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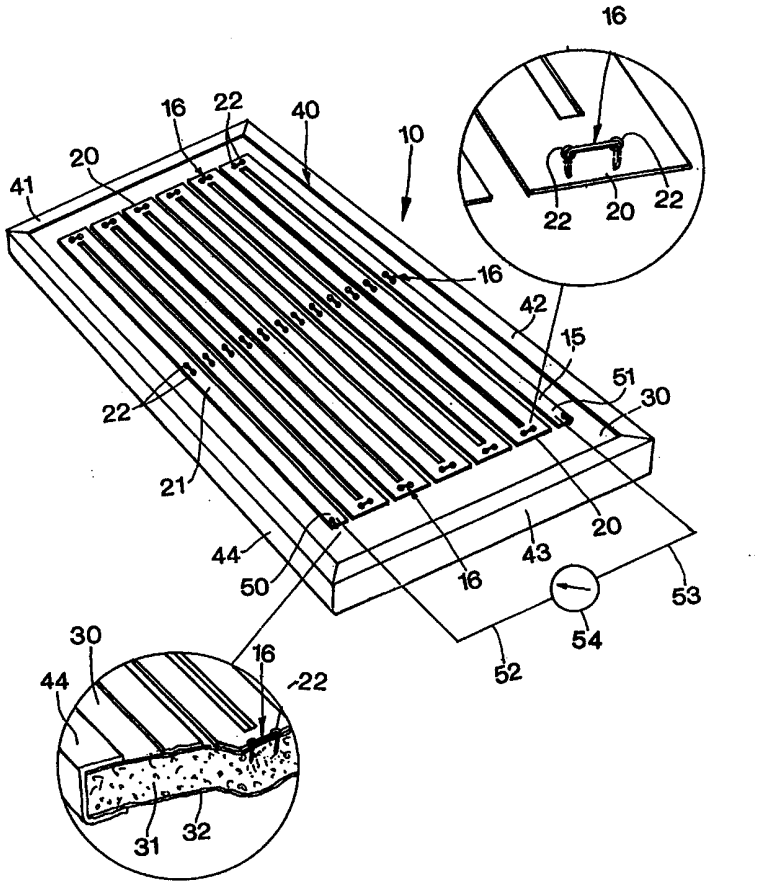
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(54) Title: THIN HEATING ELEMENT MADE FROM LOW RESISTANCE MATERIAL

(57) Abstract

System for transforming electric energy into thermal energy by means of resistances (15) of high conductive power, having a very thin cross section and an exceptionally high ratio between width and thickness, fastened flat, by clips (16), stapling and the like onto a support (30) of high insulating capacity such as mica, to obtain thermal energy of a high temperature and, due to the great surface extension, already diffused, with slight differences in heat and dimensions compared with the bodies and volumes to be heated.



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THIN HEATING ELEMENT MADE FROM LOW RESISTANCE MATERIAL

Innumerable processes and means exist for generating heat essentially based on combustion especially of gas, and on electrical resistance.

Heat is transferred by conduction, convection and radiation, energy being transferred respectively among contiguous molecules, molecules, electro-magnetic waves.

In the cases of conduction and convection, generally speaking a thermal chain is created that conditions the performance of an installation to a considerable extent.

Combustible gas for example feeds a burner whose flame, transforming energy from the gas into thermal energy, heats the water of a boiler that heats central heating panels which in turn warm the air close to them.

As it warms up the air becomes lighter and, in doing so, rises drawing in cold air towards the panels where it in turn becomes heated

A convective movement of air is thus created which warms the surrounding space.

In the case of radiation the electromagnetic waves, of suitable length, substantially heat objects while the air remains transparent.

This phenomenon, in an accentuated form in microwave ovens, creates considerable advantages not only environmental but also for materials and products generally, dispersal of heat in the air being almost entirely

avoided since it is concentrated in the bodies to be heated.

A heating installation that operates by radiation works somewhat like a microwave oven, except that it functions by radiating energy at a lower frequency and on a longer wavelength.

These advantages however are lessened by the fact that present systems are based on use of highly resistant materials becoming heated to very high temperatures with a high concentration of heat when electric current is passed through them.

These temperatures are nearly always much higher than those needed for indoor heating, for ovens and for various appliances.

Receiving heat at very high temperatures these appliances need specially made and costly means of diffusion.

The high temperatures of resistances require supporting means of special materials such as ceramics and the like, that are difficult to construct, as well as fragile and complex structures for insulation and covering that rapidly become obsolete.

Efficiency of such installations compared with that of systems operating on combustible materials is very low.

Bearing in mind the considerable cost of high resistance materials as well, all this makes for high purchasing and running costs.

It is well known that in all cases a great deal of the output of a system is lost along the thermal chain from generators to appliances, especially due to the great difference between the temperature of the flame or of the electric heating elements and the temperature to be provided, with the result that actual the amount of energy used is very low when compared with that available and consumed in the process.

By transforming electric energy into thermal energy already diffused, and by transmitting this energy through radiation and therefore by electro-magnetic wages of average length, by means of this present invention objects especially can be heated with a level of efficiency much higher than can be achieved with present techniques as will now be explained.

Subject of the invention is a system for transforming electric energy into thermal energy already diffused, at high temperature.

The electric circuit is closed by electric resistances formed of conductors possessing very high electric conduction, such as copper and aluminium, having a very thin constant cross section and a high ratio between width and thickness, applied flat with fixed fastenings, side by side reciprocally insulated, on a support that offers a superior degree of insulation against high temperatures.

A continuous heat-emitting surface is thus obtained and therefore, in relation to the prior art, a drastic increase in surface extension of the resistances with generation of thermal energy already diffused and a far lower thermal and dimensional difference in relation to the bodies and volumes to be heated.

The support is formed of a strongly insulating sheet backed with a thick layer of insulating material covered, on its other face, with a protective sheet of metal or of some other material.

The strongly insulating sheet is preferably of mica.

The fastening means are preferably clips formed of a long thin metal body bent in the shape of a wide "U" with an intermediate linear section and shanks bent at 90°, forced into the insulating support through pairs of holes made in said conductors, of a diameter considerably greater than the width of each shank of the "U" in order to ensure sufficient space between each shank and the hole in the conductor.

In another type of execution the clips can be driven into the conductors and into the insulating support even without holes being made in said conductors.

In one type of execution fastening is done by mechanical stapling.

Said stapling can hold the conductors and the heavily insulated sheet together or can even fix the conductors to the whole insulating support.

The band-shaped conductors are advantageously laid serpentine-wise.

A serpentine can also be obtained by making parallel cuts in a sheet, starting first from one edge and then from the opposite edge.

In other types of execution the band-shaped conductors are placed in a spiral that may be circular, square, rectangular or of some other shape.

Optimum thickness of the conductors is between 0.1 and 0.5 mm.

Along their length the conductors may have a constant or different cross section according to the amount of heat and the temperature level to be reached in the various sections of the length.

Dimensional variations may be gradual or sudden, continuous or discontinuous according to circumstances or needs.

Electric feed may reach the conductors either at their ends or in intermediate areas.

Values of current that feed the ends or intermediate areas may be equal or different.

Optimum temperatures of the generators described vary from 300 to 800°C:

Said generators may advantageously take the form of panels.

In one type of execution said panels are completed by a four-piece frame in the form of a U-shaped channel into which the main parts such as the mica sheet, the insulating plate and rear protective sheet are fixed.

The heat-emitting surfaces of the generators can be placed in the indoor spaces, where greater warmth than ordinary room temperature is required, for the purpose of securing physical or chemical changes in the materials, so creating static, tunnel or ring-shaped furnaces and the like through which materials to be baked or treated generally, such as impregnating means, may pass.

The advantages of the disclosure are evident.

The thermal energy produced by the low voltage electric energy is of a high temperature and simultaneously diffused, and is transmitted by electromagnetic waves of medium length and therefore by radiation.

In spite of the high temperature the system of fastenings, especially using the U-shaped clips fixed into the insulating support through pairs of holes made in the flat conductors, hole diameter being considerably greater than the section of the shanks forming the "U", ensures stability while allowing ample space for dilation of the conductors.

Concentrations of heat and high temperatures that would burn the area round the fastenings, inevitable with other systems, are here avoided.

The above advantages are allied to a level of thermal efficiency far higher

than that possible with prior art methods since the loss of heat, inevitable especially if conveyed by conduction or convection, is avoided while the cost of construction is much lower than with present generators there being no need for costly supporting bodies requiring strong thermal and electrical insulation.

The compact form of flat panels makes possible a variety of applications not only for heating static or moving bodies, as in present furnaces, but also for environmental heating.

Characteristics and purposes of the invention will be made still clearer by the following examples of its execution illustrated by diagrammatically drawn figure.

Fig. 1 Radiating panel with a band of aluminium laid serpentine-wise fixed with clips, perspective view with details.

Fig. 2 Detail of the clip, perspective from above.

Fig. 3 Exploded view of the panel.

Fig. 4 Static furnace made with the radiant panels, perspective.

Fig. 5 Tunnel furnace, made with the radiant panels, for an impregnator, perspective.

The panel 10 comprises a sheet 30 of mica on which a band 15, of aluminium 0.5 mm thick, is laid in the form of a serpentine, supported by a slab 31 of insulating foam material able to withstand high temperatures. The slab is backed with a thin metal sheet 32.

The band 15 is fixed to the support, formed by the sheet 30 of mica and of the insulating slab 31, by means of clips 16 shaped like a wide "U" with a straight section 17 and shanks 18 bent at 90°, said clips being pressed into the material of the sheet 30 and slab 31.

The ends of said shanks 18 consist of sharp point 19.

At the heads 20 of said serpentine-laid bands 15 and about halfway along their length 21, are pairs of circular holes 22 of a diamater substantially greater, at a ratio of about 3 to 1, than that of the shanks 18 of the clips 16.

The main parts shown, such as the mica sheet 30, the insulating slab 31 and the backing sheet 32 are assembled by the frame 30 consisting of

four channel-shaped pieces 41, 44. The terminals 50 and 51 of the bands are joined by wires 52 and 53 to a source 54 of electric feed.

Figure 4 shows a furnace 60 of a substantially parallelepiped structure 61, with doors 62 whose inner sides 63, 64 are lined with a pair of panels 65 substantially the same as those shown in Figures 1-3.

The terminals of the aluminium bands 70 are joined by wires 71, 72 and 73 to a source 74 of electric energy.

Figure 5 shows an impregnating means 80 and the tunnel furnace 81.

Panels 84 and 85 similar to those described are mounted on the refractary sides 82 and 83 and radiate heat directly on the two faces of the band 86 sliding slowly between the reels 87 and 88 drawn along by the pair 89 of rollers.

The conductors of said panels 84, 85 are connected by wires 90-92 to the source 93 of electric energy.

Claims

1. System for transforming electric energy into thermal energy already diffused, at high temperatures,

characterized in that the electric circuit is closed by electric resistances formed of conductors (15) of extremely high electrical conduction such as copper and aluminium, having a thin constant cross section and a high ratio between width and thickness, applied flat, with lengths laid side by side and reciprocally insulated, held in place by fasteners (16) fixed onto a support (30, 31) offering a superior degree of insulation against high temperatures, in order to provide a continuous heat-emitting surface and therefore a much larger surface extension of resistance than could be obtained by the prior art, and generation of already diffused thermal energy with much smaller thermal and dimensional differences in relation to the bodies and volumes to be heated.

2. System as in claim1,

characterized in that the insulating support is formed of a strongly insulating sheet (30) backed by a slab (31) of insulating material whose rear face is covered by a protective sheet (32) of metal or some other material.

3. System as in claim 2,

characterized in that the sheet (30) of insulating material is mica.

4. System as in claim 1,

characterized in that the fasteners are clips (16) formed of a long thin metal body bent in a wide "U" having an intermediate linear section and shanks (18) bent at 90° with sharp tips (19) to be driven into the insulating support through pairs of holes (22) made in said conductors (15) the diameter of said holes being considerably greater than the width of each shank (18) of the "U" fastener to provide sufficient space between each of said shanks (18) and the hole (92) in the conductor (15).

5. System as in claim 1,

characterized in that the fasteners are clips (16) formed of a long thin metal body bent in a wide "U" having an intermediate linear section and shanks (18) bent at 90° with sharp tips (19) driven into the conductors

(15) and into the insulating support (30, 31).

6. System as in claims 4 and 5,

characterized in that the body of the clips (16) is a metal strap.

7. System as in claim 1,

characterized that fastenering (16) is done by mechanical stapling.

8. System as in claims 2 and 7,

characterized in that stapling is done between the conductors and the strongly insulating sheet (30).

9. System as in claims 2 and 7,

characterized in that stapling is done between the conductors (18) and the insulating support (30,31).

10. System as in claim 1,

characterized in the the conductors (17) are in the form of a band.

11. System as in claim 1

characterized in that the conductors (17) are band shaped and are laid serpentine-wise.

12. System as in claim 1,

characterized in that the conductors are band shaped and are laid in a circular, square or rectangular spiral or in some other spiral.

13. System as in claim 1,

characterized in that the conductors are laid in the form of a serpentine obtained from a sheet in which parallel cuts are made starting fron one edge and alternatively from the opposite edge.

14. System as in claim 1,

characterized in that thickness of conductors (17) lies between 0.1 and 0.5 mm.

15. System as in claim 1,

characterized in that, along their length, the cross section of the conductors (17) is constant or differs according to the amount of heat and temperature level to be reached in the various sections, variations in dimensions being gradual or sudden, continuous or discontinuous as circumstances or needs may require.

16. System as in claims 1 and 15,

characterized in that the conductors (15) are fed with electric current at their terminal and at intermediate areas, values of current that feed the terminal areas and intermediate areas being of the same or different values, variations in values being gradual or sudden, continuous or discontinuous as circumstances may require.

17. System as in claim 1,

characterized in that optimum temperature of the charged conductors (15) varies between 300° and 800°C.

18. Heat generators (10, 60, 80) obtained by the system described in claims 1 to 17.

19. Heat generators (10) as in claim 18,

characterized in that they are in the form of panels (10).

20. Heat generators (10) as in claims 1, 2, 18 and 19,

characterized in that the panels (10) are surrounded by a frame (40) in four sections (41-44) in the form of a U-shaped channel into which the main parts of the panels (10), such as the sheet of mica (30) the insulating slab (31) and the protective backing sheet (32), are fitted.

21. Heat generators (60) as in claims 1 and 18,

characterized in that the heat-emitting surfaces are placed round the closed spaces where temperatures higher than room temperature must be reached to obtain physical or chemical changes in materials so creating static furnaces (60).

22. Heat generators (80) as in claims 1 and 18,

characterized in that the heat-emitting surfaces are placed around the closed spaces, where temperatures higher than room temperature must be reached, in order to obtain physical or chemical changes in materials, so creating tunnel furnaces or ring-shaped furnaces and the like through which materials to be baked or given some kind of treatment, such as impregnating and other means, slowly pass.

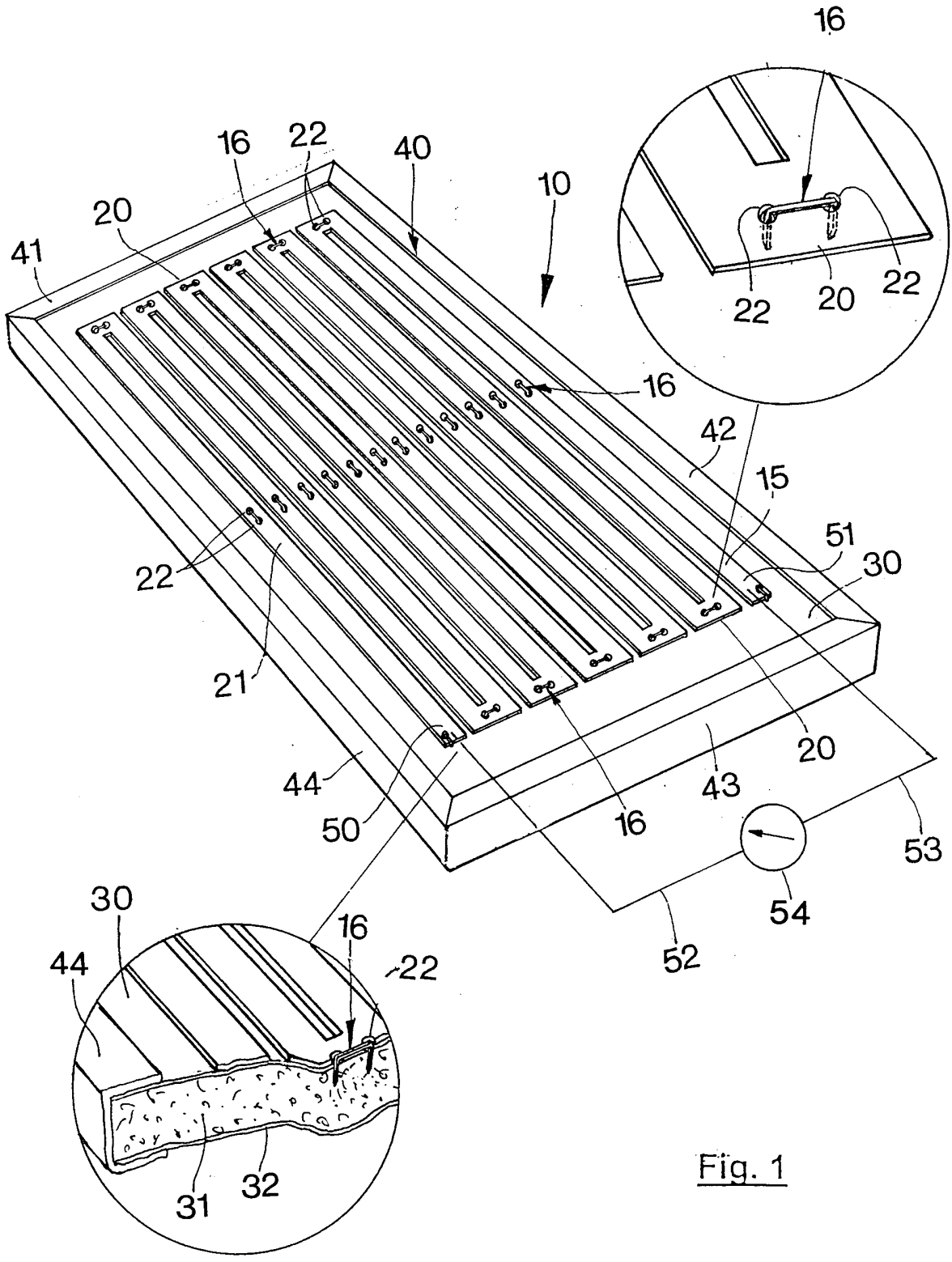
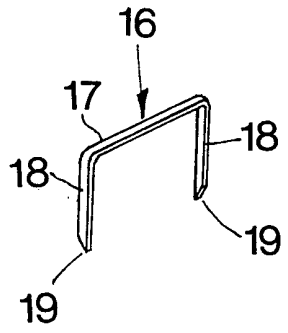

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Fig. 1

Fig. 2



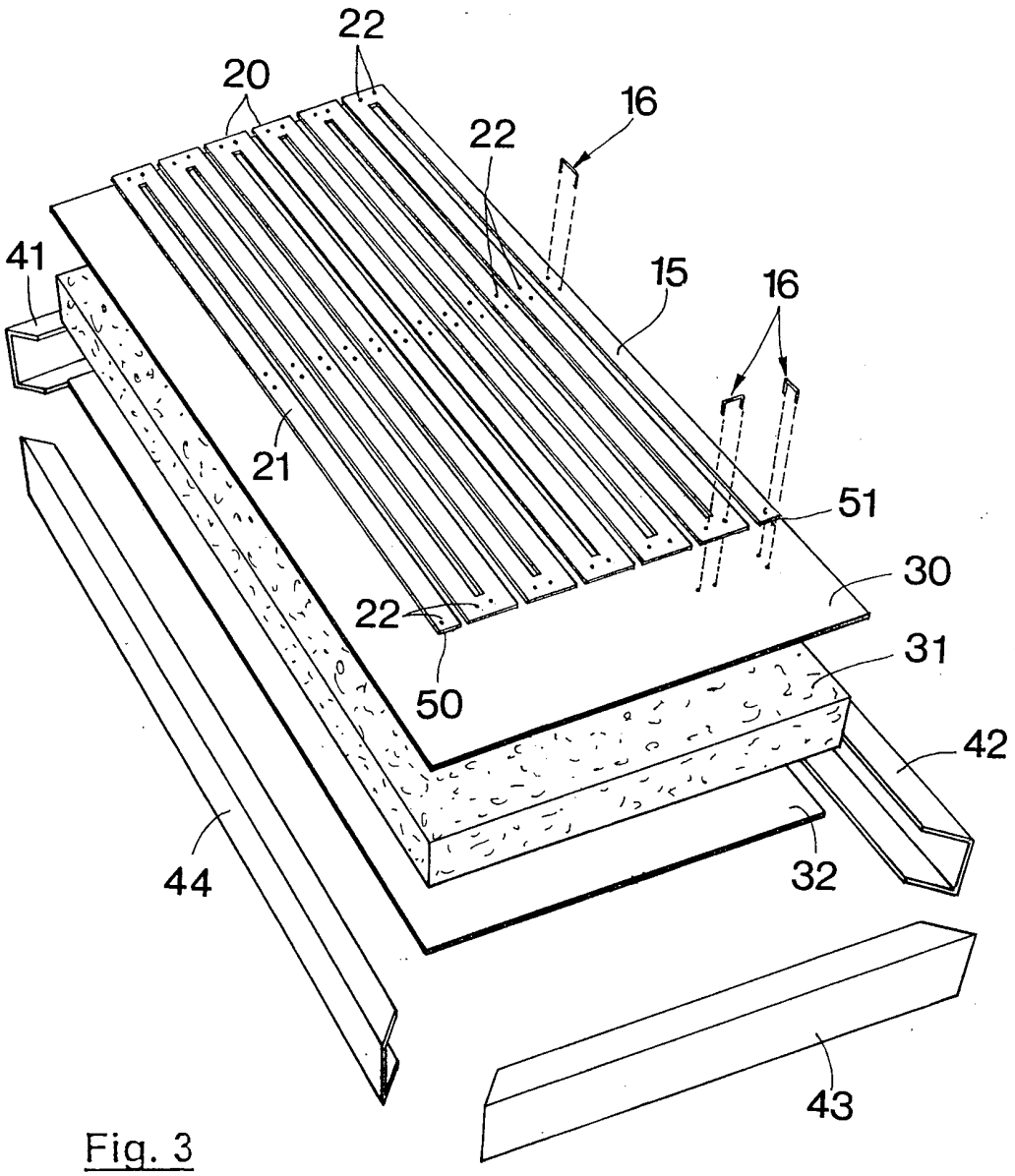


Fig. 3

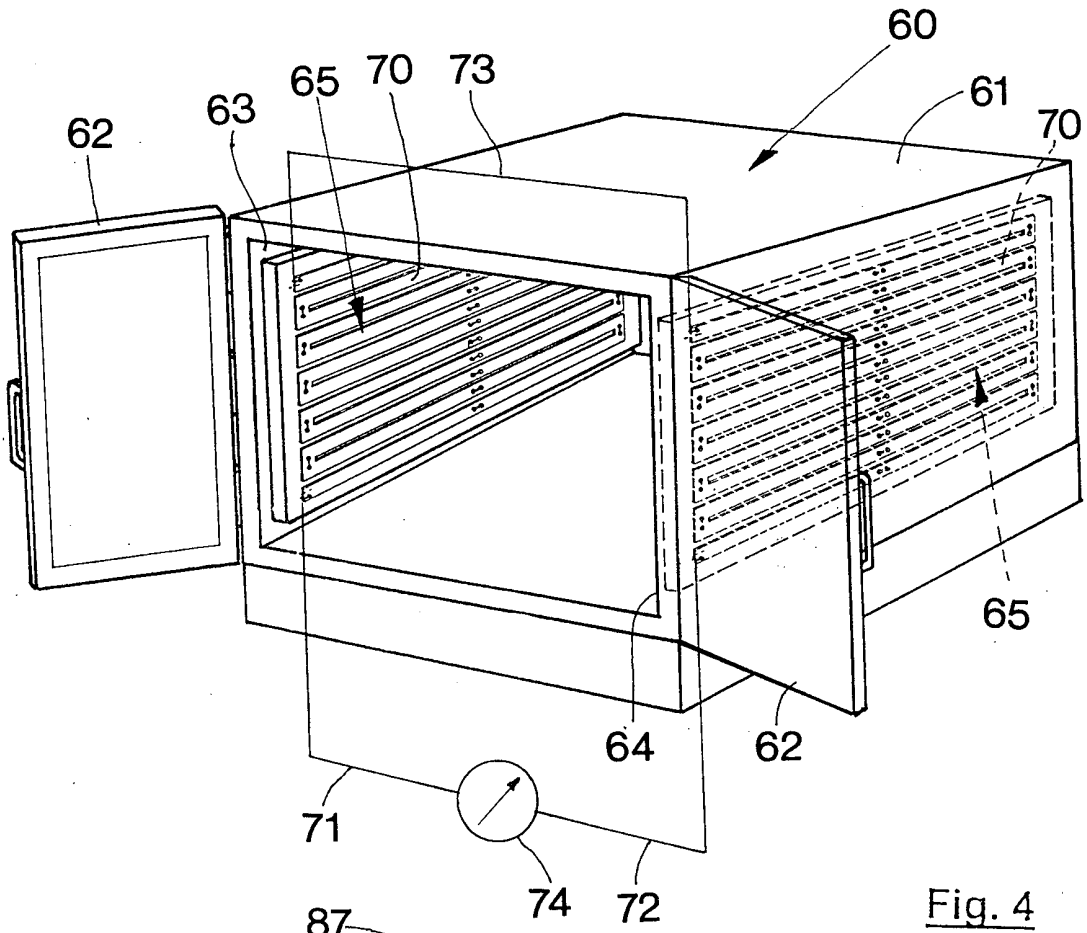

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Fig. 4

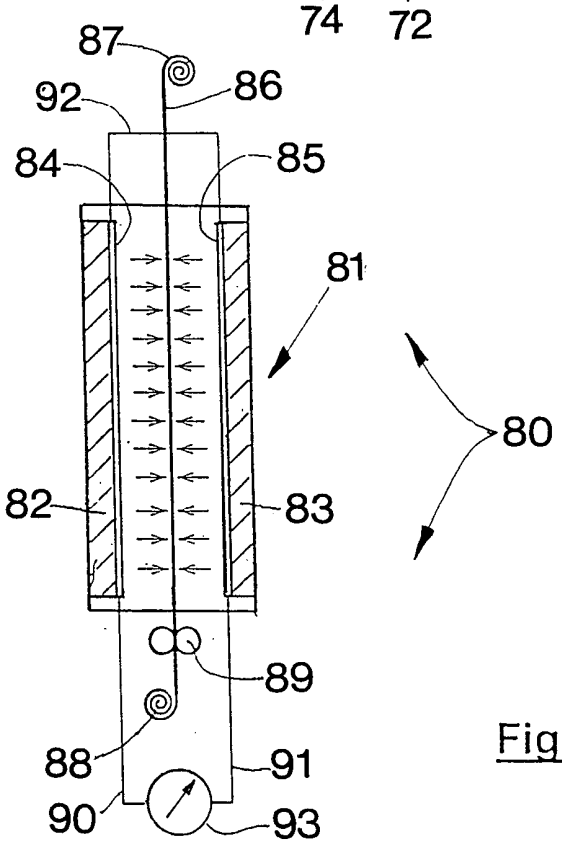

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Fig. 5

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H05B3/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	PATENT ABSTRACTS OF JAPAN vol. 015, no. 121 (E-1049), 25 March 1991 & JP 03 011584 A (SANYO ELECTRIC CO LTD;OTHERS: 01), 18 January 1991 see abstract --- -/--	3

[X] Further documents are listed in the continuation of box C.

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