

June 28, 1949.

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2,474,664

ELECTRIC HEATING SYSTEM

Filed May 15, 1946

2 Sheets-Sheet 1

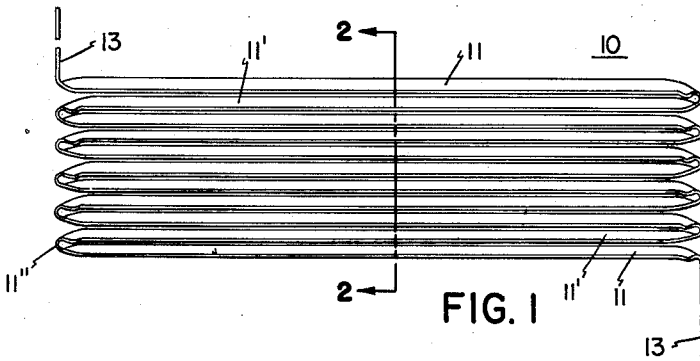


FIG. 1

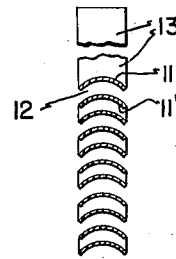


FIG. 2

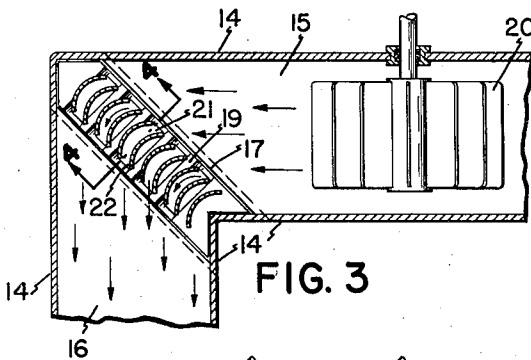


FIG. 3

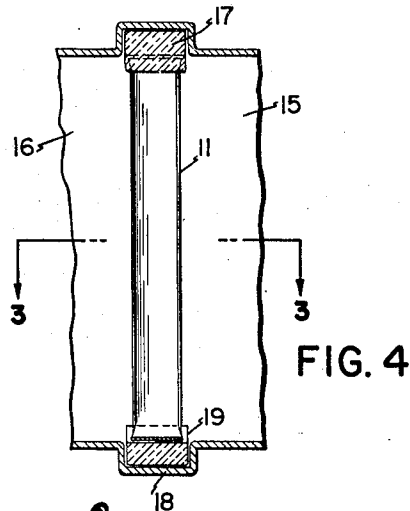


FIG. 4

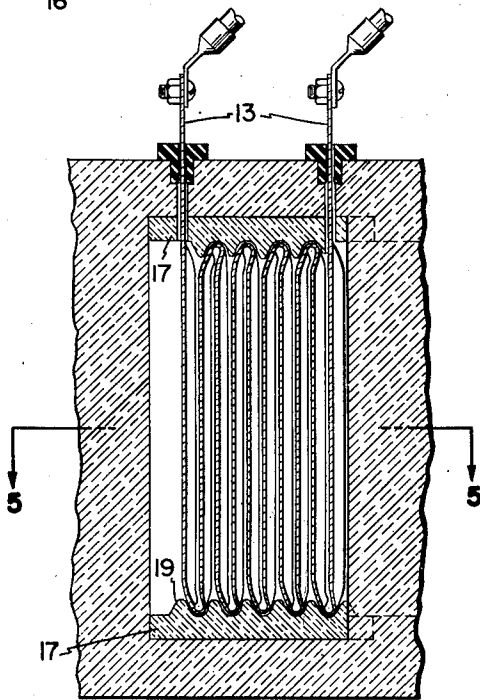


FIG. 6

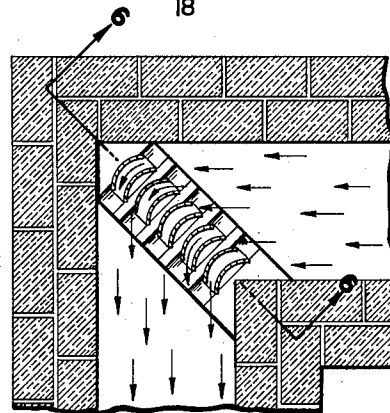


FIG. 5

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2 Sheets-Sheet 2

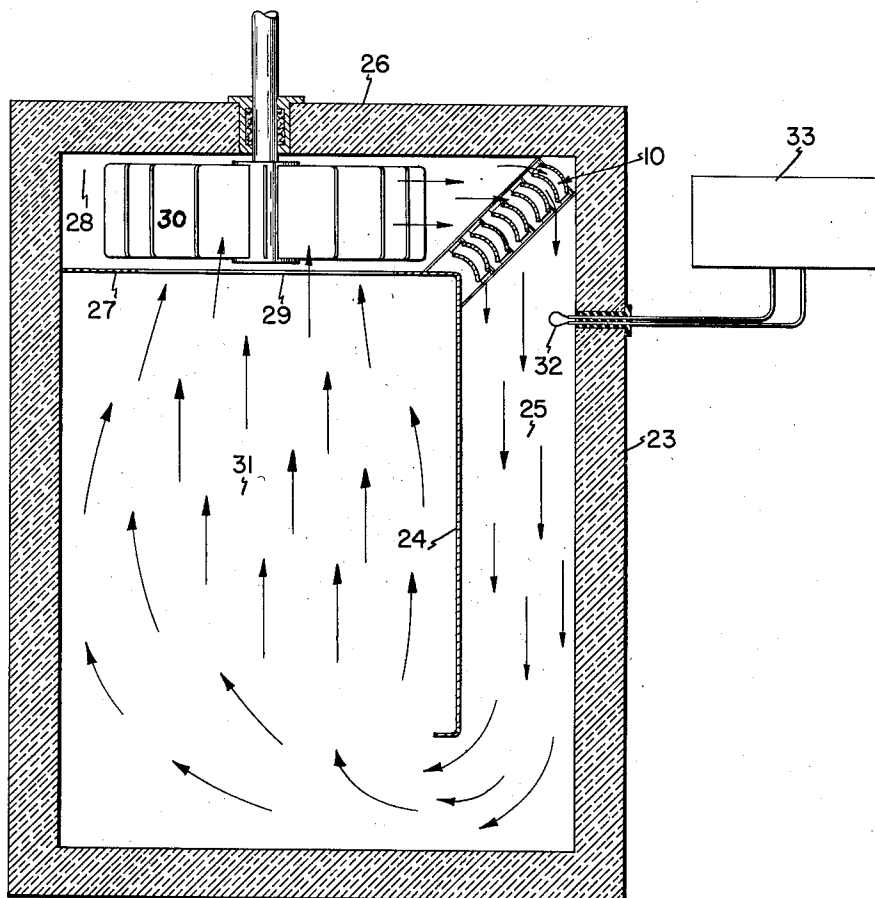


FIG. 7

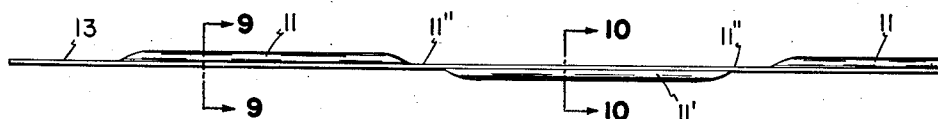


FIG. 8



FIG. 9



FIG. 10

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## UNITED STATES PATENT OFFICE

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## ELECTRIC HEATING SYSTEM

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6 Claims. (Cl. 219—39)

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This invention relates to electric heating systems and more especially to such systems applicable to the heating of electric ovens, furnaces, and rooms in buildings, although it is useful also wherever it is desired to supply by convection, forced or natural, a current of heated air.

It has been proposed to heat ovens, furnaces, and flues by electric heater convection units formed of open coils of high resistance metals disposed transversely of air passageways, but experience has shown that heat can be more uniformly imparted to a gas atmosphere current and with less loss of gas velocity or pressure drop and with lower temperature gradient, by the wiping action of the said current over relatively wide heater elements curvilinear in cross section and disposed so as to change the course of the gas current.

The object of this invention is the provision of an efficient and economical electric gas atmosphere heating and turning unit comprising an electrically heatable unit of high resistance metal formed to make a plurality of spaced arcuate vanes disposed at the juncture of two angularly related ducts, conduits, flues or passageways and substantially coextensive in area with that of the junction or at the end of such passageway and substantially coextensive with the area thereof, whereby to heat a gas, such as air, and establish a flow thereof by convection, forced or natural.

Other objects and the means for accomplishing them will hereinafter appear in the detailed description of the embodiments of my invention which have given good results in practice.

In the drawings which accompany and form a part of this specification,

Figure 1 is a front elevation of an electric gas atmosphere heating and turning unit embodying my invention.

Fig. 2 is a transverse section taken on the line 2—2 of Fig. 1.

Fig. 3 is a horizontal section taken on the line 3—3 of Fig. 4 and illustrating a portion of an electric oven.

Fig. 4 is a vertical section taken on the line 4—4 of Fig. 3.

Fig. 5 is a horizontal section taken on the line 5—5 of Fig. 6, and illustrating a portion of an electric furnace.

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Fig. 6 is a vertical section taken on the line 6—6 of Fig. 5.

Fig. 7 is a horizontal section of a typical electric oven.

Figure 8 is an edge view of a high resistance metallic strip before it is bent upon itself repeatedly to form a plurality of curvilinear spaced vanes.

Figures 9 and 10 are sectional views taken on the lines 9—9 and 10—10, respectively, of Fig. 8.

In the particular drawings selected for more fully illustrating the principle underlying my invention and which are to be considered as illustrative, merely, and not restrictive, 10 represents a unit made by repeatedly reversely bending upon itself a strip of any suitable high resistance metal that is curvilinear, for example, arcuate in cross section. The strip may be given its sectional configuration by dies or by any other suitable means. By bending said strip in the manner stated, there are produced a plurality of spaced vanes 11, 11', which define, preferably, arcuate passageways 12; that is to say, each vane defines with the vane next adjacent thereto, a curvilinear or arcuate passageway. In the form shown in Fig. 1, the end vanes terminate in flat strips 13 adapted to connect the unit to a source of electric power for current flow therethrough. It will be understood, however, that the unit may not be a single unitary member as shown in Fig. 1 and that any suitable means may be employed for mechanically and electrically connecting the vanes together for current flow therethrough and that the vanes may be connected in series with each other and with the source as illustrated, or so connected that they are in parallel with said source.

The heating and turning unit above described may be used in many ways, two of which are illustrated in the drawings.

In Figs. 3 and 4, 14 represents the walls of two ducts 15, 16, that are angularly related, said ducts being shown in the present instance at right angles to each other. The unit is suitably secured at the juncture of the ducts or passageways and as shown is coextensive with the area of said juncture.

In the particular form illustrated in Fig. 3, the means for securing the unit in the ducts at the juncture thereof and at an angle to their

respective axes, are strips of heat resisting insulation 17 such as, for example, fused alumina insulation, which strips may be disposed in depressions 18 in the walls of the ducts, the surfaces of said strips contacting the ends of the unit being corrugated, as shown more clearly in Fig. 6, and indicated thereon by the numeral 19.

A suitable fan 20 may be employed to create a forced convection current of heated air or other gas, the flow of which is indicated by arrows. It will be noted that the forward end 21 of each vane and therefore the passageway between a vane and the one next adjacent thereto is substantially parallel with the axis of the duct 15 from which the gas current is received and that the trailing end of each vane and passageway 22 is parallel with the axis of the duct 15 to which the gas current is delivered.

In Figs. 5 and 6, the application of my gas heating and turning unit to an electric furnace is shown, the distinction between an electric oven and an electric furnace being substantially that the temperature of the latter is usually in excess of 1000° F. and that of the former, usually below 1000° F. In Figs. 5 and 6, the uncorrugated surfaces of the insulation members about the plane inner walls of the duct, although it will be understood, of course, that said walls may be provided with the pockets 18 shown in Fig. 4. The operation of the unit in a furnace is identical with that above described in connection with Fig. 3.

For producing a current of heated gas by natural convection the unit will be disposed in one of the lower corners of the oven or furnace.

The unit may also be used to produce a heated air current in the flues of buildings with or without one of the usual sources of heat. If such source is used, the function of the unit will be to augment the heat delivered to rooms in the upper stories of the building.

In Fig. 7, 23 represents the walls of a typical electric oven in which the right-hand wall and the partition 24 defines a vertical duct 25 and the adjacent wall 26 and the partition 27 define a duct 28 at right angles to the duct 25.

Disposed in the duct 23 immediately above an opening 29 in the partition 27 is a fan 30. The heating and turning unit 19 is secured by insulation means such as above described at the juncture of the ducts 25, 28, and at an angle to the axes thereof, said unit being substantially coextensive with the area of said juncture. In the work area 31 of the oven will be disposed the usual shelves, trays, drawers, etc., for holding the articles to be treated. Any of the usual control systems may be employed, such as indicated by the thermocouple 32 and current controller 33.

If the heating unit is made in the manner shown in Fig. 1, by reversely bending repeatedly upon itself a strip of high resistance metal arcuate in cross section and the sectional configuration is imparted to the strip by dies, said strip will be died in the manner shown in Fig. 3, in which alternately spaced vanes are convex upwardly, as shown at 11, and convex downwardly, as shown at 11', each pair of vanes being connected by a short length of the flat strip 11'', which when the strip is reversely bent, forms one of the ends of a pair of juxtaposed vanes, as indicated at Fig. 1, the portions 11'' constituting a means mechanically and electrically connecting the vanes together for current flow therethrough.

Having thus described illustrative embodiments

of my invention without, however, limiting the same thereto, what I claim and desire to secure by Letters Patent is:

1. An electric heating system comprising in combination, a structure having two angularly related ducts, an electrically heatable unit located at the juncture of said ducts, said unit comprising a strip of high resistance metal curvilinear in cross section and reversely bent repeatedly upon itself to form a plurality of curvilinear spaced vanes defining passages therebetween, the forward end of each said vane being substantially parallel to the axis of one of said ducts and the trailing end of each said vane being substantially parallel to the axis of the other of said ducts, insulation means for securing said unit in said ducts at the juncture thereof and at an angle to the axes of said ducts, said unit being coextensive with the area of said juncture, and means adapted to connect said unit to a source of electric power.

2. An electric heating system comprising in combination, a plurality of spaced transversely arcuate vanes of high resistance material, means mechanically and electrically connecting said vanes together for current flow therethrough, a structure defining two angularly related ducts, the forward end of each said vane being substantially parallel to the axis of one of said ducts and the trailing end of the other of said vanes being substantially parallel to the axis of the other of said ducts, insulation means securing said vanes to said structure across the juncture of said ducts and means adapted to connect said vanes with a source of electric power, whereby the air-flow from one of said ducts to the other will be through the passages defined by each adjacent pair of said vanes.

3. In an electric heating system, an electrically heatable unit comprising a strip of high resistance metal having curvilinear portions alternately convexed in opposite directions, said strip being reversely bent repeatedly upon itself to form a plurality of curvilinear spaced vanes defining curvilinear passages therebetween, whereby when said unit is electrically heated, air will flow by convection through said passages.

4. In an electric heating system, a plurality of spaced transversely curvilinear vanes of high resistance material and means mechanically and electrically connecting said vanes together for current flow therethrough, each of said vanes defining with the vane next adjacent thereto, a transversely curvilinear passage, the walls of which are curvilinear in substantially the same general direction.

5. In an electric heating system, a set of spaced transversely curvilinear vanes of high resistance material, said vanes being transversely curved in substantially the same general direction, means mechanically and electrically connecting said vanes in series with each other, and means adapted to connect said set of vanes with a source of electric power, whereby when said unit is electrically heated, air will flow by convection through the passages between each pair of said vanes.

6. An electric heating system comprising in combination, a structure having two angularly related ducts, an electrically heated unit located at the juncture of said ducts, said unit comprising a strip of high resistance metal having curvilinear portions alternately convexed in opposite directions, said strip being reversely bent repeatedly upon itself to form a plurality of transversely

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curvilinear spaced vanes defining air passages therebetween, insulation means for securing said unit in said ducts at the juncture thereof and at an angle to the axes of said passageways, said unit being coextensive with the area of said juncture, and means adapted to connect said unit to a source of electric power whereby when said unit is electrically heated, air will flow through said passages by convection from one of said ducts to the other.

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