

July 22, 1941.

W. E. MOORE

2,249,776

ELECTRODE SUPPORTING STRUCTURE

Filed Dec. 27, 1937

2 Sheets-Sheet 1

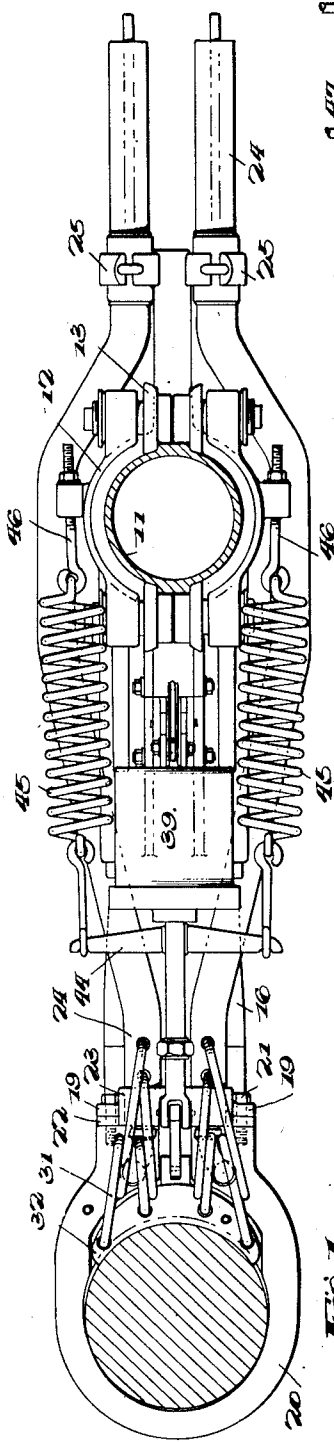


FIG. 1.

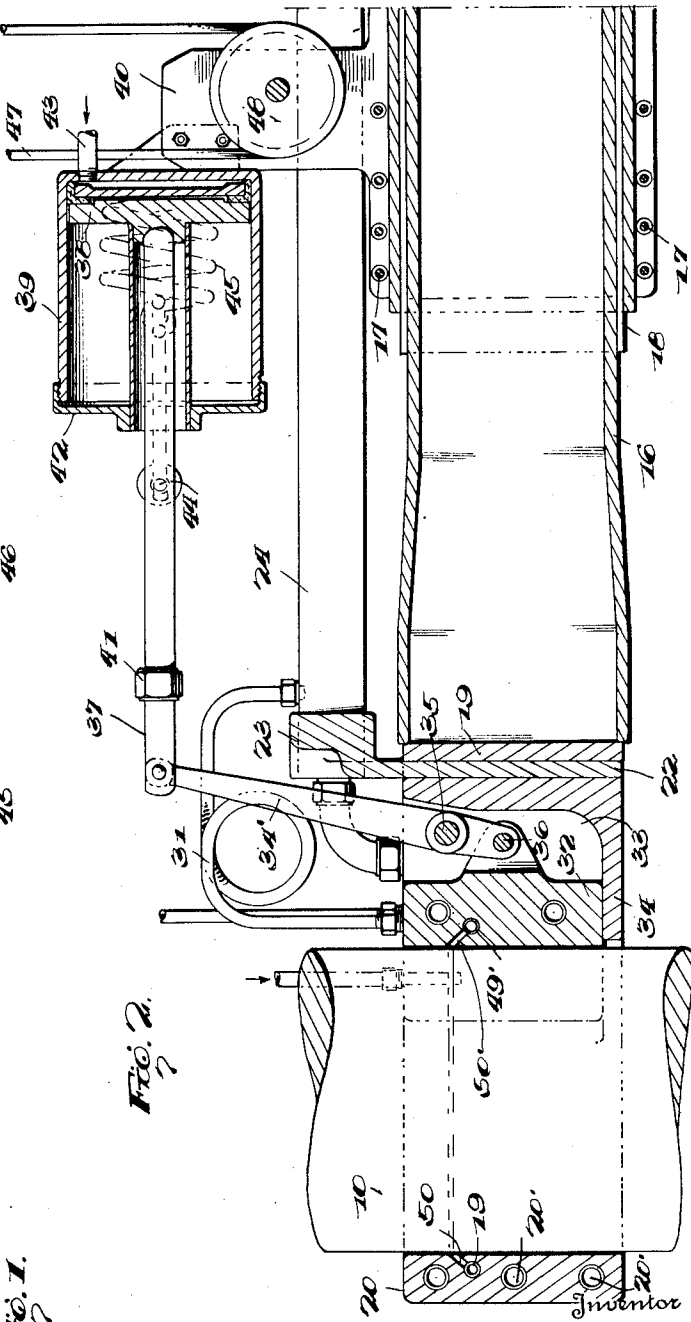


FIG. 2.

W. E. Moore.

By C. H. Fraser

Attorney

July 22, 1941.

W. E. MOORE

2,249,776

ELECTRODE SUPPORTING STRUCTURE

Filed Dec. 27, 1937

2 Sheets-Sheet 2

FIG. 3.

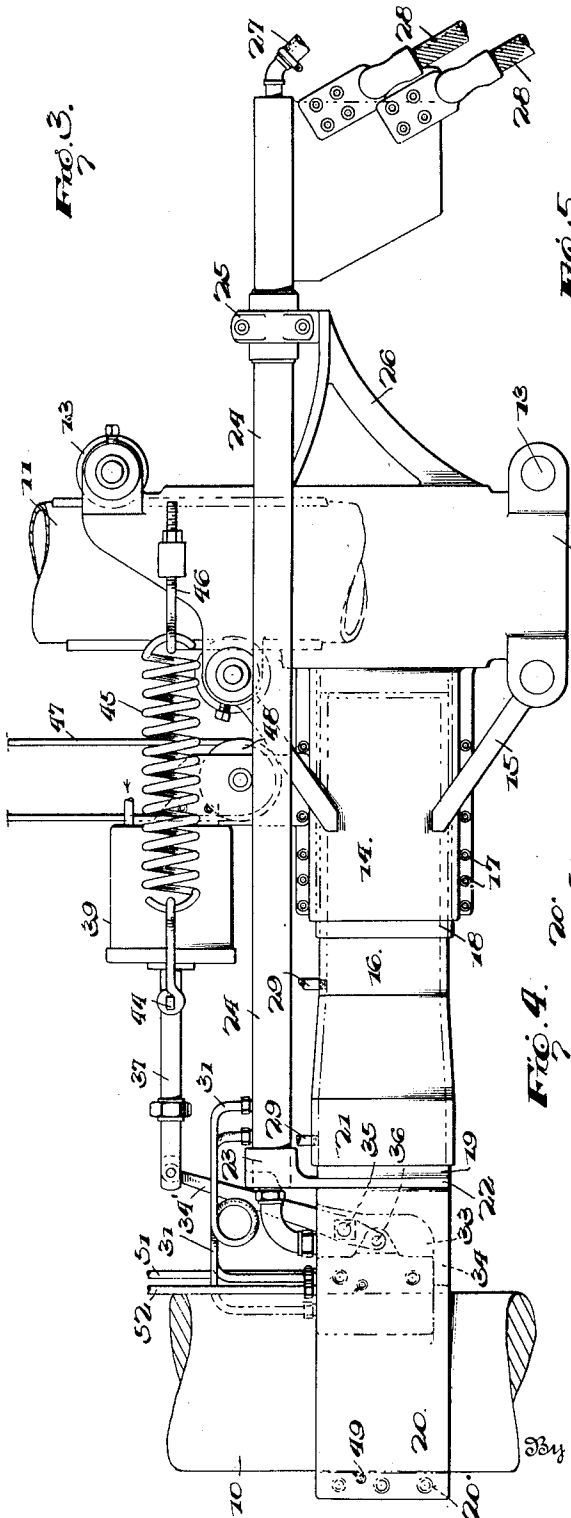


FIG. 5.

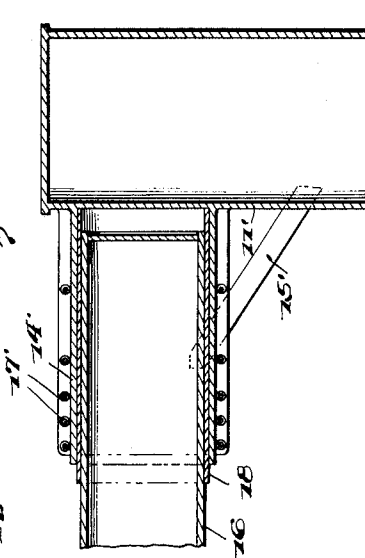
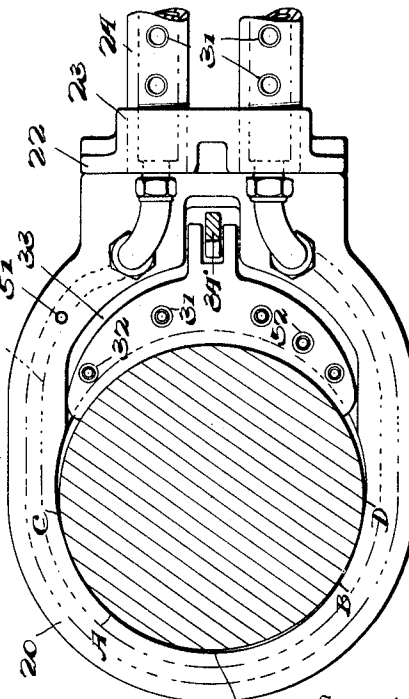


FIG. 4.



Inventor

W. E. Moore.

C. K. Fraser

Attorney

UNITED STATES PATENT OFFICE

2,249,776

ELECTRODE SUPPORTING STRUCTURE

William E. Moore, Pittsburgh, Pa., assignor, by
mesne assignments, to Delaware Engineering
Corporation, Wilmington, Del., a corporation of
Delaware

Application December 27, 1937, Serial No. 181,921

15 Claims. (Cl. 13—16)

The present invention relates to improvements in electric arc furnaces, and more particularly to electrode supporting and operating mechanism therefor.

In the operation of electric arc furnaces, speed of operation is very important, not only from the standpoint of production or output of the furnace but also because of the cost of power demand. Due to the consumption of electrodes during the furnace operation, it is necessary to periodically adjust the position of the electrodes to compensate for the consumption of the lower ends of the electrodes. In the usual furnace, adjustment of the electrode position involves a considerable loss of time in the furnace operation.

An important object of the present invention is to provide an electrode supporting mechanism which may be rapidly operated to adjust the position of the electrode and which may be operated from a point spaced a substantial distance from the electrode.

Another object of the invention is to provide an electrode clamping action which is resilient to adjust itself to any change in the fit between the electrode and its clamp.

A further object of the invention is the provision of an electrode clamp which presents a small surface to the flames issuing from the electrode receiving openings in the furnace and which is provided with water cooling of the arm and clamp to resist the destructive heating effect of the furnace.

A still further object of the invention is the location of the arm insulation at a point remote from the electrode and the provision of means to water cool the electrical contact surfaces of the arm and clamp and to cool the arm adjacent the insulation.

Still another object of the invention is to provide means for cleaning the electrode and clamp when making an adjustment of the electrode position, such means being capable of operation from a point remote from the electrode and clamp.

Yet another object of the invention is to provide an electrode clamp which resiliently clasps the electrode and which may be suitably operated, as by fluid pressure, to release the electrode.

Yet a further object of the invention is the provision of an electrode supporting arm and clamp which is light in weight, simple of construction, which is easily and inexpensively manufactured, installed and operated and which will have a long life.

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

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

Figure 1 is a horizontal sectional view through the electrode and electrode column showing the arm and clamp in top plan,

Figure 2 is a vertical sectional view through the electrode arm and clamp,

Figure 3 is a side elevation of the electrode clamp and arm,

Figure 4 is a top plan view of the electrode clamp, parts being shown in section, and,

Figure 5 is a detail sectional view illustrating the electrode arm connection with an electrode column of the rise and fall type.

In the drawings, wherein for the purpose of illustration is shown a preferred embodiment of the invention, the numeral 10 designates an electrode adapted to extend through the roof of an electric furnace. Electrodes of this type are supported from electrode columns disposed at one side of the furnace, and are moved vertically on the column when a stationary column is employed or move vertically with the column when a rise and fall type of electrode column is employed. A suitable horizontal arm is connected at one end to the electrode column and is provided at its other end with a clamp to engage the electrode. The present invention is directed to the construction and operation of this electrode arm and clamp.

In Figures 1 to 4 of the drawings, the invention is shown as applied to the stationary type of electrode column 11 on which a cross-head structure 12 is slidably mounted for vertical movement. Suitable rollers 13 are carried by the cross-head to engage the column, and these rollers are preferably adjustable toward and away from the column. A split, hollow clamping sleeve 14 is carried by the cross-head 12, preferably formed integrally therewith, and is rigidly supported in position by diagonal braces 15. A tubular electrode arm 16 telescopes at one end with clamping sleeve 14 and is secured therein by means of clamping bolts 17. A suitable tubular layer of insulating material 18 is disposed between the clamping sleeve 14 and the tubular arm 16 to completely insulate the electrode arm 16 from the clamping sleeve 14, cross-head 12 and column 11. The end of electrode arm 16 adjacent electrode 10 is closed by means of a metal plate 19 which extends beyond the sides of arm 16 to form a suitable flange to which the electrode clamp may be bolted. The other end of arm 16 is also closed as shown in Figures 3 and 5. The electrode clamp comprises an approximately ring-like body portion 20 which encircles the electrode and is bolted to the flange formed by plate 19, by means of suitable bolts 21. A contact shoe 22 is bolted between the machined contact end of the electrode clamp 20 and electrode arm 16, extending thereabove and being provided with bosses 23 above the electrode arm for connection to the

ends of bus pipes 24. The bus pipes 24 are extended back around the cross-head 12, passing through and beyond suitable insulated clamps 25 carried by a bracket 26 on the rear of cross-head 12. Suitable flexible water tubes 27 and flexible electrical conductors 28 are connected to the ends of the bus pipes 24 behind the clamps 25.

Fluid tubes 29, which may be flexible if desired, connect the interior of the hollow electrode arm with the bus pipes 24 so that a cooling medium such as water may be circulated through the arm to cool the clamp, contact shoe 22, arm 16 and insulation 18. It will be noted that the insulation 18, in addition to being water cooled, is disposed at a substantial distance from the heat adjacent the electrode. Suitable pipes 30 connect the ends of bus pipes 24 through the bosses 23 with fluid circulating pipes 20' embedded in the body of electrode clamp 20. Flexible tubes 31 connect the bus pipes with a movable clamping section 32 of the electrode clamp and circulate a cooling medium through the clamping shoe or section, as well as conducting electric current thereto.

The body 20 of the electrode clamp is chambered out at 33 to receive the clamping section 32 which is supported by and slides on a shelf or floor 34 at the lower end of chamber 33. A lever 34' is fulcrumed at 35 in the upper portion of chamber 33 and has its lower end pivotally connected at 36 to the central portion of movable clamping section 32. The lever 34' extends a substantial distance above the clamp and arm and is pivotally connected at its upper end to the thrust rod 37 of a piston 38 arranged for reciprocation in fluid operated cylinder 39 rigidly supported above the arm 16 by means of a bracket 40 mounted on clamping sleeve 14 or some other convenient portion of the cross-head 12. An insulating joint 41 of any suitable construction is arranged on the rod 37 adjacent lever 34' to insulate the cylinder 39 and bracket 40 from the electrode clamp. The cylinder 39 is preferably provided with a removable head 42, and a fluid supply pipe 43 opens into the rear of the cylinder. A cross bar 44 is horizontally arranged and rigidly connected at its center to thrust rod 37, extending laterally beyond the sides of cylinder 39 on each side of the thrust rod. Suitable coil springs 45 connect the ends of cross bar 44 with adjustable bolts 46 carried by the cross-head 12. The tension of coil springs 45 may be easily and quickly adjusted by means of the adjusting bolts 46, or by any other suitable means.

The springs 45 draw the upper end of lever 34' towards the cylinder 39 and thereby resiliently force movable clamp section 32 against the electrode to hold the electrode in adjusted position in the electrode clamp. When it is desired to release the electrode, air or other fluid under pressure is admitted to cylinder 39 behind piston 38, and the piston and thrust rod are moved against the tension of coil springs 45 to release the electrode. When pressure in cylinder 39 is released, the coil springs 45 return the lever and movable clamping section to their clamping position illustrated in Figures 2 and 3. The control valve for admitting fluid under pressure to cylinder 39 may be located at any suitable point remote from the electrode. The action of springs 45 will force the fluid out of cylinder 39.

It is preferred to utilize the tension of springs 45 for the clamping action of clamp section 32. In this manner, fluid pressure is only used to

release the clamp for adjusting or slipping the electrode, and maintaining fluid pressure within cylinder 39 is not required to hold the clamp in operative engagement with the electrode. However, if desired, the cylinder and spring action may be reversed so that the clamp is held in clamping position by fluid pressure and released by spring action, or the springs may be dispensed with and a double-action cylinder employed.

The cross-head 13, arm 16, clamp 20 and electrode 10 may be adjusted vertically as a unit on column 11 by means of a cable 47 which engages a pulley 48 on the cross-head and which may be operated by a suitable winch.

During the operation of the furnace, dust and dirt is likely to collect on the electrode so that when it is slipped downward in the clamp or when the clamp is moved upwardly on the electrode, the dust and dirt will prevent a good contact between the clamp and electrode. To prevent this result and to blow out any dirt or dust which may enter the top of the clamp, an annular passage or pipe 49 is formed or embedded in the clamp 20 at a point spaced below the top of the clamp but above the center line thereof. An upwardly inclined annular slot 50 or a series of holes or openings connects the pipe 49 with the bore of the clamp, as illustrated in Figure 2. A similar pipe 49' is embedded in movable contact section 32 and a similar slot 50' is also arranged in section 32 as illustrated in Figure 2. A supply pipe 51 extends through the clamp 20 to the pipe 49 to conduct air, steam or other cleaning fluid under pressure into the pipe 49 to be blow out through slot 50 to clean off the electrode and the upper portion of the bore of the clamp, as well as the lower portion of the clamp bore and electrode. As the fluid leaving pipes 49 and 49' enters the confined annular space between the electrode and the clamp bore, it rushes upwardly and downwardly through the bore to clean the electrode and clamp. As the electrode is adjusted downwardly, the fluid is directed so that more will pass upwardly than downwardly. A similar supply pipe 52 extends through the top of movable clamping section to pipe 49'. The valve for controlling the cleaning fluid is preferably located adjacent the valve which controls the hydraulic cylinder 39, so that the cleaning fluid may be used in conjunction with the clamp operation. The cleaning fluid is blown up between the clamp and electrode cleaning out any dust and dirt and cleaning the portion of the electrode immediately above the clamp, so that as the electrode moves downwardly in the clamp, a good contact will be obtained between the cleaned contact surfaces of the clamp and electrode.

The present invention may be used with the rise and fall type of column as indicated in Figure 5. The clamping sleeve 14' may be rigidly secured to the upper portion of the column 11' and engaged by the diagonal braces 15' so that the sleeve 14', arm 16, clamp 20 and electrode 10 will be raised and lowered with the column.

The movable clamp section 32 is supplied with current through pipes 31 connected to the bus bars, so that contact between the movable section 32 and clamp body 20 is not relied upon. While the movable clamp section 32 is shown as formed in one piece, a multiple part contact shoe with its parts pivotally connected may obviously be employed. The bore of the body section 20 of the clamp is preferably relieved through an arc of about 70° at a point opposite

movable clamp section 32 as indicated at 53 in Figure 4 to accommodate variations in the size of electrodes. Referring to Figure 4, it will be seen that the normal bore C—A, B—D is relieved from A to B to accommodate smaller size electrodes while a still larger bore from C to D permits sliding of the electrode when the clamp is released.

It will be seen that the clamp of the present invention has a simple outline which presents a small surface to the flames issuing from the furnace and that the two sections of the clamp as well as the arm 16 and insulation 18 are water cooled. The insulation 18 is disposed at a safe distance from the zone of heat adjacent the electrode. The use of spring tension to hold clamp section 32 against the electrode will assure a firm grip on the electrode while providing a yielding pressure to allow for expansion or changes in the clamp and electrode. Springs 45 are shown as uncovered, for the convenience of illustration, but may obviously be enclosed by suitable heat insulated metal casings.

While I have shown and described the preferred embodiment of the 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 the invention or the scope of the subjoined claims.

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

1. In an electric furnace having an electrode in a position at a substantial angle to a horizontal plane, an electrode clamp and supporting mechanism comprising an annular fluid cooled clamp body closely surrounding the electrode and having a bore to receive the electrode and form electrical contact therewith for a portion of its perimeter, a fluid cooled movable clamp section operatively associated with the clamp body to engage the electrode mechanically and electrically and completely surrounded by the fluid cooled clamp body, means carried by the clamp body to shield the lower portion of the movable clamp section from the heat of the furnace, resilient means normally moving the movable clamp section into clamping engagement with the electrode, and hydraulic mechanism operatively engaging the movable clamp section to move it out of engagement with the electrode against the tension of the resilient means.

2. In an electric furnace having an electrode, an electrode clamp mechanism comprising an annular fluid cooled clamp body surrounding the electrode, a movable clamp section operatively associated with the clamp body to engage and disengage the electrode, said electrode clamp having an annular blast channel spaced below its upper end and opening into its bore, and means to admit fluid under pressure to said blast channel to pass out through the bore of the clamp to clean the contact surfaces of the electrode and clamp.

3. In an electric furnace having an electrode, an electrode clamp mechanism comprising an annular clamp body surrounding the electrode and adapted to engage and disengage the electrode, said electrode clamp having an annular blast channel spaced below its upper end and an upwardly inclined slot connecting the channel with the bore of the clamp, and means to admit fluid under pressure to said blast channel to pass out through the bore of the clamp to

clean the contact surfaces of the electrode and clamp.

4. In an electric furnace having an electrode, an electrode clamp and supporting mechanism surrounding the electrode, a vertically movable clamping sleeve spaced a substantial distance from the electrode, a hollow electrode and clamp supporting arm extending into said clamping sleeve and clamped therein, insulation material disposed between the electrode arm and clamping sleeve, means connecting the electrode arm and electrode clamp, and means to circulate a cooling medium through the hollow electrode arm to cool the arm, clamping sleeve and insulation material.

5. In an electric furnace having an electrode, an annular fluid cooled clamp closely surrounding the electrode and having a fluid cooled contact surface, a hollow fluid cooled electrode and clamp supporting arm having a fluid cooled plane surface at one end, an electrically conducting contact shoe disposed between the fluid cooled plane surfaces of the clamp and arm, said clamp having a bore to receive and electrically contact an electrode of normal size, said bore being relieved through an arc of substantially 70° to accommodate an electrode of less than normal size, and said clamp being provided on the side opposite to the relieved area of the bore with an enlarged bore of greater radius than the normal electrode which extends through an arc of substantially 140° to permit free passage of an electrode through the clamp, a movable clamping member carried by the clamp at a point diametrically opposite the relieved area of the bore of the clamp, and means disposed at a point remote from said clamp to force the movable clamping member into and out of engagement with the electrode.

6. In an electric furnace having an electrode, a fluid cooled clamp closely surrounding the electrode and having a fluid cooled contact surface, a hollow electrode arm having a fluid cooled flanged contact end, an electrically conducting contact shoe disposed between the fluid cooled contact surface of the clamp and the fluid cooled flanged end of the arm and secured to said clamp and arm, said contact shoe extending beyond the electrode arm, bus bars carrying a cooling fluid and electric current and connected to the extension of said contact shoe, and fluid circulating pipes connecting the bus bars to the electrode clamp and the electrode arm.

7. In an electric furnace having an electrode, a fluid cooled annular clamp closely surrounding the electrode and having a fluid cooled contact surface, a fluid cooled supporting arm connected to said clamp and supported in an insulated clamping structure at a point spaced a substantial distance from the electrode, said arm having a fluid cooled contact surface at its end opposite to the insulated clamping structure, an electrically conducting contact shoe disposed between the fluid cooled contact surfaces of the clamp and arm and cooled from both sides thereby, resilient means supported at a point remote from the electrode and connected to the clamp to force the clamp into engagement with the electrode, and fluid pressure operated means to release the electrode clamp against the tension of the resilient means.

8. In an electric furnace having an electrode, an annular fluid cooled clamp closely surrounding the electrode to support and carry electric

current thereto, said clamp being chambered to receive a movable fluid cooled clamping section adapted to engage and carry electric current to said electrode, a shelf below said chamber to support the movable clamping section and shield it from the heat of the furnace, an operating rod operatively connected to said movable clamping section to move it toward and away from the electrode, resilient means engaging the rod to move it in one direction, and fluid operated means engaging the rod and operable to move it in the opposite direction against the tension of the resilient means.

9. In an electric furnace having an electrode, an annular fluid cooled clamp surrounding the electrode, said clamp being chambered to receive a movable fluid cooled clamping section, a shelf below said chamber to support the movable clamping section and shield it from the heat of the furnace, a lever pivotally mounted on the electrode clamp and having one end operatively engaging the movable clamping section to move it into and out of clamping engagement with the electrode, a fluid pressure cylinder and piston spaced a substantial distance from the electrode and clamp and operatively engaging the lever to move it in one direction, and resilient means spaced a substantial distance from the electrode and operatively engaging the lever to move it in the opposite direction.

10. In an electric furnace having an electrode, an annular fluid cooled clamp surrounding the electrode, said clamp being chambered to receive a movable clamping section, a shelf below said chamber to support the movable clamping section, a lever pivotally mounted on the electrode clamp and having one end operatively engaging the movable clamping section to move it into and out of clamping engagement with the electrode, a fluid operated cylinder and piston spaced a substantial distance from the electrode and clamp and operatively engaging the lever to move it in one direction, and resilient means spaced a substantial distance from the electrode and operatively engaging the lever to move it in the opposite direction, said electrode clamp having a blast channel spaced below the top of the clamp and communicating with the bore of the clamp, and means to force fluid under pressure into said channel.

11. In an electric furnace having an electrode, an annular fluid cooled clamp surrounding the electrode, said clamp being chambered, a movable fluid cooled clamping section arranged in the chambered portion of the clamp and carrying electric current to said electrode, a vertically movable support, a fluid cooled electrode arm carried by the support and connected to said clamp adjacent said chambered portion thereof, a lever pivotally secured to the clamp and having one end engaging the movable clamping section to move it into and out of engagement with the electrode, a fluid pressure cylinder and piston mounted on the support and operatively engaging the lever to move it in one direction, and resilient means mounted on the support and operatively engaging the lever to move it in the opposite direction.

12. In an electric furnace having an electrode, an annular clamp surrounding the electrode, said clamp being chambered, a movable clamping section arranged in the chambered portion of the clamp, a vertically movable support, an electrode arm carried by the support and connected to said clamp, a lever pivotally secured to the

clamp and having one end engaging the movable clamping section to move it into and out of engagement with the electrode, a fluid pressure cylinder and piston mounted on the support and operatively engaging the lever to move it in one direction, and resilient means mounted on the support and operatively engaging the lever to move it in the opposite direction, said clamp and clamping section being provided with an annular channel spaced below the tops thereof and communicating with the bore of the clamp, and means to force fluid under pressure into said channel to pass into said bore to clean out said bore and pass out of the bore in engagement with the electrode to clean the surface of the electrode.

13. In an electric furnace having an electrode, an annular clamp surrounding the electrode, said clamp being chambered, a movable clamping section arranged in the chambered portion of the clamp, a vertically movable support, an electrode arm carried by the support and connected to said clamp adjacent said chambered portion, a lever pivotally secured to the clamp and having one end engaging the movable clamping section to move it into and out of engagement with the electrode, a hydraulic cylinder and piston mounted on the support and operatively engaging the lever to move it in one direction, and resilient means mounted on the support and operatively engaging the lever to move it in the opposite direction, and means to circulate a cooling fluid through the arm, clamp and movable clamping section.

14. In an electric furnace having an electrode, an electrode clamp mechanism comprising an annular fluid cooled clamp body closely surrounding the electrode, a movable fluid cooled clamp section operatively associated with the clamp body to engage and disengage the electrode, said electrode clamp body having an annular blast channel spaced below its upper end and opening into its bore, said movable clamping section having a blast channel spaced below its upper end and opening into the bore of the clamp, a fluid supply conduit connected to the blast channel of the clamp body to admit fluid under pressure to said channel to pass out through the bore of the clamp to clean the contact surfaces of the electrode and clamp, and a flexible conduit connecting the supply conduit with the blast channel of the movable clamp section to pass fluid under pressure into said channel to escape through the clamp bore and clean the contact surface of the movable clamp section and the adjacent surface of the electrode.

15. In an electric furnace having an electrode, an annular fluid cooled clamp closely surrounding and forming electrical contact with the electrode and having a plane water cooled contact surface, a hollow electrode and clamp supporting water cooled arm, an electrically conducting contact shoe connected to a source of electric power and disposed between the plane water cooled contact surface of the clamp and the water cooled surface at the end of the hollow arm, a vertically movable clamping sleeve receiving the other end of the electrode and clamp supporting arm, electrical insulating material disposed between the clamping sleeve and the electrode arm, means to conduct electric current to the contact shoe, and means to circulate a cooling medium through the hollow electrode arm to cool the arm, contact shoe, clamping sleeve and insulating material.

WILLIAM E. MOORE.