

April 12, 1938.

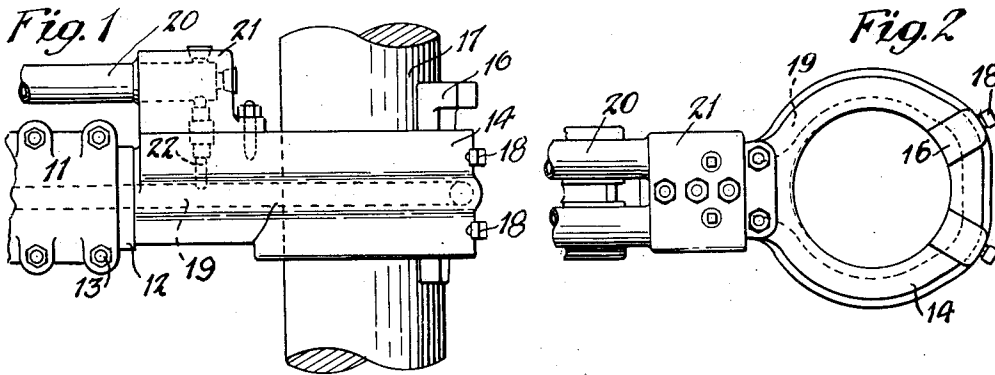
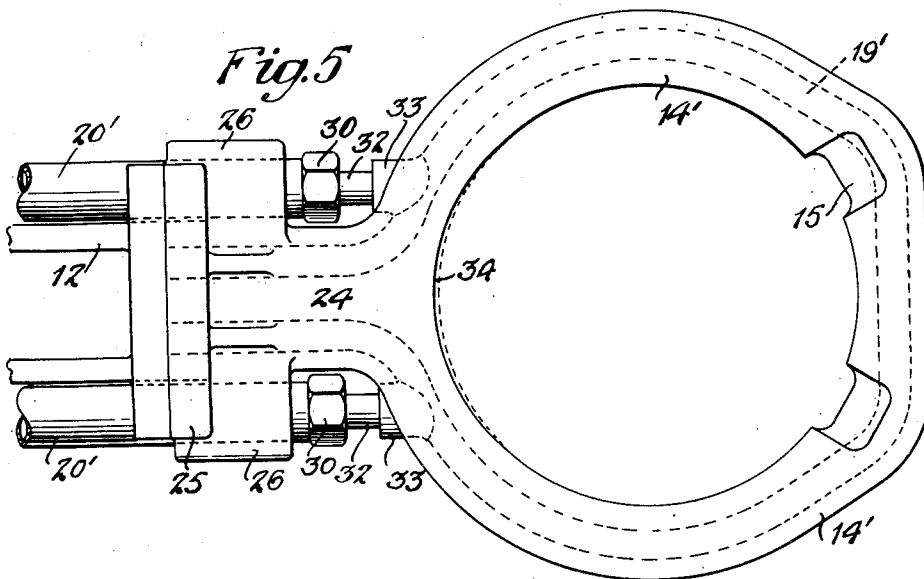
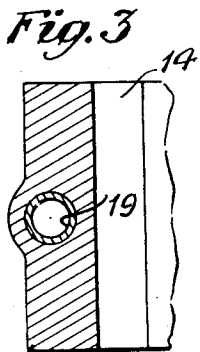
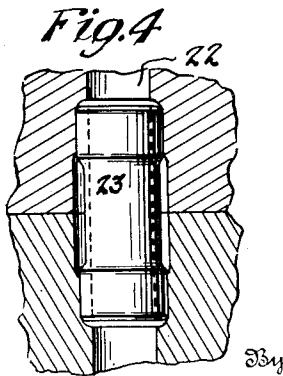
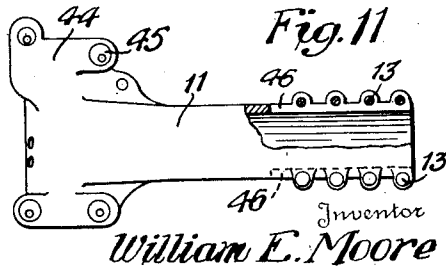
W. E. MOORE

2,114,231

ELECTRIC FURNACE

Filed Nov. 1, 1934

2 Sheets-Sheet 1



Inventor
William E. Moore

C. H. J. Mason

Attorney

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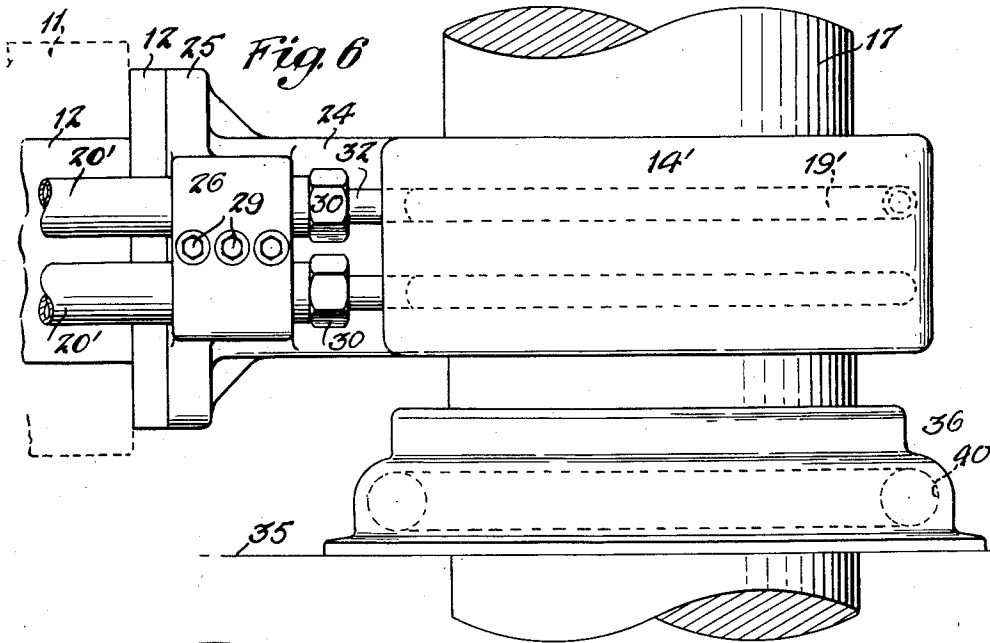
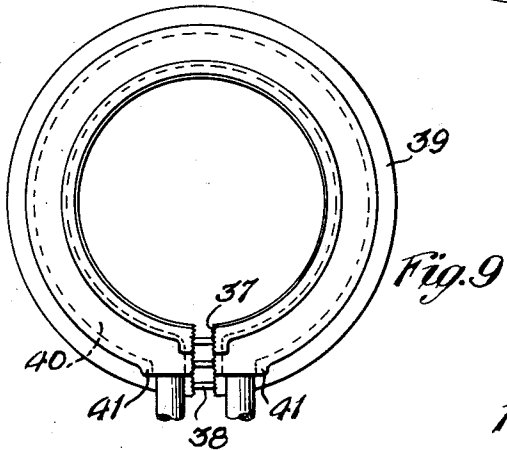
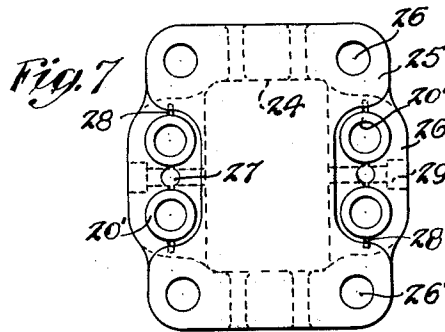
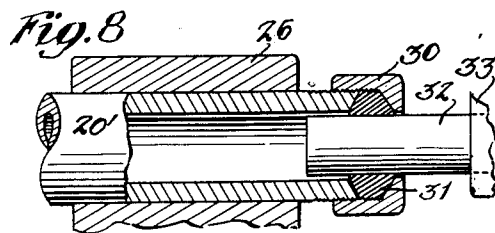
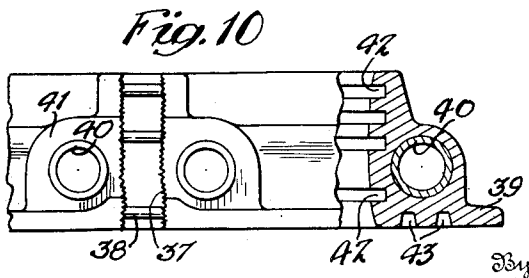
W. E. MOORE

2,114,231

ELECTRIC FURNACE

Filed Nov. 1, 1934

2 Sheets-Sheet 2



Inventor
William E. Moore

C. E. Dyer

Attorney

UNITED STATES PATENT OFFICE

2,114,231

ELECTRIC FURNACE

William E. Moore, Pittsburgh, Pa., assignor to
Pittsburgh Research Corporation, Pittsburgh,
Pa.

Application November 1, 1934, Serial No. 751,041

9 Claims. (Cl. 13—16)

My invention relates to improvements in electric furnaces, and more particularly to furnaces of the type used in metallurgical operations.

An important object of my invention is to provide a novel supporting mechanism for the furnace electrodes.

Another object of my invention is the provision of cooling means for the electrode clamps and glands.

Still another object of my invention is to provide an electrode supporting mechanism which is adjustable to suit varying conditions in electric furnaces.

Other objects and advantages of my invention will be apparent during the course of the following description.

The present application is a continuation in part of my co-pending application No. 703,639, filed December 22, 1933 for electric furnaces.

In the accompanying drawings which form a part of this specification and wherein like characters of reference denote like or corresponding parts throughout the same,

Figure 1 is an elevation of my improved electrode clamp, showing the connections to the electrode arm and bus bars,

Figure 2 is a top plan view thereof,

Figure 3 is a fragmentary vertical sectional view through the electrode clamp,

Figure 4 is a fragmentary sectional view of the water circulating connection between the bus bar and electrode clamp,

Figure 5 is a top plan view of a slightly modified form of electrode clamp,

Figure 6 is a side elevation thereof, showing the cooling gland in place on the electrode,

Figure 7 is an end elevation of the electrode clamp, on a more reduced scale,

Figure 8 is a detail longitudinal sectional view showing the bus bar connection with the electrode clamp,

Figure 9 is a top plan view of the cooling gland,

Figure 10 is a fragmentary side elevation thereof, on a larger scale, parts being shown in section, and,

Figure 11 is an elevation of the electrode supporting arm.

In the drawings, wherein for the purpose of illustration is shown a preferred embodiment of my invention, the numeral 11 designates an electrode supporting arm of the type shown in my co-pending application above referred to, and comprising the usual cast cross head construction with adjustable guide rollers engaging the electrode columns. The arm 11 is adapted to

clamp about an extension 12 on the electrode clamp. The extension 12 is of insulating material to insulate the electrode clamp from the supporting arm. Bolts 13 serve to clamp the split electrode arm to the extension 12. Adjustment of the clamp longitudinally of the arm is obtained by loosening nuts 13 and sliding extension 12 into or out of the arm 11.

The electrode clamp 14 is of the continuous ring type and is provided on its forward side with tapered slots 15 to removably receive clamping wedges 16 which directly engage the electrode 17 to wedge it in the clamping ring 14. The wedges 16 have their upper ends provided with projections or turned over portions to facilitate raising the wedges, and set screws 18 lock the wedges in position within the clamping ring, and further add to the clamping action of the wedges on the electrode. This clamping action of set screws 18 dispenses with the necessity of hammering the wedges tightly into the clamp, a practice which often results in cracking the electrode.

The electrode clamping ring 14 is provided with a cast in loop of fluid circulating pipe 19 which extends around the clamp and back into the insulating extension 12, as seen in Figure 1. The ring 14 may be of copper casting or other metal having high electrical conductivity, while the pipe 19 is preferably of steel to strengthen the clamping ring. The loop or pipe 19 encircles the electrode and forms a cooling coil for circulating cooling fluid through the clamping ring and around the electrode. While only a single loop 19 is shown in Figures 1, 2 and 3, it is obvious that any number of cooling loops may be used. In the form of the invention shown in Figures 5 and 6 I have shown two such loops for each clamp.

In addition to strengthening the clamp, the pipe 19 simplifies the casting of the clamp, as it is easier to cast the clamp about the pipe 19 than to cast the clamp with a bore therein.

Bus bars or tubes 20 of copper or other suitable electrically conducting material are of sufficient size to conduct the desired power to the electrodes and two such hollow tubes 20 are shown for the clamp so that they may also be used as cooling fluid conductors. The bus tubes 20 are supported in suitable insulated non-magnetic brackets on the electrode arm crosshead. The other ends of the bus tubes fit into a contact shoe 21 bolted to the upper surface of the electrode clamps. A vertical passage 22 extends through the contact shoe and clamping ring to connect each bus bar with the cooling pipe 19.

This passage is enlarged or counterbored adjacent the juncture of the contact shoe and clamping ring to receive a pipe tube 23 which is enlarged or barreled slightly at each end so that when it is forced into the enlarged portion of the passage 22 in the clamping ring and shoe it will be sealed against leakage. The relieved central portion of the pipe tube 23 between the enlarged ends will also permit a slight misalignment of the passages in the shoe and clamp without destroying the seal.

In the form of the invention shown in Figures 5 to 8 the electrode clamp 14' is shaped as in Figure 2 with wedge grooves 15 and with two spaced parallel cooling pipes 19' cast therein, as shown in dotted lines in Figure 6. The clamp 14' has a narrow throat 24 terminating in an enlarged end portion 25. The end portion 25 is provided with suitable openings 26' for bolting to the extension 12, and is generally rectangular in shape, as seen in Figure 7. The enlarged portion 25 is provided with contact blocks 26 extending laterally from each side thereof and provided with spaced openings for the reception of tubular bus bars 20'. Two bus bars pass through the openings of each block 26, and extend beyond the blocks to a point adjacent the electrode ring clamp 14'. The openings in the blocks 26 extend entirely therethrough, and are connected by slits 27. Other slits 28 are arranged at the opposite sides of the openings and are arranged in line with slits 27, as illustrated in Figure 7. Slits 27 and 28 render the blocks 26 resilient so that they may be contracted to securely engage the bus bars 20'. Bolts 29 contract the blocks 26 and extend between the openings and through the slots 27. It will be seen that by loosening bolts 29, pressure on bus bars 20' is released, and the electrode clamp may be adjusted longitudinally of the bus bars. When the desired adjustment is made, bolts 29 are tightened to clamp the resilient blocks 26 about the bus bars. While the integral resilient block construction is preferred, it is obvious that separate clamping plates may be bolted to the clamp in place of the construction illustrated.

The ends of the bus bars adjacent the clamping ring 14' are screw threaded and are received in packing nuts 30 having suitable packing 31 arranged therein. Connecting pipe stubs 32 communicate with cooling loops or pipes 19' and extend out through bosses 33 on the sides of the clamping ring 14' adjacent throat 24 and into packing nuts 30. Connecting pipe stubs 32 are of less diameter than the interior diameter of bus bars 20' and are telescopically received therein as indicated in Figure 8. The packing 31 may be forced into intimate engagement with the pipe stubs 32 by tightening nuts 30 which compress the packing against the ends of bus bars 20', and prevents leakage of the cooling fluid at this point.

Power is transmitted through the bus bars 20' to blocks 26 and thence to the electrode clamp 14'. The bus bars are preferably held in adjustable clamps at the column end of the electrode arm 11. However, with the construction shown in Figures 5 to 8, it is not necessary to disturb this clamp when adjusting the electrode clamp longitudinally of arm 11. To make this adjustment, nuts 13 on electrode arm 11 and bolts 29 on blocks 26 are loosened, and the extension 12 moved in or out of arm 11 to the desired point. Pipe stubs 32 will telescope with the ends of bus bars 20'. When the desired adjustment has been made,

nuts 13 and 29 are tightened and the electrode clamp is secured in adjusted position. When the bus bars are rigidly secured to the electrode clamp, it is necessary to loosen the clamps at the column or crosshead end of the arm 11 before the electrode clamp may be adjusted. With the telescoping pipe construction and resilient blocks shown in Figures 5 to 8 the electrode clamp may be adjusted longitudinally of both the arm 11 and the bus bars 20'. The wedges 16 are used in both forms of the clamp, as indicated by the presence of the grooves 15 in Figure 5.

The central bore of the clamping ring 14' is usually made circular and it is customary to form this bore with a tolerance of about 2% so as to accommodate slight variations in the diameters of electrodes used. It will be seen that when the electrode has a diameter slightly less than the diameter of the ring bore, it will be forced against the rear of the ring by the wedges 16 and will consequently have a single line contact with the ring 14' at the rear thereof. In order to avoid this situation I propose to relieve the bore of the ring at the rear thereof by a 90° arc having a radius corresponding to the minimum radius of the electrodes used. This relieved portion is indicated at 34 in Figure 5. For a seventeen inch electrode, a tolerance of 2% amounts to about three eighths of an inch and the relieved portion at its deepest point at the rear of the ring would therefore be about three eighths of an inch in depth.

With the relieved portion 34, the electrode will be forced into such relieved portion by the wedges and under any circumstances there will be at least two lines of contact between the ring bore and the electrode. Electrodes approaching the minimum diameter will tend to have a segmental surface contact with the relieved portion of the bore, while electrodes approaching the maximum diameter will tend to have a surface contact with the unrelieved portion of the bore in addition to the two line contact at the edges of the relieved portion of the bore.

This relieving of the rear of the bore may be used with any form of continuous ring clamp, and is indicated in dotted lines in Figure 2.

Where the electrode passes through the furnace roof, indicated by line 35 in Figure 6, an annular cooling gland or ring 36 is arranged. The construction of this gland is illustrated in Figures 6, 9 and 10. The gland comprises an annular split ring having the surfaces 37 of its split portion serrated and joined by suitable non-magnetic struts or bolts 38. The space between serrated surfaces 37 is filled in practice with a suitable insulating material such as mud asbestos. The gland has a lower annular flange 39 which rests upon the furnace roof and a steel cooling pipe 40 is cast within the walls of the gland. The pipe 40 extends completely around the gland and out through bosses 41 at each side of the split in the gland. The ends of the pipe 40 are connected to a source of cooling medium and a cooling medium such as water is circulated through pipe 40. The gland may be readily cast about pipe 40 which being steel, strengthens and reinforces the gland which is formed from cast iron or other suitable material.

The surface of the bore of the gland is curved or bulged inwardly as indicated in Figure 10, so as to flare at the top and bottom of the gland, and facilitate insertion and movement of the electrode through the gland. Spaced annular grooves 42 are arranged in the walls of the bore

of the gland, as shown in Figure 10. These grooves may be filled with a sealing substance to seal the clearance between the electrode and gland. It is not necessary to fill these grooves, however, as the grooves will collect the dust laden fumes arising from the furnace and will soon be filled with a soft pulverulent sealing material.

Annular grooves 43 are also arranged in the bottom of the gland as indicated in the drawings. Before putting the gland in place on the roof, a pad of mud or other suitable material may be laid on the roof, and the gland placed on top thereof, so that the mud will be forced up into the grooves and fasten the gland in place as well as seal it. Where the pad of mud or other material is not used, the dust laden furnace fumes will soon fill the grooves 43 and produce a similar result.

By splitting the electrode gland and separating the split portions with insulation, the circulation of current around the clamp due to the magnetic field of the electrode is prevented.

The construction of the split electrode arm 11 is shown in Figure 11 in which the crosshead 44 is provided with guide rollers 45. The arm is of tubular construction and is slit at top and bottom for a substantial distance, as indicated at 46. The bolts 13 serve to adjustably clamp the insulating extension 12 in the split tubular arm 11.

While I have shown and described the preferred embodiment of my invention it is to be understood that various changes in the size, shape and arrangement of parts may be resorted to without departing from the spirit of my invention or the scope of the subjoined claims.

Having thus described my invention what I desire to claim and protect by Letters Patent is:

1. In an electric furnace, an electrode clamp of electrically conducting material, a cooling pipe located within said clamp, a contact shoe secured to said clamp, a hollow bus tube connected to said contact shoe and adapted to supply current thereto, there being a bore passing through the contact shoe and clamp to connect the bus tube with the cooling pipe in the clamp, said bore being enlarged at the juncture of the contact shoe and clamp, and a sealing pipe arranged in the enlarged portion of the bore and extending into the contact shoe and clamp, said sealing pipe being enlarged at both of its ends and having an interior diameter substantially the same as that of the bore, the enlarged ends of the sealing pipe engaging the enlarged portions of the bore with fluid tightness to seal the bore at the juncture of the contact shoe and clamp, whereby a cooling medium may be passed through said bus tube and bore to the cooling pipe in the clamp.

2. In an electric furnace, an electrode supporting arm, an electrode clamp comprising a continuous ring of a metal having high electrical conductivity, means to secure an electrode in said clamp, a steel cooling pipe cast in said clamp to reinforce the clamp, fluid circulating pipes supported by said arm and slidably engaging said clamp, said fluid circulating pipes having an adjustable connection with said cooling pipe, and means to adjust the electrode clamp longitudi-

nally of the supporting arm and fluid circulating pipes.

3. In an electric furnace, an electrode supporting arm, an electrode clamp comprising a continuous ring of metal having high electrical conductivity, means to secure an electrode in said clamp, a steel cooling pipe cast in said clamp to reinforce the clamp, hollow bus bars supported on said arm and having a sliding connection with said clamp, a telescoping connection between said bus bars and cooling pipe, and means to adjust said electrode clamp longitudinally of the electrode arm and bus bars.

4. In an electric furnace, an electrode supporting arm, an electrode clamp, an insulating extension carried by said clamp and extending into said supporting arm whereby the clamp is supported by said arm while being electrically insulated therefrom, means to secure an electrode in said clamp, a cooling pipe extending around said clamp and into said insulating extension, and means to circulate a cooling medium through said pipe to cool said clamp and insulating extension.

5. In an electric furnace, an electrode supporting arm having a generally tubular form, the end of the tubular arm being slit, an electrode clamp, an insulating extension carried by said clamp and extending into the slit end of the electrode arm, means to adjustably clamp the slit end of the arm about the insulating extension, a cooling pipe extending around said electrode clamp and into said extension, and means to circulate a cooling medium through said pipe to cool said clamp and insulating extension.

6. In an electric furnace, an electrode supporting arm, an electrode clamp supported by said arm and comprising a continuous ring having a bore to receive an electrode, said bore being relieved at one of its sides, and means to secure an electrode in said bore by forcing the electrode into the relieved portion of the bore.

7. In an electric furnace, an electrode clamp comprising a continuous ring having a bore to receive an electrode, there being a groove arranged longitudinally of the bore, said bore being relieved at a point opposite the groove, and a wedge arranged in the groove and adapted to force the electrode into the relieved portion of the bore.

8. In an electric furnace, an electrode clamp comprising a ring having a bore therein to receive an electrode, there being a groove arranged longitudinally of said bore, said bore having an arcuate relieved portion at a point opposite the groove, and a wedge arranged in the groove and adapted to force the electrode into said arcuate relieved portion.

9. In an electric furnace, an electrode clamp comprising a ring having a bore to receive an electrode, there being a groove arranged longitudinally of said bore, said bore having an arcuate relieved portion at a point opposite the groove and extending along the circumference of the bore through an arc of substantially 90°, and a wedge arranged in the groove and adapted to force the electrode into the relieved portion of the bore.

WILLIAM E. MOORE.