

constructed, Sir Isambard stated, that he would make the system of attaching the poling boards, an essential part of the organisation of the shield, being convinced that it might by this means, be worked through the worst ground, with a certainty of safety and success.

February 14, 1843.

The PRESIDENT in the Chair.

No. 593. "Description of Mr. Clay's new Process for making Wrought Iron direct from the Ore; as practised at the Shirva Works, Kirkintilloch, Scotland." By William Neale Clay.

Clay's process for making Iron.

In this communication, the author first describes the various stages through which the metal passes, between the reduction of the ore and its arriving at the state of malleable iron, by the ordinary mode of manufacture; and then he explains the process which he has invented, and introduced practically at the Shirva Works.

By the ordinary system of iron-making, the ores are reduced into the state of carburet of iron, and then, by refining and puddling, the metal is de-carburetted, thus making it into malleable iron by a number of processes, which are recapitulated:—

1st. Calcining the ore.

2nd. Smelting in a furnace, by the aid of blast, either cold or heated, with raw coal, or coke, for fuel, and limestone as a flux.

3rd. Refining the "pig" into "plate" iron.

4th. Puddling, shingling, and rolling, to produce the "rough," "puddled," or No. 1 bars.

5th. Cutting up, piling, and rolling, to produce "merchant," or No. 2 bars.

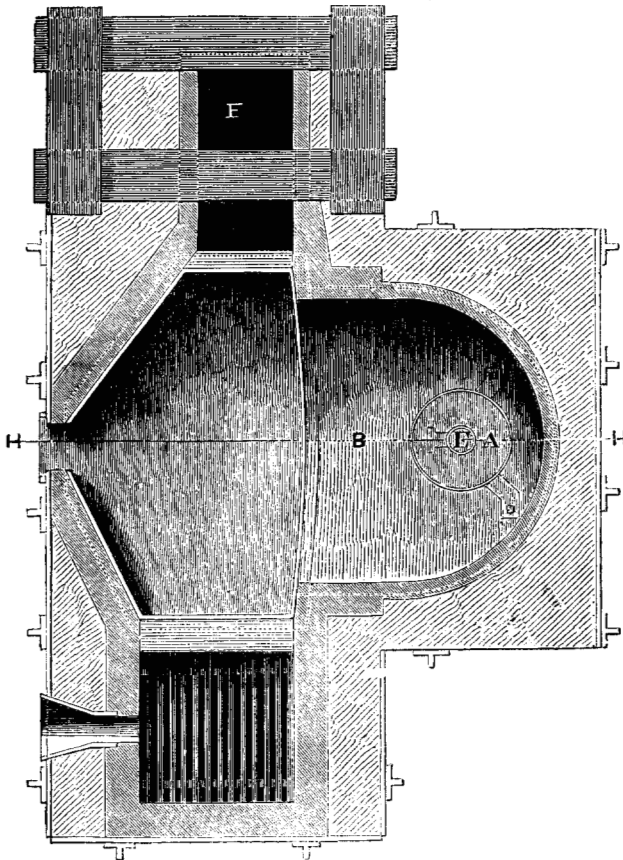
6th. A repetition of the same process, to make "best," or No. 3 bars.

Seeking to diminish the number of manipulations, by the new process a mixture of dry Ulverstone, or other rich iron-ore (Hæmatite), is ground with about four-tenths of its weight of small coal, so as to pass through a screen of one-eighth of an inch mesh. This mixture is placed in a hopper, fixed over a preparatory bed, or oven, attached to a puddling furnace of the ordinary form. While one charge is being worked and balled, another gradually falls from the hopper, through the crown, upon the preparatory bed, and becomes thoroughly and uniformly heated; the carburetted hydrogen and carbon of the coal, combining with the oxygen of the ore, advances the decomposition of the mineral, while, by the combustion of these gases, the puddling furnace is prevented from being injuriously

cooled. One charge being withdrawn, another is brought forward, and in about an hour and a-half the iron is balled, and ready for shingling and rolling.

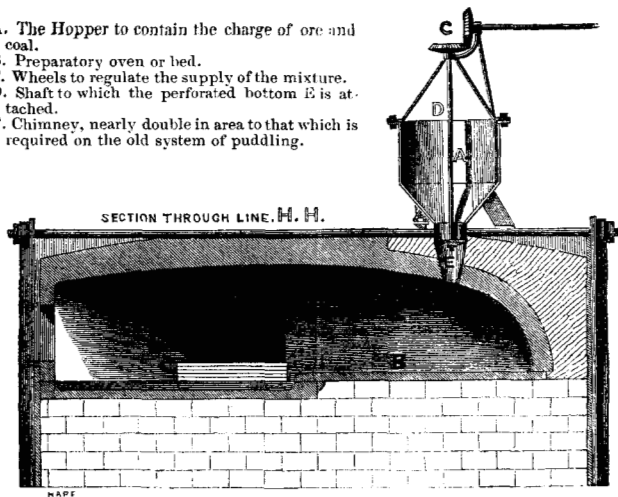
The cinder produced, is superior in quality to that which results from the common system ; it contains from 50 to 55 per cent. of iron, and is free from phosphoric acid, which frequently exists, and is so injurious, in all the ordinary slags : when re-smelted, it produces as much No. 1 and No. 2 cast-iron, and of as good quality, as the ordinary "black band" ore of Scotland.

The cast-iron produced from the slag (amounting to one-third of what was originally contained in the ore) is mixed with the ore and



Scale  $\frac{1}{4}$  inch to a foot.

- A. The Hopper to contain the charge of ore and coal.
- B. Preparatory oven or bed.
- C. Wheels to regulate the supply of the mixture.
- D. Shaft to which the perforated bottom E is attached.
- F. Chimney, nearly double in area to that which is required on the old system of puddling.



Scale  $\frac{1}{4}$  inch to a foot.

coal in the puddling furnace ; and thus, while nearly all the iron is extracted from the ore, as much wrought-iron is produced in a given time, and at the same cost of fuel, as by the old system.

The first process, producing puddled bars of superior quality, is consequently on a par with the fourth stage of the old system, as it avoids the necessity of the preceding separate manipulations.

From the absence of all deleterious mixture, by once piling and reheating the rough bars, iron is produced, of a quality, in every respect equal, and in powers of tension superior, to that which results from the second piling and reheating in the common mode ; it is therefore contended that the two processes produce from the Hæmatite nearly one-third more iron, of as good a quality as is usually obtained by the six processes of the old system.

The iron thus produced bears a high polish, is very uniform in its texture, is ductile and fibrous, having more than an average amount of tensile strength, and at the same time appears to be more dense, as it possesses a peculiar sonorousness, resembling that of a bar of steel when struck. It has also been converted into steel of a good quality.

The paper is illustrated by a drawing of the furnace necessary for the process, and by specimens of the iron and steel produced.

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**Mr. Clay.** Mr. Clay contended that the ordinary method of making iron was neither so scientific, nor so practically good as there was reason to expect