

Sept. 28, 1943.

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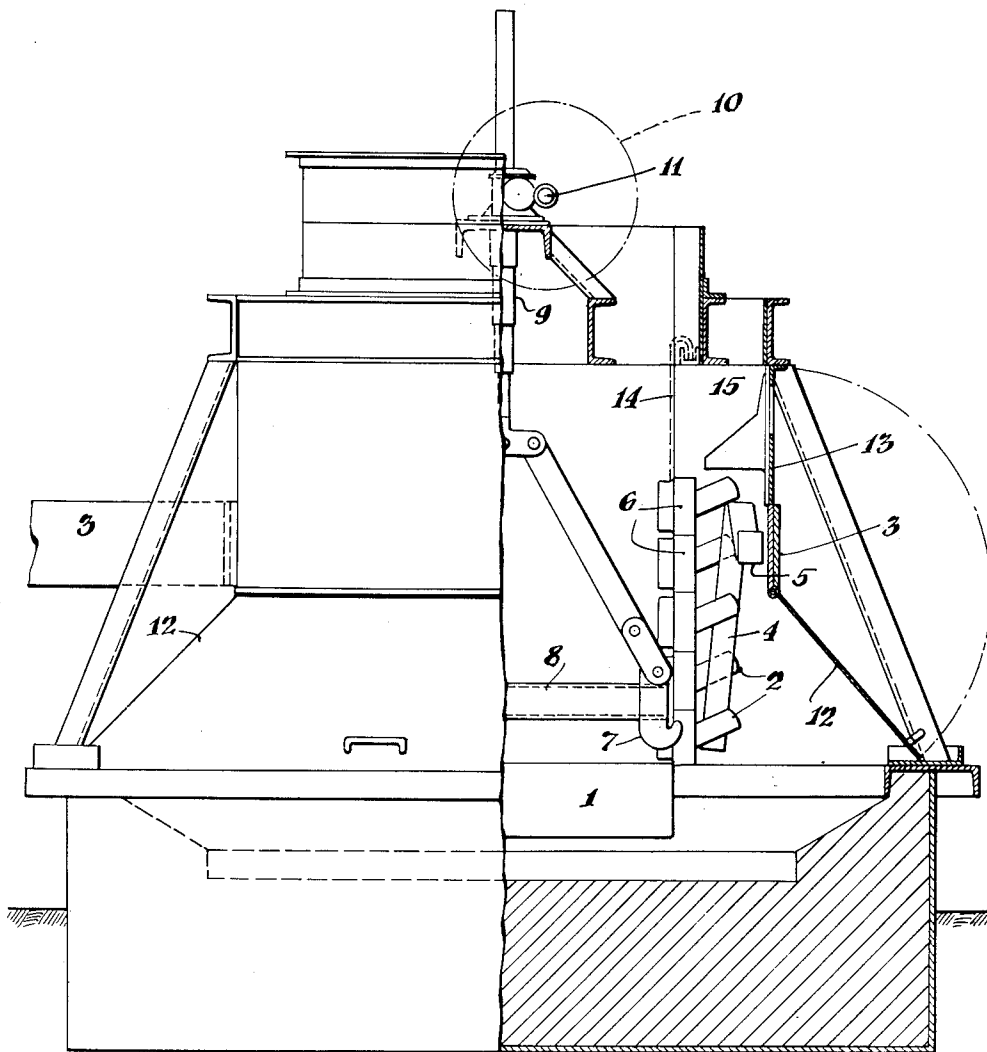
2,330,576

ALUMINUM FURNACE

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2 Sheets-Sheet 1

Fig. 1



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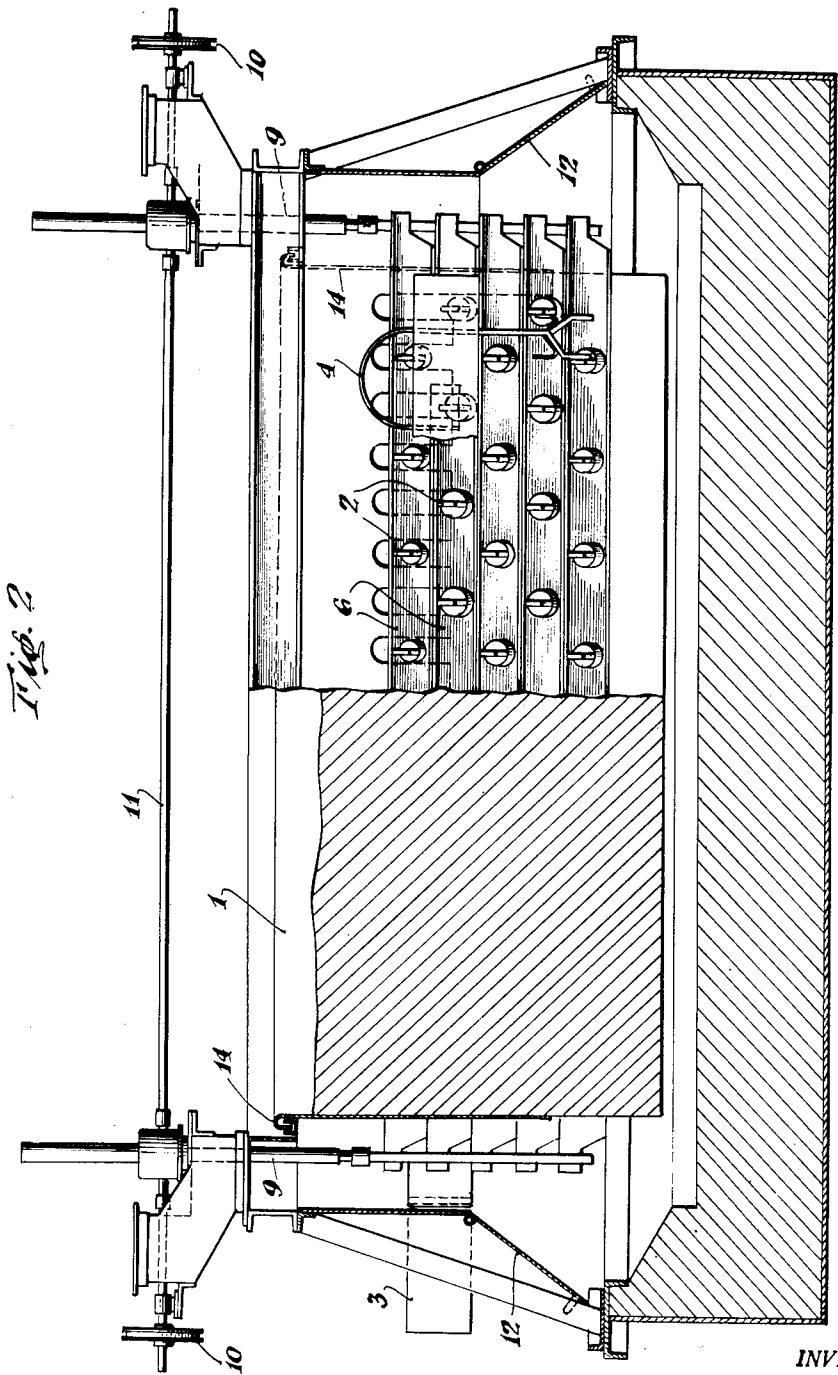
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ALUMINUM FURNACE

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Application March 28, 1942, Serial No. 436,585
In Norway April 2, 1941

4 Claims. (Cl. 13-18)

In the production of aluminum by the use of the continuous Soederberg electrode, it is now generally accepted practice to use the enclosed type of furnace. In these furnaces it is customary to employ electrodes of oblong horizontal cross-section which are provided with metal contacts (usually of iron) which are forced into the electrode at a point where it is hardened sufficiently to keep these contacts in place but above the point where there is danger of the electrode being cracked or of any great force being necessary to drive in the contact. Subsequently these contacts are removed before the corresponding part of the electrode reaches the metal bath.

Due to the necessity of carrying on these operations while the electrodes are in use, it has been necessary to have the sides of the electrodes sufficiently accessible so that these contact members can be inserted and removed and the necessary electrical connections to these members from the bus bars properly made. This has required that the bus bars be located relatively high up above the molten metal and as a result it has been necessary either to pass the electrical connectors through the enclosure of the furnace (which is disadvantageous because of the problems of electrical insulation and gas leakage) or else the enclosure of the furnace has had to be relatively high. For example, in ordinary construction the furnace roof may be as much as 2 meters above the molten bath. This occasions difficulties in connection with the proper withdrawal of the gases from the furnace, and at the same time has added substantially to the expense of installation, due to the vast amount of copper employed in the electrical circuits. In this connection, it must be borne in mind that a modern aluminum plant may comprise from 300 to 400 separate furnaces in one installation and each furnace may operate at from 20,000 to 60,000 amperes.

I have now discovered that it is possible to position the bus bars closely adjacent the electrode and quite low down on the sides. By having these bus bars just below the line where the contact members are inserted into the electrode, it is possible to provide sufficient space below the bus bars for making the necessary connections and withdrawal of the contact members and at the same time have the contact members inserted into the electrode at the proper stage in their hardening.

With the bus bars in this position, a particular arrangement of flexible current connectors

is necessary to connect the bus bars to the contact members. These must be flexible to permit the electrodes to move, and this ordinarily requires an arching of the connecting member above the bus bar to allow for the necessary movement. Such flexible connecting members ordinarily would interfere with the insertion of the contacts but this can be avoided by spacing them so that they run down between rows of contact members.

The contact members are ordinarily arranged in staggered relation as between successive horizontal rows, with the contact members in alternate horizontal rows in line vertically. It is one of the features of my invention that the flexible connectors run down between the vertical rows of contact members and are arranged so that any given connector can be connected to a contact member on either side of it and preferably to contact members on opposite sides simultaneously.

I have found that by supplying the current from a single connector to a contact member in the bottom row (nearest the molten bath) and simultaneously supplying a smaller amount of current to a connector in the row next above the bottom row, which is not vertically in line with the contact member in the bottom row, a particularly even flow of electricity can be had so that the bottom of the electrode burns off evenly, and at the same time by this arrangement I can supply sufficient current to cause a prebaking or hardening of the electrode before the contact members reach a bottom row position where they must carry the weight of the electrode.

The connection to the contact members in the bottom row and next to the bottom row may be arranged in parallel with the result that the current will be divided between these contact members in relation to their respective conductivity. It is to be borne in mind that as the bottom part of the electrode concerns all fully baked carbon of relatively high conductivity while the contact member in the next row above is seated in carbon material which is not fully baked and with relatively lower conductivity, the major part of the current will be carried by the contact member in the lower row. In fact, it will usually work out that less than half as much current will be transmitted to the contact members in the next to the bottom row as is transmitted to those in the bottom row.

The bus bars may be located within the enclosure of the furnace but I have found that

particularly advantageous results can be had where the bus bars themselves form part of the furnace enclosure so that their outer surfaces are exposed to the air to keep the bus bars cool.

This invention can readily be understood by reference to the accompanying drawings, in which Fig. 1 shows an end view of a furnace embodying my invention with one-half in section, and Fig. 2 shows a side view of such a furnace in which one-half shows a section through the electrode and the other half shows a section through the furnace, with the face of the electrode exposed.

In these drawings, the numeral 1 designates the electrode into which are forced metal contact members 2. 3 is the bus bar and 4 designates flexible current connections between the bus bar and the metal contacts 2. In this example the flexible current connections are shown as consisting of flexible copper bands fastened to the bus bars by means of angular supports 5 screwed or welded to the bus bar. These connectors are here shown as bent in such a way that their edge is toward the electrode thereby covering a minimum of the electrode surface, but in any event the connectors 4 pass down between adjacent rows of contact members 2.

As shown in Fig. 2 the flexible connectors 4 are split at their lower end to form four different connecting terminals, two of which are adapted to connect with contact members of a bottom row and two with contact members in the next to the bottom row. By supplying these four connecting terminals it is always possible to have one of the bottom terminals connected to a contact member in the bottom row and the diagonally opposite tip connected to a contact member in the upper row. The contact terminals leading to the upper rows are to carry much less electricity than those leading to the lower rows and therefore their cross-section need be only from 20% to 30% of the cross-section of the contact terminals for the bottom row.

In this case the suspension of the electrode is accomplished by means of iron frames 6 arranged as in Patent No. 2,169,563. In this case these frames are supported by means of hooks 7 fastened to the respective ends of the iron beams 8. These in turn are connected with the spindles 9 which can be moved up and down by means of the wheel 10. One such spindle is provided at each end of the electrode and they are connected by the shaft 11 so that they are moved simultaneously.

The iron beams 8 pass across the ends of the electrode which are not provided with contact members 2. These end surfaces are here shown as covered by a permanent iron plate forming a part of the casing surrounding the electrode.

The frame members 6 can slide in relation to these plates but preferably are connected therewith in such a way that the bars and plates are prevented from being forced outwardly under the influence of the hydrostatic pressure from the soft mass in the upper part of the electrode.

In this illustrative example the bus bars 3 form a part of the furnace enclosure and to them are connected covering plates 12. Suit-

able openings for insertion of the contact members above the bus bars may be provided and these openings are equipped with doors 13 which may be either hinged or sliding. The contact members 2 can readily be inserted through these doors by placing them on supports of proper configuration so that the contact members can be driven into the electrodes at the correct angle through appropriate holes in frame members 6, but at the same time this work is virtually all done on the outside of the enclosure so that the workman is not exposed to the risks of working in the furnace gases. The numeral 14 indicates a portion of the permanent iron casing for the electrode as described for example in the said Patent No. 2,169,563.

The furnace gases are collected through the upper part 15 of the enclosure and are withdrawn through appropriate flues at the ends of the furnace. By this arrangement we have found that the amount of air that needs be admitted into the enclosure is greatly reduced so that the amount of gas that need be treated is greatly reduced.

It is understood that this example is given only by way of illustration and may be modified in many particulars.

What I claim is:

1. In a furnace of the type described, an electrode mass which is hardened as it moves towards the heating zone of the furnace, successive horizontal rows of metal members in the sides of the electrode extending over a zone that runs from that portion of the electrode into which the contact members can be readily forced to a point shortly above the molten bath in the furnace, successive rows of such contact members being arranged in staggered relation to form vertical as well as horizontal rows, bus bars along the sides of the electrode positioned opposite said zone so that the contact members can be driven into the electrode above the bus bars and removed below them and flexible connections positioned between the respective vertical rows of contact members so arranged that they do not interfere with the insertion and removal of the contact members and so that they can be connected to contact members from either adjacent vertical row.

2. A structure as specified in claim 1 in which the flexible connectors are provided with branched terminals so that they may be connected at will to a contact member from a bottom horizontal row and simultaneously to a contact member in the second row on the opposite side of the flexible connector irrespective of which side of the flexible connector the bottom contact member happens to be on.

3. A structure as specified in claim 1 which comprises a furnace enclosure and in which the bus bars form part of the furnace enclosure.

4. A structure as specified in claim 1 which comprises a furnace enclosure and in which the furnace enclosure is closely adjacent to the electrode and separate openings are provided through which contact members can be driven into the electrode without exposing the workmen to furnace gases.

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