

TABLE III.—RESULTS OF EVAPORATION-TESTS WITH FIVE-FLUED BOILERS HEATED WITH WASTE-GASES, AT BEAMISH COLLIERY, MARY PIT.

	I.	II.	III.	Averages of the three Trials.
Date of trial ... 1905	Aug. 28	Aug. 30	Sept. 1	...
Duration of tests ... hours	6	6	6	...
Temperature of gases at the front of the boilers ... degs. Fahr.	1,750	1,783	1,783	1,772
Temperature of gases at the back of the boilers ... degs. Fahr.	575	616	628	606
Temperature of gases at the chimney ... degs. Fahr.	483	531	543	519
Water-gauge at the front of the boilers ... inches	0·5	0·5	0·5	0·5
Water-gauge at the back of the boilers ... inches	0·8	0·8	0·8	0·8
Water-gauge at the chimney inches	1·1	1·1	1·1	1·1
Temperature of feed-water degs. Fahr.	104	104	104	104
Coal coked per hour pounds	16,240	16,240	16,240	16,240
Water evaporated per hour "	20,330	23,963	25,373	23,222
Water evaporated per pound of coal coked pounds	1·250	1·470	1·560	1·426
Water evaporated per square foot of heating-surface of boiler pounds	3·633	4·283	4·535	4·150

Dr. F. SCHNIEWIND (New York) wrote that there were but few isolated instances of waste-heat boilers, applied on beehive coke-ovens, and, regarding the results of their operations, practically no data were at hand. The comparison between the economy of the waste-heat recovery of beehive coke-ovens, and the conditions of operation prevailing in the bye-product oven were so far apart, however, and so well understood, that they hardly need be touched upon in this connection.

DISCUSSION OF MR. M. R. KIRBY'S PAPER ON "THE COMPOUND WINDING-ENGINE AT LUMPSEY MINE."*

Mr. M. R. KIRBY, replying to the discussion, wrote that of late years some very fine and costly engines had been built for winding, some being compound and fitted with valve-gears leaving nothing to be desired with regard to steam-distribution.

* *Trans. Inst. M. E.*, 1905, vol. xxix., page 380.

The performances of these engines, however, so far as he had been able to gather, had been disappointing, the lowest steam-consumptions attained being 55 to 60 pounds per actual horsepower per hour. He, therefore, considered that he was justified in stating that the results obtained at Lumpsey mine were satisfactory. However, Mr. John McLaren might be able to inform the members of lower steam-consumptions. The valve-gear at Lumpsey mine was admittedly bad, the good results being due to the low-pressure throttle-valve which was, he believed, unique at the time when it was adopted. He would also like to state here that he was not responsible for the valve-gear. The steam-consumptions, tabulated in his paper, included all the steam used for winding, by the feed-water, air and circulating pumps, and for raising and lowering men; and it was described in his paper as being used for "other purposes."

He (Mr. Kirby) believed that he thoroughly explained in his paper the disappointing results of the condensing tests; and as a large number of tests were carefully made, and agreed pretty closely, he did not consider that there was any error in his figures. He agreed that tests on other winding-plants would be interesting and useful; and it would be desirable that they should be carried out by a committee of the members of the Institution, so as to ensure uniformity.

He (Mr. Kirby) regretted that he was not in a position to give the data asked for by Mr. S. L. Thacker. The only way of stating the commercial efficiency of a winding-engine was to ascertain the amount of fuel used to raise a given weight to a given height, and this result was most easily and accurately stated (as indicated in his paper) as "coal used per actual horsepower-hour."† It would be seen, on referring to the results of the test of March 25th, 1904, of the Lumpsey winding-engine, that while the steam-consumption was highest the evaporation was best, owing to the high temperature of the feed-water.

He (Mr. Kirby) agreed with Mr. B. Woodworth that better results would have been obtained with a cut-off at 80 to 85 per cent. of the stroke: this, indeed, was part of his original scheme, but unfortunately it was not adopted. The several winding-engines were never reversed, and seldom braked to any extent: and the mechanical efficiencies given in his paper were undoubtedly obtained.

* *Trans. Inst. M.E.*, 1905, vol. xxix., page 382.

Mr. M. Deacon doubted whether so low a steam-consumption as 35 pounds per actual horsepower per hour could be obtained with a non-condensing cross-compound winding-engine. He (Mr. Kirby) hoped shortly to erect such an engine, and he would communicate the results of tests upon it to the members.

He (Mr. Kirby) agreed with Mr. T. C. Futers that, in many cases, it was easy to try to save too much steam at too great an expense.

Engineers usually aimed at commercial efficiency, and if stone could be wound for a less weight of coal with a compound than with a simple winding-engine, that was quite enough reason for its adoption.

The power delivered at the engine throttle-valve, at Lumpsey mine, cost (including fuel, interest on capital, depreciation, upkeep and labour) about 0·55d. per actual horsepower per hour.

He (Mr. Kirby) did not agree with Mr. P. Kirkup that the use of triple-expansion winding-engines should be limited to deep mines, and he pointed to the use of the cross-compound winding-engine at Lumpsey mine, where only $9\frac{1}{2}$ revolutions were made per wind, in support of this contention.

The poor results obtained by condensing arose from the fact that the condensing plant, which was working on the winding-engine alone, was designed to condense the steam from all the engines at the mine; and, now that it was performing its full duty, it was much more efficient.

It was quite as easy, when drawing stone, to work the Lumpsey winding-engine condensing as non-condensing; for light loads, such as drawing men and shaft-work, the engine was rather quick, and the exhaust-steam was turned into the atmosphere when such work was being done.

Mr. R. H. FOWLER (Leeds) wrote that he noted, from the diagrams which Mr. Kirby had taken from the high-pressure cylinder, that although automatic gear was fitted, it did not come into operation. This, he thought, was not to be wondered at, seeing that the engine only made between nine and ten revolutions to complete the wind, and, therefore, there was not sufficient time for the automatic gear to act. He noticed in the remarks that Mr. John McLaren had written on Mr. Kirby's paper that he compared marine and other engines working under the most favourable conditions, and requiring from 11 to 13 pounds of

steam per indicated horsepower, with the Lumpsey winding-engine, which required from 38 to 42 pounds per indicated horsepower per hour, and was surprised that such a consumption should be tolerated. It appeared to have escaped Mr. McLaren's notice that a winding-engine worked under the most unfavourable conditions, and that it had to put in motion an immense mass of material as quickly as possible, and bring it to rest again, frequently under one minute of time (in the case of Lumpsey in about 27 seconds). He (Mr. Fowler) thought that such a comparison as Mr. McLaren had made was not at all applicable. Taking into consideration all the circumstances with which Mr. Kirby had to deal, he (Mr. Fowler) considered that he decided on the alteration, to the engines as he found them, that would give the most economical results at the lowest outlay; and the saving of fuel, that had resulted, fully justified the change that he had made.

Mr. B. WOODWORTH (Longton, Staffordshire) wrote that he still thought that the shaft-load efficiency of the Lumpsey mine winding-engine recorded in Mr. M. R. Kirby's paper could not be correct, as it was as high as would, probably, be guaranteed for a high-class continuous-working pumping-engine; and in his (Mr. Woodworth's) opinion a mechanical efficiency of 60 per cent. was rarely obtained from a winding-engine under normal conditions.

He (Mr. Woodworth) felt convinced that the tests were not carefully made, and it was almost certain that a stroke or a revolution, used under steam to finish the wind, had not been taken into account at all. If so, that would reduce the shaft-load efficiency from 10 to 20 per cent.; and there would be retardation of the high-pressure cylinder, owing to steam being stored in the receiver, between the high-pressure and the low-pressure cylinders. The winding-engine at the Ferreira mine showed a shaft-efficiency of 67·8 per cent.; and the shaft-efficiency of the winding-engine at the Village Deep mine was said to exceed 85 per cent.*

Mr. G. H. WINSTANLEY read the following paper on "Mining Education in the Victoria University of Manchester":—

* *The Engineer*, 1906, vol. ci., page 365.