

UNITED STATES PATENT OFFICE.

CHARLES COCHRANE, OF STOURBRIDGE, COUNTY OF WORCESTER, ENGLAND.

MANUFACTURE OF IRON IN BLAST-FURNACES.

SPECIFICATION forming part of Letters Patent No. 284,383, dated September 4, 1883.

Application filed December 30, 1882. (No specimens.) Patented in England October 19, 1882, No. 4,986.

To all whom it may concern:

Be it known that I, CHARLES COCHRANE, a citizen of England, residing at Stourbridge, in the county of Worcester, England, have invented a new and useful Improvement in the Manufacture of Iron in Blast-Furnaces, (for which I have obtained a patent in Great Britain, No. 4,986, dated October 19, 1882,) of which the following is a specification.

It has been found that the principal cause of the loss of fuel in blast-furnaces of ordinary construction is due to the carbonic acid evolved both from the limestone and from the ore in being reduced at the red-hot zone of the furnace, which carbonic acid takes up carbon from the incandescent fuel to form carbonic-oxide gas, which passes away. Now, according to my present invention, I more or less prevent the production of carbonic acid from the above substances at the red-hot zone, first, by constructing the furnace of such a large size relatively to the size of the lumps of ore treated that the reduction of the ore shall be practically completed before it reaches the red-hot zone; and, secondly, I employ, in combination with such construction of furnace and mode of charging the ore, caustic lime in place of limestone, so that, practically, no carbonic-acid gas is evolved therefrom.

In carrying my invention into practice the limestone should be thoroughly burned in suitable kilns of any known construction, and the resulting caustic lime should be drawn from the kiln while still warm, and be protected from exposure to rain or weather by being loaded into barrows or trucks suitably inclosed, and by preference arranged so that they will open of themselves when the barrow is to be emptied. By this means the caustic lime will be prevented from absorbing any sensible proportion of carbonic acid or water from the atmosphere. In furtherance of this protection, the caustic lime should be charged in its suitable proportion for smelting purposes directly onto the charging-bell of the blast-furnace, or into the furnace itself, and as quickly as possible be covered up either with coke or iron-stone. By this means, when the charge is lowered into the furnace, as the lime is below the other materials of the charge, it will not be liable to absorb the aqueous vapor rising from the moist coke or moist iron-stone,

which it would do if placed above these; also, the interval of time between the introduction of the consecutive charges will be utilized in enabling the moisture contained in the coke and iron-stone of the previous charge (which may be considerable, especially in the coke, in wet weather) to be driven off before the fresh charge of lime falls onto them. The object of the above precautions is to prevent, as far as possible, the formation of hydrate of lime, commonly known as "slaked lime," which would be as detrimental to the economic working of the furnace, if not more so, than the limestone with its contained carbonic acid.

As before stated, in order to effect the successful working of blast-furnaces according to my invention, it is also necessary that the size of the blast-furnace shall be so proportioned relatively to the size of the lumps of iron-stone charged that the whole of this shall become reduced or converted into sponge of iron before it reaches the red-hot zone. If this precaution be not taken—that is to say, if the lumps of ore are of such a size that they will descend through the upper part of the furnace and reach the red-hot zone before the whole of their mass could be properly acted upon by the carbonic oxide—carbonic acid will be evolved from the process of reduction in the presence of the red-hot coke, and this will be partly taken up by the caustic lime, which will thus become reconverted into carbonate of lime, to be again reduced in a still lower region, entailing a corresponding absorption of fuel in the process. Thus, to avoid this occurrence, if large lumps of iron-stone, or even a mixture of large and small lumps, be used, the furnace should be of very large dimensions; and I have found, for instance, that a height of about thirty feet above the red-hot zone is advisable for this purpose when lumps of about fourteen inches in size are used; but I in no way limit myself to these proportions; nor is it possible to give any precise rules as to the size of the furnace beyond the general rules above stated, because the fulfillment of the required conditions may depend not only upon the size of the iron-stone lumps, but also upon the nature of the ore, which may in some varieties be acted upon more readily by the carbonic oxide than in others.

In all cases it is important to insure the

greatest possible dryness of both iron-stone and coke to obtain the fullest possible benefit from my above-described invention.

5 With regard to the quantity of caustic lime to be used, it may be stated that, assuming the limestone to be pure and perfectly calcined, then in place of five hundred-weight of limestone, now used per ton of pig-iron made, only 2.8 hundred-weight of caustic lime need be
10 used; and, in the same proportion, in place of ten hundred-weight of limestone only 5.6 hundred-weight of limestone, 8.4 hundred-weight of lime, and so on. These proportions remain the same, no matter what size furnace is
15 used, so long as the ore is reduced therein before reaching the red-hot zone.

Having thus described the nature of my invention and in what manner the same is to be performed, I wish it to be understood that
20 I do not claim, generally, the use of caustic lime in blast-furnaces, as I am well aware that

this has been already tried, but under conditions and for purposes different from those of my before-described invention; but

I claim—

25 The within-described method of working blast-furnaces, consisting in charging the furnace with ore in the presence of caustic lime, the furnace and ore being of relative dimensions to each other, as set forth, whereby the
30 complete reduction of ore before it reaches the red-hot zone is effected and the amount of carbonic-acid gas evolved at the zone diminished.

In testimony whereof I have signed my name
35 to this specification, in the presence of two subscribing witnesses, this 11th day of December, A. D. 1882.

CHARLES COCHRANE.

Witnesses:

WILLIAM JONADAB TURNEY,
JOHN PALMER HALL.

It is hereby certified that in Letters Patent No. 284,383, granted September 4, 1883, upon the application of Charles Cochrane, of Stourbridge, county of Worcester, England, for an improvement in the "Manufacture of Iron in Blast-Furnaces," an error appears requiring the following correction, viz: in line 12, page 2 of the printed specification, the words, *of lime; in place of 15 hundred weight*, should be inserted after the word "weight" and before the words "of limestone;" and that the patent should be read with this correction therein to make it conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 13th day of November, A. D. 1883.

[SEAL.]

M. L. JOSLYN,
Acting Secretary of the Interior.

Countersigned:

BENJ. BUTTERWORTH,
Commissioner of Patents.