

1,336,017.

Fig. 1.

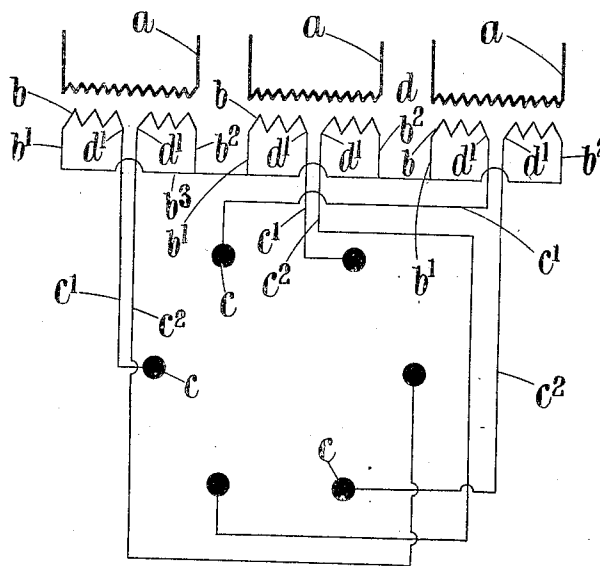
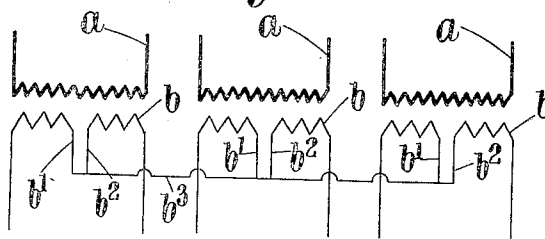


Fig. 2.



by Laurence Langner Attorney

UNITED STATES PATENT OFFICE.

JAMES BIBBY AND JENS O. BOVING, OF LONDON, ENGLAND, ASSIGNORS TO ELECTRO-METALS LIMITED, OF LONDON, ENGLAND.

ELECTRIC BLAST-FURNACE.

1,336,017.

Specification of Letters Patent.

Patented Apr. 6, 1920.

Application filed January 16, 1919. Serial No. 271,348.

To all whom it may concern:

Be it known that we, JAMES BIBBY and JENS ORTEN BOVING, subjects of the King of Great Britain, residing at 56 Kingsway, London, W. C. 2, England, have invented new and useful Improvements in or Relating to Electric Blast-Furnaces, of which the following is a specification.

This invention relates to electric blast furnaces in which polyphase current derived from suitable transformers is utilized to produce heat by ohmic resistance between electrodes entering the charge as distinguished from arc heat between electrodes above the charge. In order to obtain proper distribution of the heating zone in such furnaces, a number of pairs of electrodes are used which generally penetrate the roof of the crucible or lower part of the furnace. The electrodes enter the raw material, consisting of iron ore, carbon and fluxing agents, and the heat is generated by the passage of current between the electrodes, the material and the interstices between the particles thereof forming the desired resistance.

The current is usually obtained from three single-phase transformers or one three-phase transformer having primary windings connected in star or delta arrangement. The terminals of the respective secondary windings are connected to diametrically opposite electrodes so that the heating arrangement of the furnace consists of three independent single phases.

It is found in practice that although the tension between any pair of diametrically opposite electrodes is constant, the tension between any other pair of electrodes varies so that the current between said electrodes will vary and cause a corresponding variation of the heating zones in the furnace. This irregular heating effect causes portions of the lining and especially the roof of the furnace to be excessively heated so that the roofing material is fused and the structure rapidly destroyed. Moreover, if for any reason an electrode or its connections are broken, the other electrode associated therewith will be rendered inoperative and the single phase between said electrodes will disappear.

The chief object of the present invention is to eliminate the aforesaid defects and provide a furnace in which the heating effect is uniform and not seriously affected

by the breakage or injury of one of its electrodes.

To secure this result we employ three single-phase transformers or a single three-phase transformer and connect the neutral points of the three secondaries together. This is a known form of connection in transformers used with arc furnaces where it is adapted for a different purpose and our invention may therefore be stated to consist in an electric blast furnace wherein the heating by ohmic resistance derived from the current from three single-phase transformers or a single three-phase transformer having three secondaries which are interconnected at their neutral points takes place uniformly owing to the constant tension maintained not only between any pair of diametrically opposite electrodes but also between any other pair of electrodes. Thus if the electrodes are assumed to be placed at the corners of a hexagon and numbered in rotation the tension is maintained constant not only between electrodes 1 and 4 but also between 1 and 2 and between 1 and 3. Similarly with regard to any other electrode.

In order that the said invention may be clearly understood and readily carried into effect the same will now be described more fully with reference to the accompanying drawings in which:

Figure 1 is a wiring diagram for a furnace embodying the present invention, and

Fig. 2 is a diagram of a modified arrangement of the wiring.

The heating current is derived from three single-phase transformers or one three-phase transformer having primary windings *a* connected in star or delta arrangement and secondary windings *b* which have their neutral points connected through leads *b*¹, *b*² and *b*³ so that the resulting current phases passing through the six electrodes *c* of the furnace are maintained in definitely fixed relationship. The electrodes *c* are connected to the terminals *d*, *d'* of the respective secondary windings *b* and the arrangement is such that oppositely disposed electrodes are connected to the secondary terminals by the leads *c*¹, *c*². In some cases, the leads *b*¹, *b*² and *b*³ connecting the neutral points of the transformer secondaries, may be earthed or, the neutral points of the secondaries may be connected in any of the

recognized ways to suit particular requirements.

The arrangement shown in Fig. 2 differs from that shown in Fig. 1, in that the neutral points of the secondary windings are differently located. Otherwise the two arrangements are substantially the same.

By connecting the windings in this way the several phases are anchored together so that instead of three single independent phases, there is virtually produced six phases of fixed and definite relationship.

Consequently under normal conditions the heating is regular throughout the heating zones so that the efficiency and life of the furnace is considerably enhanced. Moreover should one of the electrodes be disconnected or injured in any way the other five electrodes will operate as a temporary five-phase heating system.

What we claim and desire to secure by Letters Patent of the United States is:—

1. In an electric resistance blast furnace, the combination with a plurality of symmetrically arranged electrodes, of a source of polyphase currents connected to the electrodes, and means whereby a constant tension is maintained not only between any pair of diametrically opposite electrodes but also between any other pair of electrodes.

2. In an electric resistance blast furnace, the combination with a plurality of symmetrically arranged electrodes, of a source

of polyphase currents connected to the electrodes, and means whereby the respective differences in tension between any one electrode and all the other electrodes is the same whichever electrode is considered.

3. In an electric resistance blast furnace, the combination with six hexagonally arranged electrodes, of a source of polyphase current connected to the electrodes, and means whereby the respective differences in tension between any one electrode and all the other electrodes is the same whichever electrode is considered.

4. In an electric resistance blast furnace, the combination with a plurality of electrodes, of a source of electric currents having a plurality of phases, transformer windings interposed between the source of currents and the electrodes, and means whereby the current phases through the electrodes are maintained in definite fixed relationship.

5. In an electric resistance blast furnace, the combination with six hexagonally placed electrodes, of a source of electric currents of three phases, transformer windings interposed between the source of currents and the electrodes, and means whereby the respective differences in tension between any one electrode and all the other electrodes is the same whichever electrode is considered.

J. BIBBY.
J. O. BOVING.