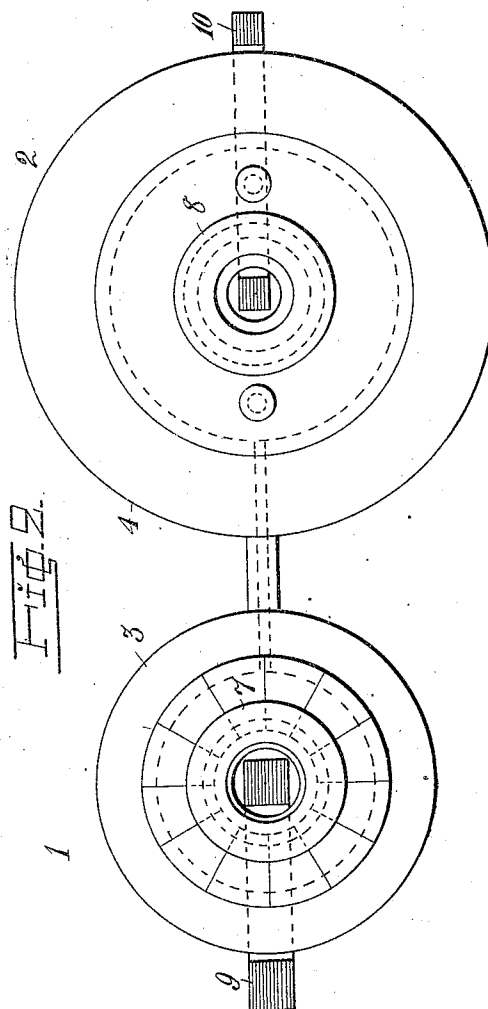
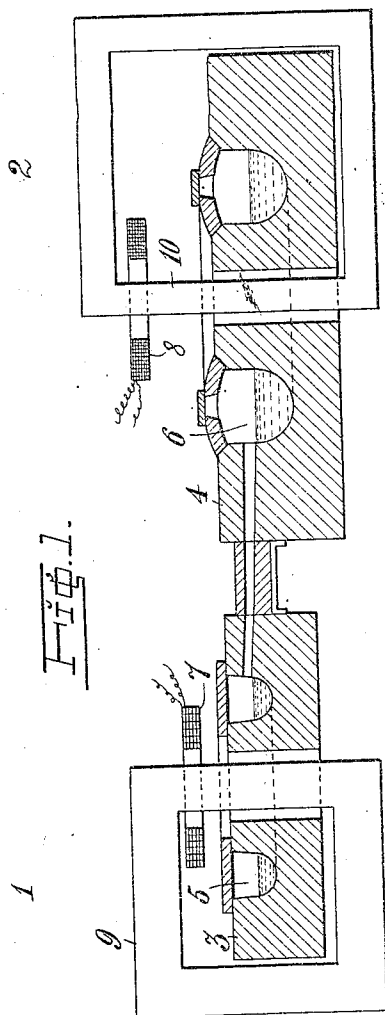


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METHOD OF WORKING METALS, ORES, AND THE LIKE.
APPLICATION FILED AUG. 31, 1905.

938,752.

Patented Nov. 2, 1909.



Witnesses

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UNITED STATES PATENT OFFICE.

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METHOD OF WORKING METALS, ORES, AND THE LIKE.

938,752.

Specification of Letters Patent.

Patented Nov. 2, 1909.

Application filed August 31, 1905. Serial No. 276,519.

To all whom it may concern:

Be it known that I, OTTO FRICK, a subject of the King of Sweden, and a resident of Saltsjöbaden, in the Kingdom of Sweden, have invented new and useful Improvements in Methods of Working Metals, Ores, and the Like, of which the following is a specification, reference being had to the drawing accompanying and forming a part hereof.

This invention relates to an improved method of working, whereby the power factor may be increased in the melting of metals, ores, and the like, and in reducing ores by means of electric transformer furnaces.

In melting metals and the like the melting of the principal parts of the charge as well as the following treatment, *i. e.*, the refining and the addition of special materials or chemical combinations for imparting special qualities to the product, and so forth, were hitherto usually accomplished in one and the same furnace, the material to be melted and the melted mass forming a single conductor of approximately constant cross-section. The said method has, however, a great disadvantage, inasmuch as it is difficult to treat large charges by it, the self-induction being very considerable and, consequently, the power factor becoming very small. The power factor decreases nearly in proportion to the increase in the cross-section and in the weight of the charge.

The British patent No. 28,805 of Charles Prosper Eugène Schneider, dated December 31st, 1903, discloses an electric transformer-furnace, the object of which is to render it possible to treat large charges, while obviating too large lag, a furnace being used wherein the larger part of the melting-room has a considerably reduced cross-section.

The object of the present invention is to make it possible to treat charges of any size by means of transformer-furnaces.

The invention consists in carrying out the treatment in two separate transformer-furnaces the first of which is constructed for a comparatively small charge and great consumption of energy, essentially for melting the principal parts of the material to be produced, while the second furnace, which is constructed for a large charge and is capable of storing the melted materials as they are continuously or intermittently poured into it from the first furnace, is adapted for a comparatively small consumption of energy and is mainly used to keep the melted ma-

terials at constant heat until the whole charge is ready. The favorable influence of this method on the power-factor in the primary circuit will be easily understood by an example. Supposing the angle of lag to be $= \gamma$ the same can be estimated by the following equation:

$$\tan. \varphi = c. \sim \frac{1}{r} \left(\frac{1}{W_p} + \frac{1}{W_s} \right),$$

if the current necessary for the magnetization of the transformer core is small, so that the ampere-turns of the primary winding may be supposed to be equal to those of the bath, which is practically the case in every well-designed transformer.

In the above equation c = a constant, $\sim$ = frequency per second, r = resistance of the melting-bath in ohms, W_p = magnetic resistance of the primary flux of leakage. W_s = magnetic resistance of the secondary flux of leakage. From this formula it is seen that $\tan. \varphi$ is universally proportional to the resistance of the melting bath. The resistance of the bath evidently decreases with increasing cross-section and weight of charge. The power-factor, or cosine φ decreases as $\tan. \varphi$ increases. Consequently, the power-factor decreases with increasing cross-section and weight of bath. If, for instance, one transformer-furnace were to be used for melting a charge of 15 tons of steel, the cross-section of the melting-bath being constant, the lag between current and voltage, for instance at 25 periods a second, would correspond to a power factor $\cos. \varphi = 0.20$,

that is to say the current would be $\frac{1}{0.2} = 5$ times larger than if the power factor, or the $\frac{\text{real power}}{\text{apparent power}}$ were = 1. As the leads and the copper windings of the dynamo are to be dimensioned to suit the current, it is evident that they must be calculated for 5 times the real power.

If the furnace-plant be constructed according to my present invention, and the larger furnace be adapted for a charge of 15 tons, then, under the same conditions, the power factor of this furnace is also $\cos. \varphi = 0.20$. As, however, the principal function of this furnace is to maintain the molten steel at a constant temperature, the energy consumed has, practically, only to cover losses due to heat radiation, and may for instance amount to only 10 per cent. of the total energy required for the whole melting

process. The other 90 per cent. of the total energy is consumed in the smaller furnace in which the materials are melted and which, thus, requires a greater energy. By constructing the smaller furnace for instance for a charge of 1 ton, the power factor of the same can be increased without difficulty to $\cos. \varphi = 0.6$. The leads and the generator thus in this case need only be calculated for an apparent power of

$$\frac{0.9}{0.6} + \frac{0.1}{0.2} =$$

twice the real power.

This useful result is obtained without losing any advantage of the usual transformer-furnace. On the contrary, further advantages are gained over the well known single transformer-furnaces, which are not suited for continuous working if different products, such as alloys of steel and chromium, tungsten, nickel, and so forth, are to be produced, one after another. It is a well-known fact that a transformer-furnace must always have a molten continuous bath, for which reason it is necessary to leave part of the bath in the furnace from one charge to the next. In making ordinary carbon steels this is not very inconvenient, but in making steel-alloys it may not be desirable to leave a part of a charge of nickel-steel to a following charge of chrome-steel.

When using two furnaces, according to this invention, this inconvenience does not occur as the addition of special materials, such as nickel, chromium, and so forth, is effected in the large furnace, which may be totally emptied after each charge, it being refilled from the smaller furnace.

By using two furnaces the continuous working and the full continuous utilization of the available machinery will also be improved in cases where the melted material requires a certain time for refining, as a new charge may be started in the small furnace during the time the preceding charge is being refined in the larger one.

The two furnaces may be supplied with current by means of a common generator or by separate generators.

In order to gain the above mentioned result it is necessary to dimension the core and the primary winding of the smaller furnace in such a manner that a higher effective voltage will be generated in its bath and that the greater part of the power will be consumed by the said furnace in spite of the higher resistance of the bath. The iron-core and the primary winding of the larger furnace must, on the other hand, be so di-

mensioned that the bath of the same consumes a comparatively small amount of energy. This is carried out in such a manner that the smaller furnace has a magnet-core of a larger cross-section and is generally worked with a smaller number of turns in the primary coil than the larger furnace.

In the drawing, Figures 1 and 2 show, in vertical section and plan-view, respectively, a furnace-plant adapted to be used in carrying out the process above described.

Referring to the drawing, 1 is the smaller furnace in which the main melting-process is accomplished and from which the melted material is conveyed, either continuously or intermittently into the larger furnace 2, which serves as a refining furnace and as a storage receptacle, until the whole charge is ready. 3 and 4 are masonry of fire-proof or other suitable material. 5 and 6 are the ring-shaped crucibles inclosed in the masonry. 7 and 8 are the primary windings supplied with alternating electric current from the same source of current, or from two separate sources of current. 9 and 10 are the magnet cores.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of increasing the power factor in treating ores and metals by means of electric transformer furnaces, which consists in melting the principal part of the charge in one transformer furnace, conveying the melted material from the said furnace into another transformer furnace adapted to hold an essentially larger charge than the former one, and refining and storing the said material in the said larger transformer furnace, substantially as and for the purpose set forth.

2. The method of increasing the power factor in treating ores and metals by means of electric transformer furnaces, which consists in melting the principal part of the charge in one transformer furnace, conveying the melted material from the said furnace into another transformer furnace adapted to hold an essentially larger charge than the former one, and storing the said material in the said larger transformer furnace, substantially as and for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

OTTO FRICK.

Witnesses:

EDWARD L. ADAMS,
CARL FRIBERG.