Jan. 26, 1932. C. L. IPSEN ET AL 1,842,972

ELECTRICAL FURNACE RESISTOR

Filed Oct. 23, 1928

Fig. 1.

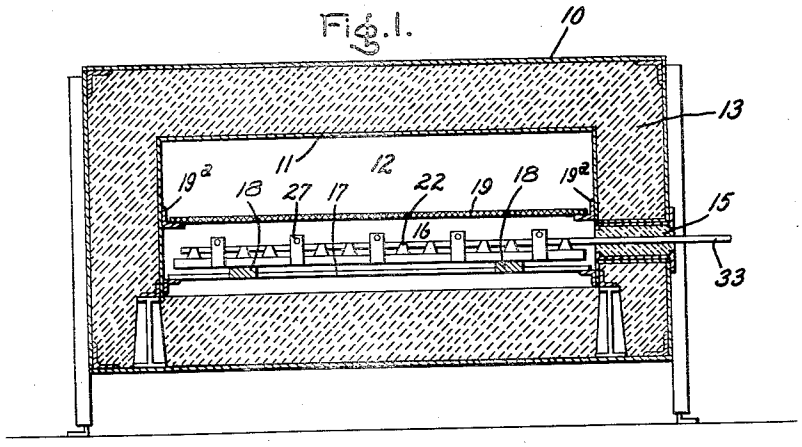


Fig. 2.

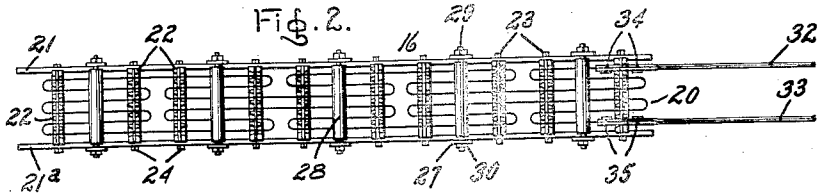


Fig. 3.

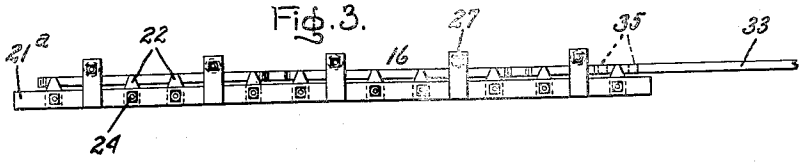
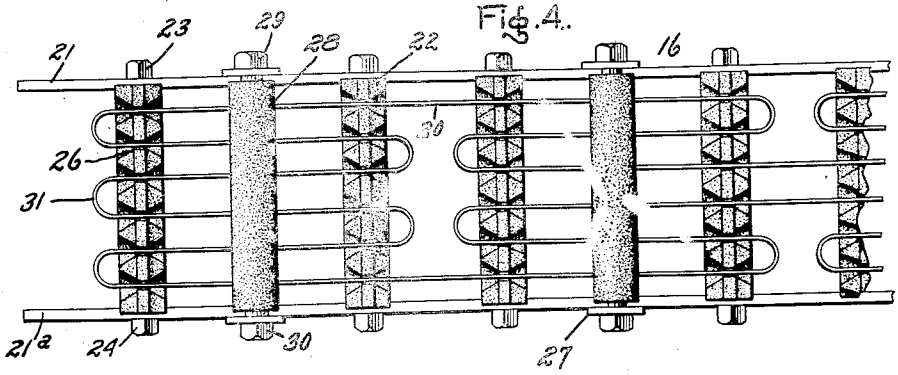


Fig. 4.



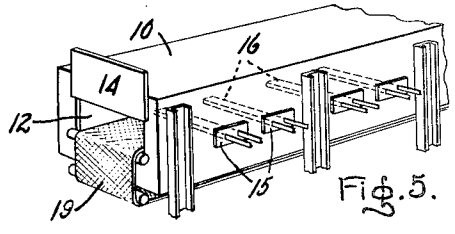


Fig. 5.

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UNITED STATES PATENT OFFICE

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ELECTRICAL FURNACE RESISTOR

Application filed October 23, 1928. Serial No. 314,476.

Our invention relates to electric furnaces, more particularly to resistance heating units for electric furnaces, and has for its object the provision of a heating unit which is rugged in construction, efficient in radiating heat and which may be easily removed as a unitary structure from the furnace.

In carrying out our invention we have provided an elongated furnace having a plurality of heating units arranged in the heating chamber transversely thereof, each heating unit comprising an elongated frame on which is mounted a heating resistor formed into a plurality of sets of loops extending lengthwise of the frame, the loops in each set being arranged side by side crosswise of the frame and connected with each other alternately at the outside and center of the frame. We have also provided insulating members for holding the resistor in the frame while allowing heat to be freely radiated from the resistor.

For a better understanding of our invention, reference may be had to the accompanying drawings in which Fig. 1 is a vertical cross sectional view of a furnace embodying our invention; Fig. 2 is a plan view and Fig. 3 a side elevation of a heating unit; Fig. 4 is an enlarged plan view of a portion of a heating unit, while Fig. 5 is a diagrammatic, perspective view of one end of our furnace.

Referring to the drawings, in carrying out our invention in one form, we provide a furnace structure comprising an outer wall or casing 10 and an inner wall 11, the inner wall defining a heating chamber 12. In the furnace shown, the inner wall 11 is made of a plurality of sheets or plates of suitable heat refractory metal such as an alloy of iron, nickel and chromium, and the space between the outer wall 10 and the inner wall 11 is filled with suitable heat insulating material 13, such as rock wool or diatomaceous earth. A vertically slidable door 14, shown diagrammatically in Fig. 5, closes an opening at the front of the heating chamber 12 and a similar door, not shown, is provided at the rear of the heating chamber. A plurality of inserts 15 of suitable heat insulating material are provided in the furnace wall along one side and near the bottom of the heating chamber 12. A plurality of heating units or resistors 16 are horizontally supported on frames comprising longitudinal bars 17 and cross bars 18, these frames resting upon angle irons attached to the inner wall 11, as shown more clearly in Fig. 1. An endless conveyor belt 19, preferably of wire mesh of a suitable heat resisting metal passes longitudinally through the heating chamber 12 just above the heating units 16 and is supported along its edges by angle iron strips 19*a* attached to the inner wall 11. This belt is driven by any suitable means, not shown.

Since all of our heating units 16 are alike, the description of one only will be given. Each heating unit 16 comprises an elongated supporting frame on which is mounted an electric heating resistor 20 which is formed from a straight or uncoiled ribbon-shaped resistance conductor made preferably of an alloy of nickel and chromium. The supporting frame is formed of a pair of longitudinal bars or strips 21, 21*a*, made of a heat resisting metal such as an alloy of iron, nickel and chromium, which are held in substantially parallel, spaced relation by a plurality of transverse insulating supporting bars 22 preferably molded from a heat refractory electrically insulating material, such as aluminum oxide. Each of the supporting bars 22 is secured between the strips 21, 21*a* by means of a bolt 23 and nut 24, the bolt passing through apertures provided for this purpose in the bar 22 and strips 21, 21*a*. As will be observed with reference more particularly to Figs. 3 and 4, each supporting bar 22 is tapered at the upper side and a plurality of transverse slots

26 are provided in the tapered portions. The sides of the tapered portions adjacent the slots 26 are divergent outwardly as is illustrated more clearly in Fig. 4, and the area of contact between the bars 22 and the resistors supported in the slots 26 is thus diminished, while the mechanical strength of the insulating members is not appreciably impaired.

Upright members 27 are secured to the sides of the strips 21 by welding or by other suitable means, these upright members serving to support tubular insulating members 28. Bolts 29 are passed through holes provided in the upright members 27 and through the center of the tubular members 28 and are held in place by nuts 30. The tubular members 28 are preferably made of a relatively hard, heat and electrically insulating material, such as aluminum oxide, and, as will be observed with reference to Fig. 4, the tubular members are slightly shorter than the distance between pairs of upright members 27 so that the tubular members are free to rotate about the bolts 29.

Each heating resistor is formed, as shown, into a plurality of sets of loops extending lengthwise of the frame formed by the strips 21, 21*a* and supporting bars 22, the resistor being supported by the bars 22 edgewise in the slots 26 formed therein. The loops of each set are arranged side by side crosswise of the frame and adjacent sets are connected alternately at the outside and center of the frame as will be observed with reference to Figs. 2 and 4. The resistor as shown in Fig. 2 is formed into five sets, each set consisting of six lengths arranged in parallel relation to each other and to the frame strips 21, 21*a*. The first set, i. e. the set nearest the right as in viewing Fig. 2 is connected to the second set substantially at the center of the frame, while the second set is connected to the third set near the outside of the frame. The third set is connected in turn to the fourth set at the center of the frame, while the fourth set is connected to the fifth set, i. e. the set at the extreme left, at the outside of the frame. It will be understood that the resistor may be formed into any number of sets, depending on the length of the heating unit desired.

Suitable terminal members 32, 33 are secured to the ends of the resistor 20, the terminal members for each resistor passing through an insulating insert 15 in the furnace wall. Each terminal member 32, 33 is formed of a pair of flat metallic strips, the ends of the strips being pressed together around the ends of the resistor 20, as is shown more clearly in Fig. 2. In order to prevent longitudinal movement of the terminals 32, 33 and resulting damage to the resistor 20, a pair of flat metallic lugs 34, 35 are welded or otherwise secured to each terminal on opposite sides of the endmost supporting bar 22. These lugs are spaced apart far enough so that each terminal can be inserted in a slot 26 of the supporting bar, and since the slots 26 are too narrow to allow the lugs 34, 35 to pass through them, longitudinal movement of the terminals is prevented.

It will be observed that due to the shape of the resistor 20, that is, due to the presence of the relatively short loops, cumulative expansion and contraction of the resistor caused by heating and cooling, can not take place. The convolutions or loops of the resistor are prevented by the insulating bars 22 from becoming laterally displaced and the resistor is retained in the slots 26 provided in the insulating members 22 by the tubular insulating members 28 which are mounted directly over the resistor. Due to the tapering of the upper sides of the insulating members 22 the area of contact between the resistor and the insulating members is very small, and since the retaining members 28 are cylindrical, line contact will be formed between these retaining members and the resistor, thus preventing localization of heat where the resistor and retaining members are in engagement. The resistor is thus held securely, whereby short circuiting of portions of the resistor is prevented, while the ability of the resistor to radiate heat freely is not impaired.

By removing one or more of the insulating inserts 15 from the furnace wall, access may be had to the heating units and, if desired, any one or all of the heating units may be removed as unitary structures, through the openings thus formed in the side wall of the furnace. Electrical connections may be made to the terminals so that the resistors will be connected either in series or in parallel, or in any series-parallel combination to secure heat of a desired temperature in the heating chamber. By arranging the heating units transversely of the heating chamber, a uniform temperature at any position in the heating chamber may be obtained, and articles placed on the conveyor belt 19 will be heated uniformly across the width of the belt. If a higher temperature is desired at one or both ends of the furnace or at any intermediate point, the heating units may be arranged closer together at that point, or, alternatively, the connections to the heating resistors may be made so that certain of the resistors will be heated to a higher or lower temperature than the remaining resistors.

While we have described our invention as embodied in concrete form and operating in a specific manner in accordance with the provisions of the patent statutes, it should be understood that we do not limit our invention thereto, since various modifications thereof will suggest themselves to those skilled in the art without departing from

the spirit of our invention, the scope of which is set forth in the annexed claims.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. A removable heating unit for electric furnaces comprising an elongated frame, electrically insulating crossbars on said frame, a pair of electrical terminals secured to one end of said frame, a heating resistor formed from an uncoiled resistance conductor having its ends secured to said terminals and extending in two lengths along opposite sides of said frame and across the opposite end of said frame, said lengths of said resistor being formed into a series of groups of relatively short loops to thereby prevent cumulative thermal expansion of said resistor, said loops extending lengthwise of said frame and being arranged respectively in spaced relation with each other along the sides of said frame, the groups in the two lengths being oppositely disposed in a direction transverse to said frame, said crossbars being provided with recesses, and means for securing said resistor in said recesses.

2. A removable heating unit for electric furnaces comprising an elongated frame, electrically insulating crossbars on said frame, electrical terminals on one end of said frame, a heating resistor formed from an uncoiled resistance conductor having its ends connected to said terminals and having a central portion formed into a group of relatively short loops at the opposite end of said frame, the lengths of said resistor extending from said central portion to said terminals respectively being formed into a series of groups of loops, said loops extending lengthwise of said frame and the groups of loops in each length being arranged in spaced relation with each other along the respective sides of said frame with the groups in each length respectively opposite the groups in the other length in a direction crosswise of said frame, said crossbars being provided with recesses to receive the convolutions of said resistor.

3. A removable heating unit for electric furnaces arranged to be inserted into the furnace with terminals projecting therefrom comprising an elongated frame made of heat resisting metal, electrically insulating crossbars on said frame, electrical terminals secured to one end of said frame in insulated relation therewith, a heating resistor formed from an uncoiled resistance ribbon having its ends connected to said terminals and extending from one of said terminals along one side of said frame across the other end and back along the opposite side of said frame, said resistor being formed into a series of relatively short loops to thereby prevent cumulative thermal expansion of said resistor, said loops extending lengthwise of said frame and being arranged in a plurality of groups spaced with respect to each other along opposite sides of said frame, the groups on said sides being oppositely disposed with respect to each other in a direction crosswise of said frame, said crossbars being provided with slots, and means for securing said resistor in said slots.

In witness whereof, we have hereunto set our hands this 22nd day of October, 1928.

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