C. FÉRY & C. LANGLET.

ELECTRIC FURNACE.

APPLICATION FILED JAN. 30, 1907.

978,146.

Patented Dec. 13, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

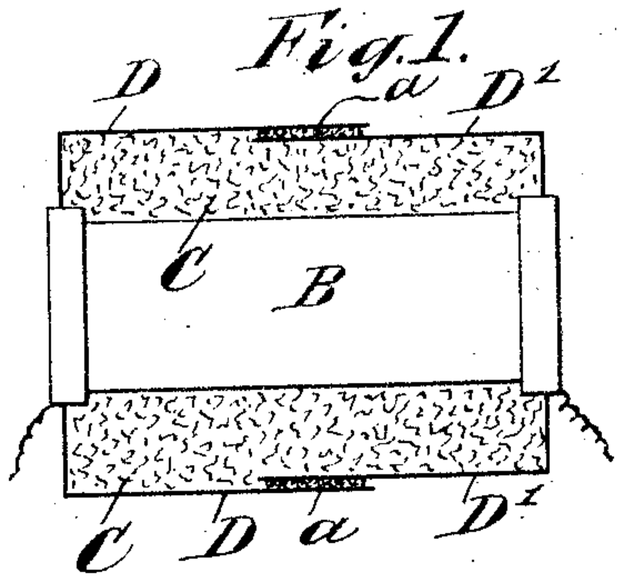



Fig. 2.

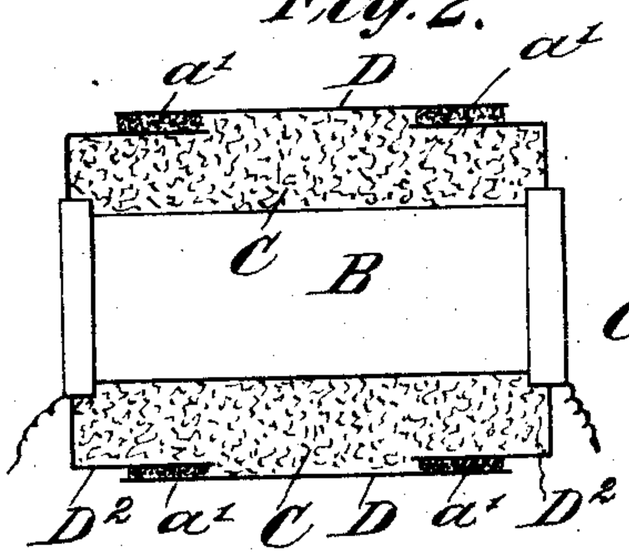



Fig. 3.

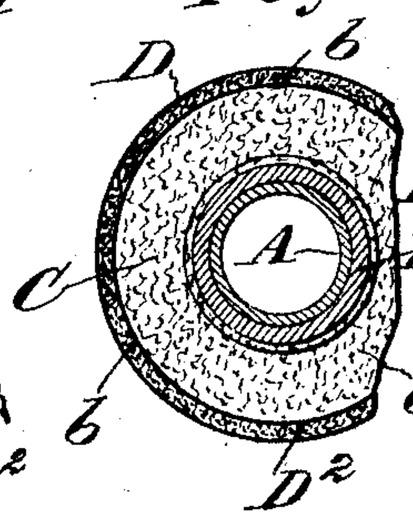



Fig. 4.

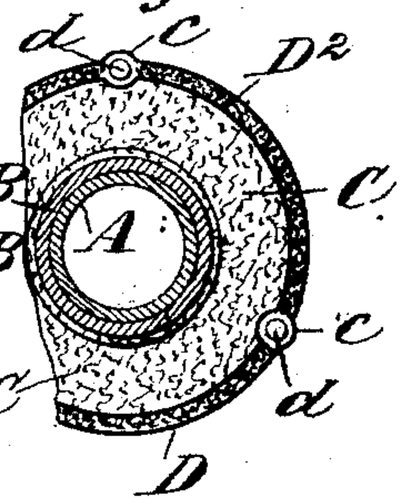



Fig. 5.

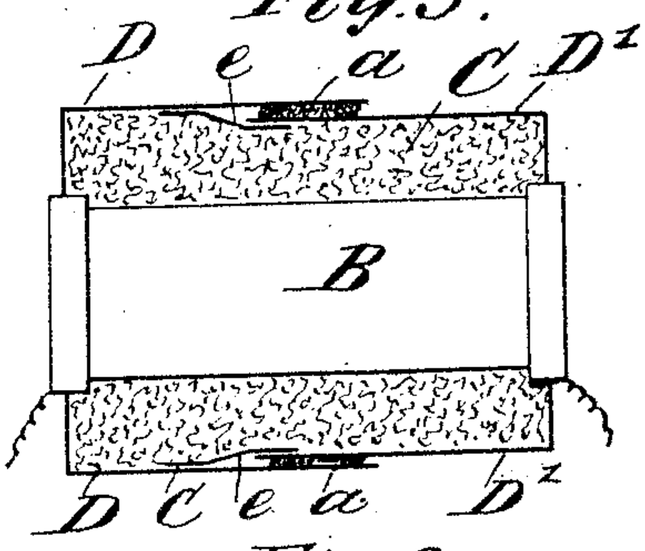



Fig. 6.

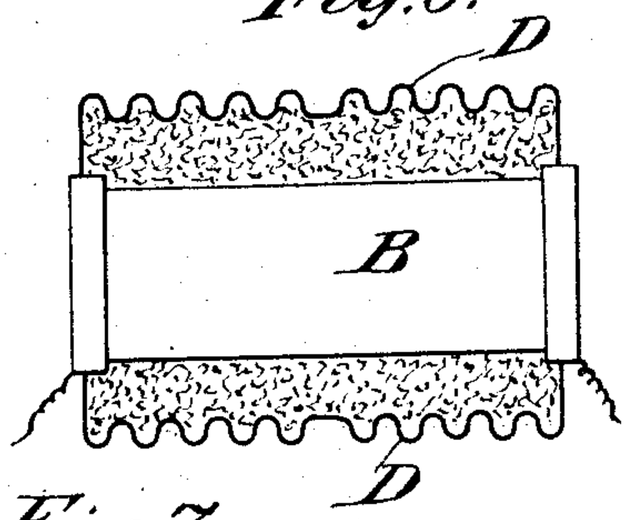



Fig. 7.


Fig. 8.

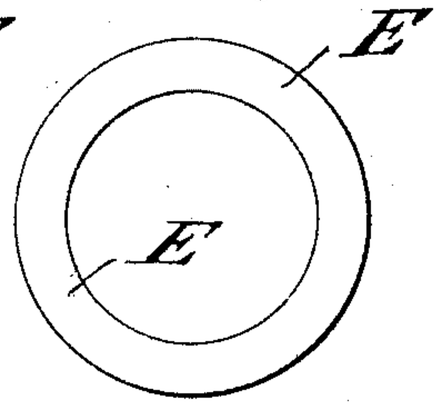
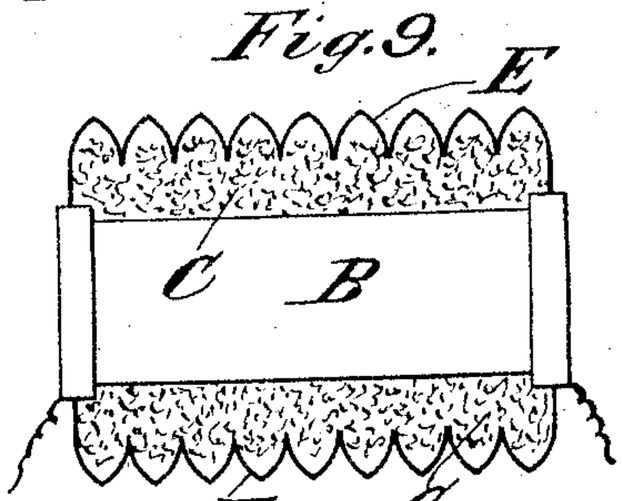



Fig. 9.




Witnesses.

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2 SHEETS—SHEET 2.

Fig. 10.

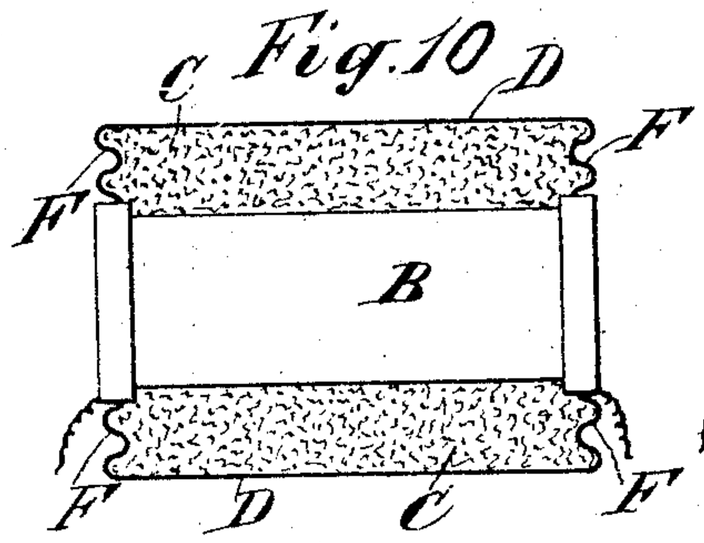



Fig. 11.

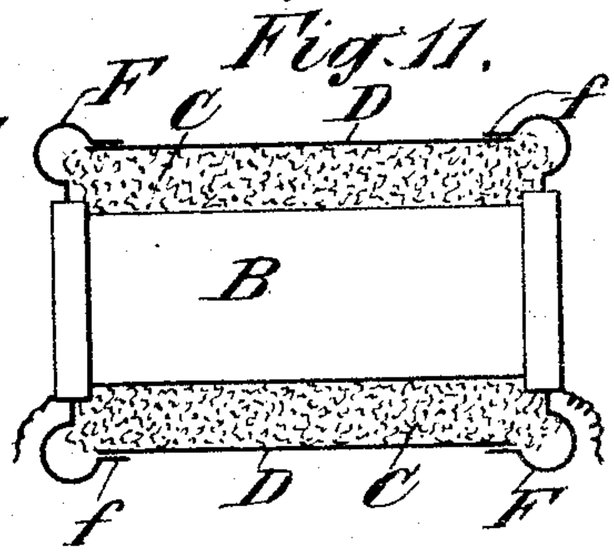



Fig. 12.

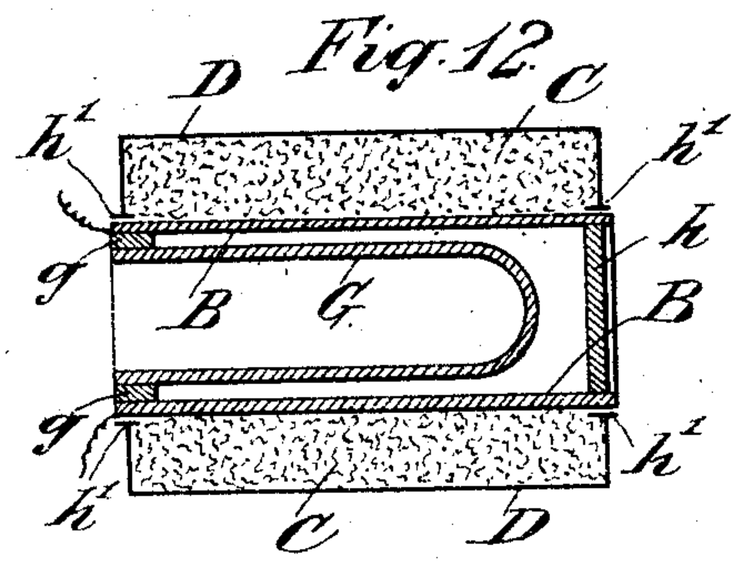



Fig. 13.

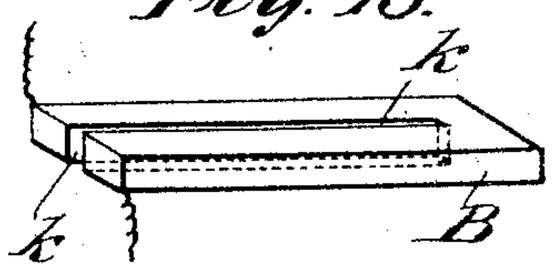



Fig. 14.

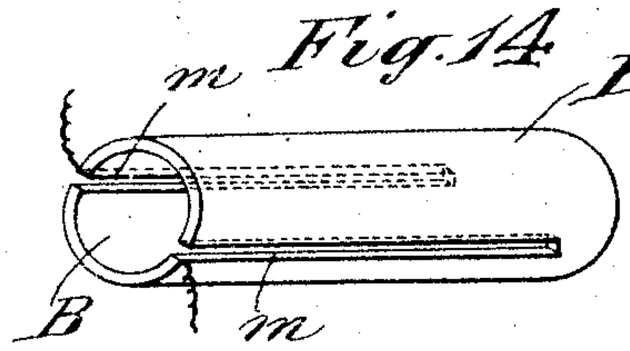



Fig. 15.

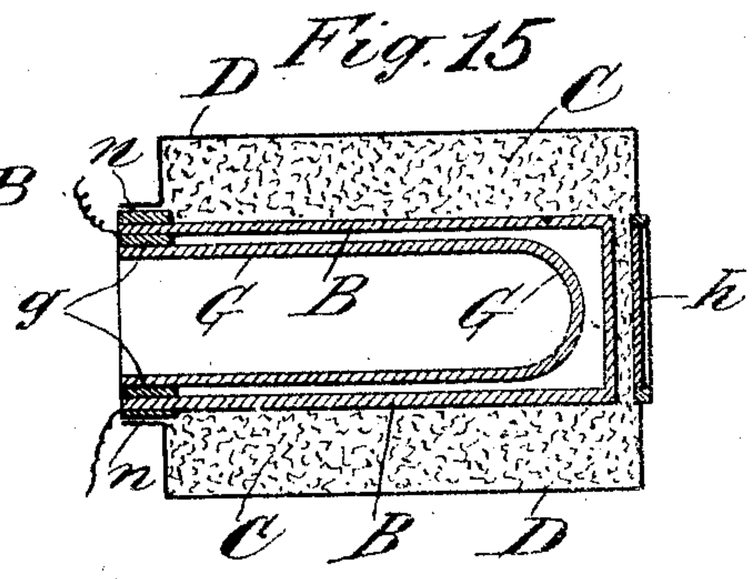
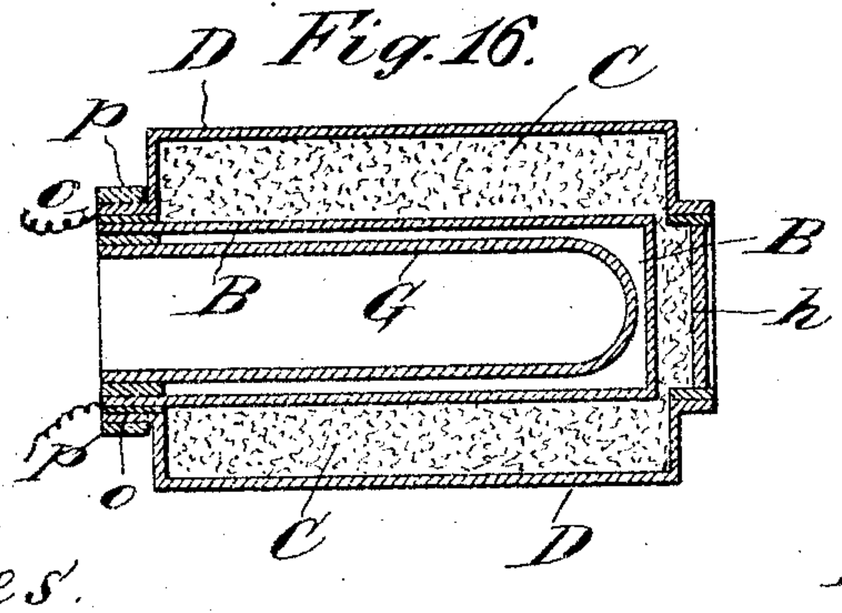



Fig. 16.




Witnesses.

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# UNITED STATES PATENT OFFICE.

CHARLES FÉRY AND CHARLES LANGLET, OF PARIS, FRANCE.

## ELECTRIC FURNACE.

978,146. Specification of Letters Patent. Patented Dec. 13, 1910.

Application filed January 30, 1907. Serial No. 354,866.

*To all whom it may concern:*

Be it known that we, CHARLES FÉRY and CHARLES LANGLET, both citizens of the French Republic, and residents of Paris, France, have invented certain Improvements in Electric Furnaces, of which the following is a specification.

Existing electric resistance furnaces are faulty because the various parts of which they are constructed expand unequally when heated. They are liable to open at the joints and in those furnaces wherein the resistance is of carbon protected by a thick layer of light carbon which is a bad conductor of heat and electricity, the air thus admitted renders the protection illusory, considerably diminishing the life of the furnace by burning the carbon resistance. The present invention is designed to eliminate this fault.

The accompanying drawings illustrate the invention. Figures 1, 2, 5, 6, 9, 10, 11, 12, 15 and 16 are longitudinal sections respectively through modifications of the furnace constructed according to the invention. Figs. 3 and 4 are transverse sections respectively of two further modifications. Figs. 7 and 8 are an end elevation and a side elevation respectively showing a detail. Figs. 13 and 14 are perspective views of two forms of conductor for use in furnaces according to this invention.

In a furnace of this kind, the central tube of refractory material is often surrounded by a helical conductor consisting of carbon. In this case the form of the conductor gives a certain amount of elasticity, sufficient to avoid any strain on the joints which unite it to the refractory tube at its ends when expansion occurs. In order that the joints between the carbon conductor and the casing shall be equally immune from destruction, the casing according to this invention is made so that it can suffer deformation, that is to say so that it can increase more or less in length, and thus withstand at the joints the strain to which it is subjected owing to the expansion of the conductor.

As shown in Fig. 1, for instance, the casing D may consist of two cylindrical portions D D′ of different diameter, such that the one can slide in the other. The annular space between the two cylindrical parts is packed with asbestos *a*. When the air inclosed in the mass of carbon C expands under the influence of the heat, it can escape through this joint *a*, and if afterward air should enter again by this path, no harm will be done, because this air will have to traverse the mass of carbon C before it can gain access to the carbon conductor B, and will thus be robbed of its oxygen, so that it cannot attack the conductor B.

In the modification shown in Fig. 2, there is a cylindrical casing D surrounding at each of its ends the corresponding cylindrical end pieces $D^2$, the intervening spaces being packed with asbestos $a^1$. In order to facilitate the relative movement of these separate pieces, and to make them slide more easily, the cylinders may carry radial projections *b* as shown in Fig. 3, or they may be made with semi-circular grooves *c* in which are placed rollers or balls *d* as indicated in Fig. 5. If it is necessary to prevent the powdered carbon C from escaping through the joint *a*, an asbestos sleeve *e* may be fastened inside the cylinder D, so that cylinder D′ may be introduced between this sleeve and cylinder D as shown in Fig. 5.

As shown in Fig. 6, the casing D may be made corrugated instead of plain, either as to the whole of its surface, as in the figure, or as to a part thereof. In this case the casing can readily adapt itself to the longitudinal strains due to the expansion of the refractory tube A together with its carbon conductor B.

Instead of making the casing in the form of a cylinder, it may be made up of stamped dished rings E, a pair of which are shown in Figs. 7 and 8. These rings are assembled in the manner indicated in Fig. 9, the object of this formation being to enable the casing to respond readily to the variations in length to which it is subjected. It is obvious that the form of the rings E may be any that is suitable for fulfilling this object. The same result may be obtained by making the casing D cylindrical, and uniting it at the ends to the carbon conductor B by elastic cheeks F formed for example as shown in Fig. 10, of circularly corrugated disks, similar to those which make up the box of an aneroid barometer.

Fig. 11 shows a variation of this form, in which the cheeks F are curved so as to allow of the expansion and contraction of the cylinder D. These cheeks can be united to the cylinder D by means of cylindrical flanges *f*, or these flanges may be left free to slide on the ends of the cylinder so that the gases can escape by the narrow passages

formed between the flanges of the cylinder, or if it is preferable to make the joint at these parts tight, a small hole can be pierced in the cylinder to serve the same purpose.

In a muffle furnace or crucible furnace of this kind, one end only of the muffle or of the crucible comes to the open part of the furnace, the other end being free to expand within the mass of powered carbon under the influence of the heat. In Fig. 12 there is a muffle G surrounded by a carbon conductor B, itself surrounded by a protecting mass of powdered carbon C contained within a casing D. If the conductor B is elastic, such as it is for example when made in the form of a helix, the casing D may be incapable of changing its form without any undue strain on the joint *g* at the front end of the muffle, or on the joints H which connect the conductor B with the casing C. It is also possible to use a casing incapable of changing its form when the muffle and the conductor only communicate with the outside of the furnace at one end thereof, as is the case, for example, when the conductor B is formed of a prismatic bar of carbon (Fig. 13) slotted as at *k* so as to have more or less the shape of a U. The same applies when the conductor is a cylinder slotted at the sides as at *m m*, Fig. 14, at opposite ends of a diameter. In this case the furnace may be arranged as shown in Fig. 15, the muffle and the carbon tube (Fig. 14) or the conducting cheeks (Fig. 13) are invariably fixed at the open end *n* of the casing D. The opening *h* only serves for the introduction of the protecting powder, and may be at the side of the cylinder instead of at the end as shown. In this case the carbon conductor and the muffle may expand freely without the necessity for providing a casing which can change its form.

Whatever may be the arrangement to insure free expansion, it is desirable to consolidate the joints between the muffle or crucible, the conductor and the casing, by a collar made in two parts *o* as shown in Fig. 16, applied to a cylindrical flange *p* formed on the casing D.

Having thus described the nature of our said invention and the best means we know of carrying the same into practical effect, we claim:—

1. An electric furnace having a heating chamber, two members, one of which is an electric conductor adapted to impart heat to said chamber, and the other of which is a jacket arranged around said conductor, and a protecting filling interposed between said members, one of said members being capable of expansion and contraction independently of the other member to compensate for unequal expansion and contraction of the members relatively to each other during the operation of the furnace.

2. An electric furnace having a heating chamber, an electric conductor adapted to impart heat to said chamber, an expansible jacket arranged around said conductor, and a protecting filling interposed between the conductor and said jacket.

3. An electric furnace having a heating chamber, an electric conductor adapted to impart heat to said chamber, a longitudinally extensible jacket arranged around said conductor, and a protecting filling interposed between the conductor and said jacket.

4. An electric furnace having a heating chamber, an electric conductor adapted to impart heat to said chamber, a jacket arranged around the conductor and provided with elastic heads connected with the conductor, and a protecting filling interposed between the conductor and said jacket.

5. An electric resistance furnace having a heating chamber, an electric conductor surrounding the said chamber, a protecting mass surrounding the said conductor, and a casing surrounding the said protecting mass and having end cheeks that are corrugated.

6. An electric resistance furnace having a heating chamber, an electric conductor surrounding the said chamber, a protecting mass surrounding the said conductor, and a casing surrounding the said protecting mass and having end cheeks that are flexible.

In witness whereof, we have hereunto signed our names in the presence of two subscribing witnesses.

CHARLES FÉRY.
CHARLES LANGLET.

Witnesses:
H. C. COXE,
GABRIEL BELLIARD.