

XXVIII. *Supplement to Mr. MACQUORN RANKINE'S Paper "On the Thermodynamic Theory of Steam-engines with dry saturated Steam, and its application to practice\*."*

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THE following additional information respecting the steam-ships referred to in the examples may be interesting, although it does not strictly belong to the special subject of the paper.

EXAMPLE I.—Paddle-steamer 'Admiral,' built by Mr. JAMES R. NAPIER; engines made by MESSRS. RANDOLPH, ELDER and Co.; draught 7 feet 6 inches; length 210 feet; breadth 32 feet; displacement 820 tons; speed with 774 indicated horse-power 11·9 nautical miles an hour. Effective work in driving the ship, about 604 horse-power.

Available heat expended per hour in foot-pounds per indicated horse-power,

$$\frac{1,980,000}{\text{efficiency of steam}} = \frac{1,980,000}{0.123} = 16,100,000.$$

Coal burned per indicated horse-power per hour, 2·97 lbs.

Available heat of combustion of one pound of coal,

$$\frac{16,100,000}{2.97} = 5,420,000 \text{ foot-lbs.}$$

The total heat of combustion of one pound of the coal employed being roughly estimated at 10,000,000 foot-pounds, it appears that the efficiency of the furnace and boiler was about 0·542.

The boilers were improved marine boilers of ordinary proportions.

EXAMPLE II.—Screw-steamer 'Thetis,' built by Messrs. C. SCOTT and Co.; the engine made by Messrs. ROWAN and Co.

Available heat expended per hour in foot-lbs. per indicated horse-power,

$$\frac{1,980,000}{\text{efficiency of steam}} = \frac{1,980,000}{0.192} = 10,312,500.$$

Coal burned per indicated horse-power per hour, during an experiment of one hour's duration, 1·02 lb.

Available heat of combustion of one pound of the coal employed,

$$\frac{10,312,500}{1.02} = 10,110,000 \text{ foot-pounds.}$$

The coal used was of very good quality; and its total heat of combustion per pound is

\* Philosophical Transactions, Part I. 1859, p. 177; Proceedings of the Royal Society, January 1859.

estimated at 11,560,000 foot-pounds. Hence the *efficiency of the furnace and boiler* was

$$\frac{10,110,000}{11,560,000} = 0.88.$$

In this case the short duration of the experiment on the consumption of coal, which was interrupted by a fog, makes the result less satisfactory than it would have been if the experiment had been continued, as intended, for several hours. The engine and boiler were of a kind invented some years ago by Mr. CRADDOCK; the boiler consisting chiefly of a sort of cage of vertical water-tubes enclosing each fire-grate. The heating surface was about nine times as great, relatively to the fuel burned, as it is in ordinary marine boilers.

EXAMPLE III.—Paddle-steamer ‘Callao,’ built by Messrs. JOHN REID and Co.; the engines by Messrs. RANDOLPH, ELDER and Co.; displacement 1100 tons; speed with 1176 indicated horse-power 12.05 nautical miles per hour.

Available heat expended per hour in foot-pounds per indicated horse-power,

$$\frac{1,980,000}{\text{efficiency of steam}} = \frac{1,980,000}{0.14} = 14,143,000 \text{ foot-lbs.}$$

Coal burned per indicated horse-power per hour, 2.67 lbs.

Available heat of combustion of 1 lb. of coal,

$$\frac{14,143,000}{2.67} = 5,300,000 ;$$

being nearly the same as in Example I.

The boilers in this case were, like those in Case I., improved marine boilers of ordinary proportions. In such boilers, 5,400,000 foot-lbs. may be considered a fair estimate of the available heat of combustion of good ordinary steam-coal.