G. JAHR.

ELECTRIC HEATING PAD.

APPLICATION FILED NOV. 17, 1911.

1,036,632.

Patented Aug. 27, 1912.

2 SHEETS—SHEET 1.

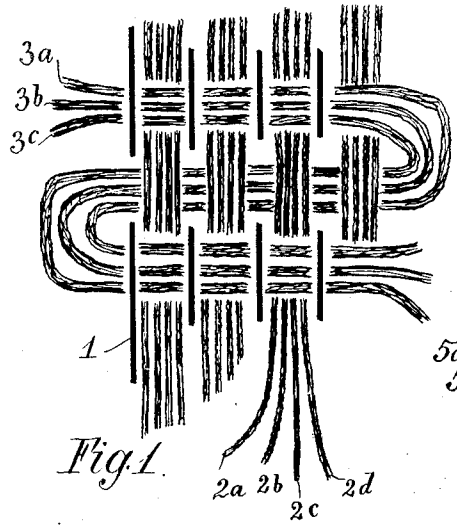

Fig. 1.

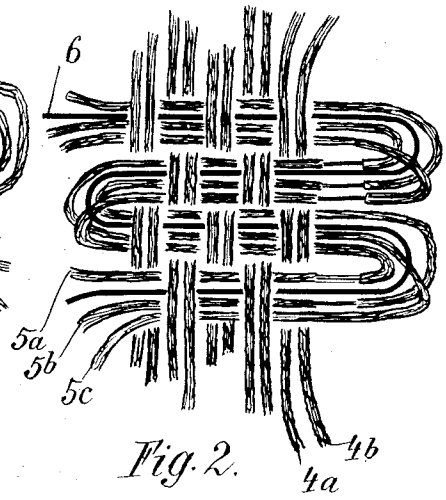

Fig. 2.

Witnesses
J. R. Pierce
O. W. Somers

Inventor
Gerhard Jahr
by A. B. Willson & Co.
Attorneys.

G. JAHR.

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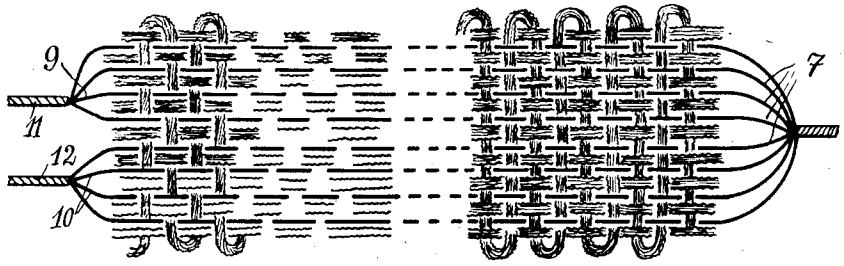
2 SHEETS—SHEET 2.

Fig. 3.



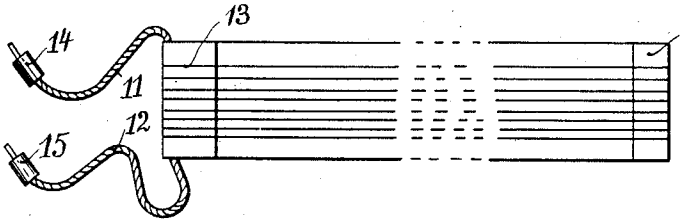


Fig. 4

Fig. 5.

Fig. 6.

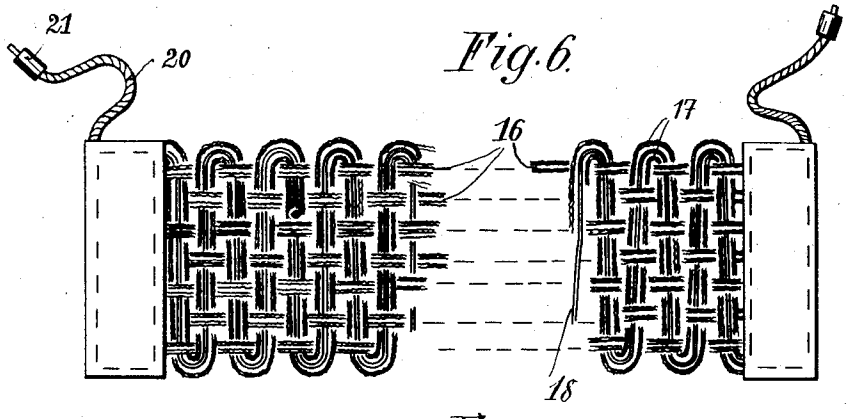


Fig. 7.

Witnesses
J. R. Pierce
O. W. Stones

Inventor
Gerhard Jahr
by A. B. Willson & Co.
Attorneys.

UNITED STATES PATENT OFFICE.

GERHARD JAHR, OF BERLIN, GERMANY.

ELECTRIC HEATING-PAD.

1,036,632. Specification of Letters Patent. Patented Aug. 27, 1912.

Application filed November 17, 1911. Serial No. 660,900.

To all whom it may concern:

Be it known that I, GERHARD JAHR, a subject of the German Emperor, residing at 8 Turmstrasse, Berlin, N. W., 21, Germany, have invented certain new and useful Improvements in Electric Heating-Pads, of which the following is a specification.

This invention relates to an electric heating pad in the form of a woven fabric for utilizing the heating effect and other properties of the electric current. In pads of this character heretofore employed, the metallic conductor was either fixed in the form of a strip or wire to the finished fabric, or was woven in as warp or weft in the making of the fabric. In the manufacture of electric heating pads for heating purposes it has been the exclusive practice hitherto to employ so-called resistance wires made of nickeline, constatan, rheotan or other metallic alloys of high electric resistance. The employment of these, however, is restricted to electrodes of slight longitudinal extension. For the manufacture of longer extended electrodes in the form of bands they are not suitable for the following reasons: For example, in order to obtain the necessary electric resistance of only about 200 to 300 ohms with a band shape permanent heater of a meter in length the resistance wire must be so thick that it cannot be woven as a flexible fabric. If, however, the resistance wire were made fine enough to be woven, it would furnish too high a resistance of some thousand ohms. Moreover, the employment of such fine wires as resistance wire is impracticable by reason of their other physical properties, particularly their lack of pliancy, and slight resistance to bending.

This difficulty is obviated by the present invention which consists in producing a fabric of suitable material made of untwilled adjacently running textile fibers, a current conducting thread of the highest conductive capacity and pliancy woven therewith, in the same direction.

In making band electrodes or pads which are intended for utilizing the heating effect of the electric current for heating parts of the human body and for similar purposes, cotton should not be used for the textile fabric, because of its heat conducting capacity and its relatively small insulating properties in relation to electricity. On the other hand, silk and wool are very suitable for the purpose, because both are poor conductors of heat and of electricity. For the current-conducting wire copper is preferable, because, it is a good conductor of electricity, is highly ductile, pliant and firm against bending, and can be woven into a fabric in the form of a fine thread, without breaking easily in the weaving process, or in the later employment of the woven fabric. Moreover, in a very short time the copper wire is covered with a natural layer of oxid by which it is insulated and it may be coated with enamel lacquer without losing its pliancy. Thus in the fabrics according to the present application extremely fine copper-wire of 0.05 to 0.1 mm. diameter can be employed, which with 10 volts and a length of one meter, offers a resistance of 1.9 to 2.5 ohms and it can be woven in lengths of more than a hundred meters without being torn or broken, so that band electric heating pads of 200 to 300 ohms resistance are obtained which have a flexibility like ordinary flannel bandages. In order to weave such fine metal wire quite free from faults, it is necessary to combine with it textile threads, these textile threads are not twisted together, but run as extremely fine elementary threads adjacent to the metal threads, so that the elementary threads of the textile fabric and the metal threads do not differ too greatly as regards their material sectional area and their resistance against being torn. It is only in this way that it is possible to weave together such different kinds of material as metal wires and textile fibers. Moreover the running of the textile elementary threads and the metal threads loosely and adjacently has the further advantage that the fibers of the textile elementary threads almost completely enwrap the metal thread, and so contribute to its physical protection and its electrical insulation.

The invention is illustrated diagrammatically in the accompanying drawings, Figures 1 and 2 showing fabrics in which the current conducting wire is employed as warp and weft respectively. Figs. 3 to 5 illustrate a band shaped heating pad with the current conductor arranged in the warp. Figs. 6 and 7 represent a band shaped heating pad with the current conductor arranged in the weft.

In the fabric as shown in Fig. 1 the wire is employed in the warp, a metal thread 1 alternating each time with a group of four ad-

jacently lying untwilled textile elementary threads 2^a, 2^b, 2^c, 2^d. In this example the weft employed consists of three untwilled adjacently lying textile elementary threads 3^a 3^b 3^c. The elementary threads 2^a to 2^d employed for the warp are each untwisted or only slightly twisted or some of these elementary threads are twisted tighter than others and adjacent to the metal wire warp-threads runs at least one textile elementary warp thread that is not at all or only slightly twisted.

In the fabric shown in Fig. 2 the wire is employed in the weft and in this case the warp thread consists of two untwilled adjacently lying groups of textile elementary threads 4^a, 4^b. The weft consists of four untwilled adjacently running threads of which three 5^a, 5^b, 5^c are textile threads, and the fourth 6, is of metal, and these four threads are run through the formed shed in a single movement. The warp threads 4^a and 4^b are each slightly twisted. The weft threads 5^a, 5^b 5^c are still less twisted. The twisting of the weft elementary threads and their number and thickness are so regulated that together they offer a greater resistance against being torn than the metal threads of the weft.

In the fabric illustrated in Fig. 1 one metal thread and one group of four textile threads always form the shed of the warp. In the fabric according to Fig. 2 the warp shed is always formed by two groups each consisting of two textile threads running together and in both figures this simple formation of the fabric with threads or groups of threads lying alternately above and below is employed. As a matter of course, however, the invention can be applied to any other preferred form of binding, and in the example according to Fig. 1, one or more textile threads may run directly together with the metal thread 1 for the purpose of supporting it in the formation of the shed, and likewise in the adjoining group of warp threads a metal thread may also be run in. In the first, as well as in the second example, the number of elementary threads comprised in any group of warp or weft threads may be varied as required. So-called No. 32 double woolen yarn has been found specially suitable for the warp in the manufacture of heating pads of this character and No. 10 single woolen yarn for the weft preferably with copper-wire of 0.09 mm. covered with enamel lacquer. The band-shaped heating pads made with such materials with current conducting wire in the weft are specially suitable for use with current up to 220 volts and consume $\frac{1}{2}$ to $\frac{1}{10}$ amperes, and a band shaped heating pad of this kind 3 meters long, and 6 cm. wide consumes about 30 watts per hour, and gives a temperature of 65° C. Band shaped heating pads with current conducting wire in the warp are specially suitable for electric currents of low potential 4 to 20 volts and currents of greater strength 4–6 amperes, as well as for faradization. In the manufacture of a band electrode with the current-conducting wire in the warp (Figs. 3 to 5) as shown on the right side in Fig. 3, the ends 7 of the wires are metallically connected with one another by being twisted and soldered together, suitably incased with insulating paper or the like, and united with the fabric to form a strip (Figs. 4 and 5) by being folded over. The ends of the wires on the other side are metallically combined with one another in two groups 9 and 10 (Fig. 3) and with a suitable current supply cable 11, 12 consisting of copper strand. By the folding over of the ends of the band a strip (Figs. 4 and 5) is formed, from which the ends of the two copper strand cables project. These cables 11, 12 terminate in hard india-rubber insulated contact plugs 14, 15.

According to the purpose or for other reasons the fabric form of the band pad may be employed in accordance with the left half of Fig. 3 or Fig. 1, in the warp of which the shed is always formed by a group of textile threads with an alternate metal thread, or the fabric form of the right half of Fig. 3 may be adopted, in which a group of textile threads always runs with a metal thread and together with the next group of textile threads and a metal thread forms the shed, or other combinations may be adopted as preferred.

According to the size of the source of current and the intermediately circuited resistances and the positions of the bandages and the number of the metal wires joined to form a group either the wires may run once forward and backward as in the example illustrated or one and a half or a larger number of times for the purpose of increasing the desired height of the resistance.

In the manufacture of a band pad with the current-conducting wire in the weft (Figs. 6 and 7) the warp and the weft consist respectively of groups of a number of untwilled adjacently running textile threads 16, 17. With the weft thread 17 runs the copper wire 18. At each end of the band the copper wire 18 terminates in a soft copper strand cable 19, 19′. Similarly as in the foregoing example, and after being incased in an insulating strip the end of the band is several times wound with the wire and cable ends and formed as a strip 20. The copper strand cables carry on their ends contact plugs 21, 21′ for connecting them with a place where the circuit is closed.

The band heating pad described above are specially suitable for so-called continuous heaters for treating invalids and for

other medicinal purposes. By regulating the current supplied the desired heating temperature of the bandage can be actually determined and be permanently maintained. Compared with the ordinary bandages the present band heating pads however have the advantage that they are thinner and consequently have greater ventilating capacity. They can therefore if necessary be employed also for drawing off water in connection with heating of the bandaged portion of the body.

If the device is not intended for use as a heating bandage or compress but for galvanizing or for the simultaneous application of medical solutions, it only needs to be immersed in water or other solution, for notwithstanding the lacquering of the wire threads, the electric current passes into the body, as the high potential of the electrode with the slight thickness of the wires insures the passage of the current, when the electrode is externally moistened, and its reaching the body.

If a band shaped electrode or heating pad is not to be formed but a larger and wider flat pad is desired, and the breadth does not allow of direct weaving, a number of band electrodes or pads of the kind described above are arranged adjacently and connected with one another by being circuited in series or in parallel according to requirements. Fig. 8 is a diagram of such an arrangement. From the wire or cable 22 that runs along the edge of the piece of work a small carpet, for example, a series of band electrodes 23, 23^a, to 23^c with metal threads in the weft runs to the other side of the piece of work. There three of them 23, 23^a and 23^b terminate in a current collecting wire 24 and the three others in a second current collecting wire 25. Two suitably adjoining places in these two wires 24 and 25 carry the junctions or supply cables 26, 27 for the current.

What I claim and desire to secure by Letters Patent is:—

An electrode consisting of a woven fabric composed of a plurality of untwisted threads adjacently arranged, and an extremely fine and pliable wire which is a good conductor of heat and electricity loosely embedded between and in contact with the threads but disconnected therefrom.

In testimony whereof I affix my signature, in presence of two witnesses.

GERHARD JAHR.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.