

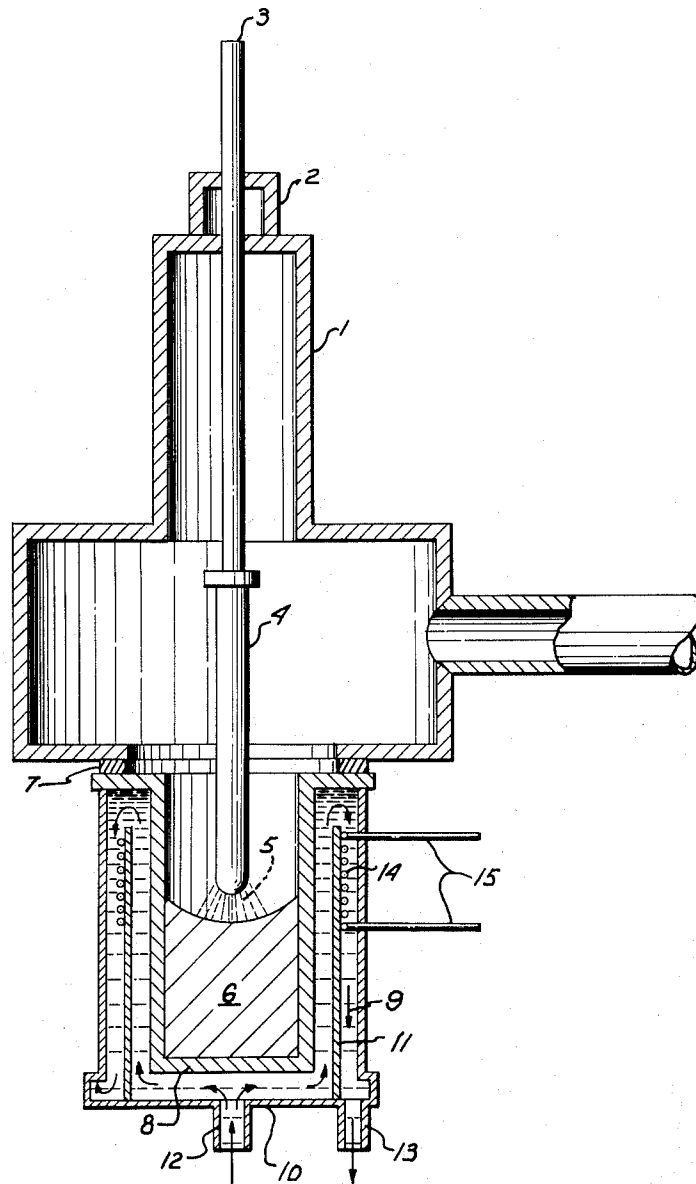
Jan. 30, 1962

H. GRUBER ETAL

3,019,274

WATER-COOLED CRUCIBLE FOR VACUUM ARC FURNACES

Filed June 6, 1958



1

2

3,019,274 WATER-COOLED CRUCIBLE FOR VACUUM ARC FURNACES

Helmut Gruber and Helmut Scheidig, Hanau (Main), Germany, assignors to W. C. Heraeus G.m.b.H., Hanau (Main), Germany, a corporation of Germany
Filed June 6, 1958, Ser. No. 740,478
Claims priority, application Germany June 11, 1957
2 Claims. (Cl. 13—31)

The present invention relates to vacuum arc furnaces and to certain valuable improvements therein.

Vacuum arc furnaces which are used for smelting highly reactive metals which have a high melting point are generally provided with a crucible which is cooled by water or similar means. Usually, such a water-cooling system previously consisted of a simple cylinder which surrounded the crucible. The water was supplied into such a cylinder laterally near the bottom thereof and it was discharged therefrom laterally near its upper end.

In the practical operation of such an arc furnace it has been found that such an arrangement of the water-cooling system has certain disadvantages. Thus, for example, the hose connections on the water-cooling jacket at two different points thereof interfere considerably with any movements of the crucible when the latter is being transported or moved to a place away from the furnace. This applies particularly to the upper hose connection. Another disadvantage of such a water-cooling jacket consisted in the fact that it usually did not extend entirely around the bottom of the crucible and that the flow of water did not always occur in a symmetrically circular path.

It is an object of the present invention to overcome the above-mentioned disadvantages of the previous water-cooling jackets of crucibles by very simple and effective means.

Another object of the invention is to provide a water-cooling jacket which also surrounds the bottom of the crucible and which has a water inlet substantially at the center of the bottom thereof.

A further object of the invention is to provide the inside of the water-cooling jacket with a partition which permits the water to flow within the jacket first in the upward direction and then in the downward direction to the outlet which is likewise provided on the bottom of the jacket itself.

A water-cooling jacket which is designed according to the present invention has the advantage that the water connections are only located at the bottom of the crucible where the hose connections thereon are of the least hindrance, and that a uniform flow of the cooling water through the cooling jacket and a more effective cooling action of the circulating water will thus be attained.

A further object of the present invention is to utilize the mentioned partition within the cooling jacket as a means for supporting a magnetic field coil which is used for concentrating the electric arc within the crucible and for agitating the molten metal so as to intermix its components. By mounting the field coil in this manner, it will be placed more closely to the crucible and thus exert a stronger effect upon the arc than the previous field coils which were simply wound about the outer wall of the water jacket. Furthermore, the field coil will thus be effectively cooled by the flow of cooling water, it will not have any direct thermal contact with the crucible itself, and it will in no way interfere with the direct cooling action of the water upon the crucible itself.

These and other objects, features, and advantages of the present invention will become more apparent from the following detailed description thereof, particularly when read with reference to the accompanying diagram-

matical drawing of a vacuum arc furnace, the crucible of which is designed according to the invention.

As illustrated in the drawing, the upper part 1 of the furnace has at its upper end a duct or bushing 2 through which an electrode suspension rod 3 which carries a consumable electrode 4 is inserted into the furnace. Electrode 4 is gradually melted within the furnace by an electric arc 5 to produce an ingot 6 within a crucible 8. The upper furnace part 1 and crucible 8 are connected to each other by a sealing ring 7 which closes the inside of the furnace including crucible 8 hermetically toward the outside.

Crucible 8 is completely surrounded by a water-cooling jacket 9 so that its entire bottom is likewise cooled by the bottom part 10 of jacket 9. At the inside of water jacket 9, a substantially cylindrical partition 11 of a shorter length than the outer wall of the jacket is mounted on the bottom thereof and extends parallel to the outer walls of crucible 8 and jacket 9 so as to divide the space within the latter into two cylindrical cooling chambers which communicate with each other at their upper ends. The bottom of jacket 9 is provided at the center thereof with a water inlet 12, and near its outer periphery with a water outlet 13. The cooling water will then enter through inlet 12, evenly divide within the bottom part of jacket 9 and flow in a uniform current upwardly within the inner cooling chamber and then downwardly within the outer cooling chamber toward outlet 13, as indicated in the drawing by the arrows. The cross-sectional area of flow of the water in both cylindrical cooling chambers and particularly at the communicating upper ends thereof is made so small in comparison to the force of the water current that any air bubbles which might be drawn with the water into the cooling jacket will not be capable of settling at any point within the jacket but will be taken along by the water current and discharged with the water through outlet 13.

Partition 11 serves the additional purpose of forming a support of a field coil 14 for producing a magnetic field for concentrating the arc within crucible 8 and for agitating the molten metal therein so as to produce a more homogeneous metal mixture. The lead-in conductors 15 of this field coil 14 are passed watertight through the outer wall of water jacket 9.

This manner of mounting the field coil has the considerable advantage over the manner previously used in which the coil was wound around the outer wall of the water jacket that the coil will now be located more closely toward the arc 5 within crucible 8 and will thus exert a stronger concentrating effect upon the arc and a stronger agitating and mixing effect upon the molten metal, and that it will be cooled directly by the flow of cooling water. By mounting the coil on the outside of the cylindrical partition 11, the wall of the crucible 8 itself will be unobstructed and the flow of cooling water will always be in direct engagement with such wall.

Actual test with the new cooling system and the new manner of mounting the field coil within the water jacket have proved a considerable superiority of such structure over those previously used.

Although our invention has been illustrated and described with reference to the preferred embodiments thereof, we wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed our invention, what we claim is:

1. A crucible for vacuum electric arc furnace comprising a container open at its upper end and closed at its bottom to form the crucible proper, a water jacket spaced from and disposed around the sides and bottom

3

of the container, a partition disposed in the water jacket and around the container to divide the space between the jacket and container into an inner compartment and an outer compartment, the two compartments communicating with each other at one end of the partition and being closed to each other at the other end, a first conduit opening at its inner end into the inner compartment, a second conduit opening at its inner end into the outer compartment, and a field coil mounted on the partition in the water jacket to be disposed around the crucible.

2. A crucible for a vacuum electric arc furnace comprising a container open at its upper end and closed at its bottom to form the crucible proper, a water jacket spaced from and disposed around the sides and bottom of the container, a substantially cylindrical partition disposed coaxially within the water jacket and around the container to divide the space between the jacket and container into an inner compartment and an outer compartment, the two compartments communicating with

4

each other at one end of the partition and being closed to each other at the other end, a first conduit opening at its inner end into the inner compartment, a second conduit opening at its inner end into the outer compartment, and a field coil mounted on the outside portion of the partition in the water jacket for concentrating the arc within the crucible and for agitating and mixing the molten metal therein.

References Cited in the file of this patent

UNITED STATES PATENTS

2,243,096	Hardin	May 27, 1941
2,625,719	Moore	Jan. 20, 1953
2,662,104	Southern	Dec. 8, 1953
2,727,936	Boyer	Dec. 20, 1955
2,727,937	Boyer	Dec. 20, 1955
2,761,002	Laird et al.	Aug. 28, 1956
2,857,445	Mangin	Oct. 21, 1958