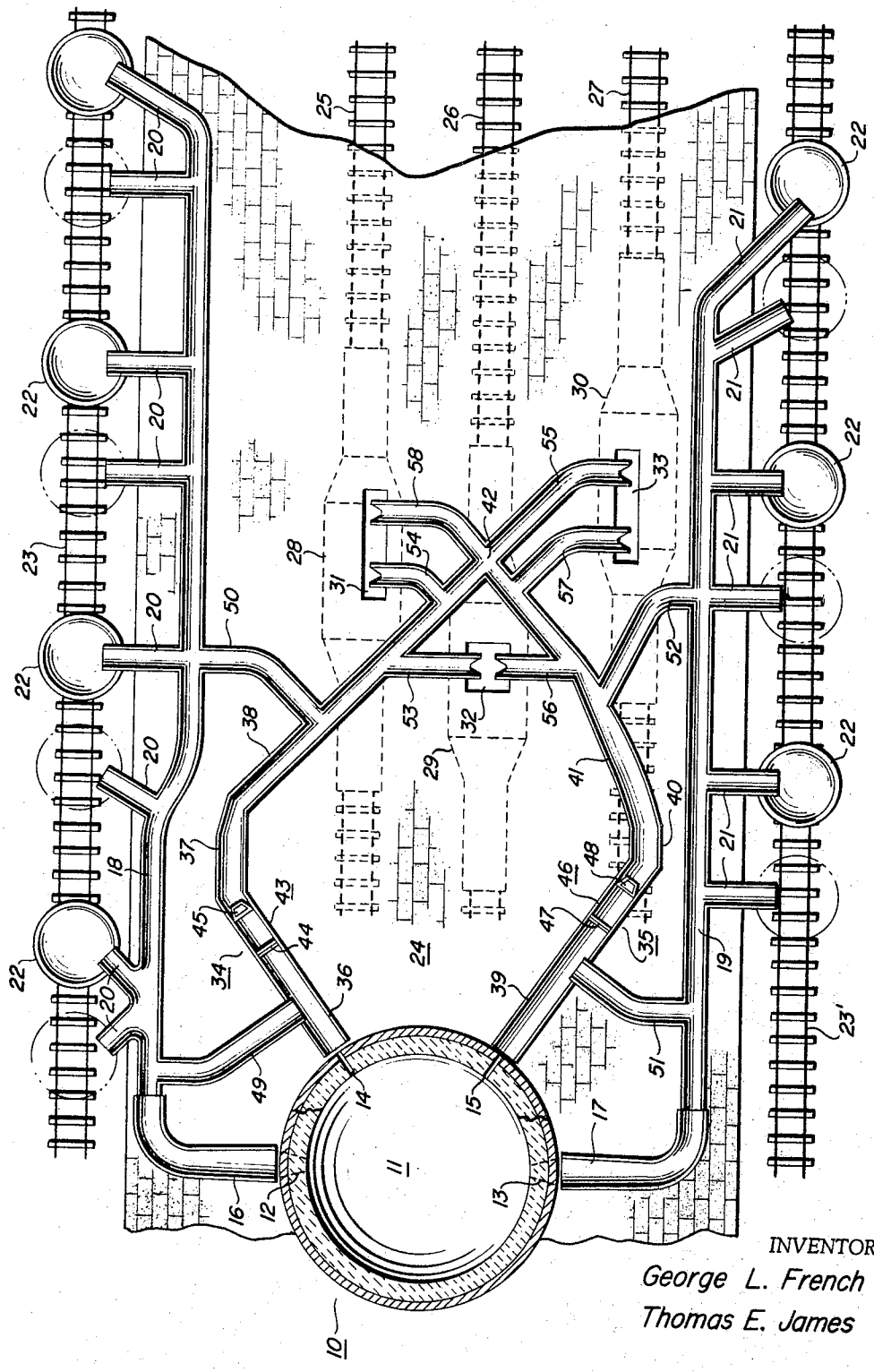
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RUNNER SYSTEM FOR BLAST FURNACE

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RUNNER SYSTEM FOR BLAST FURNACE

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This invention relates in general to an improved blast furnace cast house floor and more particularly to means for rapidly removing molten iron from a blast furnace hearth.

A problem facing operators and designers of large blast furnaces is the development of apparatus and/or a method to rapidly and efficiently remove molten iron from these furnaces. The arrangement, i.e. a single iron runner leading from a single tap hole, which was adequate to cast a furnace having a capacity for producing 2000 tons of iron per day is not satisfactory for casting the larger furnaces currently in operation. With improved burden and more efficient operating methods, the furnace which originally had cast 2000 tons per day now has a daily production in excess of 3000 tons, and the more recently constructed furnaces have a capacity of 4000 tons of iron per day. It was recognized that a single iron runner leading from a single tap hole was inadequate and would frequently cause operating delays and curtail production of large tonnage furnaces. As a consequence, the newer blast furnaces have been designed and constructed with two tap holes and a double iron runner arrangement. This dual runner system has several disadvantages. It extends over a much larger area and, thus, requires a larger cast floor and is considerably more expensive to construct than former casting arrangements. In addition, a double casting system requires twice the maintenance and a proportionate increase in manpower to insure that it is available for use when the furnace is ready to cast. In a few cases, the double runner system has been consolidated by merging, at some distance from the furnace, the runners leading from the two tap holes into a single long runner from which are extended the branch runners that lead to the floor openings above the tracks upon which the iron receiving cars are positioned. Unfortunately, this single runner extension constitutes the same bottleneck, from a time-maintenance viewpoint, as the conventional single iron runner which leads from a single tap hole.

An object of this invention, therefrom, is to provide improved means to overcome the above described disadvantages.

It is another object of this invention to provide a large capacity blast furnace with means to rapidly and efficiently remove the molten iron from the furnace hearth.

It is a further object of this invention to provide a large dual tap hole furnace with improved casting means which requires a minimum of space and which can be constructed at a relatively reasonable cost.

A still further object of this invention is to provide a large dual tap hole furnace with improved casting means which can be economically maintained and rapidly returned to operative condition for subsequent casts.

The foregoing objects can be attained by having the main iron runners, which lead from the two tap holes of a large blast furnace, intersect in front of the furnace and by having branch iron runners extend from each main runner, before and after their point of intersection, to all floor openings above the metal receiving cars.

The drawing, which is a plan view, partly in section, of a blast furnace and its cast house floor, illustrates the principles of the invention.

In the drawing there is shown blast furnace 10 which has hearth 11 that is provided with cinder or slag notches 12 and 13 and iron notches or tap holes 14 and 15. Slag tapped from the furnace runs through notches 12 and 13 into flush slag runners 16 and 17, respectively, and then into main slag runners 18 and 19, respectively. Branch runners 20 and 21, connected to main runners 18 and 19, respectively, discharge the slag to slag pots 22 which are positioned on tracks 23 and 23' located alongside the furnace cast house. In front of furnace 10 is cast house floor 24 and beneath it are spur tracks 25, 26, and 27 upon which are hot metal or transfer cars 28, 29, and 30, respectively, that are positioned beneath openings 31, 32, and 33, respectively, in the cast house floor. Molten iron tapped from hole 14 flows by gravity through main iron runner 34 and molten iron tapped from hole 15 flows through main iron runner 35.

Main iron runner 34 comprises first or upper section 36, curved intermediate section 37 and lower section 38, and main iron runner 35 comprises first or upper section 39, curved intermediate section 40 and lower section 41. Viewed generally, iron from hearth 11 runs through tap holes 14 and 15 into first upper sections 36 and 39, respectively, which diverge as they extend outwardly from the hearth, flows into inwardly curved intermediate sections 34 and 40, respectively, where the direction of flow is changed, and passes into lower sections 38 and 41, respectively, which converge and intersect, at 42, adjacent their lower ends. Upper section 36 of main runner 34 has skimming trough 43 which includes skimmer 44 and dam 45, and upper section 39 of main runner 35 has skimming trough 46 which includes skimmer 47 and dam 48.

Connected to the upper section 36 of main iron runner 34, at a location adjacent the upper end of skimming trough 43 is cast slag runner 49 which carries slag removed from molten metal in skimmer trough 43 to main slag runner 18 and thence to branch runners 20 for discharge to pots 22 located on tracks 23. Connected to the upper portion of lower section 38 of main runner 34 is drain-off runner 50 which connects with main slag runner 18 intermediate its ends. In similar fashion, connected to upper section 39 of main runner 35, at a location adjacent the upper end of skimmer trough 46 is cast slag runner 51 which carries slag removed from molten metal in skimmer trough 46 to main slag runner 19 and thence to branch runners 21 and pots 22 located on track 23'; and connected to the upper portion of lower section 41 of main runner 35 is drain-off runner 52 which connects with main slag runner 19 intermediate its ends.

After passing through skimmer trough 43 of main runner upper section 36, iron continues through intermediate section 37 into lower section 38. From lower section 38 iron is directed to branch runners 53, 54 and 55, located on either side of the point of intersection 42 of main runners 34 and 35, which lead to cast house floor openings 32, 31 and 33, respectively, through which the iron passes to cars 29, 28, and 30, respectively. Similarly, iron is directed from lower section 41 of main runner 35 to branch runners 56, 57 and 58 which also lead to cast floor openings 32, 33, and 31, respectively, through which the iron passes to cars 29, 30 and 28, respectively. By having main runners 34 and 35 converge in this manner, i.e. in front of the furnace and adjacent the centerline of the furnace and cast house floor, the length of main runners 34 and 35 is kept to a minimum. At the same time, it is possible to direct iron from each of branch runners 53, 54, and 55 and 56, 57, and 58, respectively, to each of floor openings 31, 32 and 33, respectively. Thus, as a consequence of this unique construction, iron can be directed to car 28, 29 or 30 be-

neath any one of these floor openings either simultaneously from both main runners 34 and 35, or separately from either one of them. No description has been provided of the apparatus, e.g. sand dams and gate shutters, or the manner in which it is used to control the flow of iron during its passage through main runners 34 and 35 or branch runners 53, 54, and 55 and 56, 57, and 58, respectively, as apparatus of this nature and its method of operation are well known to those skilled in the art.

In the operation of our improved apparatus, both tap holes 14 and 15 of furnace 10 are opened, in the usual manner, so that the molten metal can flow through them and into upper sections 36 and 39, respectively, of main runners 34 and 35, respectively. Any slag passing from the furnace with the molten metal will float thereon, on account of being lighter than the iron, and be skimmed from the top surface of the metal in the ordinary known manner.

In main runner 34, the molten metal flows first into upper section 36 and iron trough 43 therein, where the iron runs under skimmer 44 and over dam 45. The slag in the metal is backed up behind skimmer 44 and flows off through cast slag runner 49, main slag runner 18, and one or more branch slag runners 20 into pots 22. After passing over dam 45 the iron flows through intermediate section 37 and into lower section 38. Since the flow of iron from furnace 10 is accomplished solely by gravity, iron that enters lower section 38 is first directed through branch runner 53 and into car 29. When that car is full, the flow of iron is then directed into branch runner 54 into car 28, and when that car is full, if there is any iron remaining, it is directed into branch runner 55 and car 30.

In main runner 35, the slag backed up in upper section 39 by skimmer 47 in trough 46 flows through cast slag runner 51 into main slag runner 19 and then through one or more branch slag runners 21 into ladles 22. The iron entering upper section 39 passes under skimmer 47 and over dam 48 of trough 46 into intermediate section 40 and then continues into lower section 41. Iron in lower section 41 is then diverted successively from branch runners 56, 57 and 58 into cars 29, 30, and, if necessary, car 28, respectively. When the flow of metal from the furnace has stopped, the molten metal behind dams 45 and 48 is allowed to flow from iron troughs 43 and 46, respectively. This remaining metal, including slag, flows through intermediate sections 37 and 40, respectively, and into lower sections 38 and 41, respectively, where it is diverted into drain-off runners 50 and 52, respectively, for discharge through their respective slag runner systems into slag pots 22 on tracks 23 and 23'.

The particular embodiment illustrated is for a furnace having a daily iron production of approximately 4000 tons. The iron is discharged from the furnace during eight or more separate casts of about 500 tons each. Cars 28, 29 and 30, positioned beneath cast house floor 24 to receive the molten iron, each has a capacity of 275 tons. For reasons well known to blast furnace operators, two of these cars have sufficient capacity to receive the iron of an average cast. As is the usual practice, a third standby car is placed in position to receive iron in the event that the amount of iron produced is greater than normal and/or there is a problem with one or more of the branch runners which would prevent, for a time, iron from being discharged into one of the other cars.

The advantages of our casting apparatus will be readily apparent to those skilled in the art. By means of our improved apparatus a large producing furnace can be cast efficiently in a relatively short period of time. In the event one of the branch runners, e.g. runner 53, is damaged to the extent that it cannot be made readily for the succeeding cast, this runner can be bypassed entirely and the car beneath it filled from branch runner 56 of the other main iron runner. In the event one of the main iron runners cannot be repaired by the next succeeding cast, the furnace can be cast, at a slower rate, through the other main iron runner. In the case of a new furnace, our apparatus requires a minimum size cast house floor thereby minimizing construction costs, while, in the case of an enlarged furnace, the existing cast house and spur tracks need only be modified rather than substantially rebuilt, as would be the case if two separate runner systems were planned. In addition to the above advantages our apparatus, due to the minimum length of the main and branch runners, can be operated and maintained with a single crew thereby minimizing costs.

While one embodiment of our invention has been illustrated and described, it will be understood that other adaptations and modifications may be made without departure from the spirit of the invention or the scope of the appended claims.

We claim:

1. The improvement in casting apparatus for a blast furnace having two tap holes, comprising:
   - (a) a pair of spaced main iron runner upper sections, each said section extending downwardly from a furnace tap hole,
   - (b) a pair of spaced main iron runner intermediate sections, each said intermediate section connected to and extending downwardly from the lower end of an upper section,
   - (c) a pair of converging main iron runner lower sections intersecting adjacent the lower ends thereof, each said lower section connected to and extending downwardly from the lower end of an intermediate section and having
     - (1) a first branch iron runner extending downwardly therefrom above the intersection of said lower sections,
     - (2) a second branch iron runner extending downwardly from the lower end thereof.

2. The improvement in casting apparatus for a blast furnace having two tap holes, comprising:
   - (a) a pair of spaced diverging main iron runner upper sections, each said section extending downwardly from a furnace tap hole,
   - (b) a pair of spaced curved main iron runner intermediate sections, each said intermediate section connected to and extending downwardly from the lower end of an upper section,
   - (c) a pair of converging main iron runner lower sections intersecting adjacent the lower ends thereof, each said lower section connected to and extending downwardly from the lower end of an intermediate section and having
     - (1) a pair of branch iron runners extending downwardly therefrom above the intersection of said lower sections,
     - (2) a branch iron runner extending downwardly from the lower end thereof.

3. The improvement in casting apparatus according to claim 2 in which said pair of branch iron runners extend downwardly from each of said main iron runner lower sections, on opposite sides thereof, above the intersection of said lower sections.

4. In the combination of a blast furnace having first and second tap holes and a cast house floor, sloping downwardly from said furnace and having first, second and third openings therein located above tracks upon which are positioned cars to receive molten metal cast from said tap holes, the improvement comprising:
   - (a) first and second spaced diverging main iron runner upper sections, said first upper section extending downwardly from said first tap hole and said second upper section extending downwardly from said second tap hole,
   - (b) first and second spaced inwardly curved main iron runner intermediate sections, said first intermediate section extending downwardly from the lower end of said first main iron runner upper section and said

second intermediate section extending downwardly from the lower end of said second main iron runner upper section,

(c) first and second converging main iron runner lower sections, said first lower section extending downwardly from the lower end of said first main iron runner intermediate section and said second lower section extending downwardly from the lower end of said second main iron runner intermediate section, said first and second lower sections intersecting adjacent the lower ends thereof,

(d) said first main iron runner lower section having

(1) first branch iron runner extending from the inner side thereof, above said intersection of said first and second main iron runner lower sections, to said cast house floor first opening,

(2) second branch iron runner extending from the outer side thereof, below said first branch iron runner, and above said intersection of said first and second main iron runner lower sections, to said cast house floor second opening,

(3) third branch iron runner extending from the lower end thereof, below said intersection of said first and second main iron runner lower sections, to said cast house floor third opening,

(e) said second main iron runner lower section having

(1) fourth branch iron runner extending from the inner side thereof, above said intersection of said first and second main iron runner lower sections, to said cast house floor first opening,

(2) fifth branch iron runner extending from the outer side thereof, below said fourth branch iron runner and above said intersection of said first and second main iron runner lower sections, to said cast house floor third opening,

(3) sixth branch iron runner extending from the lower end thereof, below said intersection of said first and second main iron runner lower sections, to said cast house floor second opening.

References Cited

UNITED STATES PATENTS

843,582	2/1907	Campbell	266—13
1,458,222	6/1923	Dieter	164—135
2,762,096	9/1956	Wittmoser	164—135 X
2,805,142	9/1957	Arata	266—13 X
2,931,635	4/1960	Braun et al.	266—13 X
3,045,996	7/1962	Rice	266—31
3,208,743	9/1965	Shimizu et al.	266—38

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