ELECTRODE HOLDING DEVICE FOR ELECTROTHERMIC MELTING FURNACES  
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This invention relates to improvements in electrode holding devices consisting of several contact plates where the components of force on pressing the plates into contact are taken up by a closed ring which is flexible.  
A great variety of devices, as necessitated by the latest and newer conditions, is used for holding the electrodes of electrothermic melting furnaces. Rigid or flexible rings are used in most cases as holders for the electrodes. Owing to the heavy duty and bending stresses and the elevated temperatures of the charge in the furnace, the ring of rigid design for the pressure contact plates, which must be of a relatively great toughness, is used in operation for a short period to such an extent that expensive repairs involving stoppages become necessary. Moreover, an unwary, uniform contact pressure cannot be achieved, and this is of particular disadvantage in the case of the relatively plastic electrodes. Efforts have also been made to avoid these disadvantages by flexible rings as holding devices consisting of link chains when new and uncooled. Rigid rings are replaced by means of knee levers. Although a certain elasticity of the ring can be obtained by these levers and its length can be altered, it remains, nevertheless, impossible to transmit the contact pressure uniformly to the contact plates. This is particularly true when the holding device is tightened or loosened excessively.  

It has now been found that all these disadvantages can be avoided and a permanently uniform contact pressure achieved by a special design of the flexible ring. The object of the improvement is that, in the case of the new electrode holding device for electrothermic melting furnaces with several contact plates which, on being pressed onto the electrode are supported by a closed flexible ring, the tightening of the contact plates onto the electrode and their loosening from the same are effected directly, the length of the ring remaining unchanged. The tightening and loosening are effected by widening and narrowing the circumference produced in a plane lying vertical to the axis of the electrode, and this is effected by placing the flexible ring in a undulatory arrangement by known devices, such as levers, rolls, etc., and moving it when pressing the contact plates into contact in planes lying parallel or at an angle to the axis of the electrode.  
The tightening and loosening of the contact plates can be effected directly as shown in Fig. 3 or indirectly as shown in Figs. 1 and 2.  

A rope, which can be endless or coupled, is particularly suitable as a flexible ring and, in this case also, the tightening and loosening of the contact plates can be effected either directly as shown in Fig. 3 or indirectly as shown in Figs. 1 and 2.  

To protect the flexible ring from the destructive action of the hot charge, it should be provided with a jacket of a flexible material in the form of a tube to enable it to be cooled. In this connection it is advisable that the jacketed flexible ring be provided with expansion bodies. Liquids such as water, gases or air, can be used as a cooling medium. Chains such as link chains, gall chains, marine chains, etc., can also be used as a flexible ring and, in this case also the tightening and loosening can be effected as with the wire rope, either directly or indirectly as shown in the drawings.  

A gall chain is a conventional technical expression for link chains as used in bicycles. A gall chain is defined as a “bush roller chain” on page 197 of “Deutsch-Englischen Technischen Woerterbuch,” edited by Dr. Ing. Richard Ernst, volume I, published Taunus Edition, Hamburg, 1948.  

When using the electrode holding device for closed furnaces outside the furnace cover, cooling of the flexible ring becomes unnecessary. If, in the case of open furnaces, the rings which are formed by chains are to be used inside the covered furnace, the cooling of the chain can be carried out by blowing an inert gas or air onto the chains. In fact, the chains may be cooled in any desired conventional manner.  

When transmitting the forces for pressing the contact plates onto the electrode directly from the rope or the link chain to the contact plates, the contact plates for obtaining a tightening or loosening effect is carried out by narrowing and widening the circumference and thus, although the original circumference remains practically unchanged, the shape of the ring is altered. For instance, where round electrodes are concerned the ring forms, as long as it is loose, a larger circle or polygon lying in a plane approximately vertical to the axis of the electrode. To press the contact plates onto the electrode the diameter of this circle must be decreased. This is effected by placing the ring in an undulatory arrangement by known devices, and decreasing the diameter of the circle or polygon, projected in a plane lying vertical to the axis of the electrode, while the length of the ring remains unchanged. This procedure is reversible. When the contact plates, the projected circumference, which practically maintains the form of a polygon or a circle during all these operations, is widened by decreasing and flatting the undulations.  

When transmitting the forces for pressing the contact plates onto the electrode indirectly by installing known devices, such as levers, etc., the distances between the ring and contact plates may be the same or different, depending on the form of the electrode. It is, however, necessary to alter these distances uniformly for all shapes of electrode diameter. This can be done by installing knee levers and roll off levers of the same shape, rolls or inclined planes, components working hydraulically or pneumatically etc. If necessary, these devices can be either from inside or outside, in a conventional manner. Contrary to the direct tightening of the contact plates where the circumference is projected in a plane lying vertically to the axis of the electrode is altered, when tightening the contact plates indirectly the circumference and its projection remain unchanged and, in this case, only the intermediate members between the ring and the plates are altered in size.  

To guarantee a uniform contact pressure of the contact plates when applying uniform forces for operating the lift and to decrease friction, levers of a continuously roll off design can be used. In this connection it is advisable that the levers acting on the contact plates be secured by suitable means, for instance, indents, furcations, against any displacement.  

In the first method described above where the forces of pressure are exerted directly by means of the flexible ring, the conditions with regard to the space required are particularly favorable. Furthermore, it is possible to shorten the distance between the various electrodes considerably if polyphase furnaces are concerned, thus decreasing the inductive resistance of the entire furnace. Any widening of the electrodes for one reason or another will, however, improve the accessibility to the electrode holders.  

The small space required by the new electrode holding device—it is advisable that the ring should be regarded as a rope on the contact plates, the holding device thus requiring a minimum of space around the electrode—
considerably facilitates its use as a deep-reach holding device so that it is especially suitable for installation in closed or covered furnaces.

The invention is illustrated in detail in the Figures 1-11, a metal rope being used as a flexible ring. The arrangements shown in the figures may also be used in a similar manner for flexible rope elements consisting of a plurality of rings. A metal rope of this type, for example, facilitates the installation of a deep-reach holding device.

Fig. 1 shows a perspective view of an embodiment of the electrode-holding device in accordance with the invention. The ionization effect of the electrode 1 is shown in Fig. 1. Fig. 3 shows a perspective view of a different embodiment of an electrode-holding device in accordance with the invention.

Fig. 4 diagrammatically shows a top elevation of the structure shown in Fig. 1, and Fig. 5 diagrammatically shows a top elevation of the structure shown in Fig. 3; and Figs. 6-11 show how the new electrode-holding device may be used for the various kinds of electrodes.

Figures 1 and 4 show perspective and diagrammatically, respectively, the method of operation of the new design of an electrode holding device. The contact plate 2 is pressed onto the electrode 1 by operating the lever 3 by means of the draw bar 5 in a uniform lifting motion caused, for instance, by the hydraulically operating piston 15. The levers 3 are supported, on the one hand, by the rope 4 which is flexible and, on the other hand, by the contact plates 2. The total force exercised on the rigid ring 6 is distributed uniformly to all contact plates by the flexible rope 4. If any part of the flexible electrode is subjected to wear or flattens to a certain extent, as shown in Fig. 4, at point 17 and Fig. 9 at point 18 owing to the pressure of the contact plate, the extent of pressure exerted on the plate will decrease at point 19 in accordance with the alteration of the angle of the rope. On the other hand, the pressure is increased on the adjacent plates due to the narrowing of the angle of the rope, and the electrode becomes round again in consequence of the difference in pressure.

In Fig. 1 the power transmission and the movement of the contact plates is effected by a lever 3, which can roll off over the inclined plane 9 on the contact plate 2, hold the rope 4 by a hook 10, and is connected with the draw bar 5 by another hook 11 so that it can be easily released. In order to effect a uniform pressure of the contact plate with uniform lifting power and different adjustment of the levers, the roll off parts are curved. A jacket of flexible material in the form of a tube is used to cool the flexible ring (rope) and to protect it from high temperatures. An expansion body is placed on the flexible ring.

In Figure 2 a roll 7 (instead of the lever 3) takes over the power transmission between rope and contact plate in connection with an inclined plane 12.

In Figures 3 and 5 the pressure on the contact plates 2 is exerted directly by the rope 4 by drawing the rope 4 uniformly in an undulatory arrangement between the plates. Owing to the fact that the tractive forces in the rope 4 pull the rope 4 upwards, a component of force which may be selected at will, is formed in the direction of the axis of the electrode. In that case the draw bars 5 are connected directly with the rope 4, but between the contact plates 2, while the rope 4 is held in contact with the contact plates 2 by the hooks 13. This design constitutes a great technical advance in so far as it facilitates the installation of a deep-reach holding device for electrodes. As will be seen from the figures, the new electrode holding device requires only a small space as compared to the designs heretofore.

Figure 6 represents a holding device for an electrode of square cross section, Figure 7 of said electrode plates and longitudinal sections, Figures 8 and 9 for an electrode of round cross section, Fig. 11 for an electrode of rectangular cross section, and Fig. 10 a holding device for parallel electrodes.

When the term ‘endless rope element’ appears in the claims, there is specifically meant thereby any of the elements as described above which may be used to hold the electrodes in place. These elements, i.e., the flexible rope element, may be materials, such as wires, chains, and the like.

We claim:

1. In an electrode-holding device for electrothermic furnaces having a multiple number of contact plates, circumferentially positioned about a portion of an electrode in contact therewith, the improvement which comprises at least one flexible endless rope element encircling said contact plates, separate means contacting each plate and the adjacent portion of said endless rope element whereby said endless rope element is angularly disposed at the points of contact with said last mentioned means, and means for varying at least one of (a) the circumferential distances between the contact plates and the endless rope element, and (b) the effective diameter of said endless rope element in a horizontal plane.

2. Improvement according to claim 1, in which said means in contact with each of said contact plates and the adjacent portion of said endless rope element are adjustable projections, and including means for uniformly varying the extent of projection thereof.

3. Improvement according to claim 2, in which each of said projections is collectively defined by an inclined surface and a member in contact with said endless rope element and said inclined surface, and in which said means in contact with each of said contact plates and the adjacent portion of said endless rope element are means for varying the point of contact of said member with said inclined surface.

4. Improvement according to claim 1, in which said individual means in contact with each of said contact plates includes a bent lever with one arm thereof in contact with said endless rope elements and fulcrumed in contact with the plate, and including means for pivotally positioning said bent lever.

5. Improvement according to claim 1, in which said last-mentioned means are means for angularly displacing portions of said endless rope element distributed about the circumference thereof in a direction co-axial with the axis of the electrode.

6. Improvement according to claim 1, which includes a flexible cooling jacket positioned around said endless rope element.

7. Improvement according to claim 6, in which said flexible cooling jacket is provided with expansion means.

References Cited in the file of this patent

UNITED STATES PATENTS
2,135,408 Moore Nov. 1, 1938
2,477,077 Moore July 26, 1949

FOREIGN PATENTS
118,023 Great Britain Aug. 15, 1918
128,329 Austria May 25, 1925
808,604 France Nov. 14, 1936
846,600 France June 12, 1939
421,131 Germany Nov. 6, 1925
130,687 Great Britain Aug. 14, 1919