

Description

The electrodes of arc furnaces for steel manufacture are held by support arms which have an electrode clamp at the end and are themselves held on support columns which can be vertically adjusted. Cooling water conveying devices are provided for cooling the electrode clamp and the actual arm. The support arms which are generally used have high-current lines, which are provided separately at the support arms, to supply current to the electrodes. As these entail considerable expense in terms of manufacture and maintenance, it has also been suggested that the entire support arm be produced from copper and formed to be current-carrying (US-A 2,494,775). In this case the support arm is hollow and closed at the front end by a flanged plate serving as a flanged connection with the electrode clamp. Some of the current supply to the clamping device is also conducted via the flanged connection. The coolant is delivered from the coolant cavity, which is provided within the support arm, via external pipes past the flanged connection to the electrode clamp. There is no evidence that an electrode support arm of this kind has proved successful in practice; the unfavourable strength to weight ratio of copper as the support arm material seems most disadvantageous, at least for fairly large furnaces.

This defect is remedied by another known design (EP-A-0184140), in which the support arm, which is made of steel, is externally plated with copper or aluminium. This is very expensive. The arm, including its coolant cavity, is delimited at the end by a flanged plate, which serves as a connection with a contact jaw of the electrode clamp. This solution cannot, however, guarantee a completely uniform, large contact area in practice, which means that local overheating may occur. This can be destructive, particularly when using material which tends to oxidize.

As regards yet another known electrode support arm (FR-A-1336823) the latter, which is made entirely of aluminium so

as to be current-carrying, is not therefore connected to the electrode clamp via a flanged connection. The end plate, which delimits the support arm at the end, is instead welded to the profiled parts forming the electrode clamp. The problematic contact current conduction in the area of a flanged connection is thus avoided. However this design entails the disadvantage that the electrode clamp cannot be detached from the support arm. This may be acceptable in the known case, because the power is low and therefore little heat is generated and little maintenance required.

The object of the invention is to provide an electrode support arm which is less expensive than a steel arm plated with copper or aluminium and which permits a detachable, current-carrying flanged connection with the arm part forming the electrode clamp.

The solution according to the invention consists in the combination of features according to claim 1.

As the arm is made of light metal, it is sufficiently stable to make a steel core unnecessary. The problems which arise in the current-carrying flange area due to the tendency of the light metal to oxidize, particularly at relatively high temperatures, and its susceptibility to erosion when contact is insufficient are avoided according to the invention in that the flanged plates are cooled in a particularly efficient manner by the proximity of the coolant cavities and the intensive heat exchange with the flowing coolant in the through-holes. Although local current conduction defects are not thereby eliminated, their consequences are diminished, as local overheating does not occur to a dangerous degree. Moreover, external connecting pipes are as a result unnecessary.

The flanged connection is advantageously formed by a flanged plate not just on the side of the rear arm part, but also on the side of the front arm part, which plate consists of light metal and helps to form the coolant cavity of the

corresponding part of the front arm part. This results in symmetrical conditions on both sides of the flanged connection and reduces the risk of the components which form the latter becoming distorted under the effect of a varying temperature and an alteration in the plane parts of the flange facings, which are in effectively current-carrying contact with one another.

Actuating members, which generally consist of a pull rod, a spring assembly and a hydraulic release device, must be provided for the electrode clamp. According to the invention these are accommodated between the flanged connection and the electrode clamp in a further arm portion belonging to the front arm part. The advantage of this lies in the fact that the actuating members can also be replaced by changing the front arm part.

A plurality of through-holes may be provided in the flanged connection for the arm's coolant circuit, according to the cooling requirement of the flanged connection. The cooling effect is further increased by also providing in the flanged connection through-holes for the clamping strap's cooling water supply system, which may also consist of pipe lines or flexible tube lines which are partly laid outside of the arm or, according to an advantageous alternative embodiment of the invention, pass through a clamping strap pull rod belonging to the actuating members of the electrode clamp.

The invention is explained in detail in the following with reference to the drawings, which illustrate an advantageous embodiment and in which:

Figure 1 is a side view of the installation,

Figure 2 is a vertical longitudinal section through the front part of the support arm and

Figure 3 is a plan view onto the front part of the support arm.

Figure 1 shows the known arrangement of an electric furnace 1, one electrode 2 of whose three electrodes is illustrated. A holding arrangement, which consists of a vertically adjustable support column 3, a support arm 4 secured to the latter and a supply arrangement 5 for current and cooling water, is provided for each electrode. The support arm 4 comprises a rear arm part 10 and a front arm part 6, which consists of a fixed arm portion 7 and an electrode clamp 8. The front arm part 6 with the electrode clamp can be separated from the arm part 10, which is disposed behind, by means of the flanged connection 9 in the context of the invention.

According to the invention the support arm 4, at least its rear part 10 and preferably also the arm portion 7 of the front arm part 6 consist of aluminium and as such are current-carrying.

The rear arm part 10 is formed as an internally ribbed hollow body, which is filled with cooling water and forms two cooling water paths for circulation purposes. It ends at the front in a flanged plate 11, to which the corresponding flanged plate 12 of the front arm part 6 is screwed to form the flanged connection 9. The contact surface of these flanged plates is formed as a current conducting surface. The flanged plates 11, 12 are components of the rear and front arm parts 10, 6, respectively and, like the latter, therefore consist of aluminium or an aluminium alloy.

The fixed part of the front arm part 6 consists of the elongate arm portion 7 or 13, which is a continuation of the rear arm part 10, and a forked part 14, which belongs to the electrode clamp and comprises contact jaws 15 which bear against the electrode 3 in order to hold it and form a low-resistance current conduction path. The clamping strap 38 of the electrode clamp is in the form of a closed ring, comprises a pressure jaw 16 and, in order to produce the holding tension, is pulled backwards by a pull rod 17 under

the action of a spring plate assembly 18. The spring assembly can be compressed and the clamping strap pushed forward for the electrode change by means of the hydraulic piston-cylinder arrangement 19. The arm portion 7, the fixed forked part 14 and the clamping strap 38 of the electrode clamp 8 are formed in a hollow, known manner in order to hold cooling water.

Whereas the supporting, fixed parts 7, 14 consist of aluminium and are current-carrying, the clamping strap 38 can be produced in a conventional manner, for example from alloyed steel.

The cooling water cavities 20 of the arm portion 7 of the front arm part 6 are connected via cooling water through-holes, one of which is illustrated at 21 in Figure 2, to the cooling water cavities 29 of the rear arm part 10, so as to produce a closed path through these parts for the cooling water circulation. The arrangement of the cooling water through-holes 21 in the flanged plates 11, 12 simplifies the replacement of the electrode clamping device and cools the flanged plates. However the hydraulic lines 22 belonging to the piston-cylinder device 19 extend outside of the flanged connection.

Pipe lines are provided within the rear arm part 10 and adjacent through-holes in the flanged plates 11, 12 to supply cooling water to the clamping strap 38, these leading to external pipe connections 23, which are connected to the clamping strap in a known manner via flexible tubes 24. These external pipe connections can be avoided by forming the pull rod 17 such that it can convey cooling water. A transition chamber 25, which is divided into a delivery and a removal part and is connected in a manner which is not shown to cooling water delivery and removal pipes, may be provided for this purpose - as indicated by dot-dash lines in Figure 2. The walls of the chamber 25 are sealed against the surface of the pull rod 17. The pull rod 17 contains two longitudinal channels, which open as a delivery and a

removal hole, respectively, into the chamber 25 and are connected at the front end of the pull rod 17 to the cooling water cavities 26 of the clamping strap 38, so as to permit the flow indicated by the dot-dash arrows in Figure 2.

In the illustrated arrangement the contact jaws 15 are integral with the forked, fixed part 14 of the electrode clamp, i.e. are firmly welded to it or form parts of the walls of the forks 14 on the electrode side. As these walls are effectively cooled by embedded cooling water channels and, on account of the high thermal conductivity of aluminium, at the external surface as well, the contact jaws can be substantially simplified with respect to conventional, detachable ones. However even if, in the context of the invention, the contact jaws are formed as separate, detachable parts, they are simplified in that no insulation is required between them and the fork parts 14.



Claims

1. An electrode support arm (4) which is intended for an electric arc furnace (1) and consists of a material having a high conductivity so as to be current-carrying, characterised by a rear arm part (10) of light metal and a front arm part (6), which is connected thereto via a current-carrying flanged connection (9), has an electrode clamp (8) and contains a coolant circuit passing through the rear and front arm parts, wherein the flanged connection (9) comprises two abutting flanged plates (11, 12), one of which is connected to the rear arm part (10) and delimits at least one coolant cavity (29) provided in the rear arm part, and the other of which is connected to the front arm part (6) and delimits at least one coolant cavity (20) provided in the front arm part, which plates contain coolant through-holes (21) for connecting these coolant cavities (20, 29).
2. An electrode support arm according to claim 1, characterised in that the part (7) of the front arm part adjoining the flanged connection (9) also consists of light metal.
3. An electrode support arm according to claim 1 or 2, characterised in that the front arm part (6) has an arm portion (13) which is disposed between the flanged connection (9) and the electrode clamp (8; 14, 15, 16, 38) and which includes actuating members (17, 18, 19) for the electrode clamp.
4. An electrode support arm according to claim 3, characterised in that the electrode clamp comprises a contact jaw (15), which is connected to the arm portion (13), and a clamping strap (38), which is connected to the actuating members (17, 18, 19), and in that the clamping strap and the actuating members are electrically insulated with respect to the arm portion.
5. An electrode support arm according to one of claims 1 to



4, characterised in that a coolant circuit is provided for cooling the clamping strap, and the flanged plates (11, 12) contain through-holes (28) for the clamping strap coolant circuit.

6. An electrode support arm according to claim 5, characterised in that coolant is conveyed to and from the clamping strap (38) through a clamping strap pull rod (17) within the arm portion (13).