Jan. 23, 1945. R. A. SMITH 2,367,897

SALT BATH FURNACE

Filed March 24, 1944 2 Sheets-Sheet 1

Fig. 1.

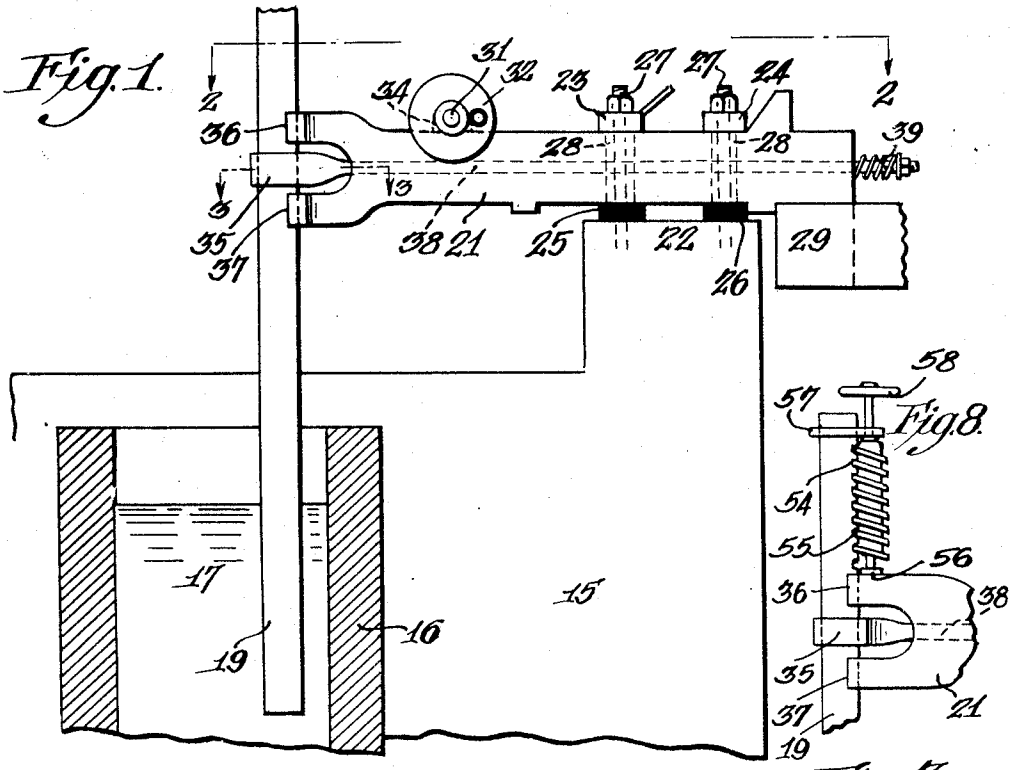



Fig. 8.




Fig. 2.

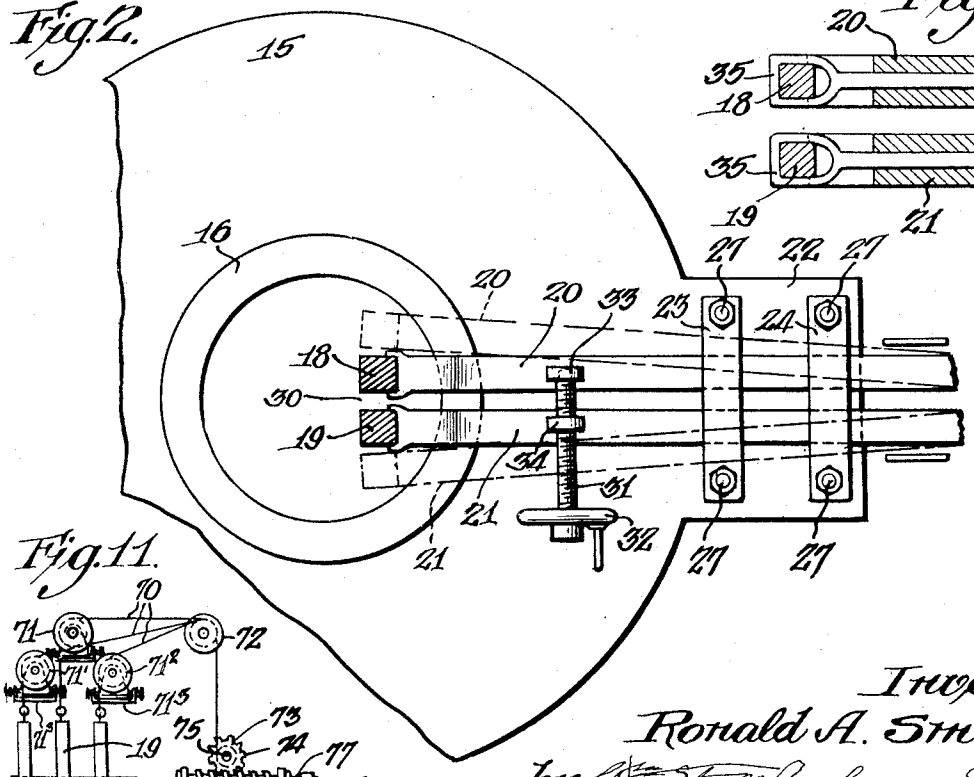



Fig. 3.




Fig. 11.




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Fig. 4.

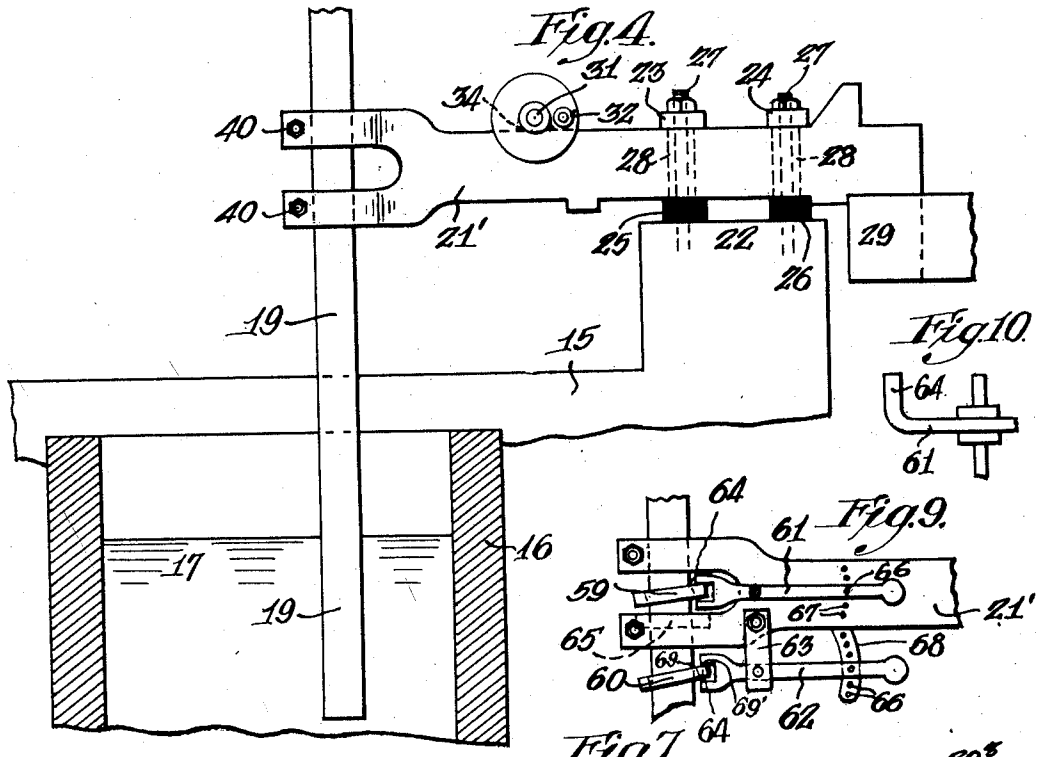



Fig. 10.




Fig. 9.




Fig. 7.

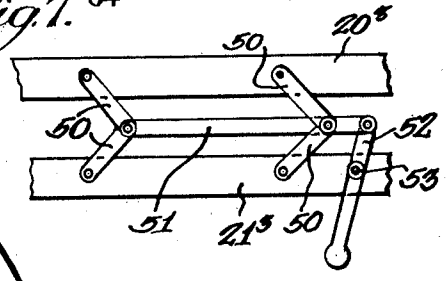



Fig. 5.




Fig. 6.




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# UNITED STATES PATENT OFFICE

2,367,897

## SALT BATH FURNACE

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Application March 24, 1944, Serial No. 527,907

4 Claims. (Cl. 13—23)

My invention relates to electric furnaces using a salt bath as the heating medium.

One purpose of the invention is to make it possible to vary the length of bath of any given cross section through which the electric current passes.

A further purpose is to vary the current used and the temperature by adjustments of electrode spacing within the bath itself as distinguished from the use of outside means affecting the current supplied.

A further purpose is to provide for coarse and fine adjustments of the current flow through a salt bath by setting the electrodes at different heights to get the greatest adjustment and by varying the distance within the bath from one electrode to another or to each other, according to whether the furnace has two electrodes only or more than two electrodes, to get the fine adjustments.

The principle of the invention is the same whether the number of electrodes be two or more than two. Since the illustration is clearer and less complicated, two electrodes only are shown except in Figure 11.

A further purpose is to provide lifting and spacing mechanism for electrodes in the same construction, so that modifications may be made both in the extent of dip of the electrodes into the bath and in the length of current path between the electrodes, whatever the height of the electrodes.

Further purposes will appear in the specification and in the claims.

In the drawings,

Figure 1 is a section of the bath with side elevation of electrode supporting structure used for salt bath furnaces.

Figure 2 is a section of Figure 1 taken upon line 2—2 through the upper part of the electrodes.

Figure 3 is a fragmentary section of Figure 1 taken upon line 3—3 to show the Adam Jr. patent form as far as needed here.

Figures 4 and 5 are views corresponding generally with Figures 1 and 2 but showing slightly different forms.

Figures 6 and 7 are top plan views showing supplemental forms by which the electrodes may be spaced positively in lateral direction.

Figures 8, 9 and 11 are side elevations of mechanism by which vertical adjustment of the electrodes may be provided. In Figure 11 lateral adjustments also can be made.

Figure 10 is a fragmentary top plan view of a part of one lever mechanism seen in Figure 9.

In the drawings similar numerals indicate like parts.

The figures are intended to be largely diagrammatic.

The object to be heat treated is immersed and means are provided to secure a desired temperature in the bath by electric current passing between the electrodes and, conveniently, to alter the current flow without the use of different outside current transformer taps or with fewer taps to control the current flow.

The preferred structure is that shown in Figures 1 and 2 and the other figures have been added for illustrative purposes to indicate that the means for making the several adjustments of the electrodes in height and spacing may be varied considerably. Except for Figures 1 and 2 it is not my intention to claim the specific constructions individually.

The furnace body 15 contains a pot 16 of fused salt 17 immersed in which are two electrodes 18 and 19 supported by carrier arms 20 and 21. The carrier arms rest upon and are clamped to an upwardly extending end 22 of the body of the furnace and are secured in position by clamps 23 and 24 insulated from the arms 20 and 21 by insulating strips 25, 26 and bolts 27. The bolts pass through insulating sleeves 28 so that the individual arms are fully insulated from the pot and from each other.

The arms 20 and 21 are supplied with current from a conventional source of supply (not shown) comprising the usual secondary windings of transformers and the current is received through conductors 29. This arrangement for the supply of current is well known in the prior art with the exception that my invention permits the desired range of current supply to be furnished using fewer transformer taps than the number previously required, because of the adjustment which I am able to make in the quantity of current passing through from electrode to electrode.

The arms 20 and 21 are capable of being shifted angularly toward and from each other for the purposes of varying the spacing 30 of the electrodes in the bath, such, for example, as to provide spacings within the range between the position shown in full lines and that shown in dotted lines in Figure 2. This or any intermediate spacing is capable of being secured by loosening or releasing the clamps 23, 24 and then shifting the position of the electrodes by turning a spindle or screw 31 by hand wheel 32 so as to

alter the distance between two insulating lugs or bosses 33 and 34, carried by the arms.

The spindle is swiveled in the insulating lug 33 and is threaded through the insulating lug 34. The electrodes can thus be spread apart or drawn together, as the case may be, to assume positions such as are shown in full lines and in dotted lines, respectively, in Figure 2.

The electrodes are fastened suitably to the ends of the arms so that by loosening the fastenings, the electrodes can be lifted by hand or positively, or allowed to lower in order that the depth of the dip of the electrodes into the bath may be varied. In the position shown, the electrodes are inserted within clamping jaw 35 (Figure 1), according to U. S. patent to William Adam, Jr., No. 2,149,003. By this Adam structure each electrode may be resiliently tightened against the faces of an arm 20 or 21 at 36, 37. The bolt 38 is spring-tightened at 39 laterally.

In Figure 4 the jaws are tightened against the electrodes by means of bolts 40 passing through one side each of the jaws and threading into the opposite side of each or into nuts. When the height has been determined, the bolts are tightened to cause the electrodes to be gripped between the opposite inwardly facing surfaces of the jaws.

In Figures 2 and 5 it will be noted that the arms 20 and 21, 20' and 21' diverge when the electrodes are spread one from the other. This divergence is not necessary as will be seen from Figure 7 and as would be true in Figure 6 if the bars by which the spreading is effected be given equal length.

In Figure 6 the arms $20^2$ and $21^2$ are coupled by insulating bars 41, 42. The bars are pivoted to the arms at one end by pins 43. At the other ends the pins 44 travel in slots 45 within the arms. The pivot point 46 is at a point which is nearer to the pins 44 than to the pins 43, if the bars are to diverge as in this illustration. If they are to move parallel the pivot point 46 would have to be in the center of the lengths of the bars.

One pin 43 and one pin 44 at one side of the construction are attached to spreaders 47 and 48, of which 47 may be swiveled merely to the spindle and the other, 48, becomes a nut upon the spindle. The spindle is turned by a hand wheel 49. By this means the arms $20^2$ and $21^2$ can be spread or drawn toward each other at a rate which is unequal at opposite arm ends when the pivot point is not in the centers of the bars. The extent of the variation in speed of the two ends of the arms is determined by the extent to which the pivot point 46 is off center.

In Figure 7 another form is shown by which the arms may be spread or drawn together positively, whether the arms be parallel or slope one to the other. The arms $20^3$, $21^3$ are coupled by links 50 which become effective as toggles through pivoting of the links both to the arms and to each other and operation of the toggles together by a thrust rod 51 operated by hand lever 52 pivoted at 53.

The illustration of the proportional links in both forms can be made to cause unequal spacing at different points along the lengths of the bars and the extent of inequality of the links will determine how great or how little taper inequality there is. Figures 6 and 7 have been selected to show that in both forms the arms can be used to present either tapered or parallel relations of the arms.

Positive vertical adjustment of the electrodes can be effected to lift them, to permit them to lower, or even to force them down through whatever guides are used to keep the electrodes in vertical position and in line with their intended axis positions.

In Figure 8 another construction for lifting or lowering the electrode is applied to the arm and strap holding mechanism shown in Figure 1. The upper part of the electrode is formed as a rack 54 and a worm 55 is used effectively as a jack. It rests upon the upper surface of the arm at 56, is strapped in against the electrode at 57 and is turned by hand wheel 58. The clamp 35 may be slacked before the worm is operated either to lift or to lower, as the electrode will be held up by the vertical worm and the rack, which is suited to the worm curvature, will act as the effective part of a worm wheel.

In Figures 9 and 10 a pair of canted clamping rings 59, 60 are operated by hand levers 61 and 62 so as to lift the electrodes or to permit them to lower. The lever 61 is pivoted upon an arm and the lever 62 is pivoted upon strap 63. The electrode is held by a clamp or by one of the rings and levers while the other lever is lifted to lower its ring-embracing jaws 64 to a new gripping position. When these jaws 64 are lifted by lowering the lever arm, the canted ring takes a new grip and lifts the electrode with it, giving part for a new gripping position of the other ring. Either ring can be used for the lifting operation while the other holds.

To lower the electrode, one of the rings is used to release by moving the lever jaw downwardly so that the jaw falls within groove 65 turning the ring directly crosswise where it will no longer grip and the other ring is then used to drop the electrode to a desired point, after which the ring previously released is caused to grip the electrode and again hold it. Pins 66 are fitted through the arms and into holes 67 in the arm or in strap 68 to hold the lever arms in supporting position.

The clamping bolts 40 can be used for the holding operation and can be released during the time when the change is being made. As seen in Figure 10 the lever jaw is turned transversely across to fit beneath the ring.

Whether the electrode be rectangular as usual or circular the canted ring desirably has the same shape of opening as the electrode in cross section and just sufficient additional size to permit it to grip the electrode when the ring is canted. The grip may be effected by an edge 69 of a diagonal interior ring face 69'.

In Figure 11 each of the three electrodes is adjusted and sustained by an insulating rope 70 passing over suitably supported pulleys 71, 71', $71^2$, and other pulleys 72 by which the opposite end of the rope from the electrode is guided to a drum 73 attached to a worm gear 74 suitably supported upon any shaft 75. The same drum 73 can be used for all unless it is desirable to be able to adjust the electrodes separately.

Each worm gear is turned to lift the electrode or to allow it to slack by a worm 76 carried by shaft 77 turned by hand lever 78. The bearings for the shaft appear at 79. The pulleys 71, 71', $71^2$ are mounted upon bearing blocks $71^3$ which can be shifted by hand or by feeding screws at both ends as shown, slacking one screw and tightening the other, to slide the blocks upon their supports so as to alter lateral spacing of one electrode with respect to the other electrode or electrodes.

It will be evident that I have provided means for laterally and positively adjusting the electrodes to bring them nearer or space them farther laterally within a salt bath as well as means for positively lifting the electrodes and lowering them or permitting the electrodes to lower, by which the lifting and lowering mechanisms can be used to make major adjustments in the current passing through the bath and the lateral adjusting mechanism can be used to make minor adjustments, permitting considerable range of adjustment to different current values in the bath independently of or additional to the range of adjustment already provided by electrical (transformer) means, such as, for example, by different transformer taps and by variation in the current drawn from the transformer.

In order to avoid passage of electric current to the lifting or spacing mechanisms in parallel with the normal passage of current through the arms and electrodes, all or a suitable part of the mechanism added will be made from insulating material.

It will be evident that the depth of immersion of the electrodes has a direct effect upon the voltage required and constitutes a means of securing major adjustment of variation of flow of current through the bath and, consequently, a major means of temperature control in the bath. On the other hand, variation of the length of current path from electrode to electrode, such as is secured by the wheel and screw has very much less effect upon the voltage required and very much less affects the flow of current. For the reasons above, the two together afford an excellent means of securing adjustment by the variation in height with minor adjustment of the temperature of the bath by lateral separation of the electrodes.

It will further be evident that the electrodes may be held in position by clamps which are pinched together by bolts passing through the ends; and that, whatever the adjustment, the bolts may be slacked to permit it and subsequently may again be tightened.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such in so far as they fall within the reasonable spirit and scope of my claims.

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

1. In a salt bath electric furnace, a furnace pot, furnace electrodes, insulated supports for the electrodes, connections for supplying electric current to the supports and through them to the electrodes, electrically insulating clamps for holding the supports against movement horizontally with respect to each other, and a screw adjustment between the electrode supports and insulated from them, whereby, when the clamps are loosened, the electrodes can be moved positively toward and away from each other, so that the supports may subsequently be clamped in different electrode positions.

2. In a salt bath furnace, a furnace pot, furnace electrodes, supports for the electrodes, electric connections for the supports, separate insulated means for varying the position of the electrodes in the bath vertically, and as regards lateral space distance between the electrodes and insulating means for holding the electrodes and their supports in adjusted positions.

3. In a salt bath furnace, a furnace pot, furnace electrodes, holders for the electrodes, connections through the holders for supplying electric current to the electrodes, means for setting the electrodes at variant heights in the supports to alter the extent of dip of the electrodes into the salt bath, means for clamping the electrodes in adjusted position, and means for moving the ends of the holders carrying the electrodes toward and from each other to vary the lateral spacing of the electrodes.

4. In a salt bath furnace, a furnace pot, furnace electrodes adapted to dip to varying extents into the pot, separate insulated supports for the electrodes, electrical connections for the electrodes, means for varying the height of the electrodes in the supports to vary their vertical extension into the pot, means for fastening the electrodes in their adjusted positions, means for wedging the electrodes apart laterally or pulling them together, whereby the lateral separation of the electrodes in the bath is changed, and insulating means for clamping the electrode supports in the adjusted positions.

RONALD A. SMITH.