

(No Model.)

2 Sheets—Sheet 1

A. C. GIRARD & E. A. G. STREET.
ELECTRIC FURNACE.

No. 571,655.

Patented Nov. 17, 1896.

Fig. 1.

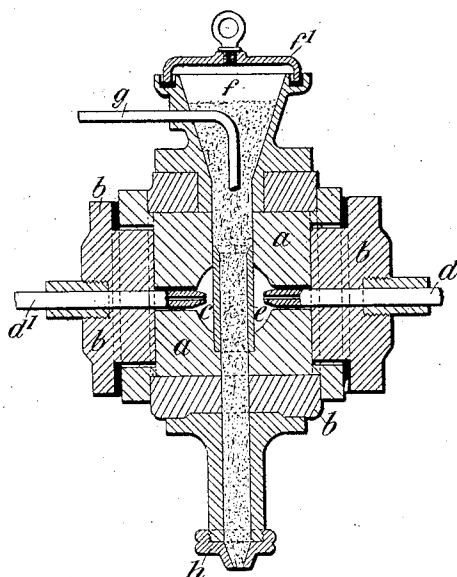
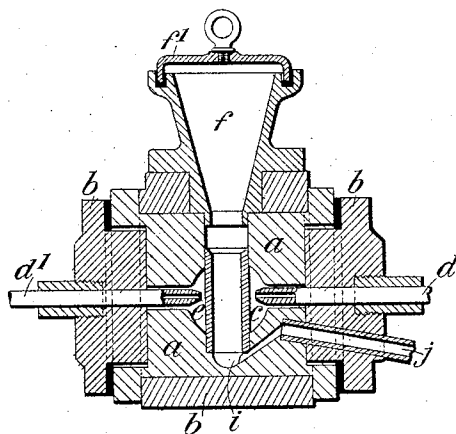


Fig. 2.



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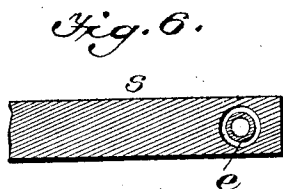
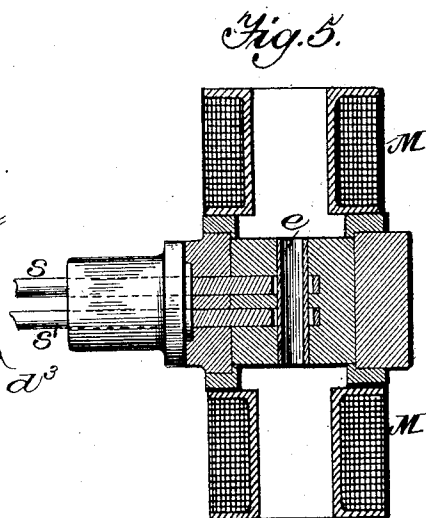
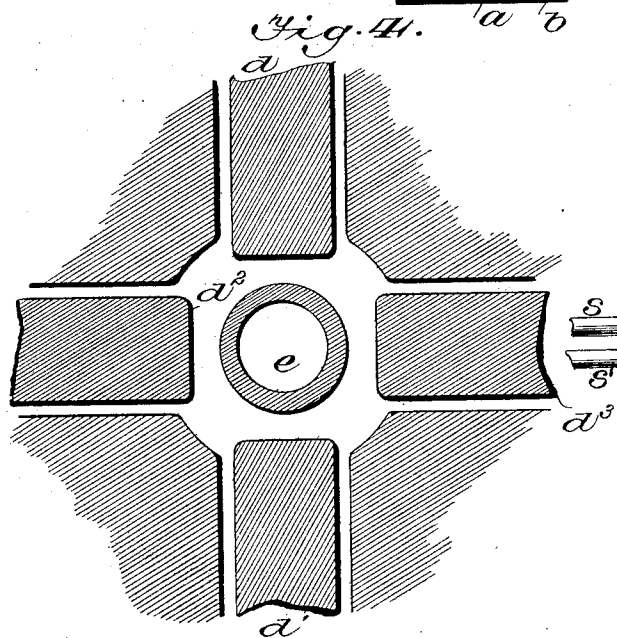
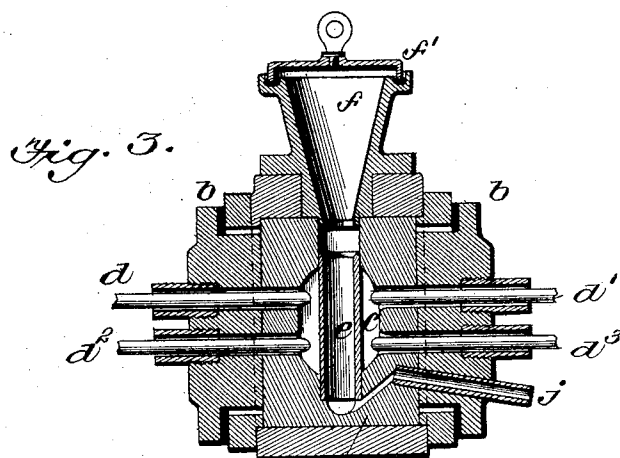
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2 Sheets—Sheet 2.

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UNITED STATES PATENT OFFICE.

ADAM CHARLES GIRARD AND ERNEST AUGUSTE GEORGES STREET, OF
PARIS, FRANCE.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 571,655, dated November 17, 1896.

Original application filed May 24, 1895, Serial No. 550,538. Divided and this application filed October 29, 1895. Serial No. 567,273. (No model.) Patented in France May 25, 1893, No. 230,341; in England July 8, 1893, No. 13,340; in Germany August 2, 1893, No. 81,479; in Austria-Hungary August 2, 1893, No. 41,930 and No. 65,879; in Belgium September 9, 1893, No. 106,309; in Switzerland September 14, 1893, Nos. 8,017 and 8,689; in Italy September 30, 1893, No. 267, and in Spain October 27, 1893, No. 14,950.

To all whom it may concern:

Be it known that we, ADAM CHARLES GIRARD, chemist, residing at 7 Rue du Bellay, and ERNEST AUGUSTE GEORGES STREET, engineer, residing at 39 Rue Joubert, Paris, France, citizens of the Republic of France, have invented certain new and useful Improvements in and Relating to Electric Furnaces, (for which we have obtained patents in France, No. 230,341, dated May 25, 1893, certificate of addition thereto dated June 8, 1893; in Great Britain, No. 13,340, dated July 8, 1893; in Germany, certificate of addition No. 81,479, dated August 2, 1893; in Austria-Hungary, No. 41,930 and No. 65,879, dated August 2, 1893; in Switzerland, Nos. 8,017 and 8,689, dated September 14, 1893; in Belgium, No. 106,309, dated September 9, 1893; in Spain, No. 14,950, dated October 27, 1893, and in Italy, No. 267, dated September 30, 1893,) of which the following, originally forming part of the application, Serial No. 550,538, filed on May 24, 1895, is a specification, reference being had to the accompanying drawings, forming part thereof.

This invention relates to electric furnaces which are more particularly adapted for heating fusible materials, and has special reference to the class of electric furnaces described in our application for patent, Serial No. 550,538, filed on the 24th day of May, 1895.

In order that our invention may be clearly understood, we will describe the same with reference to the accompanying drawings, in which—

Figure 1 is a vertical section of an electric furnace constructed in accordance with our present invention.

Fig. 2 is also a vertical section of a modified form of the furnace.

Fig. 3 is a similar view in section, showing the carbon tube or crucible as being heated by two pairs of electrodes, in which case four arcs are provided instead of two, these four arcs being two by two in series, in the first series one arc being from carbon *d* to tube *e*, second arc from tube *e* to carbon *d'*, and in the second series one arc being from carbon

*d*² to tube *e* and second arc from tube *e* to carbon *d*³. It may be easily understood that the longer the tube *e* is made and the greater heating-surface is desired the more pairs of arcs are employed.

Fig. 4 shows a tube of enlarged diameter and represents a cross-section of the central part of the furnace, wherein two series of arcs are grouped two by two in the same circuit. It will be understood that for tubes of still larger diameter more than two pairs of arcs may be employed, said arcs being placed all around the tube *e*.

Fig. 5 represents a sectional view wherein a rotating arc is used. The letter *e* indicates the carbon tube, and *s s'* are two electrodes pierced at their inner end portion with circular holes or orifices concentric with the carbon tube and through which said tube extends. A magnetic field is produced by two electric magnets or solenoids *M* and *M'*. The electric arc plays on the surface of carbon tube *e*, and the surfaces of the holes or openings in the electrodes *s* and *s'* and the magnetic field causes the arc to rotate around the carbon tube *e*. In other words, the lines of force in the magnetic field being at right angles to the faces of the pole-pieces of the magnets *M* and *M'* the voltaic arc may be represented by a line or lines at right angles to the lines of force. Thus the arc, being a current flowing at right angles to the lines of force, will revolve about the center of the field with a velocity depending on the strength of the latter, the principle being similar to that in the Faraday disk or Barlow wheel. The current employed is a continuous one and enters by *s* in the furnace and leaves by *s'*, or the inverse.

Fig. 6 is a detail sectional view of one of the concentric electrodes described.

Like letters of reference indicate similar parts in all the figures.

a is an internal block composed of some refractory material that is a bad conductor of heat. *b* is an external casing, preferably metallic, which surrounds the internal block *a*. This block *a* may be formed in one or more

parts and is provided with an internal cavity *c*, which constitutes the heating-chamber proper. This cavity is preferably formed in a block of carbon arranged within the aforesaid surrounding refractory block *a*. *d* *d'* are two carbon electrodes, whose inner ends project into the said cavity *c* and come into proximity to an inner carbon tube *e*, which serves both as a crucible or receptacle for the material to be heated and as one of the electrodes for the arc.

The heating is effected by means of two arcs in series or by means of several groups of two arcs in series, as seen in Figs. 3 and 4. One arc is formed between the carbon electrodes *d* and the carbon tube or crucible *e*, while the other arc is formed between the said tube or crucible and the second carbon electrode *d'*. The material to be treated is introduced through a hopper *f* at the upper part of the furnace, which hopper is closed with a cover *f'*, the said material being withdrawn from the lower part of the furnace. The cover *f'* is sealed by a hydraulic or other seal to effectually close the upper part of the furnace through the hopper. Special arrangements may be employed for effecting the withdrawal and introduction of the materials according as they are in a solid, liquid, or gaseous condition after their passage through the furnace. Any suitable gas may also be introduced or circulated through the furnace or through the material during its passage through the furnace. The gas employed may be introduced through an inlet-tube *g* at the upper part of the furnace and be conducted away through the outlet-orifice *h*. The size of this outlet may be so regulated that the materials can be caused to pass through the furnace at any desired speed, so that they can thus be kept in the furnace for any required length of time. The gas may in some cases be introduced and discharged through the carbon electrodes themselves, in which case the said electrodes are made hollow, as shown in the drawings.

When fusible materials are to be treated, we employ a furnace having a hearth *i*, Fig. 2, made of suitable material, to receive the fused substances and also having an outlet *j*, which latter may be so arranged that notwithstanding said outlet the special gas employed in the heating operation can be retained in the furnace as long as desired.

It will be obvious that a rotating arc produced in the manner described in our before-mentioned application for patent can be used in the furnaces above described. In this case the carbon tube or crucible *e* would be surrounded by one or more carbon disks arranged concentric therewith and insulated from each

other, the arcs produced between these disks and the said tube or crucible *e* being subjected to the action of a magnetic field, as described in the aforesaid application for patent.

Having now described our said invention and in what manner the same is to be performed, we claim—

1. An electric furnace having a fixed carbon tube or casing through which the material to be heated is fed, said carbon tube or casing constituting a common electrode, and one or more other electrodes arranged in proximity to said carbon tube to produce an arc outside of said tube, whereby the material under treatment is separated from the arc, substantially as described.

2. In an electric furnace having a heating-chamber for treating fusible materials, the combination of a carbon tube or casing located in said heating-chamber and constituting one of the electrodes between which the arc is produced, carbons *d*, *d'* constituting other electrodes, a hearth, such as *i*, located in juxtaposition to the inner end portion of the carbon tube or casing and in which the material, as it is fused, collects, and an outlet or conduit communicating with said hearth and through which the fused material can be discharged, substantially as described.

3. An electric furnace having a refractory block *a*, provided with a heating-chamber *c*, and a longitudinal passage, a hopper connected with the upper end of said passage and provided with a cover *f* at its upper end and with an outlet *h* at its lower end, a carbon tube *e* located within the heating-chamber, carbon electrodes *d* and *d'* arranged about the carbon tube for producing a voltaic arc outside said tube and enabling gaseous fluid to be conducted to the heating-chamber, and a tube *g* opening into said hopper, substantially as described.

4. An electric furnace having a refractory block *a* provided with a heating-chamber *c*, and a longitudinal passage, a hopper *f* connected with the upper end of said passage and provided with a cover *f*, a carbon tube *e* located in the heating-chamber, electrodes *d* and *d'* arranged about the carbon tube for producing a voltaic arc outside said tube, a hearth *i* located in juxtaposition to the inner end of the carbon tube, and a discharge-outlet *j*, substantially as described.

In witness whereof we have hereunto set our hands this 20th day of September, 1895.

ADAM CHARLES GIRARD.

ERNEST AUGUSTE GEORGES STREET.

Witnesses:

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