Dec. 7, 1948. J. L. STROMAN 2,455,531

METAL FURNACE

Filed Oct. 6, 1944 4 Sheets-Sheet 1

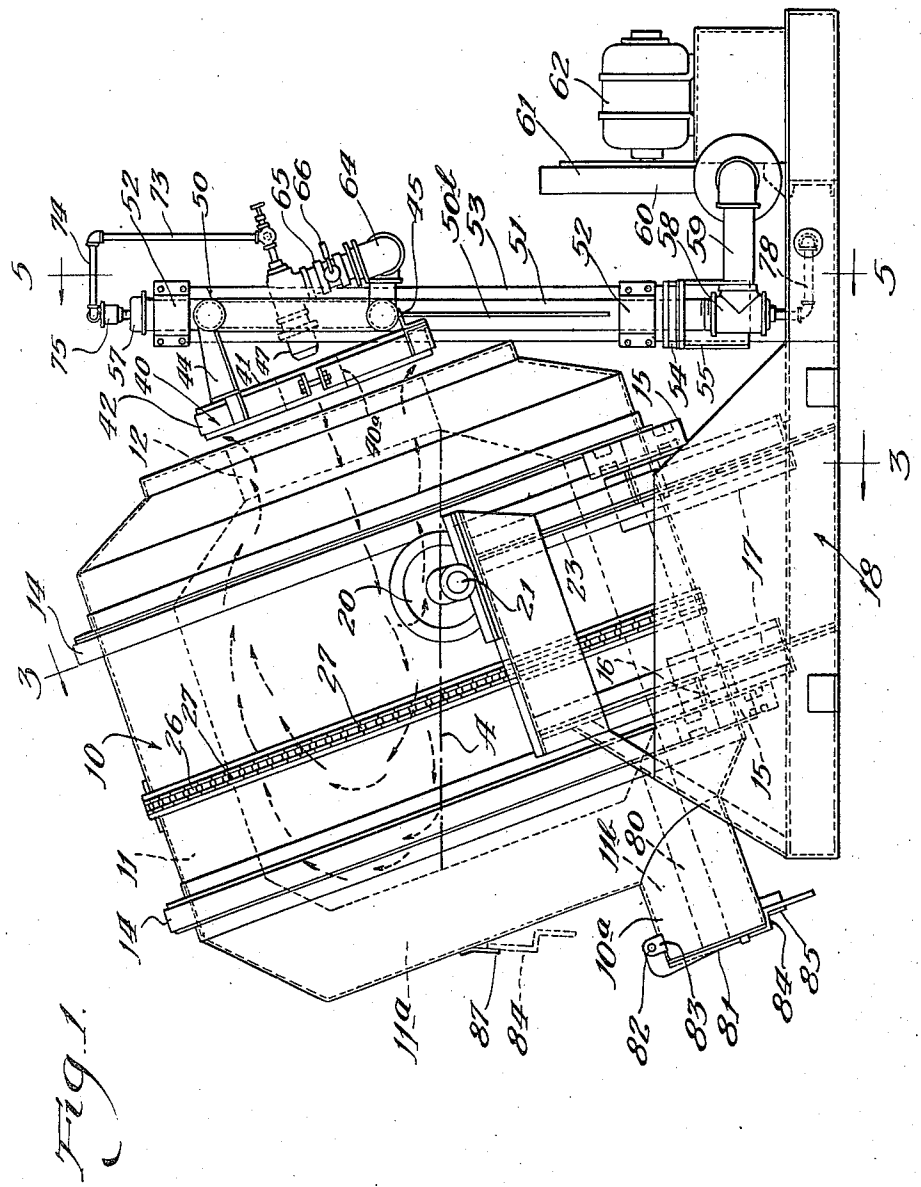


Fig. 1.

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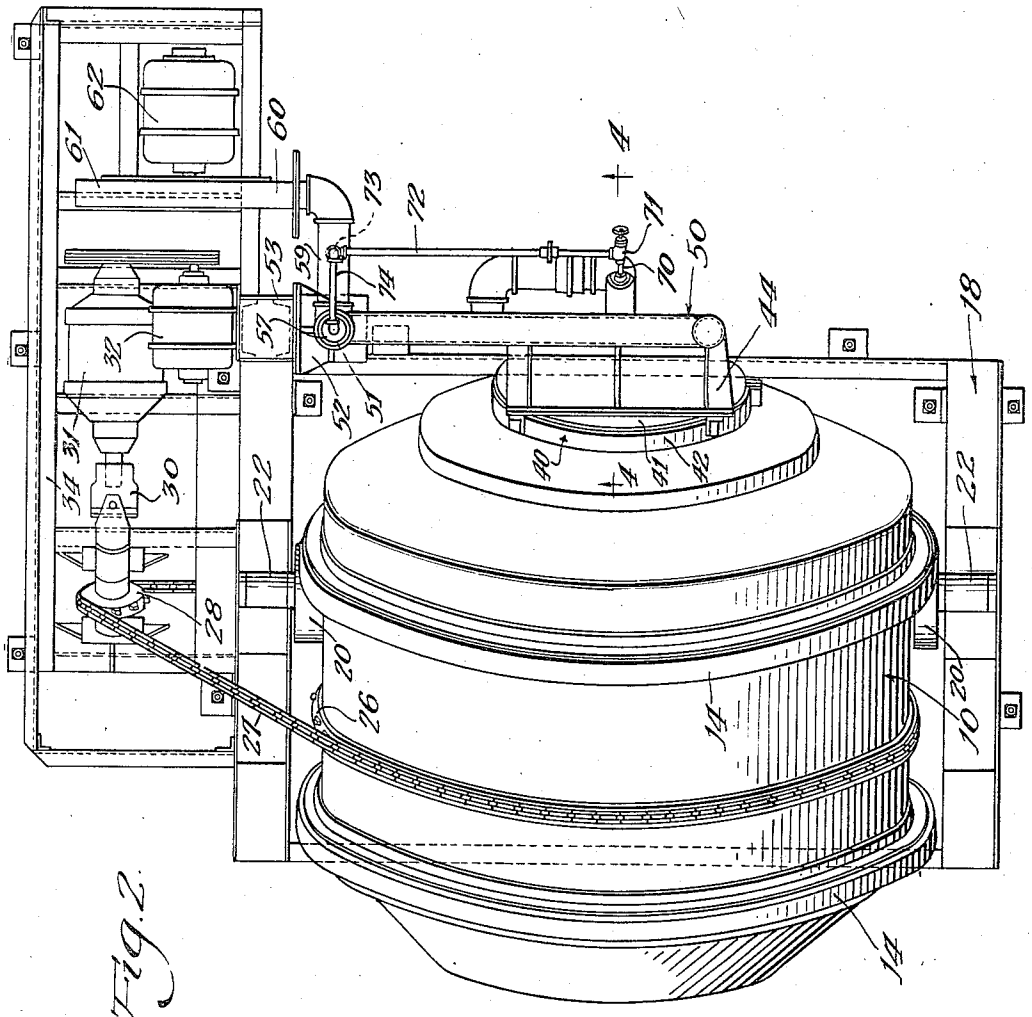


Fig. 2.

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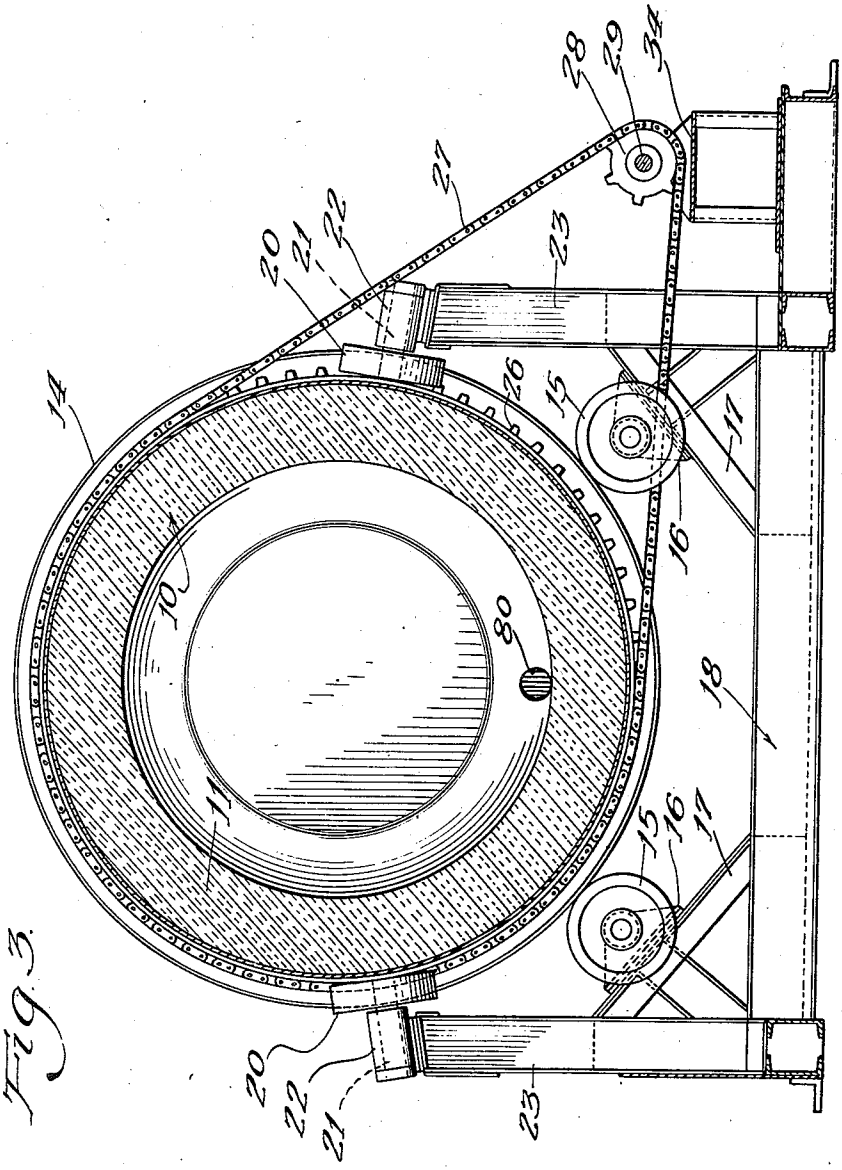


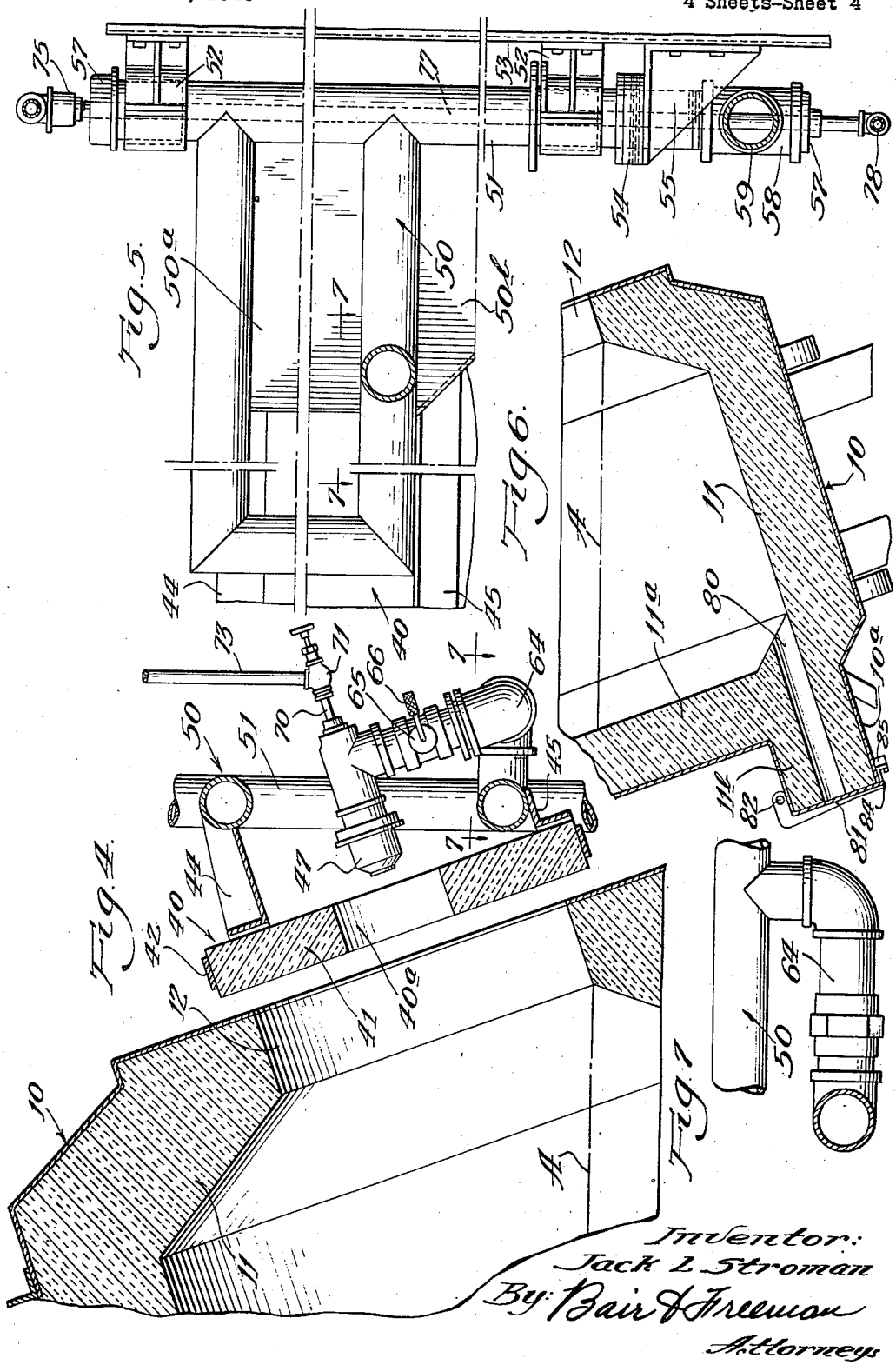
Fig. 3.

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METAL FURNACE

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METAL FURNACE

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3 Claims. (Cl. 266—33)

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This invention relates to metal melting furnaces, and more particularly to furnaces of the type having a rotary melting chamber.

Furnaces of this general type are usually provided with a melting chamber or drum, mounted for rotation about a substantially horizontal axis, and having a charging and firing port opening at one end, and an exhaust port at the opposite end. By reason of such a construction the quantity of metal which may be handled at one time in the chamber is limited, because the level of the molten metal cannot be higher than the bottom of either port opening. Furthermore, in furnaces of this general type the molten metal never contacts the central area around the exhaust end of the chamber which results in an accumulation of slag and freezing of the metal on and around said central area. By providing for firing of the chamber endwise therethrough, with the provision of an exhaust port opening opposite the firing port opening, there results substantially oxidization of certain metals together with the attendant loss of metal.

One of the objects of this invention is to provide an improved furnace construction which obviates the foregoing limitations and difficulties.

Another object is to provide an improved furnace construction, characterized by the provision of a rotary melting chamber disposed with its axis of rotation inclined to horizontal, and having its lower end normally closed, and the upper end provided with a port opening to serve for charging and firing of the chamber, and also for exhausting the gases from the chamber, while obtaining a maximum molten melting capacity for a chamber of given dimensions.

A further object is to provide an improved furnace construction, characterized by the provision of a rotary metal melting chamber disposed with its axis inclined to horizontal so that its entire lower end wall and lateral wall are continuously brought into contact with the molten metal while the chamber is rotated.

Still another object is to provide an improved furnace construction which permits safe, accurate and efficient discharge of the molten metal from the end of the chamber opposite the firing end.

A still further object is to provide an improved furnace construction wherein the rotary melting chamber is provided at one end with a single port opening to serve as the charging opening, and a movable door is adapted to be adjusted in spaced apart relation to and in registration with said port, and arranged to permit fuel to be injected into the chamber for firing said chamber, and

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wherein the spaced relation of the door provides a passageway through which the gases are exhausted from the chamber.

Other objects and advantages of this invention will be apparent from the following description taken in connection with the accompanying drawings in which—

Figure 1 is a side elevational view of the improved furnace embodying the present invention.

Figure 2 is a plan view thereof.

Figure 3 is a transverse sectional view through the furnace, taken substantially as indicated at line 3—3 on Figure 1.

Figure 4 is an enlarged fragmentary axial section through the upper end of the furnace, taken substantially as indicated at line 4—4 on Figure 2.

Figure 5 is an enlarged fragmentary view, taken substantially as indicated at line 5—5 on Figure 1.

Figure 6 is a fragmentary sectional view through the lower portion of the chamber showing the relation of the discharge outlet to the lateral wall of the chamber.

Figure 7 is a fragmentary sectional view, taken substantially as indicated at line 7—7 on Figure 5.

The furnace embodying the present invention and as illustrated in the drawings, includes a rotary melting chamber or drum 10, of substantially circular cross section, having a refractory lining or inner wall as indicated at 11. In the construction as illustrated, the chamber is disposed with its axis inclined to horizontal and having a fully closed rear end wall, 11*a*. The opposite or upper end of the chamber is formed to provide a centrally located circular port opening 12.

Surrounding the chamber are a pair of axially spaced apart annular tires or tracks, 14. Each of the tires seat upon a pair of transversely spaced apart rollers 15, as seen in Figure 3, journal supported in bearing brackets 16 which in turn are mounted on structural frame members 17, forming a part of the main frame structure 18, which is of generally rectangular form, built up of structural elements including channels, angle irons and gusset plates. The sets of rollers 15 cooperating with each of the tires 14, form a cradle for the chamber 10, and provide anti-friction support for the chamber so that the latter may be rotated about its inclined axis.

To maintain the chamber 10 in proper position with its axis inclined to horizontal and in supported relation on the rollers 15, I provide a pair of thrust rollers 20, at opposite sides of the chamber, with the tread of the rollers positioned in

engagement with under or rear face of the uppermost tire **14**, as clearly seen in Figures 1 and 3 of the drawings. The rollers **20** are mounted on stub shafts **21**, journaled in bearings **22**, which in turn are mounted on the upper ends of upright structural framing as indicated at **23**, rigidly connected to the main frame **18**.

Surrounding the chamber **10**, intermediate the tires or tracks **14**, is an annular sprocket ring **26**, engaged by a drive chain **27**, which chain is also trained around a drive sprocket wheel **28**, mounted on a shaft **29**, which in turn is connected by a universal coupler **30**, to one end of a speed reducer **31**, and the latter being driven by an electric motor **32**. The drive mechanism described is mounted on an auxiliary frame structure **34**, rigidly connected to and forming an extension of the main frame **18**.

It is to be understood that the drive for the chamber **10** is such as to result in relatively slow rotation of the chamber and suitable controls (not shown) may be provided for causing fine control of rotation of the chamber in small angular amounts for purposes as will hereinafter be described.

Due to this position of the chamber with its axis at an inclination to horizontal, it is now possible to greatly increase the molten metal capacity of a chamber of given dimensions as compared with rotary chamber furnaces heretofore available. As may be clearly seen in Figure 1 of the drawings, the horizontal level of the molten metal, as represented at A, commences from the inner end of the neck of the port opening **12**, and the opposite end of the level of the molten metal contacts the lower end wall **11***a*, of the chamber a substantial distance above the axis or center thereof. In conventional rotary chamber furnaces, the depth of the molten metal is limited to the distance between the inner end of the neck of the port opening and the lateral wall of the chamber. In addition to increased capacity, there is the further advantage that as the chamber rotates, the entire inner surface of the chamber, is continuously brought into contact with the molten metal. By virtue of this construction the entire area of the closed lower end wall **11***a* of the chamber is subjected to contact with the molten metal and reduces slag accumulation and prevents freezing of metal to the lining of the rear end wall of the chamber, as occurs in furnaces heretofore available. By virtue of this construction slag accumulation may be quickly and easily removed through the port opening, **12**. Due to the inclination of the axis of the rotary chamber the possibility of the molten metal splashing out of the charging port opening is greatly reduced as compared with conventional constructions, wherein the lower side of the neck or wall portion of the port opening is substantially in registration with or slightly above the level of molten metal in the chamber.

The port opening **12**, serves three major functions, namely, (1) to provide an opening for charging the interior of the chamber with metal to be melted; (2) to provide an opening through which fuel is injected for firing of the chamber for melting the metal therein; and (3) to provide for egress or exhaust of gases generated in the chamber.

Disposed in spaced apart relation to the upper end of the chamber **10**, in registration with the port opening **12**, is a door **40**, composed of an annular panel of refractory material as indicated at **41**, surrounded by a metal band **42**, connected to vertically spaced apart rearwardly extending brackets **44** and **45** at upper and lower ends respectively. The door **40** is mounted to swing about a vertical axis, and is adapted to always move in parallel relation to the upper end of the chamber **10**, so that when the door is in a closed position it is disposed in a desired spaced apart relation to the upper end of the chamber **10** to constitute an annular opening for discharge of the exhaust gases from the interior of the chamber, as may be seen in Figure 1. When the door is swung about its vertical axis to an open position, it is disposed entirely clear and away from the upper end of the chamber, at one side of the opening **12**, so as to permit maximum convenience in charging the chamber or for the removal of slag from the molten metal therein.

Rigidly mounted in fixed relation to the door **40** is a forced feed fuel supply apparatus, including a discharge nozzle **47**, disposed in registration with a central opening **40***a*, provided in the door **40**. Any suitable fuel may be used such as gas or liquid fuel properly admixed with a source of forced air, and injected through the opening **40***a* in the door, and ignited within the chamber. When the burner is operating the flames produced by the fuel are directed substantially centrally into the chamber with some of the currents or portions of the flame directly contacting the upper surface of the metal, and with other portions of the flames traveling into contact with the exposed lower end and lateral wall portion of the refractory lining of the chamber, as indicated by the dotted arrows in Figure 1 of the drawings. The exhaust gases generated within the chamber are caused to discharge, as indicated by the dotted arrows in Figure 1 in the drawings, by flowing through the outer marginal portion of the port opening **12** and discharging through the space between the upper end of the chamber and the door **40**. By virtue of this arrangement of firing of the chamber **10**, the slag accumulation is materially reduced, and a substantial improvement in converting the metal to a desired molten condition is effected by the head end discharge of the exhaust gases in a manner as indicated. As the fuel is fed into the chamber it is preheated by the exhaust gas and serves to increase the temperature adjacent the burner nozzle, thus obtaining greater efficiency of the fuel consumed. Furthermore, by this arrangement the cold mixture of fuel connot directly impinge upon the top surface of the molten metal. This results in avoiding chill of the metal and tends to eliminate or reduce oxidization of the metal, depending on the metals being melted. The elimination or reduction of oxidization of various metals will result in a reduction of metal loss which attends oxidization. By the slow rotation of the chamber the hot exposed lining of the chamber is continuously moved beneath the metal so that the metal is subjected to high heat from all directions, resulting in burning up fusible impurities.

Rigidly connected to the brackets **44** and **45**, which in turn are connected to the door proper is a rectangular frame **50**, formed of pipe, directly connected to and communicating with a vertical pipe **51**, which in turn is journaled in vertically spaced apart bearings **52**, rigidly bolted to an upright structural post **53**. The two horizontal pipe members of the rectangular frame are rigidly connected together by a sheet metal

plate 50*a*, welded thereto and reinforced at the under side by a brace member 50*b*, in the form of a plate, welded at its upper edge to the lower horizontal member of the frame 50, and with its vertical edge welded to the pipe 51. A thrust bearing 54 is mounted around the pipe 51, and seated on a bracket 55, also bolted to the post 53. The upper end of the pipe 51 is sealed and closed by a cap 57, and the lower end of said pipe is closed by a plug 57. A fitting 58, at the lower end of the pipe 51, is connected to a horizontal pipe 59, which communicates with a blower chamber 60, of a blower 61, driven by an electric motor 62. Opening off of the lower horizontal pipe member of the pipe frame 50, as seen in Figures 4 and 5, are piping connections, as indicated at 64, which are connected into the burner nozzle 47, in a manner well understood in the art. It is to be understood that the nozzle construction is such as to provide for suitable admixture of the forced air with the fuel incident to its discharge from the nozzle.

The forced air supply supplied to the nozzle may be controlled by a valve 65, operated by a handle 66. The forced air supplied by the blower 61 is fed through the vertical pipe 51, into either or both of the horizontal sections of the pipe frame 50, and thence into the pipe connections, 64 to the nozzle.

Extending rearwardly from the nozzle 47 is a fuel supply system including a pipe 70, connected at its outer end to a valve 71, which in turn is connected to a pipe 72, extending horizontally and connected into a vertical upwardly extending pipe 73, the upper end of which is connected to another horizontal section of pipe 74. The opposite end of the pipe 74 is connected to a fitting 75 which extends down through the cap member 57, and is connected to a fuel supply pipe 77, extends downwardly through the pipe 51, and through the plug 57 at the lower end of said pipe, as clearly seen in Figure 5 of the drawings. The end of the fuel supply pipe 77, projecting downwardly below the pipe member 51, is connected to a pipe 78, which in turn is connected to a source of fuel supply. In the construction as shown, it is to be understood that the fuel supply pipe is stationary and the forced air supply pipe 51 is rotatable with the door 40. To permit such rotation it is to be understood that the pipe 51 is rotatable a portion of a revolution at its threaded connection to the pipe fitting 58, while the fuel supply pipes swivel at their connection of the fitting 75 to the pipe 77. The latter connection may be a conventional connection commonly employed for permitting swiveling of the connected parts without leakage of the contained fluid.

By virtue of the construction described, the door 40 together with the fuel nozzle and pipe connections associated therewith, may be conveniently swung to and from operative relation with respect to the port opening 12, of the rotary chamber. Because the door is totally independent of the chamber, it is not interfered with in any manner as a result of the rotation of the chamber 10.

The rear end of the chamber 10 is provided with a discharge duct or tapping port 80, disposed in alignment with the lateral wall of the refractory lining 11, of the chamber, as seen in Figures 1 and 6, so as to insure complete drainage of all the metal in the chamber. The outer end of the duct is surrounded by a boss form of projection, 10*a* including a refractory lining 11*b*, extending rearwardly from the rear end of

the chamber. The outer end of the discharge duct is adapted to be closed by a door 81, hinged at 82 on a bracket 83. The door includes a resilient hand grip member 84, the extending end portion of which is adapted to be latched in closed position behind a lug 85. In open position of the door 81 the hand piece 84 is adapted to be latched behind a catch member 87, secured to the intermediate portion of the outer surface of the outer end wall of the chamber, as clearly seen in Figure 1 of the drawings. If desired the door 81 may be dispensed with and the discharge duct 80 temporarily plugged with suitable material such as clay, or if desired, the discharge duct may be temporarily plugged with clay or other suitable material while also utilizing the door 81.

When the metal in the chamber 10 arrives at a proper molten condition, the chamber is retarded so as to arrest the same with the discharge opening 80, disposed slightly above the level A of the molten metal. The chamber may then be gradually rotated to bring the discharge opening 80 into registration with the molten metal for accurately controlling the flow of metal therethrough into a suitable ladle (not shown). As the level of the molten metal is reduced in the chamber 10 the chamber is rotated so as to maintain registry of the discharge duct 80 with the upper liquid level of the molten metal. After the molten metal is substantially discharged in its entirety the discharge duct 80, finally assumes the position as seen in Figure 1 of the drawings, so that complete discharge of the molten metal from the chamber is effected, by reason of the downwardly sloping relation of the lateral wall of the chamber and said duct.

Although I have herein shown and described a certain preferred embodiment of my invention, manifestly it is capable of modification and rearrangement of parts without departing from the spirit and scope thereof. While my novel door construction is shown as a part of a novel arrangement of a furnace, it should be apparent that it would have similar advantages in a furnace construction such as represented in Figure 1 of the drawings and wherein the metal was discharged from the chamber by tilting it forwardly, causing the metal to flow through the same single port opening through which the chamber is charged, and through which fuel is injected, and from which exhaust gases are discharged. The door may also be used to great advantage with conventional furnaces wherein the chamber rotates about a horizontal axis. I do not, therefore, wish to be understood as limiting this invention to the precise embodiment herein disclosed, except as I may be so limited by the appended claims.

I claim as my invention:

1. A metal melting furnace comprising a rotatable chamber having a refractory lining, the rear-end of said chamber being closed and the forward end being provided with a centrally located port for charging and firing the chamber and serving as a passageway for exhaust gases, a door including a refractory panel mounted independently of said chamber on a vertical axis for movement toward and away from the forward end of the chamber, said panel having a central opening adapted to register with said port, fluid fuel feeding apparatus mounted on said door and including a nozzle disposed in registration with said opening, said mounting for the door being correlated to the end of the chamber whereby said panel may be disposed in closed position in

a predetermined spaced apart relation to the forward end of the chamber to provide a passageway for exhaust gases discharging through the outer morginal portions of said port, means for guiding and supporting the chamber during rotation, and means for rotating said chamber.

2. A metal melting furnace comprising a rotatable chamber disposed with its axis inclined to horizontal and provided with a refractory lining, the rear end of said chamber being closed and the forward end being provided with a centrally located port for charging and firing the chamber and serving as a passageway for exhaust gases, a door including a refractory panel mounted independently of said chamber on a vertical axis for movement toward and away from the forward end of the chamber, said panel having a central opening adapted to register with said port, fluid fuel feeding apparatus mounted on said door and including a nozzle disposed in registration with said opening, said door and mounting being correlated to the end of the chamber whereby said panel may be disposed in closed position in a predetermined spaced apart substantially parallel relation to the forward end of the chamber to provide a passage way for exhaust gases discharging through the outer marginal portions of said port, means for guiding and supporting the chamber during rotation, and means for rotating said chamber.

3. A metal melting furnace comprising a rotatable chamber disposed with its axis inclined to horizontal and provided with a refractory lining, the rear end of said chamber being closed and the forward end being provided with a centrally located port for charging and firing the chamber and serving as a passageway for exhaust gases, a door including a refractory panel

mounted independently of said chamber on a vertical axis for movement toward and away from the forward end of the chamber, said panel having a central opening adapted to register with said port, fluid fuel feeding apparatus mounted on said door and including a nozzle disposed in registration with said opening, in substantial alignment with the axis of the chamber, said door and mounting being correlated to the end of the chamber whereby said panel may be disposed in closed position in a predetermined spaced apart substantially parallel relation to the forward end of the chamber to provide a passageway for exhaust gases discharging through the outer marginal portions of said port, the angle of inclination of said chamber being sufficiently great to insure that the upper level of molten metal in the chamber will initially be above the center of rotation of the rear end of the chamber, means for guiding and supporting the chamber during rotation, and means for rotating said chamber.

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