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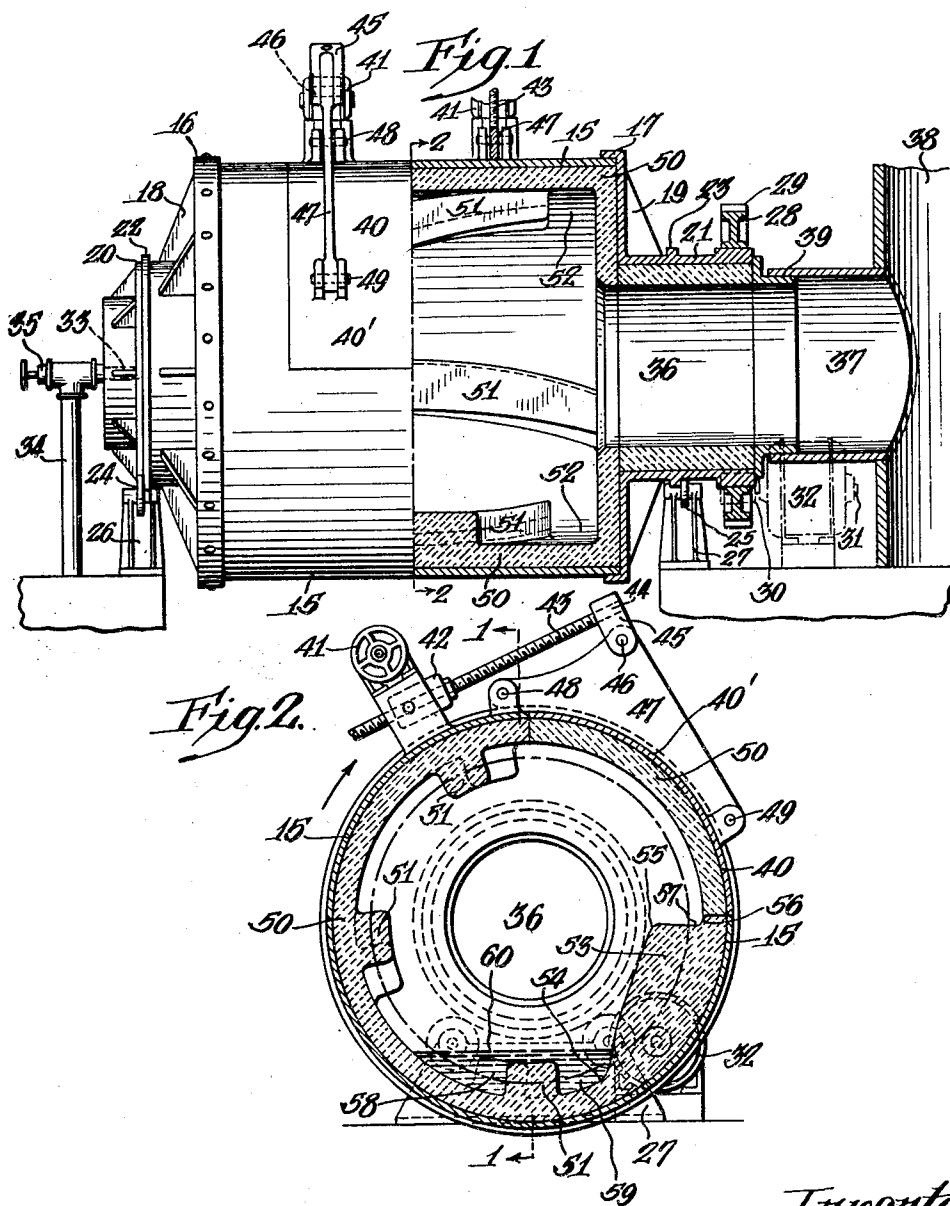
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1,892,271

METHOD AND APPARATUS FOR PUDDLING

Filed June 14, 1930

2 Sheets-Sheet 1



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Dec. 27, 1932.

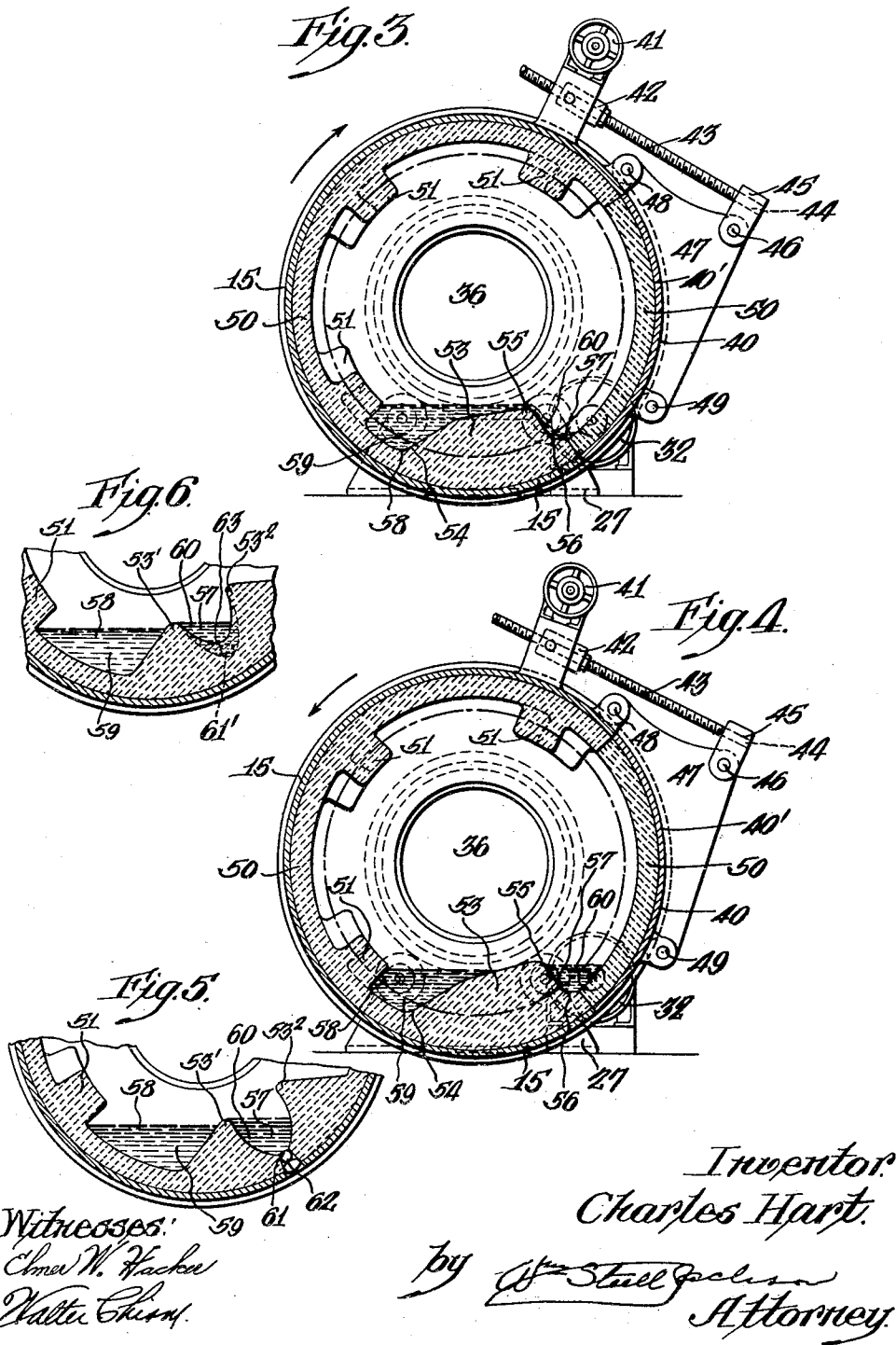
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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR PUDDLING

Application filed June 14, 1930. Serial No. 461,100.

My invention relates to methods of operating rotatory or oscillatory mixing furnaces and to features of the internal construction of the same.

5 A purpose of my invention is to effect a gravity separation of portions of a mixing furnace charge, as for example to draw off the slag from the iron in a puddling furnace.

10 A further purpose is to locate a skimming dam on the interior of a mixing furnace.

A further purpose is to place a skimming pocket beyond and below a skimming dam when in skimming position in a mixing furnace.

15 A further purpose is to provide means for tapping a skimming pocket located beyond a skimming dam of a mixing furnace.

20 A further purpose is to construct a dam in a mechanical puddling furnace wall adjacent to the furnace door so that, if the furnace be rotated to place the dam just above the level of the charge, slag during the boil will flow over the dam and be trapped behind the dam and against the door, where it can be conveniently drawn off without danger of loss of any part of the iron.

25 A further purpose is to skim, from a charge, portions having low specific gravity, regulating the point of skimming separation by the position of the apparatus ordinarily used to mix the charge.

Further purposes will appear in the specification and in the claims.

30 In the past metallurgists have constructed interior projections in the form of mixing vanes and mixing, stirring and breaking walls in mixing furnaces for the purpose of providing an irregular surface to assist in the agitation of the charge. Some attempts of this character have been highly successful, and I have myself made improvements in such structures and have filed applications for patent for the same, Serial Number 461,893, filed June 18, 1930, for furnace lining; and, Serial Number 500,555, filed December 6, 1930, for method and apparatus for mixing a furnace charge. While the present invention relates to interior projections in mixing furnaces, it is not concerned primarily with those having a mixing function, al-

though in my best form mixing vanes will be included.

55 In all mixing furnaces the charge is so fully stirred that a gravity separation is difficult. This is particularly so in mechanical puddling furnaces where mixing vanes are used, because the iron and slag become very thoroughly incorporated together, and a separation of the surplus slag from the iron has in the past been possible only after the iron has become pasty, when slag may be poured out the partially open door. At this stage of the operation the charge is very viscous and slag is removed with great difficulty, so that as a consequence the amount of slag removed before the ball goes to the squeezer is very slight.

60 There are certain advantages in the use of special slags in the puddling furnace. It may be desirable to perform the early stages of the mechanical puddling operation in the presence of one slag, as for example the usual iron silicate puddling slag, and then remove the bulk of that slag and replace it instead with some other slag in accordance with the principles disclosed in my application above referred to, or for any other reason. While in the past it has not been possible to accomplish this intermediate slag separation in the puddling furnace, by my invention I can skim off any desired quantity of the slag and remove it from the furnace at any point in the operation.

65 Unlike methods of slag separation employed in stationary furnaces, it is impossible to harmfully affect the process by making a mistake as to the point at which the slag separation should stop. Should this occur in my process through inexperience, carelessness or through the well known uncertainties characteristic of metallurgical operations, I may simply turn the furnace angularly to discharge the material in the skimming pocket back into the body of the charge, and repeat the slag separation as often as necessary to obtain critical removal.

70 In the drawings I illustrate only two of the many desirable forms in which my invention might be embodied. The forms shown are chosen from the standpoints of easy appli-

cation to furnaces at present in common use, of convenience in manufacture, construction, and repair, and of facility in illustration of the principles involved.

Figure 1 is a side elevation of a mixing furnace, partially sectional along the line 1—1 of Figure 2.

Figure 2 is a section of Figure 1 on the line 2—2, omitting certain structure in the background.

Figures 3 and 4 correspond generally to Figure 2, but show the furnace in somewhat different positions.

Figure 5 is a fragmentary section corresponding generally to Figure 4, but showing a different construction.

Figure 6 is generally similar to Figure 5, but shows the tap hole differently located.

In the drawings like numerals refer to like parts throughout.

Referring to Figures 1 to 4, the furnace comprises generally an external metallic casing 15 supported at either end by the heads 16 and 17, braced at 18 and 19 from the hubs 20 and 21. The hubs carry bands 22 and 23 which rest in and rotate or oscillate upon rollers 24 and 25 in supports 26 and 27, so that the furnace may be rotated or oscillated as desired. The hub 21 also supports a driving band 28 having gear teeth 29 engaged by the driving gear 30 on the shaft 31 of the motor 32, to turn the furnace.

Suitable gaseous or liquid fuel is admitted through the burner 33 from the pipe 34, controlled by the valve 35. Air is drawn in around the burner. The products of combustion from the furnace discharge through the neck 36 into the flue 37 and up the stack 38. The flue and the neck are desirably interrelated as at 39 in any suitable manner so that the furnace may rotate without excessive loss of draft.

For charging and discharging, the furnace has a door 40, which may very desirably be mechanically controlled by the electric motor and reducing gear units 41, as through the driving connections at 42 to the screws 43, supported in the bearings 44 of the collars 45. The collars 45 are pivoted at 46 to the lifting arms 47, pivotally secured to the furnace casing at 48. The lifting arms 47 are secured to the door frame 40' at the pivots 49.

The general outline only of the door opening mechanism is here explained, without reference in detail to the gears or other parts transmitting power from the motors to the driving connections, since door actuating means are well known in the art, being illustrated, for example, in Ely Patent 1,155,410, in Ely Patent 1,495,635, and in Hibbard Patent 1,450,533, and since the door opening mechanism is immaterial to my invention.

It will be understood that the description herein recited of the mechanical details of

the external furnace structure is entirely irrelevant to my invention, and is given merely to make clear the drawings which I show of my best form.

Within the casing 15 the lining 50 supports the charge. The lining may be of any suitable material, preferably magnesite, for example, where the mixing furnace is used in puddling.

Several mixing vanes 51 are shown at the interior of the furnace for the purpose of very thoroughly stirring the charge. It will be understood that my invention is not restricted to use in a furnace having mixing vanes, but that, since the use of mixing vanes is so desirable in puddling for thorough incorporation of slag into the charge, and since the difficulty of slag separation is so much increased where mixing vanes are used, a very desirable combination exists between my skimming dam and the mixing vanes shown.

According to the principles described and claimed in my said application, Serial Number 500,555, the mixing vanes oppositely spiral around the furnace interior as shown, and are discontinuous at points 52 as there also explained, to encourage end mixing by eddies and swirls as the charge changes direction against the end wall of the furnace in flowing from vane to vane.

Of course it will be understood that any other suitable type of mixing vane or breaking or stirring wall may be inserted in place of those shown, which are intended to be merely illustrative, at the same time disclosing the best form of which I am aware.

While the direction of rotation of a furnace is generally unimportant for the purpose of mixing, it may be a matter of importance in skimming, due to the relative positions of the skimming dam, the skimming pocket and the discharge opening.

In Figure 2 the skimming dam 53 extends from the surface of the lining at 54 to a high point at 55, where it forms a skimming edge. From 55 the dam descends rather abruptly to join the lining at 56. The abrupt face between 55 and 56 is close to the edge of the door 40, producing a skimming pocket 57 between the abrupt face from 55 to 56 and the inner lining of the furnace door 40.

It will be apparent that the capacity of the skimming pocket for the charge depends upon the angular position of the furnace, varying from a maximum when the skimming pocket is in its lowest position to a minimum when it is inverted. For example in Figure 2 the skimming pocket is substantially empty, while in Figures 3 and 4 it holds a considerable quantity of skimmed material.

While I have described my skimming wall somewhat in detail, it will be understood that the essential operating parts are the skimming separation edge 55 which determines the level of skimming, the skimming pocket

57 below the edge 55 when in skimming position, and the discharge opening from the pocket 57, for example in Figure 2 the door 40. Other features of shape and construction of the wall 53 are matters of design merely. For example, the edge extending from 54 to 55 might be of any desired shape providing it did not interfere with the skimming operation.

For convenience in further discussion of the skimming operation I shall use as an illustration the application to a mechanical puddling furnace, but it will be understood that any other charge having separable components of different densities could be similarly treated.

As seen in Figure 2, the charge 58 lying quiescent in the furnace separates into the iron 59 near the bottom and the slag 60 near the top, since the puddling furnace slag is lighter than the iron. The furnace should now be turned in the direction of the arrow of Figure 2 to the position of Figure 3, where the skimming edge 55 is below the surface of the slag. In this figure slag 60 is running into the skimming pocket 57 against the door. The edge 55 is above the level of the iron 59, so that no iron will be skimmed.

The operator may either turn the furnace at once to the position which has been found by experience to effect a proper separation of the slag from the iron, or he may progress the furnace very slowly in the direction of the arrow of Figure 3, watching the slag through the air inlet opening about the burner as it flows into the pocket 57, and stopping movement of the furnace as soon as enough slag has been removed or as soon as danger of iron flowing over becomes apparent.

The operator may at any time cease skimming by moving the furnace in the direction of the arrow of Figure 4. At this time the pocket 57 will probably contain a considerable quantity of slag 60, as seen in Figure 4.

The slag may be discharged from the pocket simply by opening the door 40 by means of the electric motors 41, as is commonly done to discharge a furnace of this type.

Should the operator wish to remove more slag from the charge than can be conveniently held at one time in the pocket 57, he may repeat the skimming and discharging operation as often as desired until the requisite quantity of slag has been drawn off.

If the operator should make a mistake by over-skimming, so that too much slag flows into the pocket 57, he may empty a portion of this slag back into the charge by rotating the furnace in the direction of the arrow of Figure 4. If the operator should over-skim to the extent of carrying metal into the pocket 57, he may empty the pocket back into the charge by rotating the furnace in the direction of the arrow of Figure 4 until it

reaches the position of Figure 2, or a similar raised position.

During the boil of the puddling operation, my invention may be applied to great advantage. At this time the charge increases in volume considerably due to the rapid ebullition of gases during the oxidation of carbon. At the beginning of the boil I will locate my skimming separation edge 55 a predetermined distance above the level of the charge, and maintain the furnace stationary or with slight oscillation for a short period. As the charge increases in volume it will finally rise to the level of the edge 55, and slag lying on the top will flow over the edge 55 into the pocket 57. When the operator wishes to cease the collection of slag in the pocket 57, he can merely rotate the furnace a short distance in the direction of the arrow in Figure 4, and then remove the slag through the door 40.

My invention is by no means restricted to use in furnaces having side discharging doors, nor in those which will skim in only one direction. In Figure 5 I show a fragment of a furnace having two skimming dams 53' and 53², either one of which may be used, depending upon the direction in which skimming is desired. The pocket 57 will cooperate with either of the dams 53' or 53².

From the pocket 57 a tap hole 61, closed by the plugs 62, is provided for discharge. I consider the form of Figure 5 less advantageous than the form of Figures 1 to 4, but I illustrate it to indicate that my invention may be applied to skimming from either side of the furnace, and that the skimming dam need not necessarily cooperate with a discharging door.

The tap opening need not be in the side of the furnace, but may be at one end, as shown in Figure 6. In this figure the bottom of the pocket 57 slopes, as for example from a point 63 toward the tap opening 61' at the end of furnace.

It will be evident that, as the skill of the operator increases, he may be able to satisfactorily effect a slag separation by leaving the discharge opening open during the skimming, so that the skimmed material, instead of remaining in the pocket 57, will flow directly from the furnace.

Doubtless other combinations of the skimming separation edge, the skimming pocket and the discharge opening from the pocket may be made to meet the special needs or wishes of particular designers, or to apply my invention to the metallurgy of other metals besides that of iron, which I have specially considered, and I intend to claim any such as are included within the reasonable scope of my invention or which apply the distinctive features taught by me.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless be-

come evident to others skilled in the art, to obtain part or all of the benefits of my invention without copying the structure shown, and I therefore, claim all such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of effecting a gravity separation in a fluid furnace charge by means of a dam which consists in progressing the dam by angularly moving the furnace until the dam is below the surface of the charge, collecting adjacent to the dam the skimmings flowing over the dam while retaining charge below the dam, reversing the direction of progression of the dam to return a quantity of the skimmings to the charge and discharging the remaining skimmings.

2. The method of effecting a gravity separation in a fluid furnace charge by means of a dam in the furnace lining which consists in rotating the lining and furnace until the upper edge of the dam dips below the surface of the charge, reversing the direction of rotation to stop skimming and discharging the skimmings.

3. The method of effecting a gravity separation in a furnace charge by means of a dam in the furnace lining which consists in rotating the lining and furnace until the upper edge of the dam dips below the surface of the charge, collecting the skimmings adjacent to the dam and discharging the collected skimmings.

4. The method of effecting a gravity separation in a fluid furnace charge by means of a dam in the furnace lining which consists in rotating the lining and furnace until the upper edge of the dam dips below the surface of the charge, collecting the skimmings adjacent to the dam, reversing the direction of rotation to stop skimming and discharging the collected skimmings.

5. The method of effecting a gravity separation in a fluid furnace charge by means of a dam in the furnace lining which consists in rotating the lining and furnace until the upper edge of the dam dips below the surface of the charge, collecting the skimmings adjacent to the dam, reversing the direction of rotation to stop skimming, concurrently returning part of the collected skimmings to the charge and discharging the skimmings.

6. The method of separating the slag from the iron during mechanical puddling which consists in locating a confining edge of the furnace lining just above the normal upper surface of the charge in a puddling furnace, boiling the iron to flow the slag free from the iron over said edge when the volume of the charge increases and discharging the overflowing slag.

7. The method of effecting a gravity separation in a puddling furnace charge by means

of a dam in the furnace lining which consists in rotating the furnace to place the dam slightly above the surface of the charge, boiling the charge to increase its volume until skimmings therefrom overflow the dam, and discharging the skimmings.

8. The method of effecting a gravity separation in a puddling furnace charge by means of a dam in the furnace lining which consists in rotating the furnace to place the dam slightly above the surface of the charge, boiling the charge to increase its volume until skimmings therefrom overflow the dam, collecting the skimmings adjacent to the dam, reversing the direction of rotation to stop skimming and discharging the skimmings.

9. In a rotatory or oscillatory mixing furnace, a furnace body, a furnace lining within the body, a skimming projection from the lining, and walls forming a discharge opening through the lining below the skimming projection when in skimming position.

10. In a rotatory or oscillatory mixing furnace, a furnace body, a furnace lining within the body, a skimming projection from the lining, walls forming a discharge opening adjacent to the skimming projection, and walls forming a skimming pocket below the top of the skimming projection when in skimming position and communicating with the discharge opening.

11. In a rotatory or oscillatory mixing furnace, a furnace body, a furnace lining within the body, a door through the body and lining, a skimming projection from the lining adjacent to the door, and walls producing a skimming pocket of which one side is formed by the door.

12. In a rotatory or oscillatory mixing furnace, a furnace body, a furnace lining within the body, stirring vanes in the lining, a skimming dam in the lining adjacent of the stirring vanes, and walls forming a discharge opening near the base of the skimming dam on the side remote from the charge.

13. In a rotatory or oscillatory mixing furnace, a furnace body, a furnace lining within the body, oppositely spiralled mixing vanes in the lining, a skimming dam having a skimming edge adjacent to the mixing vanes, and walls forming a discharge opening for the skimmings below the skimming edge when in skimming position.

14. In a rotatory or oscillatory mixing furnace, a furnace body, a furnace lining within the body, oppositely spiralled mixing vanes in the lining discontinuous over part of the length of the furnace, a skimming dam having a skimming edge adjacent to the mixing vanes, and walls forming a discharge opening for the skimmings below the skimming edge when in skimming position.

15. In a rotatory or oscillatory mixing furnace, a furnace body, a furnace lining within

the body providing pools for the metal at separated points, and a plurality of skimming projections between the pools with a pocket between the projections whereby the slag from the metal can be skimmed into the pocket from either pool position.

16. In a rotatory or oscillatory mixing furnace, a furnace body, a furnace lining within the body adapted to hold a pool in its bottom in one position of the furnace, a skimming projection adjoining the pool position, and walls forming a pocket on the other side of the projection from the pool, the bottom of the pocket sloping toward a draining opening.

17. In a rotatory or oscillatory mixing furnace, a furnace body, a furnace lining within the body, a skimming dam forming with the lining on one side a place for a metal pool and on the opposite side a pocket communicating with a discharge opening, and means for removably closing the discharge opening.

18. The method of separating slag from the charge in an angularly shiftable puddling furnace having a dam extending into the furnace which consists in angularly shifting the furnace to collect the entire charge on one side of the dam, in angularly shifting the furnace until the upper edge of the dam is below the highest level attained by the top of the charge, permitting slag to overflow the dam and to flow down the opposite side of the dam and in discharging the slag from the furnace at the level of the bottom of the opposite side of the dam.

19. The method of separating slag from the charge in an angularly shiftable puddling furnace having a dam extending into the furnace and spaces for holding charge on either side of the dam which consists in collecting the entire charge on one side of the dam, in angularly shifting the furnace until the upper edge of the dam is below the highest level attained by the top of the charge, permitting slag to overflow the dam, in catching the overflowing slag within the furnace in the space on the other side of the dam and in discharging the slag from the furnace.

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