Oct. 30, 1951 R. F. WANDELT 2,573,120

HEAT RADIATOR AND METHOD OF RADIATING HEAT

Filed Dec. 4, 1947 3 Sheets-Sheet 1

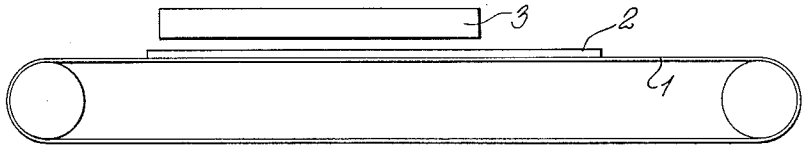


Fig. 1.

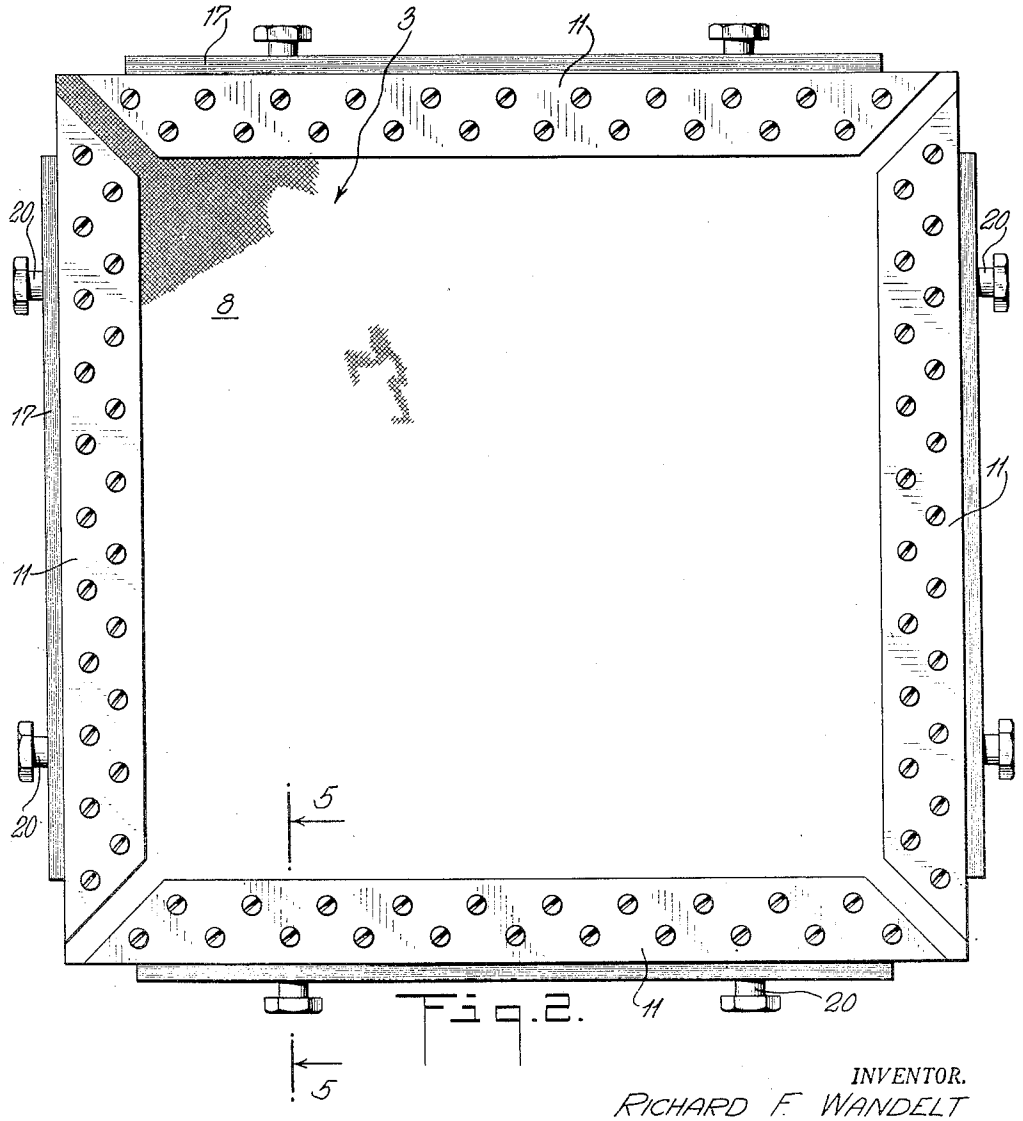


Fig. 2.

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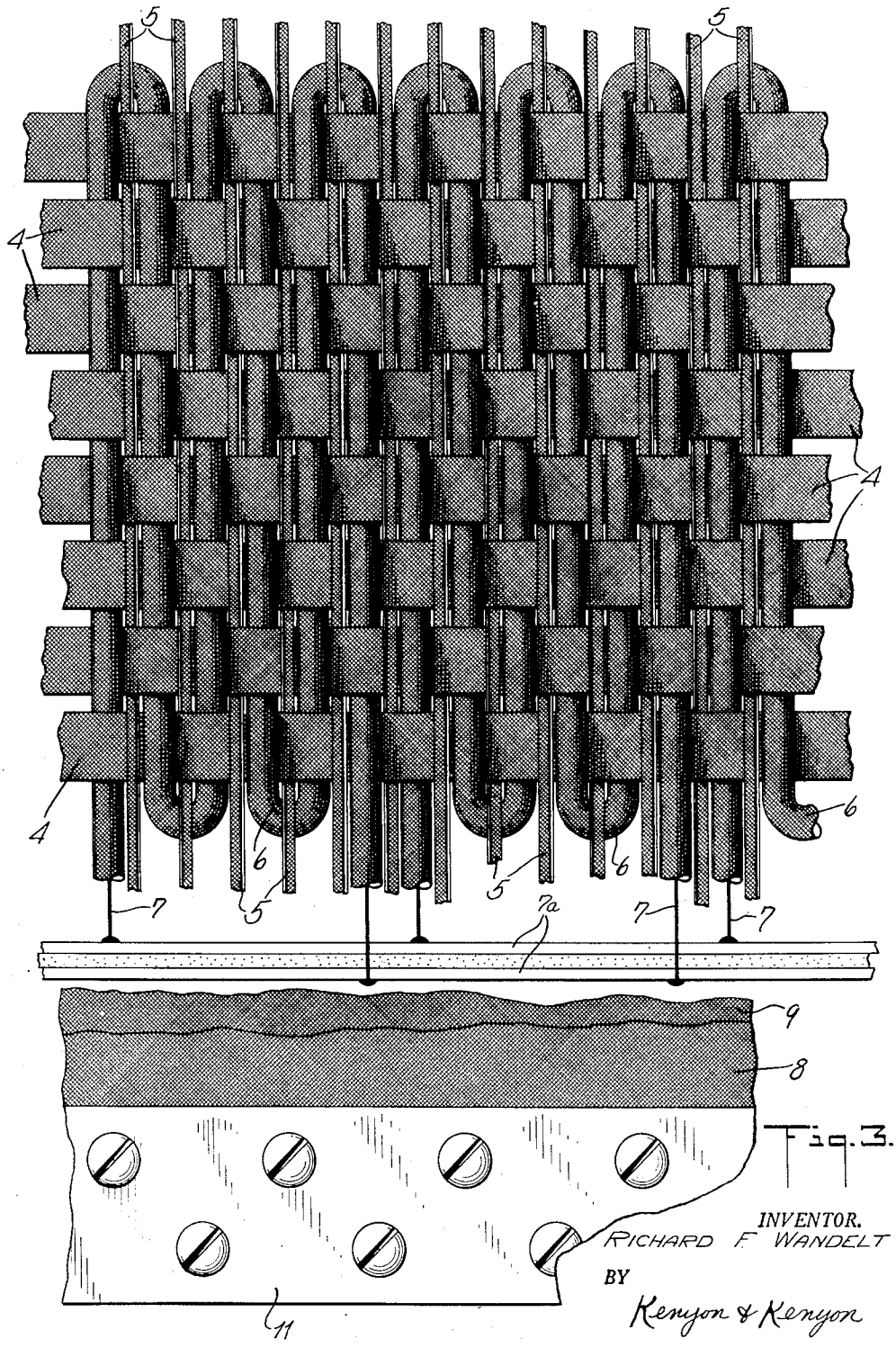


Fig. 3.

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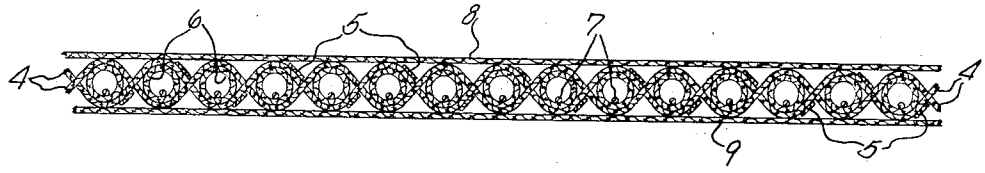


Fig. 4.

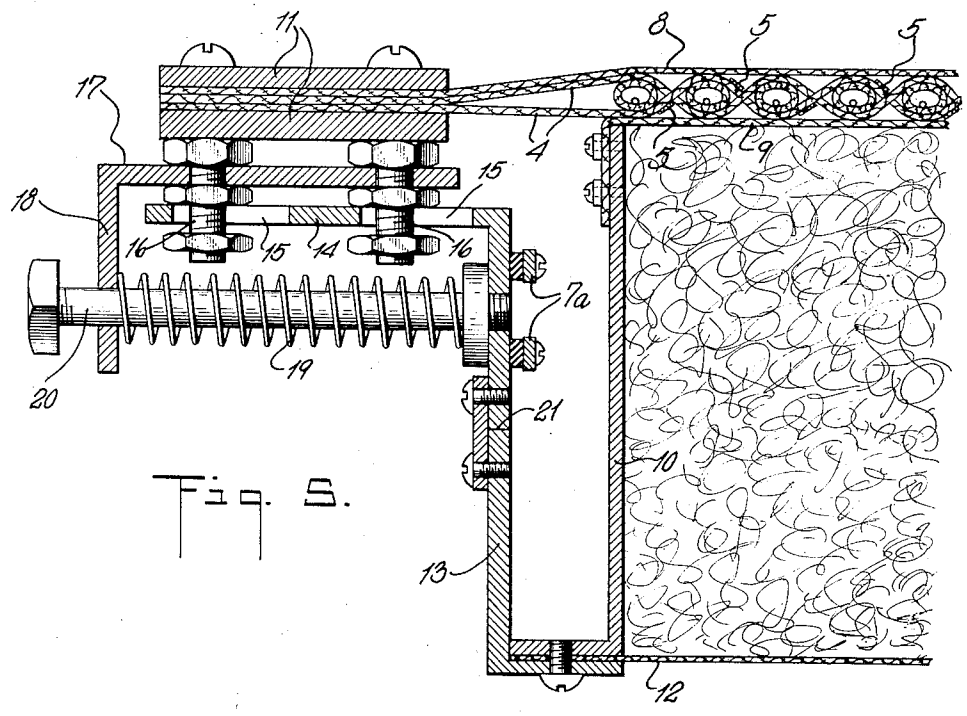


Fig. 5.

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UNITED STATES PATENT OFFICE

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HEAT RADIATOR AND METHOD OF RADIATING HEAT

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Application December 4, 1947, Serial No. 789,740

7 Claims. (Cl. 219—34)

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This invention relates to flat heat radiators used to radiate heat uniformly to flat work by being positioned parallel thereto close enough for effective heat exchange but without contacting the work.

Heretofore it has been impractical to provide a flat plane heat radiating surface embracing a square area of at least two square feet and operating at temperatures of at least 300° F. Heated metal plates of practical weight and adequate size for this, begin to buckle locally at such temperatures, and refractory materials are generally unsuited as monolithic units of such size. Any material departure from a flat plane for any reason, or any lack of uniformity of the heat radiation characteristics, prevents uniform heating of flat work by heat radiation methods.

The above deficiency of the prior art has hampered the progress of certain industries. For example, large flat sheets of thermoplastic material should be uniformly heated when they are to be plastically formed if uniform and predictable plastic flow is desired, yet prior art heat radiation equipment and methods have been unable to do this satisfactorily.

A main object of the present invention is to overcome the noted deficiency of the prior art. However, other objects may be inferred from the following disclosure.

The invention generally distinguishes from the prior art by embracing the idea of using a substantially flat, tautly-stretched, substantially free span of cloth, fabric or other comparable material respecting elastic and flexible physical properties and which is heated so it forms the heat radiating surface. The material selected should be capable of resisting temperatures of 300° F. and higher without destruction and it should have good tensile strength at such elevated temperatures, cloth material woven from glass fibers providing an example of what is meant. Such a flat radiator has the advantage that even when stretched over areas greatly exceeding a square area of two square feet, it remains flat at the desired elevated temperatures, glass fiber cloth for example remaining flat when properly fabricated, up to temperatures closely approaching the melting temperature of glass. Because cloth is elastically flexible in all directions, when it is elastically stretched to substantial flatness and heated, it is impossible for local, thermally induced, dimensional irregularities to destroy the flatness since they cannot concentrate or accumulate. This invention involves many specific distinguishments over the prior art in addition to the one just stated so generally.

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An example of the presently preferred form of the invention is illustrated by the accompanying drawings in which:

Fig. 1 schematically shows this form in action;

Fig. 2 is a top view, this particular example providing a square surface only a little more than two square feet in area since it is intended largely as a portable demonstrator;

Fig. 3 is a schematically disassembled view of the heat radiator, to show the details of the heater cloth construction;

Fig. 4 is a cross section of Fig. 3; and,

Fig. 5 is a cross section from the line 5—5 in Fig. 2.

The purpose of Fig. 1 is largely to provide an idea of how the invention is used in its presently intended manner. The endless conveyer 1 is shown horizontally carrying a flat piece of work 2 beneath the radiant heater 3. The radiating surface of this heater uniformly heats this work only when it is substantially flat and parallel the work while providing a uniformly heated surface area embracing the work area. When the necessary area starts to exceed the size previously noted, the problems solved by the present invention begin to arise. When metal plates are kept below the maximum temperatures they can withstand without loss of flatness, they are not effective heat radiators for most purposes. Refractory plates require multi-part construction since a monolith is impossible, and the necessary joints and thermal expansion spaces interfere with a uniform heat radiation.

As shown by Figs. 3 and 4, the preferred form of the present invention provides the heat radiating surface by including a warp 4 of fabric tape woven from glass fiber threads, a woof 5 of similar but somewhat narrower tape and an idle woof of tube 6 braided from glass fiber threads. The last part is an idle woof in the sense that it is simply carried by the other parts which extend therebeyond and receive the tension for tautly stretching the cloth heat radiator. A plurality of lengths of the tube 6 are used with each length looped continuously back and forth with adjacent woof tapes, and each length of tube includes an electric resistance heating wire 7 with the respective wires shown connected in parallel to bus bars 7a. This arrangement keeps the electrical resistance of each wire low enough so that the assembly can be heated by the wires to the elevated temperatures noted. In practice these may range up to 700° and 800° F. or higher providing the thermal stability of the glass fiber is not exceeded.

The inside diameter of the tube 6 is made

several times greater than the diameter of the wire 7 so the latter has room to arrange itself sinuously therein while expanding upon heating, and thus the wire does not stress the fabric assembly. This wire may be one of the nickel-chromium alloys used for resistance heating purposes.

Preferably a sheet of woven glass fiber thread cloth or fabric 8 is positioned on the outside of the described assembly, with this sheet stretched tautly so it is flat and in contact with this assembly for both radiation and conduction heating thereby. This provides a completely flat radiation surface. A similar sheet 9 may be placed on the other side.

Fig. 5 shows a wall 10 that surrounds the area of the heat radiating surface and clamps, in the form of bars 11, with the end portions of the tape 4 and 5 and sheet 8 clamped between them, positioned outside of this wall 10. This wall 10 extends from the inside of a box 12 having sides 13 with flanges 14 provided with slots 15 guiding the ends of bolts 16 which clamp the bars 11 together so they perform their function while being reciprocative transversely of the fabric assembly and the wall 10. The bolts 16 ride the slots 15 for free reciprocation but rigidly clamp angle bars 17 having flanges 18 parallel the box sides 13, and compression springs 19 are positioned by bolts 20 between these flanges 18 and sides 13. These springs provide force sources continuously biasing the clamp assemblies outwardly so the cloth assembly is stretched elastically over the edge of the rectangular wall 10, in the manner described. The top elements longitudinally carry the tension, while the sheet 8 carries it in at least two transverse directions, so everything is taut with the tubes adequately supported. The cloth sheet 9 may be simply fixed to the edge of the wall 10 as illustrated.

The box 12 is filled with thermal insulation which is illustrated as contacting the inside of the heater cloth assembly. This does not interfere with the desired flatness of the radiating surface providing the insulation is elastically deformable to a sufficient degree. Glass wool is suggested for this purpose or, better, the spun glass fibers such as the woven parts are made from. Assembly of the entire unit is facilitated by making the box walls 13 split and spliced, as indicated at 21. The space between the walls 10 and 13 may be left as an air space wherein the bus bars 7a and the necessary extensions of the wires 7 to these bars, may be safely positioned. The sheet 9 is not in the way of the electrical connection since it is terminated at the wall 10. This air space also protects the springs 19 from excessive heating.

It is to be understood that Figs. 3 through 5 show the radiation unit removed from its necessary mounting and inverted as compared to Fig. 1. However, the heat may be radiated from the cloth surface in any desired direction. Preferably the parts are rectangularly arranged.

Solely to illustrate practical dimensions, in one example the glass fabric tape 4 was 1½ inch wide, the tape 5 was ½ inch wide, the glass fiber thread braided tube 6 was ¼ inch inside diameter and the wire gauge and length were calculated to give the glass fiber thread woven sheet 8 a temperature of about 500° F. The temperature could be varied considerably by current control. The number of wire lengths, and hence the number of tubes 6, depend in all events on the electric resistance providing the desired maximum temperature.

The tape 4 has been called the warp because it is wider and would normally extend the length of the heat radiating surface when oblong dimensions are involved, and then the tape 5 and tube 6 would be the woof. However, these fabric assemblies such as disclosed herein, will frequently be made by hand weaving, and they may be installed otherwise than with the tape 4 lengthwise, the weaving terms being used herein for convenience only.

In all instances the cloth may be rectangularly stretched tightly enough, preferably by the elastic means and continuously during use, to provide a flat surface substantially incapable of losing its flatness. It may be made in widths of at least several feet and up to 6 feet or more, while the length is practically unlimited. It may operate at temperatures well above 300° F., for example up to 600° F. or 700° F., without loss of flatness. Thus this invention fully attains its object.

It will be noted that the cloth acts as a tautly stretched diaphragm that is flexible in all directions and which is heated to the high temperatures noted.

I claim:

1. A radiant heater including the combination of a wall surrounding an area defining the desired heat radiating surface, clamps positioned outside of said wall for reciprocation transversely thereof, springs biasing said clamps outwardly from said area, a layer formed by a warp and woof of interwoven glass fabric tape engaged by said clamps and stretched tautly over the edge of said wall to provide a flat surface, an idle woof of glass fabric tube interwoven with said tape and carried by said layer substantially free from tension and electric resistance heating wire in said tube with the inside of the latter providing room for sinuous formation by said wire when it thermally expands.

2. The heater defined by claim 1 with said combination further including a sheet of glass cloth engaged by said clamps and tautly stretched over the side of said layer opposite said wall to form a heat radiating surface.

3. The heater defined by claim 1, with said combination further including a sheet of glass cloth engaged by said clamps and tautly stretched over the side of said layer opposite said wall to form a heat radiating surface, the space inside said wall opposite said layer containing thermal insulation contacting the adjacent side of said layer but being elastically deformable to a sufficient degree to avoid deformation of said layer.

4. A radiant heater including, in combination, a cloth diaphragm assembly which is elastically flexible in all directions and includes a front layer formed by a sheet of cloth woven from threads of refractory fibers and a rear layer formed by fabric woven from threads of refractory fibers and carrying flexible electric heating resistance, and means tautly stretching said diaphragm in a flat plane and continuously maintaining tension directed throughout said diaphragm in a plurality of mutually transverse directions lying in said plane.

5. A radiant heater including, in combination, a cloth diaphragm assembly which is elastically flexible in all directions and includes a front layer formed by a sheet of cloth woven from threads of refractory fibers and a rear layer formed by fabric woven from threads of refrac-

tory fibers and carrying flexible electric heating resistance, means tautly stretching said diaphragm in a flat plane and continuously maintaining tension directed throughout said diaphragm in a plurality of mutually transverse directions lying in said plane, said layers intercontacting, and a layer of thermal insulation engaging the back side of said diaphragm and formed from refractory fibrous material that is elastically deformable.

6. A radiant heater including, in combination, a cloth diaphragm assembly which is elastically flexible in all directions and includes a layer of interwoven warp and woof fabric tapes woven from threads of refractory fibers and tube interwoven with said tapes and made from interwoven threads of refractory fibers and electric resistance heating wide threaded through said tube and which is longer than said tube and arranged sinuously therein, and means engaging the ends of said warp and woof tapes and free from said tube and tautly stretching said diaphragm in a flat plane and continuously maintaining tension directed longitudinally through said warp and woof tapes and lying in said plane.

7. A radiant heater including, in combination, a cloth diaphragm assembly which is elastically flexible in all directions and includes a layer of interwoven warp and woof fabric tapes woven from threads of refractory fibers and tube interwoven with said tapes and made from interwoven

threads of refractory fibers and electric resistance heating wire threaded through said tube and which is longer than said tube and arranged sinuously therein, and a sheet of cloth that is elastically flexible in all directions and is woven from threads of refractory fibers and contacts one side of said layer, and means engaging the periphery of said sheet and the ends of said warp and woof tapes and free from said tube and tautly stretching said diaphragm in a flat plane and continuously maintaining tension directed therethrough longitudinally respecting both said warp and woof tapes and lying in said plane.

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Certificate of Correction

Patent No. 2,573,120 October 30, 1951

RICHARD F. WANDELT

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 5, line 18, for "wide" read *wire*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of February, A. D. 1952.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.