March 29, 1932.

F. T. COPE ET AL

1,851,161

RESISTOR GRID

Filed Feb. 6, 1930

2 Sheets-Sheet 1

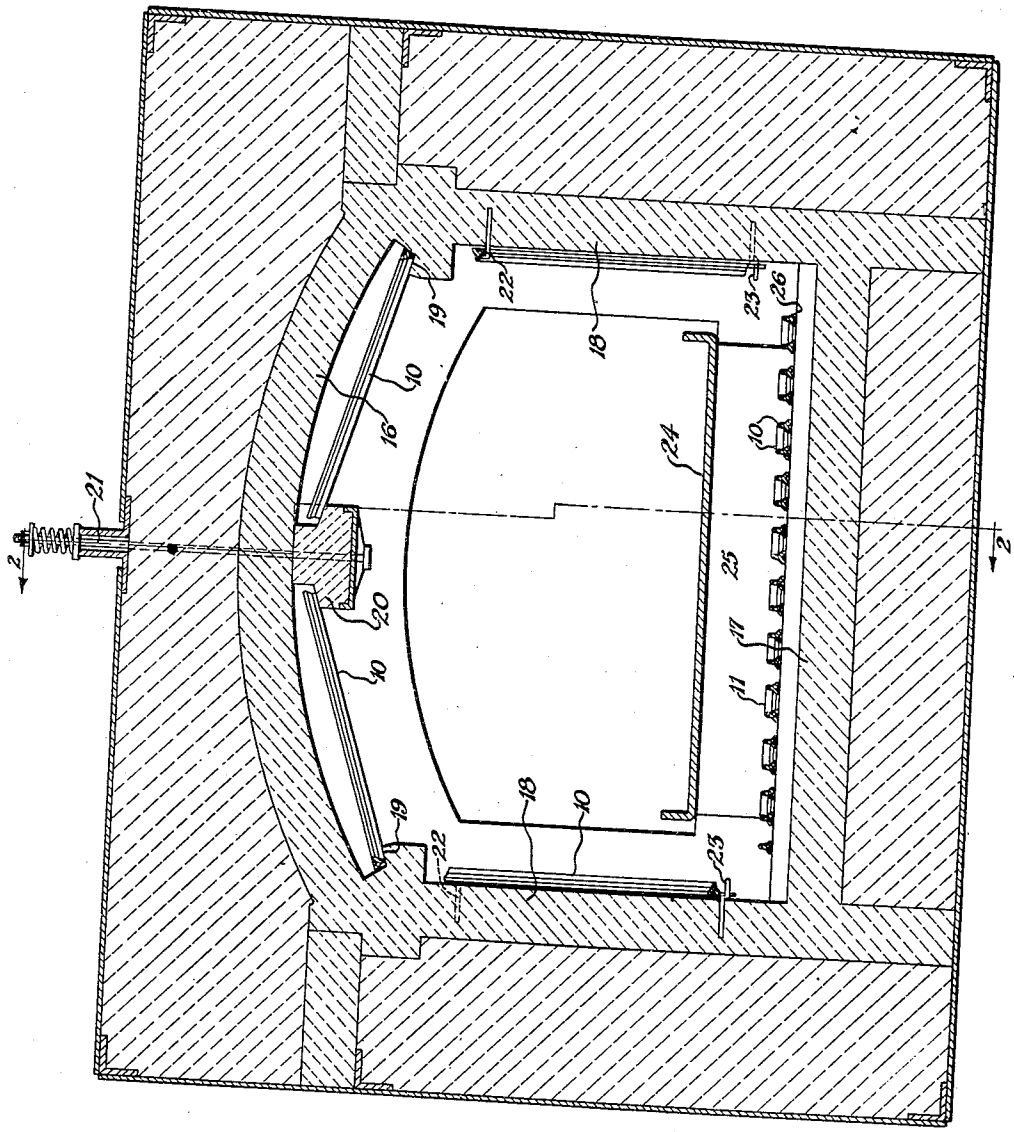

Fig. 1.

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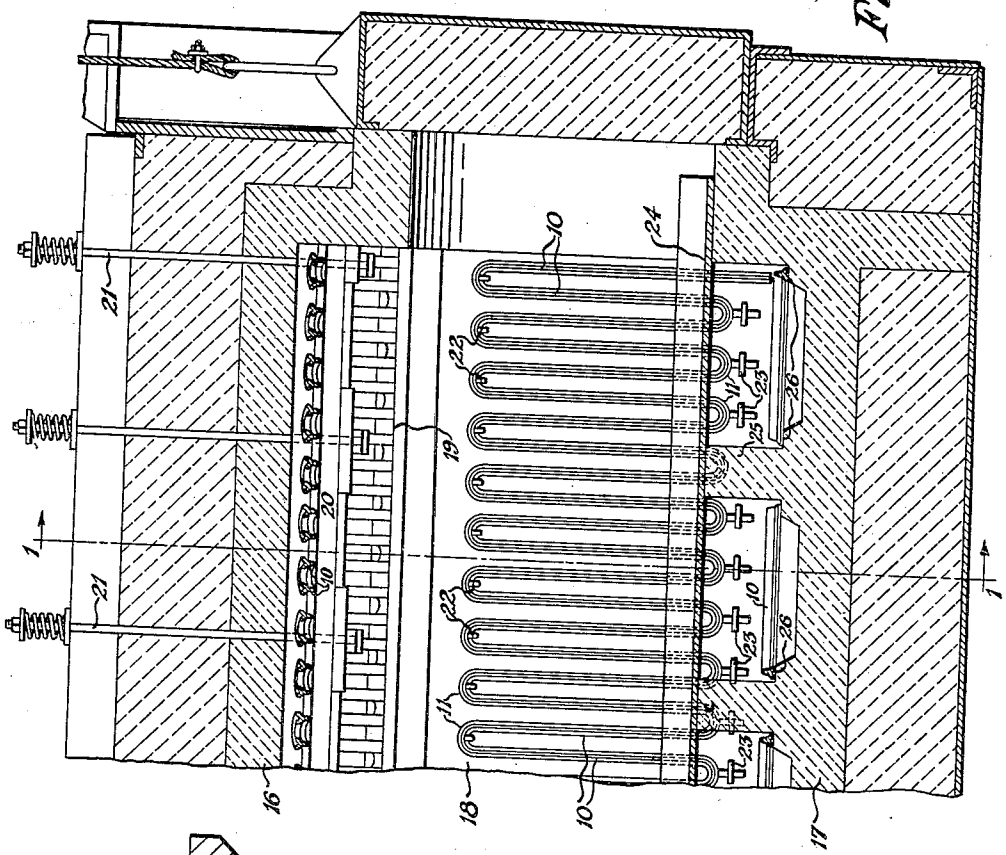
Fig. 2.



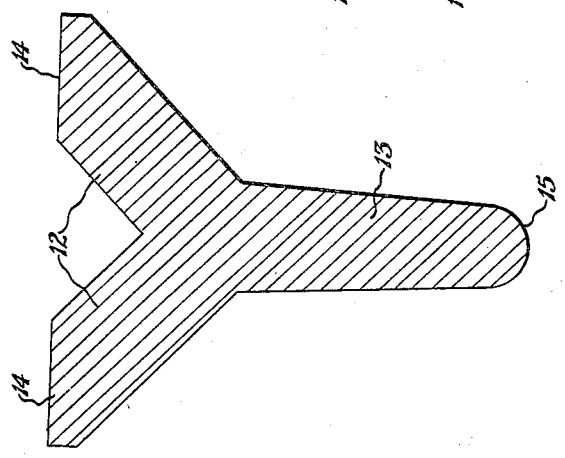


Fig. 3.

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UNITED STATES PATENT OFFICE

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RESISTOR GRID

Application filed February 3, 1930. Serial No. 426,309.

The invention relates to metallic resistor grids of cast, rolled or forged construction, for use in electric furnaces or kilns, and more particularly to the cross sectional shape of such grids and the means for supporting the same in the furnace or kiln.

It is well known that metallic resistor grids of different cross sectional shapes have been made and used in electric furnaces and the like with various degrees of satisfaction and success.

In the severe service to which such resistor grids are subjected in large industrial furnaces, we have found that the following properties are important in metallic resistor grids:

First, an efficient cross sectional shape for structural strength, so as to prevent sagging and warping under stresses due to temperature differences, and to the weight of the grid;

Second, proper disposition of the heat radiating surface of the grid so as to liberate heat and radiate it to the work with the least possible interference from adjacent parts of the grid itself and from supporting means;

Third, ability of the grid to shed scale which may fall thereon from the material when the grid is placed beneath the material;

Fourth, such cross sectional shape as will permit of soundness and homogeneity being attained when the grid is made by casting;

Fifth, resistance to oxidation such as to enable grid to withstand the temperatures at which it is operated.

To secure the necessary resistance to oxidation it is customary to employ alloys containing nickel and chromium with varying amounts of iron.

We have found that where the resistor is in the form of rolled wire or ribbon it is very difficult to attain the structural strength necessary for horizontal or inclined mounting, which is very often desired. With such resistors it is customary to employ supporting framework and additional insulators and spacers to prevent displacement which might occasion short circuits.

These additional supporting means are not only expensive but they interfere considerably with free radiation of heat from all parts of the resistor and frequently prevent placing of the resistors in the most advantageous position.

In order to radiate heat from the surface of the grid, with the least possible interference between adjacent parts of the grid, we have used grids of such cross section that the greater part of their surface is directed away from the furnace wall.

At times we have used a T-section with a tapered stem rib or flange, mounted so that the stem extends toward the interior of the furnace; and also a channel section having tapered ribs or flanges extending toward the interior of the furnace.

When we mount resistor grids near the floor or beneath the roof of a furnace, we support them at the end portions so that each of the straight portions of the grid is loaded, as a beam, by its own weight. Such a method of mounting the grids has the advantage that there is nothing to prevent the free radiation of heat from the entire length of the grid bars.

When it is desired to make the grids of cast alloys, it is extremely important that their cross section be such that the castings will be reasonably homogeneous, sound and free from internal cavities. This can only be attained when the cross section is substantially uniform in thickness at all points, the maximum thickness being necessarily thin enough so that no part solidifies appreciably later than other parts.

The object of the present invention is to provide a cross sectional shape of resistor which we have found gives the best combination of the several desirable features above referred to. This cross sectional shape is in the form of a true Y, and is intended to be placed with the tail rib of the Y extending toward the interior of the furnace and away from the adjacent wall, preferably at a right angle thereto.

We have found that while other cross sectional shapes may excel the Y in certain respects, they are not suitable in others. For instance, an inverted V-shape, with tapered

ribs, when placed in the floor of a furnace, possesses ideal scale shedding properties, but has been found to be structurally very weak, as compared to the Y-section of substantially the same cross sectional area and the same over-all dimensions.

Such a section, when made by casting, is also likely to be unsound because of slow cooling in the mold at the apex of the V. Similarly, the T-section is comparatively weak, and is not well adapted to shed scale and dirt; the latter being also true of the channel section.

An equilateral, three-pointed star section, while nearly equal to the Y in scale shedding ability, and having acceptable disposition of surface for radiation, is almost the weakest structurally of all sections which have been tried.

The above and other objects may be attained by constructing and mounting the improved resistor grid in the manner illustrated in the accompanying drawings, in which

Figure 1 is a transverse sectional view through a furnace of conventional type provided with the improved resistor grids, taken substantially on the line 1—1, Fig. 2;

Fig. 2, a longitudinal sectional view through one end portion of the furnace, taken on the line 2—2, Fig. 1; and

Fig. 3, an enlarged cross sectional view through the improved resistor grid.

Similar numerals refer to similar parts throughout the drawings.

The invention consists primarily in the provision of a metallic resistor formed of a plurality of spaced parallel bars 10, of suitable heat resisting alloy such as nickel-chromium containing varying amounts of iron, which may be connected together at alternate ends, as by the return loops or bends 11 to provide a continuous resistor.

The entire resistor may be cast in a single piece, each straight bar thereof being of substantially a true Y-shaped cross section, as best shown in Fig. 3, and including the angular fork or V-portion adapted to face toward the adjacent furnace wall and comprising the ribs 12 extending toward the wall at equal angles thereto, and the tail rib 13 preferably of greater length than the ribs 12 and extending away from the adjacent furnace wall at a right angle thereto.

The ribs 12 forming the V-portion may be of substantially the same thickness throughout their length and preferably have the angular rear edges 14 arranged to be located parallel to the adjacent furnace wall, while the tail rib 13 is preferably tapered from the junction of the V-portion to its edge which may be rounded as at 15.

The sides of the ribs 12 of the angular fork or V-portion as well as the sides of the tail portion 13 are preferably flat as shown in Fig. 3 of the drawings.

It will be seen that the effect of shaping the resistor substantially as a true Y in cross section is to reduce the thickness and consequently the mass of metal at the junction of the V-portion and tail rib with the result that there is very little difference in the thickness of the metal at the junction of the ribs as compared with the thickness of the several ribs themselves.

As above pointed out, a substantial uniformity in the thickness of the sections is very important in the casting of the metals usually employed for resistor grids because of the considerable shrinkage of such metals when cooling from the molten state and the tendency to produce shrinkage cavities in any portion of the casting which cools at a much slower rate than the other portions.

In applying the improved resistors to a furnace, such as illustrated conventionally in Figs 1 and 2, the resistors may be located adjacent to the top, bottom and side walls 16, 17 and 18 respectively, as illustrated in these figures.

The upper grids may be located adjacent to the top wall 16 and supported as by means of the ledges 19, formed near the upper ends of the side walls, and by the refractory blocks 20 supported in any suitable manner, as by the bolts 21.

The side grids may be supported adjacent to the side walls 18 as by the hooks or hangers 22 which engage the upper loops or bends of the grids, guides 23 being carried in the side walls for guiding the lower ends of the grids and permitting expansion and contraction thereof under changing temperatures.

The hearth 24 may be supported upon spaced piers 25 having ledges 26 at their bases for supporting the lower resistors spaced from the bottom wall or floor. It will be seen that the upper and lower resistors are both supported as a beam.

From the above description and the illustration in the accompanying drawings it will be seen that a resistor grid is provided having a true Y cross sectional shape, the tail rib of the Y facing toward the work while the open side or fork thereof is faced toward the adjacent furnace wall, thus disposing the greater portion of the cross section of the resistor toward the interior of the furnace and directing the major portion of the heat radiated therefrom toward the work or interior of the furnace at an angle to the adjacent furnace wall.

Where the Y-shaped grids are mounted beneath the work or beneath the hearth, the Y's are inverted with the tail ribs extending upward so that scale falling from the work or hearth and striking of the grids will slide therefrom, preventing short-circuiting of the grids by scale piling upon the same.

From the above it will be seen that a resistor grid is produced which has the best

combination of lateral and beam strength, efficient disposition of surface for heat radiation, and ability to shed scale and dirt, and which can be cast satisfactorily if it is desired to make the grid in this manner.

We claim:

1. A resistor grid including a straight bar of substantially Y cross sectional shape and having an angular fork portion and a straight tail rib each having flat sides.

2. A resistor grid including a straight bar of substantially Y cross sectional shape and having an angular fork portion and a tail rib, each having flat sides, the tail rib being tapered toward its edge.

3. A resistor grid including a straight bar of substantially Y cross sectional shape and having an angular fork portion and a tail rib, each having flat sides, the ribs of the fork portion being of uniform thickness throughout and the tail rib being tapered toward its edge.

4. A resistor grid including a straight bar of substantially Y cross sectional shape and having an angular fork portion and a tail rib each having flat sides, the tail rib being provided with a rounded edge.

5. A resistor grid including a straight bar of substantially Y cross sectional shape and having an angular fork portion and a tail rib, each having flat sides, the ribs of the fork portion being of uniform thickness throughout and the tail rib being tapered toward its edge and having its edge rounded.

6. A resistor grid including a straight bar of substantially Y cross sectional shape, and having an angular fork portion and a tail rib each having flat sides, the ribs of the fork portion being of uniform thickness throughout.

In testimony that we claim the above, we have hereunto subscribed our names.

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