No. 858,949. PATENTED JULY 2, 1907.

G. D. BULMER.

BLAST FURNACE.

APPLICATION FILED MAR. 21, 1907.

4 SHEETS—SHEET 1.

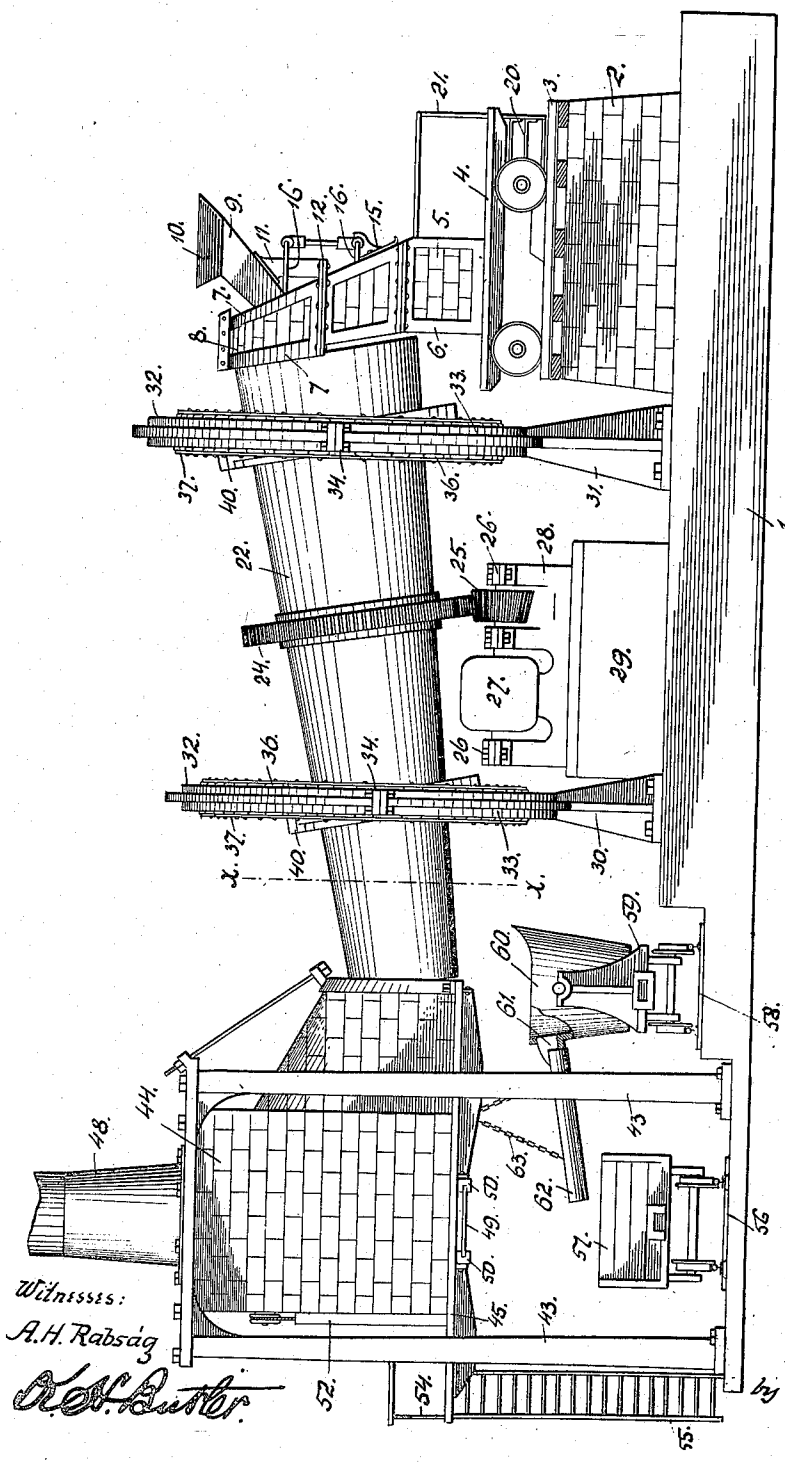

Fig. 1.

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R. C. Butler

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by A. C. Evarts Co.
Attorneys

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4 SHEETS—SHEET 2.

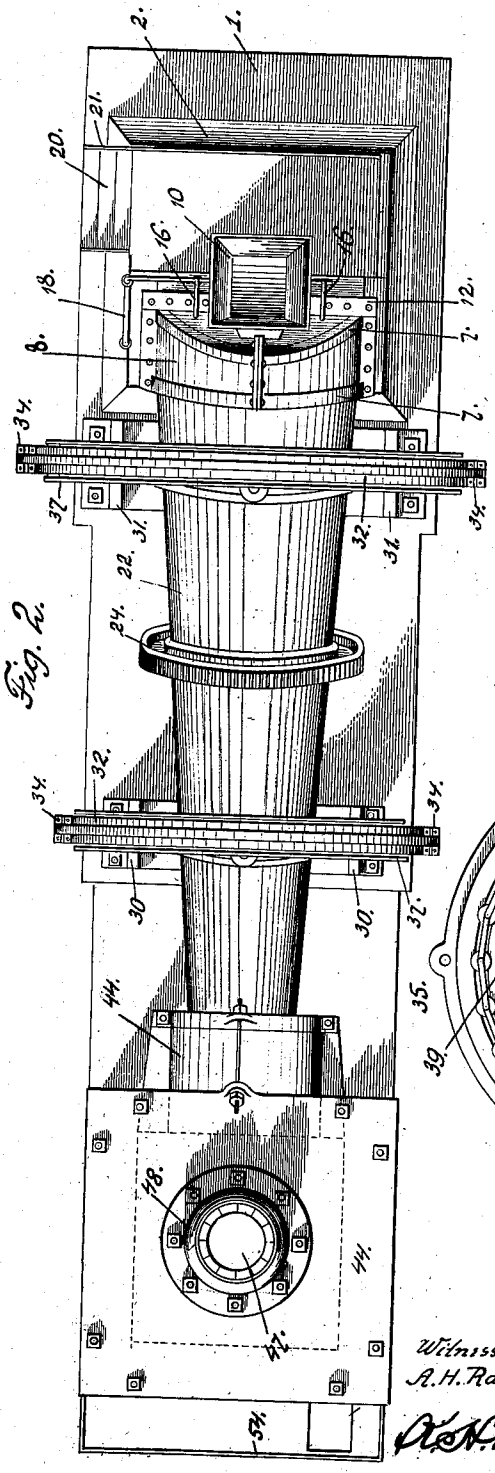

Fig. 2.

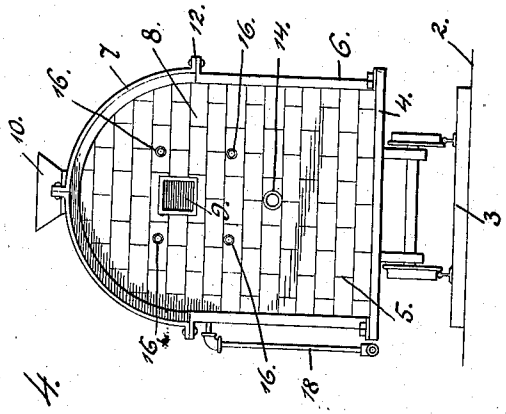

Fig. 4.

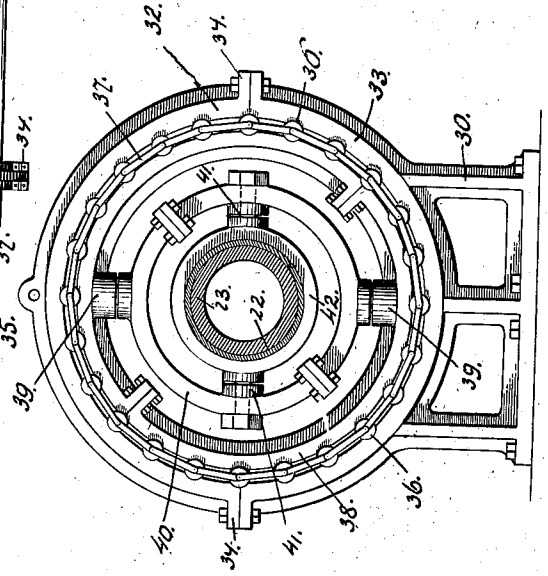

Fig. 3.

Witnesses
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4 SHEETS—SHEET 3.

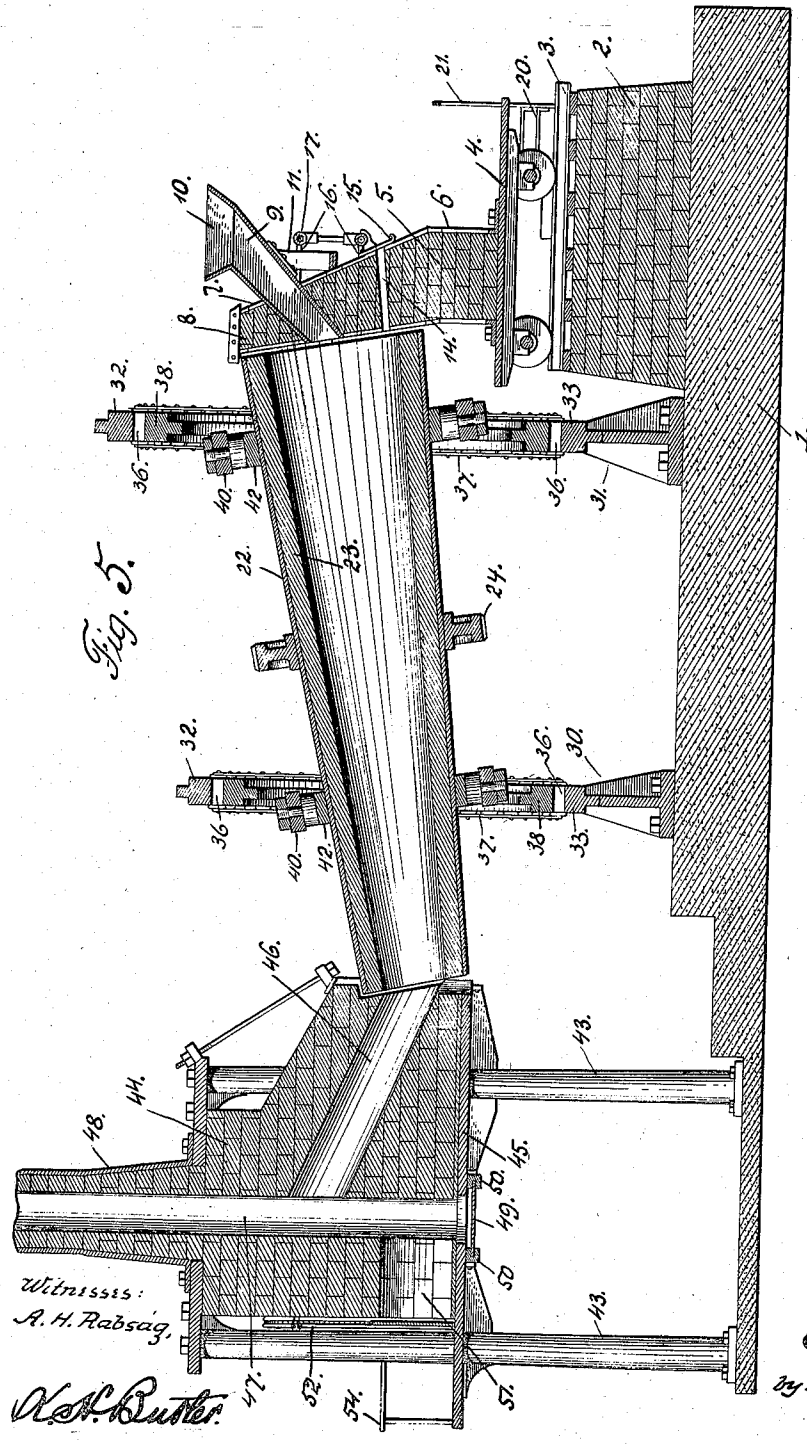

Fig. 5.

Witnesses:
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4 SHEETS—SHEET 4.

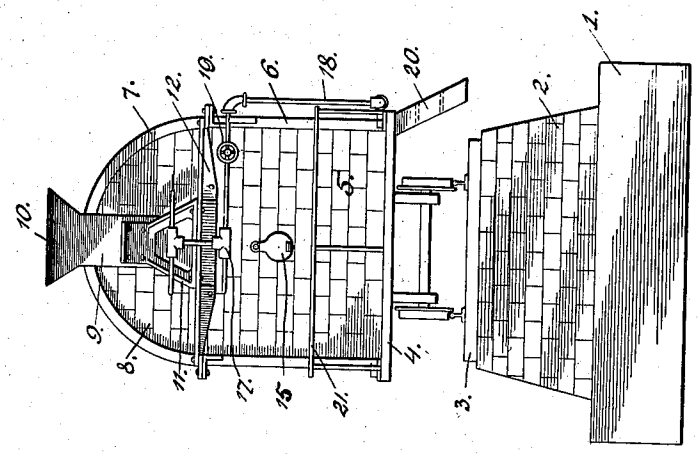

Fig. 7.

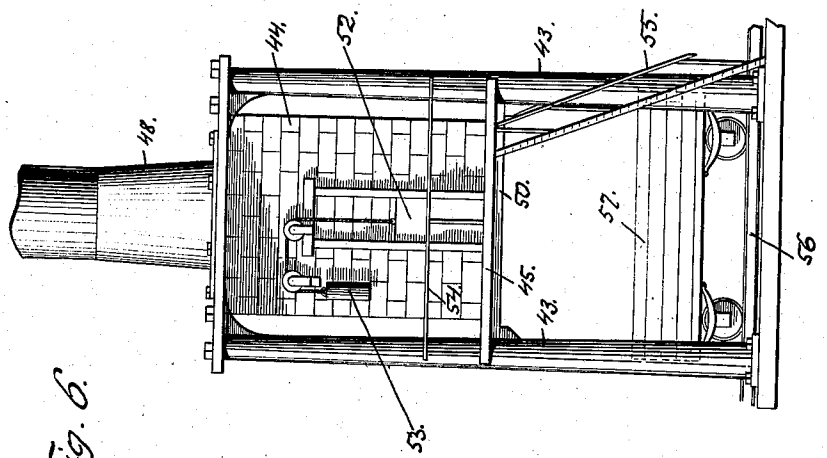

Fig. 6.

Witnesses
A. H. Rabsag
R. S. C. Butler.

Inventor:
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by A. C. Eastman
attorneys

UNITED STATES PATENT OFFICE.

GEORGE D. BULMER, OF DUQUESNE, PENNSYLVANIA, ASSIGNOR OF ONE-FOURTH TO JOHN JOHNSTON, OF HOMESTEAD, PENNSYLVANIA.

BLAST-FURNACE.

No. 858,949. Specification of Letters Patent. Patented July 2, 1907.

Application filed March 21, 1907. Serial No. 363,764.

To all whom it may concern:

Be it known that I, GEORGE D. BULMER, a citizen of the United States of America, residing at Duquesne, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Blast-Furnaces, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to blast furnaces, and the invention has for its primary object to provide a novel blast furnace which will greatly facilitate the extraction of metal from ore by dispensing with the complicated structure commonly used for such purposes.

My invention aims to provide a comparatively inexpensive blast furnace wherein positive and reliable means are employed for subjecting ore to a high degree of temperature and co-mingling the same sufficiently to insure a thorough extraction of metal from ore placed in the furnace.

In this connection, my invention aims to obviate the expensive structure heretofore used as a blast furnace, and certain defects and dangers that are experienced in connection with the same.

It is a well known fact that furnaces heretofore used have been of a vertical construction, the ore being placed in the top of the furnace and numerous mechanical structures employed for retaining the ore therein, preventing explosions within the furnace, preventing dust and cinders from escaping and insuring the safety of workmen at the furnace. With all these mechanical structures and expedients, accidents frequently happen which cost the lives of workmen and the destruction of the furnace and property in the vicinity of the same.

Having these defects and dangers in view, I have devised a novel furnace to prevent the terrible loss of life due to workmen being suffocated or burned as well as the loss and danger caused by the explosions and throwing out of material at the relief and explosion doors of an ordinary furnace.

I have constructed a furnace practically upon a horizontal plane, and have devised novel means in connection with the same for removing the cinders and dust in such a manner that they cannot interfere with the workmen or destroy property in the vicinity of the furnace.

In connection with the furnace, I employ novel means for causing a cessation of operation at any desired time, thereby allowing the furnace to be placed in and out of operation without the loss of time, as with the present day furnace.

Associated with my improved furnace is a novel ladle to collect the molten metal as the same is continually drawn off while the furnace is in operation.

The principal elements of my invention,—namely a movable feed head, the furnace proper, universal furnace bearings, a cinder and dust collector, and a ladle,—will be hereinafter separately and specifically described in detail, together with the novel arrangement and objects accomplished from such a combination of elements.

The preferred embodiments of my invention are illustrated in the drawings accompanying this specification, and I desire it to be understood that the same are susceptible to various changes without departing from the scope of the invention.

Reference will now be had to the drawing forming part of this specification wherein like numerals of reference designate corresponding parts throughout the several views, in which:—

Figure 1 is an elevation of a blast furnace constructed in accordance with my invention, Fig. 2 is a plan of the same, Fig. 3 is a cross sectional view taken on the line x—x of Fig. 1, Fig. 4 is an elevation of the inner end of the movable feed head, Fig. 5 is a longitudinal sectional view of my improved furnace, Fig. 6 is an end view of the cinder and dust collector, Fig. 7 is an elevation of the outer end of the movable feed head.

My improved blast furnace in its entirety is constructed of strong and durable metal, consisting of castings, angle bars, and masonry work which are assembled to provide a structure capable of withstanding the rough usage to which it is subjected.

Throughout the entire construction of the furnace, I have aimed to produce a safe structure which can be continually operated to extract metal from ores placed within the furnace.

Considering the various elements of the invention in detail, reference will first be had to the movable feed head.

Movable feed head.—In the accompanying drawings, I have illustrated a suitable foundation 1 for supporting my entire furnace, this foundation being stepped and provided at its highest elevation with a masonry pedestal 2 supporting a section of track 3, upon which a car 4 is movably mounted carrying the movable feed head of my improved furnace. The movable feed head is constructed of masonry work 5 bound and braced by metallic standards 6 and arch-shaped metallic frames 7, the latter being bolted to the former. The masonry work 5 presents an inclined wall 8 which is suitably capped, and said wall is provided with an inclined metallic chute 9 having a funnel shaped opening 10, said chute constituting the means of conveying ore to my improved furnace. The chute is reinforced and supported by a metallic bracket 11 carried by a girder 12 arranged transversely of the outer end of said feed

head. The inclined wall is also formed with a peep or sight opening 14, said opening being normally closed upon the outer end of said head by a pivoted shutter 15. The peep or sight opening 14 is provided whereby the interior of the furnace can be readily observed at any desired time, as will presently appear.

As the heating medium or fuel for my improved furnace, I preferably employ gas which is supplied to the furnace through a plurality of pipes 16 arranged around the inner end of the chute 9, said pipes being connected by tees 17 to a pipe 18, which extends downwardly to a point in close proximity to the car 4, whereby a flexible connection (not shown) can be employed for connecting said pipe to a main pipe of a gas supply. The pipe 18 is provided with a valve 19 of a conventional form, whereby the supply of gas to the furnace can be easily and quickly controlled by a workman, and to facilitate a workman manipulating the valve 19 and insure the safety of the workmen upon the car 4, I provide said car with steps 20 and a railing 21.

The furnace proper.—The furnace comprises a tapering inclined metallic shell 22, conforming in shape to a frustrated cone, said hell having its larger end presented at an inclination to the movable feed head, whereby ore placed within the chute 9 will be precipitated into the furnace. The metallic shell 22 is lined with fire brick or a similar non-fusible material 23 capable of withstanding the highest degree of temperature that the same can be subjected to by ignited gas emitted from the pipes 16.

The furnace is mounted for rotation, as will be presently described, and to rotate said furnace I provide the shell 22 approximately intermediate its ends with a peripheral rack 24 adapted to mesh with a beveled pinion 25, carried by the armature shaft 26 of a motor 27, said shaft and motor being located within a suitable housing 28 supported by an auxiliary foundation or pedestal 29 carried by the foundation 1. The motor 27, which is simply one of the forms of driving mechanism that can be readily employed for revolving the furnace, is controlled from a point advantageous to the workmen in charge of the furnace.

Universal furnace bearings.—On account of the tapering shape and the inclination at which the furnace proper is disposed, I have found it necessary to employ universal bearings for supporting the furnace and permitting of its rotation around a common axis having for its terminals approximately the center of the chute 9 and the opening of a cinder and dust collector, to be presently described.

I employ two bearings 30 and 31 for supporting the furnace proper, it being obvious that the number of bearings employed depend upon the length and diameter of the furnace proper. The bearings 30 and 31 are identical in construction, with the exception that the bearing 31 and its appurtenant parts is larger than the bearing 30, owing to the fact that the bearing 31 is located in close proximity to the movable feed head and at the larger end of the furnace proper.

Each bearing comprises two semi-circular frames 32 and 33, the frames 33 being suitably secured to the foundation 1. The frames 32 and 33 are connected together as at 34, and the frame 32 is provided with a pierced enlargement 35 whereby when the bearings are assembled the frame 32 can be readily gripped by a hoisting or elevating mechanism. The frames 32 and 33 when secured together provide a circular bearing for a plurality of flanged rollers 36, said rollers being connected together at their ends by rings 37. The rollers 36 bear upon a two-part ring 38, said ring being provided with diametrically opposed trunnions 39 for another two-part ring 40. This ring 40 is also provided with trunnions 41 which are disposed at right angles to the trunnions 39 and are connected to a band 42 surrounding the tapering metallic shell 22 of the furnace proper.

It will thus be observed from the novel construction of the bearings 30 and 31 that the furnace proper can be easily and quickly revolved within said bearings, the two-part ring 40 shifting during its rotation to accommodate itself to the position of the furnace proper owing to the fact that the furnace revolves upon an axis at an inclination, while the two-part ring revolves upon a horizontal axis. The friction of the bearings 30 and 31 is reduced to a minimum owing to the fact that the two-part ring 38 is free to revolve upon the rollers 36 and the rollers free to revolve upon the frames 32 and 33 of each bearing.

The cinder and dust collector.—Supported by suitable standards or columns 43 upon the foundation 1 is a cinder or dust collector for receiving cinders and dust from the furnace proper. The collector comprises a masonry structure 44 supported by pillars or columns 43 upon an elevated metallic platform 45. The masonry structure 44 is provided with an inclined flue 46, the outer end of which lies in close proximity to the smaller end of the furnace proper, while the inner end of said flue communicates with a vertically disposed flue 47 terminating in a stack or chimney 48 lined with a non-fusible material similar to the masonry structure 44. The lower end of the flue 47 is normally closed by a gate 49 slidably mounted in guide ways 50 beneath the platform 45. The masonry structure 44 is provided with an opening 51 directly above the platform 45, whereby easy access can be had to the flue 47. The opening 51 is normally closed by a door or gate 52 connecting with a weight 53 employed to assist in elevating the door or gate. The platform 45 extends a sufficient distance beyond the structure 44 to support workmen adjacent to the door or gate 52, said platform being provided with a railing 54 and with a ladder 55. The foundation 1 beneath the collector is provided with a track 56 whereby a car 57 can be placed beneath the collector to receive cinders, dust and such solid matter that will settle in the lower end of the flue 47 upon the gate 49.

The ladle.—The foundation 1 beneath the smaller end of the furnace proper is provided with a track 58 to permit of a ladle being placed beneath the lower end of the furnace proper to receive the molten metal from said furnace. The ladle comprises a car 59 having a tilting cone-shaped receptacle 60, said receptacle being provided with a tap-hole 61 near its upper edge, whereby the molten metal can be poured from the ladle. In connection with the ladle, I employ a trough 62 which is adjustably suspended as at 63, from the platform 45 of the cinder and dust collector. The trough 62 is suspended at a desired inclination to transfer slag or cinders from the ladle to the car 57.

My improved ladle can be used either in connection with an open-hearth furnace or a blast furnace, and by

providing the ladle with the tap-hole 61, slag or cinders is prevented from flowing over the top of the ladle on to the ground or into a cinder pit of an open-hearth furnace. As the ladle is filled, the slag and cinders are adapted to flow through the top opening into the trough 62 and to the car 57. This feature of my invention saves considerable time and labor. The ladle can be lined with fire brick or a non-fusible material similar to the furnace proper.

Operation.—Assuming that the motor 27 has been placed in operation to revolve the furnace proper, the workmen in charge of the furnace ignite the gas at the ends of the pipes 16 and owing to the juxtaposition of the movable head with relation to the furnace proper, the flames of the ignited gas will extend a considerable distance into the furnace and reduce ore admitted thereto through the chute 9 to a molten state. The reduction of the ore takes place approximately intermediate the ends of the furnace proper and the molten metal is adapted to flow to the small end of the furnace and in a continuous stream into the ladle located beneath. It will thus be observed that the reduction of ore is a continuous process, and that the furnace while in operation is normally tapped. What solid matter that may be carried from the furnace will be either deposited in the cinder and dust collector or in the ladle, from either of which it is transferred to the car 57. A cessation of operation is accomplished by stopping the motor 27, and shutting off the gas and ore supply.

It will thus be observed that I have dispensed with the use of blow engines where coke is commonly used and should it be necessary to place lime or any other ingredient within the furnace during the reduction of ore the same can be admitted through the chute 9.

I have mounted the movable feed head upon the car 4 whereby said head can be withdrawn from the large end of the furnace proper, to permit of easy access being had to the interior thereof for relining with a non-fusible material. The car 4 can be operated in any desired manner.

My improved ladles can be readily used in connection with the present type of vertical blast furnace, the ordinary cinder opening or run thereof being closed and the cinders coming out of the same opening as the ore. This is a feature that is not at present used, and by dispensing with the ordinary cinder opening, I save considerable time in the tapping of a furnace.

From the foregoing description taken in connection with the drawings, it will be observed that I have devised a novel blast fornace for the reduction of ore, and it will of course be understood that such changes in the arrangement, size, proportion and minor details of construction as are permissible by the appended claims, may be resorted to without departing from the spirit and scope of the invention.

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

1. In a blast furnace, the combination with a suitable foundation, of universal bearings carried by said foundation and comprising trunnioned rings and roller bearings, a tapering revoluble shell supported at an inclination in said bearings, said shell having a lining of non-fusible material, a feed head movably mounted at the large end of said shell, and embodying a chute and fuel supply pipes, a cinder and dust collector constructed upon said foundation at the smaller end of said shell, said collector having flues formed therein, one of said flues communicating with the interior of said shell, the other of said flues terminating in a stack, a gate normally closing the lower end of the last mentioned flue, a tilting ladle movably mounted beneath the smaller end of said shell and having a tap hole near its upper edge, a trough suspended from said collector adjacent to said opening, means whereby easy access can be had to the last mentioned flue of said collector, and means to revolve said shell.

2. In a blast furnace, the combination with a suitable foundation, of universal bearings carried by said foundation, a tapering revoluble lined shell supported at an inclination in said bearings, a feed head movably mounted at the large end of said shell, and embodying a chute and fuel supply pipes, a cinder and dust collector constructed upon said foundation at the smaller end of said shell, said collector having communicating flues formed therein, one of said flues communicating with the interior of said shell, a gate normally closing the lower end of one of said flues, a tilting ladle movably mounted beneath the smaller end of said shell and having a tap hole near its upper edge, a trough suspended from said collector adjacent to said opening, means whereby easy access can be had to the flues of said collector, and means to revolve said shell.

3. In a blast furnace, the combination with a suitable foundation, of universal bearings carried by said foundation, a tapering revoluble shell supported at an inclination in said bearings, a feed head movably mounted at the other end of said shell, a cinder and dust collector constructed upon said foundation at the smaller end of said shell, said collector having communicating flues formed therein, a gate normally closing the lower end of one of said flues, a tilting ladle movably mounted beneath the smaller end of said shell and having a tap opening near its upper end, and means to revolve said shell.

4. In a blast furnace, the combination with a suitable foundation, universal bearings carried by said foundation, a tapering revoluble shell supported at an inclination in said bearings, a movable feed head mounted at the large end of said shell, a cinder and dust collector carried by said foundation at the small end of said shell, a tilting ladle movably mounted beneath the smaller end of said shell and having a tap-hole near its upper end, and means to revolve said shell.

5. In a blast furnace, the combination with a suitable foundation, of a tapering revoluble shell supported at an inclination above said foundation, a feed head movably mounted at the large end of said shell, a cinder and dust collector carried by said foundation at the smaller end of said shell, a tilting ladle movably mounted beneath the smaller end of said shell and having a tap-hole, and means for rotating said shell.

6. In a blast furnace, universal bearings, an inclined shell revolubly mounted in said bearings, a movable feed head mounted at the large end of said shell, a cinder and dust collector carried at the lower end of said shell, a ladle movably mounted beneath one end of said shell and having a tap-hole, and means for revolving said shell.

7. In a blast furnace, the combination with suitable supports, of a revoluble shell carried at an inclination by said supports, a feed head movably mounted at one end of said shell, a cinder and dust collector arranged at the opposite end of said shell, a tilting ladle movably mounted beneath one end of said shell and having a tap-hole, and means to revolve said shell.

8. In a blast furnace an inclined revoluble shell having a lining of non-fusible material, a feed head movably mounted at one end of said shell, a cinder and dust collector arranged at the opposite end of said shell, a ladle movably mounted beneath one end of said shell, and having a tap-hole, and means to revolve said shell.

9. In a blast furnace, a tapering inclined revoluble shell having a lining of non-fusible material, a movable feed head arranged at one end of said shell, a cinder and dust collector arranged at the opposite end of said shell, and a ladle movably mounted beneath one end of said shell.

10. In a blast furnace, a tapering shell constituting the furnace arranged at an incline, universal bearings in which said shell is mounted, and a metal feed head mount-

ed for movement towards and away from the larger end of said shell.

11. In a blast furnace, a revoluble shell constituting the furnace, universal bearings in which said shell is mounted for rotation and means for rotating said shell.

12. In a blast furnace, the combination with a revoluble shell constituting the furnace, of universal bearings supporting said shell in which the shell is revolubly-mounted.

13. In a blast furnace, a revoluble shell constituting the furnace, and universal supporting-bearings therefor in which said shell is revolubly-mounted.

14. In blast furnaces, a revoluble shell constituting the furnace arranged at an incline to the horizontal and universal supporting-bearings therefor in which the shell is revolubly-mounted.

15. Universal supporting bearings for blast furnaces having a revoluble shell constituting the furnace, each bearing comprising an inner and an outer circular frame within the inner of which the shell is revolubly-mounted.

In testimony whereof I affix my signature in the presence of two witnesses.

GEORGE D. BULMER.

Witnesses:
MAX H. SROLOVITZ,
A. J. TRIGG.