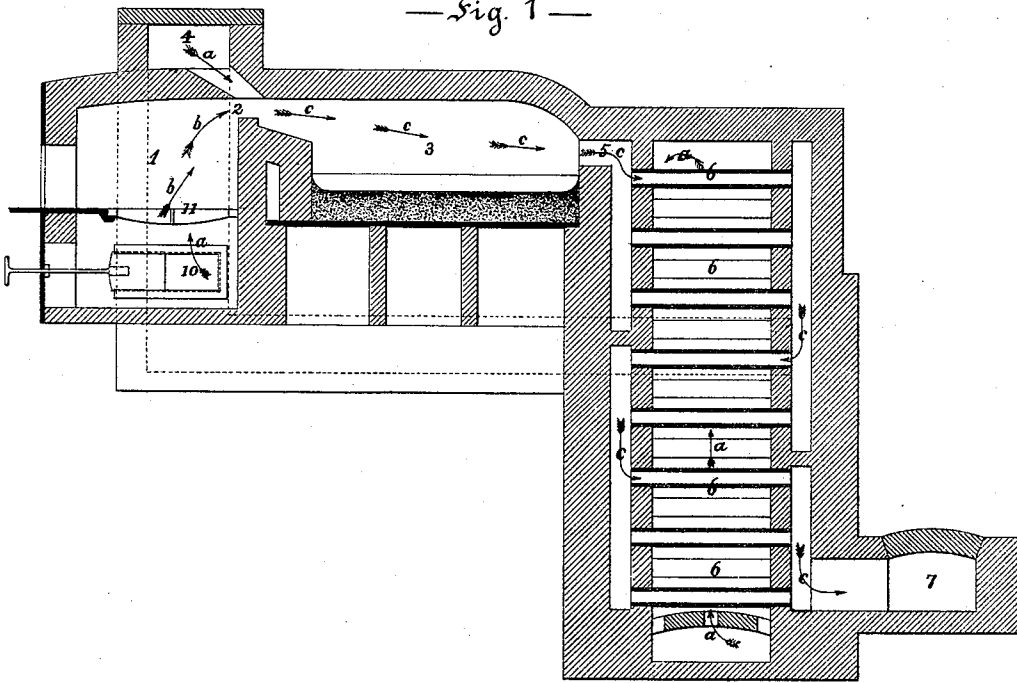


GORMAN & PATON.

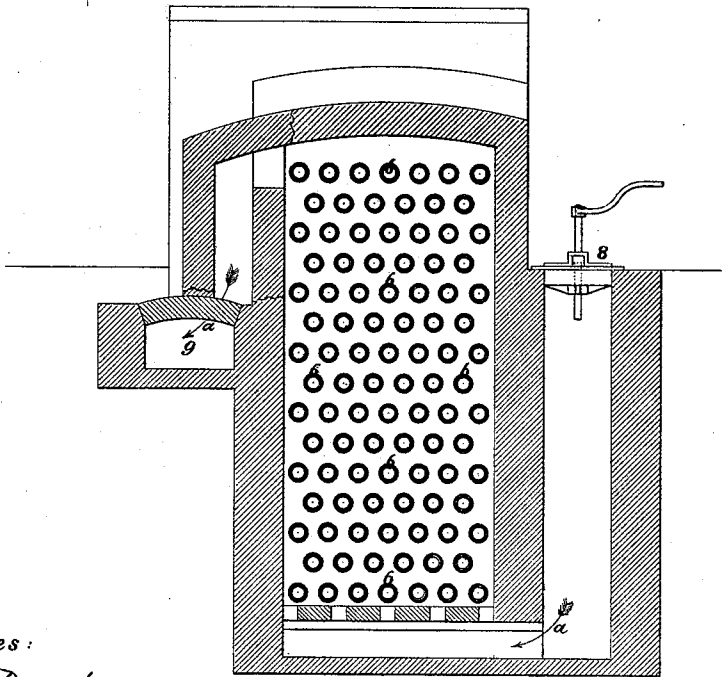
Improvement in Restoring Waste-Heat from Furnaces. No. 129,403.

Patented July 16, 1872.

— Fig. 1 —



— Fig. 2 —



Witnesses:

Mr. B. Dayton.
Jr. Snowden Bell.

William Gorman & John Paton.
by Henry Baldwin &
Attorneys.

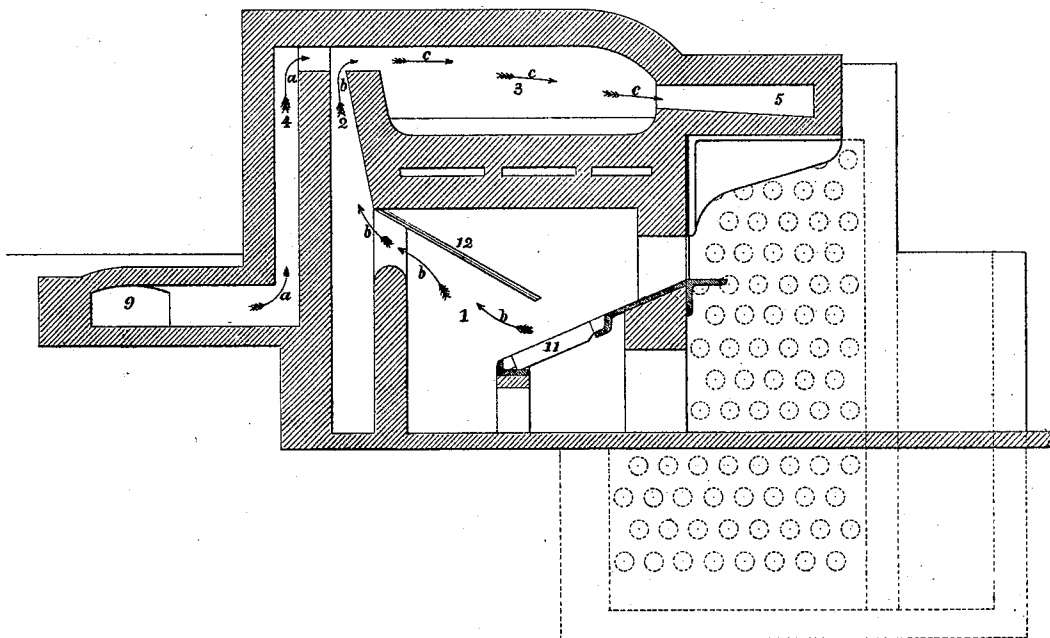
GORMAN & PATON.

Improvement in Restoring Waste-Heat from Furnaces.

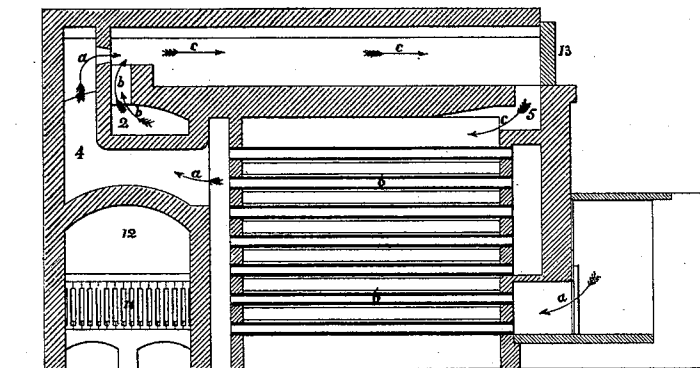
No. 129,403.

Patented July 16, 1872.

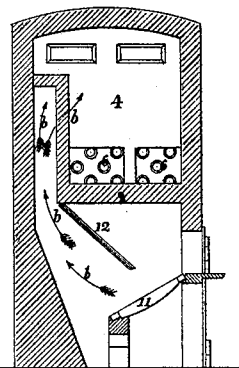
—Fig. 3.—



—Fig. 4.—



—Fig. 5.—



Witnesses:

Wm. B. Dayton
J. Snowden Bell

William Gorman & John Paton.
by Henry Baldwin &
Attorney.

GORMAN & PATON.

Improvement in Restoring Waste-Heat from Furnaces.

No. 129,403.

Patented July 16, 1872.

Fig. 6.

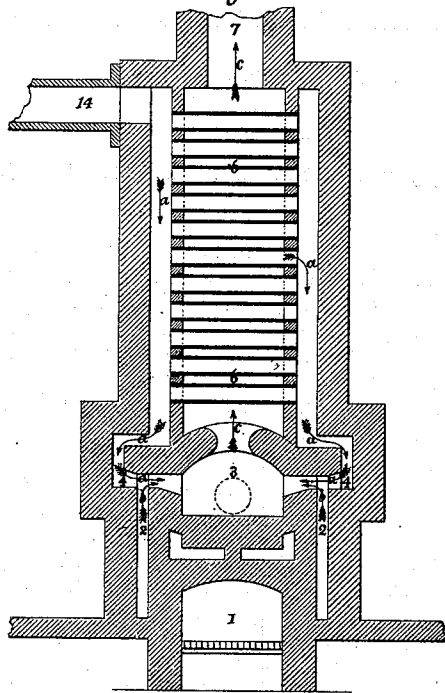
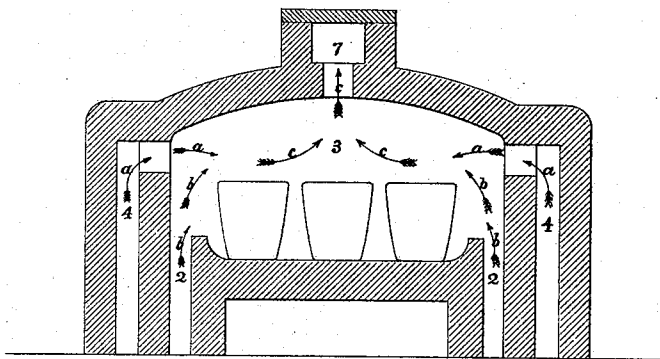


Fig. 7.



Witnesses:

Wm. B. Dayton

J. Swords & Bell

William Gorman & John Paton

by Henry Baldwin Jr.

Attorney.

UNITED STATES PATENT OFFICE.

WILLIAM GORMAN AND JOHN PATON, OF GLASGOW, GREAT BRITAIN,
ASSIGNORS TO WILLIAM SELLERS, OF PHILADELPHIA, PA.

IMPROVEMENT IN RESTORING WASTE HEAT FROM FURNACES.

Specification forming part of Letters Patent No. 129,403, dated July 16, 1872.

To all whom it may concern:

Be it known that we, WILLIAM GORMAN and JOHN PATON, both of Glasgow, in the county of Lanark, North Britain, in the Kingdom of Great Britain, have jointly invented certain Improvements in Restoring Waste Heat from Furnaces; and we hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawing making part of this specification.

In practicing our invention we in general prefer to first convert the coal or like fuel into combustible gases, and to subsequently burn such combustible gases with the aid of a further supply of air in another part of the furnace or apparatus. In our improved arrangement, to replace ordinary draught-furnaces, complete combustion of the fuel is prevented in the ordinary grate-space in which the fuel is placed as usual, the admission of air being always limited by means of valves or contracted passages to a comparatively small quantity, passing up through the grate-bars, and sufficient to form with the fuel carbonic oxide; and this gas, mixed with other volatile matters driven off from the fuel, passes over the bridge or fire-stop at the inner end of the grate-bars into a combustion-space, wherein there is injected into and mixed with it the further supply of air necessary for its complete ignition and combustion. This further supply of air is heated previously to its admixture with the combustible gases, and it is preferred to heat it by the otherwise waste heat of the fire-gases after these have acted on the objects to be heated. The heat restorer or apparatus for recovering this waste heat comprises, according to our modification, a series of horizontal tubes or ducts of any convenient form or section, through which tubes or ducts the fire-gases pass, first traversing a set in the upper part of the chamber containing them, then returning through a lower set, and alternately passing in opposite directions through lower and lower sets to the bottom of the chamber. The air enters the bottom of the chamber, and, traversing the outside of the tubes or ducts in an upward direction, passes off at the top by a passage leading to the combustion-space. The currents of the entering air and depart-

ing gases are opposed, which, as is well understood, conduces to a maximum transference of heat from the latter to the former. The tubes or ducts at the hottest part of the heat-restorer are by preference made of a refractory material, such as fire-clay; but those at the cooler part may be of cast iron.

The heat-restorer may have its details modified in various ways, provided the system of opposite currents is retained. Thus the fire-gases may pass outside the tubes or ducts, and the air inside of them and the tubes may be disposed vertically or in any other convenient position, and in a single continuous length or in sets, as described.

Figure 1 on Sheet 1 of the drawing is a longitudinal section of a heating-furnace with a heat-restorer connected therewith, and Fig. 2 is a vertical section at right angles to Fig. 1, and taken through the heat-restorer.

The arrows *a a* in these and the other figures indicate the air-passages and currents, while the arrows *b b* indicate the passages and currents of the combustible gases, and the arrows *c c* those of the mixed air and gas or issuing fire-gases. The fuel is placed in the primary conversion-furnace 1, and the combustible gases from it pass by the passage 2 over the bridge into the combustion-space 3, wherein, in this example, are placed the objects to be heated. The supply of air for the complete ignition and combustion of the gases is injected among and mixed with them from the air-inlet passage 4 just as they enter the combustion-space 3. The fire-gases leave the combustion-space by the outlet 5, and, traversing the heat-restorer tubes 6, pass off by the discharge-flue 7 to the chimney. The air admitted by the external valve 8 traverses over the outside of the restorer-tubes 6, and proceeds by the passage 9 to the air-inlet 4, a portion also entering under the grate 11 by an opening, 10, fitted with a valve wherewith to regulate the quantity.

Fig. 3 is a vertical section of a heating-furnace, which differs from that shown in Figs. 1 and 2 in having the primary furnace 1 constructed below the combustion-space, heating-space or hearth 3, and in having the grate 11 inclined downward, while there is placed above it a plate, 12, inclined downward toward it,

upon which plate the fresh fuel is first thrown, and from which it gradually descends to the grate 11 as the conversion proceeds.

Figs. 4 and 5 are vertical sections, at right angles to each other, of a third modification of furnace arranged for heating-plates. The heat-restorer tubes 6 are in this example contained in a space under the combustion-space 3, the air passing inside and the fire-gases outside of them, and the whole forming a compact and convenient arrangement.

Fig. 6 is a transverse vertical section of a fourth modification of furnace arranged for forge purposes. The restorer-tubes 6 are in this example placed above the combustion-space 3, and the air passes through them, while the fire-gases traverse over their outside to the discharge-flue or chimney 7. The air should be forced in by the inlet 14.

Having thus described our said invention, and the manner in which the same is or may be applied, what we claim, and desire to secure by Letters Patent of the United States of America, is—

1. The improvement in the art of restoring heat from furnaces, hereinbefore set forth, which consists in subjecting the air moving to the furnace in a continuous current to a progressively-increasing temperature, while the

waste products of combustion, moving from the furnace to the chimney in a continuous current, are subjected to a constantly-decreasing temperature.

2. The combination in vertical lines of chambers and series of pipes extending from one chamber to another with an intermediate chamber, across which the pipes extend, and through which air or the waste products of combustion pass, substantially as and for the purpose specified.

3. The improvement in the art of restoring heat from furnaces, hereinbefore set forth, by passing the waste products of combustion through the pipes, and passing the air to be heated over the pipes, so that the heat from the products of combustion is taken up by the interior surface of the pipes, transmitted through the body to the exterior of the pipes, and given off from the exterior surface to the air passing over the pipes.

WILLIAM GORMAN. [L. S.]
JOHN PATON. [L. S.]

Witnesses:

JOHN BROWN,
JOHN C. MACANDIE,
Clerks to J. Henry Johnson, Solicitor,
166 Buchanan street, Glasgow.