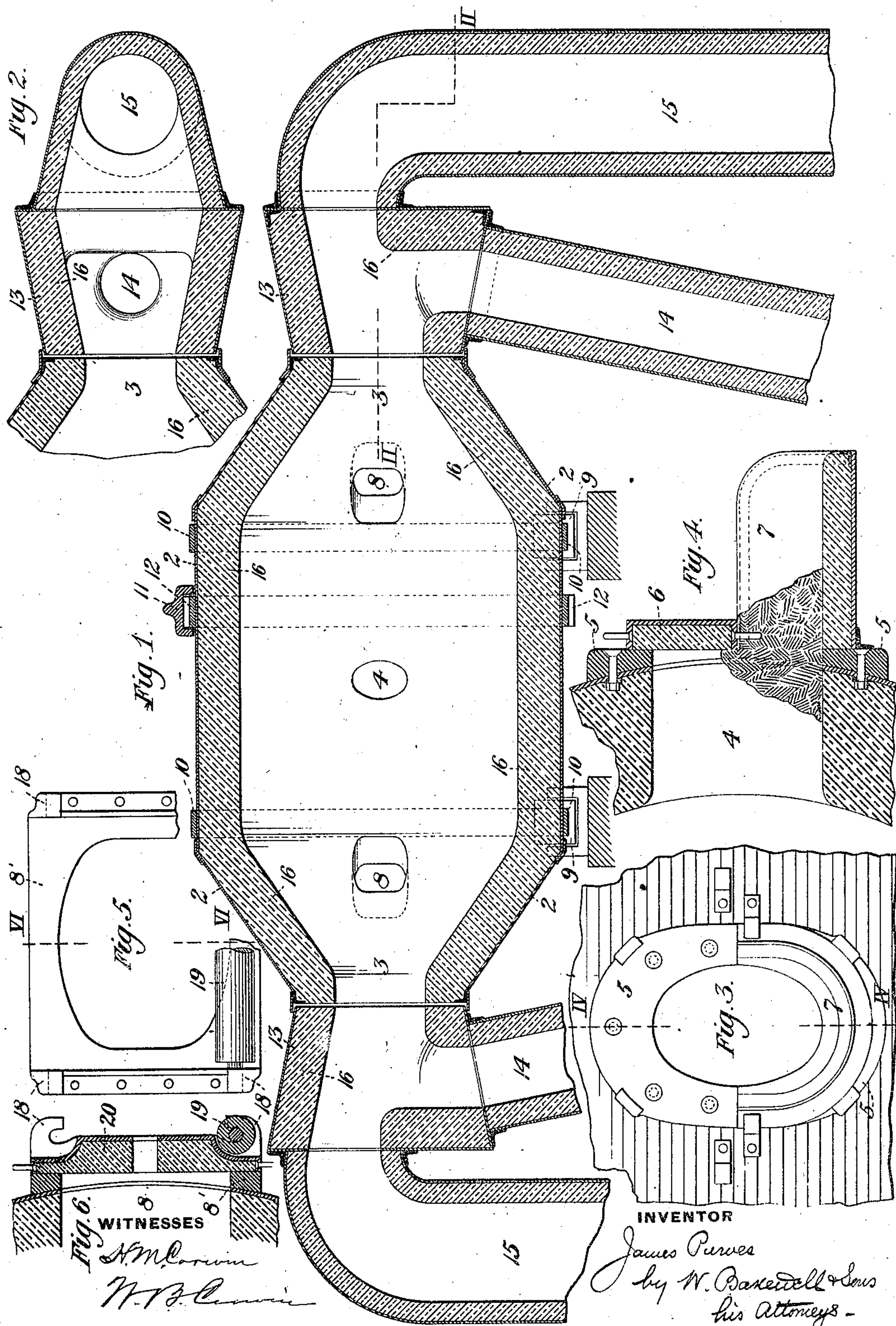


(No Model.)

J. PURVES.  
OPEN HEARTH FURNACE.

No. 528,510.

Patented Oct. 30, 1894



INVENTOR

James Purves  
by W. Baxendale & Sons  
his Attorneys -



# UNITED STATES PATENT OFFICE.

JAMES PURVES, OF MUNIHAL, PENNSYLVANIA.

## OPEN-HEARTH FURNACE.

SPECIFICATION forming part of Letters Patent No. 528,510, dated October 30, 1894.

Application filed September 22, 1892. Serial No. 446,611. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES PURVES, of Munhall, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Open-Hearth Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a vertical longitudinal section of a furnace constructed in accordance with my invention. Fig. 2 is a horizontal section on the line II—II. Fig. 3 is a front elevation of one of the tapping-holes. Fig. 4 is a vertical section on the line IV—IV of Fig. 3. Fig. 5 is a partial front elevation of one of the working holes. Fig. 6 is a vertical section on the line VI—VI of Fig. 5, showing the reversible door.

Like symbols of reference indicate like parts in each figure.

Owing to the high temperatures employed in open-hearth melting furnaces, great difficulty has been experienced with the refractory materials generally used, in that they will not withstand the heat without melting.

It is proposed, in the present invention, to construct such a form of furnace as will enable more refractory material to be used in all parts of the melting chambers and ports, and also to make the hearth and roof (the parts most liable to accident) interchangeable, thus rendering the furnace less liable to destruction by overheating, more susceptible of repair while still hot, and the skill and care hitherto indispensable, to a certain extent unnecessary.

The proposed furnace consists of a horizontal, cylindrical vessel, having three doors on each side and openings at each end to admit gas and air, or to withdraw the products of combustion, and carried on suitable rollers and capable of being turned on its longitudinal axis by a rack and toothed wheel, or other mechanical means.

In the drawings, 2 represents the shell of the body of the furnace which as stated, is substantially cylindrical in form and is made of strong metal plates. At the ends, this shell is shaped so as to constitute hollow tapering necks 3.

There are two tap-holes 4 for the furnace,

situate at diametrically opposite points, and preferably constructed as shown in Figs. 3 and 4 each having an annular casting 5, surrounding the hole in the shell and fitted with a movable door 6.

7 is a spout which projects laterally from the shell at each of the tap-holes.

The spout 7 is made detachable from the shell of the furnace, so that it may be removed and shifted in position from the upper to the lower side of the tap-hole, and vice versa, thus enabling the necessary changes to be made when the furnace is inverted as hereinafter described.

The holes 4 are used mainly as orifices through which metal and slag may be poured and for affording access to the hearth for purposes of repair. There are also other openings 8, situate near the ends of the furnace, and in the same plane with the doors 4. They are used for charging the furnace with the stock to be melted therein. The holes 8 are also provided with door-frames 8' secured to the furnace-shell and both above and below the openings 8 are journal supports or bearings 18, adapted to support a roller 19, acting also as a sill-plate, which is removable and reversible in position so that it may be properly adjusted when the furnace is inverted. The opening is provided with a door 20, which is used when the furnace is in either position. The inversion of the furnace also inverts the doors, which (top and bottom being similar) are in no way affected by the change; beyond that the lifting chains will now be hooked in what was the bottom staple before inversion, i. e., if the doors be kept over the charging holes while the furnace is being turned, which may easily be done by keying up the doors in their places before inversion. However, as the supports from which these doors are hung will be entirely independent of the furnace shell (the rollers being removed,) the furnace may be inverted while the doors are allowed to hang just where they were. This saves unhooking and hooking up again.

The furnace shell is supported on rollers 9, upheld by suitable circular frames, and bearing against bands or plates 10, which surround the furnace shell. The furnace is adapted to be turned on these supports by



means of a rack 11, which meshes with a series of gear-teeth 12 on the shell; this construction being such that the furnace can be turned throughout at least a semi-revolution 5 so as to invert it, and so that the part on which the metal is melted and which constitutes the hearth (after withdrawal of the metal and slag) may be brought uppermost and made to serve the function of a roof, the part 10 constituting the roof being then brought into position to serve as the hearth.

The ends of the parts 3 of the furnace-shell communicate directly with chambers formed by hollow shells 13, whose shape is 15 that of a truncated cone, through which gas and air enter the furnace at one end and from which the products of combustion are discharged at the other end alternately. The chamber 13 is supported independently of 20 the furnace, and in practice I prefer to make the shell of one of the parts 3 or 13 overlap the other, so as to cover the intermediate joint while permitting the free rotation of the furnace-shell.

25 14, 15, are gas and air flues at each end of the furnace, which enter the chambers 13 and connect the same with regenerators. Not shown. The flues of the chamber 13 and the interior of the furnace-shell are all provided 30 with a refractory lining 16 and in lining the chamber 13, the refractory material may be rammed or bricked around suitable cores, preferably hollow, before the attachment of the air-flue at the end. After the ports are 35 thus lined, the back-plate is put on, the air-flue attached, and the cores, which are simply supports used in construction, allowed to burn or melt out as the furnace heats up. The gas and air flues leading to and from 40 these ports may be constructed as shown, or of any other form found most convenient, although that shown is believed to be the best.

After a suitable lining has been inserted in the furnace, either by bricking or ramming, 45 I preferably proceed as follows:—The hearth or that portion of the furnace which happens to be in the position usually occupied by the hearth, is covered with material of a less refractory nature than the hearth itself, and 50 which will flux (but not to an injurious extent) with the lining itself. A quantity of slag will thus collect upon the hearth, *pro tem.* There should be sufficient of this slag to cover all the interior of the melting-chamber, and this can be effected by temporarily 55 closing one or both of the tap-hole doors, and turning the furnace through half a revolution, so as to glaze the entire surface. On the portions of the furnace next the ports 60 which the slag will not cover, it must be splashed and more of the flux aforementioned should be thrown upon them through the doors when the furnace is turned down. The face of the lining thus having been glazed 65 and set, and sufficient heat having been obtained, the furnace is ready to charge and operate in the usual manner.

The method heretofore usually employed in putting bottoms into open-hearth furnaces is also applicable to this furnace. It is to 70 put a brick lining in, just thick enough to protect the shell, then to get a melting heat on the furnace, and then begin adding the refractory stuff of which the hearth is to be composed in small quantities at a time all 75 over, setting such thin layers with sufficient heat, then adding another layer, and so on, until the desired thickness of hearth is obtained.

In the event of repairs being wanted in 80 that portion of the furnace which is being used as a roof, *pro tem.*, the furnace, after being tapped or poured, can be turned down, the repairs made through the doors, set and glazed over, and the roof returned to its 85 former position. In the event of that portion of the furnace which is being used (*pro tem.*) as a hearth becoming full of steel, (or what is generally known as "dirty") and unsafe to melt upon or defective in any other 90 way, the hearth may be used as a roof, and the portion which has been in service as a roof turned down, and a practically new and clean bottom obtained on which to begin operations. Should this portion, while acting 95 as a roof, have become thin, it is easily thickened up in the usual manner through the doors.

The manner of use of the furnace will be understood by those skilled in the art. The 100 end-flues 14, 15, being connected with regenerator-chambers, and there being suitable gas and air supplies, as usual in regenerative furnace construction the gas and air are caused to enter one end of the furnace, burn 105 therein, and then pass out the other end to the regenerators which they serve to heat, the course of gas and air and the products of combustion being reversed from time to time in the usual manner. The charge having 110 been introduced through the doors 8, is melted on the furnace-hearth, and after the melting operation, the furnace may be tipped on its longitudinal axis to discharge the cinder and molten metal through one of the tap- 115 holes. When desired, the furnace between successive melts, may be completely inverted so as to interchange the position of the hearth and roof. In such case, the same openings will serve when the furnace is in either posi- 120 tion, all that is necessary being to reverse the position of the detachable spout.

The advantages of my invention will be appreciated by those skilled in the art. By reason of the reversible construction of the 125 furnace, and the highly refractory material rendered available by such construction, the apparatus is very durable, and the ease of its operation renders it efficient in the manufacture of steel.

Without limiting myself with preciseness 130 to the construction above described and shown in the drawings, which may be modified without variance from my invention, what I



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

1. An invertible open-hearth furnace, having opposite lateral doors, supports on which it can be turned throughout at least a semi-revolution, a detachable spout, and an invertible door; substantially as and for the purposes described.

2. An invertible open-hearth furnace, having a lateral door, a door-frame having at the top and bottom thereof journal-supports for

a roller, and a removable roller adapted to be journaled in said supports; substantially as described.

In testimony whereof I have hereunto set my hand this 3d day of September, A. D. 1892.

JAMES PURVES.

Witnesses:

W. B. CORWIN,  
JAMES K. BAKEWELL.