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ELECTRIC HEATING PAD

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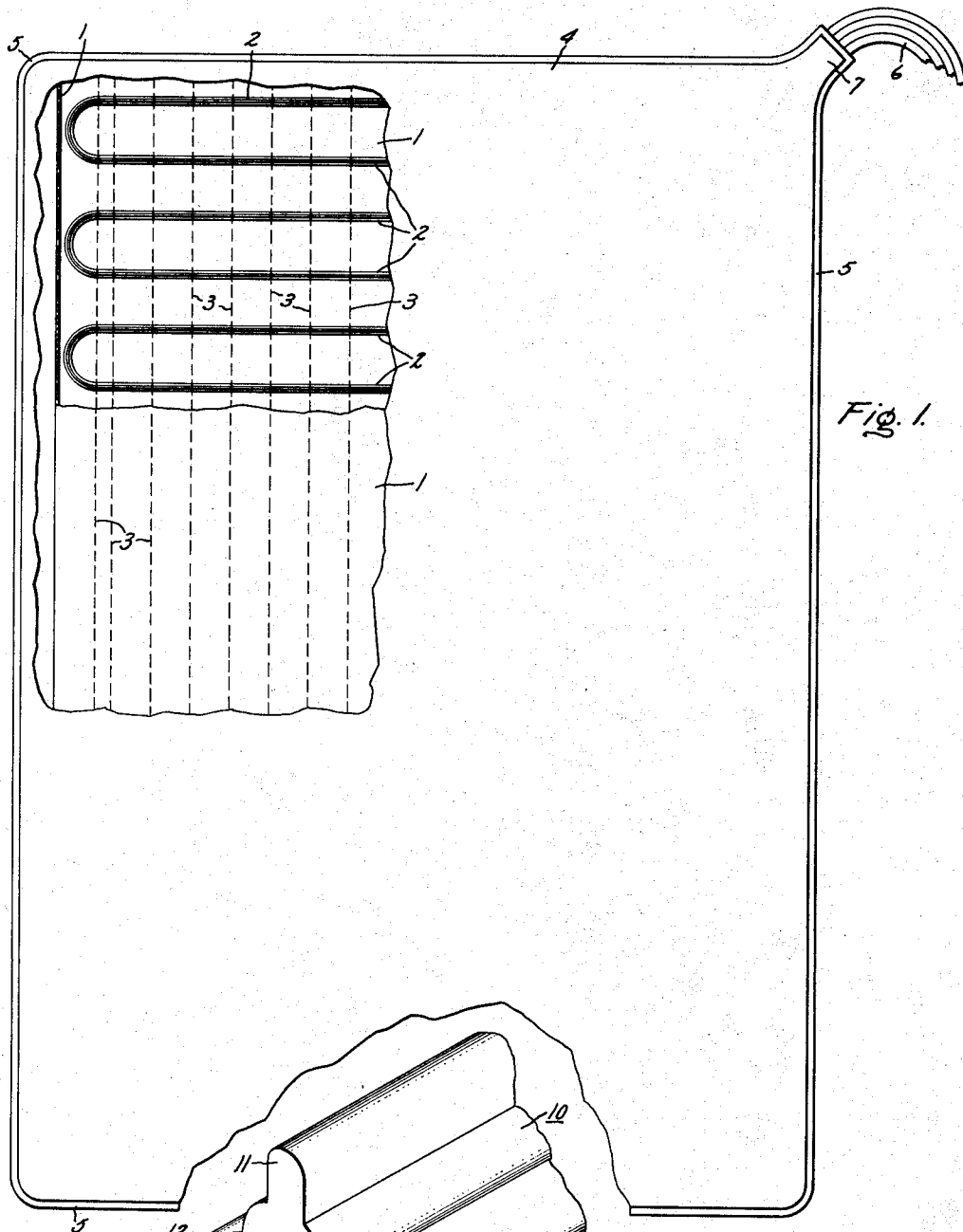
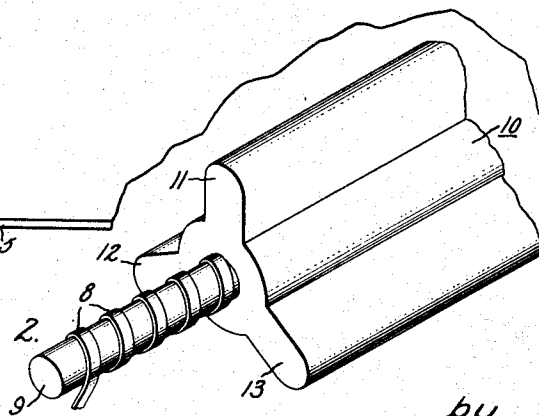


Fig. 1.

Fig. 2.



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ELECTRIC HEATING PAD

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8 Claims. (Cl. 219-46)

This invention relates to flexible electrically heated devices, such as heating pads and the like, and to an improved electrical heating element therefor.

Typically, an electric heating pad is made up of a fabric carrier to which is secured insulated electrical resistance wire. This assembly, including appropriate thermostats and electrical connections, is then encased in a protective envelope, which often is waterproof. Finally, an outer flannel or other suitable fabric cover is applied to give the over-all product not only a pleasant appearance, but also a comfortable surface for application to the human body in treatment of various ailments.

It has been found that this outer surface of an electric heating pad should be capable of attaining temperature in the range of 165° F.-175° F. during use. Such a surface temperature is commonly attained when a heating pad is on the high heat setting. There is, of course, a substantial temperature differential between the surface of the heating pad and the electrical heater itself. For example, wire temperatures in the order of 250° F. likely occur, perhaps even higher temperatures to produce a pad surface temperature of 175° F. The carrier for the heating element, for cost reasons, is typically of cotton linette. Such materials are inflammable at elevated temperatures. Hence, the maximum wire temperature must be carefully limited and Underwriters' Laboratories requires the maximum temperature on fabric backing to be no more than 221° F. For this reason, the electrical heating element for heating pads heretofore used has been in the form of a suitable resistance wire wrapped on a glass fiber core and then enclosed and insulated by a substantial outer layer of glass fiber. The outer layer of glass fiber is necessary to provide non-inflammable electrical insulation. However, at the same time this material is a thermal insulator, and this fact tends to increase the temperature differential between the heating wire itself and the outer pad.

Efforts have been made heretofore to make up an electrical heater for such a heating pad application, with the resistance wire insulated by a plastic insulating layer such as polyvinyl chloride. However, it has been found that wire temperatures in the order of 240° F. are required in order to achieve a pad surface temperature of 175° F. Thermoplastic materials available at reasonable cost and with the desired flexibility have not been available for operation at such high temperatures as 240° F. As a practical matter, the Underwriters' Laboratories limitation is again 221° F. for the continuous rating of presently available thermoplastic insulating compounds.

An object of the present invention is to provide a flexible thermoplastic insulated electrical heater for a heating pad or the like capable of producing the desired heat output within safe operating temperature limits.

A further object of this invention is to produce an improved electric heating pad, the heating element of which offers greater resistance and protection to penetration by sharp objects.

Another object of this invention is to produce an approved heating pad offering greater reliability at lower cost.

In accordance with this invention, a heating pad is constructed with an electrically insulated conductor secured to a fabric backing of material such as cotton linette. This assembly is, in turn, enclosed within appro-

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priate envelopes to provide a finished heating pad. The electric resistance wire forming the heating element is enclosed within thermoplastic electrical insulation such as polyvinyl chloride, the electrical insulation material being extruded with a plurality of outwardly extending ribs. In addition, the thermoplastic material is loaded to a limited extent with conductive particles, to increase the thermal conductivity without material impairment of the electrical insulating characteristics. In this manner, the rate of heat transmission from the resistance wire through the plastic and through the enclosing covers is sufficiently rapid so that the thermoplastic material does not exceed prescribed maximum temperature limits, even though the outer surface temperature of the pad is operated at temperatures as high as 175° F.

While this specification concludes with claims particularly pointing out and distinctly claiming the subject matter of this invention, it is believed that the invention will be better understood from the following description taken in connection with the accompanying drawing in which:

FIG. 1 illustrates an electric heating pad, with certain surfaces broken away to illustrate internal details; and

FIG. 2 is an enlarged perspective view of a portion of an electrically insulated heating element in accordance with this invention.

Referring now to the drawing, a flexible electrically heated device is shown, the typical example of which is in the form of a heating pad. The internal portion of this heating pad is formed by a cotton linette or batting material 1, and this material not only gives substance and thickness to the heating pad for comfort during use, but also serves as a mechanical support for the heating element 2. In the specific embodiment of the present invention, the heating element is arranged in a serpentine pattern on the cotton linette, and suitable stitching 3 is applied in multiple parallel rows to secure the heating element in position. We do not wish to be limited, however, to any particular pattern for the electric heating element, since obviously it could be applied in a spiral pattern or in any other suitable layout, the purpose of which would be to provide a substantially uniform temperature over the entire surface of the pad. Also, while we have shown stitching to hold the heating element in position, other techniques could be employed, such as laminating or by means of an adhesive.

To provide a completed pad, the assembly made up by the cotton linette and the secured heating element is enclosed within a jacket 4. This jacket desirably is a waterproof enclosure, made, for example, from a rubberized fabric. Preferably, however, we prefer to use an especially prepared polyvinyl chloride envelope of the type disclosed and claimed in the copending application of Joseph F. Jacoby, filed January 27, 1961, Serial Number 85,336, and assigned to the General Electric Company, assignee of the present application. Such an enclosure can be sealed around the edges as at 5, and the electrical conductors 6 entering one corner of the pad cover can be sealed in as at 7. Then, if desired, this entire assembly can be enclosed in a flannel jacket or a jacket made of some other suitable material such as toweling.

As previously indicated, it is desirable with a heating pad constructed as above described to provide an outer surface temperature in the order of 165° F. to 175° F. Lower temperatures may be used, of course, in practice; but it has been found empirically that temperatures in this range are desired by users. While non-inflammable electrical insulation can be used over the electric heating element, such materials are relatively costly compared to thermoplastic insulation. However, if a thermoplastic is used, the temperature of the plastic material itself must be maintained within safe operating limits, specifically a maximum of 221° F. in order

to comply with the requirements of Underwriters' Laboratories. Also, the support for the heating element for cost reasons is generally a flammable material made of cotton fibers. For this reason, the surface temperature of the insulated electrical heater must be maintained within safe limits. Thus, the heating element must be capable of transmitting generated heat in a safe and effective manner, without exceeding the maximum permissible temperature.

In accordance with one aspect of this invention, the electrical heater is made up by applying an electric resistance wire 8 spirally to a core 9 of electrical insulating material as clearly shown in FIG. 2. While we do not wish to be limited to such a spiralled electrical heater, such a construction is advantageous as a means of providing a high degree of reliability and flexibility for the completed product. Also, it is found in practice that the core, of Fiberglas or equivalent material, aids in transferring heat out from between turns. Enclosing both the resistance conductor 8 and the core 9 is an extruded or otherwise applied layer 10 of thermoplastic electrical insulation material, such as polyvinyl chloride. Heat transfer from the resistance wire 8 through the electrical insulation material is materially increased by forming the electrical insulation with a plurality of projecting ribs such as 11, 12, and 13 as shown by FIG. 2. While we have shown three such ribs, other numbers of ribs could be, of course, used; although we prefer three ribs rather than a larger number in order to preserve the flexibility in all directions of the completed electrical heater.

The thermoplastic insulating material 10 is selected from the various high temperature compounds available in the trade for electrical insulating purposes. Such materials are commonly known as 105° C. electrical insulating materials, and a typical example is the polyvinyl chloride compound sold by the B. F. Goodrich Company under their trademark designation "Geon 8800." It has been found in accordance with this invention that the thermal conductivity of material 10 can be increased, without a material decrease in electrical insulation characteristics, by addition of limited amounts of conductive particles. It is found, in fact, that even electrically conductive particles can be added with subsequent improvement in thermal conductivity, if the concentration of material is limited to prevent direct contact of the conductive particles dispersed through the plastic. In other words, it is desirable, in order to maintain electrical insulation qualities, that each conductive particle, or practically each conductive particle be separately suspended in the thermoplastic insulating material. It has been found experimentally that the degree of electrical conductivity is dependent upon several variables, such as particle size, particle shape, surface chemical or atomic formation, and percentage conductive plus inert filler in the plastic material. If the loading of conductive particles plus inert filler exceeds approximately 45% by weight, the resulting compound will ordinarily be too conductive for use as an insulator.

In one embodiment found to be particularly effective, the added particles were in the form of finely divided thermal carbon black. A 20%-25% loading of carbon black by weight increases the thermal conductivity by approximately 50% and without serious impairment of the electrical insulating qualities. Quantities of carbon particles in excess of 25% tend to increase rigidity beyond practical limits and also to degrade electrical insulation quality. Thermal carbon and carbon in an amorphous form are preferable to crystalline carbons such as graphite; and certain thermal carbons, the particles of which are of rounded shape are preferable to sharply pointed particles. While the preferred embodiment of this invention involves a loading in the order of 20% of such thermal carbon, other types of particles

could be added to increase thermal conductivity such as silica, magnesium oxide, and possibly small silver or copper particles.

For comparison with a heating pad constructed in accordance with the above description, a sample was made with thermoplastic insulation, but without ribs and without the carbon loading. With such a construction, it was found that temperatures on the plastic insulation in the order of 240° F. were necessary to provide a pad surface temperature of 175° F. However, when the electrical insulation 10 is extruded in the form shown by FIG. 2, and with carbon loading in the amount of 20% by weight of thermal carbon black, an external wire temperature of 190° F. was sufficient to provide the same pad surface temperature. Thus, applicant has successfully provided a thermoplastic insulated heater for this heating pad application, offering improved performance at substantially less cost and with much greater resistance to penetration by sharp objects such as pins and the like.

While this invention has been described by reference to a particular embodiment thereof, it is to be understood that various modifications may be made by those skilled in the art without actually departing from the invention. It is, therefore, the aim in the appended claims to cover all such equivalent variations as come within the true spirit and scope of the foregoing disclosure.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In a flexible electrically heated device capable of producing surface temperatures in the order of 165° F. including a fabric carrier and an electrical heater supported by said carrier within an outer enclosing cover, that improvement in the electrical heater comprising a thermoplastic electrical insulation on said heater having a maximum safe operating temperature in the order of 220° F., said insulation having a plurality of projecting heat dissipating ribs, and a quantity of heat conducting particles interspersed in said plastic sufficient to materially increase heat conductivity and not exceeding substantially 45% by weight of thermoplastic material.

2. An enclosed flexible electrically heated device capable of producing surface temperatures in the order of 165° F. comprising a fabric carrier having a limited safe operating temperature in the order of 220° F., that improvement in an electric heater for direct securement to said carrier comprising an electrical heating conductor, flexible thermoplastic insulation material encompassing said conductor, said insulation material having a plurality of extending ribs to increase the heat dissipation rate from said heating conductor, and a quantity not in excess of approximately 45% by weight of thermally conductive particles in said thermoplastic material.

3. The combination of claim 2 in which said thermoplastic material is of polyvinyl chloride.

4. The combination of claim 2 wherein said conductive particles include thermal carbon black in a quantity not in excess of 25% by weight and said thermoplastic material is polyvinyl chloride.

5. A flexible insulated electrical heater wire construction for electric heating pads and the like which operate at external surface temperatures in the order of 165° F. comprising a core, a heating wire spiralled on said core, thermoplastic electrical insulation material enclosing said heater wire having a limited safe operating temperature in the order of 220° F., said insulation material including a plurality of extending ribs, and thermally conductive particles in said insulation material sufficient to increase the thermal conductivity thereof without serious impairment of electrical resistivity.

6. The combination of claim 5 in which said plastic insulating material is polyvinyl chloride and said con-

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ductive particles are thermal carbon black in an amount in the order of 25% by weight.

7. The combination of claim 5 in which said core is of glass fibers.

8. A flexible electric heating pad or the like capable of producing surface temperatures in the order of 165° F. comprising: a fabric carrier having a safe operating temperature limit of approximately 220° F.; electric heating wire distributed over and secured to said carrier, said heating wire having an insulating core with resistance wire spiraled thereon and a ribbed heat transmitting and electrically insulating jacket thereon of polyvinyl chloride rendered thermally conductive by a quantity not in excess of 25% by weight of thermal carbon black, with said heating wire having a resistance which at normal operating voltage operates within the maximum temperature limit of approximately 220° F.; and an enclosing jacket for said carrier and heating wire.

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