

Nov. 25, 1958

A. NEGROMANTI
ELECTRICALLY HEATED FABRICS

2,862,097

Filed May 31, 1955

2 Sheets-Sheet 1

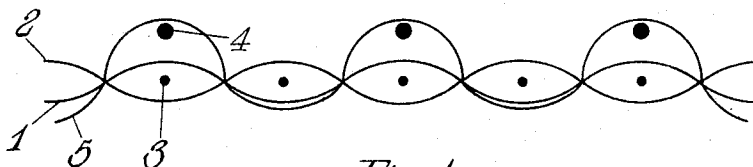


Fig. 1.

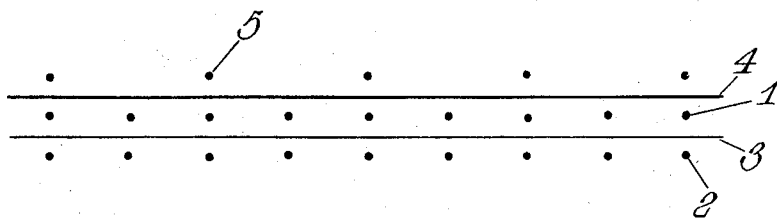


Fig. 2.

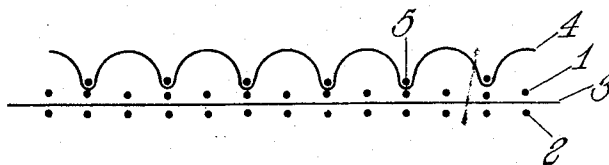


Fig. 3.

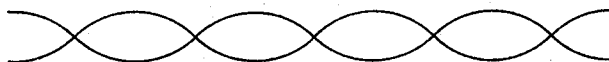


Fig. 4.

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Fig. 5.

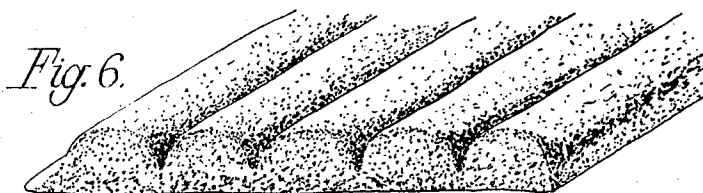


Fig. 6.

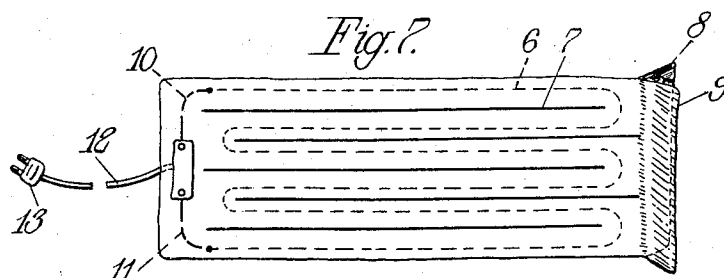


Fig. 7.

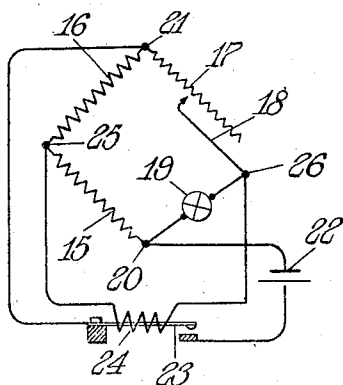


Fig. 8.

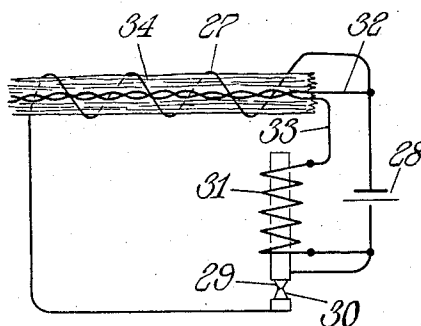


Fig. 9.

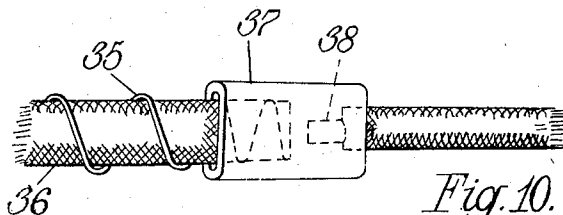


Fig. 10.

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ELECTRICALLY HEATED FABRICS

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Application May 31, 1955, Serial No. 512,092

Claims priority, application Great Britain June 3, 1954

6 Claims. (Cl. 219—46)

This invention relates to the use of retractile and non-retractile thermo-plastic threads, such for instance as vinyl chloride weaving materials in the manufacture of multiply textile fabrics of multi-tubular structure obtained directly on an ordinary weaving or hosiery loom, to be used as supports for electrical resistance wires in the production of wearing apparel and coverings for heating purposes, and particularly for heating pads and blankets. The retractile properties of vinyl chloride weaving materials are originated by the stretching to which they are subjected during spinning, which produces a lengthening of the molecular chains. These molecular chains, when warmed, tend to re-assume their original length. If such threads are sufficiently warmed before the weaving process, they are no longer retractile.

The retractile properties of vinyl chloride threads render it possible, as will be hereinafter shown, to produce textile fabrics of very high heat-insulating power, and therefore of high thermal efficiency.

Furthermore the weaving materials of this nature exhibit the following characteristics, all of which are of great value for the purposes in question, particularly for the manufacture of electrically heated pads and blankets: They are moisture-resistant, incombustible, imputrescible, of high electrical resistance, resisting all chemical agents, even the strongest, non-creasing, moth-proof, insensitive to the lowest temperatures, of adequate mechanical strength, soft as wool, of agreeable appearance, and unaffected by light.

The possibility is furthermore provided of limiting on the loom the union of the elementary fabrics with one another to zones of predetermined contours, in such a way as to have two peripheral lips at the said zones for the protection of the resistance wires in passing from one tube to the next.

Furthermore, for the purpose of rendering possible the use of bare resistance wires in order to increase their thermal dissipation without the risk of their coming into contact with one another, the possibility is provided for the lines along which the elementary fabrics are united to be disposed on the loom alternately displaced to the right and to the left, so that the ends of such lines are alternately staggered. The bare resistance wire freely introduced into the tubes, in passing from one tube to the next, passes round the ends of those uniting lines that are set back relatively to the ends of the adjacent uniting lines.

Another object of the present invention is a device adapted to prevent any excessive heating of the heating circuits from any cause whatever, a device by means of which it is possible to control and regulate at will and from a distance the temperature of the electrically heated fabric with only two wires connecting the device with the said fabric.

One of the preferred forms of construction of the present invention is illustrated merely by way of example in the accompanying drawings, in which:

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Figure 1 shows one of the elementary fabrics in longitudinal section according to the invention;

Figure 2 shows the same fabric in cross section;

Figure 3 shows the fabric in cross section after the construction of the contractile weft threads;

Figure 4 indicates in cross section a multi-tubular fabric, wherein, for simplicity, the warp threads and the weft threads have not been indicated;

Figure 5 indicates a multi-tubular fabric where only the lower basic weave is retractile in the direction transverse to the tubes;

Figure 6 is a perspective view of the fabric indicated in Figure 5;

Figure 7 is a blanket with heating circuits schematically represented.

Figures 8 and 9 are the heat-regulating devices according to the invention schematically represented and in a preferred form.

Figure 10 illustrates a method of joining the heating circuit to a supply of current.

The elementary fabric illustrated in Figure 1 has for its base and according to the invention one of the four fundamental weaves, for instance a plain tabby weave, wherein 1 and 2 are thin non-retractile warp threads, and 3 are thin retractile weft threads. 4 indicates thick non-retractile weft threads, which can be carded, constituting the external surface of the fabric, and bound only at intervals to the basic weave by means of thin non-retractile warp threads 5.

The contraction of the weft threads 3, which changes the form and arrangement of the threads from that shown in Figure 2 to that shown in Figure 3, is obtained by exposing the fabric to a temperature between 75 and 100 degrees centigrade, the temperature adapted depending upon the degree of contraction which it is desired to assign to the said fabric.

As a result of this contraction, the non-retractile weft threads 4 will assume an upwardly undulating form, which permits an abundant carding, and confers on the fabric thickness and softness, and therefore a high degree of thermal insulation.

The invention provides for putting on the loom at least two such elementary fabrics, with the two basic weaves turned inwards, united to one another at intervals, for instance in the direction of the warp.

In this way a multi-tubular fabric will be obtained, which is illustrated in a section transverse to the tubes in Figure 4, where for simplicity the individual weft and warp threads have not been indicated.

Now if the weft threads 3 are retractile in the basic weave of the lower elementary fabric only, the corrugated fabric shown in Figure 5 will be obtained, which, soon in perspective, will have the appearance shown in Figure 6, a fabric which will obviously be of great heat-insulating power, and therefore of high thermal efficiency.

Figure 7 shows diagrammatically a blanket provided with a bare heating circuit 6 having a positive thermal coefficient, for instance pure nickel, threaded freely through the tubes.

The junction tracts 7 of the elementary fabrics of the blanket are interrupted at their ends and staggered alternately to the right and to left. 8 and 9 denote two terminal lips which result therefrom, shown opened cut at the right-hand end. Those lips permit the lodgment at the left-hand end of current-supply bars 10 and 11, connected with a supply flex 12, upon which is mounted a terminal current-supply plug 13.

A marginal finishing tape may be applied on the machine in correspondence with the lips 8 and 9, in view of the absence of metallic parts there.

Figure 8 shows diagrammatically and by way of example a device for controlling and regulating the tempera-

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ture of the blanket, in one of the preferred forms of construction of the invention.

One or more heating circuits with a positive thermal coefficient are incorporated in the blanket, in series or in parallel with one another, but forming as a whole one arm 15 of a Wheatstone bridge as indicated in Figure 8. The other three arms of the bridge are lodged in a case, and are constituted by: an ohmic resistance 16 of zero thermal coefficient, an ohmic resistance 17 variable by means of a sliding contact 18, and an ohmic resistance 19 of zero thermal coefficient, which may even be an incandescent lamp.

Let it be assumed that the opposite angles 20 and 21 of the said bridge are fed with a source of electricity 22 through the relay 23, the excitation circuit 24 of which is inserted between the other two opposite angles 25 and 26 of the bridge.

The relay 23 may be either an electro-thermal relay, for instance a bi-metallic switch, as shown, or an electro-magnetic time-lag relay.

If the sliding contact 18 is put in such a position that the bridge is in equilibrium when the blanket is cold, then as soon as the blanket, diagrammatically represented by the arm 15, begins to warm up, the bridge will become unbalanced, and a current will flow through the excitation circuit 24, until it reaches a value that will energise the relay. At this point the heating current will be interrupted, and the blanket will tend to cool down. Means of any convenient known kind may be provided for regulating at will the period of interruption of the relay. For instance, with an electro-thermal relay, one of the two contacts may be mounted upon an adjusting screw; or the bi-metallic element may be exchangeable. With an electro-magnetic time-lag relay, the lag may be adjustable for example by varying the tension of a spring. The cooling may thus be reduced to a minimum, and the blanket can be maintained at a practically constant temperature.

In the event of the blanket being excessively covered up, or being folded upon itself a number of times, the current that energises the relay will be more quickly reached, but in this case also the temperature will remain practically constant.

Now when it is desired to vary at will the temperature of the blanket, all that is necessary is to vary the ratio between the arms of the bridge by means of the sliding contact 18, or else to vary the sensitiveness of the relay by means of an auxiliary resistance inserted in its excitation circuit 24. This being presumed, the blanket shown in Figure 7 can be used either with the regulating device of Figure 8 or without it.

Recourse will be had to the said device, especially for clinical purposes, when it is desired to have available, for an indefinite length of time, a number of predetermined and constant temperatures, which can be read off on a suitable dial in relation to the various degrees of sensitiveness of the relay, or else in relation to the various ratios between the arms of the bridge.

The invention also provides the possibility of obviating local overheating at any point, a case that occurs very occasionally, by having recourse to the device shown in Figure 9, which may also be used in conjunction with the device of Figure 8.

In Figure 9 the heating circuit 27 of the blanket is supplied with current by a source of electricity 28 through contacts 29 and 30, actuated by a preferably electro-magnetic relay 31. The circuit of this relay is connected in series with two conductors 32 and 33 in close contact with one another throughout their entire length, but insulated from one another by a substance which is electrically insulating at the ordinary surrounding temperature but becomes a good conductor at a temperature of about 120° C., and yet becomes insulating again when the temperature falls, as occurs for instance in the case of certain metallic oxides, or polyamide resins.

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If these conductors 32 and 33 are coated with combustible fibres 34, asbestos for instance, or glass, and the heating circuit 27 is wound thereon, it will be readily understood from Figure 9 that an excess heating to 120° C. at any point of the heating circuit 27, from any cause whatever, will occasion at that point a passage of current between the two conductors 32 and 33, and consequently the relay 31 will be energised, so as permanently to interrupt the heating current, thereby giving opportune warning that something abnormal has occurred in the blanket.

Figure 10 represents according to the invention a joint connecting the heating circuit with current-supply wires. By 35 is denoted the resistance wire wound upon a core 36, the core and the wire together being threaded through a leaden sleeve 37 where they are pressed with the current-supply conductor 38, preferably threaded into the sleeve from the opposite end. Such a joint can be maintained electrically perfect and mechanically indestructible.

What I claim is:

1. An electrically heatable fabric such as a blanket or pad, comprising: a multi-tubular textile fabric incorporating both retractile and non-retractile vinyl chloride threads in which the tubes are formed by the retractile threads, bare electrical resistance heating wiring having a variable thermal coefficient extending freely through the tubes of the said fabric, means for supplying electric current to the said heating wiring, and a Wheatstone bridge, one arm of which is constituted by the electrical heating wiring, a case containing the other three arms of the Wheatstone bridge, and means for interrupting the heating circuit in the event of the Wheatstone bridge becoming unbalanced to a predetermined extent by the temperature of the heating circuit exceeding a predetermined limit.
2. An electrically heatable fabric such as a blanket or pad as claimed in claim 1, the two arms of the Wheatstone bridge adjacent to the arm constituted by the electrical heating wiring being of constant resistance, and the arm opposite to the said wiring being a resistance variable at will, by means of a sliding contact, for the purpose of varying the temperature at which the control means come into operation to interrupt the heating circuit.
3. An electrically heatable fabric such as a blanket or pad as claimed in claim 2, the supply of heating current to the blanket being effected at two opposite angles of the Wheatstone bridge, and the means for interrupting the circuit comprising a thermo-electric relay, the excitation circuit of which is inserted between the other two opposite angles of the same bridge.
4. An electrically heatable fabric such as a blanket or pad as claimed in claim 1, further comprising a dial upon which the temperatures of the blanket can be read off.
5. An electrically heatable fabric such as a blanket or pad as claimed in claim 1, further comprising means connecting the ends of the electrical heating wiring to the current-supply conductors, the said connecting means including leaden sleeves, into each of which one end of the electrical heating wiring and one end of a supply conductor is inserted, the sleeve then being flattened by pressure so as to grip the end of the wiring and the conductor tightly and to conduct current from the conductor to the wiring.
6. An electrically heatable fabric such as a blanket or pad, comprising: a multitubular textile fabric incorporating retractile vinyl chloride threads transversely to the tubes which are formed by the retractile threads, bare electrical resistance heating wiring having a variable thermal coefficient enclosed in the said fabric, and extending freely through the tubes of the said fabric, means for supplying electric current to the said heating wiring, a Wheatstone bridge, one arm of which is constituted by the electrical heating wiring, a case containing the other three arms of the Wheatstone bridge, and means for interrupting the heating circuit in the event of the Wheatstone bridge be-

coming unbalanced to a predetermined extent by the temperature of the heating circuit exceeding a predetermined limit.

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