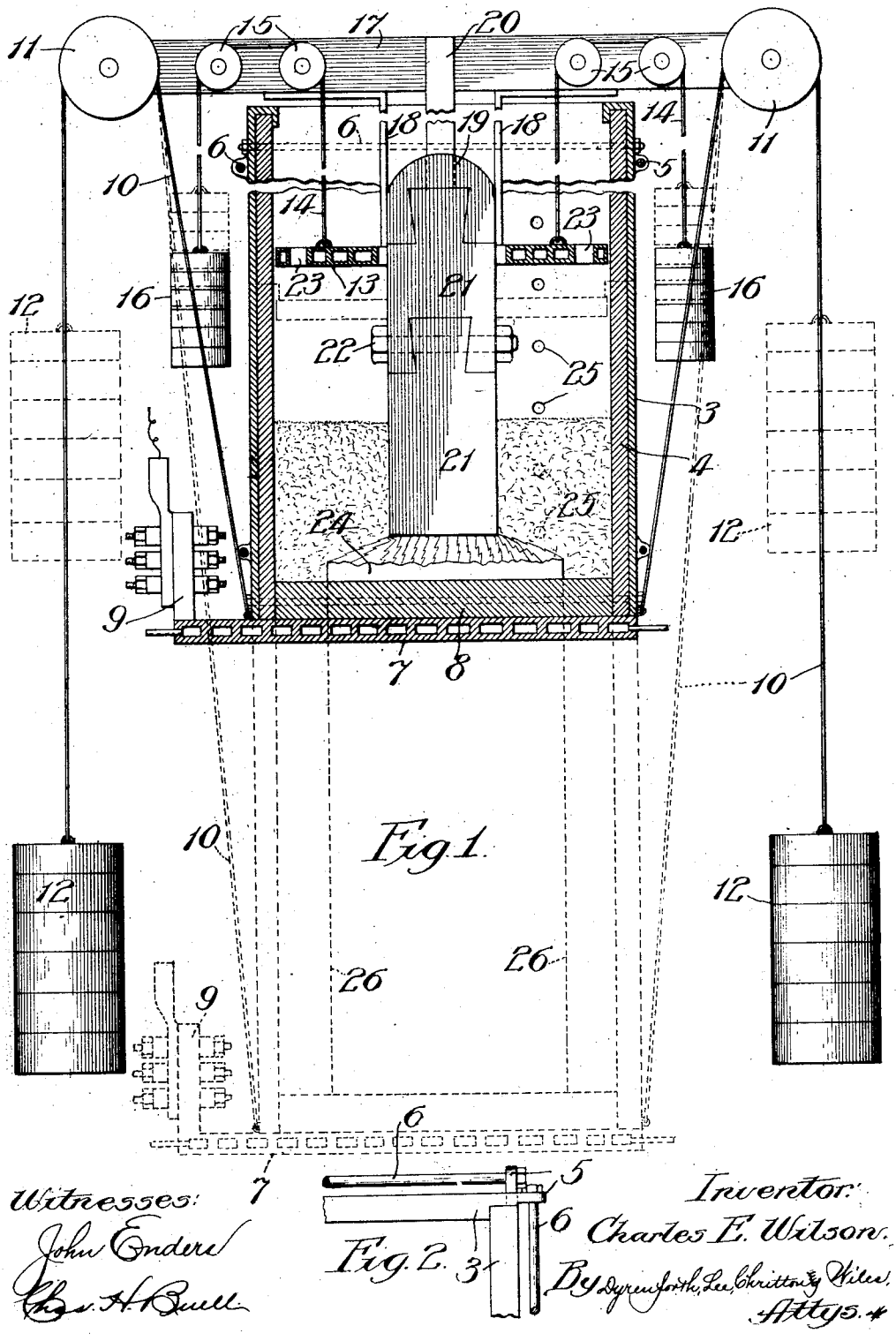
C. E. WILSON.

ELECTRIC FURNACE.

APPLICATION FILED FEB. 1, 1909.

943,290. Patented Dec. 14, 1909.



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UNITED STATES PATENT OFFICE.

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ELECTRIC FURNACE.

943,290. Specification of Letters Patent. Patented Dec. 14, 1909.

Application filed February 1, 1909. Serial No. 475,493.

To all whom it may concern:

Be it known that I, CHARLES E. WILSON, a citizen of the United States, residing at Hood River, in the county of Hood River and State of Oregon, have invented a new and useful Improvement in Electric Furnaces, of which the following is a specification.

My invention relates to improvement in the construction of electric smelters for use in reducing ores carrying certain highly refractory metals, or metal alloys, and more especially for reducing wolframite to obtain what is known as "high-grade" ferro-tungsten. By "high-grade" ferro-tungsten is meant a product over seventy per cent. pure.

The higher the grade of ferro-tungsten the more refractory it becomes, and while ferro-tungsten of a comparatively low grade, say, for example, only fifty per cent. pure, may be melted in an electric furnace and tapped therefrom, this metal-alloy when over, say, seventy per cent. pure is so refractory and chills so quickly, that unless the temperature to which it is subjected is high enough to volatilize a large proportion of the metal, it cannot be run out successfully. It is necessary, therefore, in the production of ferro-tungsten above, say, seventy per cent. pure that the ore be subjected to a temperature capable of driving off the oxygen constituents and of fusing, to the fluid state, any slag-making constituents. The temperature should at the same time be high enough to render the ferro-tungsten constituent sufficiently plastic to agglomerate in a distinct mass.

In furnaces hitherto provided for the production of a high-grade ferro-tungsten it has been usual to treat but a limited quantity of ore in a single furnace-run and permit it after reduction to cool in the furnace. As the high-grade ferro-tungsten would tend to adhere tenaciously to the furnace-lining it had to be chiseled out by slow, laborious means.

My object is to provide an electric furnace of novel and improved construction in which a large amount of high-grade ferro-tungsten may be produced in a single run or operation and permit the removal of the reduced mass with facility and with comparatively little, if any, injury to the furnace.

In carrying out my invention I provide a furnace chamber, in the form of a crucible, with removable and replaceable sides, lined with refractory material, and with a bottom of graphite, or other suitable carbonaceous material, forming one of the electrodes. Extending downward through the open top of the furnace is an electrode in the form of a pencil of graphite, or other suitable carbonaceous material, means being provided for raising and lowering the furnace with reference to the carbon pencil. In practice the ore to be treated is fed into the furnace around the pencil and the slag-making constituents of the ore form the heat-generating material. Sufficient heat is generated by the passage of the electric current from one electrode to the other through the resistance material, to reduce to a plastic state the ferro-tungsten, drive off the oxygen, and melt, to a fluid state, the less refractory gangue which forms the slag-making constituent of the ore. As the ferro-tungsten is reduced it agglomerates between the electrodes and settles upon the carbon base. A core of ferro-tungsten is thus gradually built up enveloped in slag, and as it increases in height the carbon electrodes are separated, as required, to maintain the heat-generating arc. The operation is continued until a core of the ferro-tungsten of the desired height, which may approximate the depth of the furnace, is formed, when the electric current is shut off and the contents of the furnace allowed to solidify, after which the walls of the furnace are removed from the contained mass. Thereafter the slag enveloping and adhering to the ferro-tungsten may be readily broken away, leaving a column of finished high-grade ferro-tungsten.

In the accompanying drawing, I show the furnace structure I prefer to employ for the production of ferro-tungsten from wolframite, and wherein the furnace carrying the lower electrode is vertically adjustable with reference to the upper electrode.

Figure 1 is a broken, sectional elevation showing in full lines the furnace raised to initial position, and in dotted lines the position of the furnace at the end of a run; and Fig. 2, a broken, fragmentary plan view of a corner portion of the furnace, illustrating the means for holding the sides removably in place.

The furnace shown is rectangular in cross-section and formed of four sides, consisting each of an outer plate 3 and an inner refractory lining 4. The plates have per-

forated projecting lugs 5 near their upper and lower ends to receive tie-bolts 6, which hold the sides together. The sides rest at their lower edges on a metal current-conducting base-plate 7, which should be of suitable water-jacketed construction. Resting on the base-plate and forming the bottom of the furnace is a block or layer 8 of graphite, or other carbonaceous material, forming the lower electrode. The base-plate 7 has means, as shown at 9, for its connection with suitable electric current leads. The base-plate 7 carrying the furnace is suspended upon cables 10, running over pulleys 11 and carrying counter-weights 12. Fitting into the top of the furnace is a suitable raising and lowering heat-confining cover 13, of highly refractory material, or of water-jacketed construction, suspended upon cables 14, running over pulleys 15, and carrying counter-weights 16. Extending downward from a support 17 are brackets 18 forming retaining guides for an electrode-holder 19, which is connected by a lead 20 with the electric-current supply. The holder is formed with a dove-tail socket to fit over and receive the upper dove-tail end of a carbon pencil or electrode 21. As indicated, the pencil is formed in sections, each of comparatively short length, the sections being dove-tailed together and fastened, as indicated, by means of graphite bolts 22.

The ore to be treated may be fed through openings 23 in the cover. Initially the furnace would be raised to bring the electrode 8 close to the lower end of the electrode 21, and a layer of ore and coke, in proper proportions, would be placed between them to form the heat-generating resistance material. The passage of the current from one electrode to the other soon raises the temperature in the furnace to the melting point of the ore, thus generating the heat necessary for the reduction of the ore. The core or column 24 indicates the zone of highest temperature in which the ferro-tungsten constituent of the ore will be reduced to a state sufficiently soft and plastic to separate from the slag and agglomerate into a mass or core which settles by gravity initially upon the surface of the electrode 8, becoming an extension thereof. As the column or core 24 of ferro-tungsten forms, the molten slag will surround and overlie the same, tap-holes 25, with removable plugs, being provided through which the slag is drawn off from time to time. Care should be employed during the operation to lower the furnace as fast as the column 24 grows, to maintain the proper distance between it and the upper electrode. The operation may be continued until the core grows to the proportions indicated by the dotted lines 26, wherein the furnace is shown in its extreme lowered position. At the end of the run described, the electric current is shut off and the furnace allowed to remain intact until its contents solidify. The bolts 6 are then removed and the sides lifted away from the solidified column which remains standing upon the base. It is then but a simple matter to break away the slag and remove the core of ferro-tungsten from the furnace base.

It is the common practice in furnaces of this type to provide a stationary furnace-body and to suspend the electrode in a raising and lowering support. The support is connected with the current-supply by means of a flexible insulated cable. The cable, being above the furnace, its insulation is very apt to become charred and to break off, leaving the wires exposed so that, in the event they contact with the top of the furnace, a short circuiting results. In my present construction a heavy stationary lead may be employed without insulation to hold the electrode with great steadiness while the furnace is being raised and lowered. This construction renders it necessary to connect the base-plate at 9 to flexible conductors, in the form of cables, but these are not in position to be injured by the furnace-heat.

What I claim as new and desire to secure by Letters Patent is—

1. In an electric smelter for reducing ore containing ferro-tungsten, or a like refractory metal, the combination of a furnace formed with an electrode-carrying base and removable and replaceable sides, means for raising and lowering the furnace, and a stationary electrode extending downward into the furnace.

2. In an electric smelter for reducing ore containing ferro-tungsten, or a like refractory metal, the combination of a furnace formed with an electrode-carrying base and removable and replaceable sides, means for raising and lowering the furnace, a stationary electrode extending downward into the furnace, and a heat-resisting cover surrounding the upper electrode with means for raising and lowering the cover.

3. In an electric smelter for reducing ore containing ferro-tungsten, or a like refractory metal, the combination of a furnace formed with a base-plate, removable and replaceable sides with means for securing them together and an electrode on the base-plate, counter-weighted suspending means for the furnace, an upper stationary electrode extending downward into the furnace, a heat-resisting cover surrounding the upper electrode in the furnace, and counter-weighted suspending means for the cover.

CHARLES E. WILSON.

In the presence of—
H. F. DAVIDSON,
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