Jan. 26, 1926. 1,570,704

F. ORTH

SLAG POCKET AND METHOD OF DRAINING THE SAME

Filed March 14, 1923 3 Sheets-Sheet 1

Fig. 1.

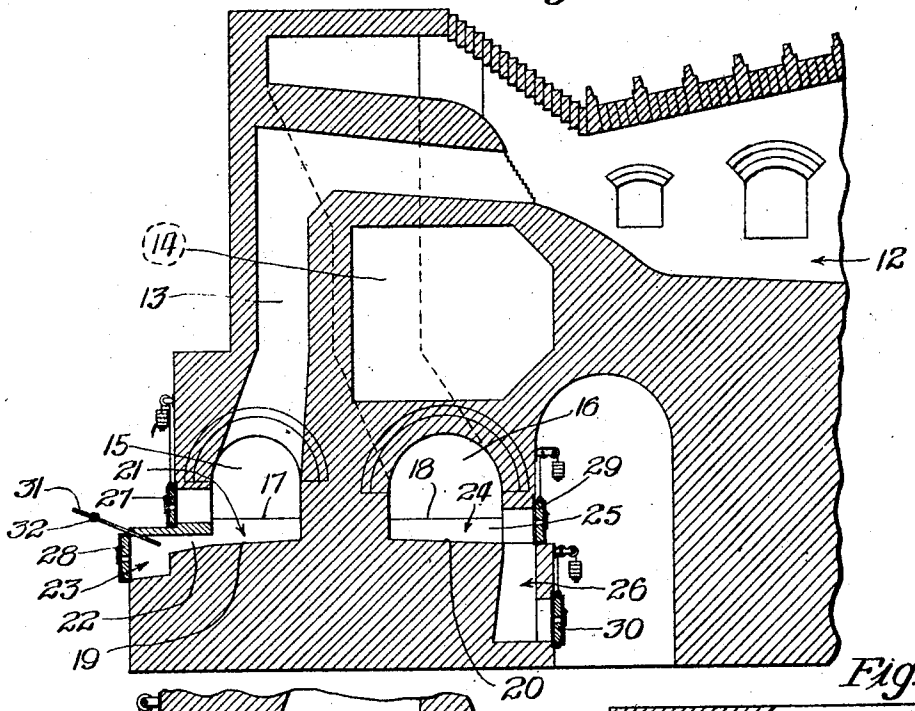


Fig. 2.

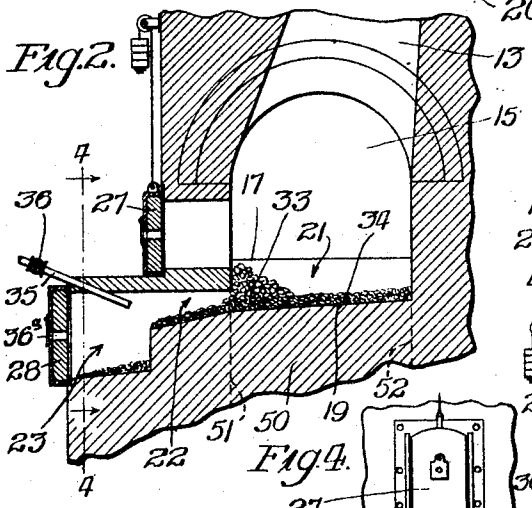


Fig. 4.

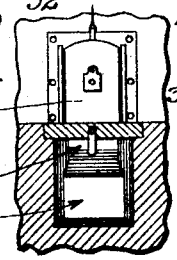
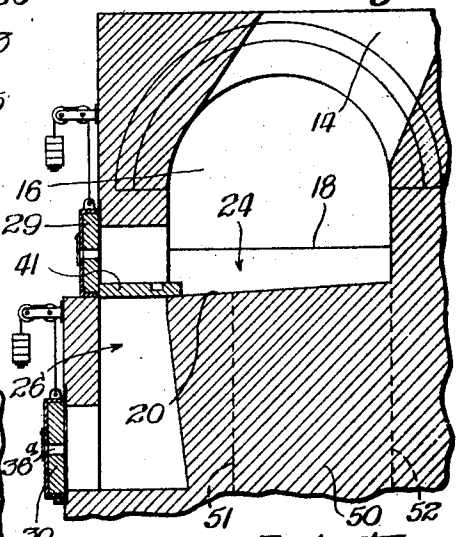


Fig. 3.



Witness:
Harry L. Gaither

Inventor:
Frank Orth
by Bowman & Bowman
Attys.

Jan. 26, 1926. 1,570,704

F. ORTH

SLAG POCKET AND METHOD OF DRAINING THE SAME

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Fig. 5.

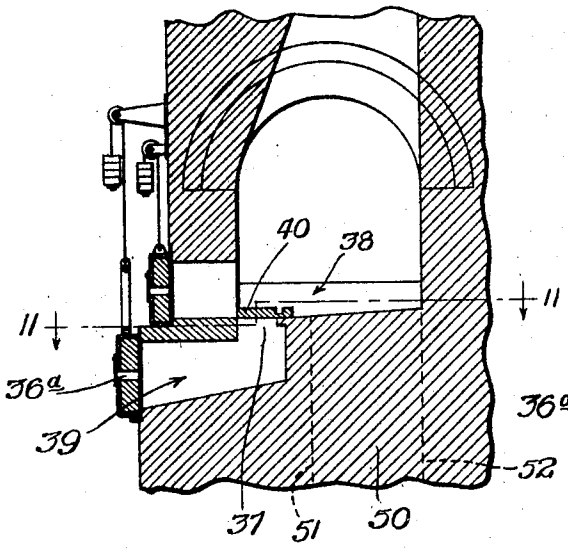


Fig. 6.

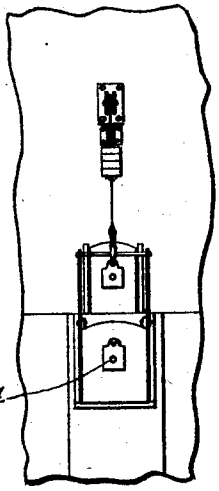


Fig. 7.

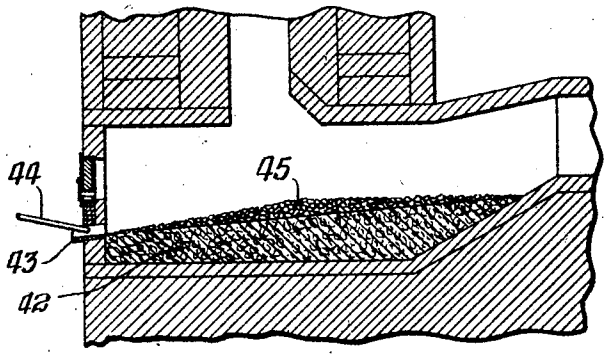
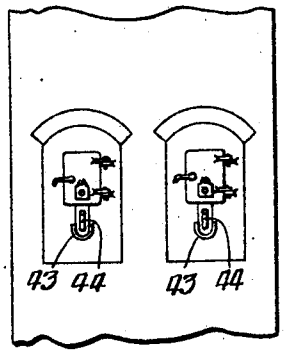


Fig. 8.



Witness:
Harry S. Gauthier

Inventor:
Frank Orth
by Banning & Banning
Attys.

Jan. 26, 1926. 1,570,704

F. ORTH

SLAG POCKET AND METHOD OF DRAINING THE SAME

Filed March 14, 1923 3 Sheets-Sheet 3

Fig. 9.

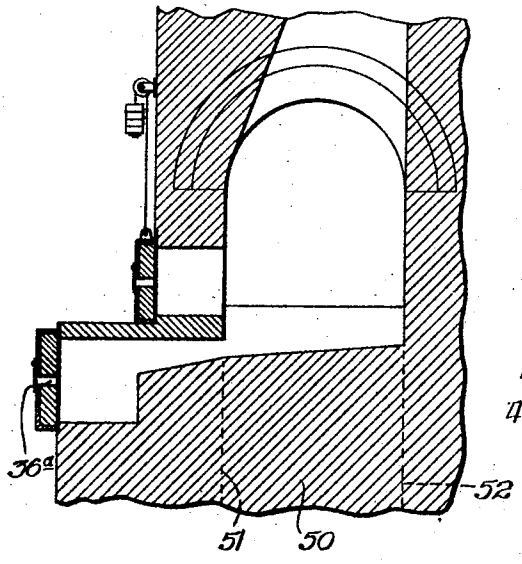


Fig. 10.

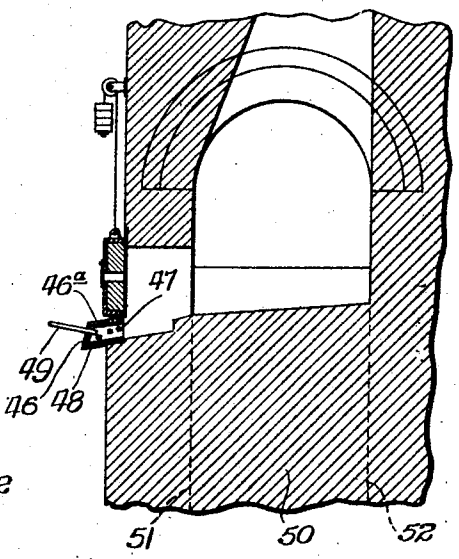
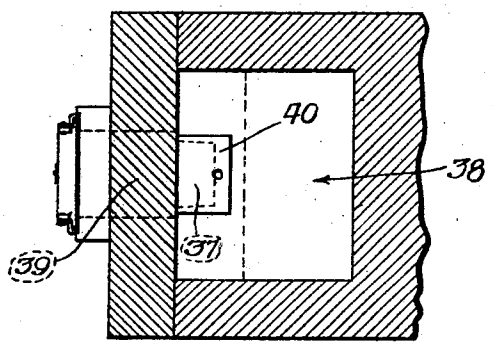


Fig. 11.



Witness:
Harry S. Gaither

Inventor:
Frank Orth
by Bowman & Bowman
Attys.

Patented Jan. 26, 1926. 1,570,704

UNITED STATES PATENT OFFICE.

FRANK ORTH, OF INDIANA HARBOR, INDIANA.

SLAG POCKET AND METHOD OF DRAINING THE SAME.

Application filed March 14, 1923. Serial No. 625,095.

To all whom it may concern:

Be it known that I, FRANK ORTH, a citizen of the United States, residing at Indiana Harbor, in the county of Lake and State of Indiana, have invented certain new and useful Improvements in Slag Pockets and Methods of Draining the Same, of which the following is a specification.

The present invention has to do with improvements in the construction of slag pockets and the methods of operating the same so as to ensure proper drainage and satisfactory operation at all times. The features of the invention are very well adapted for use in connection with the slag pockets of open-hearth furnaces and the like, although it will presently appear that the said features are not necessarily limited to use in this particular connection. However, for purposes of convenience in illustration and description, I will illustrate and describe the features of the invention as the same may be conveniently applied to open-hearth furnace construction.

In the construction of open-hearth furnaces, it is customary to provide air and gas down-comers at both ends of the furnace, said down-comers providing communication between the respective ends of the furnace and the corresponding regenerators or the like. On one half of each cycle of the blow, air and gas pass upwardly at one end of the furnace through their respective down-comers, while the spent gases are traveling downwardly through the down-comers at the other end of the furnace. On the other half of the cycle, the operation is reversed, the air and gas passing upwardly through the down-comers at the second mentioned end of the furnace, and the spent gas passing downwardly through the down-comers at the first mentioned end of the furnace.

It is found that more or less fluid or some fluid material, generally slag and the like, is carried over under intense draft, and is driven down through the down-comers towards the regenerators. In order to collect this material and prevent the same from reaching the regenerators or the passages leading thereto, it is usual to provide some form of slag pocket for each of the down-comers, into which slag pocket the slag and other materials are driven and collected. The customary practice has heretofore been to extend each down-comer downwardly a considerable distance below the elevation of the connection sidewise to the corresponding regenerator passage, so that the portion of the down-comer beneath the sidewise connection to the regenerator passage constitutes in effect a trap of considerable capacity within which the slag and the like collects. This arrangement presents a number of serious objections, among which may be enumerated a considerable increase in the cost of installation. Said increase in cost is occasioned, among other things, by reason of the necessity of extending the foundations downwardly a distance depending upon the depth of the slag pockets so produced.

Another objection to the above mentioned construction is that no provision is made for draining the slag pocket from time to time, but the slag and other materials are simply allowed to collect within the pocket during an entire campaign or portion of campaign of the furnace. Thereupon, it is necessary to shut down the furnace, and, after allowing the furnace to cool, to undertake the extremely difficult and hazardous operation of cleaning out the accumulated materials.

One of the objects of the present invention is to provide a construction of slag pocket which may be conveniently drained from time to time during the operation of the furnace, thus making it unnecessary to provide for the accumulation of a large amount of material, and also making it unnecessary to provide a slag pocket of very large size. At the same time the very large amount of labor is saved which would otherwise be necessary for cleaning out the slag pockets, and the furnace does not have to stand idle for a long time in order to cool down preparatory to the cleaning operation.

On account of the manner in which the slag and other similar materials are delivered through the down-comer, it is not always convenient to drain them continuously, and consequently it is quite desirable to provide for the accumulation of said materials for a short time within an auxiliary pocket from which they may be cleaned out from time to time without interrupting the operation of the furnace. I have, therefore, provided a construction such that the said materials may collect for a period of time within an auxiliary pocket, which pocket may then be isolated from the down-comer and

cleaned out during the continued operation of the furnace.

It is also found that frequently the slag and other materials come over in relatively cooled condition, or at any rate at a temperature considerably below their fusing point. Consequently said materials in such condition will not readily find the way into the auxiliary slag pocket. I have, therefore, provided means for introducing fuel, such as coal, coke, gas, oil, and the like, at the desired point and for burning the same at a point where they will maintain the slag and other materials in molten condition, or will bring said materials into molten condition, so that they will properly drain into the auxiliary slag pocket.

On account of the fact that the introduction of fresh air into the gas down-comer might result in a serious explosion, it will be seen that means should be provided to ensure against the entrance of fresh air at such point. I have, therefore, so arranged the parts that assurance may be had that any air entering the slag pocket will be consumed before it reaches the gas down-comer, to thereby ensure the elimination of free oxygen.

Other objects and uses of the invention will appear from a detailed description of the same which consist in the features of construction and combinations of parts hereinafter described and claimed.

Referring to the drawings:

Figure 1 shows a vertical section through the end portion of an open-hearth furnace and the down-comers and connections to the regenerators, and it shows applied to said connections slag pockets embodying the features of the said invention;

Fig. 2 shows in enlarged detail the slag pocket on the gas side of the construction shown in Fig. 1;

Fig. 3 shows in enlarged detail the slag pocket on the air side of the construction shown in Fig. 1, the pocket shown in Fig. 3 being reversed in position from that shown in Fig. 1;

Fig. 4 shows a vertical section taken on the line 4—4 of Fig. 2, looking in the direction of the arrows;

Fig. 5 shows a vertical section through a modified form of pocket;

Fig. 6 shows a face view of the pocket shown in section in Fig. 5;

Fig. 7 shows a vertical section through another form of pocket embodying the features of the present invention;

Fig. 8 shows an elevation of the construction shown in Fig. 7;

Fig. 9 shows a vertical section through another modified form of construction embodying the features of the present invention;

Fig. 10 shows a vertical section through still another modified form of construction embodying the features of the present invention; and

Fig. 11 shows a plan view of the construction shown in Fig. 5, being a section taken on line 11—11 of Fig. 5, looking in the direction of the arrows.

Referring now to the several figures, the open hearth furnace is designated by the numeral 12. At the end, which is illustrated in Fig. 1, it is provided with a gas down-comer 13 and an air down-comer 14. The lower ends of these down-comers will be connected sidewise through the ports 15 and 16, respectively, to the gas and air regenerators. The bridge walls at the lower edges of these ports are designated by the numerals 17 and 18, respectively.

In the usual type of construction each of the down-comers is extended below the corresponding edge 17 or 18 a very considerable distance so as to provide a pocket of very large capacity within which the slag and other similar material may collect without the possibility of the said material passing through the regenerator ports into the regenerator chambers. In carrying into effect the features of the present invention, I have provided constructions whereby the said pockets of large capacity may be eliminated if desired, or whereby the said pockets may be retained if desired, and used in conjunction with the features presently to be described. Ordinarily, however, the lower surface or floor of the slag pocket, when using the features of the present invention, will be only slightly below the corresponding edge 17 or 18, and I have illustrated such constructions in the several figures.

The lines 19 and 20, in Fig. 1, designate the floors of the main slag pockets for the down-comers 13 and 14 respectively. Said floors are only slightly below the lower edges 17 and 18 respectively of the corresponding regenerator ports. On the gas side the main slag pocket 21 leads sidewise by a connection 22 to the auxiliary slag pocket 23, whereas on the air side the main slag pocket 24 leads by a connection 25 to the auxiliary slag pocket 26. The doors 27, 28, 29, and 30 give access to the several slag pockets 21, 23, 24, and 26, respectively. These doors may be of any suitable construction, but a convenient construction is one in which the doors may be raised and lowered vertically, as illustrated in the several figures.

The floors 19 and 20 of the main slag pockets preferably slant towards the corresponding auxiliary pockets, so that the slag and other molten material will readily drain into the auxiliary pockets. Consequently, only a small amount of material will collect at one time in the main pockets, from which it will immediately drain into the auxiliary pockets. The result is that by opening the doors 28 and 30 the accumu-

lated material may be removed from time to time from the auxiliary pockets without the necessity of shutting down the furnace.

In many cases, the material so carried over will not possess sufficient fluidity to drain over properly into the auxiliary pockets. Consequently, I have provided means for introducing fuel at the desired point for generating heat within or adjacent to the pockets so as to fuse the said material. In the construction shown in Figs. 1 and 2, said means takes the form of a pipe 31 whereby gas or liquid fuel may be introduced directly into the passage 22 under the control of the valve 32. In other cases it may be desired to make use of coal or other like solid fuel for this purpose. I have, therefore, illustrated in Fig. 2 an embankment or pile of coal or coke 33 on the lower outer corner of the slag material 34, so that by burning the said fuel, the desired heat will be generated. This fuel may be burned by the introduction of air through a pipe 35 under the control of a valve 36, or the air may be introduced through the sight hole 36a. The air passing upwardly along the passage 22 will strike the coal or the like 33 and burn the same, so that by the time the gases reach the down-comer 13, there will be present no free oxygen, such as might otherwise cause combustion of the gases or explosion of the same. The slag materials which are fused by the heat thus generated, will run down into the auxiliary pocket 23. In Figs. 5 and 6, I have illustrated a construction somewhat similar to that just described. However, in this case the connection 37 extending between the main pocket 38 and the auxiliary pocket 39 is vertical, so that a plate 40 may be slid over the upper end of said connection, as shown in Figs. 5 and 11, for the purpose of temporarily isolating the auxiliary pocket from the main pocket. In this way, the auxiliary pocket can be entirely cut off from the down-comer during the cleaning operation, so that no air will enter the down-comer at that time. Thus the furnace will not be chilled, and free oxygen will not be admitted to the gas side. A similar arrangement is shown in the construction of Fig. 3, but in that case a block 41 is seated directly across the upper end of the auxiliary pocket.

In the construction shown in Fig. 7, the slag material 42 is allowed to collect until it reaches the level of the discharge spout 43. Thereupon it will discharge from time to time provided it be in sufficiently fluid condition. A nozzle 44 is illustrated in the said figure for introducing fluid fuel or air as for the purpose of burning coke or coal 45 so as to keep the slag, etc., in molten condition.

In the arrangement shown in Fig. 10, a somewhat similar construction is illustrated, but in the arrangement of that figure, the spout 46 is provided with a number of air openings 47 and with a bottom drainage opening 48. A pipe 49 is shown for the introduction of air or fluid fuel. A plate 46a covers over the top of the spout to prevent radiation of heat and chilling of the slag.

It will be observed from an examination of each of the several constructions above described, that the floor of the main pocket is below the elevation of the lower edge of the port leading to the regenerator chamber, whereas the floor of the main pocket in each case is at a sufficient elevation to ensure proper drainage of the slag. In some cases it may be desired to adapt the features of the present invention to constructions already installed, wherein there are provided very deep slag pockets in the lower ends of the down-comers. When it is desired to so adapt the features of the invention, this may be readily done by providing the auxiliary pocket and the drainage ports at the desired elevation in the outer wall of the down-comer, and then allowing the furnace to run for a sufficient length of time to fill up the lower portion of the down-comer by the accumulation of slag material. For example, in the constructions shown in Figs. 2, 3, 5, 9, and 10, the space 50 between the dotted lines 51 and 52 represents the space which will be filled in by the accumulation of slag material in the lower portion of the down-comer. After such accumulation has taken place, the pocket will operate according to the features of the present invention, draining according to the manner herein set forth.

I have heretofore mentioned the fact that fuel and the like may be introduced into the slag pocket for the purpose of keeping the slag and other materials in molten condition, so that they can be readily drained. At times it may also be desirable to introduce flux materials in addition to the fuel, or in place of the fuel, so as to assist in keeping the slag and the like in molten condition. In some cases, when coal or coke is used as the fuel, the same will contain a sufficient amount of ash and the like to properly flux the slag, etc., without the necessity of adding a separate fluxing material. Therefore, I contemplate as being within the scope of my invention the use of any suitable fuel or flux materials or both. It is frequently desirable to flux the materials contained within the slag pocket so as to ensure that they will more easily flow over into the auxiliary slag pocket, thus keeping the slag pocket and adjoining parts relatively clear and unobstructed at all times. Another benefit which will be secured from this method of operation is

that the material which will find its way into the auxiliary slag pocket will be a mixture of slag, flux material, ore, etc., which can be more easily broken up than a solid chunk or cake of ordinary slag material.

Referring to the construction shown in Figs. 7 and 10 in particular, it will be observed that it is very desirable to keep the slag, etc., in molten condition as the same is delivered from the spouts 43 and 46 shown in the said figures. Consequently, it is very desirable to consume a portion of the fuel directly adjacent to the said spouts. This may be done in some cases by the introduction of fluid fuel through pipes 44 and 49, or in other cases fuel such as coal or coke may be consumed immediately adjacent the said spouts for the purpose indicated.

While I have previously mentioned slag and the like as being carried over with the air blast from the furnace, it will be understood that the features of the present invention are intended to refer to the collection of any material which will normally gather in the slag pocket, including, for example, material which may be melted off from the side walls of the down-comers themselves and overflow from the furnace bath.

Reference to several of the figures will disclose sight-holes in the doors or closures of the slag pockets and the auxiliary pockets. These may be closed in any suitable manner, as, for example, by the use of small plates which are pivoted or hinged to the doors and normally fall into the closed position. When desired, the said plates may be provided with sight-holes so that the operations within the slag pockets may be observed without the necessity of uncovering the openings. Furthermore, ordinarily, sufficient air for the combustion of the fuel introduced into the slag pockets will find its way through these openings so as to properly consume the said fuel.

Any suitable form of scraper or the like may be used during the cleaning operation for the removal of the accumulative materials, both from the slag pocket and from the auxiliary pocket.

It will be observed that in certain of the constructions, notably those shown in Figs. 3, 5, and 11, that removable partitions or sills 40 and 41 are shown interposed between the main slag pocket and the auxiliary pockets. These serve to isolate the auxiliary pockets from the main pockets for whatever purpose may be desired. If the slag be allowed to drain continuously into the auxiliary pocket the best operating conditions may not always be secured, and, in many cases, it may be desirable to allow the slag to collect in the main pocket for a number of heats, after which the material so collected may be allowed to drain as a body into the auxiliary pocket. This desirable result may be secured by temporarily isolating the main pocket from the auxiliary pocket, as, for example, by the use of partitions such as those above mentioned.

I claim:

1. The combination with the down-comer of an open-hearth furnace or the like, of a slag pocket in the lower portion of said down-comer, there being an opening in said outer wall giving access to the slag pocket, a suitable closure for said opening, an auxiliary slag pocket at a lower level than the first mentioned slag pocket, a connection from the lower portion of the first mentioned slag pocket to the auxiliary slag pocket, there being an opening giving access to the auxiliary slag pocket, a suitable closure for said opening, means for introducing fuel or the like into the first mentioned slag pocket for the purpose specified, and means for at times isolating the auxiliary slag pocket from the first mentioned slag pocket.

2. The combination with the down-comer of an open-hearth furnace, of a slag pocket within said down-comer, there being an opening in the outer wall giving communication with said slag pocket, a suitable closure for said opening, an auxiliary slag pocket at a lower level than said first mentioned slag pocket, a drainage connection from the first mentioned slag pocket to the auxiliary slag pocket, there being an opening in the wall of the auxiliary slag pocket giving access to said auxiliary slag pocket, a suitable closure for said opening, and means for introducing fuel into the first mentioned slag pocket for the purpose specified.

3. The method of draining a slag pocket which consists in introducing fuel and flux materials directly into said slag pocket for the purpose of maintaining the desired temperature within said slag pocket, and which consists in draining molten materials from the slag pocket without interruption to the operation of the furnace.

4. The method of draining a slag pocket which consists in introducing fuel and the like directly into the slag pocket in such manner and in such quantities as to maintain the desired temperature within the slag pocket, while at the same time consuming free oxygen prior to the entry thereof into the down-comer.

5. The method of draining a slag pocket which consists in introducing fuel directly into said slag pocket for the purpose of maintaining the desired temperature within said slag pocket, and which consists in draining molten materials from the slag pocket without interruption to the operation of the furnace.

6. The method of draining a slag pocket which consists in introducing flux materials directly into said slag pocket for the pur-

pose of maintaining the materials in molten condition within said slag pocket, and which consists in draining the molten materials from the slag pocket without interruption to the operation of the furnace.

7. The method of removing slag and the like from the down-comer of a furnace which consists in collecting slag and the like in molten condition for a desired interval of time in a slag pocket, and which consists in thereafter permitting said materials to drain into another auxiliary slag pocket for removal purposes.

8. The method of removing slag materials and the like from the downcomer of a furnace which consists in collecting said materials in the lower end of the downcomer until they have reached a desired elevation, and which consists in thereafter draining subsequently accumulated materials from above said elevation while maintaining within said lower end the materials accumulated therein up to said elevation.

9. The method of removing slag materials and the like from the downcomer of a furnace which consists in accumulating said materials within the lower portion of the down-comer until a desired elevation of the materials has been reached, and which consists in thereafter removing additional materials collecting above said elevation while maintaining within said lower end the materials accumulated therein up to said elevation.

10. The combination with the down-comer of an open-hearth furnace, of a slag pocket within said down-comer, there being an opening in the outer wall giving communication with said slag pocket, a suitable closure for said opening, an auxiliary slag pocket at a lower level than said first named slag pocket, a drainage connection from the first mentioned slag pocket to the auxiliary slag pocket, there being an opening in the wall of the auxiliary slag pocket giving access to said auxiliary slag pocket, and a suitable closure for said opening, substantially as described.

11. The method of draining a slag pocket which consists in introducing fuel into said pocket locally to produce local heat at the point of drainage from the main slag pocket into an auxiliary slag pocket at a lower level.

12. The method of draining a slag pocket which consists in introducing fuel into said pocket locally to produce local heat at the point of drainage from the main slag pocket into an auxiliary slag pocket at a lower level, said auxiliary pocket having a lower temperature than the main pocket.

13. The method of draining a slag pocket which consists in introducing fuel thereinto to supplement the operation temperature to cause additional heat localized to the point of drainage from the said main slag pocket into another slag pocket.

14. The method of draining a slag pocket which consists in introducing fuel thereinto to supplement the operation temperature to cause additional heat localized to the point of drainage from the said main slag pocket into another slag pocket, said other pocket having a lower temperature than the temperature of the main pocket.

15. The method of draining a slag pocket which consists in introducing fuel thereinto to supplement the operation temperature to cause additional heat localized to the point of drainage from said slag pocket into another slag pocket, said other slag pocket having a temperature below the fluxing temperature of the slag drained from the main slag pocket.

16. The method of draining a slag pocket which consists in introducing fuel thereinto to supplement the operation temperature to cause additional heat localized to the point of drainage from said slag pocket into another slag pocket, to cause the practical separation for removal purposes of slag from a main slag pocket into a secondary slag pocket.

17. The method of draining a slag pocket which consists in introducing fuel thereinto to supplement the operation temperature to cause additional heat localized to the point of drainage from said slag pocket to permit removal of the slag therefrom without adhering to the walls of the pocket.

FRANK ORTH.