May 15, 1956 I. M. COHEN 2,745,942

ELECTRICALLY HEATED MAT AND THE LIKE

Filed June 18, 1953 2 Sheets-Sheet 1

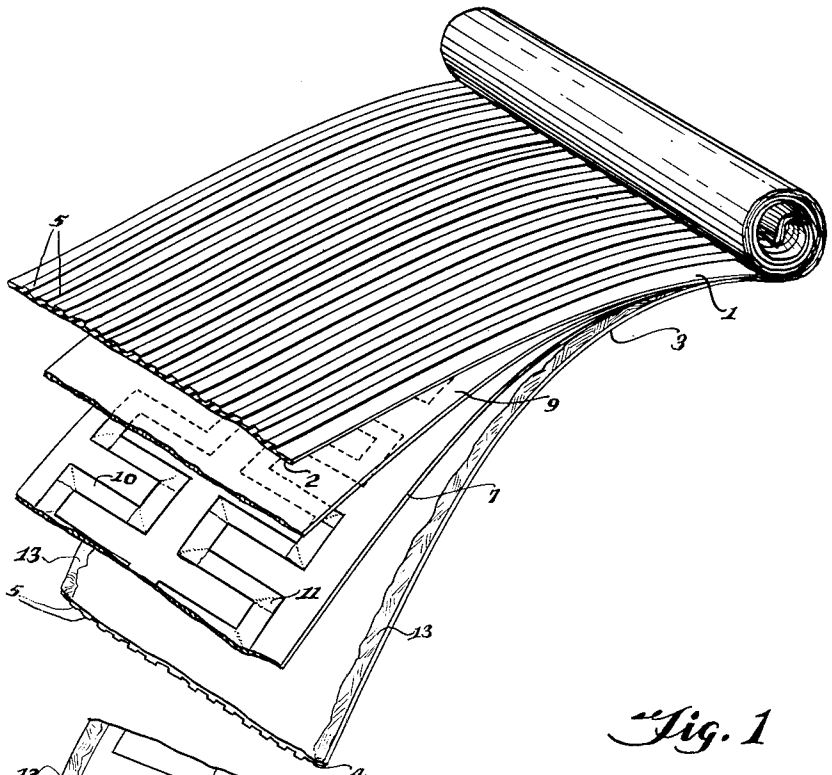

Fig. 1

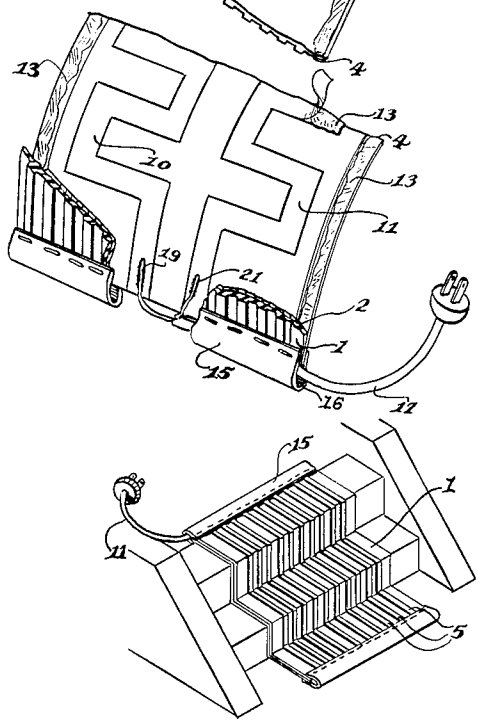

Fig. 2

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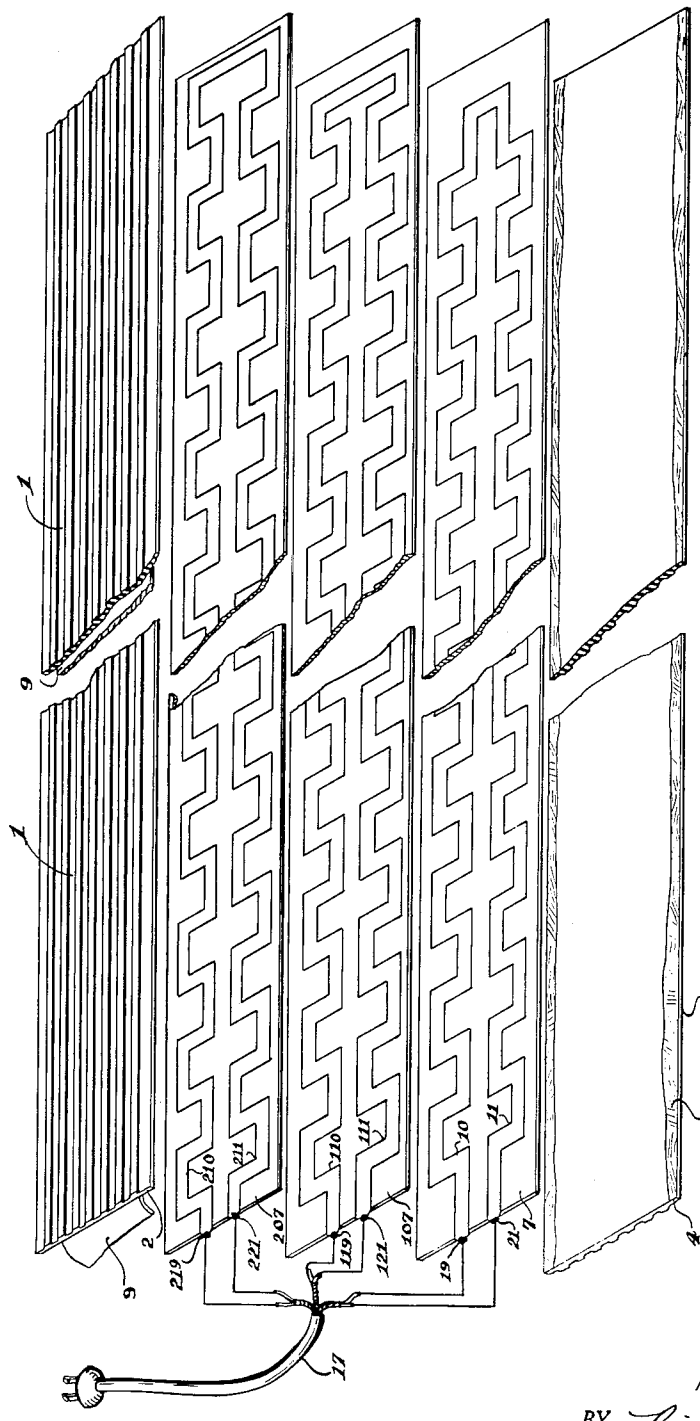

Fig. 3

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ELECTRICALLY HEATED MAT AND THE LIKE

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7 Claims. (Cl. 219—46)

The present invention relates to electrically heated mats or the like and more particularly to snow- and ice-melting mats or coverings.

It has heretofore been proposed to dissipate snow or ice from a surface, such as a driveway or a flight of outdoor stairs, by covering the surface with a mat or other covering provided interiorly with relatively thick wire conductors through which an electric current is passed. The heat generated by the current passing through the wire conductors elevates the temperature of the mat or other covering and melts the individual snow or sleet particles as they impinge upon the mat or other covering, thereby preventing the accumulation of snow or ice.

These prior-art proposals, however, have been impractical and disadvantageous for several reasons. In the first place, but little of the surface area of the usually cylindrical wire conductors radiates heat in the desired direction, thus rendering these devices relatively inefficient; second, a large number of back-and-forth bends in the wire conductors is required not only to provide an adequate heat distribution over the mat, but, also, to present sufficient resistance to the electric current to prevent a short circuit; third, the bending or flexing of the mat is difficult because of the relative stiffness of the wire conductors; and fourth, the wire conductors are subject to fracture after several flexing movements of the mat.

An object of the present invention is to provide a new and improved mat or other covering of the above-described character that shall not be subject to any of the before-mentioned disadvantages. This result is attained, in accordance with the invention, through the use of a thin planar zigzag strip conductor providing a continuous flat electrically conductive and heat-radiative path, appropriately loosely interposed between the mat covers.

A further object is to provide such a mat or other covering of vastly improved efficiency.

An additional object is to provide an electrically heated mat or other covering that lends itself to mass-production techniques, even with unskilled labor, and with a minimum of specialized equipment.

Other and further objects will be hereinafter explained and will be more particularly pointed out in the appended claims.

The invention will now be explained in connection with the accompanying drawing, Fig. 1 of which is a perspective view of a mat or other covering constructed in accordance with a preferred embodiment of the invention, the parts being shown broken away and expanded to illustrate details of construction; Fig. 2 is a similar view of the mat in use upon a stairway; and Fig. 3 is an expanded perspective view of a modification.

The mat of the present invention comprises a pair of longitudinally extending covers 1 and 3, preferably of flexible resilient insulating material, such as rubber or rubber substitutes. The covers are shown exteriorly provided with ridges 5. The ridges 5 in the upper cover 1 provide a tread surface for the mat, as more particularly shown in Fig. 2, and also assist in channeling off or

draining water. A frictional grip upon the stairs of Fig. 2, or upon the ground or other repository for the mat, is provided by the ridges 5 in the lower cover 3, and these ridges again serve to assist drainage.

To avoid direct contact between the heating elements and the mat covers and for other purposes, later explained, a pair of juxtaposed flexible longitudinally extending insulating sheets 7 and 9 are interposed between the covers 1 and 3. The insulating sheet 7 is provided upon its upper surface with the heating element. Unlike the prior-art cylindrical or other wire conductors that are of substantial thickness, the heating element of the present invention is in the form of a thin, planar strip conductor, preferably metal-foil a few thousandths of an inch thick. Aluminum foil has been found quite satisfactory for the purposes of the present invention. Other flat strip conductors, however, such as the printed-circuit type, may also be employed, though metal foil appears to be the most economical at present. The conductor is formed into a pair of symmetrical oppositely disposed longitudinal zigzag paths 10 and 11 to provide a continuous flat conductive path extending from a terminal 19 at the lower transverse edge of the mat in Fig. 1, longitudinally along the mat in zigzag fashion, as at 10, to the oppositely disposed transverse edge of the mat within the roll in Fig. 1; and then, back longitudinally along the mat in zigzag fashion, as at 11, to a second terminal 21. The strip conductor 10, 11 is secured to the flexible sheet 7 by adhesive 13, by tape, not shown, or by any other desired means. The upper flexible sheet 9, of course, prevents the strip conductor 10, 11 from contacting the upper mat cover 1.

Since the heating element 10, 11 is in the form of a thin, planar strip conductor, it does not impede the flexing of the mat, as do the prior-art wire conductors of substantial thickness. While such a strip conductor is more friable than a wire conductor, fracture of the strip conductor is prevented by loosely interposing the flexible sheets 7 and 9 between the covers 1 and 3. This is effected by constructing the sheets 7 and 9 of width less than the width of the covers 1 and 3, and securing the covers 1 and 3 together, as by adhesive 13 or other means, along their longitudinal margins 2, 4 external to the longitudinal edges of the sheets 7 and 9. Further to limit the possibility of damage to the strip conductor 10, 11 during the flexing or other abuse of the mat, the flexible sheets 7 and 9 are constituted of material such as paper, fabric, or appropriate plastic of less resiliency than the resiliency of the covers 1 and 3, in order to provide for less bending thereof than the bending of the covers during the flexing or use of the mat, and thereby to exert less bending strain upon the strip conductor 10, 11. An additional insert or inserts, such as an insulating sheet or sheets (not shown), corresponding to the sheet 9, may also be inserted, if desired, between the strip-conductor-carrying sheet 7 and the cover 3 of the mat.

Not only do the above-described advantages follow from the use of the strip conductor, but a much more efficient heating system is provided since all of the flat surface area of the strip conductor 10, 11 contributes heat to the mat covers. Fewer zigzag sections are thus required to distribute heat along the complete surface area of the mat than with wire conductors. In addition, since the electrical resistance of the strip conductor is high per unit length, the overall length of the strip conductor need not be very long to provide sufficient resistance to prevent a short-circuit of the heating current fed into the pair of terminals 19 and 21 by a pair of wire conductors of an electric cable 17 connected thereto, as by solder. The cable 17 may be plugged into any desired power source, such as the alternating-current mains. Very short, as well as very long, mats, and mats of any de-

sired intermediate length, may therefore equally well be fabricated in accordance with the invention.

The edges of the mat are preferably bound by U-shaped insulating binders 15. The arms of the binder 15, shown in Fig. 1, receive the edges of the covers 1 and 3 and the intermediate sheets 7 and 9. The neck of the U of the binder, however, is shown displaced from the edge of the mat to provide a channel 16 for receiving the current-providing cable 17. The binders 15 may be stitched or otherwise secured to the edges of the mat, and they may, if desired, be closed off with waterproofing tape or other apparatus, not shown.

Where an extremely high heat concentration is desired, a plurality of staggered strip conductors may be employed. Thus in Fig. 3, the plurality of strip conductors 10—11, 110—111 and 210—211 are shown provided upon a plurality of successively disposed flexible sheets 7, 107 and 207, with each of the zigzag strip conductors being staggered to provide interlaced conductive paths. The strip conductor 10, 11 is disposed between the flexible sheet 7 and the lower surface of the flexible sheet 107; the strip conductor 110, 111 is displaced slightly to the right thereof and is disposed between the upper surface of the flexible sheet 107 and the lower adjacent surface of the flexible sheet 207; and the strip conductor 210, 211 is displaced still further to the right, disposed between the upper surface of the flexible sheet 207 and the adjacent flexible sheet 9. The mat is otherwise assembled in the same manner described in connection with the mat of Figs. 1 and 2, except that the cable conductor 17 is preferably connected in parallel with the pairs of terminals 19—21, 119—121 and 219—221 of the respective zigzag strip conductors 10—11, 110—111, and 210—211. If desired, the zigzag strip conductors may be disposed on opposite surfaces of the same flexible sheet in the embodiments of Figs. 1 and 3.

While the invention has been described as applied to snow-and-ice-melting mats or coverings and the like, this is only by way of a preferred illustration. The invention is also useful, however, in other applications including radiant-heating units on floors in exposed places such as toll roads, collector's booths, army sentry posts, and so on.

Further modifications will occur to those skilled in the art and all such are considered to fall within the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A mat or the like comprising flexible resilient longitudinally extending insulating covers one of which is provided with an outer tread face, a pair of juxtaposed flexible longitudinally extending insulating sheets of less width than the width of the covers loosely interposed between the covers, the covers being secured together along their longitudinal margins exterior to the longitudinal edges of the sheets, one of the flexible sheets being provided substantially coplanar with its surface adjacent to the other flexible sheet with a thin planar zigzag strip conductor providing a continuous flat conductive path, the said other flexible sheet preventing contact between the strip conductor and the cover adjacent thereto, the sheets being of less resiliency than the resiliency of the covers in order to provide for less bending thereof than the bending of the covers during the flexing of the mat and thereby to exert less bending strain upon the strip conductor, a pair of terminals disposed at the ends of the strip conductor, and connectors connected to the respective terminals for connecting a source of electric current to the terminals to heat the strip conductor.

2. A mat or the like comprising flexible resilient longitudinally extending insulating covers one of which is provided with an outer tread face, a pair of juxtaposed flexible longitudinally extending insulating sheets of less width than the width of the covers loosely interposed between the covers, the covers being secured together along their longitudinal margins exterior to the longitudinal edges of the sheets, one of the flexible sheets being provided substantially coplanar with its surface adjacent to the other flexible sheet with a thin planar zigzag strip conductor providing a continuous flat conductive path extending from one transverse edge of the mat longitudinally along the mat to the oppositely disposed transverse edge and back longitudinally along the mat to the said one edge, the said other flexible sheet preventing contact between the strip conductor and the cover adjacent thereto, the sheets being of less resiliency than the resiliency of the covers in order to provide for less bending thereof than the bending of the covers during the flexing of the mat and thereby to exert less bending strain upon the strip conductor, a pair of terminals disposed at the ends of the strip conductor at the said one edge of the mat, and connectors connected to the respective terminals for connecting a source of electric current to the terminals to heat the strip conductor.

3. A mat or the like comprising flexible resilient longitudinally extending insulating covers one of which is provided with an outer tread face, a pair of juxtaposed flexible longitudinally extending insulating sheets of less width than the width of the covers loosely interposed between the covers, the covers being secured together along their longitudinal margins exterior to the longitudinal edges of the sheets, one of the flexible sheets being provided substantially coplanar with its surface adjacent to the other flexible sheet with a thin planar zigzag strip conductor providing a continuous flat conductive path extending from one transverse edge of the mat longitudinally along the mat to the oppositely disposed transverse edge and back longitudinally along the mat to the said one edge, the said other flexible sheet preventing contact between the strip conductor and the cover adjacent thereto, the sheets being of less resiliency than the resiliency of the covers in order to provide for less bending thereof than the bending of the covers during the flexing of the mat and thereby to exert less bending strain upon the strip conductor, a pair of terminals disposed at the ends of the strip conductor at the said one edge of the mat, a U-shaped insulating binder for receiving the said one edge of the mat with the arms of the binder secured to the covers and with the neck of the binder displaced from the said one edge of the mat to provide a channel, and an electric cable inserted within the channel and provided with connectors connected to the respective terminals of the strip conductor at the said one edge of the mat for connecting a source of electric current to the terminals to heat the strip conductor.

4. A mat or the like comprising flexible resilient longitudinally extending insulating covers one of which is provided with an outer tread face, a pair of juxtaposed flexible longitudinally extending insulating sheets of less width than the width of the covers loosely interposed between the covers, the covers being adhesively secured together along their longitudinal margins exterior to the longitudinal edges of the sheets, one of the flexible sheets being provided substantially coplanar with its surface adjacent to the other flexible sheet with an adhesively secured thin planar zigzag metal-foil strip conductor providing a continuous flat conductive path extending from one transverse edge of the mat longitudinally along the mat to the oppositely disposed transverse edge and back longitudinally along the mat to the said one edge, the said other flexible sheet preventing contact between the strip conductor and the cover adjacent thereto, the sheets being of less resiliency than the resiliency of the covers in order to provide for less bending thereof than the bending of the covers during the flexing of the mat and thereby to exert less bending strain upon the strip conductor, a pair of terminals disposed at the ends of the strip conductor at the said one edge of the mat, a U-shaped insulating binder for receiving the said one edge of the mat

with the arms of the binder secured to the covers and with the neck of the binder displaced from the said one edge of the mat to provide a channel, and an electric cable inserted within the channel and provided with connectors connected to the respective terminals of the strip conductor at the said one edge of the mat for connecting a source of electric current to the terminals to heat the strip conductor.

5. A mat or the like comprising flexible resilient longitudinally extending insulating covers one of which is provided with an outer tread face, a plurality of successively disposed juxtaposed flexible longitudinally extending insulating sheets providing a plurality of successive pairs of adjacent surfaces of less width than the width of the covers loosely interposed between the covers, the covers being secured together along their longitudinal margins exterior to the longitudinal edges of the sheets, one of the said surfaces of each pair of surfaces being provided substantially coplanar therewith adjacent to the other surface of the respective pair of surfaces with a thin planar zigzag strip conductor providing a continuous flat conductive path, the zigzag strip conductors associated with the pairs of surfaces being staggered to provide interlaced conductive paths, the sheets being of less resiliency than the resiliency of the covers in order to provide for less bending thereof than the bending of the covers during the flexing of the mat and thereby to exert less bending strain upon the strip conductors, terminals connected to the ends of each strip conductor, and connectors connected to the respective terminals for connecting a source of electric current to the terminals to heat the strip conductors.

6. A mat or the like comprising flexible resilient longitudinally extending insulating covers one of which is provided with an outer tread face, a pair of juxtaposed flexible longitudinally extending insulating sheets of less width than the width of the covers loosely interposed between the covers, the covers being secured together along their longitudinal margins exterior to the longitudinal edges of the sheets, one of the flexible sheets being provided substantially coplanar with its surface adjacent to the other flexible sheet with a thin planar zigzag strip conductor providing a continuous flat conductive path, the said other flexible sheet preventing contact between the strip conductor and the cover adjacent thereto, the sheets being of less resiliency than the resiliency of the covers in order to provide for less bending thereof than the bending of the covers during the flexing of the mat and thereby to exert less bending strain upon the strip conductor, a pair of terminals disposed at the ends of the strip conductor near a transverse edge of the mat, a U-shaped insulating binder for receiving the said edge of the mat with the arms of the binder secured to the covers

and with the neck of the binder displaced from the said edge of the mat to provide a channel, and an electric cable inserted within the channel and provided with connectors connected to the respective terminals for connecting a source of electric current to the terminals to heat the strip conductor.

7. A mat or the like comprising flexible resilient longitudinally extending insulating covers one of which is provided with an outer tread face, a plurality of successively disposed juxtaposed flexible longitudinally extending insulating sheets providing a plurality of successive pairs of adjacent surfaces of less width than the width of the covers loosely interposed between the covers, the covers being secured together along their longitudinal margins exterior to the longitudinal edges of the sheets, one of the said surfaces of each pair of surfaces being provided substantially coplanar therewith adjacent to the other surface of the respective pair of surfaces with a thin planar zigzag strip conductor providing a continuous flat conductive path extending from one transverse edge of the mat longitudinally along the mat to the oppositely disposed transverse edge and back longitudinally along the mat to the said one edge, the zigzag strip conductors associated with the pairs of surfaces being staggered to provide interlaced conductive paths, the sheets being of less resiliency than the resiliency of the covers in order to provide for less bending thereof than the bending of the covers during the flexing of the mat and thereby to exert less bending strain upon the strip conductors, a pair of terminals connected to the ends of each strip conductor, a U-shaped insulating binder for receiving the said one edge of the mat with the arms of the binder secured to the covers and with the neck of the binder displaced from the said one edge of the mat to provide a channel, and an electric cable inserted within the channel and provided with connectors connected to the pairs of terminals of the strip conductors at the said one edge of the mat for connecting a source of electric current to the terminals to heat the strip conductors.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 21,474	McCleary	June 4, 1940
416,360	Dewey	Dec. 3, 1889
1,950,124	Samuels	Mar. 6, 1934
2,215,042	Howard et al.	Sept. 17, 1940
2,340,097	Woodman	Jan. 25, 1944
2,511,378	Roberson	June 13, 1950
2,513,733	Morris	July 4, 1950
2,600,486	Cox	June 17, 1952
2,610,286	Cox	Sept. 9, 1952
2,619,580	Pontiere	Nov. 25, 1952