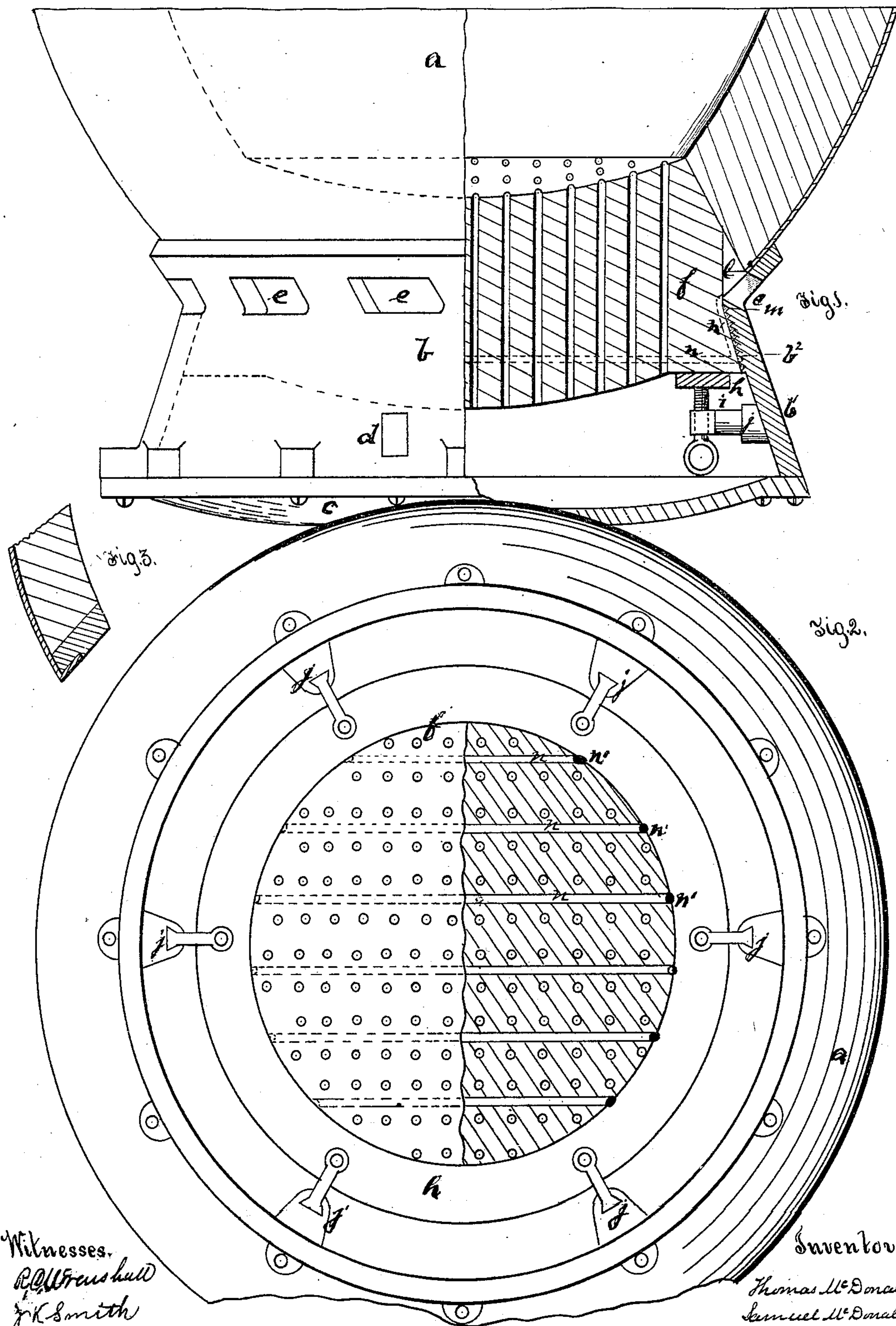


T. & S. McDONALD.  
Converter Bottom.

No. 230,142.

Patented July 20, 1880.



Witnesses.  
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# UNITED STATES PATENT OFFICE.

THOMAS McDONALD AND SAMUEL McDONALD, OF BRADDOCK'S FIELD,  
ASSIGNORS OF ONE-THIRD OF THEIR RIGHT TO J. M. NELSON, OF  
PITTSBURG, PENNSYLVANIA.

## CONVERTER-BOTTOM.

SPECIFICATION forming part of Letters Patent No. 230,142, dated July 20, 1880.

Application filed December 29, 1879.

*To all whom it may concern:*

Be it known that we, THOMAS McDONALD and SAMUEL McDONALD, both of Braddock's Field, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Converter-Bottoms; and we do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a side elevation, partly in section, of our improved tuyere-bottom. Fig. 2 is a view of the under side of the same, partly in section, showing its attachment to the converter; and Fig. 3 is a view of the lower end of a tile-faced converter.

Like letters of reference indicate like parts in each.

The bottoms of converters used in the manufacture of steel by the pneumatic or Bessemer process, as heretofore constructed, are commonly known as the "tuyeres" and refractory material surrounding and removable with them. The method of constructing them is substantially as follows: A number of tuyeres are inserted upward through a pair of metallic plates and fastened from below. On the upper of these plates, and around the tuyeres, is rammed as much refractory material as will fill up the space between the plate and the top of the tuyere. Formerly the ramming was done by men from within the converter, the bottom being built while the plates were attached to the vessel. As, however, a cool converter was necessary to enable this method to be practiced, it was done at the expense of a greatly-diminished production of the plant.

To obviate the difficulty another plan was adopted, and is the one now in common use. A section of the vessel containing the bottom is detached and removed to some suitable place where workmen can knock out the tuyeres, remove the debris, insert new tuyeres, fasten them from below, and ram the refractory material around them from above. By means of duplicate sections containing bottoms this method facilitates repairs and is much better

than the other plan named. It is, however, very expensive. The great weight, and consequent difficulty in handling the bottom, the fact that when one or two, or at the most a few of the tuyeres, are burned out the whole bottom has to be renewed, and the cost of construction and repairs are objections that may be named here.

Another method is to have the metallic plates through which the tuyeres are inserted of such size that when the bottom, constructed as previously described, is built thereon they, with the bottom, may be inserted through the tuyere-box, just as the tuyeres were inserted in the old style, and rammed around through the converter, openings being made therefor. In this case the great difficulty in making the blast-joint and the joint between the bottom and the lining of the vessel prevented its use.

By other methods only one metallic plate is used. This plate forms the top of the tuyere-box, as did the lower plate in the methods before described.

In all other methods, so far as we know, the bottoms are built in a detached section of the vessel, and are objectionable on account of the weight, expense of making, baking, glazing, handling, &c.

The principal objection to all styles of bottoms heretofore and at present in use may be thus stated: It frequently happens that a bottom, as at present known, burns out during a blow. Its weight and difficulty of handling make it necessary to put in a new bottom when the vessel is in such a position that it must be empty—that is, either from above or below.

In case of a bottom giving out during a blow the partially-converted metal is cast or poured out of the vessel. It must then be broken up, conveyed to the cupola, remelted, weighed twice, and reconverted. If it has been cast into ingots the molds are damaged and often rendered unfit for further use. Sometimes, however, the metal is shotted by casting it in water, thus obviating this difficulty.

A bottom as at present constructed cannot be renewed so as to save the expense referred



to. The bottom section cannot be removed while the charge is in the vessel. Plates cannot be withdrawn and new bottoms built on plates swung into position and put in and rammed. This is a serious drain on the producing capacity of the plant.

By our invention we are able to renew the bottom while a charge is in the vessel, and thus obviate the difficulty and save the loss aforementioned.

Our invention consists of an improved construction which enables us to put in and replace the bottom by simply removing the lower plate of the tuyere-box.

It also consists in an improved construction of the bottom.

To enable others skilled in the art to make and use our invention, we will now describe its construction and operation.

The converter *a* is made in the usual way, having a metallic casing lined with refractory material. Bolted or otherwise fastened to the metallic part is the tuyere-box *b*, which is provided with a bottom plate, *c*, closing its lower end and blast-openings *d*. Around it, at suitable intervals, are holes *e*, just below the lower end of the sides of the converter.

The tuyere *f* is composed of suitable refractory material, and is of such shape that it may be inserted through the tuyere-box *b* by removing the plate *c*, and such size that it will fit closely to its adjacent parts in the lower end of the converter and constitute the bottom of the vessel. It is provided with a sufficient number of vertical perforations or tuyere-openings, such perforations being arranged in any desired way. It is held in place by a flat ring, *h*, supported on screw-clamps *i*, which have their bearings in dovetail recesses *j* in the sides of the tuyere-box. Between the end of the converter, the sides of the tuyere *f*, and the upper portion of the tuyere-box is an annular space, *l*, the purpose of which is to contain the ganister or other packing or cement used to seal the joint between the sides of the adjacent parts and the tuyere, such packing being rammed in through the holes *e*, which open into the space *l*. In the sides of the casting *b* we form grooves opposite to the tuyere, to receive the cement or paste which is put in to close up the joint between the tuyere *f* and tuyere-box *b*.

To insert the tuyere *f*, the converter is turned down in a nearly horizontal position, the plate *c* removed, the tuyere having been "battered" with a refractory and quickly-setting paste, is pushed into position by means of a ram of any convenient construction, to which it had been previously attached, the flat ring *h* is put on it, the screw-clamps inserted in their bearings *j*, and screwed up tightly, the cement put in at *m*, the ganister rammed in at *l*, and finally the plate put back and properly secured.

In case the tuyere burns out during a blow the vessel is swung into a horizontal position, the plate *c* and the ring *h* removed, the rem-

nant of the old tuyere driven into the vessel by a blow from the ram, and the tuyere put in, as before described.

It will ordinarily not be necessary to ram the joint of the tuyere in order to finish the blow. The joint will be sufficiently closed by the paste with which the edges of the tuyere are buttered for such temporary work. After the blow is finished and sufficient time can be taken with safety it may be rammed. The old tuyere is fused and mixes with the slag in the vessel, and passes off with it.

The tuyere *f* is dished or concave on its upper face and convex on its lower face.

The tuyere being a large piece may, for convenience of manufacture, be made in several pieces, if preferred; but such pieces or sections should be secured together, either by bolts or interlocking edges, to prevent their being displaced by the pressure of the blast in the tuyere-box or in the converter.

The bottom in converters is gradually worn away, and there is danger of its being cut through during a blow and the whole charge of molten metal run out through the tuyere-box, thereby entailing serious loss. To guard against this we make a series of small transverse perforations, *n*, in the tuyere *f*, near its lower side, extending to the openings *e* or to vertical grooves *n'* in the tuyere, above the cement *m*, leading to the openings *e*. Then when the tuyere wears down to the perforations *n* the blast will force the molten metal out through the perforations in the form of sparks, which, indicating to the operator the condition of the tuyere, will enable him to change it in good time.

If desired, the joint between the tuyere and its adjacent parts may be rammed through the tuyere-box, instead of from the outside through the holes *e*. In that case the transverse perforations would be led out through holes in the casing *b'* below the ramming, such holes being cut off from the blast to prevent its escape by a suitable cap or plate covering the groove through which the joint was rammed.

The lining of the converter is composed of refractory material rammed in while plastic, and then dried. In ramming the joint between this material and the tuyere the lining of the converter is liable to crumble and break off. We face the lower end of the converter with hard-baked tile or fire-brick of proper shape, and thus secure a hard even surface to ram against—one that preserves its shape and will not crumble or break.

The advantages of our invention are that it cheapens the cost and increases the durability of the converter, facilitates repairs, improves the apparatus, and prevents loss arising from the burning out of the bottom.

We are aware that converter-bottoms have been formed around the tuyeres and continuous with the lining of the body of the converter, and also that converter-bottoms have been formed of disconnected sections, which, after having been put in position to form the



bottom, were subsequently rammed with ganister and grouted to close the interstices between the sections, and do not herein claim the same, as in both instances it is necessary to work through the mouth of the converter to complete the bottom, and this cannot be done while the converter contains molten metal, nor after the removal of the metal until the converter has been allowed to cool off.

10 What we claim as our invention, and desire to secure by Letters Patent, is—

1. In combination with a converter-body, a refractory tuyere-bottom formed in a single piece and having beveled edges forming a close joint with the lining, and a supporting-ring and clamps for holding the refractory tuyere-bottom in place, whereby a new bottom can be inserted during a blow, without removing the molten metal, by cutting off the blast and turning the converter upon its side, so that the molten metal shall be retained in the belly of the converter, and whereby the usual bottom plate can be dispensed with, substantially as specified.

2. In combination with a converter-body and its tuyere-bottom, the tuyere-box having grooves opposite the tuyere-bottom to receive the cement or paste with which the tuyere-bottom is coated at the time of its insertion, substantially as and for the purpose specified.

3. A converter-bottom having transverse perforations *n'* therein, substantially as and for the purposes described.

4. The combination, with a converter, of a tuyere-box having diverging sides and widest below, said tuyere-box closed by a detachable plate or cover, substantially as and for the purpose specified.

5. The combination, with a converter, of a tuyere-bottom formed in a single piece and beveled at its edges, thus forming a close joint with the converter-lining, and an annular channel, *l*, below the same, a supporting-ring, and clamps for holding the bottom in place, the converter having openings *e* for filling the channel *l* with ganister or cement, substantially as and for the purpose specified.

6. The combination, with a converter, of a tuyere-bottom formed in a single piece and beveled at its edges to form a close joint with the tuyere-lining, and an annular channel, *l*, below the same, and a tapering tuyere-box grooved on its interior opposite the tuyere-bottom to receive the paste or cement with which the tuyere-bottom is coated at the time of its insertion, substantially as and for the purpose specified.

In testimony whereof we, the said THOMAS McDONALD and SAMUEL McDONALD, have hereunto set our hands.

THOMAS McDONALD.  
SAMUEL McDONALD.

Witnesses:

I. F. McDONALD,  
JOHN MORRISON NELSON.