E. F. COLLINS,
FURNACE.
APPLICATION FILED NOV. 10, 1917.

1,281,521.

Patented Oct. 15, 1918.

4 SHEETS—SHEET 1.

Fig. 1.

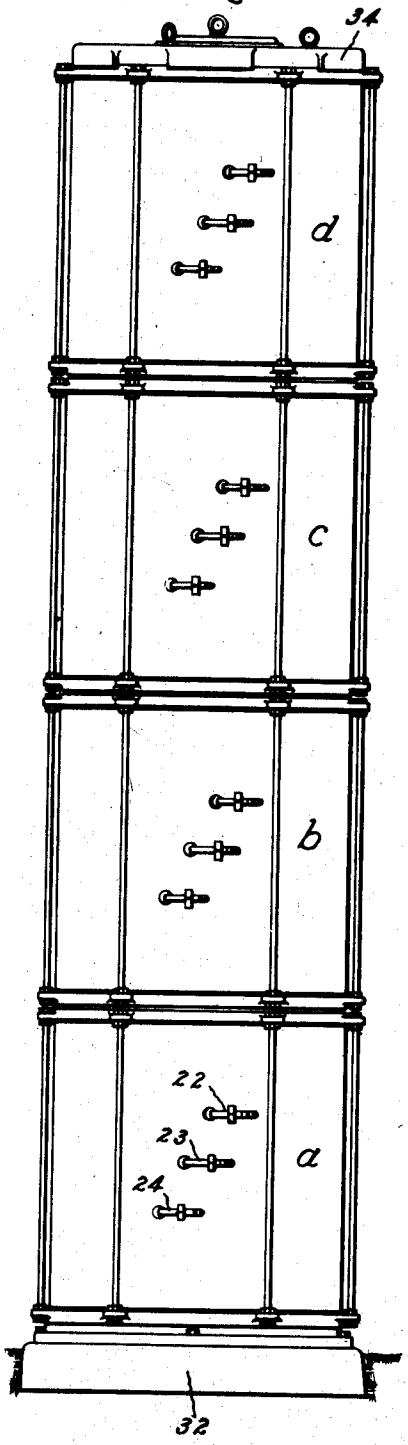


Fig. 2

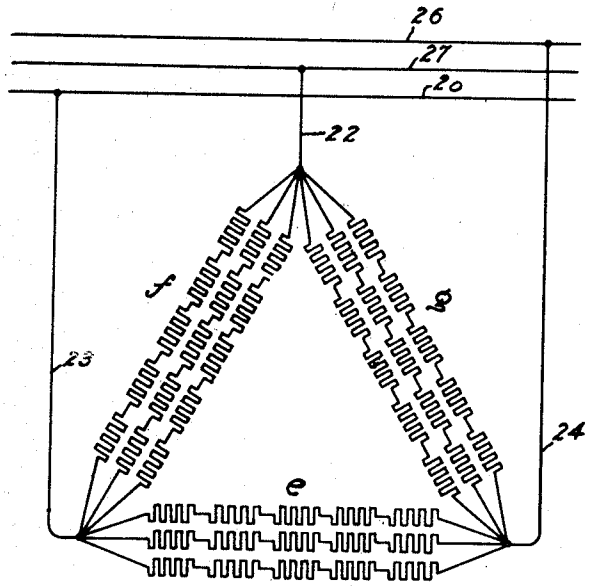
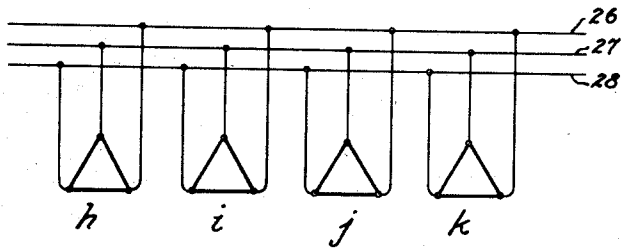


Fig. 3.



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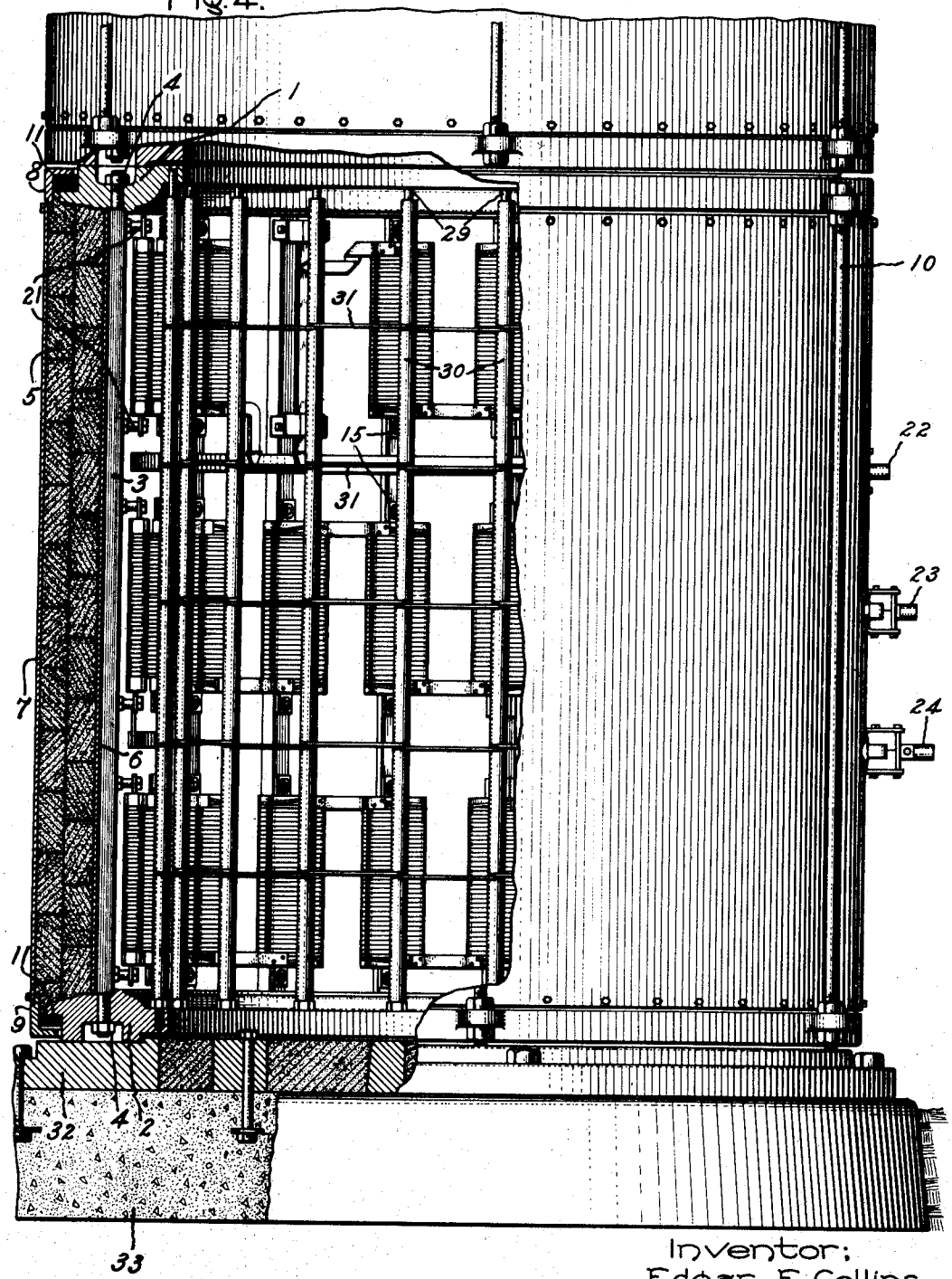
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4 SHEETS—SHEET 2.

Fig. 4.



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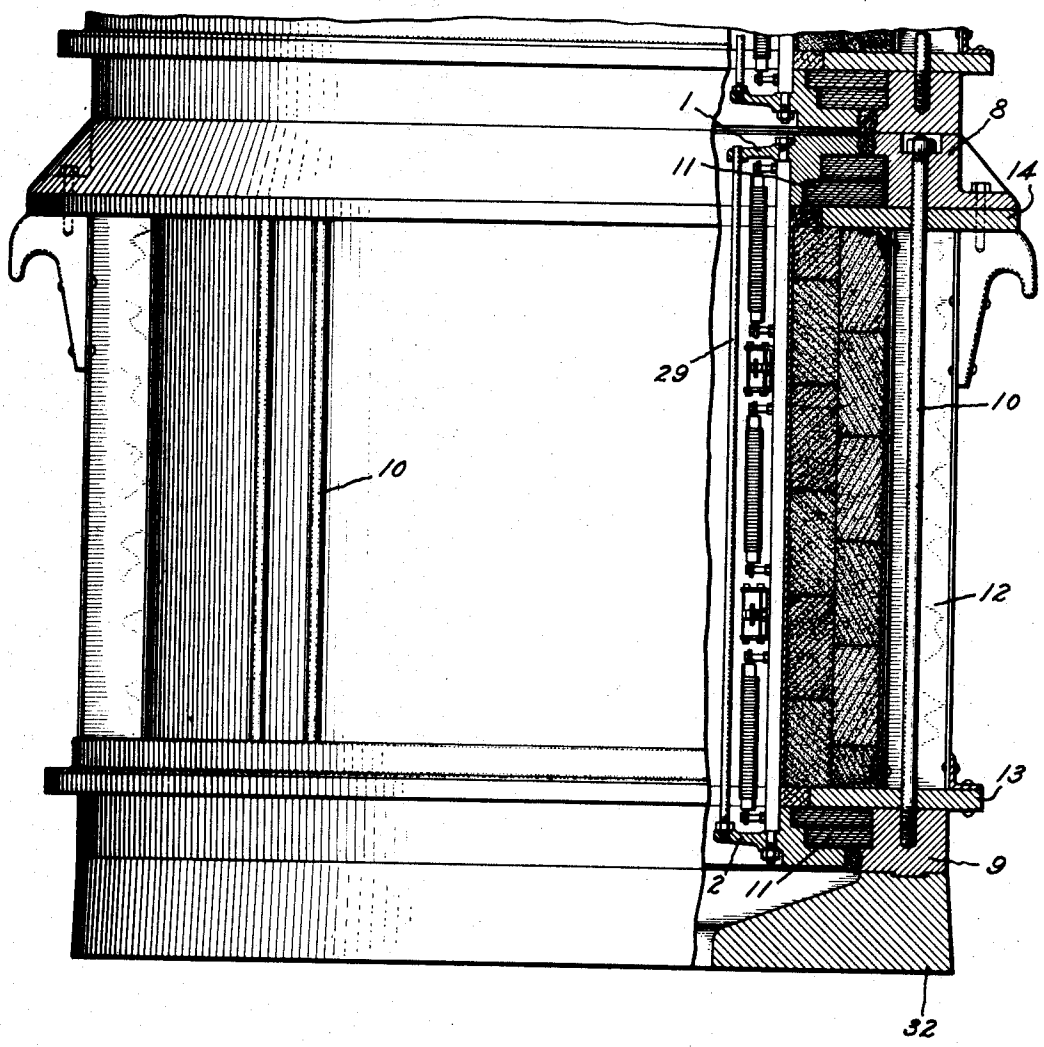
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4 SHEETS—SHEET 3.

Fig. 5.



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4 SHEETS—SHEET 4.

Fig. 6.

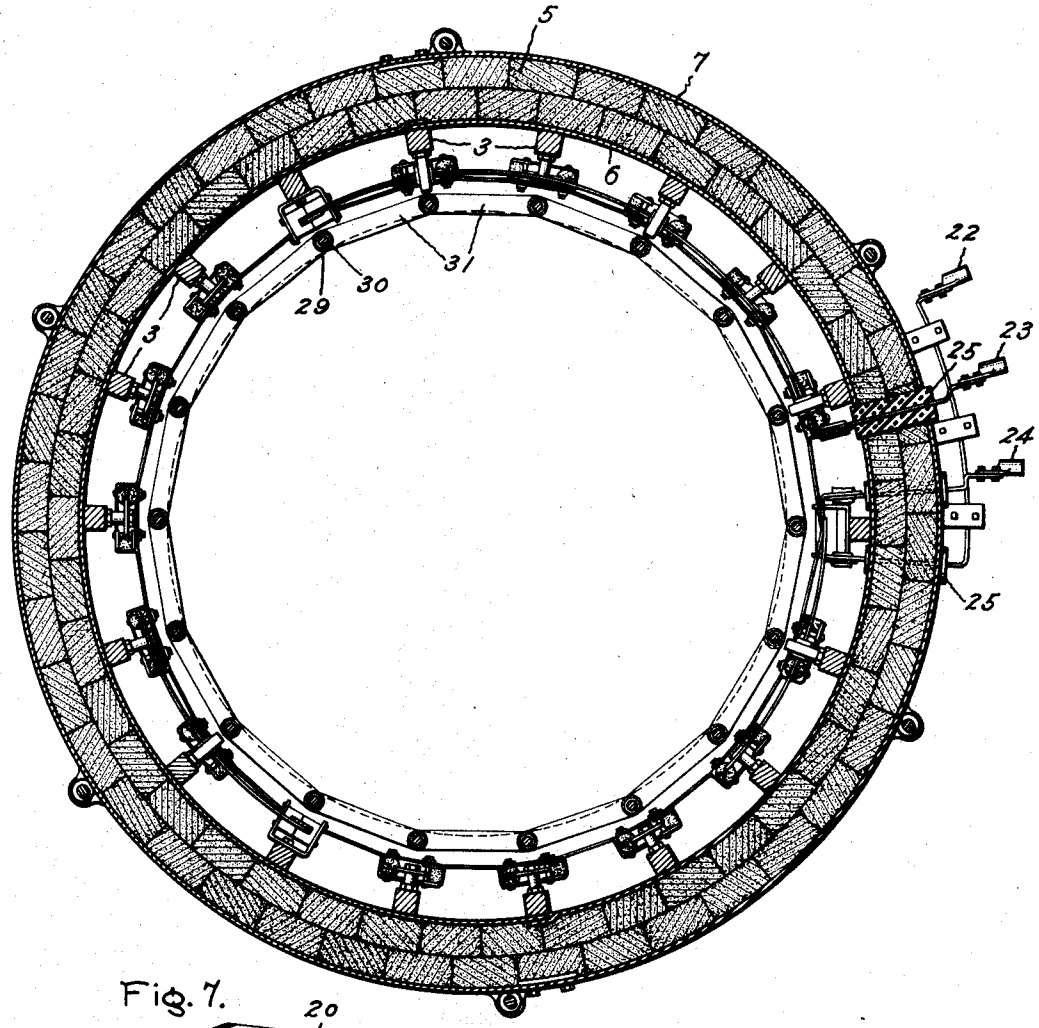
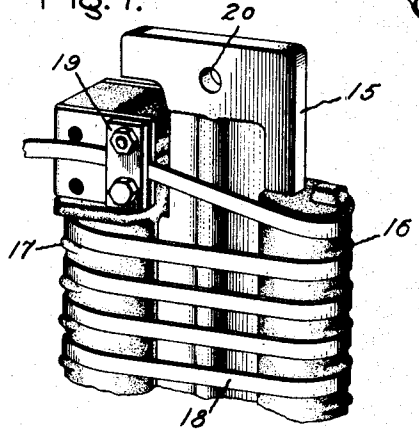


Fig. 7.



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UNITED STATES PATENT OFFICE.

EDGAR F. COLLINS, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

FURNACE.

1,281,521. Specification of Letters Patent. Patented Oct. 15, 1918.

Application filed November 10, 1917. Serial No. 201,208.

To all whom it may concern:

Be it known that I, EDGAR F. COLLINS, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Furnaces, of which the following is a specification.

The present invention comprises a novel electric resistance furnace, which while useful for general service, is particularly suitable for heating objects of great dimensions such for example, as the largest caliber guns, turbine and engine shafts, propeller shafts, and the like.

One of the main difficulties experienced with large furnaces is due to the thermal expansion and contraction of the parts. The repair and replacement of heating units and the protection of heating units from injury by the parts to be heated in very large furnaces also constitutes problems which are far more troublesome than in small furnaces which may be rewound entirely without prohibitive expense.

In the furnace constituting my present invention some of the novel features which contribute to overcome the above-noted difficulties are as follows:

The furnace comprises separate units or sections, each complete in itself, a number of which may be combined to constitute a furnace of desired length.

The separate units are constructed so that in each section adjustment occurs to compensate for the difference in expansion between the outer parts which are maintained relatively cool and the inner parts which are heated during the operation of the furnace. In other words the difference of expansion of the parts of each section is not additive.

The outer casing of each unit is thermally insulated from the inner metallic framework. The casing is constructed to permit expansion and contraction without distortion or damage.

The framework of the furnace units is constructed to provide space for expansion of the parts without distortion.

The electric heaters are located and constructed to enable quick and easy replacement of injured or burned out parts and are protected from mechanical injury by objects to be heated when placed within or removed from the furnaces.

These and other novel features of my invention are set forth with greater particularity in the appended claims. For a better understanding of my invention reference may be had to the following description taken in connection with the accompanying drawings in which—

Figure 1 shows diagrammatically a number of sections or furnace units assembled; Figs. 2 and 3 show diagrammatically suitable electrical connections for the heaters; Fig. 4 is a view partly in perspective and partly in section of one form of furnace unit; Fig. 5 is a perspective unit partly in section of another type of unit, both embodying my invention; Fig. 6 is a plan view of a section of the furnace; Fig. 7 is a fragmental perspective view of one type of electric heater suitable for use in a furnace embodying my invention.

As shown in Fig. 1 the furnace units are preferably assembled by vertically superimposing one unit on the other so that parts of the structure are free to adjust themselves to thermal expansion and contraction which would be rendered more difficult if the furnace was disposed horizontally. Only four units *a*, *b*, *c* and *d* are shown assembled, but it is to be understood that this is illustrative only.

One construction permitting take-up or adjustment of thermal expansion or contraction is best shown in Fig. 4. In the construction here shown the weight of the furnace structure is carried by an inner framework. It will be observed that the framework of each furnace unit comprises an annular, recessed top ring 1, a recessed bottom ring 2 and a number of longitudinal connecting rods 3, the ends of which terminate within the recesses in the end rings 1 and 2. The ends of the connecting rods are held in place by the nuts 4, as shown in the drawing. A number of connecting rods are preferably placed circumferentially at adjacent points, as best shown in Fig. 6. Around the cage constituted by these rods there is placed an envelop of heat insulating material 5. This envelop preferably is provided with an inner casing 6, and an outer casing 7 consisting of sheet iron, or the like. The outer casing 7 is attached by screws to a top ring 8 and a bottom ring 9, these rings being held together by the tie rods 10. The rings 8 and 9, the tie rods and

the outer casing 7 constitute a separate outer framework which is relatively movable to take up differences of expansion caused by the unequal heating of the same with respect to the inner framework. A gap is left between the ring 9 and adjacent rigid parts of the furnace to permit the adjustment required to compensate for the difference in expansion between the inner and outer framework. The end rings 8 and 9 are separated from the rings 1 and 2 by spacers 11 of asbestos, or similar heat insulating material, which largely reduces the flow of heat to avoid local heating of the outer framework and casing.

In some cases, as shown in Fig. 5, the weight of the furnace column is supported by the outer framework. In this case there are provided heavy I-beam supports 12 bolted to the plates 13 and 14 against which the top ring 8 and the bottom ring 9 are drawn by the tie rods 10, asbestos board heat insulators 11 being provided as in the construction shown in Fig. 4 to reduce heat transfer from the inner end rings 1 and 2. In this modification clearance spaces are provided for the expansion of the inner framework of each unit.

Attached to the connecting rods 3 adjacent the inner casing 6 of the furnace are a number of electric heaters, as shown in detail in Figs. 4 and 7. Each of these heaters consists of an iron frame 15 and refractory, insulating supports 16 and 17, which are fitted to the edges of the iron frame. Upon these supports is wound a ribbon or wire 18 of suitable electrical resistance material such, for example, as calorite, an alloy of about 62 to 65 per cent. nickel, about 10 to 12 per cent. chromium, about 7.5 to 8 per cent. manganese and the balance iron. Each end of the heater ribbon is mechanically clamped to a terminal 19 and the ribbon may then be carried to the next electrical heater if desired, or the end of another heater may be inserted at the terminal. The frame 15 is provided with holes or slots 20 at each end (only one being shown in Fig. 7) in order to attach the heater by means of pins 21 (Fig. 4) to the inner furnace framework.

The heaters may be connected electrically in any desired way. In this case, a plurality of heaters have been shown connected in series, and heater groups *e*, *f*, *g* have been connected in delta to electrical terminals 22, 23 and 24, as indicated in Fig. 4 and shown diagrammatically in Fig. 2. Fig. 6 shows how the terminals are led through the furnace wall surrounded by suitable insulators 25. Each of the delta-connected groups of heaters of the respective furnace units is then connected in parallel to bus-bars 26, 27 and 28. The delta-connected heater groups *h*, *i*, *j*, *k* of the vertically superimposed corresponding sections are shown diagrammatically in Fig. 3.

In order to obviate damage to the heaters by an object to be heated while being placed in the furnace or removed therefrom, a barrier to screen is placed adjacent the heaters consisting of vertical rods 29, as shown in Figs. 4 and 5. The lower end of the rods 29 may be threaded and firmly affixed to the bottom ring 2 while the upper end of the rods simply projects into an aperture within the top ring so as to permit thermal expansion and contraction without bending or buckling of the rod.

In some case, for convenience in building up the barrier, sections of pipe 30 are conveniently placed about the rods as shown in Fig. 4. One ring of connecting links 31 is placed at the top of these pipes and then another section of pipes is placed in position, then another circle of the connecting links is added, and so on until the barrier is completed.

The furnace units thus assembled may be placed in a pit upon a base 32 fixed to a concrete foundation 33 (Fig. 4) and successive units then added, one unit being superimposed upon the other by placing the bottom ring of one unit on the top ring of the other unit until a furnace of sufficient length has been built up, the top of which may, if desired, project beyond the ground level. The top section may be provided with a removable cover 34. In this manner furnaces for heating large guns and shafts 80 or 90 feet long, or even of greater length, have been used successfully without encountering any difficulties due to changes of temperature.

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

1. A furnace comprising a plurality of superimposed sections, each of said sections comprising a wall of heat insulating material, an inner and an outer framework, one of said frameworks supporting said furnace structure, and the other framework being relatively movable in each section with respect to the supporting framework, and means for heating the space within said furnace.

2. A furnace comprising a plurality of sections, each of said sections comprising a wall for supporting the weight of said furnace, a framework attached to the wall of each section and constructed to be capable of movement independently of the framework of other sections and separated by clearance spaces from adjoining frameworks to permit expansion due to changes of temperature, and heating means attached to said framework.

3. A furnace unit comprising an envelop, comprising inner and outer metallic frameworks, electric heaters supported by said inner framework, and heat insulating means

separating said frameworks, leaving clearance spaces to permit longitudinal adjustments due to the thermal expansion and contraction of the inner framework.

4. An electric furnace unit comprising a tubular envelop comprising material of poor heat conductivity, annular end rings, longitudinal rods joining said rings, and electric resistance heaters located between the inner wall of said envelop and said rods.

5. An electric furnace unit comprising annular end plates, longitudinal rods joining said plates, a heat-insulating envelop located outside said rods, a plurality of supports spaced away from the inner wall of said envelop, electric resistance heaters carried by said supports and longitudinal rods joined to said plates spaced circumferentially within said envelop adjacent said heaters.

6. A furnace comprising a plurality of vertically superimposed sections, heaters for each of said sections, a metallic framework in each section for supporting said heaters, said sections being provided with clearance space to permit thermal expansion of the framework of each section independent of the remaining sections.

7. An electric resistance furnace unit comprising annular metal end plates, metal tie rods connecting said plates, a tubular envelop of refractory material, a metal casing therefor, supports for electric heaters attached to said tie rods and spaced away from the inner wall of said envelop, resistance heaters mounted upon said supports, a protecting barrier between a heating zone within said envelop and said heaters, and electric supply conductors for said heaters passing through said envelop and casing.

8. A furnace consisting of a plurality of units each of said units comprising an inclosing and supporting wall, a framework carried thereby separated by a clearance space from the corresponding framework of the parts adjoining said unit to permit expansion and means for heating the space within said wall.

In witness whereof I have hereunto set my hand this 8th day of November, 1917.

EDGAR F. COLLINS.