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ELECTRIC SMELTING FURNACE.

APPLICATION FILED MAY 1, 1906.

953,029.

Patented Mar. 29, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

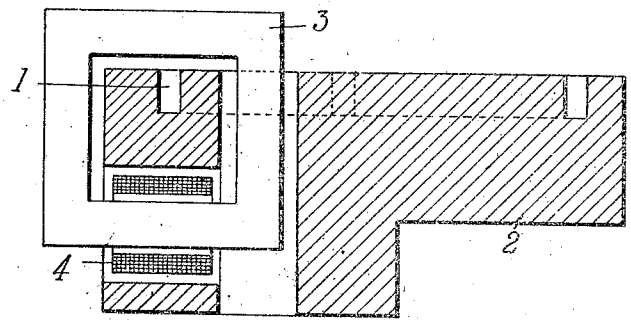
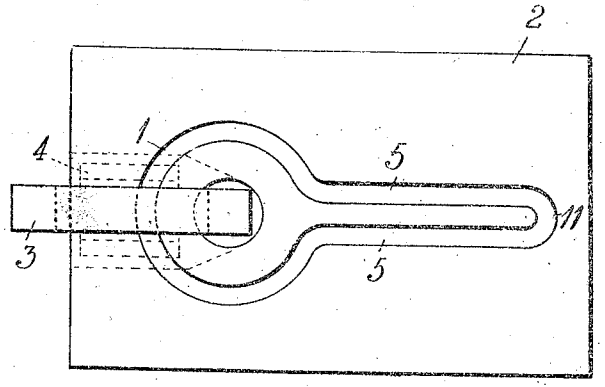


Fig. 2.



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3 SHEETS—SHEET 2.

Fig: 3.

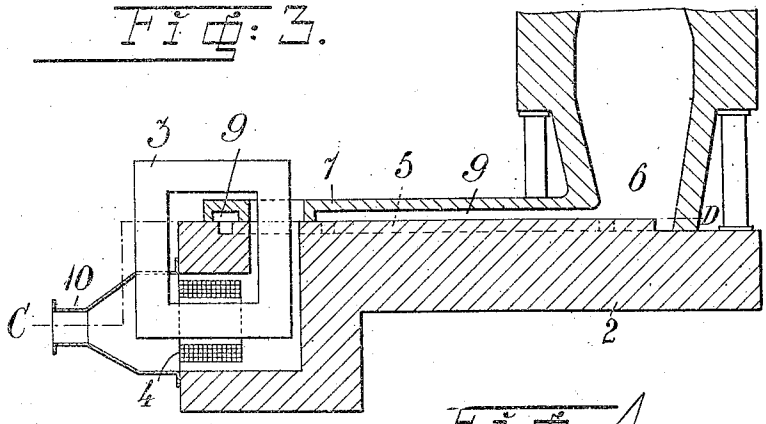


Fig: 4.

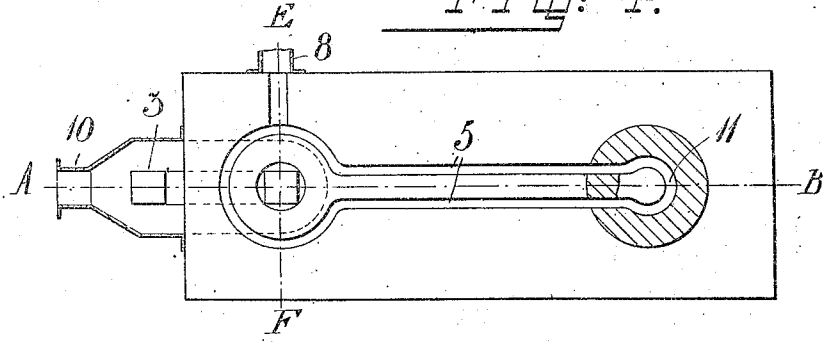
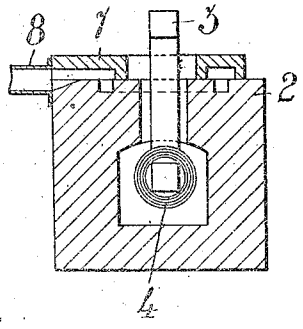


Fig: 5.



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3 SHEETS—SHEET 3.

Fig. 6.

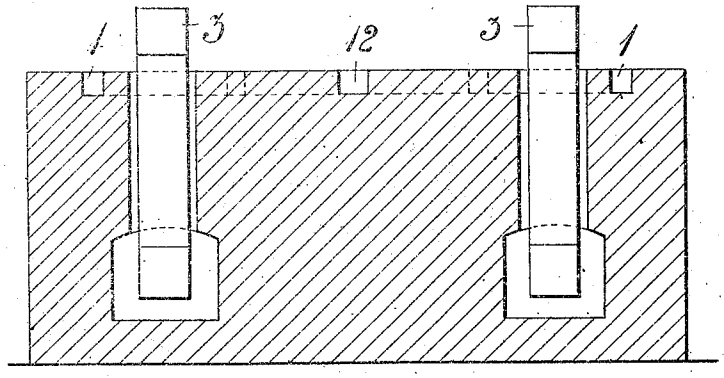
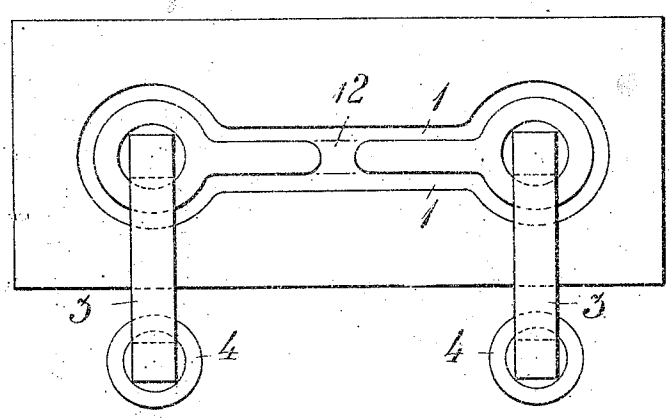


Fig. 7.



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UNITED STATES PATENT OFFICE.

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ELECTRIC SMELTING-FURNACE.

953,029. Specification of Letters Patent. **Patented Mar. 29, 1910.**

Application filed May 1, 1906. Serial No. 314,662.

To all whom it may concern:

Be it known that we, EUGEN ASSAR ALEXIS GRÖNWALL, AXEL RUDOLF LINDBLAD, and OTTO STÅLHANE, engineers, subjects of the King of Sweden, residing at Ludvika, in the Kingdom of Sweden, have invented certain new and useful Improvements in Electric Smelting-Furnaces.

The present invention relates to improvements in electric furnaces of the so-called transformer-type where the crucible is formed of an endless groove intended for the reception of the material to be treated which material alone or together with other conducting materials placed in said groove forms the secondary coil of an electric transformer.

The invention consists in a special form of the said groove or canal which is intended for the reception of the material to be treated and in the combination of the said groove with two or several transformers.

The invention also consists in the combination of the smelting groove or canal of the said special form with a blast furnace or other similar furnaces.

In the use of electric smelting furnaces of the above mentioned type and of the constructions hitherto known certain difficulties have been experienced consisting partly therein that a great difference of phases takes place which becomes greater, the greater the area which is inclosed by the said groove forming the hearth or crucible and partly therein, that only an electric current of relatively low tension may be used in the charge. According to the present invention these difficulties are overcome thereby, that the said endless groove intended for reception of the charge to be heated or smelted and which as usual incloses a part of the iron core of the transformer is partly bent around the said core but provided with one or more relatively long projections or arms formed in such a way that certain parts or branches of said groove are arranged substantially parallel to each other and so near each other as is practicable which parts or branches at their outer ends are connected with each other in such a way that the same together with the parts partially bent around a part of the said core form an endless groove or canal. By giving the said groove or canal this form, it will have a comparatively great volume but at the same time incloses a comparatively small area which is a considerable advantage. Another advantage is that a greater working tension in the charge may be used than otherwise, which tension will be greater, the longer the said projection or projections of the smelting groove. Thus the electric machinery necessary for carrying out the work of the furnace may be considerably cheaper than with the use of the constructions before known. An electric smelting furnace of this construction can also suitably be combined with a blast furnace or another similar furnace in such a way that the projecting part or parts of the groove of the electric furnace—or in general words, the parts of the groove arranged substantially parallel to and near each other—is drawn into or through the hearth of the furnace. Thus the hearth of the blast furnace will consist of a part of the smelting groove of the electric furnace, and the material heated or smelted in the blast furnace will directly drop down into the smelting bath of the electric furnace and will there be submitted to further treatment by means of an electric current.

On the accompanying drawings there are, as examples, shown some forms of construction of the invention.

Figure 1 is a vertical section of a transformer furnace in accordance with the present invention. Fig. 2 is a plan view of the same. Fig. 3 is a vertical section on the line A—B in Fig. 4 of such an electric furnace combined with a blast furnace. Fig. 4 is a plan view of the same and partly in section on the line C—D in Fig. 3 and Fig. 5 is a transverse section on the line E—F in Fig. 4. Fig. 6 is a vertical section and Fig. 7 a plan view of another form of the invention.

In the several figures the same parts are indicated with the same figures of reference.

Referring to Figs. 1 and 2, 1 is the endless groove or canal arranged in a frame 2 of brickwork or the like and intended for the reception of the material to be treated. Said groove incloses as usual one leg 3 of the transformer core and 4 indicates the primary coil of the transformer. The said groove 1 is partly bent around the one leg of the iron core so as to form a nearly closed circuit, but is provided with one (or

several) relatively long projection or arm formed by the parts or branches 5 of said groove being arranged parallel (or substantially parallel) to and so near each other as practicable, the said parts being at their outer ends 11 connected with each other so that an endless groove is formed. In transformer furnaces where alternate electric two- or multiphase current is used, the groove may also be provided with such arms or projections, in which case the ends of the same may be connected so as to form an electric "zero-point."

When the groove intended for the reception of the material to be treated is given the form above stated, a part (for instance at 11) of the projection or arm of the same may be placed within the hearth of a blast furnace or another similar smelting furnace. Such an arrangement is shown on the drawing in Figs. 3, 4 and 5. In these figures, 5 indicates the parts of the groove that form the projecting arm. Said parts enter into the hearth of the blast furnace 6 (or a similar furnace) where they are connected with each other in the way shown in Fig. 4. The material heated and reduced within the blast furnace may thus, in a melted or heated condition drop down directly into the said groove of the electric furnace, where it is submitted to the action of electric current. In this case the electric current will pass through the hearth or through the smelting zone of the blast furnace, thereby generating a quantity of heat, sufficient to make up for the quantity of coal or other fuel that otherwise would be necessary for the smelting of the ore within the blast furnace. The groove 1 is suitably covered with a vault or with plates 7 of fireproof or refractory material, so that a covered canal or passage 9 is formed.

It will in some cases be preferable to reintroduce the gases issuing from the blast furnace or a part of said gases into the lower part of the said furnace through the pipe 8 and the above mentioned passages 9, whereby a continuous circulation of the gases through the blast furnace is obtained. Besides that, by means of these arrangements, the introduction of gases into the blast or smelting furnace may be carried out in a very simple and practical manner, the advantage is also gained that when the said gases pass through the passage 9 over the smelted mass in the groove 1, said gases absorb heat that radiates from the slag, covering the smelted iron in said groove so that said heat may be utilized for the process going on in the blast- or smelting furnace. Canals or passages 12 are also provided for leading air to the transformer for the purpose of cooling the same.

In the Figs. 6 and 7 a form of the invention is illustrated according to which the smelting groove incloses two transformer cores 3. In this case the groove is thus formed, that its end portions are partly bent concentrically around a leg of the cores of the transformers and its middle portions are arranged substantially parallel and near each other (see the full lines in Fig. 7). This latter arrangement may in some cases be preferable for instance in the case where it is desirable to provide a collecting room for the smelted mass, in which the temperature shall be kept lower than in other parts of the grooves. Through employment of two transformers for one and the same smelting bath or groove the advantage also is gained that if a fault occurs in one of the transformers this transformer may be cut out of use and repaired while the smelting bath is kept heated with the aid of the other transformer.

Having thus described our invention we declare that what we claim is:

1. In an electric transformer furnace, an electric transformer, the furnace having an endless groove or crucible for the material to be treated that is formed partly of a channel or groove arranged close around the leg of the transformer to form a nearly closed circuit, and formed partly by a projection extending from the ends of said part and formed of grooves or channels arranged near each other and connected with each other and with the first mentioned part whereby all such parts form a continuous endless groove or channel.

2. In an electric transformer furnace the arrangement of a plurality of transformers, parts of the different transformer cores being inclosed by a member having a common endless groove adapted for the reception of the material to be smelted, portions of said groove being bent around each of the said parts of the transformer cores so as to form a nearly closed circuit, said portions of the groove being united with each other by grooves arranged substantially parallel and in close proximity in such a way, that all these parts together form an endless groove.

3. In an electric transformer furnace a plurality of transformers, a member having an endless groove adapted for the reception of the material, portions of said groove being arranged substantially parallel and in close proximity, said member having a basin for the smelted product arranged to unite said portions of the endless groove.

4. In a transformer furnace the combination of a member having an endless groove adapted for the reception of the material to be treated, portions of said groove being arranged substantially parallel and in close proximity, and a smelting furnace into which a portion of the groove extends.

5. In a transformer furnace the combination of a member having an endless groove

adapted for the reception of the material to be treated and a smelting furnace into which the groove portion extends, portions of said groove being arranged substantially parallel and in close proximity, said grooves being covered so as to form closed passages extending into the smelting furnace said passages being provided with inlets for introducing suitable gases into the smelting furnace.

In testimony that we claim the foregoing as our own, we have hereto affixed our signatures in the presence of two witnesses.

EUGEN ASSAR ALEXIS GRÖNWALL.
AXEL RUDOLF LINDBLAD.
OTTO STÄLHANE.

Witnesses:
JOHN ANDERSSON,
BERNHARDT RYDT.