2 Sheets—Sheet 1.

H. McDONALD.

REVERBERATING AND REGENERATOR FURNACES.

No. 182,211. Patented Sept. 12, 1876.

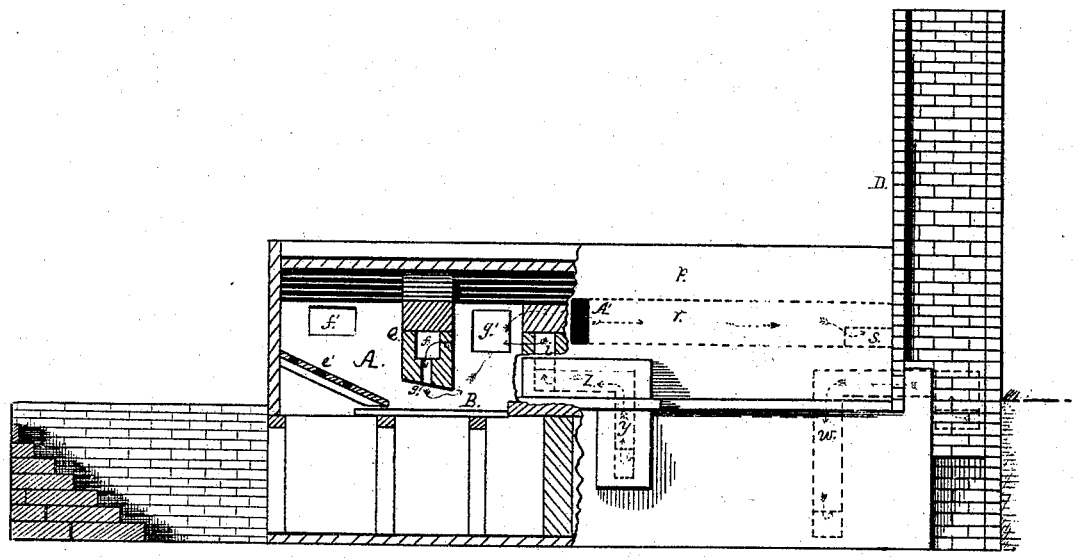

Fig. 1.

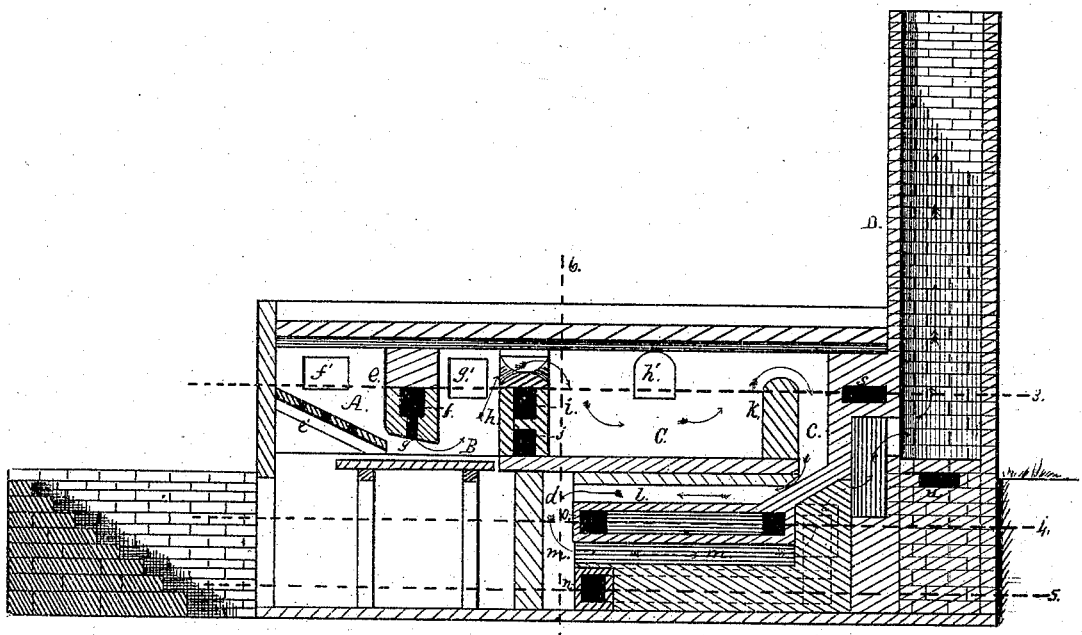

Fig. 2.

WITNESSES.

James I. Johnston
A. L. Johnston

INVENTOR.

Haugh, McDonald

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

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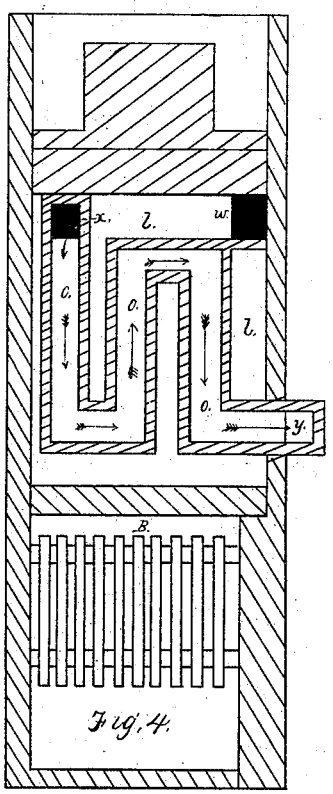

Fig. 4.

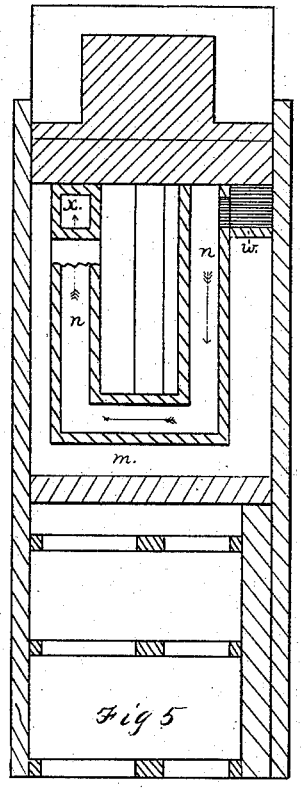

Fig 5

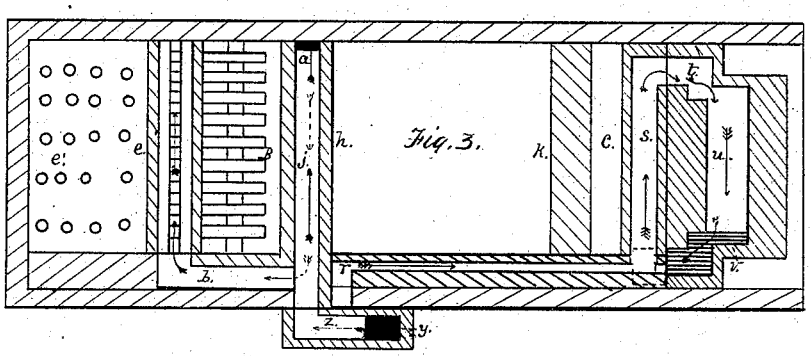

Fig. 3.

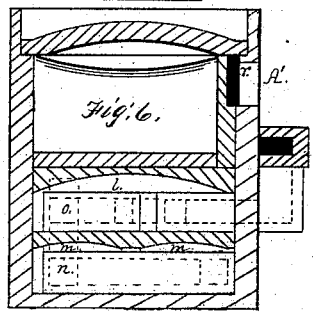

Fig. 6.

WITNESSES.

James L. Johnston

A. C. Johnston

INVENTOR

Hugh McDonald

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE

HUGH McDONALD, OF ALLEGHENY, PENNSYLVANIA.

IMPROVEMENT IN REVERBERATING AND REGENERATOR FURNACES.

Specification forming part of Letters Patent No. **182,211**, dated September 12, 1876; application filed September 20, 1875.

To all whom it may concern:

Be it known that I, HUGH McDONALD, of the city of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented a certain new and useful Improvement in Metallurgic Furnaces; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to furnaces used in the manufacture of iron and steel, and is an improvement of the two furnaces (combined) for which Letters Patent Nos. 129,153 and 139,683 were granted to me July 16, 1872, and June 10, 1873.

My present invention consists in providing a furnace with a fuel-chamber communicating with a fire-chamber, which communicates with the working-chamber of the furnace, which last-mentioned chamber communicates with heating-chambers, in which are arranged air-flues communicating with each other and with air-flues in the walls of the furnace and its stack, the whole being so constructed that the fuel placed in the fuel-chamber of the furnace is subjected to a sweating process and suppressed combustion prior to being conveyed to the grate of the furnace. Atmospheric air is passed through the before-mentioned air-flues, which are heated by and through the medium of the heat of the furnace after it has performed its office in the working-chamber, and prior to its passage out through the stack. In this passage the air becomes highly heated, and also changed in its character, by the oxygen—about one (1) part—and the nitrogen—about three (3) parts—of which it is composed, combining with the gases evolved in the furnace. This highly-heated gaseous compound coming in contact with the sweated and smoldered fuel as it is carried forward on the grate, and then sweeping over the burning fuel, will cause perfect combustion, generating an intense white heat, having great velocity and power of reduction.

To enable others skilled in the art to make and use my invention, I will proceed to describe more fully its construction and operation.

In the accompanying drawings, which form part of my specification, Figure 1 is a side elevation of my improvement in furnace, representing a part of one of the side walls broken away. Fig. 2 is a vertical and longitudinal section of the same. Fig. 3 is a horizontal section at line 3 of Fig. 2. Fig. 4 is a horizontal section of the furnace at line 4 of Fig. 2. Fig. 5 is a horizontal section of the same at line 5 of Fig. 2. Fig. 6 is a vertical section of the furnace at line 6 of Fig. 2.

In the accompanying drawings, A represents the fuel-chamber; B, the fire-grate; C, the working-chamber, and D the stack of the furnace. The fire-grate or chamber B is separated from the fuel-chamber A by a partition-wall, *e*, in which is a flue, *f*, having at its lower side an aperture or apertures, *g*, communicating with the space between the lower edge of the partition *e* and the grate.

Between the grate or chamber B and the working-chamber C is a bridge-wall, *h*, having flues *i j*, and between the chamber C and stack D is a wall, K. Below the bottom of the working-chamber C are two heating-chambers, *l m*, in which are arranged flues *n* and *o*. In the rear side wall *p* of the furnace is a flue, *r*, which communicates with a flue, *s*, which is arranged across the furnace next to the stack D, and connects with a flue, *t*, in the side of the stack, which flue connects with a flue, *u*, at the bottom of the stack, and this flue *u* connects with a flue, *v*, in the opposite side of the stack, and the flue *v* connects with a flue, *w*, which connects with the flue *n* in the heating-chamber *m*. The flue *n* connects with the flue *x*, which connects with the flue *o* in the heating-chamber *l*. The flue *o* connects with the flue *y*, which connects with the flue *z*, which connects with flue *j*, which connects at *a* with the flue *i*, both the last-mentioned flues being in the bridge-walls *h*. The flue *i* communicates with the flue *f* in the partition *e* through the medium of the flue *b*.

The working-chamber C communicates with the heating-chamber *l* by means of the flue *c*, and the heating-chamber *l* communicates with the heating-chamber *m* by means of the flue *d*, and heating-chamber *m* communicates with the stack D by means of a flue at the end of the chamber next to the stack.

The bottom plate e' of the fuel-chamber A may be provided with a large number of small openings for admitting air into the fuel-chamber A.

The furnace is constructed of fire-brick, and clamped in the usual manner. The form and course of the several flues hereinbefore mentioned are clearly shown in the accompanying drawing.

f' represents the door for charging the chamber A with fuel. g' represents a door used in connection with the grate B or fire-chamber. h' represents the charging-door of working-chamber.

The operation of the hereinbefore-described furnace is as follows: The chamber A is charged with fuel, and fire is started in grate B. The charge of metal is placed in working-chamber C. The flame, heat, and gas resulting from the burning fuel on grate B passes over the bridge-wall h into the working-chamber C, and, having performed its office in said chamber, passes over the wall K into the flue c, into the heating-chamber l, and from it down through the flue or space d into the heating-chambers m, and from them out through a flue at their forward end into the stack D. By this arrangement of the heating-chambers l and m and flues c and d, with relation to working-chamber C and stack D, the flues n and o, built within the heating-chambers l and m, are heated to a very high degree by the heat of the furnace after it has performed its office in the working-chamber C, and prior to entering the stack D.

Atmospheric air enters the opening A′, and passing along the flue r in the side wall p, enters the cross-flue s, passing from it down through the flue t in the side stack D, enters the flue n at the bottom of the stack, and, passing through it, enters the flue v on the opposite side of the stack, passes up through it, and enters the flue w; passing down, it enters the flue n in the heating-chamber m, and, passing through it in a circuitous route, enters the flue x, and, passing up through it, enters the flue o in the heating-chamber l, and, traversing back and forth in a zigzag course, enters the flue y, and, passing up through flue y, enters the flue z, and, passing from it, enters the flue j in the bridge-wall h, from which it passes at a and enters the flue i, and, passing along it, enters the flue b, from which it passes into the flue f in the partition e, and, passing down through the opening or openings g, comes in contact with the burning fuel on the grate B, and, sweeping over the surface of the burning fuel, produces perfect combustion, thereby generating intense heat. The operator draws the fuel from chamber A by inserting a suitable tool through the door g', and with it draws the fuel in suitable quantities forward on the grate B. By this arrangement of the flues in the side wall p, partition e, bridge-wall h, cross-flue s, and the flues at the sides at the bottom of the stack, and the flues in the heating-chambers l and m all communicating with each other, and all being heated and subjected to the draft of the stack of the furnace, the air entering at the opening A′, after having passed through a great number of flues, and the great distance it has to travel by the time it passes out at the opening or openings g, is highly heated and changed in its character, so that, in coming in contact with the burning fuel on the grate B, a heat is generated having great velocity and reducing power. The side walls of the partition e and bridge-wall h may be provided with a number of openings communicating with the flues in said partition and bridge-wall, whereby jets of highly-heated air may be brought in contact with the flame and gases of the fire in the furnace.

Having thus described the nature, construction, and operation of my improvement, what I claim as of my invention, and desire to secure by Letters Patent, is—

1. A series of zigzag flues in chamber l under the bottom of the working-chamber C, communicating through the medium of vertical and transverse flues, with chambers in the bridge-wall h and partition-wall e, the latter communicating with the fire-grate B, whereby atmospheric air is highly heated, and subsequently commingled with the products of combustion by the inductive draft of the furnace, substantially as hereinbefore described, and for the purpose set forth.

2. In a metallurgic furnace, the flues r s t u v w n x o y z j i b f, in combination with the fuel-chamber A, grate B, working-chamber C, flue c, heating-chambers l m, and stack D, all constructed and operating with relation to each other, substantially as herein described, and for the purpose set forth.

HUGH McDONALD.

Witnesses:

JAMES J. JOHNSTON,

A. C. JOHNSTON.