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MEANS FOR SUPPLY OF CURRENT TO ELECTRIC FURNACES

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Fig. 1

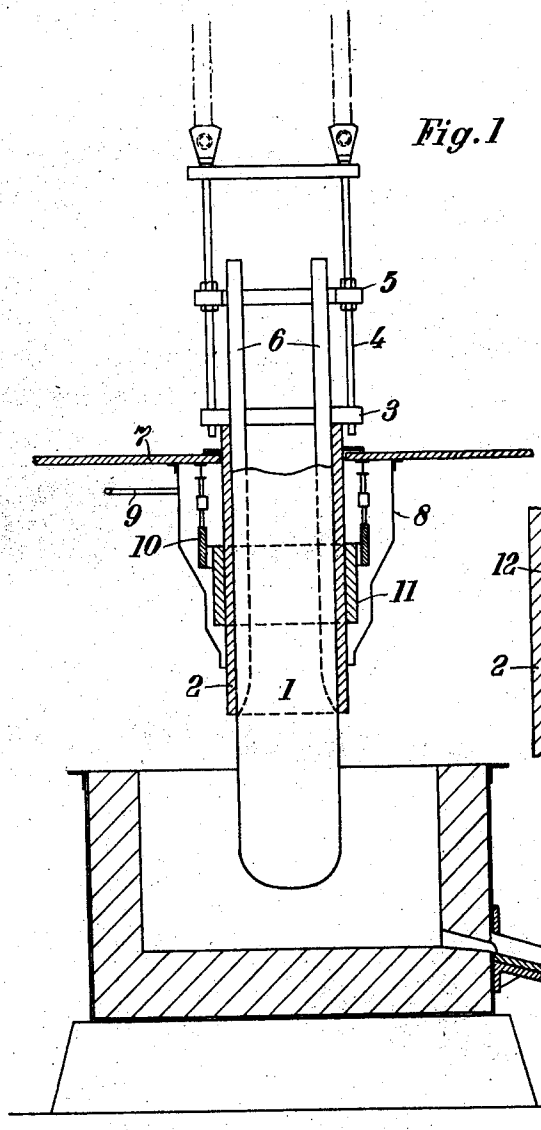
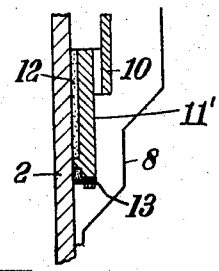


Fig. 2



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MEANS FOR SUPPLY OF CURRENT TO ELECTRIC FURNACES

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6 Claims. (Cl. 13—15)

This invention relates to current supply for electrodes in electric furnaces and while not limited to use in furnaces employing selfbaking electrodes commonly referred to as Söderberg electrodes it is well adapted thereto.

One object of the invention is a reduction in the inductive voltage loss in the supply of current to the electrodes, more particularly in that part of the circuit between the transformer and the electrodes. Such inductive loss is particularly marked where a three-phase current is employed, but it is to be understood that the invention is not limited to furnaces employing multi-phase currents.

Reference being had to the development of Söderberg electrodes, such development has made it possible to construct three-phase furnaces of practically any size desired. Hitherto, however, the size of such furnaces has been limited by electrical conditions commonly referred to as "skin-effect, inductive voltage drop, and dead-phase." In practice the furnace voltage is determined by the resistance in the smelting furnace. It can therefore not be increased over what by experience has been found suitable for each special case. The amperage may be somewhat increased but not more than to a point where the phase displacement will sink to cos. $\phi=0.702$ for the whole system, as a further increase of the amperage at constant voltage will not result in a corresponding increase of the kilowatt development in the furnace.

Applicant has made exact measurements regarding the distribution of the inductive drop of voltage in the system and has for example in one case found that only 3% is in the transformer and that part of the busbars where the individual phases are effectively interlaced. Not less than about 97% of the total inductive loss of voltage is found in the cables leading from the interlaced part to the individual electrodes, in the electrode itself and in the smelting furnace. As the conditions in the smelting furnace are determined by other circumstances which may only in a very small degree be adjusted, applicant in his present invention has solved the difficulties above set forth by an improvement of the electrical conditions by effecting to a reduction of the inductive voltage loss in the non-interlaced part of the system. This part consists principally of flexible copper cables which besides leading the current to the electrodes will also allow these to be moved in the smelting furnace as is necessary to effect the required adjustment of the kilowatt development. Usually the current carrying cables must be long enough to allow a displacement of the electrode holder of about 1–2 meters. The length of the non-interlaced part of the bus bars will then in big furnaces generally amount to 5–6 meters, although the electrode distance is generally not over 1–2 meters.

Applicant has thoroughly investigated these questions, and has found that the flexible cables may advantageously be avoided by instead making use of a slide-contact which by a suitable construction of the current carrying parts surrounding the electrode will secure the movability of the electrode and at the same time allow important reduction of the length of the non-interlaced part of the bus bars.

The reduction of inductive voltage loss is obtained by cable elimination and employment of a sliding contact is particularly advantageous in furnaces employing the construction set forth in U. S. Letters Patent No. 2,193,434, issuing on my copending application Ser. No. 202,896, filed in the United States on April 19, 1938, to which reference may be had.

One object of the invention is an improvement in electric furnace construction and operation by combining the sliding contact arrangement hereof with the structure of said Letters Patent.

In brief, in the construction of the said Letters Patent, a metallic casing is employed which serves as a mold for the electrode replacing the commonly employed mantel, and which at the same time functions as an electrode holder. Current supplied to the casing is directly transmitted to the electrode primarily by contact strips which are embedded therein. The inductive voltage loss occurs in transmitting the current from the transformer to the casing by the usual cable connections and it is in this respect that the sliding contact arrangement hereof has become of great importance.

Further objects of the invention will be apparent as this description proceeds.

In the drawing which forms a part hereof, two forms of the invention are illustrated, but in both instances it must be understood that the drawing is purely illustrative and not limitative on the scope of the invention. In the said drawing—

Fig. 1 is a vertical cross-section of an open electric furnace, the electrode and certain parts being shown in elevation, illustrating the sliding contact arrangement hereof in which the current carrying contact is of a solid conductive material; and

Fig. 2 is a detailed showing in vertical cross-

section of a modified form in which the current carrying contact is primarily of liquid conductive material.

Reference being had to Fig. 1, the electrode 1, illustrated as a selfbaking electrode, has an outer casing 2 which operates both as a mold for the electrode and as a holder therefor. The casing, optionally illustrated as cylindrical, is supported above by a ring 3 which is in turn carried by rods 4 suitably connected with means for raising and lowering the ring and its attached casing 2. The electrode is provided with suitable metallic ribs 6 of conductive material which lead the current to the interior of the electrode. These ribs are connected with a bar 5 supported on rods 4 by suitable means for raising and lowering the bar 5 and its interconnected ribs and electrode in respect to the casing 2. The electrode 1 and its casing 2 extend through a suitable aperture in an electrode platform 7, suitable provision being made for a gas-tight joint between the platform and casing. The construction thus described is more fully set forth in said U. S. Letters Patent No. 2,193,434, to which reference should be had.

The sliding contact by which current is transmitted to the electrode may consist of copper pieces, finger contacts, brushes, or the like, suitably pressed against the casing or holder 2, the outer surface of the holder and the inner surface of the contacts being so constructed and arranged as to assure a good electrical connection. As illustrated in Fig. 1, the sliding contact has the form of a metallic cylinder 11, the inside diameter of which is substantially the same as the outside diameter of the casing or holder 2, only sufficient play being provided to permit of the casing sliding through the contact.

The contact 11 has rigidly attached thereto at the top a plurality of current carrying bus bars 10 by means of which current is supplied to the contact. These bus bars are attached to the electrode platform 7 by suitable means to provide for vertical adjustment. A packing box or the like may conveniently be provided at the bottom of the contact 11 to keep the contact clean and free from dust, in a manner well known to those skilled in the art. Such a contact is, for example, illustrated at 13 in Fig. 2. As an additional means for protecting the sliding contacts I may if desired enclose the sliding contacts with a compression chamber 8 suspended from the electrode platform 7 and conveniently supplied with pressure air through pipe 9, said compression being only schematically illustrated.

As above set forth the structure in the form shown in Fig. 2 differs from that of Fig. 1 only in the provision of a conductive liquid material for making the sliding contact with the electrode casing or holder. In Fig. 2, therefore, the parts corresponding with those of Fig. 1 bear the same reference numerals as in Fig. 1. The cylindrical contact member or sleeve, numbered in Fig. 2, 11', is cut away on the inside to form an annular chamber with the casing or holder 2. In this chamber is carried the liquid conductive material 12 to be employed, such, for example, as mercury.

The sleeve 11' at the bottom is provided with packing 13 which is in contact with the casing or holder 2 so as to keep the sliding contact clean and free from dust, as above set forth. Likewise as in the case of Fig. 1, a compression chamber 8 may conveniently be employed.

To control the action of the slide contact whether in the form of Fig. 1 or that of Fig. 2 the electrode platform should be provided with suitable openings through which the action of the slide contact may be observed. One of said openings should preferably be sufficiently wide to allow a man to pass and inspect and repair the slide contact if difficulties in the operation should arise. This is however not shown in the drawing.

The operation of the sliding contact arrangement hereinabove described will be apparent from the description. A good electrical connection is maintained between the contact and the casing or holder 2 in both forms as the said casing or holder 2 is lowered with the electrode into the furnace in the operation thereof, and inductive voltage loss is prevented by the elimination of the usual wire connections heretofore referred to.

In closed furnaces conditions are considerably more favorable than in open furnaces as the slide contact may then be placed low down on the electrode, if desired in the furnace roof opening, as the electrode holder must then be able to reach more or less down into the furnace.

In this way it is possible to reduce the length of the electrode below the holder, whereby the reliability of operation of the electrode is increased and at the same time the electrical conditions greatly improved.

It is self-evident that on account of wear on the slide contact it is advantageous to adjust the load of the furnace by voltage regulation whereby the movement of the electrodes in the furnace is reduced as far as possible.

The foregoing detailed description has been given for clearness of understanding and no undue limitation is to be inferred therefrom.

I claim:

1. In an electric furnace, the combination of an electrode, an electrode holder of conductive material in which the electrode is slidably mounted, the electrode holder being mounted for movement with the electrode toward and away from the charge, and means for supplying current to the electrode comprising a member so constructed and arranged as to maintain a sliding contact with the electrode holder and a bus bar rigidly attached to the said member.

2. In an electric furnace, the combination of an electrode, a cylindrical electrode holder of conductive material in which the electrode is slidably mounted, the electrode holder being mounted for movement with the electrode toward and away from the charge, and means for supplying current to the electrode comprising a cylindrical member slidably mounted on the electrode holder and a bus bar rigidly attached to the said cylindrical member.

3. In an electric furnace, the combination of an electrode, an electrode holder of conductive material in which the electrode is slidably mounted, the electrode holder being mounted for movement with the electrode toward and away from the charge, and means for supplying current to the electrode comprising a member mounted adjacent to the electrode holder, liquid conductive material carried by the said member in sliding contact with the electrode holder and a bus bar rigidly attached to the said member.

4. In an electric furnace, the combination of an electrode, a cylindrical electrode holder of conductive material in which the electrode is slidably mounted, the electrode holder being mounted for movement with the electrode toward and away from the charge, and means for supplying current to the electrode comprising a cylindrical member surrounding the electrode holder and relatively movable in respect thereto, liquid

conductive material carried by the said member in sliding contact with the electrode holder and a bus bar rigidly attached to the said cylindrical member.

5. In an electric furnace, the combination of an electrode, an electrode holder of conductive material in which the electrode is slidably mounted, the electrode holder being mounted for movement with the electrode toward and away from the charge, means for supplying current to the electrode comprising a member so constructed and arranged as to maintain a sliding contact with the electrode holder and a bus bar rigidly attached to the said member, and a pressure chamber surrounding the sliding contact parts to maintain tne contact parts free from furnace dust and gas.

6. In an electric furnace, the combination of an electrode, a cylindrical electrode holder of conductive material in which the electrode is slidably mounted, the electrode holder being mounted for movement with the electrode toward and away from the charge, means for supplying current to the electrode comprising a cylindrical member surrounding the electrode holder and relatively movable in respect thereto, liquid conductive material carried by the said member in sliding contact with the electrode holder and a bus bar rigidly attached to the said cylindrical member, and a pressure chamber surrounding the sliding contact parts to maintain the contact parts free from furnace dust and gas.

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