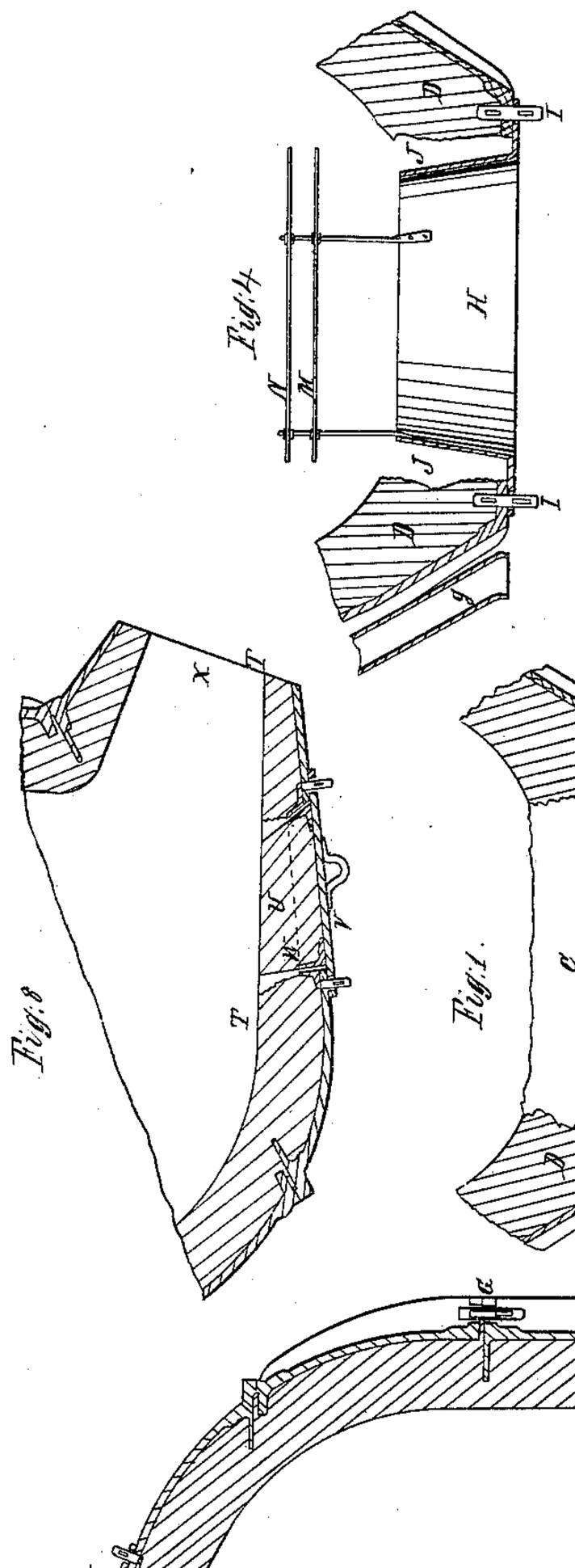
Holley & Pearse.

Making Bessemer Steel.

No. 86,304. Patented Jan. 26, 1869.



United States Patent Office.

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Letters Patent No. 86,304, *dated January* 26, 1869.

IMPROVEMENT IN APPARATUS FOR THE MANUFACTURE OF IRON AND STEEL.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that we, ALEXANDER L. HOLLEY and JOHN B. PEARSE, of Swatara township, in the county of Dauphin, and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for the Manufacture of Iron and Steel; and we hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings.

This invention relates to the apparatus for the manufacture of iron and steel by the Bessemer or pneumatic process; and consists in improved means of repairing the linings of converters.

The tuyeres, generally made of fire-clay, cylindrical in shape, and perforated with longitudinal air-holes, (by which air is forced into melted iron for the purpose of decarburizing it,) and the refractory lining in the lower part of the converter in which the tuyeres are set, the whole being called the "bottom," are usually so much burned or worn away after five or six heats as to require renewal.

The practice has heretofore been to knock the tuyeres out of the lining, to insert new ones from without into the old holes in the lining, and to make the lining good around the tuyeres either by pouring granulated refractory material, made semi-liquid by water, into the mouth of the converter, and allowing it to settle around the tuyeres, which does not often make a good bottom, or to wait twelve to twenty-four hours, until the converter should cool enough for workmen to enter and work in it, and then to make the bottom good by ramming the refractory material around the tuyeres. The latter method wastes much time, and reduces the product of a given plant.

An improvement heretofore used in some cases is the duplicate removable bottom, as shown in figs. 1 and 2 of the accompanying drawings,

Figure 1 representing the lower part of a converter, in section, and

Figure 2, the removable bottom, with the tuyeres A and tuyere-box B in section.

The old bottom, including the tuyeres, having been removed from the converter, (fig. 1,) a new bottom, (fig. 2,) with the tuyeres previously rammed and dried, is inserted.

When the old bottom is pulled away from the lining D in the sides of the converter, it sometimes carries away some of the lining with it, and sometimes a part of the bottom is left sticking to the lining, and must be knocked out. In any case the fracture is irregular, so that, when the new bottom (fig. 2) is inserted, there remains an irregular and often large space to be filled and made sound with refractory material. To get into the converter, to fill this space, requires waiting till the converter is cool. To pour semi-fluid refractory material into the large and irregular space thus formed is subject to the risk of unsoundness, as in the case above mentioned when similar material is poured around the tuyeres.

Another method, heretofore used in some cases, of facilitating the repairs of converter-bottoms, is shown in Figure 3, which is a section of a converter, and consists in removing the whole top of the converter E at the joint F G. The old tuyeres may then be knocked out, and new ones rammed by men working from without while the converter is still very hot. The grand defect of this method is the uncertainty of making a good joint when the top part of the converter is replaced. The joint cannot be inspected nor made good from within the converter without waiting for it to cool, which again imposes the delay above mentioned.

Our improvement consists, first, in means and apparatus for making a sound joint between a removable bottom and the lining of the body of the converter.

To enable others to construct and use our invention, we have shown several forms of it in the drawings, which form a part of this specification, and in which—

Figure 4 is a section of the lower part of a converter, and

Figure 5 is a removable bottom.

When the old bottom is removed, leaving the irregular fracture in the converter-lining, as shown at C, fig. 1, we insert a mould, H, fig. 4, into the bottom of the converter, and fasten it there in any suitable manner, by preference by means of three or four of the bolts I that hold the bottom when it is inserted into the converter.

We then ram the space J between the mould H and the lining D with refractory material, and, when it is set, we remove the mould H.

The removable bottom (fig. 5) is prepared by forming or inserting new tuyeres, placing the mould K around them, and ramming refractory material between the mould K and the tuyeres, and then removing the mould K. We make the interior of the mould K either of the same or of a slightly larger diameter, and of the same shape as the exterior of the mould H, so that, when the bottom (fig. 5) is inserted into the lower part of the converter, (fig. 4,) it will either exactly or almost exactly fit the opening or seat in the lining D J.

By properly proportioning and fitting the male and female moulds H and K, the joint between the bottom, which thus forms a stopper, and the lining, which thus forms a seat for the said stopper, will be perfectly closed. But, to insure a perfect joint, we prefer either to cover the sides L of the bottom, before it is inserted into the converter, with a paste made of fire-clay, or any suitable refractory material, or to pour semi-fluid refractory material, such as ground silicious stone and fire-clay mixed with water, into the converter after the bottom is inserted, so that the semi-fluid material thus poured in shall run into any opening there may be between the

bottom and the lining D J; or we sometimes use both these measures of securing a perfect joint.

The worn bottom may be removed, and the new bottom inserted, by means of a screw, or a hydraulic lift, or in any suitable manner. After it is inserted, the converter is dried and heated by means of a fire made in it in the usual manner, when it is ready for use.

Workmen can stand outside of the converter and place and ram the refractory material J, fig. 4, while the interior of the converter is so hot as to prevent their working inside of it. In order to protect them from the heat radiated from the lining, thus enabling them to repair it while the interior of the converter is red hot, we employ a shield, M N, by preference made of two disks of sheet-iron, with an air-space between, and attached to the mould H.

We sometimes prefer to prepare the lining of the converter to receive the new bottom when the converter is turned bottom upward, so that the workmen can ram the refractory material around the mould more directly, and without being so much exposed to the heat of the interior of the converter. For this purpose, we suspend the mould H′, Figure 7, centrally in the inverted bottom of the converter by any suitable means, as the beam P, and ram the refractory material directly down into the space J′.

In case the lining D′ is so much broken away that the refractory material thus rammed in would fall through the space J′ down into the converter, we stop the bottom of the space J′ by any suitable means, for instance, by the adjustable stopper R, which is shown in plan by Figure 9, and consists of a piece of plate-iron, attached to a suitable handle.

This stopper is inserted in one of the spaces S, and rests on the ring *a*, which is suspended from the mould H′. By means of the handle, a workman adjusts the stopper to the lining, so as to stop the lower part of the annular space J′. When the space over the stopper has been rammed full, the stopper is removed and laid upon another part of the ring *a*, until the whole space J′ has been rammed full.

In order to make the space in the lining, after the old bottom has been pulled out of it, so true and regular that the mould H′ will nearly fit the space J′, fig. 7, and so that the space J′ will require but little fresh refractory material, we sometimes prefer to cut out the lining, for the insertion of the mould, by means of the cutter *c*, Figure 6, fastened to the hand-lever *b*, the fulcrum of which is pivoted upon the beam *e*, laid across the bottom of the converter for that purpose, so that a workman, by moving the lever *b* up and down, and around the circle formed from the centre, *d*, can cut the hole in the lining comparatively smooth and regular.

It will thus be seen that, by means of our said improvements, a bottom is set in a converter rapidly and soundly.

By means of the corresponding male and female moulds, the converter is fitted to receive the new bottom immediately or very soon after the old bottom is removed.

Another arrangement of removable bottom, which we sometimes prefer to employ, is shown by fig. 3, where the joint between the lining and the bottom is made inside of the tuyere-box B′.

In figs. 4 and 5, previously described, this joint is made above the tuyere-box, so that the tuyere-box is removed together with the bottom, and so that the joint in the air-pipe *g* and *g′*, leading from the trunnion of the converter to the tuyere-box, is broken whenever a bottom is removed, and must be made good whenever a bottom is inserted; and in figs. 4 and 5 a tuyere-box is required for each duplicate bottom, and the bottom must be inserted with the air-pipe *g′* always in the same position, to fit the air-pipe *g*; but in fig. 3 the duplicate bottom consists simply of a plate, *k*, or of the plates *k* and *m*, the tuyeres A′, and surrounding refractory material *f*, and may be removed without breaking the air-pipe *g′* or removing the tuyere-box B′, and may be replaced without reference to the position of the air-pipe.

The plate *k* must fit tightly against the bottom of the tuyere-box, to prevent the escape of air, and for this purpose we prefer to face off the interior of the flange *m* and the top of the plate *p*, to form a tight joint.

The bottom may be inserted into place by any suitable means, such as a crane, letting it down into the converter when bottom upward, or a lift, raising it into place when the converter is mouth upward, as shown in the drawing.

The bottom may be held in place by any suitable means.

We prefer several screws, *h*, as shown in fig. 3, with heads projecting through the walls *j* of the tuyere-box, so as to be easily got at.

Should the bottom stick so fast as not to drop or pull out easily, it may be started off by setting up the screws *i* after slacking the screws *h*.

In some cases we use only a single plate *k* for the removable bottom to rest upon; but in order to prevent the plate *k* from being warped by the heat of the lining, and at the same time to leave a space, in the usual manner, for any air that leaks from the tuyere-box to pass into the atmosphere, instead of blowing up into the lining, we sometimes employ the plate *n* also, leaving the air-space *o* between the plates.

The removable bottom, and the opening in the converter, into which it is inserted, are moulded, as hereinbefore described, or in any suitable manner, by means of corresponding male and female moulds.

The bottom that is removed from the converter may be refurnished with tuyeres or air-openings, and got ready to be replaced, while the lining in the body of the converter is being moulded or repaired; but we prefer to use one of several interchangeable bottoms, prepared and thoroughly dried and heated beforehand.

The converter may be taken apart at other places than those specified, and the lining made good by means of suitable moulds, substantially in the manner specified.

Our improvement further consists in arranging openings in the converter, through which men standing outside the converter can see and work upon the bottom and around the tuyeres while the converter is hot, and, by preference, so that when such an opening is closed, its joint, with the lining, can be seen and made good on the inside by men standing on the outside of the converter.

This is explained by fig. 3, which is a section of a converter mounted on trunnions and standing upright, and Figure 8, which is a section of the upper part or nose of the converter turned down, so that the part of the lining T T is in a nearly horizontal position.

We form a hole in the upper part of the converter, by preference, directly over the bottom, as shown by fig. 3, and of such dimensions that workmen, standing upon or around the nose of the converter, can work through the hole upon the bottom and lining, by means of long rammers and other suitable tools.

We close the hole by a stopper, made, by preference, of a plate-iron cap, V, and flange W, lined with suitable refractory material, U.

When the stopper has been removed and replaced, there will be a ragged annular opening around it, similar to that hereinbefore described, between the bottom, fig. 2, and the lining D, fig. 1.

By turning the converter into the position, fig. 8, a workman can see and make good the annular opening, by looking and working through the mouth, X, of the converter.

In case an opening that requires stopping is made, for any purpose, in the converter, at a place where it cannot be conveniently stopped, as above described, by working through the mouth of the converter, we stop said opening in the manner that the opening in the lining D D, fig. 4, is stopped, as previously described, by moulding the hole, and moulding the stopper to fit the hole, by means of suitable moulds, thus forming a seat for the stopper.

What we claim, and desire to secure by Letters Patent, is—

1. The combination of a converter with a moulded stopper and seat, substantially as and for the purposes set forth.

2. The combination of a shield with a converter, for protecting the workmen, substantially as and for the purposes described.

3. The combination, with a converter and mould, of the adjustable stopper R or its equivalent, substantially as and for the purposes described.

4. The combination, with a converter, of the cutter *c*, substantially as and for the purposes described.

5. A tuyere-box, in combination with a converter-bottom, when the latter is so constructed as to be capable of being introduced into the converter through the tuyere-box, substantially as described.

6. An aperture in the converter, so located, with respect to the mouth and to the bottom of the converter, that the bottom can be worked upon through it, and so that it can be stopped through the mouth of the converter, substantially as described.

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Witnesses:
H. S. NOURSE,
JOSEPH POTTS.