2 Sheets--Sheet 1.

P. W. MACKENZIE.

Cupola Furnaces.

No. 138,510. Patented May 6, 1873.

Fig. 1.

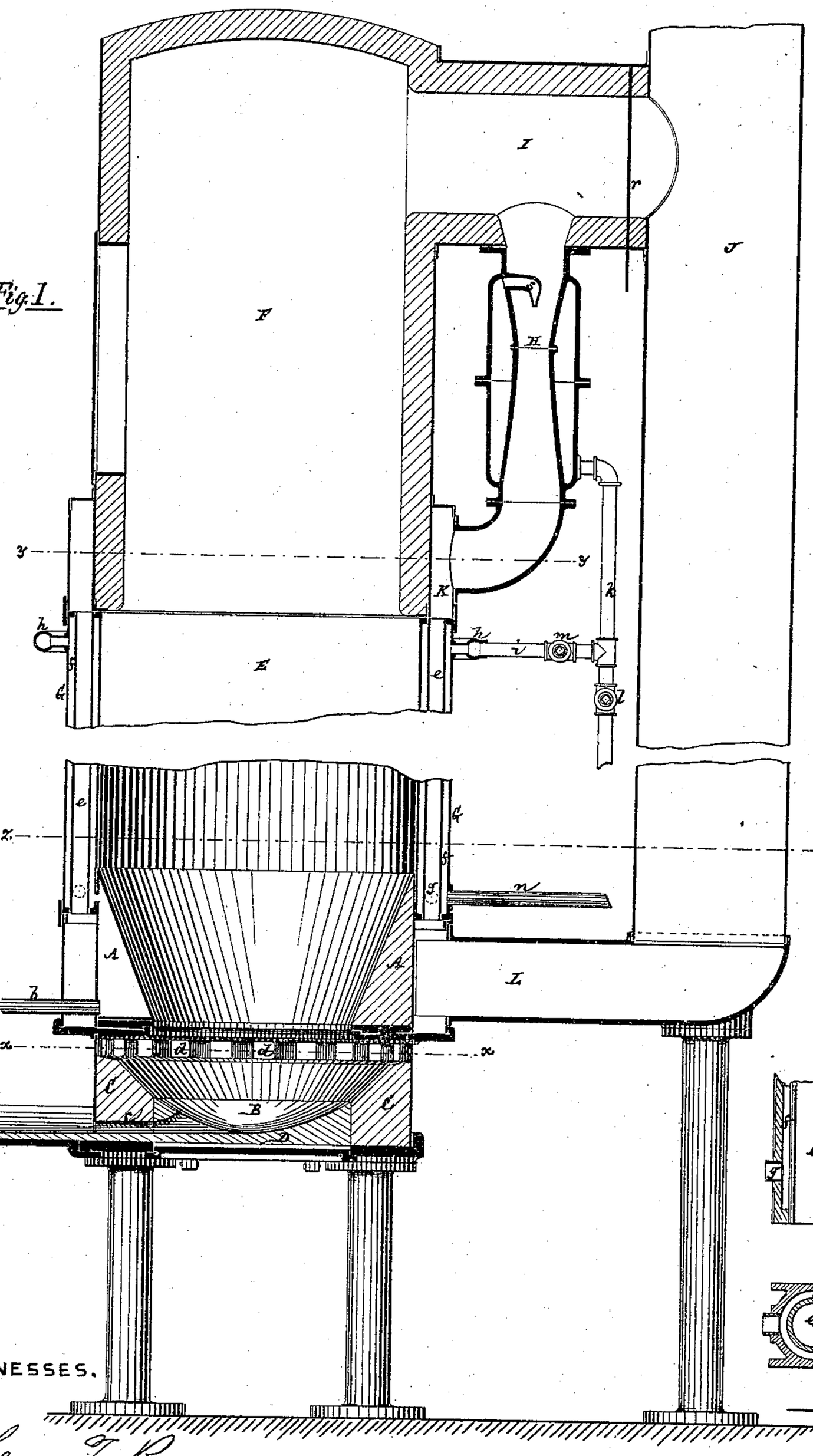


Fig. 2.

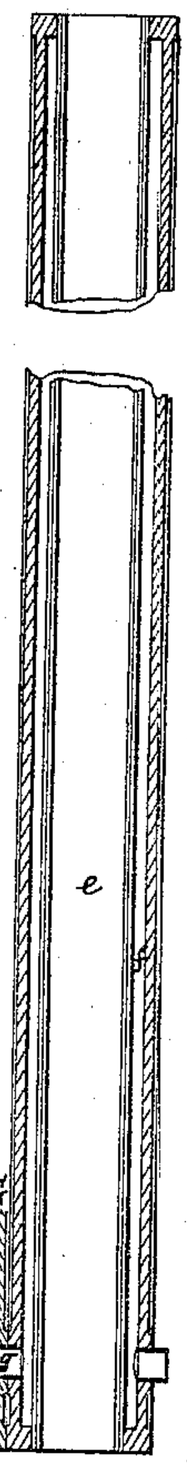
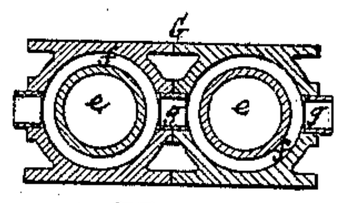


Fig. 3.



WITNESSES.

Henry J. Brown

Fred Haynes

INVENTOR.

P. W. Mackenzie

2 Sheets--Sheet 2.

P. W. MACKENZIE.

Cupola Furnaces.

No. 138,510. Patented May 6, 1873.

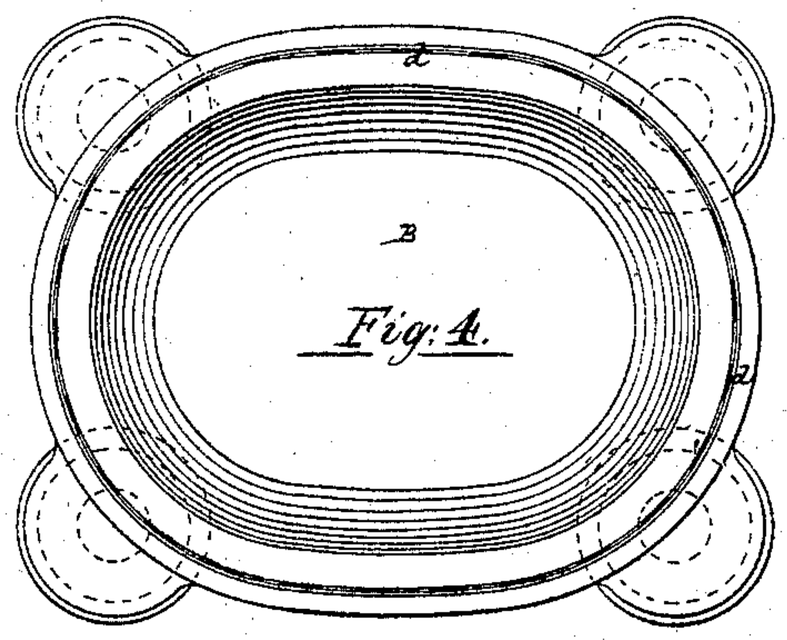


Fig: 4.

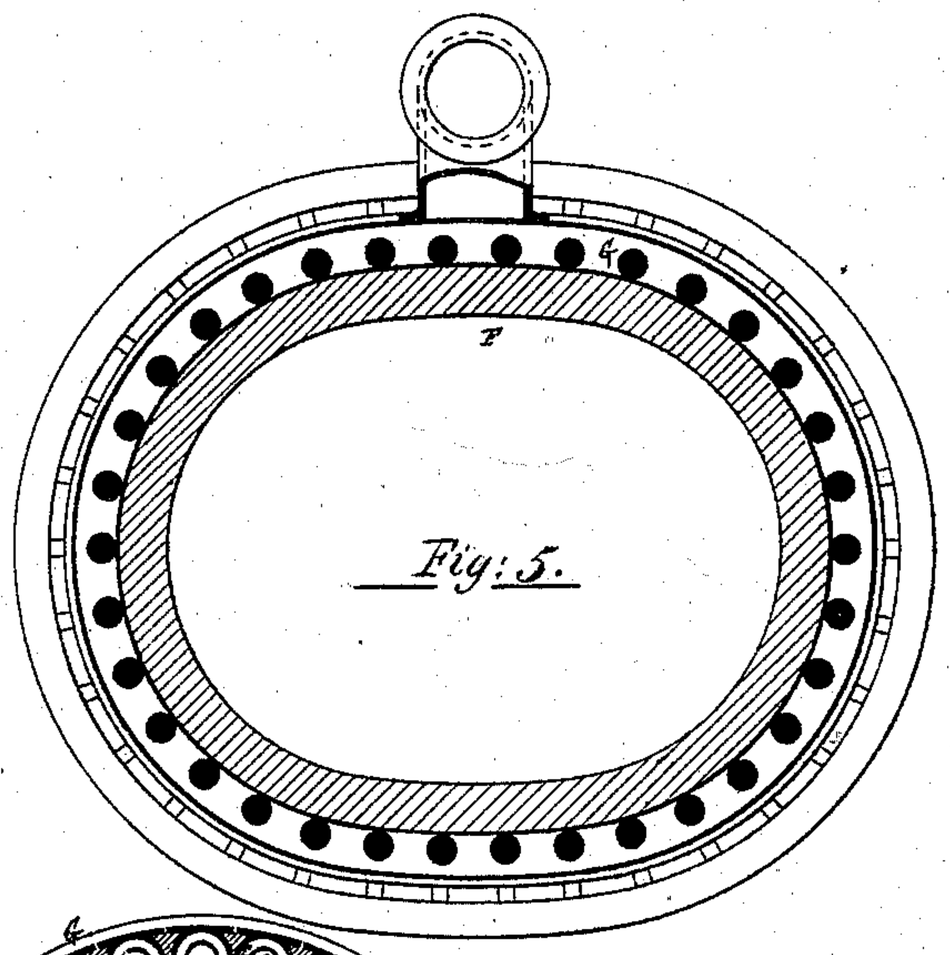


Fig: 5.

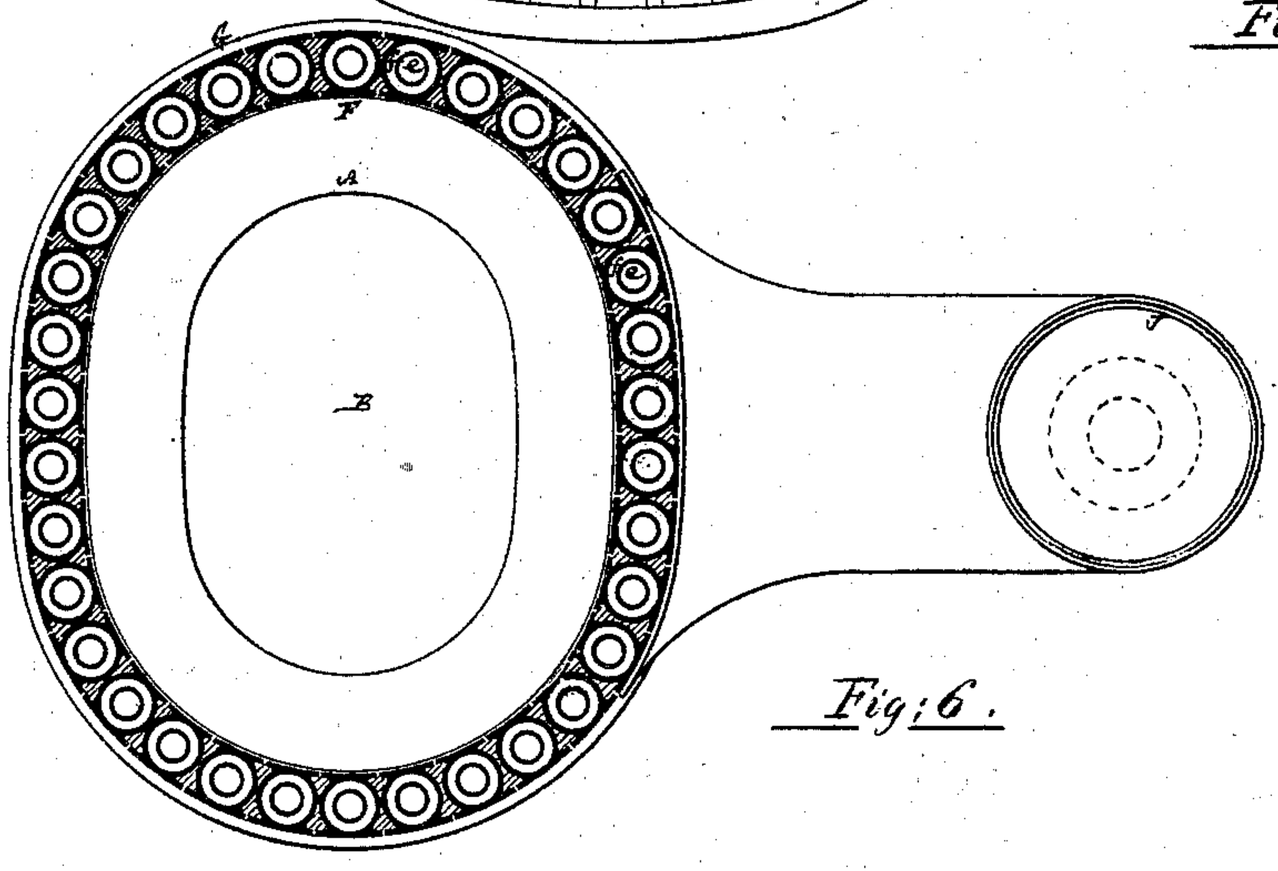


Fig: 6.

Fig: 7.

WITNESSES.

Fred Haynes
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INVENTOR.

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UNITED STATES PATENT OFFICE.

PHILIP W. MACKENZIE, OF BLAUVELTVILLE, NEW YORK.

IMPROVEMENT IN CUPOLA-FURNACES.

Specification forming part of Letters Patent No. **138,510**, dated May 6, 1873; application filed June 20, 1872.

To all whom it may concern:

Be it known that I, PHILIP W. MACKENZIE, of Blauveltville, in the county of Rockland and State of New York, have invented a new and useful Improvement in Furnaces for Metallurgical Purposes; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing forming a part of this specification, in which—

Figure 1 represents a sectional elevation of a cupola-furnace having my invention applied to it; Fig. 2, a vertical section, upon a larger scale, of two adjacent sections, in part, of a steam-generator used in and forming part of the invention; Fig. 3, a horizontal or transverse section of the same; Fig. 4, a horizontal section of the furnace at the line *x x* in Fig. 1; Fig. 5, a similar section at the line *y y;* Fig. 6, a like section at the line *z z*. Fig. 7 is a detail horizontal sectional view of a modified construction of the steam-generator.

Similar letters of reference indicate corresponding parts throughout the several figures of the drawing.

This invention is mainly designed for the smelting of the precious metals, such as gold and silver; but it is also applicable to inferior metals, and may be used in cupolas for smelting iron ore. The invention consists in a combination, with the smelting-furnace, of a steam-generator, heated by said furnace and by gases passing therefrom, and a steam-injector deriving its supply of steam from said generator and jetting it into a draft flue or flues connected with the chimney or main outlet for the escaping products of combustion, whereby the products of combustion are made to maintain the blast of the furnace. The invention also consists in certain peculiarities of construction and combinations or arrangements of parts, whereby the above result is obtained in a most perfect and advantageous manner, and great convenience is afforded for fitting the whole together, as also for repairs, when necessary, and for starting or operating the furnace under different conditions of its draft.

In the accompanying drawing, the invention is shown as applied to a cupola-furnace embracing many or most of the essential features described in Letters Patent originally issued to me August 25, 1857, and subsequently twice reissued and extended; but it is equally applicable to other constructions of furnace.

A represents the bosh of the furnace, which may either be of brick, as shown at the right-hand side of Fig. 1; or may be of a hollow metal construction to contain water, as shown at the left hand of said figure. When a water-bosh is used, then the feed-water to the steam-generator G, designed to be heated by the furnace, may be introduced through said bosh by a pipe, *b*, and the bosh connect at its top with the lower portion of the water-space of the generator. B is the bowl of the furnace, having a tap-spout, *c;* C, the bed brick; D, the sand hearth; and *d d*, the air-openings, by which the furnace is supplied with air. E is the lower, and F the upper, portion of the body of the furnace, both of which, if desired, may be lined with brick, but the lower portion of which is here represented as not having its shell lined. The steam-generator G is arranged to surround the lower portion E of the body, and, as shown in Figs. 1, 2, 3, 5, and 6 of the drawing, is composed of a number of vertical sections of polygonal shape in their transverse section, so as to form a compact body around the furnace, and having tubular flues *e* and surrounding annular water-spaces *f* through them, the latter connecting with each other near their base by thimbles *g*, as shown in Figs. 2 and 3, and said annular spaces connecting near their tops by branches with a surrounding steam-belt, *h*, from which the injector H draws its supply by a pipe or pipes, *i k*, from which steam may be taken by a branch or extension of the pipe *k* to drive an engine, or for any other purpose that steam may be required. The pipe *k* may also be used, on opening a cock, *l*, to supply the injector with steam from an independent steam-boiler for the purpose of starting the furnace, during which a cock, *m*, in the pipe *i* should be closed; but after steam of the necessary pressure is formed in the generator G, then the cock *m* is opened, and the cock *l* may be closed. When the generator G is not connected with a water-bosh, then the water may be fed to it by a pipe, *n*.

The hereinbefore-described construction of the generator G is a very advantageous one, not only on account of the convenience with

which the generator may be erected around the body of the furnace, and its sections be removed or replaced, when required, but also on account of the facility which it affords for a downward draft of heated gases from the furnace through it, and so that the generator is heated, not merely by its contact with or proximity to the lower portion of the body of the furnace, but also by the escaping products of combustion passing through it. Thus the products of combustion may either pass—that is, when a natural draft is required—direct from the top of the cupola, which is covered, by or through a main upper outlet, I, to the chimney J on opening a damper, *r;* or said products may be forced to pass through the injector H down into a box, K, with which the flues *e* connect at their top, and from thence down through said flues to a lower box, from which is an outlet, L, that connects with the chimney J below. This draft is quickened by the steam-injector H to produce the necessary blast to the furnace; and, as said injector is supplied with steam from the generator G, the furnace is accordingly made to maintain its own blast. Said injector, of which *s* is the nozzle, may be constructed with an outer drying case or shell for the steam, and inner reversely-tapering body, substantially as described in Letters Patent No. 114,163, issued to me April 25, 1871.

Fig. 7 of the drawing shows a modified construction of the generator G. Thus, instead of each vertical section being made to contain a single flue, *e*, and annular water-space *f*, it is made to embrace a number of such flues and water-spaces of other than annular shape.

What is here claimed, and desired to be secured by Letters Patent, is—

1. The combination, with a steam-generator heated by a reducing-furnace, of a steam-injector deriving its supply of steam directly from said generator, and operating to pass the products of combustion of said furnace through the generator, and thence to the chimney or main outlet, as shown and described.

2. The steam-generator G made up of vertical sections arranged to form a jacket on the outside of the shell of the furnace, and provided with draft-flues *e* and water-spaces *f*, in combination with an upper outlet, I, from the furnace, a steam-injector, H, a lower escape passage or outlet, L, the chimney J, and a lower air-supply opening or openings, *d*, essentially as shown and described.

Witnesses: P. W. MACKENZIE.

FRED HAYNES,

FERD. TUSCH.