J. H. GRAY.

ELECTRIC FURNACE.

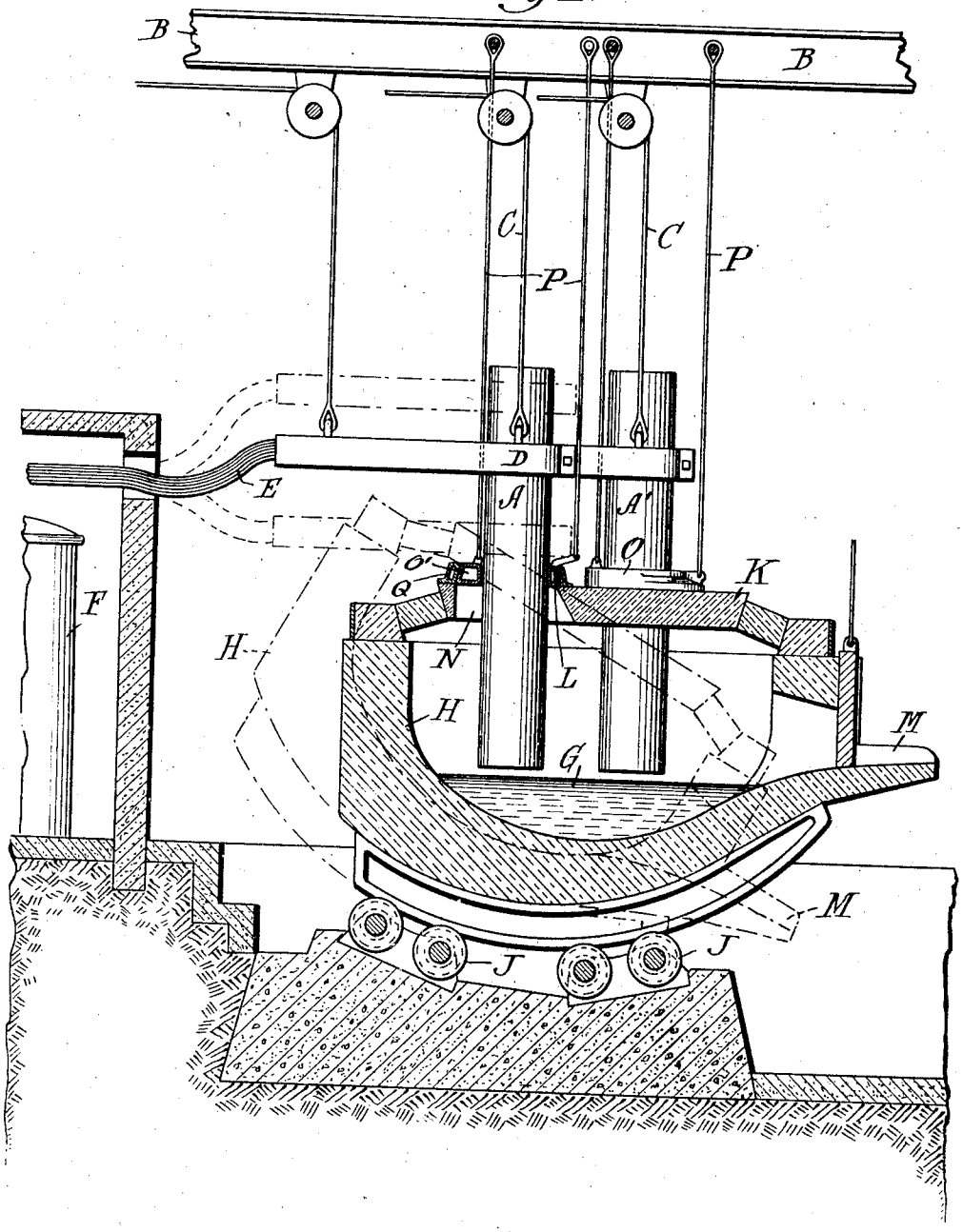
APPLICATION FILED MAY 18, 1918.

1,313,890.

Patented Aug. 26, 1919.

3 SHEETS—SHEET 1.

Fig. 1.



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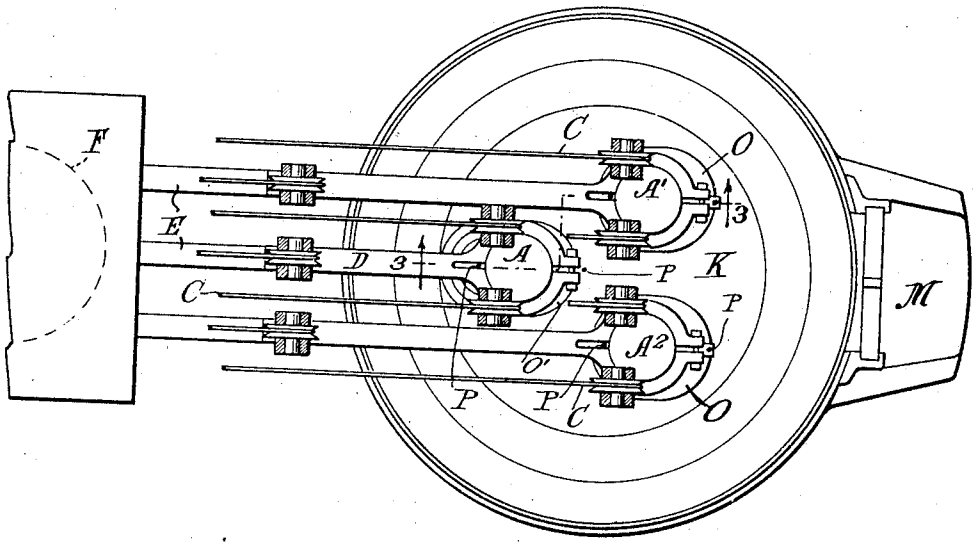
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3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

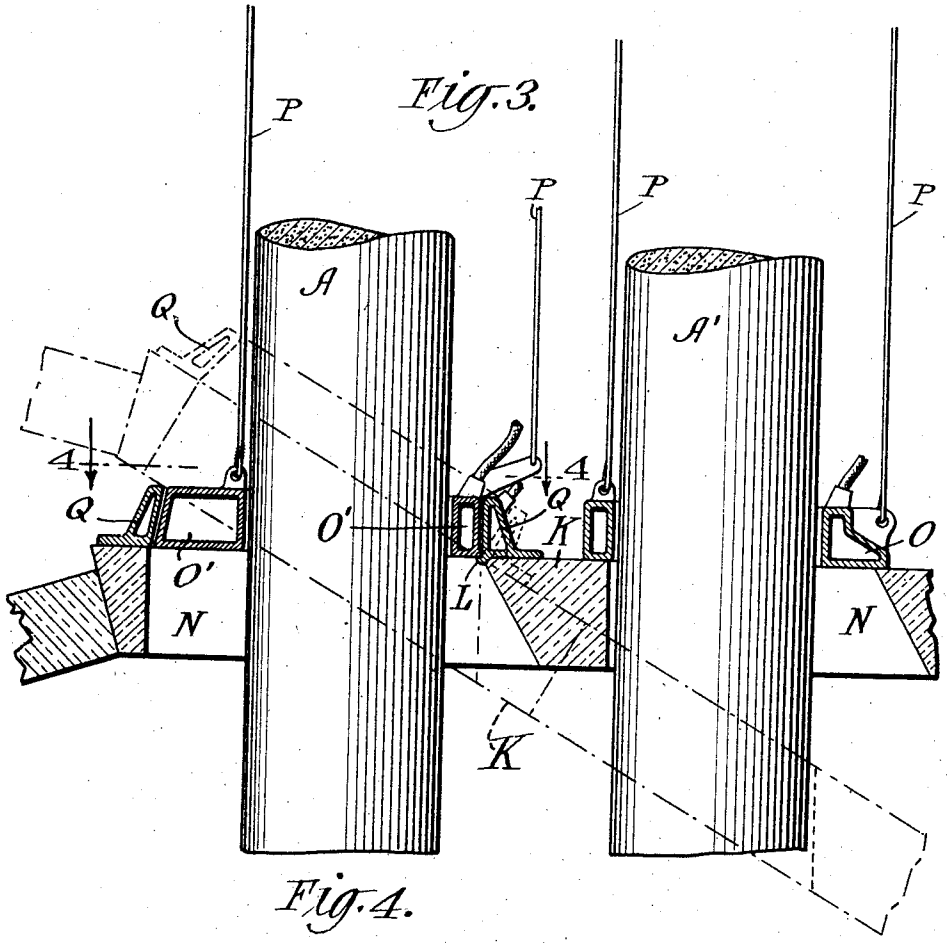
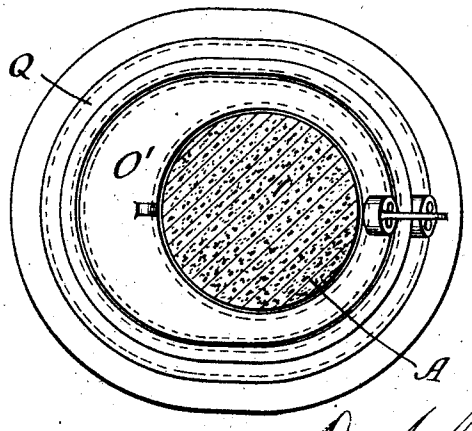


Fig. 4.



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UNITED STATES PATENT OFFICE.

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ELECTRIC FURNACE.

1,313,890. Specification of Letters Patent. Patented Aug. 26, 1919.

Application filed May 18, 1918. Serial No. 235,280.

To all whom it may concern:

Be it known that I, JAMES H. GRAY, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

My invention aims to provide an electric arc furnace designed to simplify and lessen the weight of the electric connections and having certain other advantages referred to in detail hereinafter.

The accompanying drawings illustrate an embodiment of the invention.

Figure 1 is a longitudinal section with the electrodes and their connections and supporting means in elevation;

Fig. 2 is a plan of the same with certain details in section;

Fig. 3 is an enlarged section through the roof approximately on the line 3—3 of Fig. 2;

Fig. 4 is a horizontal section on the line 4—4 of Fig. 3.

The furnace illustrated is of the Heroult arc type commonly used in the making or refining of steel and other metals and having electrodes A, A′ and A² which pass downward through the roof of the furnace and are suspended from overhead cranes or arms B by means of cables C attached to clamps or holders D connected by flexible cables E to bus bars of the transformer F. The invention may be applied also to furnaces of other types and differing in detail from that illustrated. For adjustment of the arc between the electrodes and the bath G the electrodes are raised or lowered automatically by means of electric motors. Such furnaces are generally of high power but comparatively low voltage and require very heavy flexible cables E. In tilting the furnace to pour its contents it is impossible to disconnect the conductors because of their very heavy construction. Therefore, long loops of heavy cables are used connecting the electrodes with the transformers, which loops are straightened out as the furnace is titled and the upper ends of the electrodes swing forward. These usual long loops require a very heavy construction of the supporting base and the overhead structure and powerful motors, and they introduce an amount of electric reactance which complicates the problem of handling heavy currents for this class of work.

I reduce the length of the flexible connection E by arranging to tilt the furnace without moving the electrodes from their working position. The loops required by the tilting movement of the electrodes in former constructions are practically eliminated. The length of the flexible member E need be only great enough to allow for a short vertical adjustment of the electrodes so as to maintain the lower ends thereof at the proper elevation. I have shown the approximate limits of such adjustment in dotted lines in Fig. 1.

The furnace H is arranged to tilt, either by mounting it on rollers J or on trunnions or in any other suitable way, and the center of rotation is located at such a point as to facilitate the tilting of it with the least effect on the electrodes. This center of rotation should best be located within the group of electrodes and approximately at the upper surface of the roof K of the furnace. In the design illustrated the center of rotation is at a point L and the furnace is shown in dotted lines rocked about this center and with its spout M inclined to pouring position. The pivotal point is also near the point of connection of the cables with the electrodes so that even if the electrodes tilted with the furnace the movement of the connections would be very slight and a considerable advantage would be obtained. Preferably, however, I take advantage of the slight movement of the roof to provide for such movement independently of the electrodes, that is without tilting the electrodes.

The openings N in the roof are slightly elongated in the direction of the tilting movement and beveled as shown so that the roof can rock through the short distance required without moving the electrodes. See especially Fig. 3.

It has been proposed to withdraw the electrodes from the furnace before tilting the latter, but this is objectionable because they are red hot and readily burn in the air when they are withdrawn and because the openings which they leave in the furnace cause a draft through the latter which rapidly cools it; and it is for these reasons that the usual type of furnace is so built that the electrodes are tilted with the furnace. This tilting, however, brings a great strain on the red hot electrodes and on the joints between the several sections of which

they are usually composed, and this strain is accentuated by the vibration of the furnace in starting and stopping the tilting movement. By having the electrodes suspended and out of operative engagement with the furnace roof it can be held at all times in vertical position and the occasional strains above referred to occurring in the old type are not imposed on the electrodes and these may be of less costly manufacture than those which have heretofore been necessary to avoid or limit breakage.

An important part of these furnaces is the water cooled collars or rings which surround the electrodes where they pass through the roof. The cooling of these rings permits them to be fitted closely around the electrodes. The gases from the furnace containing soot and dust of various kinds condense and form a smut on the cold surfaces, thus sealing the openings between the coolers and the electrodes and preventing a draft around the electrodes which would cause an objectionable oxidizing atmosphere in the furnace and would also burn the electrodes at this point and reduce their diameter and increase the openings around them. In my improved furnace I propose to retain the cooling rings in their normal position about the electrode during the tilting of the furnace, supporting them independently from any suitable overhead structure.

For the two forward electrodes A′ and A^2 the movement of the adjacent part of the roof is downward and it is necessary to elongate the openings N only in the forward direction. The cooling rings O for these electrodes are of elongated approximately elliptical shape fitting fairly close around the electrodes and overlapping slightly the upper edge of the openings through the roof. Their position is practically permanently fixed so as to rest by their weight on the roof of the furnace during operation and they are supported in this position by means of cables P fastened to the overhead girder or crane arm B. When the furnace is tilted the adjacent part of the roof is lowered to the position shown in dotted lines, but the rings O remain practically stationary and when the furnace is restored the roof strikes the undersides of these rings.

For the rear electrode A a slightly different construction of the cooling rings and openings in the roof is required because of the upward movement of this portion of the roof. The opening N for this electrode must be elongated both forward and backward from the electrode and must be large enough to surround the cooling ring O′ so that while the latter is supported in stationary position the adjacent part of the roof can swing upward to the dotted line position. In order to make a good closure of the opening for the operative position of the furnace a supplementary cooling ring Q is provided which rests on the roof and surrounds the inner cooling ring O′ and the rear portion of which is beveled as shown in Fig. 3 to permit it to swing upward without striking the ring O′. At the forward side the ring Q swings away from the ring O′ and the adjacent faces of these parts may be vertical.

When it becomes necessary to tilt the furnace the electrodes with their holders D and flexible connections E are raised until the arcs are broken and the electrodes clear the metal in all positions which it may assume during the tilting movement and until the electrode holders and connections clear the top of the furnace at the highest point to which it will be tilted. Such a position, for example, may be that shown in full lines in Fig. 1. The cooling rings O and O′ remain suspended in position and as the roof turns about the point L the portion under the coolers O recedes while the portions about the cooler O′, and the cooler Q carried by the roof at this point, rise past the stationary cooler O′. The point L about which the furnace rotates is located in the particular construction shown at the junction of the front edge of the cooler O′ with the cooler Q. In effect this point is an imaginary hinge connecting the two holders O′ and Q so that the auxiliary cooler Q hinges about the point L in its upward movement. The hinge point might have other locations in the neighborhood of the one illustrated, which would necessitate various modifications in the design of the coolers and roof openings but would not change the general scheme.

Various other modifications may be made in detail and in the arrangement of the parts without departing from the invention as defined in the following claims.

What I claim is—

1. An electric furnace having an electrode passing through its roof, and having a cooling ring on top of the roof surrounding the electrode, the furnace being adapted to tilt about a center substantially on a line with the top of the roof without moving the electrode and cooling ring from their working positions.

2. An electric furnace having a group of electrodes passing through its roof, and means for supporting the furnace whereby it can be tilted about a center located within the group of electrodes, near the upper surface of the roof without moving said electrodes.

3. An electric furnace having a group of staggered electrodes passing through its

roof, the openings in the roof being shaped to permit the tilting of the furnace without movement of the electrodes.

4. An electric furnace having electrodes passing through its roof in staggered relationship with each other, the openings in the roof being shaped to permit the tilting of the furnace without movement of the electrodes, and cooling rings surrounding the electrodes immediately above the roof in the working position, said cooling rings supported independently of the furnace roof.

5. An electric furnace having an electrode passing through its roof, the furnace being adapted to tilt with an upward movement of the portion of the roof surrounding the electrode, an independently supported cooling ring surrounding the electrode just above the roof and a supplementary cooling ring supported on the roof and surrounding the first cooling ring, the openings in the roof and supplementary cooling ring being shaped to permit the roof to be moved upward without movement of the first cooling ring.

6. An electric furnace having an electrode passing through its roof and a cooling ring on top of the roof surrounding the electrode at the point where it passes through the roof and supported independently of the roof.

7. An electric furnace having a group of electrodes passing through its roof and means for supporting the furnace whereby it can be tilted about an axis passing through a point located within the group of electrodes near the top of the roof.

8. An electric furnace having a group of triangularly arranged electrodes passing through its roof, and means for supporting said furnace whereby it can be tilted about a center located within said group of electrodes the electrodes being supported independently of the furnace and the openings in the roof being shaped to permit the tilting of the furnace relatively to said electrodes.

9. An electric furnace having a group of triangularly arranged electrodes passing through its roof, cooling rings surrounding said electrodes and supported independently of the roof and means for supporting said furnace whereby it can be tilted about a center located within the group of electrodes without moving said electrodes or said cooling rings.

10. An electric furnace having a group of electrodes passing through apertures in its roof, cooling rings surrounding said electrodes, means for supporting said cooling rings independently of the furnace roof and means for supporting said furnace whereby it can be tilted about a center located within the group of electrodes near the top of the roof so that as the furnace is tilted one portion of the roof will move downward and recede from the cooling rings on one side of said center and another portion of the roof will move upward and allow the cooling rings on the other side of said center to pass through the opening in the roof.

11. An electric furnace having a plurality of electrodes passing through apertures in its roof, cooling rings surrounding said electrodes supported independently of the roof, means for supporting said furnace whereby it can be tilted about a center located between the electrodes and near the top of the roof so that as the furnace is tilted one portion of the roof will move downward and recede from the cooling ring on one side of said center and another portion of the roof will move upward and allow the cooling ring on the other side of said center to pass through the aperture in the roof and a supplementary cooling ring supported on the upwardly moving portion of the roof, and normally surrounding the cooling ring in juxtaposition to the upwardly moving portion of the roof.

In witness whereof I have hereunto signed my name.

JAMES H. GRAY.