United States Patent

[11] **3,564,198**

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[33] **Great Britain**
[31] **52516/67**

[54] **HEATING ELEMENT**
9 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **219/243,** 219/468, 219/552
[51] **Int. Cl.** **H05b 1/00**
[50] **Field of Search** ..... 219/243, 468, 552, 553; 338/279; 156/580, 582, 583; 53/(Inquired)

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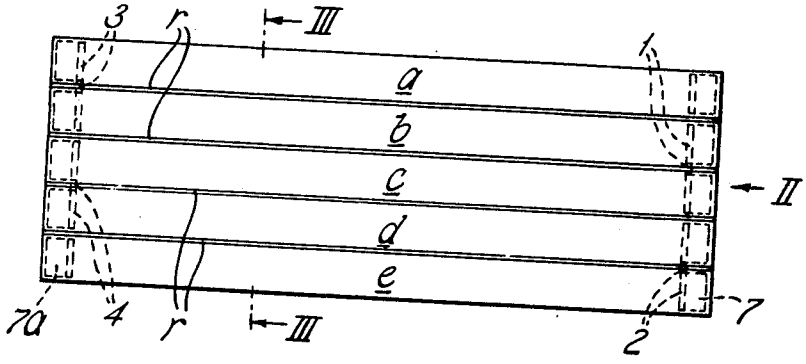
ABSTRACT: A heating element comprises a member of low specific heat material, providing a heating surface flanked by two parallel side flanges and having electric connections at its ends; several such elements may be assembled in parallel positions to present a continuous heating surface, the electrical connection preferably being a series connection.



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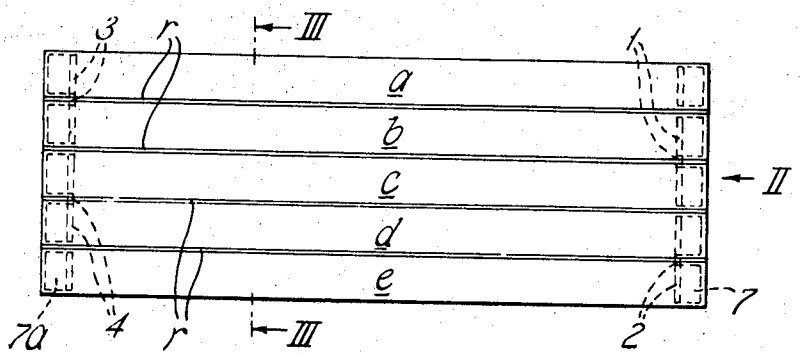

Fig. 1.

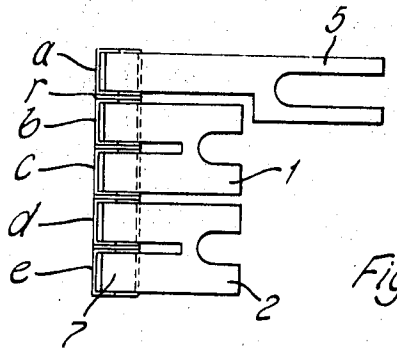

Fig. 2.

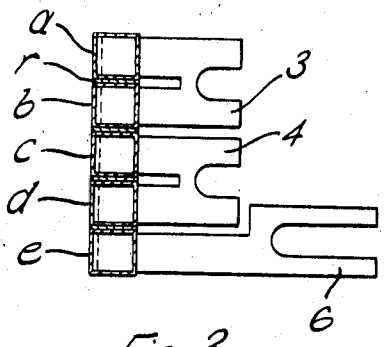

Fig. 3.

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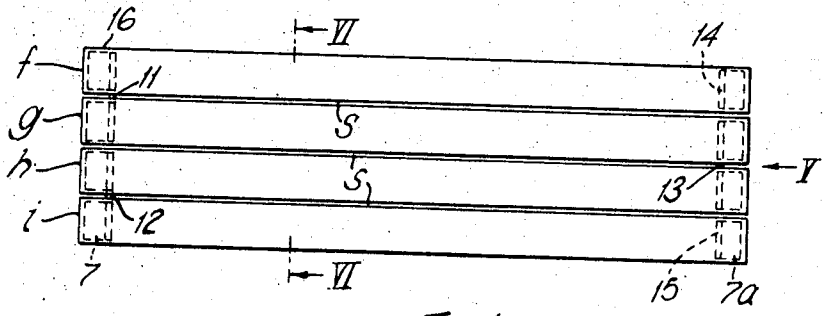


FIG. 4.

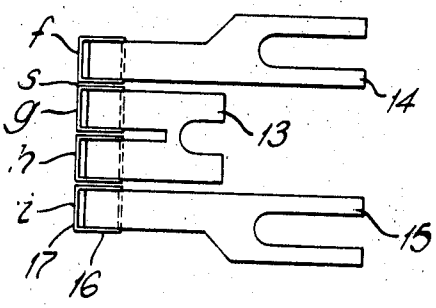


FIG. 5.

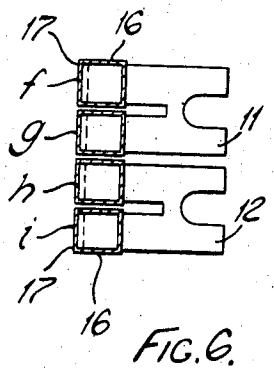
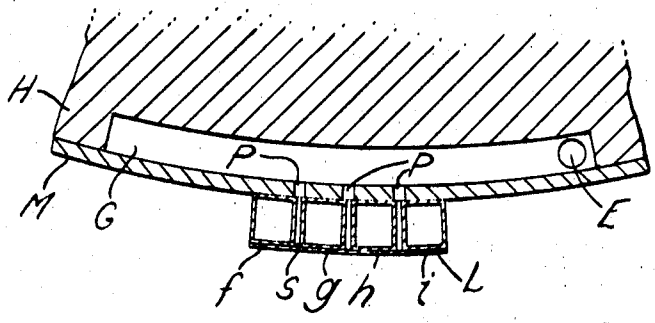


FIG. 6.

FIG. 7



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HEATING ELEMENT

This invention relates to heating elements more especially a heating element for use with high speed machinery.

With high speed machinery having heating elements, required for an operation such as heat-sealing thermoplastic film, difficulty has been experienced in their operation. This difficulty has in large part arisen owing to the high thermal capacities of heaters used hitherto. It is known to use material for wrapping which can be heat welded, for example the material sold under the Registered Trade Mark "Cellophane," by applying a thermal element in contact with a join in the wrapper. It is found generally that it is necessary to perform such operations at high speeds in keeping with the production rates of associated machinery. However, there have been difficulties owing to the need for heating elements with low thermal capacity. Such difficulties as have been experienced include overheating of the seal so that the wrapper becomes molten and causes undesirable soiling of machine parts and of the product being packed. A further difficulty experienced has been the necessity in some instances to have a heating element of low mass, i.e. low mechanical inertia. The importance of this latter characteristic can be realized in relation to high speed reciprocation or oscillation of the thermal element in and out of a sealing position.

Yet another difficulty which has been experienced has been that often such an element will be used for a range of operating speeds (and therefore contacting periods) and a range of temperatures suitable for the particular speed of operation. Low thermal capacity is most desirable in such circumstances to provide a thermal element which is capable of changing its temperature rapidly whenever the speed of operation of the machine is changed, otherwise for some time after a speed change the operating temperature of the thermal element is either lower or higher than that required for the new operating speed of the machinery, and hence the operation involving the use of the thermal element, for example sealing, will be unsatisfactory in that the seal is not made or the wrapping is damaged by excessive heat. Hitherto, the flexibility in range of machine operation has been inhibited by the time delays required for elements of high thermal capacity to reach the correct operating temperature.

According to the present invention there is provided a heating element comprising an elongated member formed from a material having low specific heat, said member having a substantially planar heating surface carrying on two opposed edges a pair of flanges forming parallel sidewalls, and said member being provided at its ends with electrical connections to enable an electric current to be passed through said member. In a preferred embodiment said elongated member is a tube of substantially rectangular section, one wall of said tube providing the heating surface, and portions are removed from the ends of the wall of such tube which is parallel to the wall providing the heating surface to allow clearance for connection of terminals for a current supply to said one wall; preferably such terminals are welded to the ends of the wall providing the heating surface.

The invention further provides a heating module which comprises a plurality of the aforesaid heating elements connected together with their sidewalls parallel so as to present a continuous heating surface. Advantageously, the elements are cemented together with a resin which is electrically an insulator.

According to a preferred embodiment of the heating module the heating elements are linked together by end plates which provide both electrical and mechanical connections between the elements, and terminals provided for connection to a current supply. Preferably, the elements should be connected electrically in series as this tends to give the heating surface a uniform temperature distribution.

Owing to the geometry of the elements the module is rigid yet has low mass. With suitable choice of material, for example stainless steel, the individual elements and therefore the heating module will have a low thermal capacity. In addition,

the individual elements have low resistances (e.g. of the order of 0.05 ohm) and thus resistances at the joins between adjacent elements are a factor to be considered in designing a module; with electrically parallel connection of the elements differing joint resistances tend to cause an irregular temperature distribution across the heating surfaces due to unequal current sharing between elements. Whilst therefore, it is possible to join the elements electrically in parallel connection, it is not a preferred arrangement owing to the practical difficulty of matching all the joint resistances with sufficient accuracy. It will be understood that by the use of elements of differing lengths the geometry of the module can be varied e.g. to have a substantially circular heating surface.

According to yet another embodiment of the invention there is provided a heating module for use with a suction chamber which comprises heating elements as hereinbefore described arranged with their sidewalls parallel and their heating surfaces coplanar so as to provide suction apertures between the sidewalls of adjacent heating elements.

It will readily be appreciated that the modules hereinbefore described can be used to advantage as components in g high speed machinery since they are characterized by low mass and low thermal capacity. Temperature response to incremental changes in current applied will be rapid, and can also be directly related to the speed of machine operation. For example, the temperature control for the elements (e.g. a rheostat) can be ganged together with the control governing the operating speed of the machine.

A substantially rectangular section tube is preferred for the heating elements, since it s gives rigidity to the element. A module formed with elements having an open cross section (i.e. of U-section) may have a tendency under thermal stress to bow undesirably.

Reference will now be made, by way of example, to the accompanying drawing in which:

FIG. 1 shows a view of a heating module looking in to the heating surface;

FIG. 2 shows an end view of the heating module of FIG. 1 as indicated by arrow II in that FIG.;

FIG. 3 shows a sectional view taken on the line 111–111 of FIG. 1;

FIG. 4 shows a plan view of a heating module provided with suction apertures;

FIG. 5 shows an end view as indicated by arrow V in FIG. 4;

FIG. 6 shows a section on the line V1–V1 of FIG. 4;

FIG. 7 shows a sectional view of a heating module as shown in FIG. 4 mounted on a suction chamber.

Referring to FIG. 1 , there is shown a plan view of a heating module, which comprises five similar heating elements *a*, *b*, *c*, *d*, *e* electrically linked together in series connection by connecting plates 1 to 4 with provision for electrical supply connections to be made at input terminals 5 and 6 respectively. The heating elements *a* to *e* are cemented together in geometrically parallel relation with a resin film *r* which provides a mechanical link and electrical insulation between the elements. Individual elements are all mutually similar, and by way of illustration the element designated *e* will be described. It can be seen from FIGS. 1 to 3 that the element *e* is tubular with a substantially rectangular cross section (FIG. 3). Element *e* is provided at either end with cutaway portions of its top wall (i.e. opposite to the heating surface) in the areas designated 7 and 7*a*. These cutaway portions allow clearance for the welding of terminal 6 and a connecting plate 2 to opposite ends of the bottom wall of the element. The lower surfaces of the elements are also mutually similar and, as shown for *e* , are substantially flat surfaces smooth at their edges (i.e. radiused to avoid a sharp edge capable of damaging articles to which the module may be applied). The lower surfaces of the elements *a* to *e* are aligned so as to form a substantially planar surface to be presented as a heating face.

It can readily be seen from FIGS. 1 to 3 that when electric current is supplied to the module it will pass from terminal 5 through element *a* , plate 3, element *b*, plate 1, element *c*,

plate 4, element *d*, plate 2, and element *e* to terminal 6, i.e. the elements are series-connected.

Referring now to FIGS. 4 to 6 there is shown a heating module generally similar to that of FIGS. 1—3 but provided with suction apertures for use with a suction chamber, as shown in FIG. 7. This module comprises four similar elements *f*, *g*, *h*, *i*, mounted with their sidewalls 16 parallel and their heating surfaces 17 coplanar, and electrical connections similar to those of the module of FIGS. 1—3. The elements are spaced apart by suction apertures *s* which, when the module is mounted on a suction chamber (as shown in FIG. 7), lead via ports *p* in a masking plate M into the suction chamber G.

FIG. 7 shows a suction chamber housing H which is a rotary member, having chamber G therein. The chamber G is masked by masking plate M having inlet ports *p* leading to the suction apertures *s* between the heating elements *f*, *g*, *h*, *i*. The exhaust connection of the suction chamber G with a suction pump (not shown) is designated E. FIGS. 4 to 6 show the electrical connections made between the heating elements. The elements are coupled electrically in series by plates 11, 12, 13 and a current supply connected via terminals 14 and 15. The ends of the elements have portions removed from the wall opposite to that providing the heating surface mentioned previously with reference to areas 7, 7*a* of the embodiment described with reference to FIGS. 1 to 3. As an indication of the scale of the drawing suction apertures *s* would have a width of the order of 0.013 inch. With the apparatus in FIG. 7, an article such as a label L can be held against the heating surface of the module by the application of suction via the chamber G, ports *p* and apertures *s*.

To illustrate the use of the embodiment shown in FIG. 7 an example will be described. In a machine for sealing cigarette packs with a label it has been usual to carry the label through a heated cowl on a rotary suction drum. Whilst in the heated cowl the label which is gummed becomes tacky and is subsequently applied to the pack. It is found advantageous in preventing heat losses from the label through the face in contact with the suction drum to employ a heating module as shown in FIG. 7. This means of applying the label has the advantage that the state of the drum on the label can be better controlled and, thus, ensures better sealing of the packs.

It will be apparent that elements and modules embodying the invention can readily be provided with temperature-sensing devices for thermostatic control if desired. For example, platinum resistance elements may be inserted in the tubular heating elements or thermo-couple junctions may be secured to the inner face of the wall of one of the elements providing the heating surface.

I claim:

1. A heating element comprising an elongated tube of substantially rectangular cross section, said tube being formed from a material having low specific heat, one wall of said tube constituting a substantially planar heating surface, and terminals attached to the ends of said one wall to enable an electric current to be passed there through, in which portions are removed from the ends of the wall of said tube parallel to said one wall constituting the heating surface to allow clearance for said terminals provided on said one wall, said terminals extending through and beyond the space left vacant by removal of said portions.

2. A heating module comprising a plurality of elements as claimed in claim 1, and means for connecting said elements together with their sidewalls parallel whereby the one walls of said plurality of elements present a substantially continuous heating surface.

3. A heating module as claimed in claim 2 in which said connecting means comprises a resin cementing the sidewalls of said elements together, said resin being an electrical insulator.

4. A heating module as claimed in claim 2, in which said connecting means comprises end plates providing both electrical and mechanical connections between the elements, terminals being provided for connection to a current supply.

5. A heating module as claimed in claim 4, in which the connecting means connects the elements electrically in series.

6. A heating module as claimed in claim 2, in which the elements are arranged so as to provide apertures between the sidewalls of adjacent elements.

7. A conveyor for heating articles while being conveyed comprising a transport member, a heating module as claimed in claim 6 mounted on said transport member, inlet ports in said transport member communicating with said apertures between the side walls of adjacent elements, and suction means for drawing a vacuum through said inlet ports and apertures for retaining articles on said heating surface.

8. A conveyor as claimed in claim 7 wherein said transport member comprises a rotary member.

9. A conveyor as claimed in claim 8 further comprising a suction chamber in said rotary member, a masking plate thereover and suction means connected to said suction chamber, said masking plate containing said inlet ports and said heating module being mounted on said making plate.