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APPARATUS FOR THE DISTRIBUTION OF HEAT

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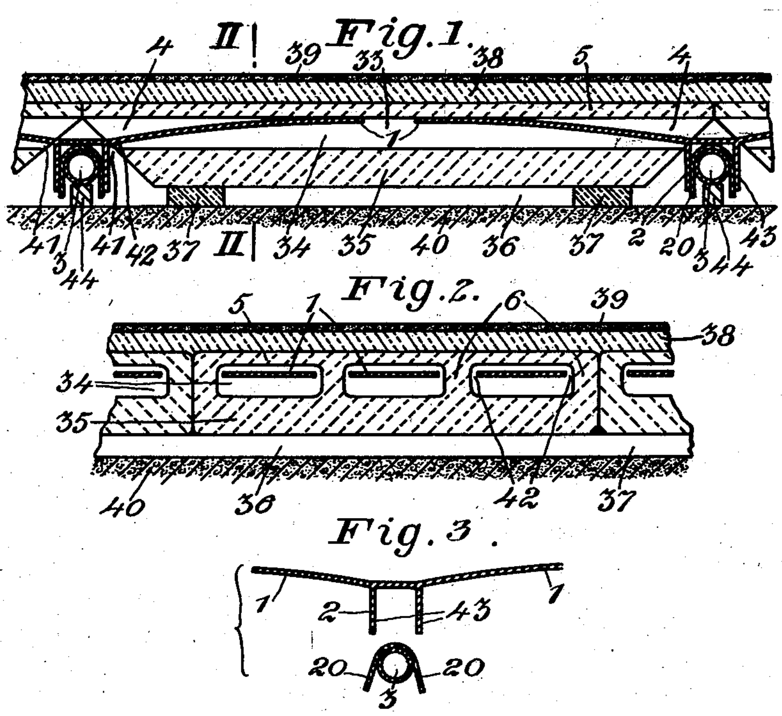

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APPARATUS FOR THE DISTRIBUTION OF HEAT

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The present invention relates to an installation for heating or cooling in practically uniform manner such items as the surface of a floor, a ceiling, or a wall.

According to the invention, said installation comprises supporting members for the surface to be heated or cooled, a net of tubes disposed parallel to said surface and containing the source of thermal energy, the enveloping surface of said tubes being materially smaller than the exchange surface, heat distributing means between the tubes and the said surface, at least one compensating part of greater specific resistance to thermal transmission than the distributing means and disposed between said means and said surface, the compensating part having the value of its absolute thermal resistance measured at right angles to the said surface greater in a region near the tubes than in a region remote therefrom in such manner that there is obtained a practically uniform temperature throughout the entire heat-exchange surface.

By the expression "thermal transmission" is understood any heat transmission or absorption of heat (cooling) which may occur due to conduction, radiation, convection or any combination of these phenomena.

In order to vary the value of the absolute resistance of the compensating part, the latter may be so shaped that its thickness measured at right angles to the surface to be heated or cooled is greater in a region near the source than in a region remote from the source. It is also possible to accomplish the same end by designing this compensating part to have a specific resistance greater in a region near the source than in a region remote from the source.

Hereinafter the surface to be heated or cooled will be briefly designated as an "exchange surface" since a calorific exchange takes place between this surface and its surroundings. This exchange surface may be flat, spherical, cylindrical, etc., as desired.

The object of the invention is to heat or cool the surroundings by permitting the transmission of large quantities of heat from the exchange surface to the surroundings or vice versa, while having the different points of the exchange surface practically at the same temperature.

The present invention finds its principal application in the heating of buildings. In this case, the exchange surface is preferably the floor, and the tubes may be for instance electrical heaters or pipes traversed by hot water or gases (vapour). The invention may also be applied to cooling refrigerating chambers, the exchange surface then preferably being constituted by the ceiling of such chambers.

The heating (by means of the floor, ceiling or walls) of wagons, motor cars, drying rooms, stoves, incubators, heating plates, as well as the cooling of artificial skating rinks, are also fields of application of the invention.

The distributing means distributes or absorbs the heat (by conduction, radiation, convection or any combination thereof) approximately parallel to the exchange surface. In other words, if the paths followed by the heat are graphically represented, as for example is the case with the lines of electro-magnetic forces, it will be seen that the "lines of heat content" will be arranged, between the tubes and the exchange surface, in large measure and over a large portion of their length, parallel to said exchange surface.

It results from the foregoing that the tubes may be separated from each other a materially greater distance than the smallest distance separating these tubes from the exchange surface. For example, the tubes may be spaced from each other a distance of 60 cms. while the distance from one tube to the exchange surface is only 1 or 2 cms. The distributing means will be briefly designated hereinafter as a "distributor". It is preferably made of metal, for example iron, copper or aluminium, copper and aluminium being especially suitable for this purpose, due to their respective good conductivities. This distributor may also consist of an enclosure in which the heat is transmitted by the transfer of a carrying substance or vehicle, for instance by convection.

As for the compensating part, which has been referred to previously, and which has a greater specific thermal resistance than that of the distributing means, it may consist of a solid or fluid (air, a vacuum more or less complete in which the heat transfer is by radiation, conduction, convection or combination thereof); or it may consist of a mixture of homogeneous or heterogeneous materials (for example a mixture of wood shavings and air, wood shavings and metal particles), etc.

This compensating part, which hereinafter will be called a "compensator" compensates the decrease or increase of temperature of the distributor.

The net of tubes disposed parallel to the exchange surface, may consist of a plurality of tubes connected in parallel or in series (in this last case the net of tubes may be a flat coil for instance) and the tubes are not only elongated bodies of circular cross section, but may also be of any other cross section (rectangular, square, etc.) uniform or variable lengthwise the tubes. In the following description these tubes are designated as "heaters" or "heating body".

The annexed drawing represents only by way of example a heating installation according to my invention.

Fig. 1 shows a vertical section through a floor presenting the heating installation.

Fig. 2 is a section according to line II—II of Fig. 1.

Fig. 3 is a detail view of the piece connecting the distributing means to the tubes.

The distributor 1 consists of like metallic elements in the form of a ribbon, separated from each other and lodged in the recesses of a supporting member 5—6—35. This supporting member rests on a slab 40, by means of wedges 37. These latter are made of mortar or other suitable material which is preferably a heat and sound insulator.

A layer of air 36, existing between the supporting member and the slab 40, has an insulating effect. Due to the wedges 37, the inequalities and irregularities of the slab may be absorbed and the supporting members placed at the same level. These latter may be for example hollow bricks (hourdis), terracotta, or other hollow bodies.

In the example shown, the supporting members comprise two layers of material 5 and 35, separated by recesses 4 and 34 and connected by supports 6. The upper layer 5 is as thin as possible in order to impede only slightly the transfer of heat while the layer 35 may be thicker in order to resist the tensional stresses when the supporting member is loaded. The floor rests upon said supporting members; and may consist for example of linoleum 39 resting on a bed 38.

The distributors 1 are thermally connected to the heaters 3 by connecting pieces 2. The heat from the heaters 3 is conveyed by the connecting pieces 2 to the distributors 1 and is then evenly distributed on the exchange surface 5 through the layer of air 4 forming the compensator.

Indeed, the thickness of this compensator diminishes from the point nearest the heater 3 to the extremities of the distributor, the heat liberated near the tube 3 will have greater difficulty in reaching the floor than that liberated near the extremities of the distributor. The cross-section of the distributor as well as the thickness of the compensator 4 are chosen, along with the total quantity of heat provided so that a determined, practically constant quantity of heat will be transmitted to the floor per unit of surface, throughout its entire length. In practice, the distributor has a constant thickness and is preferably made of stamped copper, aluminum or sheet iron. It follows that when the heater 3 is maintained at a constant temperature and the air above the floor likewise remains at an appreciably constant temperature, an equilibrium of temperature is established in the installation such that the upper surface of the floor has substantially the same temperature throughout its entire extent.

Thus, should the temperature of the heating body 3 vary, all the the other temperatures will also vary and the quantities of heat will remain in the same proportions. The temperature of the exchange surface will therefore always remain uniform throughout its whole extent.

Fig. 3 shows the form of the two parts 20 and 43 of the connecting piece 2 before the assembly of the installation. The part 20 rests upon the heater 3 and with its two arms diverging outwardly. When the parts 43 are slipped onto the heater 3, these parts come into effective contact with the said parts 20, due to which arrangement, it is possible to maintain the distributor 1 in a predetermined position even when the heater 3 varies in vertical position. If the heater, instead of being of circular section, has two faces parallel to the parts 43, it is possible to slide the parts 43 directly against these two faces.

The air cushions formed by the recesses 34 act as insulators, as also does the layer of air 36; and the wedges 37 permit the loss of but very little heat. As the spaces between the distributors are short, the heat is practically uniformly distributed through the layer 5 and consequently in the floor 38 and 39.

The distributors are thermally connected to the heaters and at their extremities contact the layer 5 with a slight pressure, at the same time being slidable thereon. A small space 33 is left, in each recess 34 for play between two adjacent distributors so that these latter may expand freely. Further, provision is made for spaces 41 between the supporting member and the connecting piece and for space 42 between the distributor and the supporting member, to provide for relative movement between these parts.

The heaters 3 rest upon the wedges 44. As the assembly, comprising the heaters 3 (as well as the headers and receivers), the connecting pieces 2 and the distributors 1, presses against the layer 5 (presenting the exchange surface) with but a very slight pressure, the said assembly may expand or contract or be displaced slightly without the production of any dangerous stress. As the contacting surfaces between the distributors 1 and the layers 5 and between the heaters 3 and the wedges 44 are parallel to the exchange surface, the assembly formed by the distributors 1, the connecting pieces 2 and the heaters 3 may be displaced parallel to the floor without being subject to any stress. In the mass of the supporting members and in the floor (bed 38 and linoleum 39), the temperature will vary less and the expansion will consequently be weaker than in the assembly indicated above. Provision however may be made that these supporting members and the floor (38 and 39) may expand freely in relation to the slab 40, by forming the wedges 37 of a material which does not adhere to the supporting members or to the slab, but which permits a sliding movement between these parts.

This embodiment of my invention permits the elimination of all dangerous stresses due to expansion.

The contact pressure between the distributor 1 and the layer 5, may be as small as necessary.

According to a modification, the spacing between the different points of the distributor 1 and the layer 5 (that is to say, the thickness of the compensator 4) may be calculated in such manner that these two members do not come into contact with each other, as a result of which all the heat must traverse a layer of air, before reaching the exchange surface. Thus there will be no friction between the distributor 1 and the layer 5.

The heaters 3 may also be suspended in such manner as to render their displacement by expansion easier, or the distributor 1 may be fixed to the layer 5 so as to cause relative variations of position to be absorbed by the connecting piece 2. This latter may either for this purpose be flexible or present contacting surfaces which permit a sliding movement. This connecting piece may also be integral with the distributor.

Instead of the hollow bodies shown, supporting members may be employed formed simply of a layer **5** and ridges **6**, without a lower layer **35**. Further, the supporting members, instead of resting on the wedges **37**, may rest directly on the slab **40**, or upon a bed of cement.

If the layer **5** is sufficiently resistant and if the supporting members are symmetrically located at calculated intervals, this layer **5** may serve directly as the floor.

The bed **38** and the linoleum **39** may be replaced by a tile-flooring, a layer of cement or other material containing saw-dust or cork, a floor without joints or even a parquet floor.

Although the invention has been described in detail, such description is intended as only illustrative, as the invention may be variously embodied.

What I claim is:—

1. A heat-exchange installation comprising means for giving a substantially uniform temperature to all points of a heat-exchange surface, the said means comprising a net of tubes disposed parallel to said surface and containing the source of thermal energy, the enveloping surface of said tubes being materially smaller than the exchange surface, heat-distributing means between the tubes and the said surface, at least one compensating part of greater specific resistance to thermal transmission than the distributing means and disposed between said means and said surface, the compensating part having the value of its absolute thermal resistance measured at right angles to the said surface greater in a region near the tubes than in a region remote therefrom in such manner that there is obtained a practically uniform temperature throughout the entire heat-exchange surface.

2. A heat-exchange installation comprising means for giving a substantially uniform temperature to all points of a heat-exchange surface, the said means comprising a net of tubes disposed parallel to said surface and containing the source of thermal energy, the enveloping surface of said tubes being materially smaller than the exchange surface, heat-distributing means between the tubes and the said surface, at least one compensating part of greater specific resistance to thermal transmission than the distributing means and disposed between said means and said surface, the compensating part being so shaped that its thickness measured at right angles to the exchange surface is greater in a region near the tubes than in a region remote therefrom, the thickness being so graduated that there is obtained a practically uniform temperature throughout the entire heat-exchange surface.

3. A heat-exchange installation comprising means for giving a substantially uniform temperature to all points of a heat-exchange surface, the said means comprising a net of tubes disposed parallel to said surface and containing the source of thermal energy, the enveloping surface of said tubes being materially smaller than the exchange surface, heat-distributing means between the tubes and the said surface, at least one compensating part of greater specific resistance to thermal transmission than the distributing means and disposed between said means and said surface, the compensating part having a specific thermal resistance greater in a region near the tubes than in a region remote therefrom, the specific thermal resistance of said compensating part being so graduated that there is obtained a practically uniform temperature throughout the entire heat-exchange surface.

4. A heat-exchange installation comprising means for giving a substantially uniform temperature to all points of a heat-exchange surface, the said means comprising a net of tubes disposed parallel to said surface and containing the source of thermal energy, the enveloping surface of said tubes being materially smaller than the exchange surface, heat-distributing means between the tubes and the said surface, at least one compensating part of greater specific resistance to thermal transmission than the distributing means and disposed between said means and said surface, the compensating part having the value of its absolute thermal resistance measured at right angles to the said surface greater in a region near the tubes than in a region remote therefrom and the heat-distributing means limiting at least partly the compensating part, the thermal resistance of said compensating part being so graduated that there is obtained a practically uniform temperature throughout the entire heat-exchange surface.

5. A heat-exchange installation comprising means for giving a substantially uniform temperature to all points of a heat-exchange surface, the said means comprising a net of tubes disposed parallel to said surface and containing the source of thermal energy, the enveloping surface of said tubes being materially smaller than the exchange surface, heat-distributing means between the tubes and the said surface, at least one compensating part of greater specific resistance to thermal transmission than the distributing means and disposed between said means and said surface, the compensating part having the value of its absolute thermal resistance measured at right angles to the said surface greater in a region near the tubes than in a region remote therefrom, and means allowing the net of tubes to move relatively to the exchange surface, the thermal resistance of said compensating part being so graduated that there is obtained a practically uniform temperature throughout the entire heat-exchange surface.

6. A heat-exchange installation comprising means for giving a substantially uniform temperature to all points of a heat-exchange surface, comprising hollow bodies carrying the said surface, a net of tubes disposed parallel to said surface and containing the source of thermal energy, the enveloping surface of said tubes being materially smaller than the exchange surface, heat-distributing means between the tubes and the said surface and placed in the cavities of said hollow bodies, at least one compensating part of greater specific resistance to thermal transmission than the distributing means and disposed between said means and said surface, the compensating part having the value of its absolute thermal resistance measured at right angles to the said surface greater in a region near the tubes than in a region remote therefrom, the thermal resistance of said compensating part being so graduated that there is obtained a practically uniform temperature throughout the entire heat-exchange surface.

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