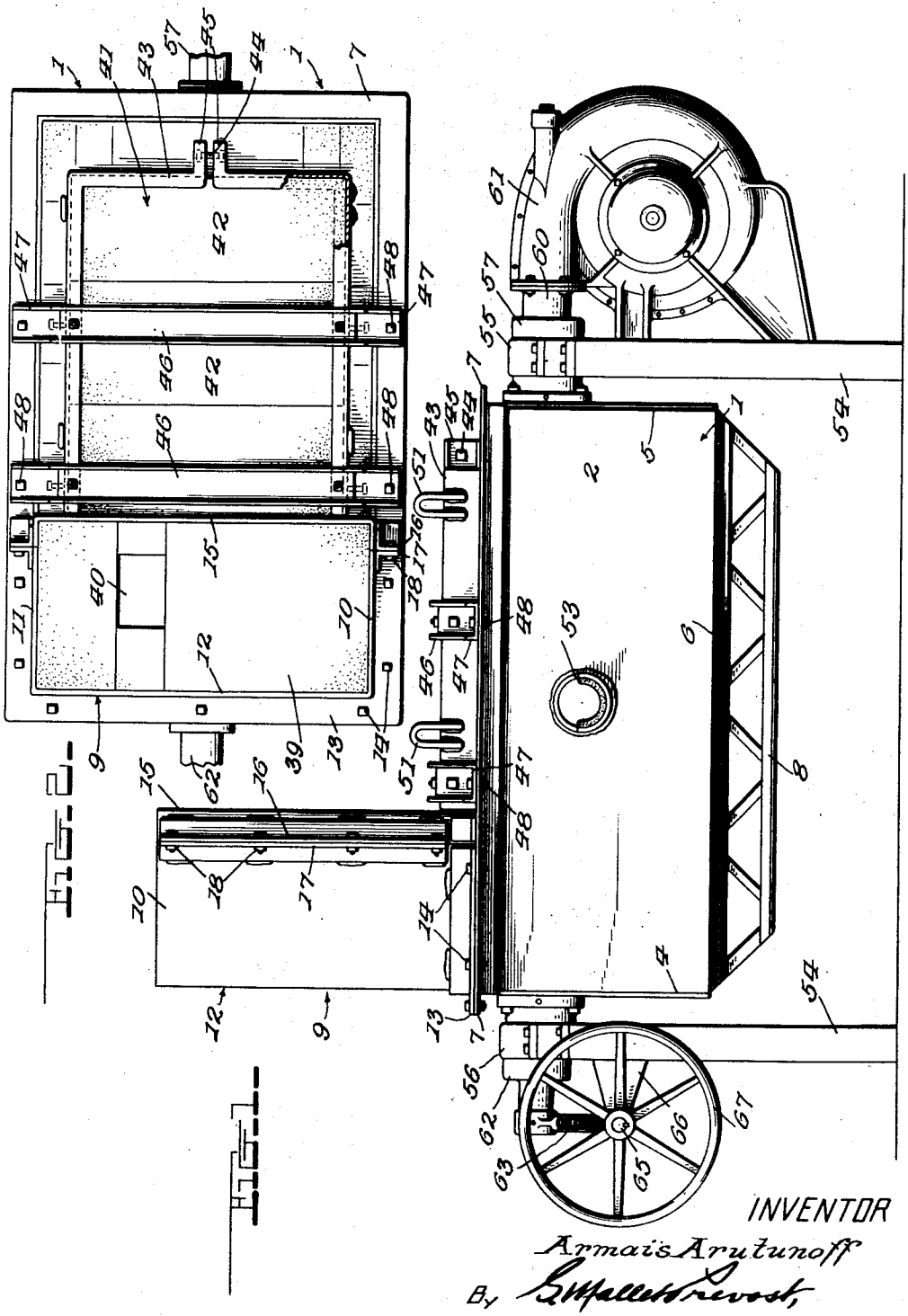
Dec. 15, 1953 A. ARUTUNOFF 2,662,764

OSCILLATORY, DIRECT-FIRED, STACK-LOADED MELTING FURNACE

Filed April 18, 1951 4 Sheets-Sheet 1



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Dec. 15, 1953 A. ARUTUNOFF 2,662,764

OSCILLATORY, DIRECT-FIRED, STACK-LOADED MELTING FURNACE

Filed April 18, 1951 4 Sheets-Sheet 2

FIG. 4

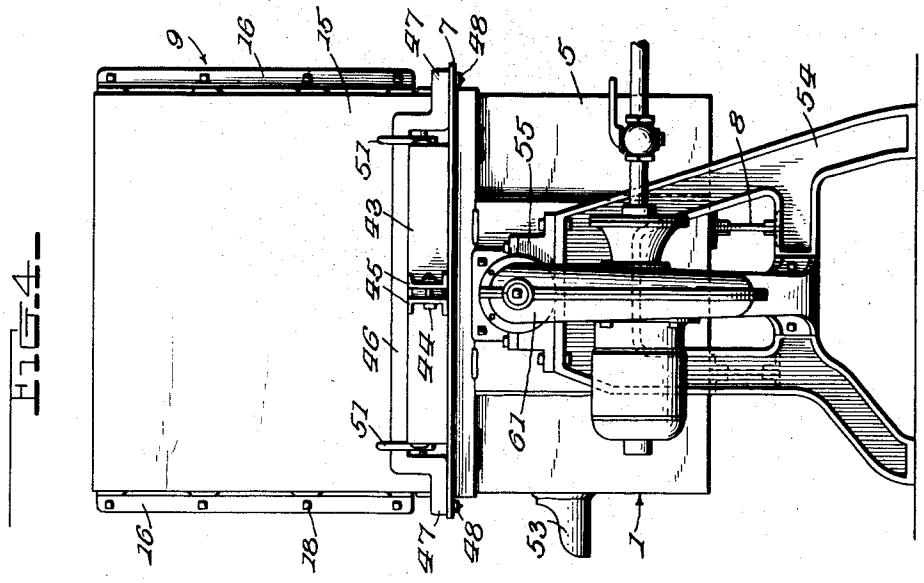
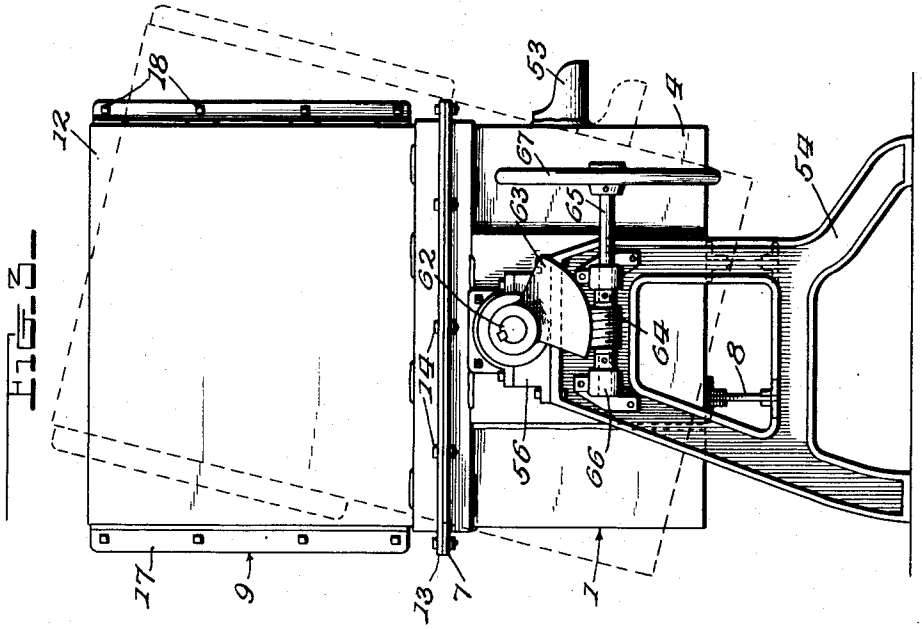


FIG. 3



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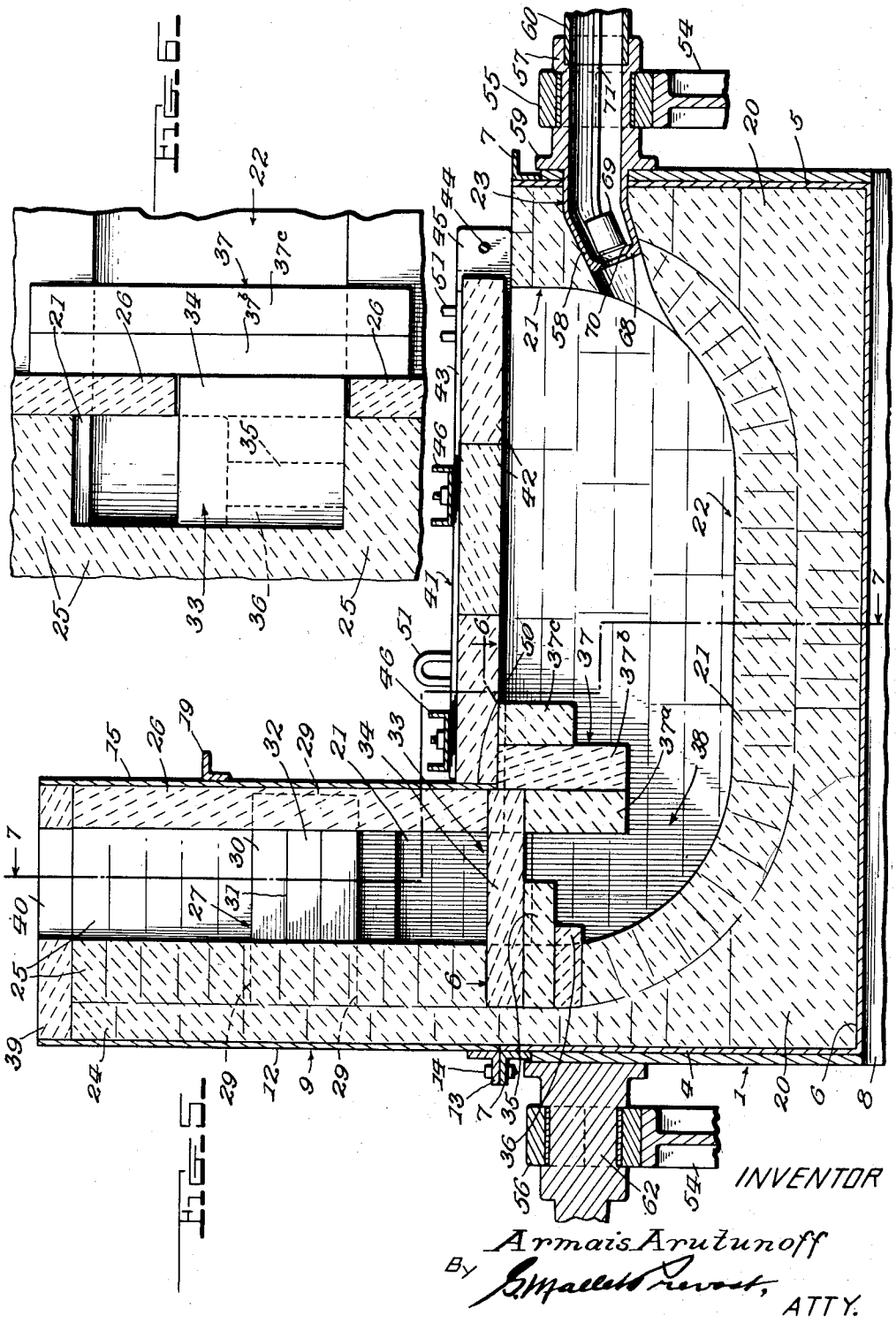
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OSCILLATORY, DIRECT-FIRED, STACK-LOADED MELTING FURNACE

Filed April 18, 1951 4 Sheets-Sheet 3



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Dec. 15, 1953 A. ARUTUNOFF 2,662,764

OSCILLATORY, DIRECT-FIRED, STACK-LOADED MELTING FURNACE

Filed April 18, 1951 4 Sheets-Sheet 4

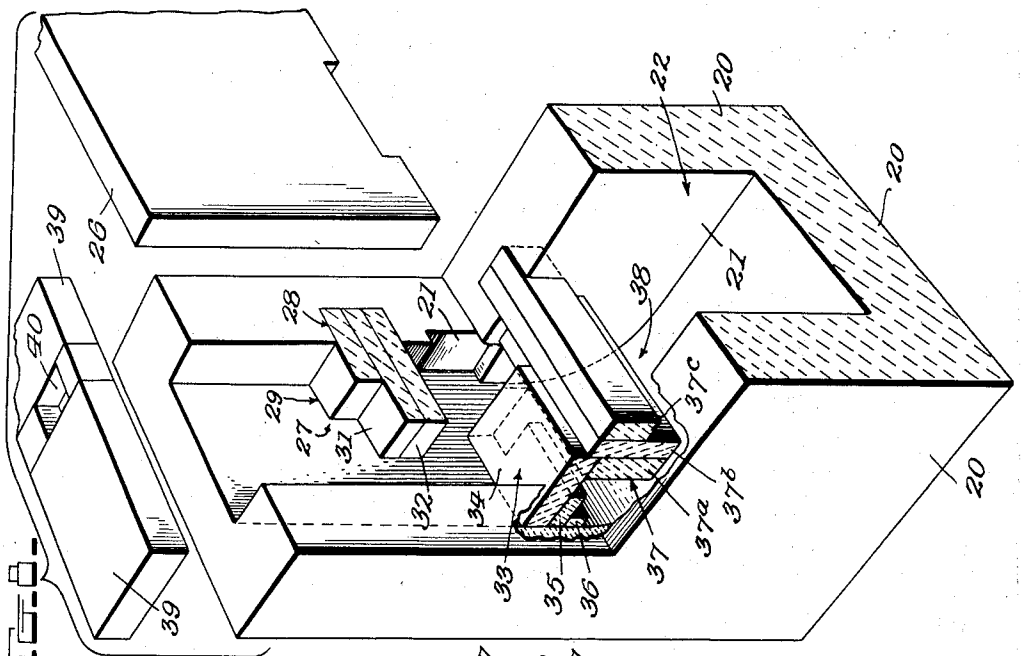


FIG. 6.

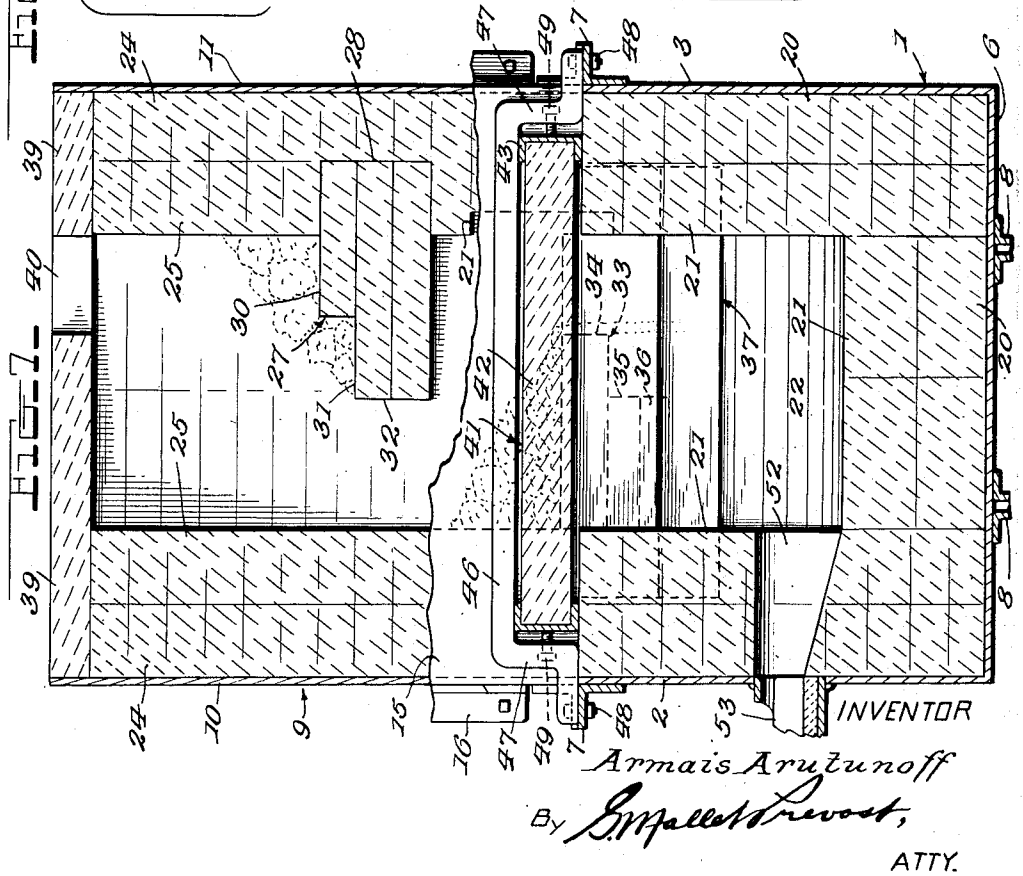


FIG. 7.

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UNITED STATES PATENT OFFICE

2,662,764

OSCILLATORY, DIRECT-FIRED, STACK-LOADED MELTING FURNACE

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Application April 18, 1951, Serial No. 221,699

6 Claims. (Cl. 266—33)

1

This invention relates to the art of metal melting furnaces, more particularly stack-loaded, direct-fired furnaces of the oscillatory type, and its principal object is to provide a melting furnace of this character adapted for continuous operation and designed to duplicate, in effect, the advantages of a cupola type furnace while avoiding its disadvantages.

The advantages of the cupola type furnace are well known but the attendant disadvantages resulting from the use of alternate beds of coke and ingots or metal charge, present a problem both from the standpoint of operation and quality of product, and the present invention was developed to the end of avoiding these objectionable features.

Another object of the invention is to effect a better utilization of fuel and heat of the flue gases by directing and controlling the flow of metal charged through the stack, with relation to the counterflow of flue gases being discharged therethrough.

A further object is to provide an oscillating furnace having a vertical stack structure mounted in fixed relation to the furnace proper so as to oscillate therewith, and provided internally with a series of horizontal ledges relatively positioned to progressively control and direct the path of travel of the metal ingots charged through the upper end of the stack. The internal structure or profile of the stack defines therein a preheating zone and a melting zone, the latter of which zones communicates directly with the highly heated accumulating trough in the furnace proper.

A still further object is to so arrange the melting ledge with respect to the axis of oscillation of the furnace and stack, that upon tilting the furnace for pouring, said ledge will act to retain the freshly melted molten metal thereon and prevent its flow and admixture with the accumulated superheated molten metal being poured.

Another advantage of the invention lies in its simplicity of design, construction, and assembly which naturally result in economy in initial costs, operation, and maintenance.

With the above and other objects in view which will appear as the description proceeds, my invention consists in the novel features herein set forth, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

Referring to the drawings in which numerals of like character designate similar parts throughout the several views,

2

Figure 1 is a view in side elevation showing a completely assembled melting furnace, representing one embodiment of the invention.

Figure 2 is a top plan view of the furnace shown in Figure 1 with certain auxiliary elements omitted.

Figure 3 is an elevational view of the furnace taken from its oscillating control end.

Figure 4 is a similar view taken from the opposite or blower end.

Figure 5 is an enlarged vertical sectional view taken longitudinally through the furnace and stack.

Figure 6 is a horizontal sectional view taken on line 6—6 of Figure 5.

Figure 7 is a transverse sectional view taken on line 7—7 of Figure 5.

Figure 8 is an exploded perspective view showing the internal structure and contour of the stack and the adjacent end of the furnace proper.

My improved furnace consists of a rectangular main furnace shell generally indicated by the numeral 1, which is formed of vertical sheet metal side walls 2 and 3, end walls 4 and 5, and a bottom 6, all welded or otherwise joined together at adjacent edges to form a container. The top edges of the vertical walls are provided with outwardly directed flanges or angle irons 7 which may extend entirely around the top of the furnace shell 1 as shown, or, if desired, they may extend across only the end wall 4 and partially along the two side walls 2 and 3, their main purpose being to accommodate complementary flanges on the furnace stack shell, as will later appear. The bottom of the shell 1 may be reinforced by any suitable steel bracing structure such, for example, as shown at 8 in Figure 1.

Directed upwardly over one end of the furnace shell 1, is a stack shell generally indicated by the numeral 9, which extends transversely entirely across the furnace shell 1 and preferably overlies approximately one-third of its top area. This stack shell 9 is composed of two vertical side walls 10 and 11, joined by an end wall 12, to form a rigid vertical channel, fixed to the corresponding vertical walls of the furnace shell by means of flanges or angle irons 13, adapted to register with flanges 7 and removably secured thereto by a series of bolts 14.

A front closure shell 15 which is also substantially channel shaped, is provided with vertically disposed flanges or angle irons 16, extending along its opposite edges for engagement with complementary flanges 17 on the adjacent edges

of stack shell walls 10 and 11. These flanges are secured in engagement by means of suitable bolts 13, whereby the closure shell is removable from the front of the main stack shell. If desired, although not shown in all figures of the drawings, the closure shell 15 may be stiffened transversely to prevent buckling, by means of a reinforcing angle 19, welded to the outer face of the closure, as shown in Figure 5.

Turning to Figures 5 to 8, which illustrate the interior of the furnace and stack, it will be seen that the furnace shell 1 is provided with an outer lining 20 of suitable insulating brick or the like built up to form a base or supporting foundation for an inner lining 21 of conventional refractory brick, preferably first quality stiff-mud fire brick or the like. The inner lining 21 is arranged to provide a trough-like refractory receptacle or accumulator 22, the floor of which is preferably curved upwardly at opposite longitudinal extremities, with an intermediate flat portion, as shown in Figure 5. At the end 5 of the furnace, opposite the stack 4, I provide a burner opening 23 which extends through the shell and the linings 20 and 21 to accommodate the nozzle of a burner which will be hereinafter referred to. The stack shell 9 is similarly lined on each of three sides with an outer layer 24 of insulating brick and an inner layer 25 of fire brick or refractory material, the latter being arranged to form substantially a continuation of the adjacent upwardly curved end of the inner lining 21 of the accumulator 22. The closure channel 15 is also lined with a layer of fire brick or refractory material 26, preferably in the form of large slabs arranged to accommodate the interfitting ends of the bricks forming the impact ledge 27, which will be later described.

As before stated, the stack 9 and the underlying portion of the furnace, are provided with horizontal ledges relatively positioned to progressively control and direct the path of travel of the metal ingots charged through the upper end of the stack. The first of these ledges is the impact ledge 27 which is formed of a plurality of refractory bricks having their rear ends inset and interfitting with the bricks of the inner lining 25 of the stack, as shown at 28 in Figure 7, the longitudinal extremities of said ledge bricks being interfitted with the adjacent stack relining at one end and the closure channel lining 26, at the opposite end, as shown at 29 in Figure 5. Preferably the bricks of the impact ledge 27 are installed in a step-like arrangement providing an initial impact step 30 and an extended second step 31, the latter preferably comprising two or more bricks to afford greater strength and support for the ledge. The front face 32 of the main ledge bricks 31, is appropriately spaced from the opposite lining 25 to form a passageway for permitting the progressive descent of the metal ingots charged at the top of the stack, and the counter flow of hot flue gases from the furnace.

Immediately beneath the stack 9, the furnace proper is provided with a second or melting ledge 33, which is oppositely disposed with respect to ledge 27 and similarly formed of a plurality of refractory bricks arranged to interfit in the adjacent inner lining 21 of the accumulator 22. This ledge, as will be seen in dotted lines in Figure 7, includes a top brick 34 having its forward edge spaced a predetermined distance from the opposite inner lining 21 with its projecting end underlying approximately one-half of the lower

bricks of the impact ledge 27, two supporting bricks 35 and 36 being stepped inwardly beneath the brick 34, as shown in Figure 5. The space between the projecting face of the melting ledge 33 and the lining 21 forms a passageway which is offset with respect to the passageway adjacent the impact ledge 27, and is designed to permit the flow of molten metal from the melting ledge, into the accumulator 22 and the countercurrent flow of flue gases from the furnace.

The top brick 34 of the melting ledge extends transversely across the interior of the stack with one extremity imbedded in the lining 25 and the opposite end supported on the upper edge of the innermost slab 37a of a baffle member 37. This baffle member is formed of a series of refractory slabs 37a, 37b, and 37c which extend horizontally across the furnace proper with their opposite ends inset in the lining 21, and their lower edges projecting downwardly in the accumulator 22. The depth of the baffle 37 is such that its lower edge is spaced a predetermined distance from the upwardly curved end portion of the lining 21, to form a restricted throat 38 which extends entirely across the stack end of accumulator 22. The top of the stack is closed by a series of slabs 39, formed of refractory material and arranged to leave a restricted opening 40, located vertically above the impact ledge 27 as will be seen from Figure 7. These slabs 39 rest upon the top edges of the stack linings and are confined within the vertical walls of the stack shell 9.

The top of the furnace proper is provided with a closure 41, preferably consisting of a plurality of slabs 42 which extend transversely across the furnace walls and rest upon the upper edges of opposite linings thereof. In the form of the invention illustrated, these slabs 42 are retained as a unit by a channel-like frame member 43 made in two sections which bound three sides of the closure and are removably secured together at one end by means of a nut and bolt arrangement 44 which engages complementary ears 45 on respective sections of the frame. A series of cross channels 46 bridge the closure 41, their opposite ends being bent downwardly and outwardly as at 47, to overlie and engage the flanges 7 at the upper edges of the furnace shell walls, suitable bolts and nuts 48 being employed to retain the channels 46 and the closure 41 in place.

As will be seen from Figure 7, the angular ends 47 of the channels 46 are spaced outwardly a slight distance from the closure frame 43, to permit adjustment and additional securing means for the frame. Each of the downturned ends 47 is drilled and threaded to receive a bolt or set screw 49, adapted to be screwed into abutment with the webs of respective channel sections of the frame 43. When the closure 41 is in place, its inner unbounded end 50 fits closely against the wall of the stack shell closure 15, as will be seen in Figure 5, and the usual hoisting loops 51 are provided for removing and replacing the furnace closure 41.

In one side wall of the accumulator 22 I provide a pouring opening or throat 52 which extends through the inner and outer linings 21 and 20, and terminates in communication with a pouring spout 53 welded or otherwise suitably secured to the wall 2 of the furnace shell. The opening 52 is in the form of a passageway, the inner extremity of which is in line with the floor of the accumulator 22, the passageway preferably being inclined upwardly to the point where it merges

with the spout 53. It will be noted that the pouring opening 52 is on the same side of the furnace as the melting ledge 33 and on the opposite side of the stack from the impact ledge 27, as and for the purpose hereinafter set forth.

Returning to Figures 1 to 4, it will be seen that the furnace is mounted on a supporting structure comprising a pair of vertical standards 54, which in this particular embodiment of the invention, are respectively provided with aligned bearings 55 and 56, adapted to tiltably support the furnace in an elevated position. The bearing 55 at one end of the furnace rotatably embraces a supporting sleeve 57 formed on the projecting end of a burner nozzle 58 which extends through the opening 23 in the furnace wall and linings, said sleeve 57 being provided with a flange 59 by means of which it is secured to the furnace wall. The opposite end of the sleeve 57 is connected to the discharge conduit 60 of the burner blower 61 which is rigidly supported on the adjacent supporting structure 54, the connection between the sleeve 57 and the conduit 60 being such as to permit relative rotation of the sleeve when the furnace is tilted. Preferably the burner opening and the burner nozzle 58 are downwardly directed into the adjacent upwardly curved end of the accumulator 22, as will be seen from Figure 5, to facilitate the proper functioning of the burner.

The burner shown in the drawings is designed for use with either liquid or gas fuel or a combination of the two, and consists of the burner nozzle 58, the discharge end of which is restricted by an internal annular shoulder 63 disposed at a 45° angle with respect to the axis of the nozzle. A hollow cylinder 69 is arranged concentrically within the nozzle and spaced inwardly to form with the shoulder 63, an annular restricted throat 70, and fuel is introduced to the cylinder by means of an inlet pipe 71. Thus, the combustible mixture ejected from the cylinder is acted upon by air passing through the annulus 70.

Opposite the burner end, the bearing 56 rotatably embraces a journal 62, fixed to the adjacent end wall 4 of the furnace shell and carrying at its outer end a segmental gear 63 which is adapted to mesh with a worm gear 64 for controlling the tilting of the furnace. The worm gear 64 is carried by a transverse shaft 65, rotatably mounted in bearings 66, carried by the upright support 54 and its outer end is provided with an operating hand wheel 67, whereby the furnace may be tilted in either direction.

While I have shown and described this particular mounting arrangement for tilting the furnace, it will be understood that I do not intend to confine myself to this structure, for obviously various mounting means may be employed without affecting the operation of the particular design of furnace described. Furthermore, the same general structure of furnace may employ a pair or a number of laterally spaced burners instead of the single, centrally disposed burner above described.

In preparing the furnace for use, care should be taken to insure the proper fit and engagement of the furnace closure 41, over the top of the accumulator 22 and the closure is preferably sealed by the use of a refractory cement of high fusion point, so as to avoid leakage of gases from the accumulator and the resultant loss of heat.

The blower is first run for a sufficient time to be sure there is no gas in the lines or the furnace and then the burner is lighted in the usual manner. After the lining is completely dried out, the furnace is charged through the stack opening 40, the ingots dropping on to the impact ledge 27 which absorbs the impact of the pieces of metal to be melted and retards their descent.

As the operation progresses the ledge 27 cooperates with the underlying melting ledge 33, to build up in the stack, a bed of metal through which the hot gases from the furnace flow on their way to discharge through the restricted opening 40 in the top of the stack. This arrangement of ledges defines in the stack, an upper preheating zone and a lower melting zone, the latter communicating directly with the highly heated accumulating trough 22 in the furnace proper.

The upflowing gases preheat or soak the upper layers of the incoming charge and the heat progressively increases towards the lower end of the stack until the area immediately above the melting ledge 33 has reached a melting temperature. During the melting operation the furnace is intermittently tilted from side to side by means of the hand wheel 67, or automatic hydraulic piston means which cause a progressive controlled feed through the stack and likewise the progressive heating of the charge by the counter flow of the flue gases.

When the furnace and stack are tilted in counterclockwise direction (Figure 7), during the intermittent oscillation of the furnace or during the pouring operation, the freshly melted metal is retained by the melting ledge 33 due to its angle of inclination, and is thus prevented from flowing into the accumulated superheated molten metal in the furnace proper. This avoids chilling of the superheated metal being poured through the spout 53. Simultaneous oscillation of the furnace and stack causes the charge to descend from ledge to ledge because of the alternate angles of inclination of the oppositely disposed ledges 27 and 33. Tilting of the furnace in a clockwise direction permits the freshly melted metal to flow from the melting ledge 33 into the accumulator and at the same time prevents the freshly charged ingots from dropping directly into the accumulating trough 22.

It will thus be seen that with this stack arrangement, I provide a melting zone at one point and an accumulator zone for molten metal in another superheated area, the latter being maintained at the proper pouring temperature and free from chilling by the introduction of freshly melted metal during the pouring operation.

The advantages of my improved furnace from the standpoint of simplicity in initial construction and maintenance, will be apparent from the drawings. The closure 15 which is preferably lined with fire brick slabs rather than individual bricks, affords ready access to the stack and this is also true with respect to the closure structure for the top of the furnace proper. Both of these closures are easily removed when it is necessary to determine the condition of the furnace and its need of repair. These elongated slabs require a minimum of additional structural support and also reduce to a large extent the necessity of sealing between individual bricks at these points.

From the foregoing it is believed that my invention may be readily understood by those skilled in the art without further description, it being borne in mind that numerous changes may be made in the details disclosed, without departing from the spirit of the invention. For example, while I have illustrated a gas burner for use in connection with the furnace, it will be understood

that any suitable type of fuel may be employed with equal effect.

I claim:

1. An oscillatory, direct-fired, melting furnace comprising a furnace proper, lined with refractory material, a fuel burner directed through one end wall of said furnace, a vertical loading stack, lined with refractory material, at the opposite end of the furnace, a flue-opening from the furnace proper to the bottom of the stack, a horizontal melting ledge adjacent the lower extremity of said stack and having its free edge spaced from the opposite wall of the stack, to form a restricted passageway, at least one oppositely disposed horizontal impact ledge, vertically spaced above said melting ledge with its free edge spaced from the opposite wall of said stack and overlying the corresponding edge of the melting ledge, to form a second restricted passageway, a pouring spout in the side wall of the furnace adjacent the melting ledge and means for jointly oscillating said furnace and stack on a horizontal axis parallel with the free edges of the planes of said ledges, to alternately tilt said ledges to charge-retaining and charge-releasing angles of inclination.

2. A melting furnace as claimed in claim 1, including a closure for the top of said stack and a restricted opening in said closure.

3. A melting furnace as claimed in claim 1, including a closure for the top of said stack and a restricted opening in said closing, said restricted opening being located directly above said impact ledge.

4. A melting furnace as claimed in claim 1, wherein said ledges are formed of fire brick, anchored in the adjacent linings of the stack.

5. A melting furnace as claimed in claim 1, including a vertical baffle depending into said flue opening on the under side of the melting ledge, to form in said flue opening, a restricted throat.

6. An oscillatory, direct-fired, melting furnace comprising a furnace proper having a fuel burner

at one end and including a main furnace shell having sheet metal walls, a vertical stack shell located above the end of said furnace shell opposite said burner end and including two sheet metal side walls joined by a sheet metal rear wall, said side and rear walls being contiguous with the adjacent walls of the furnace shell, means securing the stack shell to the furnace shell, a fixed refractory lining for the furnace shell and for said walls of the stack shell, a removable sheet metal closure forming a front wall of said stack shell, facing the burner end of the furnace, a refractory lining for said closure, a horizontal melting ledge adjacent the lower extremity of said stack, extending from a first side wall and having its free edge spaced from the opposite side wall of the stack, to form a restricted passageway, at least one oppositely disposed horizontal impact ledge, extending from the opposite side wall and vertically spaced above said melting ledge with its free edge spaced from the first wall of said stack and overlying the corresponding edge of the melting ledge, to form a second restricted passageway, a removable refractory closure for the top of the furnace, a pouring opening in the side wall of the furnace adjacent the melting ledge and means for jointly oscillating the furnace and stack about a horizontal axis extending parallel with the free edges of the planes of said ledges.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,470,728	Sklenar	May 17, 1949
2,510,352	Sklenar	June 6, 1950

FOREIGN PATENTS

Number	Country	Date
148,540	Switzerland	Oct. 6, 1931
258,202	Germany	Apr. 1, 1913