No. 847,869. PATENTED MAR. 19, 1907

E. F. WHITE.

SULFUR SMELTING APPARATUS.

APPLICATION FILED JULY 11, 1906.

3 SHEETS—SHEET 1.

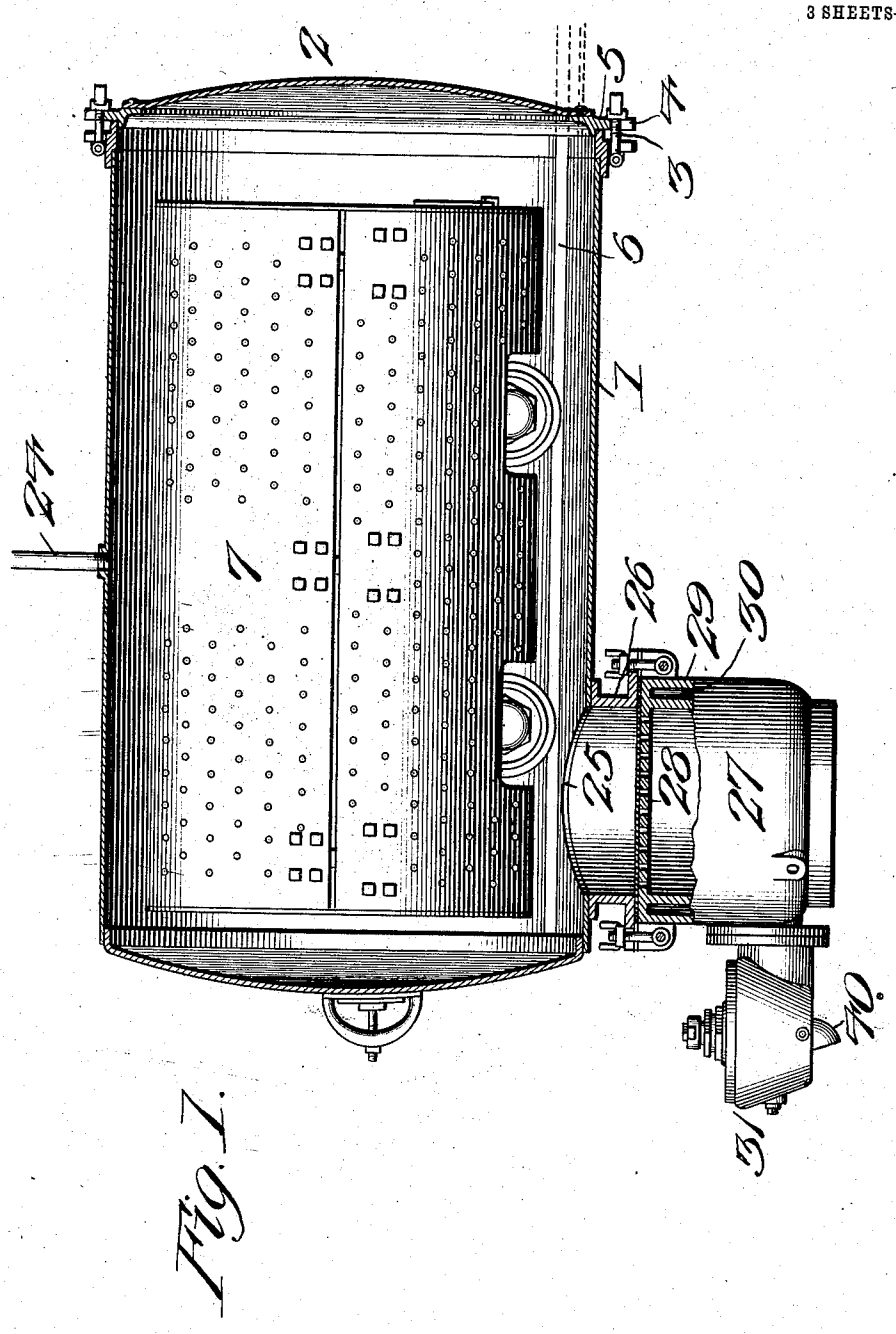


Fig. 1.

Witnesses

Louis R. Heinrichs

Wm. J. Koerth

Inventor

E. F. White,

By Victor J. Evans

Attorney

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3 SHEETS—SHEET 2.

Fig. 2.

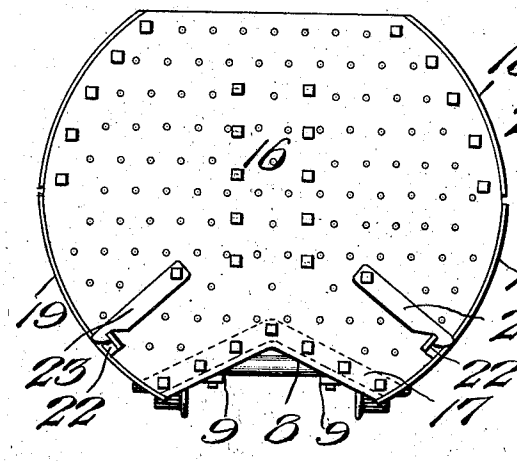


Fig. 3.

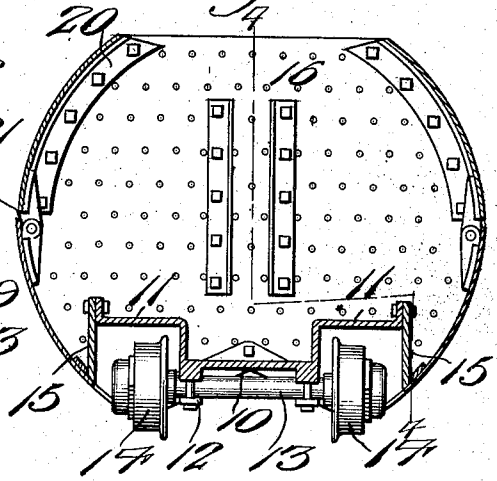
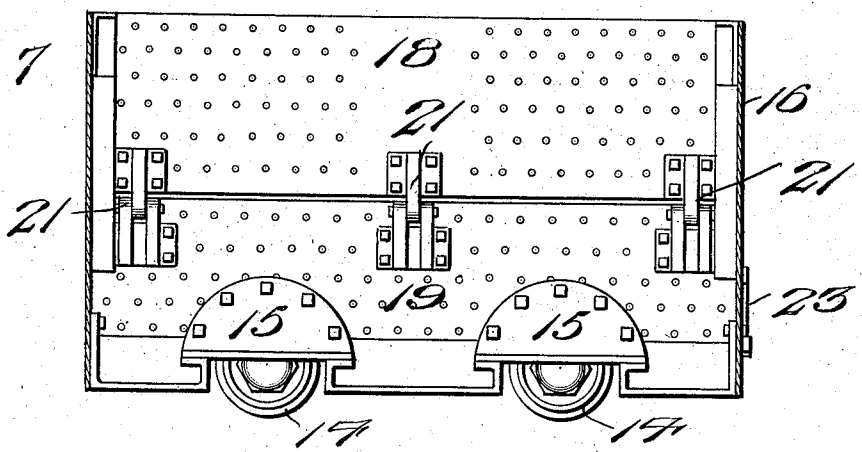


Fig. 7.



Witnesses

Louis R. Kuenzel

Wm. J. Nossett.

Inventor

E. F. White,

By Victor J. Evans

Attorney

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E. F. WHITE.

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3 SHEETS—SHEET 3.

Fig. 5.

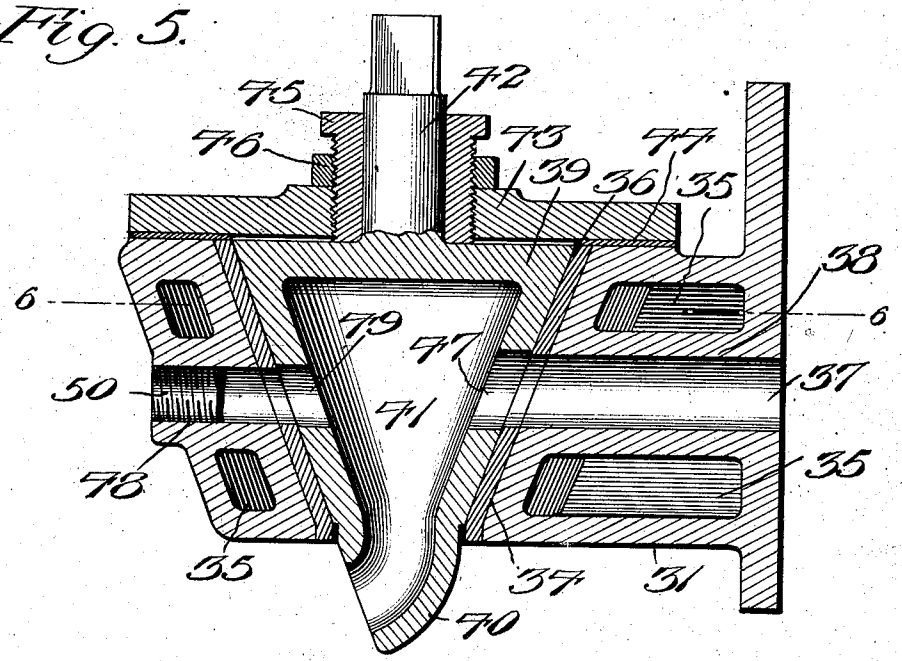
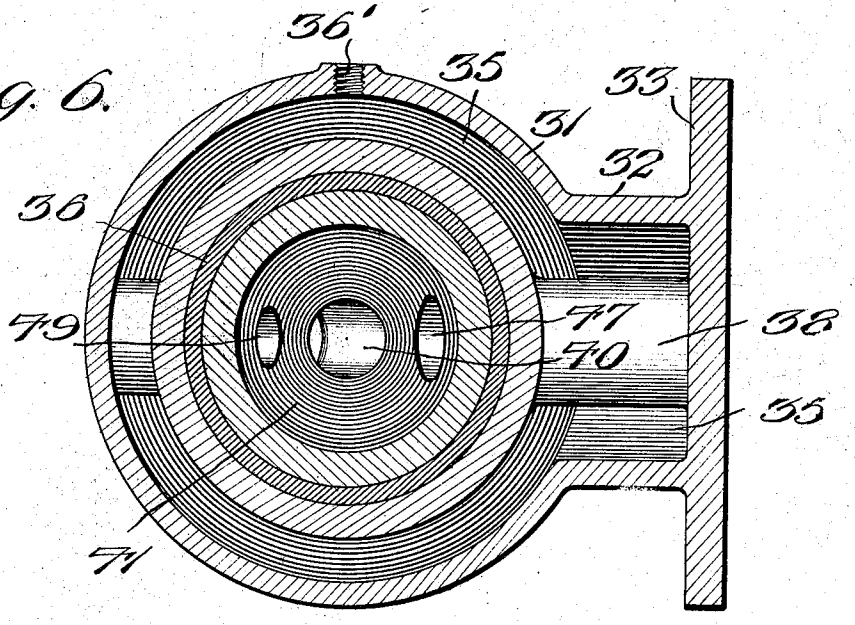


Fig. 6.



Witnesses

Louis R. Heinrichs

Wm. J. Korth.

Inventor

E. F. White

By Victor J. Evans

Attorney

UNITED STATES PATENT OFFICE.

EDWARD F. WHITE, OF EASTON, PENNSYLVANIA.

SULFUR-SMELTING APPARATUS.

No. 847,869. Specification of Letters Patent. Patented March 19, 1907.

Application filed July 11, 1906. Serial No. 325,622.

To all whom it may concern:

Be it known that I, EDWARD F. WHITE, a citizen of the United States, residing at Easton, in the county of Northampton and State of Pennsylvania, have invented new and useful Improvements in Sulfur-Smelting Apparatus, of which the following is a specification.

The invention relates to an improvement in ore-smelting apparatus, primarily designed for smelting sulfur ore.

The main object of the invention is the production of an apparatus constructed and arranged to permit the utilization of the maximum available space within the smelting-cylinder as an ore-space, whereby to increase the product of the apparatus in a given time, minimize the necessary steam consumption, and materially reduce the cost of the smelting operation.

Another object of the present invention is the production of an ore-charging car which is particularly constructed to provide for its maximum life and efficiency as a sulfur-ore carrier, the construction of the car providing for the ready smelting of the ore while within the car and for the automatic discharge of the refuse ore after smelting.

Another object of the invention is the provision of a tap-valve manually controlled for communication with the sump and so constructed as to provide for a continuous and even discharge of the sulfur, the valve being particularly designed to continuously subject the sulfur to the action of heat, whereby to cause the discharge of the sulfur in a liquid condition to avoid the usual solidification incident to the effect of the atmosphere upon the sulfur.

With the above and other objects in view the invention consists in certain details of construction and combinations of parts, which will be fully described in the following specification, reference being had particularly to the accompanying drawings, in which—

Figure 1 is a view in section, partly in elevation, of an ore-smelter constructed in accordance with my invention. Fig. 2 is an end elevation of the ore-charging car; Fig. 3, a transverse section of the same; Fig. 4, a longitudinal section on the line 4 4 of Fig. 3. Fig. 5 is a longitudinal section of the improved tap-valve; and Fig. 6 is a transverse horizontal section of the same, taken on the line 6 6 of Fig. 5.

In the drawings, 1 represents the usual smelting-cylinder, having a removable head or cover 2, which is arranged to be secured in place in a steam-tight manner through the medium of swiveled bolts 3, engaging notches 4, formed in the usual flange extension 5 of the head. The smelting-cylinder is preferably cylindrical in cross-section and is provided in its relatively lower portion with spaced tracks 6 to permit the necessary movements of the ore-charging car 7.

So far as essential for the purposes of the present invention the smelting-cylinder may be of any usual or preferred construction, the form shown in the drawings being the ordinary form and being intended to represent any desired type of cylinder.

The car 7 for use with the smelting-cylinder is sectionally constructed, comprising a perforated cast-iron bottom 8, centrally and longitudinally hipped to provide inclined sections 9, extending from the longitudinal center of the bottom to the side edges. At appropriate distances from the respective ends the bottom is shaped to provide a transversely-disposed section 10 and raised end sections 11, all of said sections being formed by bending the material of the bottom or proper casting as may be necessary. The central section 10 is on a plane with the highest point of the bottom and provides a support for hangers 12, in which is mounted an axle. The sections 11 of the bottom are rounded in longitudinal section and form housings for the wheels 14, secured upon the ends of the axle 13. The relatively free end of the housings 11 terminate within the plane of the bottom, the open ends thereof beyond the wheels being closed by half-round cover-plates 15, the lower edges of which are in alinement with the free edges of the bottom 8. The wheels 14 are thus completely housed against admission of the flowing sulfur during the smelting operation.

The end sections of the car, as 16, are approximately cylindrical in plan, being squared at their relatively upper edges and shaped at their relatively lower edges to fit the double incline of the bottom. The ends are secured to the bottom in any approved manner, as by the use of angle-plates 17, and said ends are preferably regularly and uniformly perforated, as shown. The sides of the car conform to the curvature of the peripheral edges of the ends, each side including a relatively fixed section 18 and a relatively moving sec-

tion or dumping-scuttle 19. The upper or fixed sections 18 extend from the upper squared portion of the ends to a point about midway their height, being secured in place by angle-iron connections 20. The movable sections are shaped to conform to the curvature of the peripheral edges of the ends and are movably supported from the fixed sections by hinges 21, comprising the usual duplicate members and secured on the inner surfaces of the respective sections. As the point of connection of the dumping-sections with the fixed sections is at the place of greatest width of the car, said sections will swing to open position by gravity, and to provide for holding the dumping-section in closed position I provide said sections with laterally-projecting ears 22 and arranged for engagement with said ears latch members 23, which are pivotally supported on the ends of the car. To avoid projection beyond the plane of the car, the ears 22 are disposed with their engaging portions within the plane of the ends, and the nose or free ends of the latches 23 terminate within the plane of the peripheral edge of the ends.

Both the fixed and dumping sections of the car are perforated for the escape of the material, the perforations of the fixed sections being omitted from the transverse central portion thereof, as shown.

As described the ore-charging car of this invention includes a perforated cast-iron bottom having a double-inclined surface, which bottom is formed to provide for supporting the axles of the wheels and to form complete housings for the wheels. The ends of the car are approximately circular in plan and are rigidly secured to the bottom, said ends in turn forming a support for the car sides. The sides of the car are each made in two sections, the upper sections being fixed with relation to the car-body and the lower section movable, the latter being arranged for hinged connection with the fixed section and so disposed as to gravitate to open position. Through the squared portion of the car ends a relatively large opening is provided to provide for charging the car, while the movement of the dumping-sections when released from the latches provides for the automatic discharge of the contents of the car when desired. The perforations in the car-body permits a free flow of the liquid sulfur, as will be evident.

The smelting-cylinder, as shown, is practically circular in cross-section, and the ore-charging car shown and described is also approximately circular in cross-section. The diameter of the car is to be but slightly less than the interior diameter of the cylinder, while the length of the car is such as to permit its complete inclosure within the cylinder, as clearly shown in Fig. 1. The wheels 14 of the car are of course designed for coöperation with the track 6 of the cylinder, said track, as is usual in ore-smelting apparatus, being a continuation of the mine-track, so that cars loaded at any appropriate point may be readily conveyed to and placed within the cylinder.

The relative sizes of the car and cylinder are such that when the car is in place within the cylinder an annular space is provided between the car and cylinder wall. The smelting agent, as steam, is admitted to the cylinder through the medium of a supply-pipe 24 and completely envelops the car, acting through its heating quality to smelt the ore in a well-known manner. As the size of the car relative to that of the cylinder is such as to leave a comparatively small annular space between the cylinder and car wall, it will be obvious that the steam consumption is reduced to a minimum, while at the same time providing for the maximum quantity of ore affected in the smelting operation. As this result by leading to the economy in steam consumption and at the same time increasing the ore capacity of the cylinder materially reduces the cost of operation of the smelter and is directly due to the shape and size of the car relative to that of the cylinder, it will be understood that the relative size and shape of the ore-charging car, as well as the detailed construction of the car, are important and material parts of the present invention.

The smelting-cylinder is formed with an outlet 25, having a depending flanged wall 26, to which wall is removably secured the usual sump or sulfur-receiver 27. The sump shown is of usual construction, having a removable perforated head-plate 28, through which the material is passed to the body of the sump. The sump illustrated acts as a direct receiver for the liquid sulfur and is jacketed at 29 to provide a space 30, surrounding the wall of the sump, for the reception of steam or other heating medium for a purpose which will later appear.

In ordinary smelting apparatus the discharge from the sump is through a tap-valve, by which the sulfur is delivered to any desired receptacle. In apparatus of this character the construction of the delivery or tap valve is of importance, it being highly desirable that the sulfur be delivered therefrom in liquid form and in even steady flow. In the smelting operation the sulfur as it leaves the smelter is surcharged with water under pressure at the temperature of the smelting agent. On contacting with the atmosphere, as in the tap-valve, the water carried by the sulfur expands into steam, with a consequent absorption of a large degree of heat. As the sulfur is of very low specific heat, the absorption due to the expansion of the contained water cools the sulfur, with the effect to cause it to solidify and flow through the valve in an atomized condition, the sulfur

under certain inherent conditions solidifying to such an extent as to entirely "choke" the valve. It is one of the prime objects of the present invention to provide a tap-valve of such construction as to prevent the cooling of the sulfur and at the same time provide for the expansion of the material, thereby insuring the discharge of the sulfur in a continuous liquid stream of even flow.

The tap-valve forming part of this invention comprises a metallic body 31 of approximately conical form in section and having a laterally-disposed neck 32, flanged at the free end, as at 33, whereby to permit the securing of the valve in proper position relative to the discharge-opening of the sump. The body 31 is formed with a centrally-disposed plug-seat 34, extending vertically through the body and opening through the respective upper and lower surfaces thereof. The wall of the seat is entire, except for the ports hereinafter referred to, and between said wall and the wall of the body proper the body is hollow, as at 35, to provide a jacket or steam-space designed to be supplied with a heating medium, as steam, through an inlet 36', as shown. The wall of the plug-seat is lined with an acid-resisting metal, as aluminium 36, this lining forming the bearing for the valve-plug, hereinafter referred to. The valve-body is formed with a transversely-arranged port 37, communicating at one end with the discharge-opening of the sump and extending through the lining 36 of the plug-seat. The port 37 extends transverse the jacket-space of the body, the latter being in the form of a pipe-section 38, joining the wall of the plug-seat and the wall of the valve-body.

Within the plug-seat, which, as before stated, is in the form of an inverted truncated cone, is arranged the valve-plug 39, said plug being a hollow cast-iron body accurately fitting to the lining of the plug-seat and provided at the lower end with a discharge-spout 40. The opening 41 within the valve-plug corresponds in shape to the exterior shape of the plug, so that the greatest area of said opening is at the upper portion of the plug. The upper surface of the plug is approximately flush with the upper surface of the valve-body, being centrally provided with a projecting stem 42, squared at the upper end for the reception of a suitable operating-tool. The plug is secured within the seat through the medium of a cover 43, formed with a central opening to permit passage of the stem 42, the cover being secured to the valve-body and held spaced from the upper surface of the plug through the medium of a layer 44 of asbestos or the like interposed between the cover and body. The wall of the central opening in the cover is threaded for the reception of a gland-nut 45, snugly fitting the stem of the valve-plug and exteriorly threaded for engagement with the threaded opening in the cover. The lower end of the gland bears upon the upper surface of the valve-plug to provide for adjusting the plug relative to the seat, a lock-nut 46 serving to secure the parts in adjusted position. The wall of the plug is formed with a port 47, designed in a certain position of the plug to aline with the port 37 in the valve-body and thereby provide an uninterrupted passage from the sump through the spout 40 of the valve. By preference the port 47 is approximately elliptical in shape to provide for the more ready control of the flow of the sulfur. The valve-body is formed with an opening 48, diametrically alining with the port 37, while the valve-plug is also formed with an opening 49, diametrically alining with the port 47. The opening 48 opens through the wall of the body and is interiorly threaded for the reception of a plug 50, as seen in Fig. 5. The arrangement of the openings 48 and 49 provides for an uninterrupted opening extending wholly through the valve-body and valve-plug for convenience in clearing or cleaning the valve.

The jacket of the valve-body, as well as that of the sump, is to be supplied with steam or other heating agent from any suitable source, both jackets in the use of steam being preferably formed with valved outlets to provide for the escape of condensation when necessary.

The operation of the improved apparatus is fully apparent from the above description, taken in connection with the accompanying drawings, it being understood that so far as the smelting and delivery of the sulfur is concerned the present invention does not differ materially in operation from the usual apparatus. In connection with the delivery of the sulfur, however, it is to be noted that the plug of the tap-valve is so formed as to provide an interior expansion-chamber and is at all times maintained in a highly-heated condition through the medium of the steam-jacket. The expansive force exerted upon the material by the flashing of the contained water and steam, as hereinabove referred to, is thus effectually provided for and the sulfur caused to flow from the discharge-spout in a continuous even stream. The heated condition of the tap-valve prevents the cooling of the sulfur by the absorption before noted, so that the sulfur flows from said valve in liquid form. The salient and important features therefore of the present invention are the ore-charging car and the tap-valve. The car is of the maximum capacity for the smelting-cylinder and is shaped similar to that of the cylinder, being relatively of slightly less size. The full effect of the smelting medium is thus gained, as said medium reaches all portions of the car to effect the ore. The relative size of the car and cyl-

inder provides for the minimum consumption of the smelting agent, all possible space other than that necessary for the passage of the smelting medium being filled with ore. The fluid sulfur readily passes through the perforations in the car-body, the detailed construction of the car preventing any of the material finding its way to the bearings of the track-wheels. The bearings are thus prevented from being "frozen in" on cooling the car, and hence a larger quantity of ore can be handled at one time with greater facility than would be otherwise possible. Furthermore, the car will automatically dump or clear itself of refuse by releasing the locking means of the dumping-section. The car is constructed wholly of metal, the connections between the respective parts being such as to provide for ready renewal or repair when desired.

The tap-valve is constructed to counteract the expansive force of the material incident to the contact thereof with the atmosphere and to further insure a sufficient heating of the material as to provide for its delivery in a liquid condition.

Both the salient features of the present invention tend to a more economic smelting of sufur than heretofore possible, both from the fact that a less degree of heating agent and a greater quantity of ore is utilized in a given time and the choking of the delivery-valve is wholly prevented.

Having thus described the invention, what is claimed as new is—

1. The combination with an ore-smelting apparatus, of a smelting-cylinder, an ore-charging car arranged for travel within the cylinder, a sump in open communication with the interior of the cylinder, and a tap-valve in communication with the sump, and means for heating the sump and tap-valve.

2. The combination with a smelting-cylinder having a sump and a tap-valve leading therefrom, and means for heating the sump and tap-valve, of an ore-charging car adapted to be inserted within the cylinder and corresponding in contour to the contour of the cylinder and of less dimensions than the interior of the cylinder.

3. The combination with a smelting-cylinder having a sump and a tap-valve leading therefrom, and means for heating the sump and tap-valve, of an ore-charging car adapted to be inserted within the cylinder and constructed of perforated sections.

4. The combination with a smelting-cylinder having a sump and a tap-valve leading therefrom, and means for heating the sump and tap-valve, of an ore-charging car adapted to be inserted within the cylinder and constructed of perforated metallic sections, the the bottom of the car being inclined from the longitudinal center toward the side edges.

5. The combination with a smelting-cylinder having a sump and a tap-valve leading therefrom, and means for heating the sump and tap-valve, of an ore-charging car adapted to be inserted within the cylinder and constructed of perforated metallic sections, a plurality of said sections being mounted for independent movement to provide dumping-sections.

6. The combination with a smelting-cylinder having a sump and a tap-valve leading therefrom, and means for heating the sump and tap-valve, of an ore-charging car adapted to be inserted within the cylinder and comprising a plurality of connected metallic sections, supporting-wheels for the car and housings partially inclosing the wheels.

7. The combination with a smelting-cylinder having a sump and a tap-valve leading from the sump, and means for heating the sump and tap-valve, of an ore-charging car comprising a plurality of connected metallic sections, and supporting-wheels connected to one of the sections, one of the car-sections being integrally formed to provide housings for the wheels.

8. The combination with a smelting-cylinder having a sump and a tap-valve leading from the sump, and means for heating the sump and tap-valve, of an ore-charging car comprising a bottom section inclined downwardly in both directions from the longitudinal center toward the side edges, end sections secured to the respective ends of the bottom section, fixed side sections secured to the end sections, and dumping-sections movably connected to the fixed side sections.

9. The combination with a smelting-cylinder having a sump and a tap-valve leading therefrom, means for heating the sump and tap-valve, of an ore-charging car comprising a bottom section inclined downwardly in both directions from the longitudinal center toward the side edges, end sections secured to the respective ends of the bottom section, fixed side sections secured to the end sections, and dumping-sections hinged to the fixed side section, said hinge connections being secured on the relatively inner surface of the respective sections.

10. The combination with a smelting-cylinder having a sump and a tap-valve leading from the sump, means for heating the sump and tap-valve, of an ore-charging car comprising a bottom section inclined downwardly in both directions from the longitudinal center toward the side edges, end sections secured to the respective ends of the bottom section, fixed side sections secured to the end sections, dumping-sections hinged to the fixed side section, said hinge connections being secured on the relatively inner surfaces of the respective sections, and means for securing the dumping-section in closed position.

11. The combination with a smelting-cylinder approximately circular in cross-section and tracks secured in the relatively lower portion of the cylinder, a sump in communication with the cylinder, a tap-valve leading from the sump, of a metallic ore-charging car constructed of perforated sections arranged for travel on the track, the sectional area of the car conforming in contour with and being of slightly less dimension than the similar area of the cylinder.

12. The combination with a smelting-cylinder, an ore-charging car adapted for insertion within the cylinder, and a sump in communication with the cylinder, of a tap-valve for the sump, said valve being formed with an expansion-chamber.

13. The combination with a smelting-cylinder, an ore-charging car adapted for insertion within the cylinder, a sump in communication with the cylinder, means for heating the sump, of a tap-valve for the sump, and means for heating the valve.

14. The combination with a smelting-cylinder, an ore-charging car adapted for insertion within the cylinder, a sump in communication with the cylinder, and means for heating the sump, of a tap-valve for the sump, said valve being formed with an expansion-chamber and with a steam-jacket.

15. The combination with a smelting-cylinder, an ore-charging car adapted for insertion within the cylinder, a sump in communication with the cylinder, and means for heating the sump, of a tap-valve for the sump integrally formed to provide an expansion-chamber above the outlet from the valve.

16. The combination with a smelting-cylinder, an ore-charging car adapted for insertion within the cylinder, a sump in communication with the cylinder, and means for heating the sump, of a tap-valve for the sump, means for heating the valve, said valve comprising a hollow inverted-cone-shaped plug having a discharge-opening at the reduced end, the inlet to the plug being formed about midway its height, whereby to provide an expansion-chamber above said inlet.

17. The combination with a smelting-cylinder, an ore-charging car adapted for movement within the cylinder, a sump in communication with the cylinder, means for heating the sump, of a tap-valve in communication with the sump, said valve comprising a valve-body formed with an inverted-cone-shaped plug-seat, a lining of acid-resisting material for said seat, a valve-plug fitting the seat, and a steam-jacket surrounding the seat.

18. The combination with a smelting-cylinder, an ore-charging car adapted for movement within the cylinder, a sump in communication with the cylinder, means for heating the sump, of a tap-valve in communication with the sump, said valve comprising a valve-body formed with an inverted-cone-shaped plug-seat, the body between the plug-seat and side wall being hollow to provide a heating-jacket, a hollow valve-plug fitting the seat, means for securing the plug in the seat, and means for adjusting the plug relative to the seat.

19. The combination with a smelting-cylinder, an ore-charging car adapted for movement within the cylinder, a sump in communication with the cylinder, means for heating the sump, of a tap-valve in communication with the sump, said valve comprising a valve-body formed with a transversely-disposed port, a cone-shaped plug-seat opening through the body, a heating-jacket surrounding the seat, a valve-plug fitting the seat, said plug being formed with openings to register with the port in the body, a cover secured to the body and overlying the plug, and a gland-nut having threaded connection with the cover and bearing upon the plug.

In testimony whereof I affix my signature in presence of two witnesses

EDWARD F. WHITE.

Witnesses:
J. S. DOWNS,
SALVATOUARN CIANFRANI.