

Nov. 24, 1970

H. SCHEIDIG

3,542,932

POWER LEAD ARRANGEMENT FOR ELECTRIC ARC FURNACE

Filed June 3, 1969

2 Sheets-Sheet 1

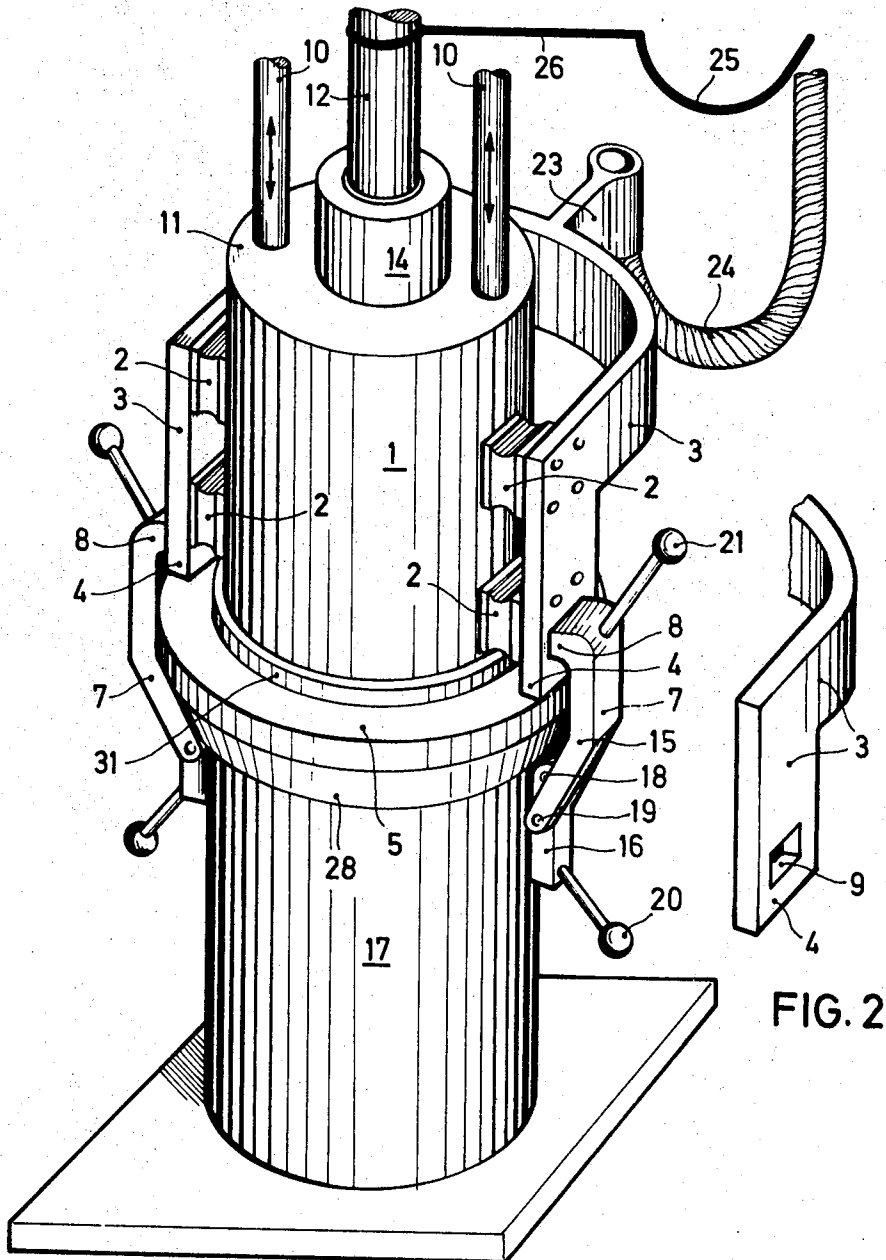


FIG. 1

FIG. 2

Inventor:

H. Scheidig
By *Joseph F. Patton, Atty*

Nov. 24, 1970

H. SCHEIDIG

3,542,932

POWER LEAD ARRANGEMENT FOR ELECTRIC ARC FURNACE

Filed June 3, 1969

2 Sheets-Sheet 2

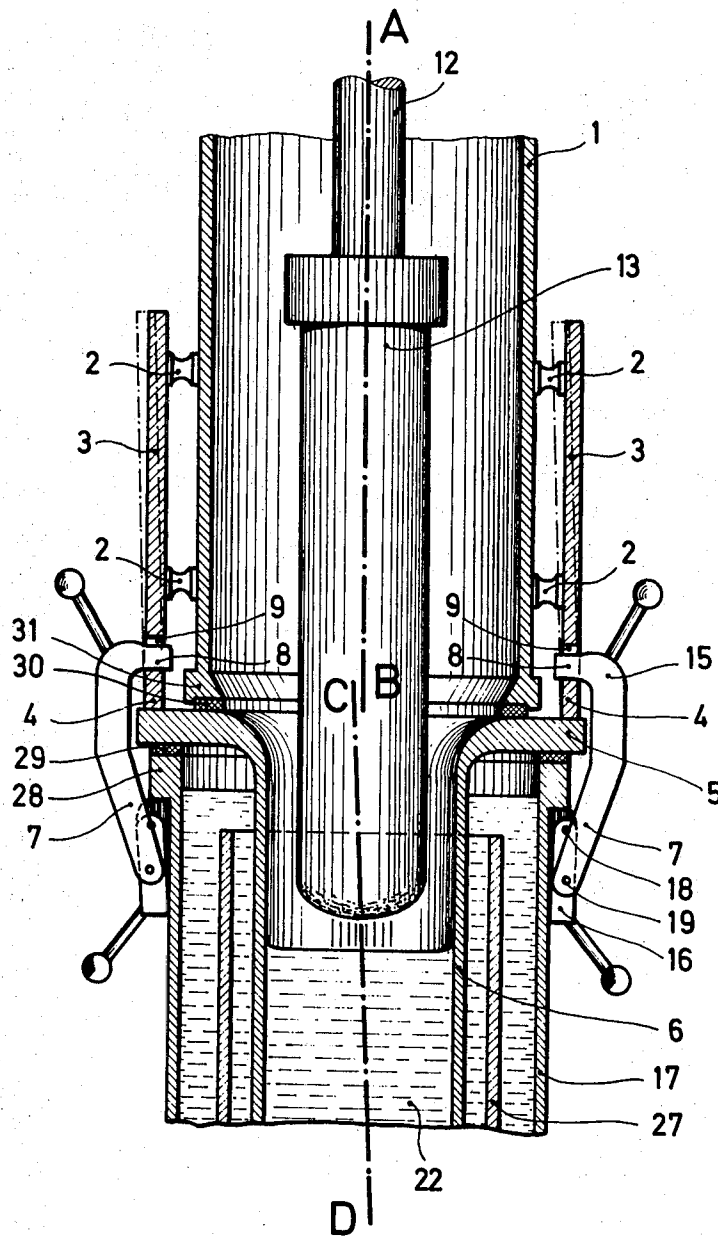


FIG. 3

Inventor:

H. Scheidig
By *Joseph F. Padon, atty*

1

3,542,932

POWER LEAD ARRANGEMENT FOR ELECTRIC ARC FURNACE

Helmut Scheidig, Rossdorf, near Hanau am Main,
Germany, assignor to Leybold-Heraeus-Verwaltung,
G.m.b.H., Cologne-Bayental, Germany

Filed June 3, 1969, Ser. No. 830,023

Claims priority, application Germany, Aug. 3, 1968,

1,765,899

Int. Cl. H01r 3/00; H05b 7/18

U.S. Cl. 13—34

8 Claims

ABSTRACT OF THE DISCLOSURE

Power lead arrangement for a vacuum electric furnace with a consumable furnace electrode wherein the power lead is resiliently mounted on the furnace and attached by clamping to the top of the crucible such that the power lead will be properly in contact with the crucible even though the furnace and the crucible may be misaligned.

The invention relates to a power lead arrangement for an electric arc furnace with consumable furnace electrodes wherein the furnace body is vertically movable in a suspension mechanism and adapted to be set down on a crucible.

Known electric arc furnaces for making metals by melting in a vacuum have furnace bodies mounted in a suspension mechanism which are lowered on the previously charged crucibles. After melting of the crucible contents, the crucible with its charge is carried off for further processing, and the furnace body is connected with a new crucible. A consumable electrode is located within the furnace body and produces the electric arc with the charge. It is particularly difficult to provide a conductive current path to the bath and to the furnace electrode because a substantial influence of the transfer resistance at the contact points must be expected on account of the high current values at relatively low potential differences. In known vacuum arc furnaces of the kind described the power leads are arranged in such a manner that the positive current supply to the crucible is provided by fixedly installed bus bars which are led to the crucible or crucibles from one side and horizontally, are divided symmetrically ahead of the crucible circumference, and are then connected to two diametrically opposite contact points at the crucible. The furnace electrode is connected with the negative terminal by means of water-cooled flexible cables. The current conducting bars which approach the crucible from the side have a strong magnetic field which, in the event of asymmetry, has an unfavorable effect on the metal melt in the crucible and on the shape of the electric arc. The metal melt in the crucible may be caused to rotate, and the arc to be blown off laterally. A non-homogeneous melt is caused thereby in which certain ingredients of the melt are accumulated in certain areas, and there cause undesirable segregation or occlusion.

With the above in view it is an object of the invention to provide a power lead arrangement for an electric arc furnace with consumable furnace electrode which insures good contact of the current supply conductor with the crucible with uniform distribution of the current flow over the crucible circumference. In order to achieve this object, it is being proposed, according to the invention,

2

to provide contact elements at least at two diametrically opposite locations which elements are insulated from the furnace body and adapted to be connected with the electric current supply, the contact elements being arranged relatively movable to the crucible surface in such a manner that they engage circumferential portions of the crucible under pressure for the purpose of providing contact after the furnace body was set down on the crucible. By an arrangement including contact bodies insulated and separate from the furnace body which engage circumferential portions of the crucible, more specifically on the surface of the crucible flanges, an adequate contact area with low contact resistance is provided even if the furnace axis deviates from the crucible axis. At that, it may be advisable to arrange the contact elements on the circumference of the furnace body in symmetrical distribution relative to the furnace electrode. According to a further feature of the invention, a power lead supplying current to the contact elements or to their supporting mountings may be provided horizontally in the region of the upper edge of the furnace body with vertically descending connecting lines for avoiding undesirable magnetic fields in the area of the electric arc and of the melt. Because the contact elements are located parallel to the axis of symmetry of the cylindrical crucible, the axial symmetry of the entire arrangement results in a uniformly developed magnetic field which cannot exert motive power on the electric arc and the melt.

A preferred embodiment may be arranged in such a manner that the contact elements are mounted on bus bars which are elastically displaceable on the furnace body. The elastic mounting may be provided in various ways by means of tension springs or by the elastic properties of the material or by the supports of the bus bars. It may be advisable to provide additional clamping elements for connecting the current carrying bars with the crucible, the clamping elements being pivotally mounted on the bus bars, on the crucible, or on the cooling tank according to choice. Such clamping elements capable of being applied under pressure may be arranged advantageously for example on the cooling tank, and may engage suitably adapted lugs on the bus bars. However, such clamping elements are required on each cooling tank. According to an advantageous embodiment, clamping elements may also be provided at the lower ends of the current carrying bars whereby the total number of required clamping elements is reduced. After lowering of the furnace body on the crucible, the contact elements already engage circumferential portions of the crucible. When the clamping elements are applied under pressure, the engagement is additionally improved for lowering the contact resistance. The clamping elements may be clamped on manually, but also in a well known manner in the arc by means of pneumatic or hydraulic devices. A further advantage may be achieved by employing the clamping elements as fasteners for fastening the crucible to the cooling tank which envelops the crucible.

It may be useful in certain cases to let the furnace body rest on the crucible in the lowered condition partly without balancing its weight so that the weight of the furnace body increases the contact pressure of the contact elements. Moreover, the pressing force generated by the vacuum may be utilized for enhancing the contact pressure.

The proposed power lead system permits good contacts to be established and provides precisely defined current paths symmetrically located relative to the electrode

3

and the melt so that any effect on the electric arc is properly balanced.

A preferred embodiment of the invention is illustrated in the accompanying drawing, in which:

FIG. 1 is a perspective view of the essential parts of a furnace;

FIG. 2 is a perspective view of a detail of a part of the furnace; and

FIG. 3 is a section of FIG. 1 taken along the axis thereof.

Referring now to the drawings wherein like numerals refer to like parts throughout, FIG. 1 shows the essential parts of a furnace. The furnace consists of a vacuum tight, cylindrical furnace chamber or body, preferably made of sheet metal. Said furnace body 1 can be raised and lowered by means of a suspension mechanism, not shown, in the drawing. Of this mechanism only tie rods 10 are shown. At the outer circumference of furnace body 1, current carrying bars 3 are resiliently mounted on supports 2 arranged in symmetrical distribution. The lower ends of the bars 3 constitute contact elements 4 which rest on the surface of a crucible flange 5 of the crucible 6. As is evident from the position of the bars 3 shown in dotted lines, the resilient mounting is such that the bars 3 are always parallel to the axis of symmetry of the crucible 6 regardless of the alignment of the furnace body 1 and the crucible 6. In order to improve the contact resistance, suitable clamps 7 are provided on crucible 6, and their projections 8 engage corresponding recesses 9 of the current conducting bars 3 and increase the contact pressure in the tensioned condition. Although, as is indicated in the drawing, the axis of symmetry CD of the crucible is tilted relative to the axis of symmetry of the furnace body AB, a reliable contact is provided at the contact elements. The paths of current flow from the contact points on the crucible to the melt are also symmetrically distributed so that disturbing field effects are eliminated.

From the foregoing it will be noted that tie rods 10 are fastened to roof 11 which permits the movement of a consumable electrode 13 which is surrounded by the furnace chamber 1 as shown in FIG. 3. Shell 14 represents a vacuum seal, as in form of several pressure stages, permitting a longitudinal movement of feed rod 12.

Attached to the periphery of the furnace chamber are symmetrically arranged conductors 3 as indicated. Said conductors are preferably of copper and are mounted for example on rubber-metal connections. The essential characteristics of these supports are that they are good electrical insulators. Said conductors 3 are resting with their lower ends which serve as contacts 4 on the upper surface of flange 5 of crucible 6. In order to improve the contact between conductors 3 and flanges 5, clamping devices 7 are provided for each conductor. Said devices 7 are formed like hooks and their ends 8 extend into openings 9 of conductors 3.

It will be further noted that each clamping device 7 consists of a hook 15 and a lever 16, the latter being movably attached to an outer casing 17 of crucible 6 by means of bolt 18. Said bolt is preferably resiliently mounted in order to adjust differences in the geometry of the contact pieces or members. Hook 15 and lever 16 are interconnected by means of bolt 19. The coordination of hook 15, lever 16 and bolts 18 and 19 is such that by a downward movement of lever 16 by handle 20, hook 15 presses conductor 3 against flange 5 in which position the clamping device is self-arrested after having passed a dead center. Handle 21 serves to place the clamping device into position when loosened.

Conductors 3 are, in their first section, led into a position parallel to the axis of the furnace chamber 1 so that any disturbance of the melt 22 (FIG. 3) in crucible 6 by an electromagnetic field caused by high current in the conductors 3 is thereby avoided. Furthermore, conductors 3 are then bent in a right angle such, that both

4

conductors are still in parallel. At a certain length, both conductors are bent in a circle in opposite direction until they join at cable connection 23, which is electrically connected to cable 24. The other phase is connected to a feed rod 12 by a similar cable 25 and a conductor 26, as diagrammatically shown.

As shown in FIG. 3, a section is given through the arc furnace along the axis of furnace chamber 1 and crucible 6 wherein the consumable electrode 13 is suspended and moved by feed rod 12 and is coaxial with the axis. An arc is drawn between the lowest end of electrode 13 and melt 22. The heat of the arc, melts the electrode which drips into the water-cooled copper crucible 6 thereby forming an ingot by gradually freezing from the bottom (not shown) of the crucible. The outer casing 17 of the crucible forms a so-called cooling jacket (Kuhltopf), as the space between crucible and casing is filled with water. The intermediate cylindrical wall 27 serves as guiding means for the circulating cooling water. It is to be noted that clamping device 7 presses flange 28 of the outer casing 17 against flange 5 of crucible 6, the tightness being achieved by intermediate annular gasket 29.

The embodiment of the invention functions as follows:

The axis of crucible 6 and outer casing 17 may be tilted against the axis A-B of furnace chamber 1 in normal position, as shown by the dotted line C-D in FIG. 3.

If after charging furnace chamber 1 with a new electrode 13, the assembly is lowered by tie rods 10 of the suspension arrangement, furnace chamber 1 by its flange 31 would touch gasket 30 on crucible flange 5 in the first instant only in one single point. It should be noted that the deviation of the axis is very small and the position of the dotted lines A-B and C-D is somewhat exaggerated. Thus, due to the weight of the furnace chamber vacuum tightness is achieved, since gasket 30 is, to a certain degree, elastic. In the prior art, however, the contact elements are not elastic.

In such a case a contact between furnace chamber and crucible would normally be poor and unsymmetrical. By means of the elastic supports 2, however, conductors 3 can follow the tilted position of the crucible and reach the position as indicated by the dotted lines. Hence, the contact pressure remains equal on both sides of crucible flange 5 and the contact surfaces of conductor 3 and flange 5 are in parallel which is highly important for good conductivity to obtain a clean melt.

It will be noted that the herein disclosed arrangement is applicable to vacuum electric arc furnaces or to non-vacuum electric arc furnaces.

I claim:

1. Power lead arrangement for an electric arc furnace with a consumable furnace electrode in which a furnace body vertically movable in a suspension mechanism is adapted to be lowered onto a crucible, characterized in that contact elements are provided on said furnace body at least in two diametrically opposite locations, said contact elements being insulated from said furnace body and capable of being connected with an electrical current supply, said contact elements being further arranged relatively to the supporting surface of the crucible whereby they engage circumferential portions of the crucible under pressure for providing contact after lowering of the furnace body on said crucible.

2. The arrangement according to claim 1 characterized in that said contact elements are arranged on the circumference of said furnace body in symmetrical distribution relative to the furnace electrode.

3. An arrangement according to claim 1, characterized in that said contact elements has leads provided horizontally near the upper edge of said furnace body with vertically descending connecting lines.

4. The arrangement according to claim 1 characterized in that said contact elements are provided on current

5

carrying bars mounted on the furnace body for elastic displacement.

5. The arrangement according to claim 4 characterized in that tensionable clamping elements are provided for connecting the current carrying bars and the crucible.

6. The arrangement according to claim 5 characterized in that the current carrying bars are provided with clamping elements near said contact elements.

7. The arrangement according to claim 6 characterized in that said clamping elements are utilized for fastening said crucible to a cooling tank.

8. The arrangement according to claim 1 characterized in that the furnace body is suspended in such a manner relative to the crucible that at least a portion of the weight thereof is available after lowering of the furnace

10

15

6

body for providing contact pressure to the contact elements.

References Cited

UNITED STATES PATENTS

2,227,176	12/1940	Berghaus et al.	13—31 X
2,551,341	5/1951	Scheer et al.	13—31
3,078,529	2/1963	Cooper et al.	13—31 X

BERNARD A. GILHEANY, Primary Examiner

R. N. ENVALL, JR., Assistant Examiner

U.S. Cl. X.R.

164—252; 339—147