

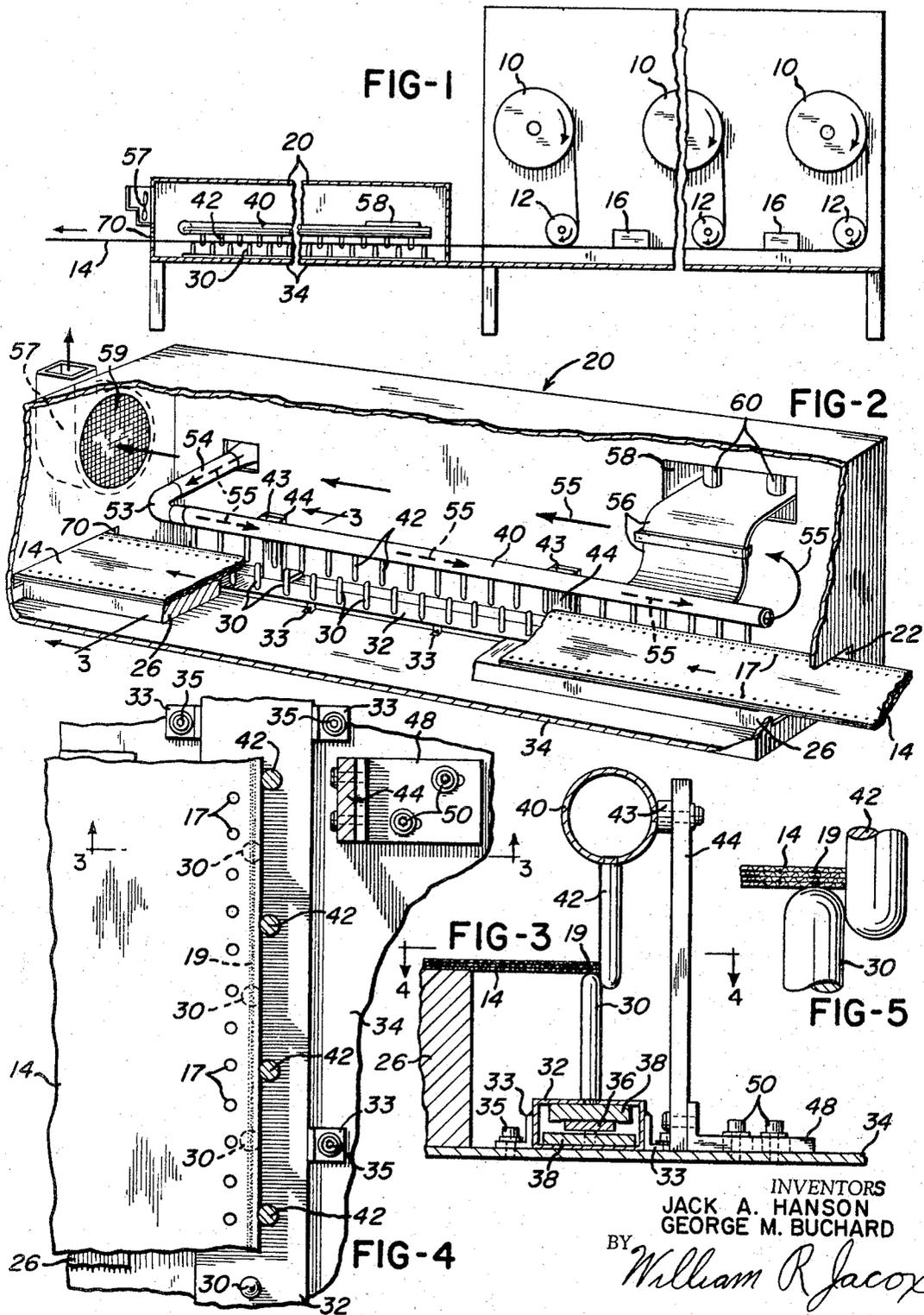
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DIELECTRIC HEAT APPARATUS

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DIELECTRIC HEAT APPARATUS

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ABSTRACT OF THE DISCLOSURE

High frequency dielectric heat apparatus for rapidly drying liquid glue which is disposed between adjacent superposed continuous sheets which form a web. The apparatus includes a plurality of electrodes, at least one of which is adjacent an edge of the web so that electrical energy flows directly into and out of the edge of the web, thus causing very rapid heating and drying of the glue which is disposed between the superposed sheets of the web. The apparatus also includes means for removing moisture from the region within which the electrodes are disposed.

In the art of dielectric heating, a source of electrical energy is used. The electrical energy is preferably one which is capable of applying a relatively high voltage at a relatively high frequency to subject matter which is treated thereby. The quantity of heat produced in the subject matter within a given interval of time is a function of the voltage and frequency of the electrical energy applied thereto. Numerous problems have arisen in regard to dielectric heating of glue which is disposed between adjacent sheets of paper or the like for drying of the glue for attachment of the sheets together. It has been found that voltages of a magnitude which are desirable for rapid heating of the glue break down because the usual spacing between electrodes is so small when the electrodes are positioned in the conventional manner with respect to the sheets to which the electrical energy is applied. Furthermore, it has been found that the volatile matter which emanates from liquid glue during drying thereof causes problems, because the electrodes through which the electrical energy is applied, tend to become wet with condensation of the volatile matter which emanates from the glue. Therefore, in the past, dielectric heating of glue which is applied between sheets of paper or the like has by necessity been a relatively slow process.

An object of this invention is to provide such apparatus which is capable of rapid drying of liquid glue which is applied between layers or sheets of thin laminate material.

Another object of this invention is to provide such apparatus which is capable of rapid drying of glue which is applied between continuous sheets of paper which form a web, the drying operation occurring while the web is moving at a relatively high rate of speed.

Another object of this invention is to provide such apparatus which has a relatively small physical size.

Another object of this invention is to provide such apparatus which can be constructed at relatively low cost.

Other objects and advantages reside in the construction of the invention, combinations thereof, the method of manufacture, and the mode of operation, as will become more apparent from the following description.

In the drawings:

FIGURE 1 is a side sectional view, with parts broken away, of apparatus of this invention in association with apparatus which forms a web which is treated by apparatus of this invention.

FIGURE 2 is a perspective view, with parts broken away and drawn on a larger scale, of apparatus of this invention.

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FIGURE 3 is an enlarged sectional view taken substantially in line 3—3 of FIGURE 2. FIGURE 3 is also a sectional view taken substantially on line 3—3 of FIGURE 4.

FIGURE 4 is a sectional view taken substantially on line 4—4 of FIGURE 3.

FIGURE 5 is an enlarged fragmentary view of a portion of the apparatus as viewed in FIGURE 3.

Referring to the drawings in detail, among the various uses of apparatus of this invention, apparatus of this invention may be used for drying glue which is applied as a liquid at room temperature between sheets of paper or the like which are collated to form a web.

FIGURE 1 shows a plurality of rolls of paper 10 or the like. The paper 10 extends in a continuous sheet or strip from each roll thereof. Each sheet of paper 10 moves under a roller 12 for collating of the several sheets or strips of paper 10 into a web 14.

Liquid glue is applied to a marginal portion of the sheets of paper 10 by means of any suitable glue applicator means 16 so that as the sheets of paper 10 move into juxtaposition and form the web 14, glue 19 exists between adjacent continuous sheets of paper 10 at the marginal portions thereof.

The web 14, formed by the continuous sheets of paper 10 with liquid glue therebetween, moves into a housing 20 through an opening or slot 22 thereof. Within the housing 20 the web 14 comes into engagement with any suitable support structure such as a base 26 which, at least partially, supports the web 14.

FIGURE 4 illustrates the position of the glue 19 at a marginal portion of the web 14. The glue 19 may be in the form of a continuous stripe or stripes or in the form of a broken stripe or stripes between adjacent sheets of paper 10. Stripes of glue 19 may be applied to either or both of the marginal portions of the sheets 10 or to any other portion thereof. The web 14 is shown as being provided with marginal pin feed holes 17 which may be used if desired for movement of the web 14.

Below the marginal portion of the web 14 at which the glue 19 is located are a plurality of vertically disposed pins or electrodes 30 which are arranged in a row or in any suitable substantially straight line spaced-apart formation. The pins 30 are of electrically conductive material. The pins 30 are secured to an elongate support member 32 which is shown as being hollow or tubular and which rests upon a floor 34 of the housing 20. Brackets 33 with bolts 35 attach the support member 32 to the floor 34.

The hollow support member 32, as shown in FIGURE 3, has a suitable elongate electric heater member 36 therein which extends along the length thereof and which is disposed between carrier members 38.

Positioned above the support member 32 and above the pins 30 in spaced relationship therefrom is an elongate tube 40 which is substantially parallel with the support member 32. The tube 40 is composed of electrically conductive material. Secured to the tube 40 and extending downwardly therefrom are a plurality of spaced-apart pins or electrodes 42 which are of electrically conductive material. The pins are arranged in a row or in substantially straight line spaced-apart formation.

The tube 40 also has attached thereto connector members 43 which are carried by one or more support members 44 of insulator material, as shown in FIGURE 3.

Each of the support members 44 is attached to the floor 34 by means of a connector member 48 and bolts or studs 50.

Each of the pins 42 is disposed between two of the pins 30 as the pins 30 and 42 are viewed in FIGURES 1 and 2. However, the row of pins 30 and the row of pins 42 are slightly laterally spaced apart, as shown in FIGURE 4. Furthermore, the lowermost portion of each pin 42 is

lower than the highest portion of the pins 30 which are adjacent thereto, as shown in FIGURES 3 and 5.

As shown in FIGURE 2, an electrically insulated connector tube 53 at the left hand end of the tube 40 connects the tube 40 to a gas supply tube 54. The right hand end of the tube 40 is open, as shown in FIGURE 2. A source of heated gas, such as hot air, is connected to the gas supply tube 54 outside the housing 20. Hot air is forced into the supply tube 54 and flows through the tube 40 and moves from the tube 40 at the right hand end thereof, as illustrated by arrows 55 in FIGURE 2. An exhaust fan 57 or the like at the left hand portion of the housing 20 draws the hot air from the housing 20 as a large portion of the hot air moves in the region above the tube 40. A screen 59, through which the air moves to the exhaust fan 57, is shown in the wall of the housing 20.

An electrical conductor 56 is attached to the tube 40 and enters the housing 20 through an opening 58, as shown in FIGURE 2. Insulator support members 60 are shown attached to the electrical conductor 56 and to the housing 20 for support of the electrical conductor member 56 by the housing 20. The electrical conductor member 56 extends outwardly from the opening 58 and is connected to a suitable source of electrical energy, not shown. Preferably, the source of electrical energy is one which has a relatively high voltage, for example, in excess of one thousand volts, and which has a relatively high frequency, for example, in excess of one megacycle per second. However, a source of electrical energy having a lower voltage and/or frequency may also be employed. The source of electrical energy is also connected in any suitable manner, such as by means of the brackets 33, to the support member 32. The support member 32 may therefore herein be considered to be at "ground" potential. Thus, a high frequency voltage is applied between the pins 30 which are carried by the support member 32 and the pins 42 which are carried by the tube 40.

The web 14 moves longitudinally through the housing 20. The major portion of the web 14 is carried by the base 26. The right hand marginal portion of the web 14 is, at least partially, supported by the lower row of electrodes 30 as the glue portion 19 is disposed above the lower row of electrodes 30, as illustrated in FIGURES 3, 4, and 5.

The right hand edge of the web 14 engages or is in juxtaposition with the electrodes 42, as shown in FIGURES 3, 4, and 5.

As stated above, in order to obtain rapid dielectric heating, it is desirable to have a high voltage exist between electrodes. This is due to the fact that by the use of higher voltages higher values of power can be applied to the subject matter heated. However, ordinarily it is difficult to use high voltages in heating thin laminate structure such as a web of paper. In this invention, as discussed above and as shown in the drawing, the electrodes 42 are positioned at the edge of the web 14 and the electrodes 30 are positioned below the location of the glue 19 which is within the web 14. Furthermore, the electrodes 30 are alternately positioned with respect to the electrodes 42. Such positioning of the electrodes 30 and 42 one with respect to the other and with respect to the web 14 provides means by which a relatively large mass of the web 14 is effectively positioned between each pair of the electrodes 30 and 42. Thus, a relatively high voltage can be applied between the electrodes 30 and 42. Thus, comparatively large quantities of electrical energy flow through the portion of the web 14 within which the glue 19 is located. As stated above, a relatively high frequency of electrical energy is used.

Also, as stated above, the glue 19 is preferably a glue which is a liquid at room temperature, and the glue 19 is applied between adjacent sheets of the web 14.

The electrical energy which flows between the electrodes 30 and 42 and through the portion of the web within which the glue 19 is located rapidly heats that portion of the web 14 as the web 14 moves through the housing 20.

Due to the fact that high values of electrical energy can be applied to the web 14 for drying the glue 19, the web 14 can be moved at a relatively high rate through the housing 20. The heat applied to this portion of the web 14 causes the volatile matter in the glue 19 to emanate therefrom. Thus, the glue 19 rapidly dries as the web 14 travels through the housing 20. The web 14 moves from the housing 20 through an opening 70 therein, as shown in FIGURE 2.

Of course, due to the fact that the volatile matter within the liquid glue emanates therefrom during the heating and drying operation, a relatively large quantity of volatile matter moves from the liquid glue into the air in the region of the electrodes 30 and 42.

If condensed moisture should be permitted to exist upon the electrodes 30 and 42, the voltage applied thereto would have to be relatively small to prevent breakdown of the voltage.

As stated above, the support member 32 is heated by means of the electric heater strip 36. Thus, the electrodes 30 are also heated by the heater strip 36. Also, as stated above, hot air or other hot gas is forced through the tube 40, as illustrated by arrows 55 in FIGURE 2. Thus, the tube 40 and the electrodes 42 which are attached thereto are heated. The electrodes 30 and 42 are thus heated to such a temperature that no appreciable moisture condenses thereupon, even though large quantities of volatile matter exist in the region of the electrodes 30 and 42. The moisture laden air in the region of the electrodes 30 and 42 is moved from the housing 20 by movement of the hot air which is discharged from the right hand end of the tube 40, as shown in FIGURE 2. The hot air moves from the tube 40 and is drawn by the exhaust fan 57 through the region within the housing 20 within which the electrodes 30 and 42 are located. Thus, moisture laden air is continuously moving from the region of the electrodes 30 and 42, and the moisture laden air moves from the housing 20 through the exhaust fan 57.

Therefore, by means of the apparatus of this invention a web having liquid glue applied thereto can be rapidly continuously moved from one location to another location as the glue is dried during such movement of the web.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

The invention having been thus described, the following is claimed:

1. Dielectric heater apparatus for a continuous web having a surface portion and an edge portion, the web being substantially coplanar, comprising:

- a first electrically conductive support member,
- a plurality of first electrically conductive electrode pins, the first electrode pins being attached to the first support member and extending therefrom and arranged in a row,
- a second electrically conductive support member, the second support member being spaced from the first support member,
- a plurality of second electrically conductive electrode pins, the second electrode pins being attached to the second support member and extending therefrom and arranged in a row,
- each of the electrode pins having an end surface and a side surface,
- means for joining the first support member and the second support member to a source of electrical energy, all of the row of first electrode pins being substantially in a given plane which is normal to the web, all of the row of second electrode pins being substantially within a plane which is normal to

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the web and which is parallel to the plane of the first electrode pins,

the electrodes being adapted to have a continuous web move in adjacent relationship thereto, as a surface portion of the web is adjacent the end surface of the first electrode pins, an edge portion of the web being adjacent the side surface of the second electrode pins.

2. The apparatus of claim 1 which includes means for heating the first electrically conductive support member and the second electrically conductive support member.

3. The apparatus of claim 2 in which at least one of the electrically conductive support members is tubular for heating thereof by flow of hot fluid therethrough.

4. The apparatus of claim 3 in which each tubular electrically conductive support member is open at one end thereof for flow of hot gas therefrom and in which the apparatus includes fan means for forcing hot gas to flow through the region within which the electrode pins are located, the hot gas moving from the open end of each tubular electrically conductive member and flowing through the region within which the electrode pins are located.

5. Apparatus for rapidly removing volatile matter from glue which is applied as a liquid between adjacent sheets which are collated to form a continuous web, the web having a surface and an edge comprising:

first electrode means, the first electrode means being adjacent the surface of the web,

second electrode means, the second electrode means being adjacent the edge of the web,

and means for connecting the electrode means to a source of high frequency electrical energy,

electrical energy thus flowing through the first electrode means and into and out of an edge of the web, electrical energy also flowing through the second electrode means and into and out of a surface of the web.

6. Apparatus for drying glue which is applied as a liquid between adjacent sheets which are collated to form a web, the web having a surface and an edge, the glue being in the form of a stripe adjacent the edge of the web,

a plurality of first electrode pins, the first electrode pins being arranged in a row with each of the first electrode pins being substantially parallel with each of the other first electrode pins,

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a plurality of second electrode pins, the second electrode pins being arranged in a row with each second electrode pin being substantially parallel with each of the other second electrode pins, the row of second electrode pins being laterally spaced from the row of first electrode pins,

means connecting the first electrode pins together, means connecting the second electrode pins together, means for connecting a source of high frequency electrical energy to the electrode pins,

the row of first electrode pins being adjacent the surface of the web and adjacent the stripe of glue so that electrical energy flows through the first electrode pins and through the surface of the web and through the stripe of glue, the row of second electrode pins being positioned at the edge of the web and adjacent thereto so that electrical energy flows through the second electrode pins and into and out of the edge of the web and through the stripe of glue.

7. The apparatus of claim 6 which includes heater means for heating at least one of the means for connecting the electrode pins together.

8. The apparatus of claim 7 in which the heater means includes means for causing hot gas to flow in engagement with at least a portion of the means connecting the electrode pins together, to prevent the formation of condensation upon the means for connecting the electrode pins together and to prevent formation of condensation upon the electrode pins.

9. The apparatus of claim 6 in which the means connecting at least a portion of the electrode pins together comprises a tube, and means for forcing a hot fluid through the tube to heat the tube and to heat the electrode pins to prevent formation of condensation thereupon as moisture emanates from the glue.

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