Nov. 25, 1958 W. C. SEIFERT 2,862,091

RESISTANCE ELEMENT AND FURNACE CONTAINING THE SAME

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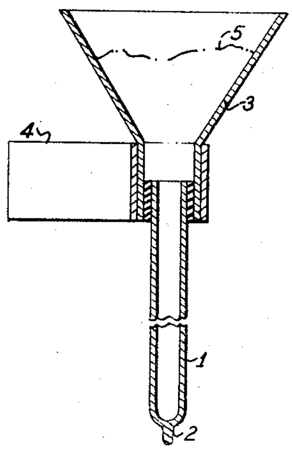

Fig. 1

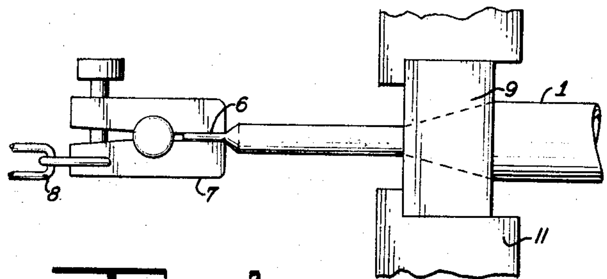

Fig. 2

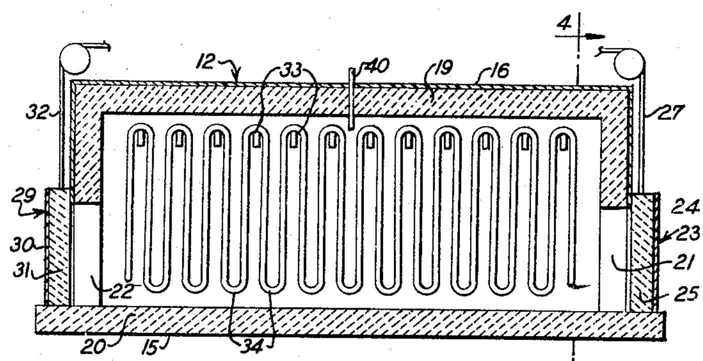

Fig. 3

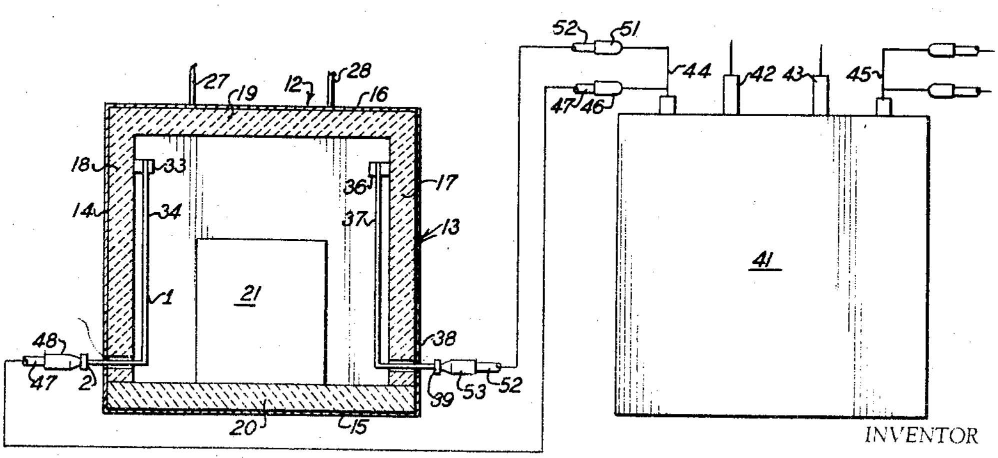

Fig. 4

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RESISTANCE ELEMENT AND FURNACE CONTAINING THE SAME

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2 Claims. (Cl. 201—66)

This invention is a new and useful electrical resistance element of the direct radiation type and furnace containing the same. The invention will be fully understood from the following description, read in conjunction with the drawings, in which:

Fig. 1 is a diagrammatic showing of one step in the manufacture of the element of my invention;

Fig. 2 is a diagrammatic showing of a second step in the manufacture of said element;

Fig. 3 is a longitudinal section through a furnace containing said electrical resistance element; and

Fig. 4 is a transverse section through the showing in Fig. 3 on the plane indicated by the line 4—4.

Referring to Fig. 1, the tube **1** is made of a metal resistant to gas phase corrosion. The exact composition will be determined by the atmosphere to be maintained in the furnace in which the eventual resistance element is installed. The following are examples of alloys which are suitable:

Nickel 80%—chrome 20%
Nickel 72%—chrome 14–17%, balance Fe
Chrome 11–14%, balance Fe
Nickel 18%, chrome 8%, balance Fe

The lower end of tube **1** is sealed by squeezed portion **2**, and the upper end is connected to hopper **3**, provided with vibrator **4** and containing finely divided high-melting-point inorganic oxide, such as alumina, zirconia, or magnesia. By operating vibrator **4**, tube **1** is completely filled with oxide. For certain critical uses this operation may be performed under vacuum. The other end of tube **1** is then sealed by squeezed portion **6** and engaged by gripper jaws **7**, upon which traction is exerted by chain **8** to draw the tube through swaging die **9**, secured in holder **11**. The drawing reduces the external diameter without substantially affecting the wall thickness, thereby reducing the enclosed volume and compressing the contained oxide. The reduction is carried to the point at which the oxide has reached maximum density, i. e., at which the voids are substantially eliminated. This results in a current carrier, which is characterized by uniformity of thermal radiation combined with exceptional strength and rigidity at extremely high temperatures. It is easily formed by mechanical deformation into loops, festoons, or other special shapes for special purposes, which retain their form even at temperatures in excess of 2000° F.

In Figs. 3 and 4, furnace or heating chamber **12** includes sides **13** and **14**, bottom **15** and top **16** enclosing refractory inside walls **17** and **18**, roof **19**, and floor **20**. The ends of the furnace define ports **21** and **22**. Port **21** may be closed by door **23**, consisting of steel frame **24**, carrying refractory facing **25**. The door may be lifted out of position by steel cables **27** and **28**. Port **22** may be closed by door **29**, consisting of steel frame **30**, carrying refractory facing **31**. Door **29** may be lifted out of position by cables, of which **32** is shown in Fig. 3.

The refractory inside wall **18** carries a series of projections **33**, which may, for example, consist of a suitable refractory, such as bonded alumina or magnesia set in and projecting from the inside surfaces. The fully formed tube **1** is mechanically deformed into a series of loops 34, which are simply hung on these projections.

Refractory wall **17** also carries a similar series of projections **36**, upon which a similar tube **37** is hung.

Each end of tube **1** is formed into a right-angle bend, which is carried through a hole **35** in one side wall **18** of the furnace and connected into an external electric circuit by which the heating current is provided. At this point the tube cross-section is reinforced with an external metal sleeve to lower its resistance. Temperatures obtaining in the furnace are measurable by thermocouple **40** in combination with any suitable recording instrument (not shown). Tube **37** is similarly formed into a right-angle bend, which is carried through hole **38** in the side wall **17** of the furnace.

Referring to Fig. 4, transformer **41** receives current through the primary connections **42** and **43** and supplies current through secondary posts **44** and **45**. The end of tube **1** shown in the figure is electrically connected through lug **48**, cable **47**, and lug **46** with secondary post **44**. The end of tube **37**, shown in the figure, is electrically connected through lug **53**, cable **52**, and lug **51** with secondary post **44**. The other ends of tubes **1** and **37** are similarly connected with post **45** through similar cables and lugs.

In operation the tubes may, for example, be maintained at a temperature of about 2150° F. to hold the furnace interior within 50° F. of the resistor temperature. Owing to the construction, the furnace may conveniently be constructed to operate with a vacuum or special atmosphere.

The resistors of my invention are characterized by extremely high uniformity of wall thickness and by circumferentially uniform radiation characteristics. They do not distort even at extremely high temperatures. They are free from the interference effects which obtain with ribbon-type resistors and show little or no tendency to creep at high temperatures.

I claim:

1. An electrical resistance element of the direct-radiation type, consisting of an external, tubular sheath of high-melting-point metal, resistant to gas-phase corrosion, surrounding a core of high-melting-point inorganic oxide and reduced in diameter upon said core by longitudinal extension to compress said core to maximum density.

2. An electric resistance element of the direct-radiation type, comprising an external tubular sheath of high-melting-point metal resistant to gas-phase corrosion, surrounding a core of high-melting-point inorganic oxide reduced in diameter upon said core to compress said core to maximum density, and means for electrically connecting the ends of said sheath to an external electric circuit.

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