M. KILLEEN.

BLAST FURNACE CASTING APPARATUS.

APPLICATION FILED OCT. 29, 1908.

912,688.

Patented Feb. 16, 1909.

2 SHEETS—SHEET 1.

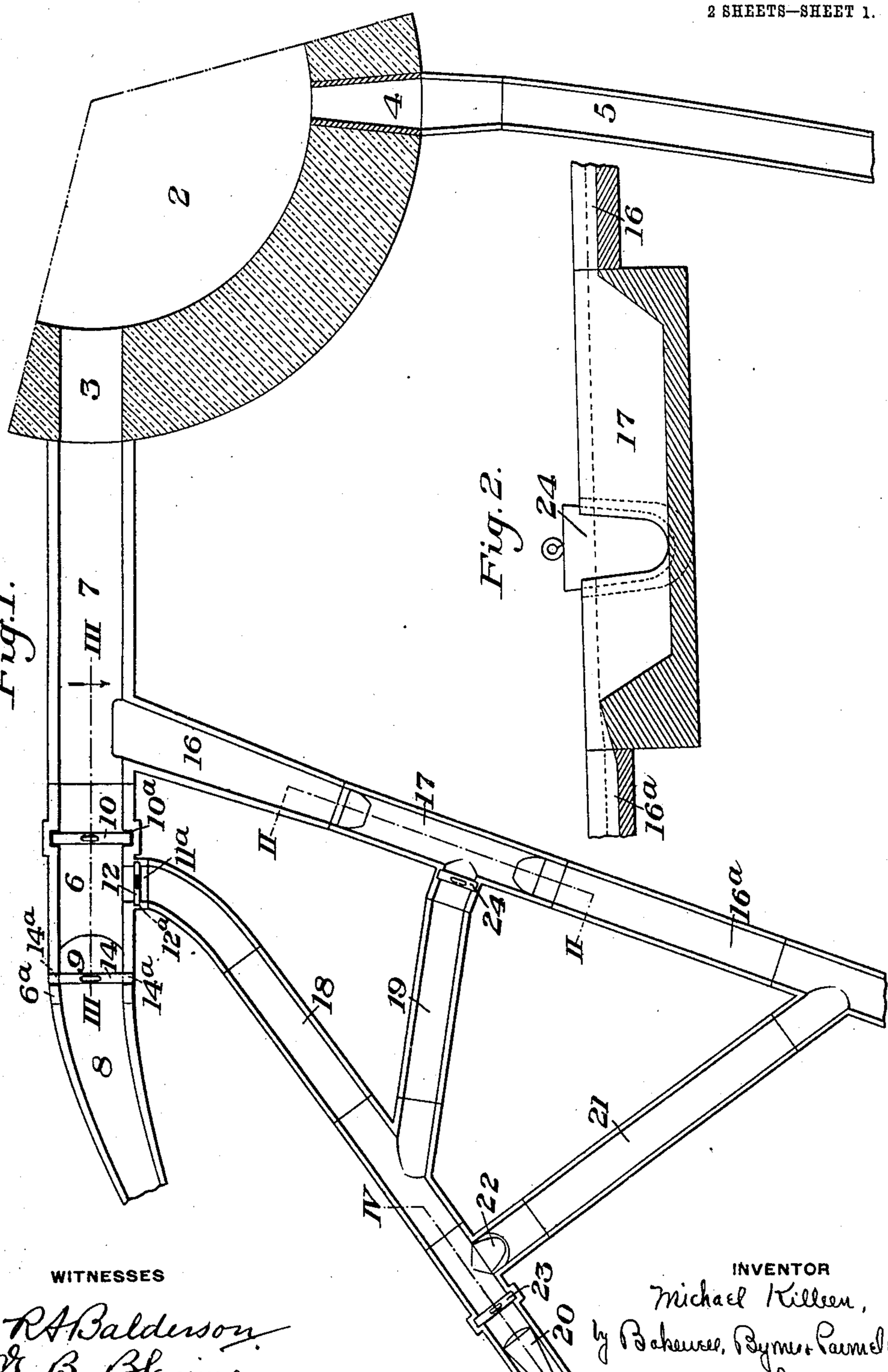

Fig. 1.

Fig. 2.

WITNESSES

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G. B. Fleming

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2 SHEETS—SHEET 2.

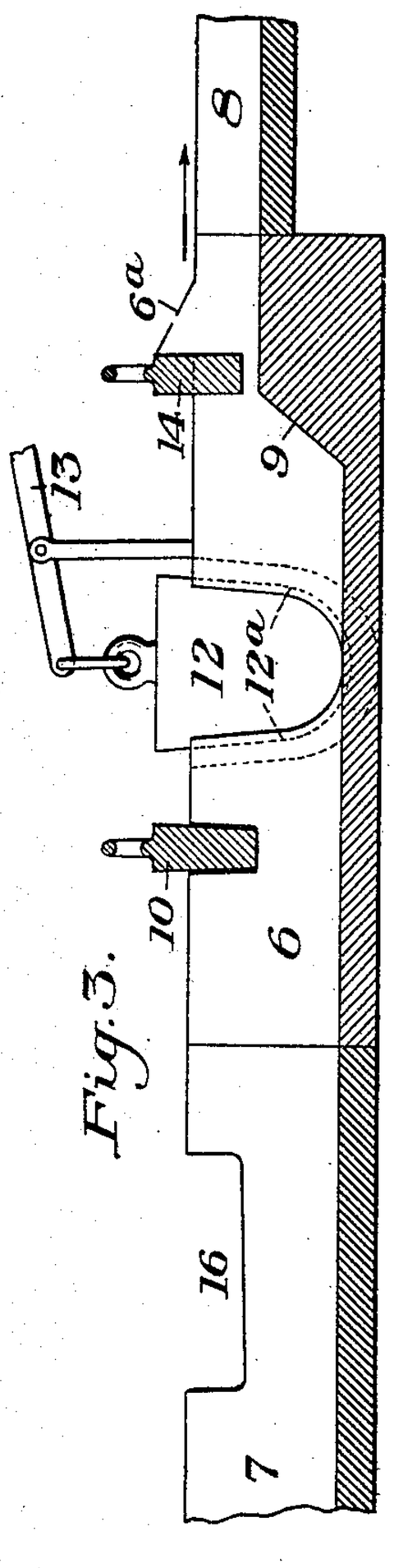

Fig. 3.

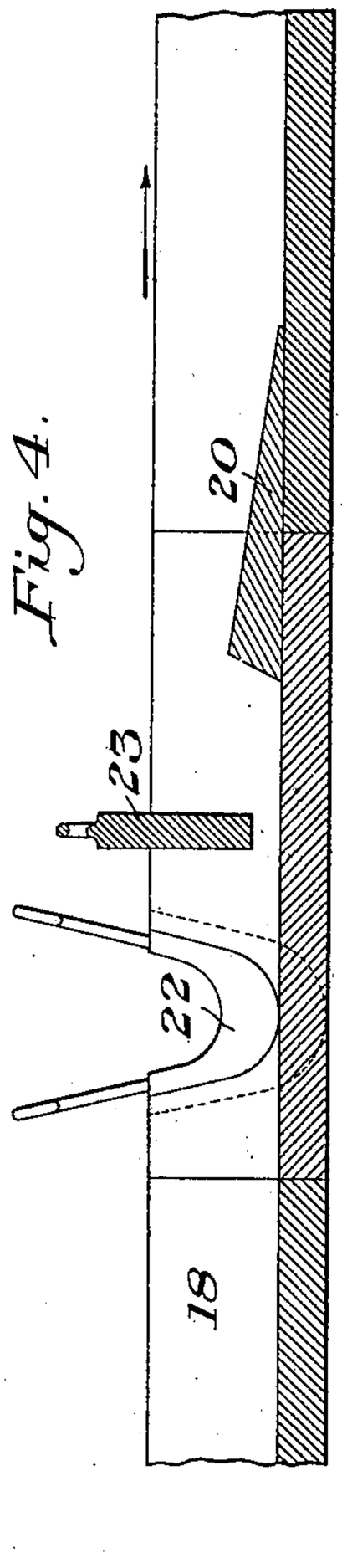

Fig. 4.

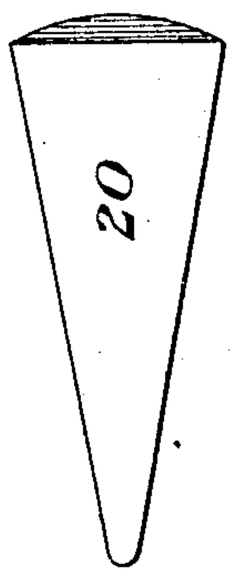

Fig. 7.

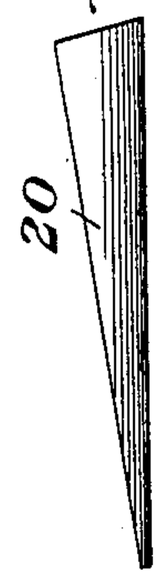

Fig. 8.

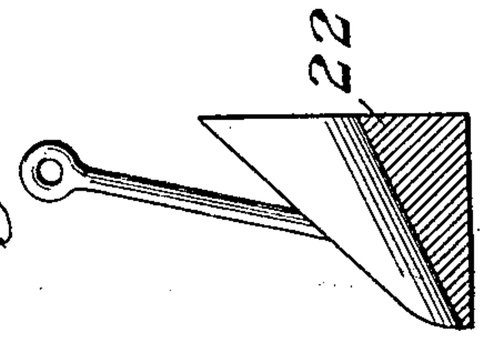

Fig. 5.

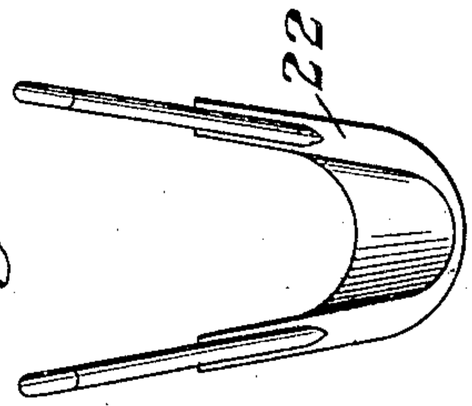

Fig. 6.

WITNESSES

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UNITED STATES PATENT OFFICE.

MICHAEL KILLEEN, OF BRADDOCK, PENNSYLVANIA.

BLAST-FURNACE CASTING APPARATUS.

No. 912,688. Specification of Letters Patent. Patented Feb. 16, 1909.

Application filed October 29, 1908. Serlal No. 460,009.

To all whom it may concern:

Be it known that I, MICHAEL KILLEEN, of Braddock, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Blast-Furnace Casting Apparatus, 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 plan view of apparatus constructed in accordance with my invention as applied for use with a blast furnace; Fig. 2 is a longitudinal sectional side elevation of a portion of the apparatus on the line II—II of Fig. 1 and showing the settling basin forming part of the invention; Fig. 3 is a similar view taken on the line III—III of Fig. 1 and showing the skimming-trough with its skimmer and dam, the drain opening behind the dam, the skimming-barrier and the cinder overflow opening leading from the skimming-trough behind the dam and skimming-barrier; Fig. 4 is a longitudinal sectional side elevation on the line IV—IV of Fig. 1 showing the removable overflow gate and the supplemental dam, which are located in the drain trough leading from behind the dam in the skimming-trough; Fig. 5 is a detail sectional side elevation, and Fig. 6 an end elevation showing the cinder overflow gate forming part of this invention; Fig. 7 is a top plan view, and Fig. 8 is a side elevation of the removable dam which is located and is used in the skimming-drain-trough in connection with the removable overflow gate.

This invention relates to apparatus of the class shown in Patent No. 608,143, for a blast furnace casting apparatus, granted to me on July 26th, 1898, which apparatus was designed for use in handling and controlling the flow of molten materials issuing from the tapping hole or iron notch of blast furnaces or similar smelting furnaces.

In the operation of tapping blast furnaces, considerable cinder flows from the iron-notch or tapping-hole together with the iron, especially toward the latter end of the casting operation. A large amount of the iron is in the form of small globules carried in suspension in the cinder, which is skimmed from the stream of molten iron and is carried off by the cinder trough to the cinder ladle cars or other place of disposal for the cinder. This results in a considerable waste of iron, which adds to the cost of producing iron in the blast furnace. The iron in the cinder also frequently burns holes through the metal lining of the cinder ladle cars, causing wrecks and serious delays in the operation of handling the molten cinder and increasing the cost of maintenance of such cars.

The object of my invention is to provide an improved casting apparatus having means whereby the molten materials are more effectually separated from each other in the skimming-trough.

Another object of my invention is to provide means by which molten iron carried in suspension in the cinder skimmed from the top of the flowing stream of molten iron in the skimming-trough is caused to collect in a pool, which is afterward delivered in bulk into the iron runner or draining trough leading from above the dam in the skimming-trough.

A further object of the invention is to provide means for separating the iron from the cinder in the pool of molten materials remaining behind the dam in the skimming-trough, and means for delivering each the cinder to the cinder trough and the iron to the iron trough, leading respectively to the cinder and iron ladles, and into which ladles the separated materials finally flow.

In the drawings, 2 represents a blast furnace provided with the usual iron notch or tapping hole 3, and with the customary cinder notch or cinder tapping hole 4, which is located at a higher level in the hearth or well of the furnace. The cinder which is "flushed" or tapped from the furnace through the cinder notch 4 is led in the cinder runner trough 5 to the cinder ladle cars used in connection with modern furnaces, or, in cases where such devices are employed, to the cinder-garden or cinder granulating pit. The iron flowing from the furnace during the casting operation is handled or conveyed in a system of runners or troughs, which are preferably formed of cast metal, made in sections of convenient length, to a series of branch runners or troughs leading each to an iron ladle car, in which cars the metal is removed in bulk and in a molten state from the blast furnace, or to a pig bed, in cases where the metal is cast into pigs in the cast house of the furnace. The troughs are provided with suitable shutters or removable gates, by which the stream of molten metal is controlled and is directed into the different

branch troughs in the usual manner. The trough system is provided with an improved skimming-trough 6, one end of which is connected by the trough 7 with the iron notch or tapping hole 3 in the furnace 2, and which is connected by its other end with the main iron trough or runner 8, in which the molten iron is caused to flow into the branch runners leading to the several ladle cars, or to the equivalent pig beds.

The skimming-trough 6 is provided with dam 9, which is preferably formed integral therewith, and with a removable skimming barrier 10, which is adjustably held in the slots or recesses 10[a] located in the opposite sides of the skimming-trough 6. The skimming trough 6 is also provided with a draining opening 11[a] at a point above the dam, preferably in one of the side walls of the trough 6, as is shown, in which case, the opening is closed by means of the shutter or removable gate 12, which consists of a vertically removable plate or metal block fitting within the transverse grooves 12[a] in the trough, and operatively connected with the hand lever 13. A second skimming-barrier 14 is placed in the skimming-trough 6, being located below the first skimming-barrier 10 and above the dam 9 and projecting downwardly into the stream of molten iron. This skimming-barrier also is removably secured in the trough 6, the lugs 6[a] projecting upwardly on the sides of the trough 6, and engaging with the lugs 14[a] on the barrier 14, to hold it and prevent its being overturned by a rush of metal in the skimming-trough. The draining opening 11[a] in the skimming-trough 6 is provided with a branch trough 18, which extends to a point above one of the iron ladle cars, or is connected with the drains into the main iron runner or trough 8 at a suitable point in its length, below the dam 9. The skimming-trough is also provided at a point behind the skimming-barrier 10 with a shallow branch trough 16, which serves to carry off the cinder backed up in the skimming-trough by the skimming-barrier 10 during the casting operation. The trough 16[a] leads from the skimming-trough to the cinder ladle car, or other point of disposal for the molten cinder. The shallow trough 16, which is made of a depth equal to or slightly less than the distance the skimming-barrier 10 projects downwardly into the trough 6, is provided at a point in its length with a deeper trough, forming the settling basin 17, the continuation 16[a] of the cinder runner or trough being made shallow in the same manner as the trough 16. The settling basin 17 is provided with a draining trough 19, which connects with and drains the settling basin into the draining-trough 18. The draining-trough 18 also is provided with a removable dam 20, and, at a point above this dam, the trough 18 is provided with a draining-trough 21, which connects with and empties the trough 18 into the cinder trough 16[a]. The draining-trough 21 is provided with a removable overflow gate 22, which is shown in detail in Figs. 5 and 6, this trough serving to raise the level of the molten materials behind the dam 20 while in place. The trough 18 is also provided with a removable skimmer barrier 23, which is constructed to skim the cinder floating on top of the iron in the trough 18 and divert it into the trough 21 over the overflow gate 22, the iron continuing over the dam 20 and down the trough 18. The draining-trough 19 for the settling basin is also provided with a gate or shutter 24 by which the branch opening in the trough 17 to the draining-trough 19 is closed until such times as it is desired to empty the settling basin.

In the operation of my improved apparatus, the tapping hole 3 of the blast furnace is opened in the usual manner. The iron then flows from the furnace and down the trough 7 into the skimming-trough 6, and after backing up and forming a pool behind the dam 9, flows over the dam 9, and thence downwardly through the main iron trough 8 into the several branch troughs which deliver the molten iron to the ladle cars. The skimming-barrier 10 projects downwardly into the skimming-trough 6, the bottom edge of the skimming-barrier being at or about the level of the top of the dam 9. The cinder flowing from the blast furnace with the iron, on account of being lighter, will float on top of the molten iron, and on reaching the barrier 10 will be backed up in the trough behind the barrier. The heavier molten iron flows below the sheet of lighter molten cinder, under the barrier and up over the dam, and then downwardly through the main trough 8. The cinder backed up in the trough 6 by the skimming-barrier is carried off sidewise by the shallow cinder trough 16, this trough being of a depth about equal to the distance the skimming-barrier projects downwardly into the trough. It will be understood that all these troughs slope away from the furnace and from each other sufficiently to cause the metal to readily flow in them. During the casting operation, particularly toward the latter end of this operation, there is considerable iron mixed with the cinder in the form of globules, which is known as buckshot, and this buckshot is carried down the cinder trough 16 by the cinder flowing in this trough. The heavier molten iron will settle out of the molten cinder if given sufficient time, and for this purpose the settling basin 17 is provided, which is considerably deeper than the trough 16, and which forms a pool of cinder and iron in this portion of the cinder runner, and gives the iron sufficient time to separate out of the cinder and settle to the bottom of the

settling basin. The larger portion of the cinder continues on down the cinder trough 16ª to the cinder ladle cars. At times considerable cinder having iron in the form of buckshot mixed with it is carried in under the skimming-barrier, and, in order to prevent this cinder being carried over the dam and down the main iron trough 8, I provide a second skimming-barrier 14, which is placed at a point in the skimming-trough between the dam and the first skimming-barrier, and preferably projects downwardly below the level of the top of the stream of molten iron. After the casting operation has been completed, there is a considerable pool of molten iron remaining in this trough behind the dam 9. The gate 12 in the draining opening 11ª is then raised and the pool of molten material is allowed to drain from the trough 6 and downwardly through the trough 18, which leads to the iron ladle cars. The settling basin 17 is then drained by raising the gate 24 and allowing the iron separated out of the cinder together with the small amount of cinder floating on top of this iron, to flow downwardly through the trough 19 into the trough 18. The removable dam 20 and overflow gate 22 have been previously placed in position in the trough 18. The molten materials flowing down the trough 18 are then separated, the skimmer 23 stopping the progress of the cinder down the trough 18 and causing it to be diverted over the overflow gate 22 and down the branch draining trough 21 into the cinder trough 16ª, in which it is finally delivered to the cinder ladle cars. The iron in the molten materials passing down the draining-trough 18, both from the skimming-trough 16 and from the settling basin 17, passes in under the skimmer 23 and over the removable dam 20 and thence downwardly into the iron ladle cars or other place of disposal. After this operation has been completed, the system of troughs is carefully luted with clay wash or other refractory materials so as to prevent the molten materials from sticking to the trough in the usual manner, this operation being performed after each casting operation.

The advantages of my invention are many, and will be appreciated by those skilled in the art. By providing the settling basin in the cinder runner or trough, a large amount of iron which heretofore has been delivered into the cinder ladle cars and has been lost is recovered. The molten iron collected in the settling basin is afterwards skimmed and delivered into the main iron runner or to the iron ladle cars, while the cinder is separated and delivered to the cinder ladle cars. By the use of the second skimming-barrier in the skimming-trough 6, the iron is separated from the cinder, and the passage of cinder down the main runner is prevented. By the arrangement of troughs as shown in the drawings, I am enabled to drain the skimming-trough and to separate the materials drained from this trough and cause the cinder to flow into the proper channel and the iron into its proper channel. The settling basin 17 is emptied in such manner that the cinder is separated from the iron and each is directed into its proper channel. The draining-trough 18 leading from the skimming-trough 6 is also arranged with a skimming-barrier and a drain opening, by which the materials are separated and the cinder caused to flow into the branch trough 21, from which it flows into the cinder runner 16 while the iron is continued on its way to the iron ladle cars or pig beds.

Modifications in the construction and arrangement of the parts may be made without departing from my invention.

I claim:—

1. A blast furnace skimming-trough having a skimming-barrier and a dam below the barrier and projecting upwardly above that portion of the trough bottom which is beneath the barrier, said trough having above the dam a draining opening for the metal backed up by the dam, and a second skimming-barrier in the trough below the first barrier and above the dam; substantially as described.

2. A metal skimming trough having a skimming-barrier and a dam below the barrier, said trough having a draining opening in its side at a point between the dam and the barrier and a second skimming-barrier in the trough below the first barrier and above the dam; substantially as described.

3. In blast furnace casting apparatus, a trough system leading from the furnace having a skimming-trough with a dam, and a skimming barrier, a cinder trough for draining cinder from behind the skimming-barrier during the casting operation, and a draining-trough for draining the skimming-trough behind the dam after the casting operation, said cinder trough having a settling basin therein; substantially as described.

4. In blast furnace casting apparatus, a trough system leading from the furnace having a skimming-trough with a dam and a skimming barrier, a cinder trough for draining cinder from behind the skimming barrier during the casting operation, and a draining-trough for draining the skimming-trough behind the dam after the casting operation, said cinder trough having a settling basin therein and having means for draining the settling basin; substantially as described.

5. In blast furnace casting apparatus, a trough system leading from the furnace comprising a main trough for iron having a

dam, a skimming-barrier above the dam, a draining-trough leading from the main trough above the dam, a cinder overflow trough leading from above the skimming-barrier, a branch trough connecting and draining from the cinder overflow trough into the draining-trough, and a second branch trough connecting and draining from the draining-trough into the cinder overflow trough; substantially as described.

6. In blast furnace casting apparatus, a trough system leading from the furnace having a skimming-trough with a dam and a skimming-barrier, a cinder trough for draining cinder from behind the skimming-barrier during the casting operation, and a drain trough for emptying the skimming-trough behind the dam after the casting operation, a dam in the draining-trough for the skimming-trough, a skimmer above said dam, a branch trough leading from the draining-trough above the skimmer and dam, and a removable overflow gate in the branch trough leading from the draining-trough; substantially as described.

7. In blast furnace casting apparatus, a skimming-trough having means for separating cinder from the iron flowing in said trough and having a cinder overflow trough leading therefrom, said overflow trough having a deeper portion forming a settling basin therein; substantially as described.

8. In blast furnace casting apparatus, a skimming-trough having a cinder overflow trough leading therefrom, said overflow trough having a deeper portion forming a settling basin therein, and a drain outlet in the side of the settling basin for emptying the basin; substantially as described.

9. In blast furnace casting apparatus, a skimming-trough having a cinder overflow trough leading therefrom, said overflow trough having a deeper portion forming a settling basin therein, a drain outlet in the side of the settling basin for emptying the basin, and a removable gate arranged to close the drain outlet in the settling basin; substantially as described.

10. In blast furnace casting apparatus, a trough system leading from the furnace, comprising a trough for molten iron, means for separating molten cinder from the iron therein, a cinder trough leading from the iron trough into which the skimmed cinder is diverted, and means in the cinder trough arranged to separate the skimmed cinder from any iron contained therein; substantially as described.

11. A blast furnace skimming-trough having a drain outlet, and having a skimming barrier located on opposite sides of said outlet; substantially as described.

12. A blast furnace skimming-trough having a dam, a drain opening above the dam, and a skimming barrier located above and below the drain opening; substantially as described.

13. A blast furnace casting apparatus, a trough system leading from the furnace, and comprising a skimming trough, means for separating molten cinder from the iron therein, separate conducting channels for the separated iron and cinder, and means in each of said channels for effecting a further separation of the iron and cinder; substantially as described.

In testimony whereof, I have hereunto set my hand.

MICHAEL KILLEEN.

Witnesses:

G. E. F. GRAY,

FRANK A. POWER.