April 21, 1925. 1,534,553

F. VON SCHLEGELL

ELECTRIC HEATING UNIT

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Fig. 1

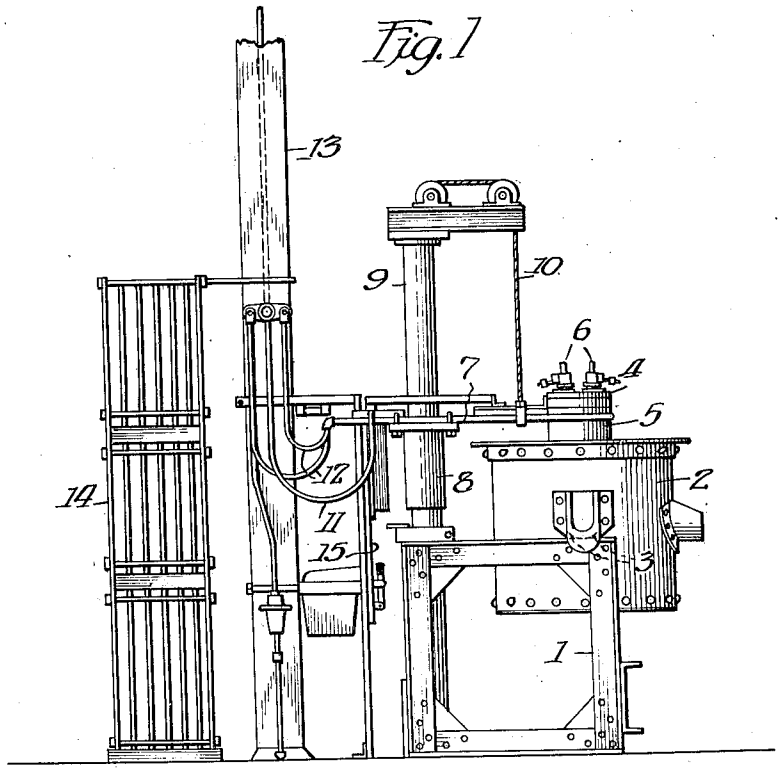


Fig. 7

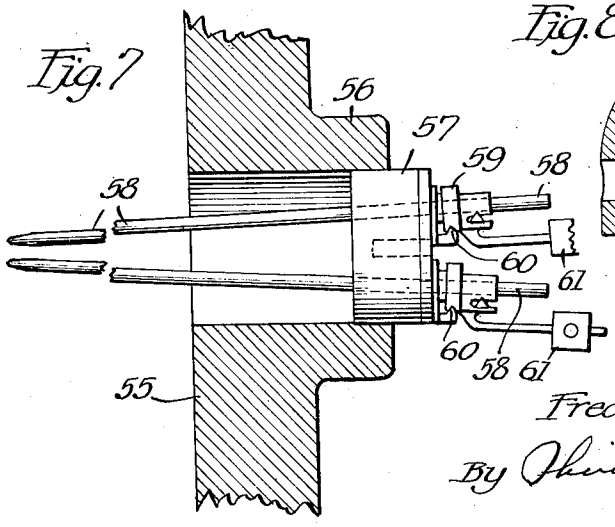
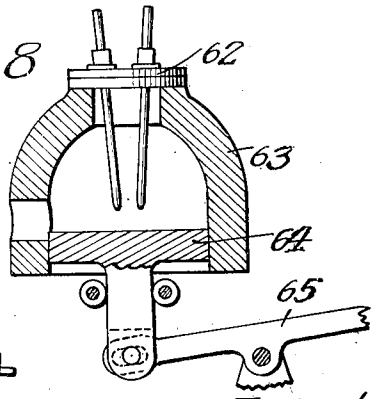


Fig. 8



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Fig. 3

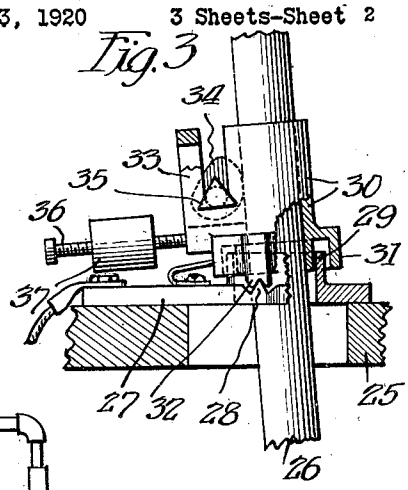


Fig. 2

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Fig. 4

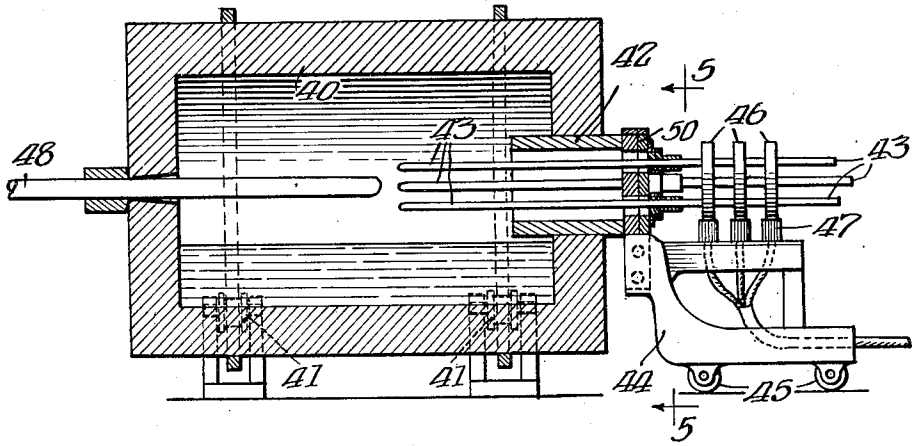
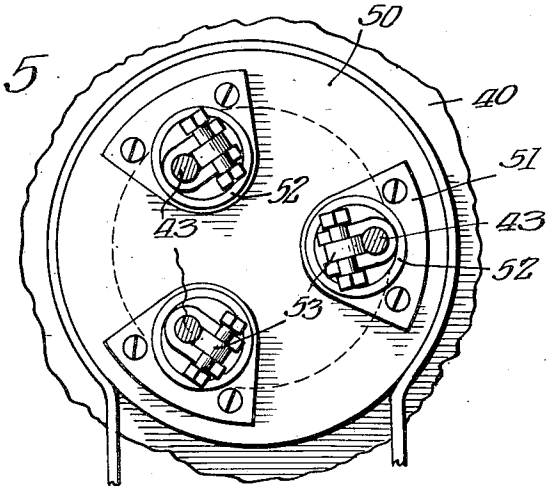


Fig. 5



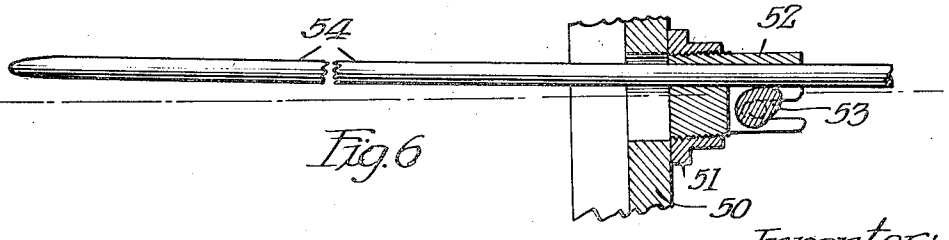


Fig. 6

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Patented Apr. 21, 1925. 1,534,553

UNITED STATES PATENT OFFICE.

FREDERICK VON SCHLEGELL, OF CHICAGO, ILLINOIS.

ELECTRIC HEATING UNIT.

Application filed September 13, 1920. Serial No. 409,833.

To all whom it may concern:

Be it known that I, FREDERICK VON SCHLEGELL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Heating Units, of which the following is a specification.

My invention relates to improvements in electric arc heating. In its various embodiments it is applicable to melting or annealing furnaces, electric welding, forging, and the heating of ladles and other containers.

The present application is a continuation in part of my copending application Serial No. 354,700, filed January 29, 1920.

The general object of the invention is to provide a heating unit comprising a plurality of substantially parallel electrodes held in spaced relation by an insulating support, whereby they may be made to project into a chamber, or toward the work to be heated, and may be advanced as a group as the ends thereof are consumed by the arc or arcs, or as the condition of the work may require.

Another object is to provide a small portable, inexpensive unit of this character which may be inserted into a heating chamber at any angle, and which may be conveniently used for any one of a number of different heating purposes.

A further object is to provide a duplex electric furnace comprising a single heating unit and two or more heating chambers heated in succession by the same heating unit, whereby a fuel preheating operation may be carried out in one heating chamber while a charge is being electrically melted in another heating chamber, thereby avoiding loss due to having the electric equipment idle a considerable portion of the time.

In the accompanying drawings I have illustrated several embodiments of the invention.

Figure 1 is a side elevation of a melting furnace;

Fig. 2 is a front elevation of a duplex melting furnace;

Fig. 3 is an enlarged sectional elevation of a pivoted electrode holder;

Fig. 4 is a diagram of a rotary furnace with a modified heating unit;

Fig. 5 is a section taken on the line 5—5 of Fig. 4;

Fig. 6 is an enlarged sectional view of one of the electrode holders;

Fig. 7 is an elevation of a modified holder; and

Fig. 8 is a sectional elevation of an electric forge.

In Fig. 1 the equipment comprises a frame 1, which supports the electric furnace 2, the latter consisting of a suitable refractory lined shell, pivotally supported on trunnions 3. The heating unit consists of a plate of insulating material 4, having a cylindrical refractory member 5 extending downwardly therefrom and fitting within an opening in the top of the furnace. A plurality of carbon electrodes 6 pass through openings in the insulating plate 4 and project downwardly into the heating chamber. Said electrodes in the present case are, preferably, three in number and are pivotally mounted, whereby the arc is automatically struck and regulated in the manner described in my prior application.

The heating unit is supported by an arm or crane 7, carried by a guide 8 which slides vertically on a mast 9, the weight of the heating unit being carried by a flexible cable 10 which passes downwardly inside the mast and carries a counterbalancing weight, not shown. With this arrangement the heating unit may be lifted from the furnace and swung to one side, enabling the furnace to be tilted so as to pour the molten bath therefrom, after which it may be charged through the opening in the top and the heating unit swung back into place and lowered into said opening. The up and down movement of the heating unit is effected without disturbing the electrical connections, which are maintained by flexible conductors 11 at the rear of the furnace. In addition, flexible hose or water connections 12 are also supplied to cool the supporting member of the heating unit. These water connections and flexible conductors are supported on a frame 13, arranged preferably in the rear of the furnace, adjacent to which is a second frame 14 carrying suitable reactance coils. A switch board 15 is located in a position convenient to the operator, preferably at one side of the furnace.

In Fig. 2 I have illustrated a duplex

equipment comprising two electric furnaces 16, each of which has trunnions 17 supported on a frame 18. A suitable mast 19 is mounted between said furnaces and carries a frame comprising a guide 20, an arm 21, and suitable water connections 22. The construction of the heating unit is similar to that illustrated in Fig. 1, and will now be described more in detail. It comprises a refractory cylindrical member 23, having an annular groove into which the pipe 22 fits to clamp it in place and to cool it. At its upper end it carries a refractory cap 24, on which is supported an insulating plate 25, said members having registering openings therein, through which the electrodes 26 pass. There are two such electrodes shown in the present case, although a greater number may be employed.

The electrodes are pivotally supported in the following manner: A metal base plate 27 is secured to the insulating plate 25 and has an opening therein to receive the electrode 26. It is also provided with a pair of knife edges 28 at the opposite sides of said opening, together with an upwardly extending flange 29 forming a continuation of said opening. Above it a holder 30 is arranged, consisting preferably of a cylindrical casting in which the electrode 26 has a sliding fit. Said casting has a lower flange 31 loosely surrounding the flange 29 and providing a circuitous passage to obstruct the escape of the gases from the furnace and prevent egress of a flame. Said flange is provided with a pair of lugs 32, having recesses which fit over the knife edges 28, thereby pivotally supporting the electrode clamp and the electrode. A side extension 33 is spaced from the casting, and provides a slot which receives a locking cam 34 with triangular extensions 35. Said cam bears against the electrode and locks it in place, but it may be released by turning the extension 35. A counterbalancing arm 36 projects from the casting and carries a weight 37, which may be adjusted to determine the angle of the electrode 26 to ensure striking the arc, in the manner described in my previous application.

It will be seen that the electrodes are closely grouped and are supported on a common structure, whereby they may be lowered simultaneously into the heating chamber as the lower ends thereof are consumed. When the furnace is in operation the electrodes swing somewhat in carrying out the automatic regulation, but, generally speaking, they are nearly parallel, except when no current is flowing, at which time they are in contact with each other at their lower ends. During normal operation, the electrodes are sufficiently close to each other and the voltage sufficiently high to ensure that the arcs may be maintained between the ends of the electrodes rather than between the electrodes and the charge or the work to be heated, except when the operator purposely moves said ends very close to the work.

The refractory sleeve 23 permits the heating unit to be adjusted, i. e. moved into or away from the heating chamber, leaving practically no opening through which the flame may issue. Furthermore, the construction is very simple and inexpensive as compared with the usual automatic regulators provided in connection with electric arc furnaces now on the market. The duplex furnace is operated by lowering the heating unit into one furnace while the other is being charged. Furthermore, the other furnace and its charge may be preheated by an oil, or other fuel flame supplied through the pipe 38, or in any other suitable manner, during the operation of the first furnace. When the first heat is ready to pour, the electric heating unit is then swung over, lowered into the second furnace, and immediately put in operation, thereby keeping the electrical equipment in almost continuous use and effecting a substantial economy in time, cost of equipment, and cost of operation.

Also, the furnace shells may have two different types of linings, for example acid and basic, whereby a great variety of work may be accomplished by a single electrical equipment with a corresponding saving in first cost of electrical apparatus, saving of time and expense in tearing out one lining and installing another, and saving in loss, due to equipment standing idle, unnecessarily high maximum demand power charges, etc.

Due to the compact arrangement of the electrodes and the inherent stability of the apparatus, the heating unit may be operated directly from a 220 volt circuit, without transformers.

The furnace may also be constructed as an elongated chamber, with two upper openings, through each of which a heating unit may be inserted. When the heat is ready to pour, these two heating units may be swung to a second similar furnace, operated in the manner just described. After a heat has been poured a subsequent charge is added, and the furnace may be preheated, as, for example, by the use of an oil flame while the charge in the second furnace is melted by the heating unit. Such elongated furnace would, preferably, be provided with a pouring spout at each end thereof, so that the receiving ladle may be placed at whichever end is most convenient to the cranes.

Fig. 4 shows, somewhat diametrically, a rotary furnace 40, supported on suitable rollers 41, and having an opening at each end thereof concentric with the axis of rotation. A cylindrical refractory member 42

fits one of said openings and rotates therewith, said member being preferably closed at the outer end in the manner previously described, and supporting a plurality of carbon electrodes 43, which pass through openings therein. Said electrodes and support constitute a heating unit which may be advanced bodily into the heating chamber, said unit being supported in part on a truck 44 having wheels 45. As the furnace rotates, current is supplied to the electrodes by means of suitable slip rings 46 and brushes 47. The arc is struck by providing an auxiliary member, such as a neutral electrode 48 projecting through the opening at the opposite end of the furnace, although it may be otherwise arranged. Said electrode may be moved inwardly by hand to short-circuit the ends of the electrodes 43, after which it may be drawn away from said ends, thereby starting the arcs, which are blown outwardly by magnetic repulsion, and thus maintain themselves at the outer extremities of the electrodes as the latter are gradually consumed. The truck is advanced from time to time, to push the heating unit farther into the furnace as the electrodes shorten.

If the furnace is stationary instead of being rotatable, as in the case of a reservoir for holding or mixing the molten metal, the truck may be omitted and the heating unit supported in the opening and pushed inwardly from time to time, as conditions require.

The electrodes shown in Fig. 4 are held in fixed spaced relation, as distinguished from the pivoted electrodes previously described. They pass through an opening in an insulating plate 50 (Fig. 5) and are adjustably secured by clamps 51, comprising, preferably, castings having screw-threaded engagement with cylindrical outward extensions 52 carrying cams 53, similar to those previously described.

The clamp is also shown in Fig. 6 in slightly modified form, in that the opening is arranged somewhat diagonally to support the electrode 54 in a slightly diagonal position. It will be seen that the electrodes (in Figs. 4, 5, and 6) are mounted eccentrically with reference to the cylindrical extension 52, in which they are clamped. Therefore, by rotating said extensions the electrodes may be moved toward or away from each other in accordance with conditions of voltage, current, etc. With the arrangement shown in Fig. 6 one or more of the electrodes are mounted somewhat diagonally, and rotation of the extension 52 will cause the end of the electrode to sweep through the arc of the circle, engaging the ends of the other electrodes, thereby striking an arc without the use of an auxiliary member such as shown in Fig. 4. It will also be noted that in many cases the charge in the furnace may be used to short circuit the electrodes, for the purpose of starting the arc, and that where the auxiliary member is used it may be introduced into the heating chamber in a number of different ways.

While a construction wherein the electrodes are rigidly supported, as in Fig. 4, for example, is particularly well adapted for insertion into a heating chamber in horizontal position, nevertheless a pivotal support for one or more of the electrodes may be provided in a horizontal or inclined heating unit. Such an arrangement is shown in Fig. 7, for example, in which the wall of the heating chamber 55 may be considered part of a refractory receptacle, such as a ladle, reservoir, electric furnace, &c., said wall having an opening therethrough surrounded by an extension or sleeve 56, in which the heating unit is inserted. Said unit comprises a refractory support 57, carrying electrodes 58, at least one of which is pivotally mounted in a holder 59, supported on a knife edge 60 and counterbalanced by an adjustable weight 61, in a manner similar to that previously described. The electrodes are so positioned that contact between the ends of the electrodes results whenever the current is interrupted, the arc being automatically regulated when current is flowing. One movable electrode may be made to close the circuit simultaneously to two fixed electrodes, as in the case of three-phase current, for example, or a single movable electrode may contact with a single fixed electrode, or two of the electrodes may be movable, or all three may be movable and arranged not only horizontally, but in an inclined position or in a vertical position, as previously described.

The adjustment of the heating unit as a whole is effected by sliding the supporting member 57 within the sleeve 56, which sleeve may be sufficiently long to ensure a substantial range of adjustment without uncovering the opening. In other words, the sleeve in this case is located primarily on the stationary wall, as distinguished from a sleeve on the movable heating unit, as in many of the other figures.

In Fig. 8 I have shown diagrammatically an electric forge comprising a heating unit 62, similar to those previously described, closing an opening in the upper part of a chamber of refractory material 63, the hearth bottom 64 of which may be adjusted vertically by a lever 65 as the electrodes are consumed and to adjust the distance from the arc to the material being heated. In other words, the articles to be heated may be gradually raised to maintain them at the proper distance from the arc or to vary the intensity of the heat.

The heating unit need not necessarily be

enclosed in a heating chamber, but may be supported in any convenient manner adjacent the work to be heated, as, for example, where the unit is to be used for electric arc welding.

The invention is not to be limited to the several embodiments thereof described in detail herein, as various other forms of the invention may be devised which fall within the scope of the appended claims.

I claim:—

1. A heating unit comprising a plurality of electrodes, and an insulating support holding said electrodes in substantially parallel relation to ensure maintenance of an arc between the ends of said electrodes as the latter are consumed.

2. A heating unit comprising a plurality of electrodes, an insulating support holding said electrodes in substantially parallel relation to ensure maintenance of an arc between the ends of said electrodes as the latter are consumed, and a refractory sleeve associated with said support and surrounding said electrodes for part of their length.

3. The combination with a heating receptacle having an opening therein, of electrodes passing through said opening, an adjustable electrode support adjacent said opening, a hollow member surrounding said electrodes and serving to guide said support and permit adjustment of said electrodes in said opening, said electrodes being held by said support in substantially parallel relation.

4. The combination with a heating chamber having an opening therein, of a hollow refractory member arranged to fit said opening and having a supporting member closing the outer end thereof, said supporting member having openings therein, and a plurality of electrodes passing through said openings and extending beyond said refractory member into said heating chamber.

5. The combination with a heating chamber having an opening therein, of a refractory member arranged to fit said opening and having an electrode supporting member at the outer end thereof, said refractory member having openings therein and a plurality of electrodes passing through said openings and extending into said heating chamber.

6. A heating unit comprising a plurality of substantially parallel electrodes, a supporting member normally holding said electrodes in fixed relationship, and means permitting adjustment of said electrodes, as a whole, toward or away from each other.

7. A heating unit comprising a plurality of substantially parallel electrodes, a supporting member having openings through which said electrodes pass, and sleeves fitting within said openings, each sleeve supporting an electrode eccentrically, whereby rotation of said sleeves varies the distance between said electrodes.

8. A heating unit comprising a support having a plurality of openings therein, a sleeve rotatably secured in each opening and having an opening therethrough eccentric with reference to said first opening, an electrode passing through said eccentric opening, and means for locking said electrode against longitudinal movement.

9. A heating unit comprising a supporting member, a plate secured thereto having an opening therein with knife edges at opposite sides of said opening, a sleeve pivotally supported on said knife edges, an electrode passing through said sleeve, and a cam carried by said sleeve for locking said electrode in position.

10. A heating unit comprising a supporting member, a plate secured thereto having an opening therein with ridges at opposite sides of said opening, a clamp pivotally supported on said ridges, an electrode passing through said clamp, a cam carried by said clamp for locking said electrode in position, and cooperating flanges on said stationary and pivoted members to obstruct the egress of flame through said opening.

11. A heating unit comprising a supporting member, a plate secured thereto having ridges thereon, a clamp pivotally supported on said ridges, an electrode passing through said clamp, a cam carried by said clamp for adjustably locking said electrode in position, and an adjustable weight secured to said pivoted clamp to counterbalance said electrode.

12. As a new article of manufacture, an electric heating unit comprising a sleeve, an insulating support closing one end thereof, and a plurality of electrodes passing through said support and said sleeve, said electrodes being arranged in close compact relation, whereby an arc may be maintained directly between said electrodes, or through the work to be heated when the latter is closely adjacent thereto.

13. As a new article of manufacture, an electric heating unit comprising a plurality of substantially parallel electrodes of different polarity having means supporting and mantaining them in close compact relationship, as they are consumed.

14. As a new article of manufacture, a portable electric heating unit comprising a sleeve, a closure for one end thereof, and a plurality of electrodes supported by said end and projecting through said sleeve in close compact arrangement to ensure a continuous arc between the projecting ends of said electrodes as the latter are consumed.

15. In combination, a plurality of electric furnaces in fixed relation, each having an opening of uniform size therein, and a single electric heating unit arranged to be

moved to any of said openings, whereby a charge in one furnace may be heated while another furnace is being pre-heated by a fuel flame.

16. In combination, a plurality of electric furnaces mounted in fixed relation, each having an opening in the top thereof, a single heating unit arranged to enter either of said openings, a support for said unit permitting the latter to be moved from one furnace to the other, said openings also permitting said furnaces to be charged through the top when the heating unit is removed therefrom.

17. The combination of a supporting base, a plurality of electric furnaces each pivotally supported thereon and having an opening in the top thereof, a supporting member arranged equi-distant from each of said openings, and a single heating unit carried by said member and arranged to be swung over any of said openings and lowered into the heating chamber, whereby the heating of one furnace may progress while another furnace is being poured, charged, preheated, or relined.

In testimony whereof, I have subscribed my name.

FREDERICK VON SCHLEGELL.