P. L. T. HEROULT.

CARBON HOLDER FOR ELECTRIC FURNACES.

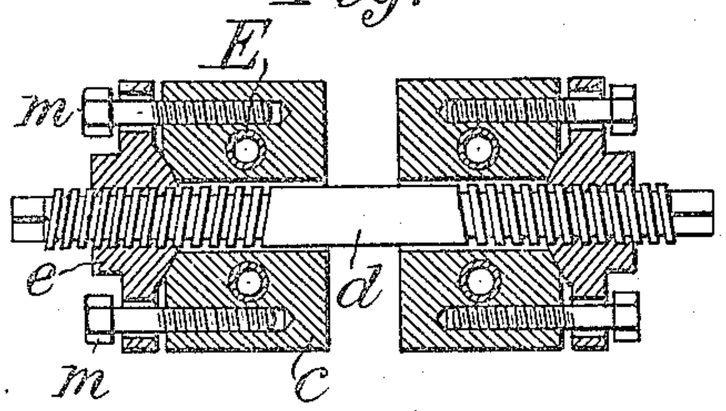
APPLICATION FILED SEPT 7, 1910.

989,148.

Patented Apr. 11, 1911.

2 SHEETS—SHEET 1.

Fig. 6.



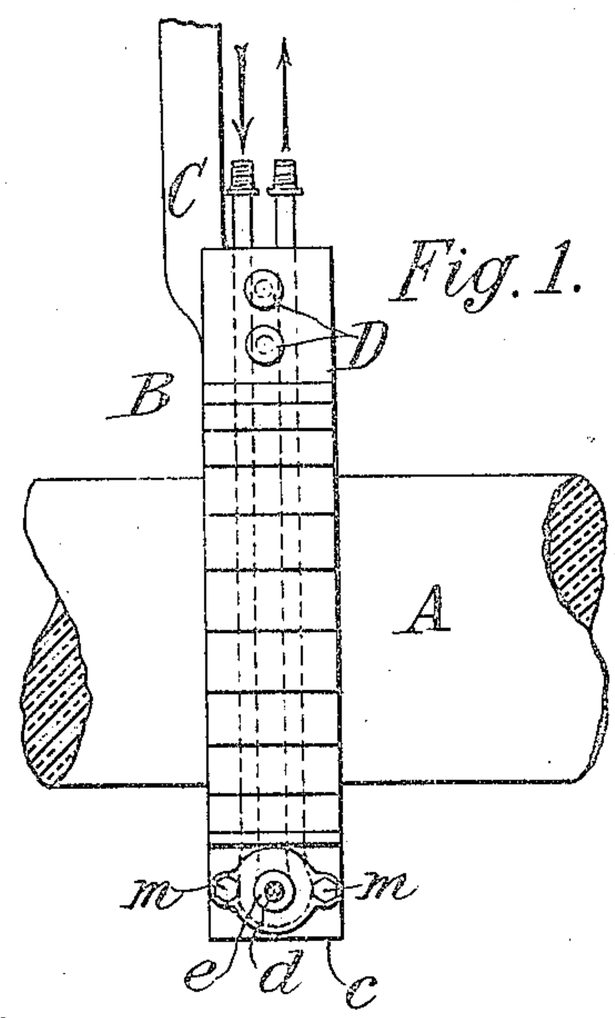


Fig. 1.

Fig. 2.

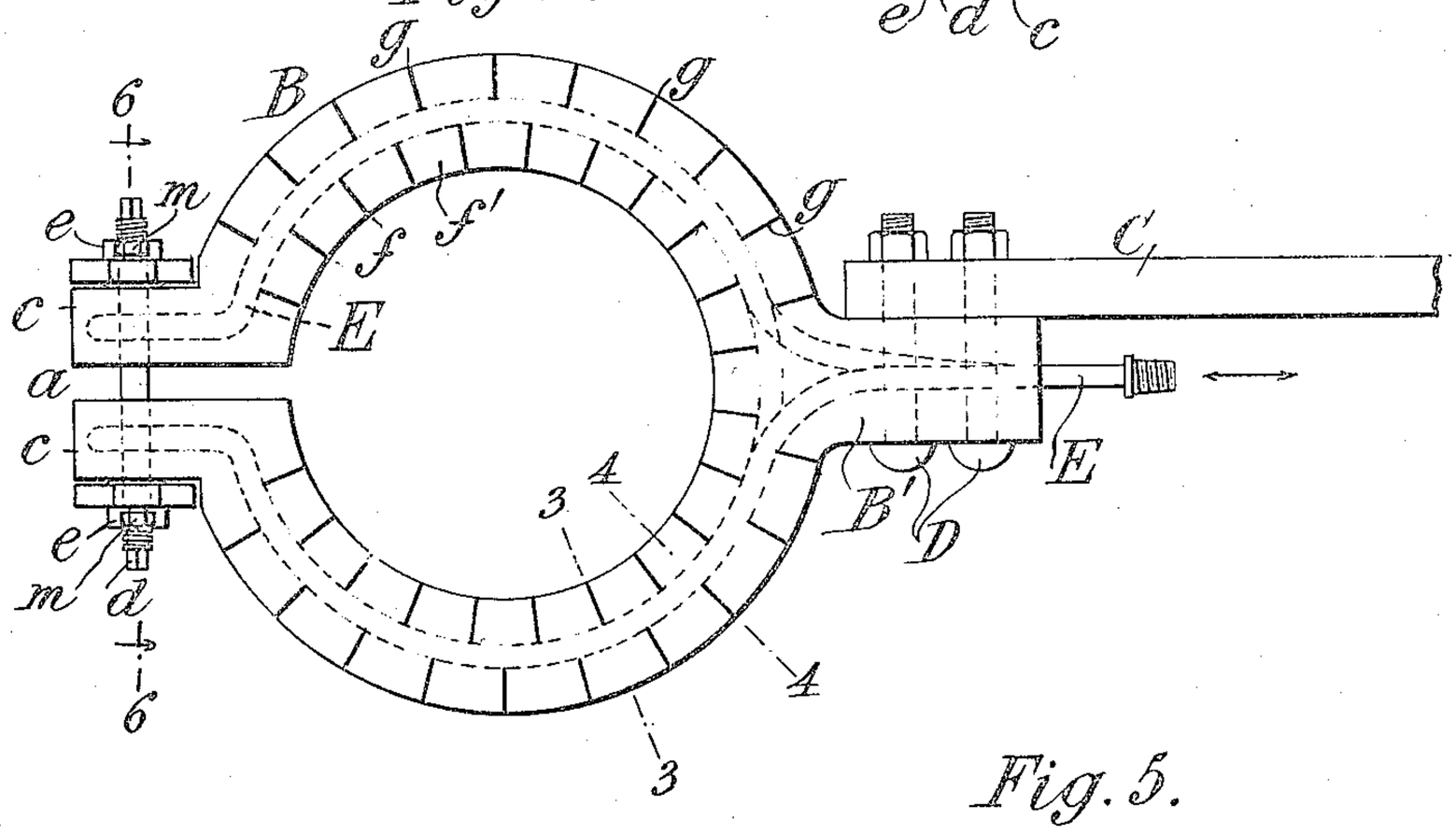


Fig. 3.

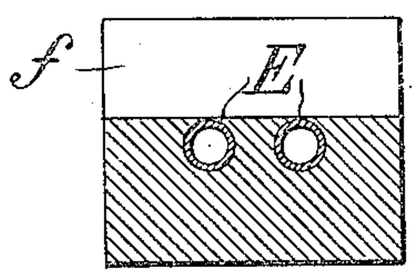


Fig. 4.

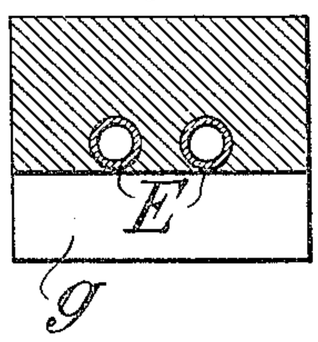
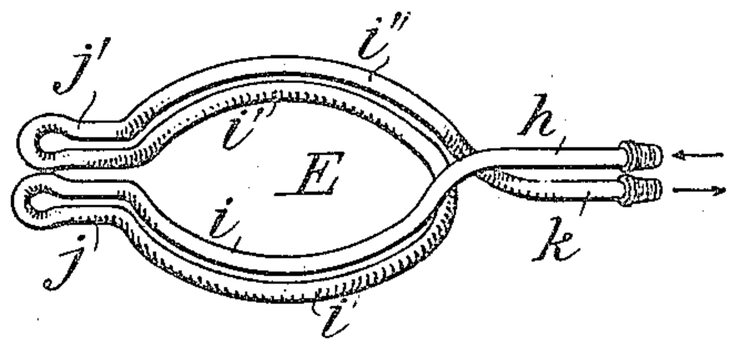


Fig. 5.



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2 SHEETS—SHEET 2.

Fig. 7.

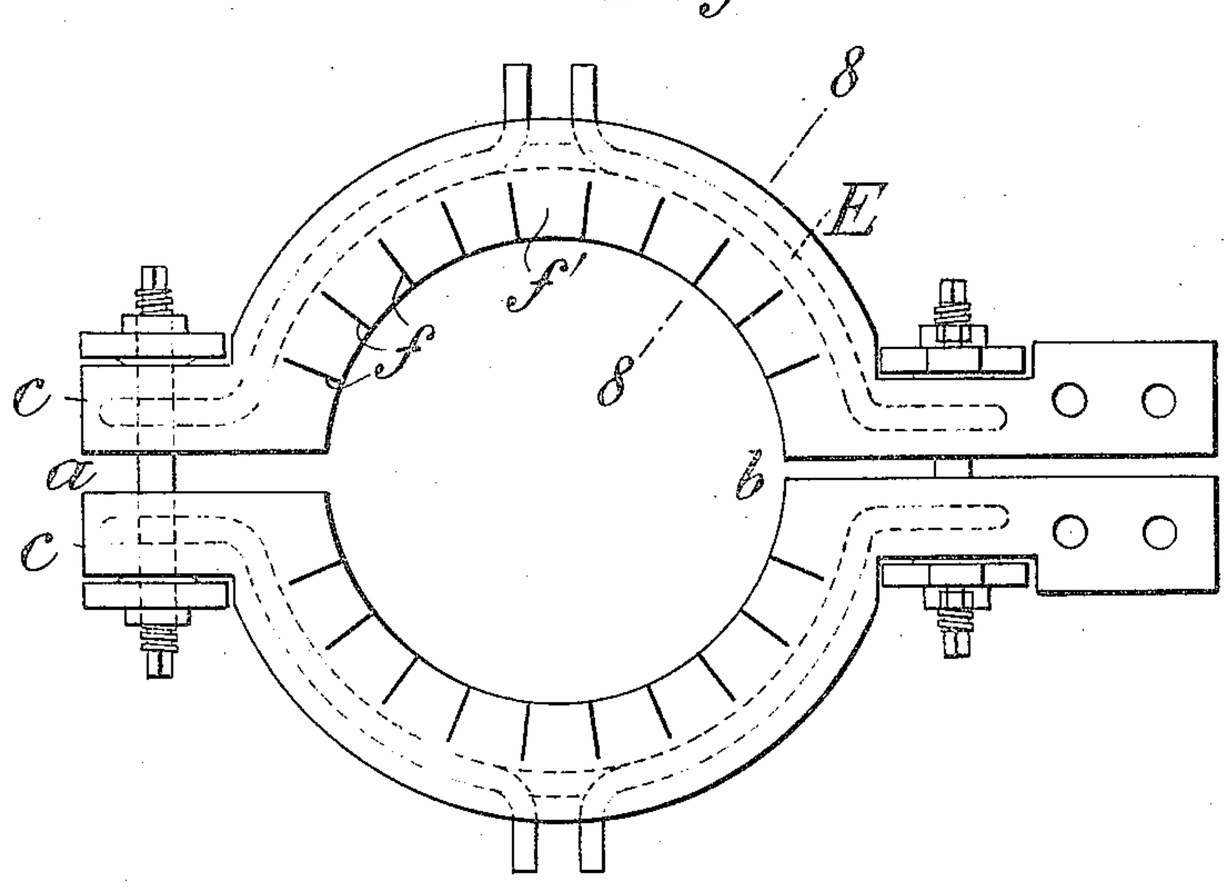


Fig. 8.

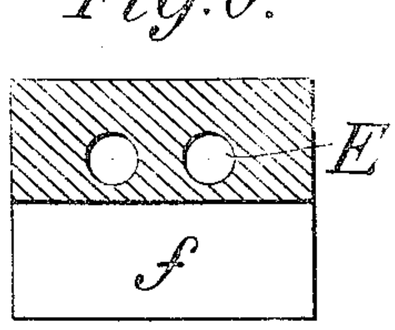
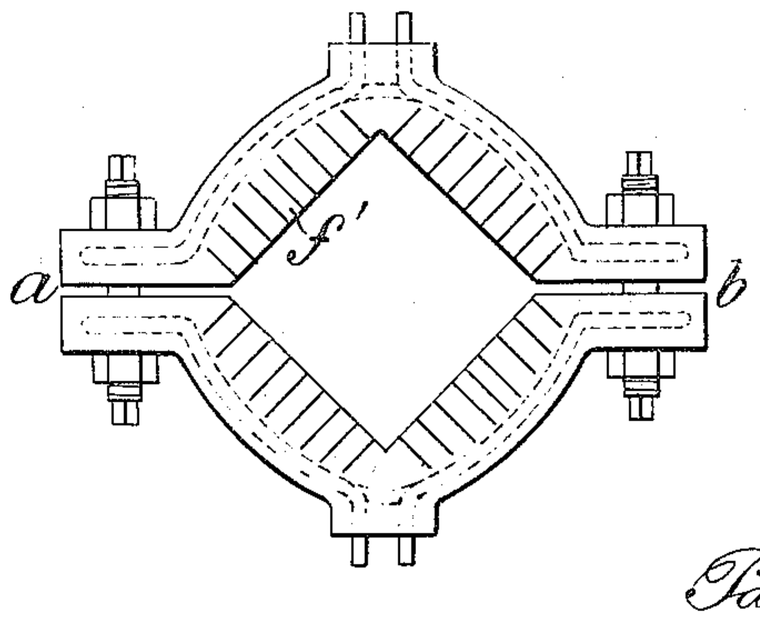


Fig. 9.



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CARBON-HOLDER FOR ELECTRIC FURNACES.

989,148. Specification of Letters Patent. Patented Apr. 11, 1911.

Application filed September 7, 1910. Serial No. 580,806.

To all whom it may concern:

Be it known that I, PAUL LOUIS TOUSSAINT HÉROULT, a citizen of the Republic of France, residing at La Praz, Savoie, France, have invented certain new and useful Improvements in Carbon-Holders for Electric Furnaces, of which the following is a specification.

In the operation of electric furnaces, difficulty has been experienced by reason of the heating of the metal carbon holders or clamps through which the current is transmitted to or from the carbon pencil or electrode. Such heating is due to imperfect contact between the metal surfaces and the carbon. It has been common to circulate water or other cooling fluid through a duct or passage in or adjacent to the carbon holder in order to keep it cool. This has not however sufficed to prevent destructive arcing and consequent disintegration of the carbon at the surfaces where the imperfect contact exists.

The present invention aims to provide means for keeping the carbon holder suitably cooled, and for diminishing the generation of heat through imperfect contact at the contacting surfaces.

The present invention is shown in the accompanying drawings as embodied in a suitable construction of carbon holder, this being deemed the preferable embodiment of the invention.

Figure 1 is an elevation of the carbon showing the holder applied to it; Fig. 2 is an end view or elevation of the holder on a larger scale; Figs. 3 and 4 are radial transverse sections of the holder upon a still larger scale, on the lines 3—3 and 4—4; Fig. 5 is an oblique elevation of the water cooling core or duct; Fig. 6 is a cross-section on the line 6—6 in Fig. 2 on the same scale as Figs. 3 and 4; Fig. 7 is a view corresponding to Fig. 2 but showing a somewhat modified construction; Fig. 8 is a radial transverse section of part of Fig. 7, on the line 8—8; Fig. 9 is a view of a further modification.

In Fig. 1, A is the carbon pencil or electrode, which may be cylindrical or of any other suitable shape, and B is as a whole the carbon holder. The latter is constructed as a clamp completely or partially encircling or inclosing the carbon. If the carbon is cylindrical, the holder will be shaped as an approximately circular ring as shown in Fig. 2. This ring may be divided on one side *a* as in Fig. 2, or at opposite sides *a b* as in Fig. 7. At the division *a* (or each division *a b*) the clamp is formed with flanges *c c* through which pass a tightening screw or bolt *d* having one or more nuts *e*. To render the holder sufficiently flexible to readily adapt itself to slight irregularities in the surface of the carbon, it is slitted radially on its inner side at *f f*, and on its outer side at *g g* at suitable intervals, the inner and outer slits being staggered or alternated as best shown in Fig. 2.

The carbon holder may be supported and connected in any suitable way with the source of current, a common construction being to form the carbon holder with a projection or arm B′ which is bolted or clamped tightly to a supporting and conducting bar C, which connects in any suitable way with the current generator. The arm B′ is shown as clamped to the bar C by bolts D.

For cooling the carbon holder, a duct or passage E is provided which is best constructed as a tube of iron or other metal of suitably high melting point, and which for the construction of holder shown in Fig. 2 is best bent to approximately the shape shown in Fig. 5. That is to say the water or other cooling fluid entering at *h* passes in straight direction through the arm B′ and then traverses in the bent portion *i* of the tube the curved portion of the holder, is then bent into the lug *c* where it forms an eye or loop *j*, returning thence at *i′* parallel to the portion *i* and traversing substantially the entire circumference of the clamp, being again bent into an eye *j′* within the opposite lug *c*, and returning in a curve *i″* to the arm B′, which it traverses as an outlet portion *k* of the tube from which the fluid emerges.

Preferably the main portion of the holder B is made of copper, brass, or other suitable metal more fusible than the tube E, and is cast upon and around this tube so that the tube is embedded in it in a manner clearly shown in the cross sections Figs. 3 and 4, which are taken respectively in the radial planes coinciding with the inner and outer slits *f* and *g*. The looped portions *j j′* of the tube form eyes encircling the clamping screw *d* as shown in Fig. 6. The effect of these loops is to cool the metal around the

clamping screw, and thus to cool the screw and its nuts. The depth and spacing of the slits *f* and *g* are such with relation to the mass and conductivity of the carbon holder, that a sufficient cross section of the latter is retained between the nearest approaching portions of the respective slits to afford ample conductivity to carry the required current.

In tightening the carbon holder upon the carbon, either the screw *d* or the nuts *e* are turned so as to draw together the lugs *c c* and thereby contract the holder upon the carbon. In so doing the lugs *c c* change their relative planes so that if originally parallel they become inclined the one relatively to the other. This would tend to bend or distort the tightening screw *d* if the parts were inflexibly united. It is preferable therefore to provide a compensating or self-adjusting or rocking bearing between the nuts *e e* and the lugs *c c*. This is best done by forming the nuts with their surfaces which bear against the lugs, as segments of spheres (or it may be as segments of cylinders), these bearing against surfaces on the lugs which conform to them. It is preferable to make the nuts non-rotative, and to make the screw *d* a right-and-left thread screw with squared ends to be engaged by a key for turning it. To make the nuts non-rotative it is desirable to form them with ears having holes which are loosely engaged by screws *m m* (Fig. 6) which fasten them to the lugs *c*, but in so loose a manner that the nut is free to rock upon the screws *m* to adapt itself to the varying inclination of the lugs relatively to one another.

When the carbon holder has been clamped tightly upon the carbon, water or other cooling fluid is circulated through the pipe or duct E, and upon causing the electric current to pass through the holder to the carbon (or vice versa) the heat generated at their contacting surfaces is largely taken up by the circulating water, which thereby counteracts the tendency of the holder to expand circumferentially under heat and thereby relax its grip upon the carbon, the effect of which would be to render the contacting surfaces more imperfect and thereby to generate still more heat. The holder is thus by reason of the water circulation maintained of substantially uniform contraction upon the carbon. My invention, however, goes beyond this in that it introduces a compensating effect to at least partially offset any slight expansion of the carbon holder. This is due to the inner slits *f f* which divide the metal of the holder into separate segments *f'* slightly spaced apart from one another, and which when heated expand mainly or partly toward the center, since the cooling effect of the duct E is to maintain the portion of the holder adjacent to it so cool that it cannot materially expand, and hence any expansion due to the heating of these inner portions between the slits necessarily results in their approaching the center, and thereby contracting the holder more firmly upon the carbon as the heat increases. Thus the effect of the generation of heat through imperfect contact is to partially or even entirely compensate for any expansion such as would make the contacts more imperfect, and may even so contract the holder upon the carbon as to diminish the imperfection of contact which caused the heat and thereby diminish the generation of heat. This effect can be accentuated by prolonging the slitted internal portion of the holder inwardly, as indicated in Fig. 7, where the cooling duct E is shown located closer to the outer than to the inner part of the holder, so that the separate inner segments *f'* between the slits *f* are given greater radial length, so that their expansion under heat is more effective to contract the holder upon the carbon.

The shape of the holder may be variously modified in accordance with the shape of the carbon to which it is to be applied. For example in Fig. 9 is shown a holder adapted for a square carbon, in which case the outer portion of the holder instead of being equally square, is preferably curved in an approximation to a circle, whereby to afford the most effective circumferential resistance to the outward thrust of the interior segments *f'* as they expand under heat.

The invention may be variously modified, as will be apparent to those skilled in the art, without departing from its essential features. In the broader aspects of my invention I do not regard the looping of the cooling tube at *j j'* within the lugs, as indispensable.

What I claim is:—

1. A carbon holder comprising a metal clamp adapted to embrace the carbon, having means for cooling it, having a portion circumferentially intact to afford tensile strength and internally slitted to form segments capable of expansion toward the center under heat.

2. A carbon holder comprising a metallic clamp adapted to embrace the carbon, having a portion circumferentially intact and having therein a duct traversing it in circumferential direction through which to circulate a cooling fluid, and internally slitted to form segments capable of expansion toward the center under heat.

3. A carbon holder comprising a metal clamp adapted to embrace the carbon, having means for cooling it, and slitted both internally and externally.

4. A carbon holder comprising a metallic clamp adapted to embrace the carbon, having a duct traversing it in circumferential

direction through which to circulate a cooling fluid, and slitted both internally and externally.

5. A carbon holder comprising a metallic clamp adapted to embrace the carbon, and having ears and a clamping screw for drawing said ears together to contract the clamp, provided with a duct traversing it in circumferential direction looped in said ears to encircle said screw.

6. A carbon holder comprising a metal clamp adapted to embrace the carbon, having a portion circumferentially intact, and radially slitted to increase its flexibility, and a cooling duct consisting of a tube of metal of higher melting point than said clamp, traversing it in circumferential direction, and embedded in the clamp by the casting of the latter around said tube.

7. A carbon holder comprising a metal clamp having ears and a clamping screw for drawing said ears together, a nut engaging said screw having a rocking engagement with one of said ears, and fastening means for holding said nut against said ear while leaving it free to rock thereon.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

PAUL L. T. HÉROULT.

Witnesses:
ARTHUR C. FRASER,
FRED WHITE.