Composition of, and losses due to, flue gas.—The most striking feature of the flue gas composition (Table X), is the very high carbon monoxide content, and this, it will be seen, is especially high for trial 85, during which very little air was admitted above the fuel bed. The total dry flue gas losses for the first two trials compare favourably with the same loss for this fuel when burnt under the water-tube boiler, in which the total losses were 27·8, 25·5, and 26·7 per cent. respectively; while that for trial 85 is not so high as might at first be expected from a gas containing 4·7% carbon monoxide, which is equivalent to a heating value of 15 B.Th.U. per cubic foot of flue gas. The high percentage of carbon monoxide obtained from this boiler is to be attributed to the small water-cooled firebox, which arrests the combustion of the burning gases.

On referring to the heat balance sheet (Table XI), it will be seen that the boiler efficiency for trial 85 was much lower than those efficiencies for the two previous trials; and one obvious reason for this is, that the total dry flue gas losses were largest for this trial, due to incomplete combustion of the carbon monoxide, thus increasing the heat loss to a greater extent than it was reduced by decreasing the air supply per unit weight of fuel.

TABLE XI.

Heat balance.

	83.	84.	85.
Heat used for steam generation	48·8	48·0	38·9
Loss due to total heat of the dry flue gases	18·9	17·9	13·7
Loss due to total heat of superheated steam leaving with flue gas	9·8	9·0	10·0
Loss due to unconsumed combustible:—			
(a) unburnt carbon monoxide	7·2	7·4	16·1
(b) combustible in ash and refuse	0·2	0·5	0·4
Heat loss due to radiation and unaccounted for	15·1	16·3	20·9
Total heat in fuel as fired	100·0	100·0	100·0

The loss in efficiency for trial 85, however, is only partially explained by the total dry flue gas loss, and the only remaining loss which is materially greater for this trial is that due to "radiation and unaccounted for."

If the radiation loss be considered, it will be seen that, since the boiler is internally fired, all the heat lost by radiation must pass by conduction, through the steam or water, through the shell.

Since the steam and water temperatures were approximately the same for the series of tests, the radiation rate for all three tests must have been approximately the same; and for the trials in which the rate of steaming was smallest the loss of heat by radiation expressed as a percentage of the heat generated was greatest.

For trial 85, therefore, the percentage of radiation loss was least, so that the increase in the "radiation and unaccounted for" loss must be due solely to the "unaccounted for" loss, which means that the flue gas contained unburned gases which were undetected by gas analysis.

Loss due to combustible in ash and refuse.—In the heat balance sheet, it will be noticed that the loss due to this cause is extremely small, which shows the fire bar supplied by the makers to be admirably suited for this fuel. All the ash passed through the grate very easily, and it was unnecessary to clean the fires at all during these trials.