E. K. SCOTT.

ELECTRIC FURNACE.

APPLICATION FILED FEB. 25, 1916.

1,203,276.

Patented Oct. 31, 1916.

FIG. 1.

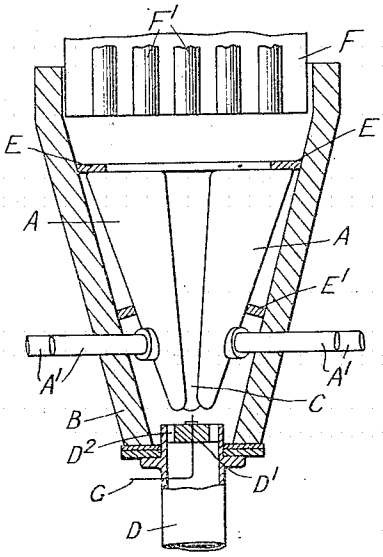



FIG. 3.

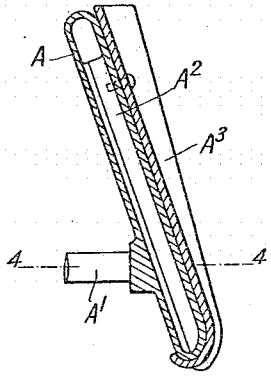



FIG. 2.

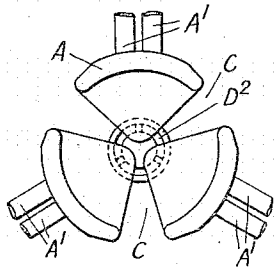



FIG. 4.

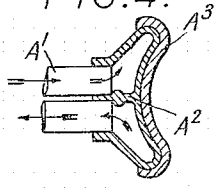



FIG. 5.

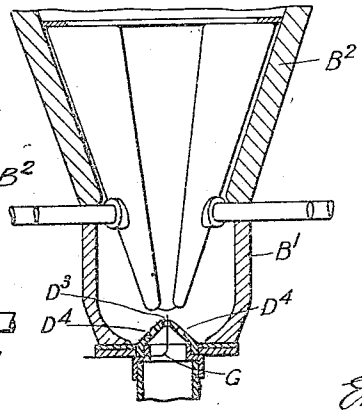
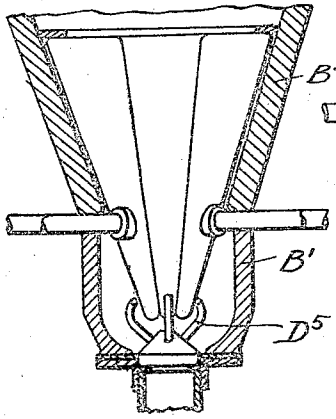



FIG. 6.




Inventor
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# UNITED STATES PATENT OFFICE.

ERNEST KILBURN SCOTT, OF BELVEDERE, ENGLAND, ASSIGNOR TO ATMOSPHERIC NITRATES (KILBURN SCOTT PATENTS) LIMITED, OF MANCHESTER, ENGLAND.

## ELECTRIC FURNACE.

1,203,276. Specification of Letters Patent. Patented Oct. 31, 1916.

Application filed February 25, 1916. Serial No. 80,437.

*To all whom it may concern:*

Be it known that I, ERNEST KILBURN SCOTT, subject of the King of England, residing at Belvedere, Kent, in England, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

This invention relates to electric furnaces and has particular reference to furnaces for the fixation of nitrogen from the atmosphere.

The primary object of the invention is to increase the efficiency of such furnaces by insuring that practically all the air which enters the furnace passes through the arc. This object is attained according to this invention by the employment of electrodes so shaped and disposed that they inclose a central space, which is preferably in the form of an inverted cone, arcing gaps being provided between adjacent electrodes.

In a preferred arrangement each electrode is provided with a shield-like plate which forms the active portion of the electrode the shape and proportions of each plate being such that when the electrodes are arranged in their operative position in the furnace, the plates inclose a central space to which air can pass through gaps between the sides or edges of adjacent plates. These spaces or slots are comparatively narrow and in practice it is found that arcing takes place over the whole length of the slot. Thus if the air be caused to enter the central space from outside the electrodes it must necessarily pass through the arcs. To insure this direction of the air as far as possible a baffle or partition of some suitable refractory material is placed in the furnace over the electrodes so as to close or substantially close the space between the electrodes and the furnace wall. The air inlet at the bottom of the furnace is preferably of annular form so that the air first passes into the inclosed chamber outside the electrodes and is there preheated and thence passes through the arcing gaps into the central space.

The shape of the shield-like plate of each electrode will differ in accordance with the number of electrodes used but in a preferred construction working with three-phase current where three electrodes are used, these are set at an angle of about 120° and are provided with triangular curved plates so disposed that when in their operative position they inclose a central space in the form of an inverted cone. With electrodes of this shape the air inlet or inlets can be easily arranged so that the air entering the furnace chamber first passes to the outside of the electrodes and thence through the slots between them and away upward.

Obviously a somewhat similar arrangement slightly modified could be employed with a furnace working on a six-phase circuit.

The shield-like plates of the electrodes may be water-cooled in any convenient way, for instance they may be hollow and water may be circulated through them or the plates may be cast on to pipes through which water can be circulated. It is preferred to make the front surface and edges of each electrode in the form of a removable plate so that it can be renewed without difficulty.

The baffle or partition of refractory material above the electrodes may in some cases not entirely close the space between them and the furnace wall, a small opening being left for the admission of cooling air to the tops of the electrodes. For the same purpose, namely for cooling the electrodes, the shield-like plates may be provided with holes or slots so that some air may pass into the central space through the body of the electrode.

Although it is preferred to cause the air to pass from the outside of the electrodes through the slots or arcing gaps into the central space yet that arrangement may be reversed and the furnace constructed so that the air is first admitted to the central space and then caused to pass out through the arcing gaps into the outer annular chamber. In such a construction the space between the tops of the electrodes and the furnace wall would be left open instead of being closed and the central space between the tops of the electrodes would be closed wholly or partially by a baffle or partition. Whatever may be the construction in this respect it is convenient to employ a steam generator to cool the gases passing from the arc flame and to utilize their heat for raising steam. This generator, which may be of any well-known form, is preferably brought down close over the partition or baffle.

In the accompanying drawings:—Figure 1 is a vertical section through one construction of electric furnace according to

this invention. Fig. 2 is a plan of the electrodes. Figs. 3 and 4 are respectively vertical and horizontal sections through portions of an electrode, these figures being drawn to a larger scale than Figs. 1 and 2. Fig. 5 is a vertical section, similar to Fig. 1, but illustrating a modified construction of electric furnace also according to this invention. Fig. 6 is a vertical sectional view similar to Fig. 5 but showing a modified construction of air inlet.

The furnaces illustrated by way of example are intended to work on a three-phase circuit and thus are provided with three electrodes. Each of these electrodes comprises a hollow shield-like body or plate A and tubular stems or connections A′ which pass through the wall B of the furnace and are connected up in any usual way to the circuit. The shape of the plates A is such that when the electrodes are in position they inclose a central space roughly in the form of an inverted cone access to that space being afforded at the bottom *i. e.*, the apex of the inverted cone and through the slots or spaces C separating one electrode from its neighbor.

In the form shown in Figs. 1 to 4 the air to be treated is admitted from the bottom of the furnace through a pipe D which, in the example illustrated, is provided with a central plug D′ so that the air entering passes through the annular space $D^2$ between the pipe and the plug and thus tends to pass first to the outside of the electrodes. The air thus entering cannot pass away without going through the arc, for the top of the space in the furnace surrounding the electrodes is inclosed by a baffle E of refractory material. Thus the air has to pass into the central space through the slots or spaces C through the arc which fills the space between the electrodes and thence up through the central opening in the baffle E. As the hottest part of the arc is found to be toward the lower part of the electrodes, a second baffle E′ may be provided to cause the air to enter through the lower portions of the spaces C. This effect is also assisted by so disposing the electrodes that their upper edges are nearer the wall of the furnace than are the lower edges. In close proximity to the baffle E and preferably adjustably supported relatively to the furnace wall B, is a steam generator F which is shown by way of example as having vertical heating flues F′. The functions of a steam generator so placed are well known, namely, to cool the gases quickly and to utilize as far as possible the heat which they give up. The electrodes are conveniently water-cooled and in the construction shown the hollow plate or body A is provided with a vertical diaphragm $A^2$ extending from the bottom nearly to the top as shown in Fig. 3. Water flows, as indicated by the arrows in Fig. 4, along one of the tubular stems A′ up one half of the hollow body A, down the other half of that body and out along the other pipe or stem A′. In order that the face of the electrodes which is liable to be pitted or burnt may be readily renewed, detachable plates $A^3$ (Figs. 3 and 4) may be provided. Other constructions may be adopted for insuring the cooling of the electrodes for instance, they may be made of plates backed with a coiled tube through which water is circulated.

In the furnace shown in Fig. 5 the furnace is made in two parts, the lower portion B′ forming the chamber into which the air enters, and the upper part $B^2$ coming close around the outside of the electrodes so that the air is forced to enter the arcing space through the lower portions of the spaces C. This figure also shows a modified construction of air inlet pipe in which there is a central aperture $D^3$ and side holes $D^4$. These holes $D^4$ are preferably situated in line with the spaces C. The wire G is for the starting spark and is preferably provided in both forms of furnace.

In a modified construction pipes or nozzles may be provided to lead the air from the openings $D^4$ to points just outside the lower portions of the spaces C. Such a construction is illustrated in Fig. 6 where pipes or nozzles $D^5$ are shown leading from the air inlet up to the lower extremity of each of the gaps between the electrodes.

The depth and the inclination of the plates forming the electrodes may be varied as is found desirable and the dimensions of the spaces C separating the electrodes can also be arranged to suit the size of the furnace and the conditions of the circuit from which the power is obtained.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In an electric furnace for the fixation of nitrogen the combination of a furnace chamber, electrodes within such chamber so shaped and disposed that they inclose and surround a central space except for comparatively narrow gaps between the edges of adjacent electrodes, an inlet for air, and means for causing the admitted air to pass through the gaps between the electrodes.

2. In an electric furnace for the fixation of nitrogen the combination of a furnace chamber, electrodes having shield-like ends within such chamber and so shaped and disposed as to inclose and surround a central space in the form of an inverted cone except for comparatively narrow gaps between the edges of adjacent electrodes, an inlet for air, and means for causing the admitted air to pass through the gaps between the shield-like ends of the electrodes into and through the central space.

3. In an electric furnace for the fixation of nitrogen the combination of a furnace chamber, electrodes having shield-like ends within such chamber and so shaped and disposed as to inclose a central space in the form of an inverted cone an inlet for air near the bottom of the furnace and a baffle or partition between the upper portions of the electrodes and the wall of the furnace chamber.

4. In an electric furnace for the fixation of nitrogen the combination of a furnace chamber in the form of an inverted cone, a plurality of electrodes passing through the walls of such chamber and having shield-like ends forming an inverted cone with gaps between the electrodes, an air inlet at the bottom of the furnace chamber and a baffle to prevent air from passing up between the electrodes and the wall of the furnace chamber without passing into the central space.

5. In an electric furnace for the fixation of nitrogen the combination of a furnace chamber in the form of an inverted cone, a plurality of electrodes passing through the walls of such chamber and having hollow shield-like ends forming an inverted cone with gaps between the electrodes, removable face plates to said shield-like ends, an air inlet at the bottom of the furnace chamber and a baffle to prevent air from passing up between the electrodes and the wall of the furnace chamber without passing into the central space.

6. In an electric furnace for the fixation of nitrogen the combination of a furnace chamber in the form of an inverted cone, a plurality of electrodes passing through the walls of such chamber and having shield-like ends forming an inverted cone with gaps between the electrodes, an air inlet at the bottom of the furnace chamber having openings in line with the gaps between the electrodes and a baffle to prevent air from passing up between the electrodes and the wall of the furnace chamber without passing into the central space.

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

ERNEST KILBURN SCOTT.

Witnesses:
ROLAND HEFFORD,
GLADYS M. L. JONES.