Claims

What is claimed is:

1. A low-profile heater apparatus, comprising:

at least one lower assembly, including at least one first sheet, at least one heating sheet including at least one heating element formed on one or more dielectric sheets, at least one intermediate sheet, and one or more electrical leads in electrical communication with the at least one heating element and configured to supply electrical power to the at least one heating element;

at least one upper assembly, including at least one top sheet with one or more passages formed therein, the passages configured to allow at least one lead sleeve to traverse therethrough, the at least one lead sleeve and at least one lead sleeve passage extending therethrough, the at least one lead sleeve passage configured to accept the one or more electrical leads from the lower assembly to pass therethrough; and

at least one strain relief structure configured to prevent damage to the one or more electrical leads~~.~~,

wherein the first sheet of the lower assembly and the top sheet of the upper assembly are made from at least one heat-resistant fabric.

2. The low-profile heater apparatus of claim 1, wherein the at least one strain relief structure includes one or more split sleeves extending from the at least one lead sleeve, and one or more stitches or coupling features configured to securely attach the one or more split sleeves to the at least one top sheet.

3. The low-profile heater apparatus of claim 1, further comprising one or more perimeter stitches or coupling features extending around at least one perimeter of the lower assembly and the at least one upper assembly and configured to securely attach the upper assembly to the lower assembly, thereby forming at least one heater body.

4. The low-profile heater apparatus of claim 1, wherein the at least one heating sheet includes one or more pads formed thereon and in electrical communication with the

at least one heating element, the one or more pads configured to allow one or more proximal ends of the one or more electrical leads to be attached thereto.

5. The heater apparatus of claim 1, further comprising at least one temperature sensor formed on or attached to the at least one heating sheet and in thermal communication with the at least one heating element.

6. The heater apparatus of claim 1, further comprising one or more retention members configured to engage and securely retain the heater apparatus in thermal communication with one or more tubes of at least one plumbing apparatus.

7. The heater apparatus of claim 1, further including one or more reliefs formed in the at least one heater body.

8. The heater apparatus of claim 7, further including one or more apertures formed in the heater body, the one or more aperture configured to allow clearance for one or more fittings of one or more tubes of at least one plumbing apparatus.

9. The heater apparatus of claim 8, further including one or more chamfers formed in the heater body, the one or more chamfers configured to allow clearance for at least one fitting or feature of one or more tubes of at least one plumbing apparatus.

~~10. The heater apparatus of claim 1, further comprising one or more retention members configured to engage and securely retain the heater apparatus in thermal communication with one or more tubes of at least one plumbing apparatus.~~

10~~11~~. A heater apparatus, comprising:

at least one lower assembly including:

at least one first sheet made from at least one heat-resistant fabric;

at least one heating sheet including at least one dielectric sheet, at least one heating element formed on the at least one dielectric sheet, and one or more pads formed on the at least one heating element, the one or more pads configured to allow one or more electrical leads to be attached in electrical communication with the at least one heating element;

at least one intermediate sheet, including one or more passages formed on or therethrough and configured to permit the one or more electrical leads to traverse through the one or more passages and be securely attached in electrical communication with the one or more pads formed on the heating element;

at least one upper assembly including:

at least one top sheet with at least one passage formed therein, the at least one passage configured to allow at least one lead sleeve to traverse therethrough, the at least one lead sleeve further including one or more split sleeves and at least one lead sleeve passage extending therethrough, the at least one lead sleeve passage configured to accept the one or more electrical leads from the lower assembly to pass therethrough; and

one or more stitches or coupling features in the at least one top sheet and configured to securely attach the one or more split sleeves to the at least one top sheet; and

one or more perimeter stitches or coupling features extending around at least one perimeter of the at least one lower assembly and the at least one upper assembly and configured to securely attach the at least one upper assembly to the at least one lower assembly, to form at least one heater body.

1112. The heater apparatus of claim 1011, wherein at least one temperature sensor is formed onto or attached to the heating sheet.

1213. The heater apparatus of claim 1011, further comprising at least one electrical connector configured to be electrically connected to the one or more electrical leads.

1314. The upper assembly of claim 1011, further comprising at least one cover sheet stitched to the at least one top sheet and the one or more split sleeves.

1415. The heater apparatus of claim 1011, further including one or more reliefs formed in the at least one heater body.

1516. The heater apparatus of claim 1415, further including one or more apertures formed in the heater body, the one or more apertures configured to allow clearance for one or more fittings of one or more tubes of at least one plumbing apparatus.

1617. The heater apparatus of claim 1516, further including one or more chamfers formed in the heater body, the one or more chamfers configured to allow clearance for at least one fitting or feature of one or more tubes of at least one plumbing apparatus.

1718. The heater apparatus of claim 1011, further comprising one or more retention members configured to engage and securely retain the heater apparatus in thermal communication with one or more tubes of at least one plumbing apparatus.

1819. The heater apparatus of claim 1718, wherein the one or more retention members are formed integral to the at least one heater body.

1920. A method of manufacture of a low profile heater apparatus, comprising:

providing at least one lower assembly, the lower assembly comprising at least one first sheet, at least one heating sheet including at least one dielectric sheet with at least one heating element formed thereon, at least one intermediate sheet, and one or more electrical leads in communication with the at least one heating element;

providing at least one least one upper assembly, the upper assembly comprising at least one top sheet with one or more passages formed therein, the one or more passages configured to allow at least one lead sleeve to traverse therethrough, the at least one lead sleeve further including one or more split sleeves and at least one lead sleeve passage extending therethrough, the at least one lead sleeve passage configured to accept the one or more electrical leads from the lower assembly to pass therethrough;

forming one or more strain relief structures in the at least one upper assembly by stitching or otherwise coupling the one or more split sleeves to the at least one top sheet with one or more stitches or coupling features; and

joining the at least one lower assembly to the at least one upper assembly, with one or more stitches or coupling features extending around at least one perimeter of the lower assembly and at least one perimeter of the at least one upper

assembly, the one or more stitches or coupling features configured to securely attach the upper assembly to the lower assembly, to form at least one heater body.

20~~21~~. The method of claim 19~~20~~, wherein the one or more stitches or coupling features comprises one or more adhesives disposed between the at least one lower assembly and the at least one upper assembly.

21~~22~~. The method of claim 19~~20~~, wherein the one or more stitches or coupling features comprises temperature-resistant thread.