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METHOD OF READJUSTING THE METAL SUPPORTING
RODS OF CONTINUOUS SELF-BAKING ELECTRODES
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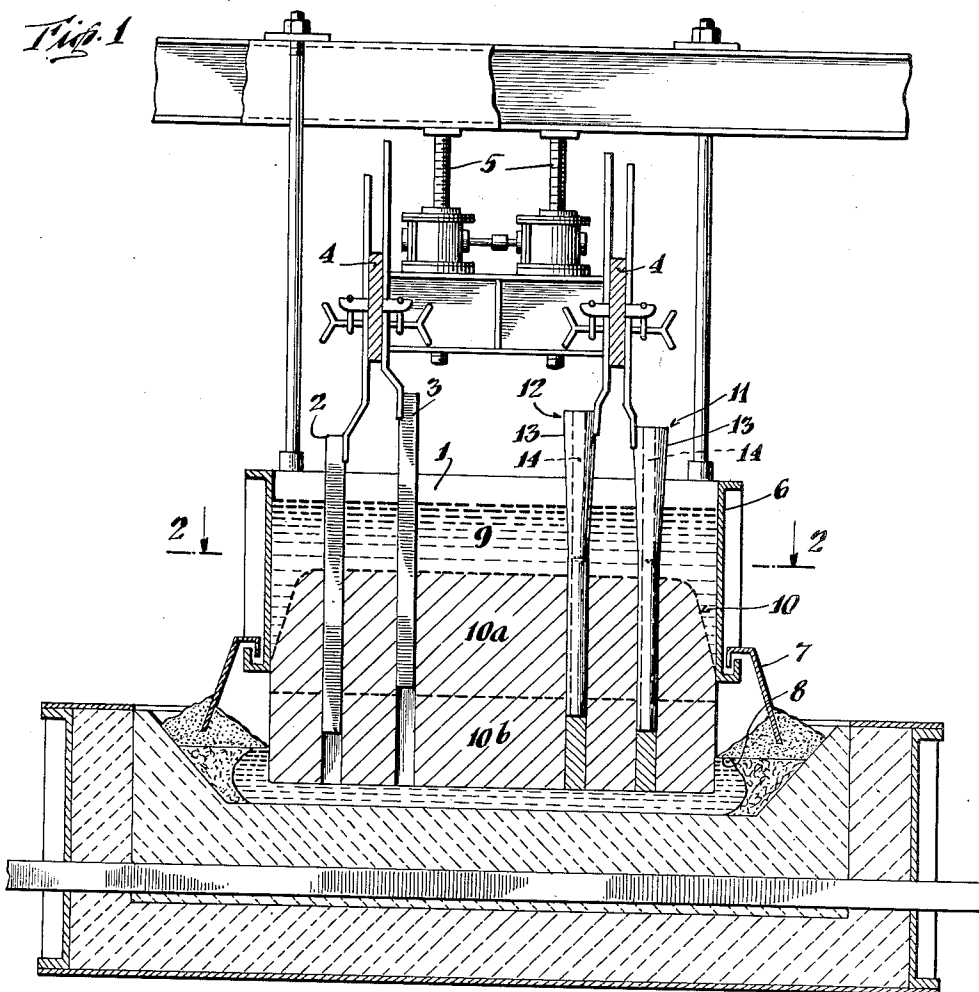
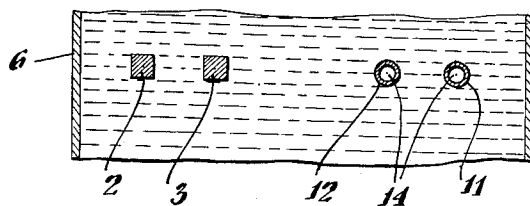


Fig. 2



INVENTORS
John Waddington
BY *Robert Stanley Cleo*
Eyre, Mann & Parsons
ATTORNEYS

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METHOD OF READJUSTING THE METAL
SUPPORTING RODS OF CONTINUOUS
SELF-BAKING ELECTRODES

John Waddington, Kinlochleven, and Robert
Stanley Clegg, St. Ola, Fort William, Scotland,
assignors to Elektrokemisk A/S, Oslo, Norway,
a corporation of Norway

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3 Claims. (Cl. 13-18)

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This invention relates to a method of handling the current supplying and supporting metal rods of continuous self-baking electrodes of the type used for the smelting of aluminum.

United States Patent No. 2,475,452 describes the general structure to which this invention relates but in that patent the metal rods are tapered toward their lower end and the feature of that invention is that the rods are withdrawn and then a small amount of electrode paste is dropped in the hole and the rod is pushed back into the hole while still hot so that the electrode paste in a molten state is squeezed up around the tapered side of the rod to anchor it in place as the paste carbonizes. That method is quite successful but has the drawback that there is a tendency for tar fumes to escape from the empty hole when one of the rods is withdrawn and before it can be replaced in a higher position. With a large number of pots in one room, each with many such rods, this may create a real difficulty.

According to the present invention, the rods instead of being tapered, are made with substantially parallel sides in a zone adjacent the lower end. When the electrode mass has descended to the point where it is necessary to raise certain of the rods to keep them out of the bath, the rod to be raised is loosened in the electrode mass as by being struck a sharp blow for example with a pneumatic hammer and then is raised the necessary distance (usually about 20 to 40 centimeters). We have made the very surprising discovery that with the type of electrodes now being employed and using a rod with parallel sides, the elevated rod if held in position relative to the electrode mass will very quickly be cemented back into place and will very soon give good electrical contact without the necessity of pulling the rod out of the hole and without the necessity of introducing soft paste into the hole.

We attribute this very surprising result to the presence in the electrode mass of substantial quantities of tar fumes containing unsaturated hydrocarbons which surround a portion of the contact rod which is still red-hot. As the rods have no substantial taper, there is very little clearance between the rods and the sides of the hole and we believe that the rods, after being lifted, are cemented back into place by the decomposition of the unsaturated hydrocarbons with the deposition of coke against the rods which fill the cracks between the rods and the electrode mass.

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An analysis of the nature of the electrode mass during operation seems to support this explanation.

In the Soederberg electrodes now used in aluminum furnaces the electrode mass is made up of a soft, molten portion on top, below which is the baked zone, the upper portion of which is hard and firm though not fully carbonized. The fully carbonized zone is at the bottom of the electrode mass.

The location of the zone where the electrode mass hardens can readily be determined by pushing a bar down through the soft part of the paste. In this way it will be found that the top of the baked zone is substantially flat in the central area and curves downward around the edges toward the molten bath and by keeping the melting point of the electrode paste relatively high, for example from 80 to 100° C., the height of the raw paste on the electrode top can be reduced to about 10 to 12 centimeters. The height of the baking zone will depend somewhat on the current density employed in the electrode during electrolysis but usually it will be situated at a distance of about 50 centimeters above the molten bath. As the electrode is lowered it gets progressively hotter and the tar employed as the binder gives off fumes. The upper raw paste on the electrode top which is more or less liquid and without porosity prevents these tar fumes from escaping upward through the top of the electrode and therefore the only way that the fumes can escape is downward through the baked part of the electrode which when fully carbonized has a considerable porosity in the order of about 25%. This results in a downward stream of tar fumes in the electrode mass which escape from the mass below the lower edge of the permanent casing. Since the permanent casings now employed generally end at a distance of 15 to 30 centimeters from the molten bath, as described for example in United States Patent No. 2,526,876, there always exists a great quantity of tar fumes in the top 20 to 30 centimeters of the baked zone where this extends up into the permanent casing. These tar fumes contain unsaturated hydrocarbons and when the rods with parallel sides are raised up so that an incandescent portion is brought into this zone, we believe that the unsaturated hydrocarbons are cracked by contact with the red-hot metal surfaces, with the deposition of coke to act as a bonding agent.

We recognize that previously attempts have been made to shape the contact rods as screws

permitting the rods to be screwed out gradually as the electrodes are lowered. Experience with these screws has not indicated any such phenomenon as we have now discovered, but we believe this to be due to the fact that the screws were only lifted a few centimeters at a time so that there was no extension of the incandescent rod up into the zone containing substantial quantities of unsaturated hydrocarbons. Such gases as are present in the lower part of the zone such as H_2 , CH_4 and the like give very little coking effect.

While it is desirable that the portion of the contact rods which move up from the incandescent zone into the zone containing the unsaturated hydrocarbon fumes should have parallel sides, we have found that it is sometimes useful to have the upper parts of the rods slightly tapered (formed conical) so that these rods can readily be freed from the softer part of the electrode mass near the upper surface. It is important that the liquid paste flow into the empty spaces at the top remaining around the contact rods as they are lifted, and for this reason the conical part of the contact rods should be well polished and preferably greased.

By operating in the manner described, holes will be left in the electrode below the contact rods. The bath will tend to rise in these holes to reach the same level as outside the electrode. To protect the contacts from being attacked by the melt, they must therefore be lifted before the lower ends of the contacts reach the level of the bath. This means that the voltage drop in the electrode will be somewhat higher than normal.

To overcome this difficulty, it is advantageous to fill up the hole below the contact rods with electrode paste which may be introduced in either liquid or solid form or with cryolite or with alumina or with mixtures of these materials. Applicants have found that this may be accomplished, for example, by employing hollow contact rods through which the material can be introduced or by making holes in the electrode at the sides of the contacts. We have also found that the strength of the bond between the electrode mass and the rods can be increased by increasing the perimeter of the latter without increasing their area as by making them non-circular and preferably with an angular cross-section, for example square.

This invention may be readily understood from the accompanying drawings in which Fig. 1 shows a section through an aluminum pot wherein vertical contact rods are handled in accordance with this invention and Fig. 2 is a horizontal section showing the shape of the contact rods.

In this drawing, 1 is the upper part of the electrode mass, 2 is a vertical contact rod in the lowest position and 3 is a similar rod in the highest position. The suspension of the electrode as well as the current supply thereto is accomplished by means of main bus bars 4 vertically adjustable by means of the jacks 5. 6 shows the permanent steel casing acting as a mold for the electrode and carrying the gas collecting ring 7. 8 indicates the level of the bath in the furnace. 9 is the raw unbaked part of the electrode which is impenetrable by the tar fumes developed by baking of the lower part of the electrode. 10 is the hard baked part of the electrode which is divided into two zones 10a and 10b. In the zone 10a which is the upper part of the baked zone and below the temperature of incandescence, the concentration of unsaturated hydrocarbons is

very high while in the lower zone indicated as 10b, the concentration is much lower because in this zone the unsaturated hydrocarbons are decomposed in contact with the red-hot coke and the residual gases leak out sideways below the permanent casing.

On the right hand side of the drawing, the two contact rods 11 and 12 which are in intermediate positions are shown as formed with conical upper portions 13 and these rods are made hollow with central openings 14. As stated above, either electrode paste or alumina or cryolite, or mixtures, can be pushed down through these central openings 14 to fill the space below the contact rods. As shown in Fig. 2, rods 2 and 3 are in this instance made square whereas rods 11 and 12 are shown as being round.

In operation, the electrode is lowered until a point is reached where it is necessary to raise one or more contact rods. With rods of the type indicated at 2 and 3, this should be before the bottom of the rod reaches the level of the bath. The rod is then loosened by striking it a sharp blow, and it is simply raised up from the position shown for example in connection with rod 2 to the position shown for rod 3. As stated, this ordinarily involves lifting the rod from 20 to 40 centimeters. An incandescent portion of the lifted rod is now in the zone 10a where it is held in fixed position relative to the electrode mass while its heat serves to decompose the tar fumes. As a result it is quickly sealed in place so that it makes good electrical contact and again can be used for supporting the electrode mass.

Where rods such as those indicated by numerals 11 and 12 are employed, they may be permitted to go down slightly below the level of the bath, as in this case the space below the rods is kept filled. The filling of this space will ordinarily be carried out shortly after the rod has been sealed in place. As stated, electrode paste, alumina or cryolite, or mixtures, may be employed and such material can be forced down through the rod by using an appropriately shaped bar.

It is understood that ordinarily rods of only one type will be employed in a single electrode but the two types are here shown for the purpose of illustration.

What we claim is:

1. In the operation of an electric furnace including a self-baking continuous electrode mass having a bottom incandescent portion, a top portion formed of soft, substantially liquid paste and an intermediate portion which is solidified but is below the temperature of incandescence, and metal rods extending into the electrode mass for suspending said electrode and for supplying current thereto, said rods being characterized by the fact that lower portions thereof have a constant cross-section, the method of re-positioning such rods which comprises loosening such a rod in the electrode mass and without withdrawing it from the mass, raising it sufficiently so that an incandescent portion of the rod enters the intermediate zone in the electrode mass where the mass is solidified but is below the temperature of incandescence, and holding the rod in such position relative to the electrode mass while the heat of the rod decomposes hydrocarbon bodies within the mass to secure the rod to the electrode mass and to bring the rod again into good electrical contact with the mass and thereafter employing such rod for suspending the electrode and supplying electric current thereto.

2. A process as specified in claim 1 in which the

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contact rods are provided with a hole in their longitudinal direction and filler material selected from the group consisting of electrode paste, alumina and cryolite is introduced through such hole into the opening below the contacts after the rod has been sealed in its elevated position.

3. A process as specified in claim 1 in which after the contact rod is loosened it is raised a distance of between 20 and 40 centimeters and then held in a fixed position relative to the electrode mass while it is sealed in place.

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