An electric arc furnace consists substantially of a melting pot having a vault, electrode pillars and electrode arms extending at right angles thereto. Said electrode arms support in turn electrode clamps and the present invention relates to said electrode clamps.

During the melting operation, the major part of the electrodes are consumed and, therefore, they have to be lowered successively to that amount of their length which corresponds to the consumption. Previously this operation has been carried out entirely manually in that two operators had to go up on the furnace and to release the clamp by means of socket wrenches, whereas the electrode was lowered into the desired position by means of a hoist or another hoisting device and screwed up. This work was both time consuming and unhealthy and strenuous owing to the heat occurring on the top of the furnace. In recent years, therefore, remote operated clamps have been used, by means of which the displacement of the electrodes with respect to the clamp may be carried out by hydraulic or pneumatic means.

The designs which have been developed, however, have proved to be very complicated and less suitable to warrant operation without disturbance during the extremely difficult working conditions which occur in the operation of electric arc furnaces.

The requirements for a good electrode clamp are the following:

1. Simple and strong construction which can work reliably under the most difficult working conditions.
2. Simple fully automatic operation in opening and closing the clamp.
3. During operation, the clamp shall be kept closed without any mechanical aid, for instance hydraulically, pneumatically or the like.
4. The pressure of the clamp must be distributed as equally as possible around the surface of the electrode. This is of special importance with the Söderberg electrode, in which uneven clamp pressure can involve a deformation of the cover.
5. In opening the clamp the clamping shoes shall move radially outwards so that a uniform gap around the surface of the electrode may be obtained. If any of the shoes is stationary and the other ones are movable, the electrode would scrape against the stationary shoe during the movement of the electrode, which would cause nipple breakage when using graphite or carbon electrodes.

All of the requirements mentioned above can be fulfilled by the present invention which has for its object to obtain in a simple way a positively operated movement in the radial direction, which movement is brought about through the medium of a reciprocating operating device working at right angles to the central axis of the electrode.

The present invention, therefore, relates to a clamping device for electrodes of electric arc furnaces having movable articulated clamp shoes. The new feature consists in that the clamp shoes are positively guided with respect to each other, due to the fact that one clamp has each of its ends articulated with the end of its adjacent clamping shoe, the last mentioned being operated over an individual link system by means of a common operating device in such a way, that all clamp shoes in closed position engage the electrode surface with uniform pressure, and in open position leave a uniform gap around said surface.

The invention will be described reference being made to the accompanying drawing which shows by way of example an embodiment of the invention.

Fig. 1 shows the clamp closed during operation.

Fig. 2 shows the clamp in open position and the device for opening and closing the clamp.

Figs. 3 and 4 illustrate diagrammatically the operation of the positively guiding means.

1 is an electrode which is embraced by a clamping shoe 2 articulated with clamping shoes 3, which are jointed by means of links 4 and 5 partly with the diagrammatically indicated electrode arm 6 and with a yoke 7, respectively, which yoke is jointed with an operating device, such as an operating rod 8. The positive displacement of the clamping shoes with respect to each other is accomplished by the manner in which the links are positioned. These are arranged in such a manner that on moving the operating rod for releasing, all shoes move equally from the center axis of the electrode in such a way that the center of the circle which is formed by the inner limitation surface of the electrode shoes always coincides with the electrode axis thereby causing the formation of a uniform gap 9 around the electrode when the clamp is opened. It is also an especial feature of the clamp according to the invention that it does not require any surrounding casing serving as supporting means, but the clamp is suspended entirely freely and only supported by the links.
On the drawing, the clamp is only illustrated in plan view so that its extension in the longitudinal direction of the electrode is not shown. In reality, the clamp of course has a certain axial extension so that there are usually at least four links 4 and four links 5. Furthermore, the clamping shoe 2 may consist of two parts, but they must be joined together rigidly in this case.

The clamp may be held in closed position by an extension spring and be opened by electrical, hydraulic or pneumatic means.

The mode of operation of the clamp will best be seen from the diagrammatical Figures 3 and 4.

As will be seen from Fig. 3 that when the operating device is moved from the electrode center axis, the link points c and b tend to withdraw radially therefrom, the points c and d move outwards, which should have the result that the points c and e should tend to move inwards in the direction of the arrows. Due to the rigid connection between these points, formed by the clamping shoe 2, no movement can take place in this direction but the clamping shoe 2 tends to withdraw from the electrode, i.e. the clamp will be opened uniformly.

Fig. 4 shows the movement of the clamping shoes as the clamp is closed. When the operating rod is pushed towards the electrode center, the points c and d are displaced uniformly in the same direction. Thus the points c and d move in the opposite direction, which should have as a consequence that the points e and f would tend to move outwards, but for the same reason the clamping shoe 2 and also the shoes 3 are pressed uniformly against the electrode.

On Fig. 1, the connection for current-leading conductors and pipes for cooling water, if any, has been indicated at 10. In reality, the current-leading conductors also will conduct the cooling water to the clamping shoes.

Fig. 2 indicates by way of example schematically an embodiment of the operating device comprising substantially a coil spring 11 and a piston 12. The coil spring is mounted around the rod 8 in such a manner that it forces the rod to close the clamp and to hold it closed during the normal working period of the furnace. When the electrode has to be lowered, a working fluid is admitted to the chamber 13 causing the piston 12, fixed on the end of the rod 8, to withdraw the latter and therewith to open the clamp. It is clear that said operating device also may consist of an electrically or pneumatically operated arrangement.

In order to minimize additional losses in the clamp, which occur owing to the heavy current, the clamps are made from non-magnetic material which has good electric conductivity, good mechanical tenacity, and further great resisting power against oxidation at higher temperatures.

We claim as our invention:

1. An electrode clamping device comprising two clamping shoes opposed to each other at opposite sides of the electrode, a third clamping shoe interlinked between the opposed shoes and articulated to one end of each of said opposed shoes, an individual link connection for each of the said opposed shoes to support the whole clamping device, each of said individual link connections having one end articulated to one of the said opposed shoes and having its opposite end pivoted at a point located in fixed relation to the axis of the electrode, and a common operating member articulated to the ends of the said opposed shoes remote from said third shoe for the actuation of said link connections whereby all the clamping shoes are caused to engage the surface of the electrode with uniform pressure and whereby a uniform gap is formed around the said electrode surface when the clamping device is in the open position, means whereby the clamping shoes are normally retained in the electrode-holding position, and power-operated means for actuating said member against the action of said retaining means to open the clamping shoes.

2. An electrode clamping device according to claim 1 wherein the device is freely suspended from said link connections without any other supporting or covering means.

3. An electrode clamping device according to claim 1 wherein the shoes are made from a copper alloy having good electric conductivity, good mechanical tenacity, and heavy resisting power against oxidation, even under high temperatures.

4. An electrode clamping device according to claim 1 comprising means for cooling the shoes.

5. An electrode clamping device according to claim 1 comprising flexible metallic tubes for supplying electric current and cooling fluid to the said shoes.

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