

April 2, 1935.

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1,996,522

HEATING PANEL

Filed April 29, 1932

2 Sheets-Sheet 1

Fig. 1.

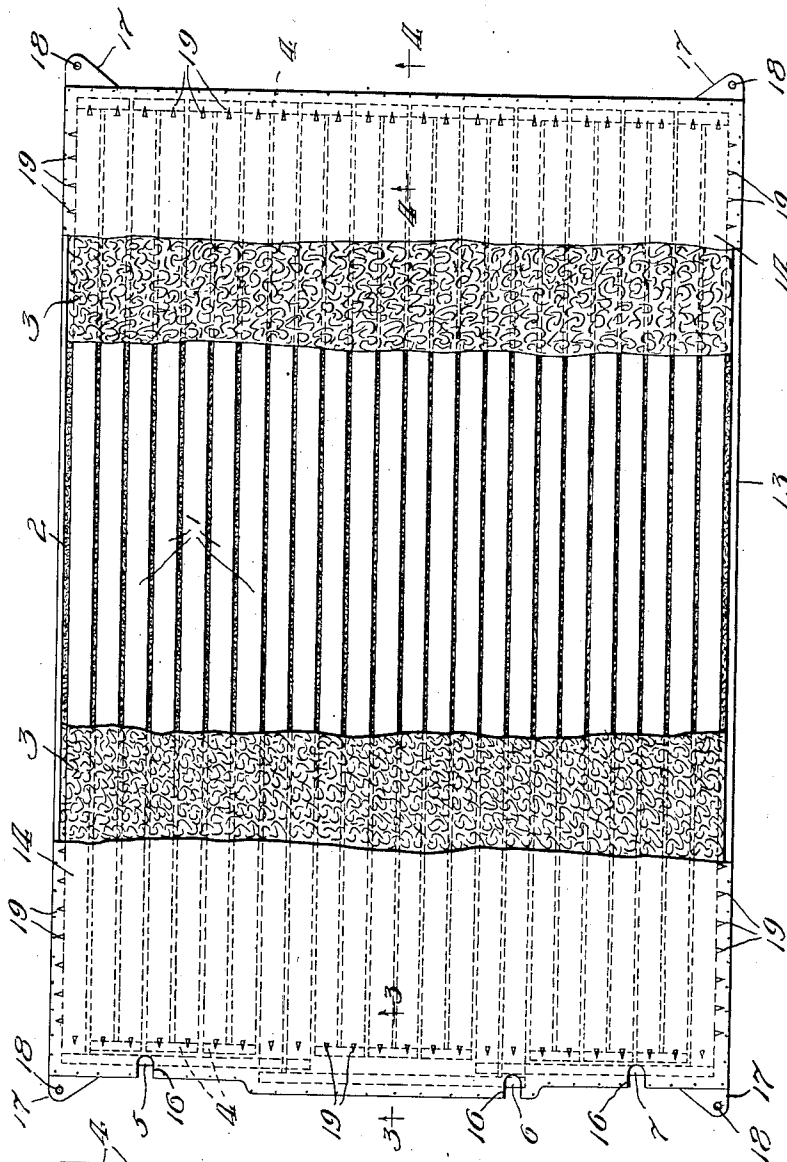
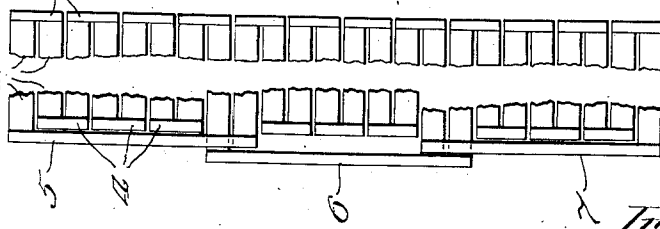


Fig. 2.



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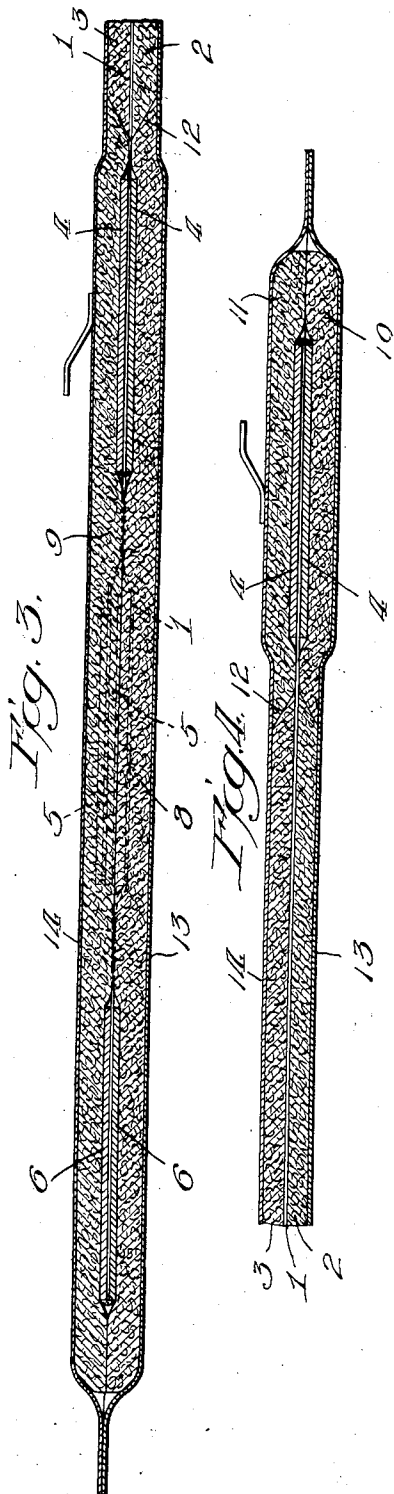
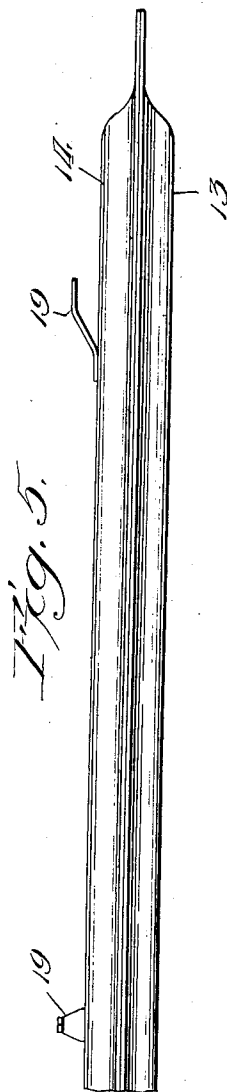
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## UNITED STATES PATENT OFFICE

1,996,522

## HEATING PANEL

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Application April 29, 1932, Serial No. 608,217

14 Claims. (Cl. 219—19)

The present invention has to do with the art of gluing multiple-ply panels as, for example, panels each composed of a plurality of layers of wood and a facing layer of cloth, although the invention is not limited in its application to panels of this specific type. The invention may also be said to relate to panels of large size, although it may, of course, be employed, if desired, in the production of small panels. It has long been the practice to glue up multiple-ply panels one at a time, where both heat and pressure are necessary to complete the gluing operation. Much more efficient use of a press may be secured if it can be caused to act on a considerable number of panels simultaneously. What may be termed gluing in bulk must be done by placing the panels in stack formation, whereby the press may be closed upon and apply pressure to as many panels as can be piled up in the same. However, ordinary methods of applying heat will not be suitable where this stack method is employed, and the necessary heat must be supplied by individual heating elements placed between the panels at intervals throughout the stack. Specifically considered, the present invention relates to heating elements or units adapted for this purpose and has for its object to produce a simple, novel and efficient unit which can be manufactured at a cost sufficiently low and be sufficiently durable to make the method of gluing in stack formation economical.

In gluing up panels in stack formation with heating elements distributed throughout the stack, the heating elements are, of course, removed from the press with the completed panels and are cooled before they again are placed in the press with other panels to be glued. It is therefore desirable that the heating elements be such that it will not take any great amount of heat energy to raise their temperature to their working temperature in the press; whereby the loss of heat that necessarily results from the cooling of the heating elements, after leaving the press and before being returned to the same, will be reduced to a minimum. Viewed in one of its aspects, the present invention may be said to have for its object to produce a heating element for the purpose specified which will require but little heat energy to raise its temperature to that at which it leaves the press, whereby there will be but little loss of heat energy by the subsequent cooling of the element.

Viewed in one of its aspects, the present invention may be said to have for its object to produce a large, panel-like heating element which

will be comparatively light and which may easily be handled by the workmen required to lay up the elements in the stack of panels.

The heating elements should be thin so as to leave a maximum amount of the height of the opening in the press available for the reception of panels to be glued. Viewed in another of its aspects, the present invention may be said to have for its object to produce a heating element that will comply with this requirement.

In carrying out my invention, I produce a large, panel-like device that is electrically heated. To secure the proper distribution of heat throughout the device it is necessary that it contain a great length of conductor for the electric current. One of the objects of the present invention is to produce an electrically energized heating element of panel-like form which shall be comparatively thin and yet be so constructed that, when placed under pressure in the press, it will act substantially like a panel of uniform thickness and of uniform structure or composition throughout; whereby there will be uniform distribution of pressure on the work, resulting in effective gluing and avoiding all danger of denting or otherwise marring the faces of the various pieces of work engaged with the heating elements by reason of unequal distribution of pressure.

Furthermore, because of the large area of the thin panel-like heating devices and the necessity of handling them and in building up and taking down stacks, they must be flexible in order that the insulation for the resistance elements shall not break down and cause short circuits. At the same time these devices must be mechanically strong and rugged. Viewed in one of its aspects, my invention may be regarded as having for its object to produce a large panel-like heating unit which shall be flexible and yet be armored to protect the conductors and the insulation.

Regarded in its most specific aspect, the present invention may be said to have for its object to produce at a comparatively low cost a large, thin, panel-like element light enough that it may easily be handled by the workmen; of such little mass that only a small amount of heat energy is required to raise its temperature to the working temperature; of such construction that it will act under pressure, when lying between two panels, as though it were a simple panel composed of only one kind of material; of a thickness such that it will take up but little vertical distance in the stack in which it may be placed; and of such construction as to be durable and long lived.

In the preferred embodiment of my invention,

the resistance element is composed of long, wide strips of very thin stainless steel of the type containing considerable chromium and some copper, the strips being less than three one thousandths of an inch thick and four or five inches wide, laid flatwise about one half an inch apart. These strips are interposed between two layers of asbestos felt; the whole being united into a compact unitary body by a cement capable of withstanding high temperatures and having a high dielectric strength. Potassium silicate or sodium silicate, preferably the former, or a mixture of either with other substances as, for example, aluminum oxide or aluminum hydroxide may advantageously be employed as the cement. The core, thus formed, is then encased in a metal sheathing consisting conveniently of two sheets of thin steel, larger in transverse dimensions than the core, lying respectively underneath and on top of the core and welded together at their edges.

Frequently, in gluing up multiple-ply panels, cauls of thin steel are interposed between the panels to keep them from sticking together and, also, heavier cauls are placed at intervals in stacks so as to insure that the work will be level. Where my improved heating units are employed they serve as cauls, not only preventing consecutive panels from sticking together but also acting as leveling devices, and therefore make the use of additional cauls unnecessary.

The various features of novelty whereby my invention is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of my invention and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a plan view of one of my improved heating units, portions of the two uppermost layers of material being broken away to illustrate the interior construction; Fig. 2 is a plan view of the resistance element, removed from the unit, the major portion being broken away so as to leave only the two extreme ends intact; Fig. 3 is a section on line 3—3 of Fig. 1, on a much larger scale; Fig. 4 is a section on line 4—4 of Fig. 1, on the same scale as Fig. 3; and Fig. 5 is an edge view of that portion of the unit shown in Fig. 4, the scale being the same as that of Figs. 3 and 4.

The foundation of my improved heating unit is a resistance element composed of many broad, flat strips 1 of very thin metal, preferably stainless steel. In actual practice, for panels having transverse dimensions of from ten to fourteen feet, I have employed strips having a thickness not much greater than two one thousandths of an inch and almost five inches wide, spaced apart about half an inch. These strips may, of course, be made of other metals, but I have found a very satisfactory metal to be steel containing about 16% of chromium and about 1% of copper. In the manufacture of the unit these metal strips are laid flat upon a flexible sheet 2 of asbestos, preferably what is known as asbestos roll fire felt, and are then covered by a second sheet or layer 3 of the asbestos or felt. The bottom sheet is preferably covered with a proper cement before the metal strips are laid on, and the under side of the upper sheet of asbestos is preferably coated with cement before this sheet is laid on top of the metal strips. The cement must be one capable of withstanding comparatively high temperatures

and should have high dielectric strength. I prefer to use as the cement potassium silicate or a mixture of the same with aluminum oxide or aluminum hydroxide. The metal strips are made longer than the asbestos sheets or layers so that the ends of the strips project beyond the latter. The asbestos will usually be in widths narrower than the corresponding dimension of the finished heating unit, and the sheets of asbestos will therefore be placed edge to edge and the metal strips be laid at right angles to the joints in the pieces of asbestos. The three-ply structure, comprising the two layers of asbestos and the interposed thin layer of metal, is placed in a press and compacted. After this is done, the strips are connected at their ends by suitable cross pieces 4 of thin steel welded to the strips, and suitable terminals are also welded to the resistance unit thus produced. In the arrangement shown, the terminals are in the form of three bars 5, 6 and 7 extending across one end of the unit. The bars or cross pieces 4, 5, 6 and 7 are all double, each being composed of two pieces lying one upon the other. Each of the resistance strips 1 extends at its ends between the two elements of each of the bars to which it is to be secured, so that the welding may be effected by applying the energizing terminals to the comparatively heavy bar sections instead of directly to the thin strip material. Pieces of asbestos felt are then laid on top of and underneath the projecting portions of the resistance element and are cemented thereto in the manner heretofore described in connection with the layers 2 and 3 of asbestos. As shown in Figs. 3 and 4, these added pieces of asbestos, indicated at 8 and 9 at one end of the panel and at 10 and 11 at the other end, join the main bodies of asbestos in scarf joints 12, 12. The end sections of the panel-like member are then placed under pressure so as to compact the insulating pieces 8, 9, 10 and 11 and insure that they will be firmly united to the resistance element. What may be termed the core of my improved heating unit and caul is now complete and requires only to be covered with a protective skin to be ready for actual use.

After the core has been completed it is laid between two large metal sheets 13 and 14, respectively, that project a short distance beyond the core at all four edges. The projecting marginal portions of the metal sheets are brought together and joined by spot welding. The two sheets of which the casing or sheathing is formed are simply laid in contact with the core and are not fastened thereto in any way. Therefore, when the panel is flexed, there is no tendency to shear the insulation as would be the case if the insulation were glued or cemented to the sheathing.

The terminal bars 5, 6 and 7 have portions thereof exposed for engagement with clamps, clips or other devices for connecting current-supplying conductors thereto. This is accomplished by cutting away small sections of the insulating elements 13 and 14 at their outer long edges and providing the metal sheathing with cut-outs 16 in registration with the excisions in the insulation, thus exposing a small section of each of the three terminal bars.

The unit as a whole is made longer than the corresponding dimension of the panels to be glued, so that the panels may lie wholly in the space between the cross pieces at opposite ends of the resistance element. Or, in other words, the panels to be glued overlies only a single uniform layer

of metal in the resistance element. Consequently, when my improved unit is in use and under pressure between two panels to be glued, there is no tendency to cause an irregular distribution of pressure due to lack of uniformity of structure throughout the working portion of the heating unit.

The device may be provided at its four corners with projecting ears 17 provided with openings 18 adapted to receive hooks by which the unit may be suspended or by which it may be moved in the direction of its length or width.

One of the important uses to which the invention will be put is that of gluing up panels faced with cloth. In order to prevent the cloth from becoming wrinkled in the act of building up a stack of panels to be glued, the combined heating units and cauls may be caused to act somewhat in the manner of curtain stretchers to hold the cloth sufficiently taut to avoid the formation of wrinkles. To this end numerous sharp prongs 19 may be welded or otherwise secured to the metal sheathing near the four edges. In laying up the various layers of a multiple-ply panel adapted to be faced on both sides with cloth, a sheet of cloth is laid on a heating unit and engaged with the four rows of prongs so as to be held smooth. The layers adapted to form the body portion of the panel are then added and, finally, the second sheet of cloth is applied; the marginal portions of the second sheet being drawn down and engaged with the prongs or hooks so that the second sheet, also, is held straight and smooth. It will thus be seen that my heating unit serves not only to supply heat and as a caul, but may be used also as a stretcher.

While I have illustrated and described with particularity only a single preferred form of my invention, I do not desire to be limited to the exact structural details thus illustrated and described; but intend to cover all forms and arrangements which come within the definitions of my invention constituting the appended claims.

I claim:

1. A combined heating element in the form of a thin flat panel comprising a core containing two flexible layers of insulating material and an interposed very thin layer of metal cemented together, said metal layer consisting of comparatively wide metal strips laid flatwise, and a sheathing of thin metal enclosing said core without having their contacting faces united.

2. A combined heating element in the form of a thin flat panel comprising a core containing two flexible layers of insulating material and an interposed very thin layer of metal cemented together, said metal layer consisting of comparatively wide metal strips laid flatwise, and a sheathing for said core consisting of thin metal sheets extending over and resting loosely on the two broad faces of the core and connected together at their edges.

3. A combined heating unit in the form of a thin flat panel comprising a core containing two flexible layers of insulating material and an interposed resistance element cemented together, said resistance element being formed of thin metal strips disposed flatwise and provided at their ends with terminals, and a sheathing of thin metal enclosing the core, the sheathing and the insulating material having openings registering with the said terminals.

4. A combined heating unit in the form of a thin flat panel comprising a core containing two flexible layers of insulating material and an inter-

posed resistance element, said resistance element being formed of thin metal strips disposed flatwise and provided with terminals adjacent an edge of the core, sections of both layers of insulation at said edge being omitted to expose the terminals, a sheathing of thin metal enclosing said core without having their contacting faces united, and sections of the sheathing registering with said terminals and extending to the adjacent edge of the sheathing being omitted to give access to the terminals.

5. A combined heating unit in the form of a thin flat panel comprising a core composed of two flexible layers of asbestos fire belt and an interposed resistance element cemented together and compressed, said resistance element being formed of thin metal strips lying flatwise, and a sheathing of thin metal enclosing the core without having their contacting surfaces united.

6. A combined heating element in the form of a thin flat panel comprising two flexible layers of insulating material and an interposed very thin layer of metal cemented together, said metal layer consisting of comparatively wide strips of steel laid flatwise, and a sheathing of thin metal enclosing said core without having their contacting faces united.

7. A combined heating element in the form of a thin flat panel comprising a core containing two flexible layers of insulating material and an interposed very thin layer of metal cemented together with a substance having a high dielectric strength and being capable of withstanding high temperatures, said metal layer consisting of comparatively wide metal strips laid flatwise, and a sheathing of thin metal enclosing said core without having their contacting faces united.

8. A combined heating element in the form of a thin flat panel comprising a core containing two flexible layers of asbestos felt and an interposed very thin layer of metal cemented together, the cementing substance being of a type having a high dielectric strength and being capable of withstanding high temperatures, said metal layer consisting of comparatively wide metal strips laid flatwise, and a sheathing of thin metal enclosing said core without having their contacting faces united.

9. A combined flexible heating element and caul in the form of a thin panel comprising a core containing two thin, flexible layers of insulating material and an interposed layer of metal cemented together, said metal consisting of strips several inches wide and having a thickness of not more than three one-thousandths of an inch laid flatwise about half an inch apart, and a flexible sheathing of thin metal enclosing said core without being fastened to the same at the flat faces thereof.

10. A combined flexible heating element and caul in the form of a thin panel comprising a core containing two thin, flexible layers of insulating material and an interposed layer of metal cemented together, said metal consisting of strips several inches wide and having a thickness of not more than three one-thousandths of an inch laid flatwise about half an inch apart, and a sheathing for said core consisting of thin flexible metal sheets extending over and resting loosely on the broad faces of the core and connected together at their edges.

11. A resistance element comprising strips of rust- and corrosion-resisting metal not more than three one-thousandths of an inch thick and several inches wide, spaced about half an inch

apart, connecting means and terminals for said strips each consisting of two metal bars between and in contact with each of which an end of each of a plurality of strips lies and to which said ends are fused.

- 5 12. A combined flexible heating element and caul in the form of a thin panel comprising a core composed of two thin, flexible layers of asbestos and a single interposed layer of metal  
10 cemented together with a substance having a high dielectric strength and capable of withstanding high temperatures, said metal layer consisting of strips of stainless steel several inches wide and having a thickness of not more  
15 than three one-thousandths of an inch laid flatwise about half an inch apart, and a sheathing of thin metal composed of two metal sheets overlying the broad faces of the core without being fastened to such faces, the marginal portions of  
20 the metal sheets extending beyond the core and being welded together.

13. A combined heating element and caul in the form of a thin flat panel comprising a core containing two flexible layers of insulating material and an interposed very thin layer of metal cemented together, said metal layer consisting of comparatively wide strips of steel containing a considerable amount of chromium, the strips lying flatwise, and a sheathing of thin metal enclosing said core without having their contacting faces united.

- 10 14. A combined heating element and caul in the form of a thin flat panel comprising a core containing two flexible layers of insulating material and an interposed very thin layer of metal cemented together, said metal layer consisting  
15 of comparatively wide strips of steel containing a considerable amount of chromium and some copper, the strips lying flatwise, and a sheathing of thin metal enclosing said core without having their contacting faces united.

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