nor requiring any repairs, merits special mention.

The steam winch and feeling engine have given scarcely any trouble, and have done their work admirably.

The smithing of the ship has been satisfactorily done by one of our first-class firemen.

The speaking tube has been overhauled, and many joints, hitherto leaking, have been repaired and telephonic communication re-established between the engine-room and pilot-house.

The Dividson Pump Company voluntarily, and without compensation, supplied new stud bolts for the circulating pump, to diminish the lift of the valves and relieve the thump.

The "Little Wonder" injectors work very well, one at a time; if both are placed in circuit it is a little wonder if either will continue. They deliver the feed water hot, and are an acquisition when the main engine is not in operation.

The receivers were ordered to be enlarged—by the engineer who designed the ship—when the crank angle was changed from 145° to 90°. This was effected by placing a large convex bonnet on each low-pressure valve-chest. This increased the receivers from $1\frac{6}{10}$ to $2\frac{6}{10}$ times the volume swept by the H. P. pistons. Seeing an excellent opportunity for a valuable experiment I took the responsibility of putting only one of the new bonnets on, and selected the starboard engine for that purpose, so that for all the steaming recorded in this log-book, the port engine had the small receiver, and the starboard engine the large receiver. The results show no essential difference in the performance; what little difference does appear is in favor of the engine with the small receiver. I therefore reduced the starboard receiver by restoring the original valve-chest bonnet.

I would respectfully call attention to the high temperature of the engine-room, which I fear will become so great in hot climates as to seriously injure the men.

The steam heaters have been overhauled, six new angle valves put in place of six broken ones. Two new heaters have been bought for the cabin (one being for the office); they have much greater surface than the old ones and will, consequently, keep the cabin more comfortable in cold weather.

The springs on the drum of the reeling engine, found to be too weak, were replaced and doubled at the Washington yard. An additional drain cock has been put on the engine of Sigsbee sounder, part of the steam lead taken off, and a wooden cover put over the cylinder to prevent burning the gutta percha belts. The bolt sheared off the arm of the *circulating pump* for want of oil. A Detroit oil cup has been bought and put in place, and this, being a *sight feeder*, can be observed from the working platform. The counters, which were hitherto unsatisfactory, have been put in order by the Crosby Valve Company. The ½-inch valve stems of the main reversing engines being too light (they bent), have been replaced by ¾-inch stems. The boilers, having been recalked at the leaky corners by the Pusey & Jones Company, by the Washington yard and Norfolk yard, continued to leak; at the New York yard soft patches were put on and then they leaked; our force on board has remade the joints under these three patches, and are encouraged to find one is tight. A split elbow in the steam-whistle pipe was replaced at Norfolk, the bell wires were overhauled, and additional bolts put in donkey check-valves at the same place.

We have succeeded in adjusting one of the Svedberg governors, which works well, and when opportunity offers the other will be adjusted. Its position, however, is against it, as it is on the H. P. chest, where it is very hot, and I fear the mercury evaporates.

One piston rod was discovered to have a transverse flaw. Though the flaw does not appear to increase, it has been considered necessary to order a new rod; this is now being made at the Washington yard.

STEAMER ALBATROSS, *July*, 1883.

73.—HOW TO COOK CARP.

By C. GERBER, Jr.

I append a few receipts translated from a German cook-book. As a general rule the pond carp is not considered good to eat during the summer months, May, June, July, August (during and after spawning), but at all other times it is a most excellent table fish.

RECEIPT No. 1.—Clean a carp of about five pounds well, and split and cut it into convenient pieces. Take three table-spoonfuls salt, half a dozen kernels black pepper, same of allspice and cloves, a few cardamoms, four laurel leaves, a medium-sized onion, some celery and a sliced carrot, and a quart of water (or enough to cover the carp); let these boil together fifteen minutes, put in the carp, scale side down, head pieces first, middle pieces next, tail pieces on top, and let boil fifteen minutes longer; add one-half pound butter in small pieces, and a gill of red wine, or in place