

Aug. 22, 1961

H. O. LEIPOLD ET AL

2,997,568

HEATING STRUCTURE

Filed Jan. 19, 1959

2 Sheets-Sheet 1

FIG. 1

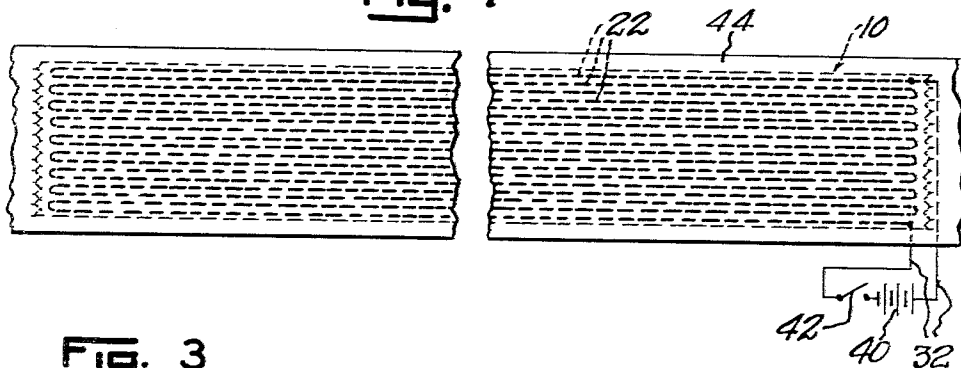


FIG. 3

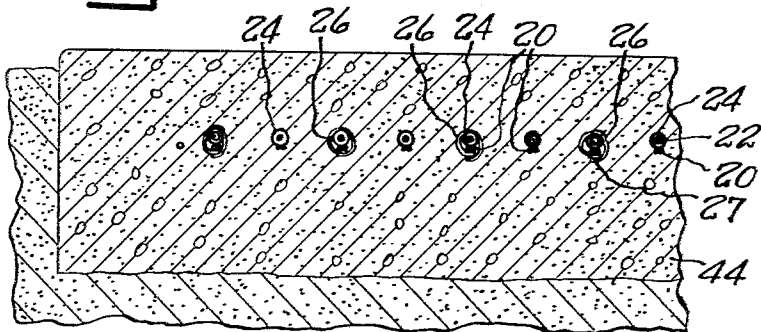
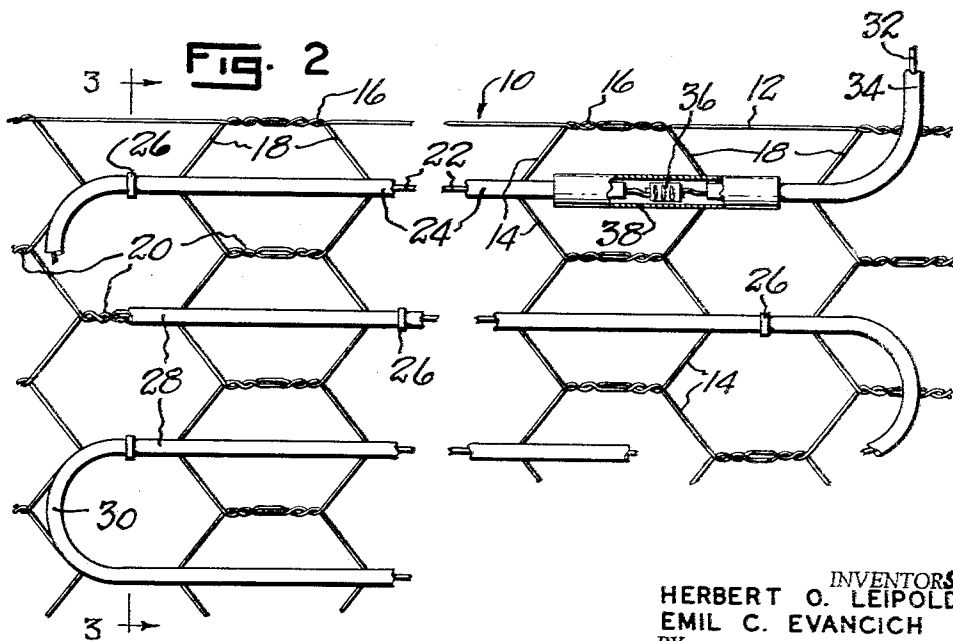


FIG. 2



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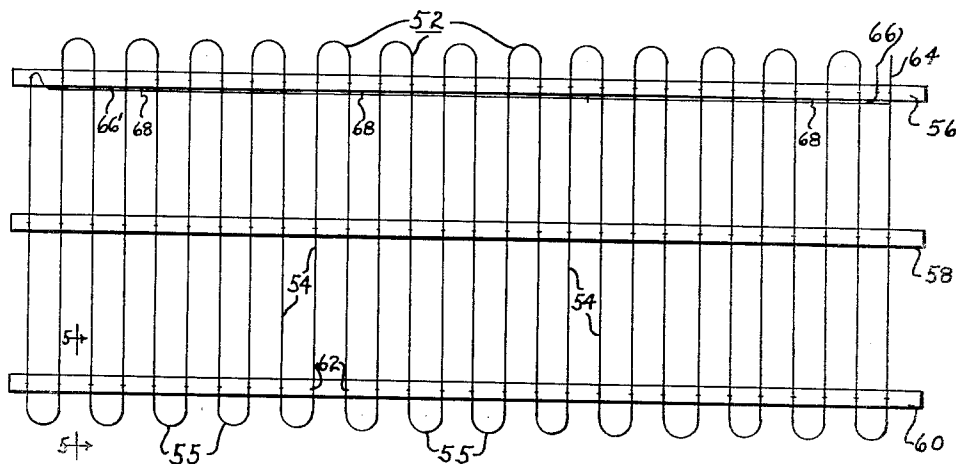


FIG. 4

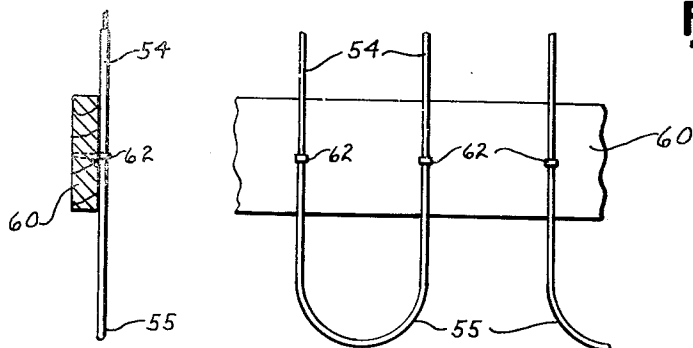


FIG. 6

FIG. 5

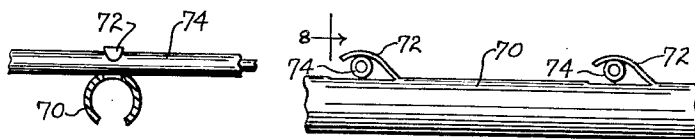


FIG. 8

FIG. 7

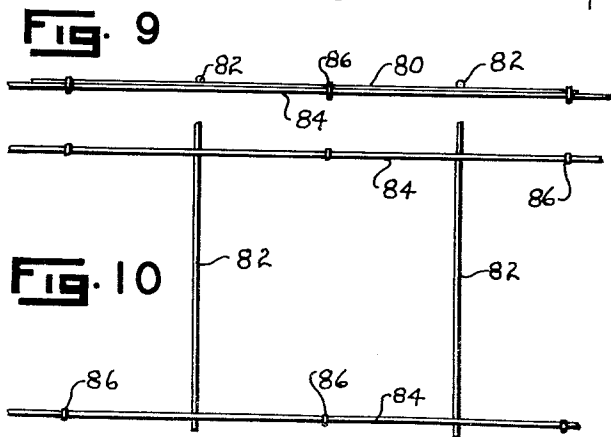


FIG. 11

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## HEATING STRUCTURE

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Filed Jan. 19, 1959, Ser. No. 787,546

7 Claims. (Cl. 219-19)

The present invention relates to a heating unit and more particularly to an electrical heating structure adapted to be embedded in the ground, driveways, runways, sidewalks, ramps, steps, roads and the like.

One of the principal objects of the invention is to provide an electrical heating structure which will effectively and economically maintain the temperature of driveways, sidewalks, ramps and the like at a level sufficient to melt ice and snow and prevent its formation thereon, and which is so constructed that it can be easily stored, transported and readily incorporated in driveways, runways, ramps and roads during the construction thereof.

Another object of the invention is to provide a structure having an electrical heating wire distributed substantially throughout which permits the wire to be quickly laid and held in place during construction of driveways, walks and the like, eliminating the tedious and time consuming operation normally interrupting the construction work of laying and securing the individual strands or sections of wire in place.

Another object of the invention is to provide a heating structure for the aforesaid uses which not only functions as an effective means for maintaining the material of a driveway or the like in which it is embedded above a desired minimum temperature but also forms an effective reinforcing means for the material to prevent or minimize cracking.

A further object of the invention is to provide an electrical heating unit which is adapted to be embedded in concrete or other material forming driveways, sidewalks, roads and the like, and which has an electrical resistance wire supported on and carried by a porous, flexible metal structure giving substantial protection to the wire while it is being embedded in the concrete and facilitating effective and uniform distribution of heat from the wire throughout the surface of the driveways and sidewalks overlying the unit.

Still another object is to provide a porous flexible unitary structure which can readily be placed or embedded in the ground or in concrete or asphalt in a single simple operation without any special skill or know-how and without any special tools, equipment or fixtures.

Another object of the invention is to provide a relatively simple, easily fabricated heating structure adapted for the aforesaid uses and constructed of materials resistant to corrosive and decaying conditions.

Another object of the invention is to provide a heating structure which can be laid on fluid concrete during the installation operation and which will remain in place while an additional layer of concrete is poured thereon.

Additional objects and advantages will become apparent from the following description and accompanying drawings, wherein:

FIGURE 1 is a plan view of a strip of pavement or a section of a driveway illustrating schematically in broken lines the manner in which our heating structure is positioned therein;

FIGURE 2 is an enlarged fragmentary plan view of our new heating structure with portions broken away to better show the construction thereof;

FIGURE 3 is a fragmentary transverse sectional view taken on line 3-3 of FIGURE 2 showing our heating

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structure embedded in a section of pavement such as a driveway;

FIGURE 4 is a plan view of a modified form of a heating structure embodying our invention;

FIGURE 5 is a vertical fragmentary cross sectional view of the structure shown in FIGURE 4, taken on line 5-5 of said figure;

FIGURE 6 is a fragmentary plan view of the structure shown in FIGURE 5;

FIGURE 7 is a fragmentary elevational view of a further modified form of the present invention;

FIGURE 8 is a vertical cross sectional view of the structure shown in FIGURE 7, taken on line 8-8 of said figure;

FIGURE 9 is a side elevational view of a still further modified form of the present invention;

FIGURE 10 is a plan view of the modified form of heating structure shown in FIGURE 9; and

FIGURE 11 is an end elevational view of the heating structure shown in FIGURE 9.

Referring to the embodiment of the present invention disclosed in FIGURES 1 through 3, numeral 10 designates a wire mesh or screening characterized by light weight, flexibility, capability of being rolled, and large openings which preferably are in the order of one inch or more in size. In the form shown, the screening is characterized by longitudinal marginal wires 12 and intermediate wires 14. Each marginal wire is connected with an adjacent intermediate wire 14 at spaced intervals, as at portions 16 at which said wires are interlocked by twisting. The portions of the intermediate wire between the twisted portions 16 are offset laterally at 18. The offset portions 18 are in turn twisted or intertwined with portions of adjacent intermediate wires 14 at 20. The arrangement is such that a regular substantially hexagonal pattern is formed in the screen with adjacent intermediate wire portions 14 interconnected at twisted portions 20 thereof regularly and uniformly throughout the area of the screen. The twisted portions 16 and 20 provide regularly spaced and arranged portions of reinforced character for increased strength. The screen may also be woven wire screen of any mesh and of any pattern desired. The wire may be of any suitable gauge and we prefer to use wire sufficiently thin to be inherently flexible. The wire will preferably be galvanized or otherwise treated to resist rusting thereof. We prefer to employ wire screens in selected sizes. Thus we find that the screen will serve well its intended purposes in widths of twelve inches to twenty-four inches, and preferably a width of approximately eighteen inches. The screen is preferably formed in convenient lengths, such as lengths of five feet, ten feet, twelve feet, twenty feet, or any other length which can be handled conveniently when rolled and which will enable a user to complete a drive of any desired length by using a combination of units of different standard lengths.

An insulated electric resistance or heating element is carried by the screening. The heating element consists of resistance wire 22 encased within an insulating waterproof sheath 24 of flexible material, such as a thermoplastic. One thermoplastic material particularly well suited for the insulation 24 is a vinyl resin of thin wall construction which accommodates bending of the wire 22, is waterproof, and constitutes a good electrical insulation. It will be understood, however, that any type of insulation coating, such as rubber, synthetic rubber, fabric coated or impregnated with waterproofing material, or the like, may be utilized.

The electric resistance wire is secured to the screening by any suitable means. We find that metal loop or staple members 26 are particularly well suited for use as securing members, the same preferably being formed of

narrow thin flat or strip stock bent to looped form around the insulation and a part of the wire screening to provide a split ring of slightly more than one convolution so that the ends thereof lap, as illustrated at 27 in FIGURE 2. Securing members 26 will preferably be formed of wire stock of sufficient strength and rigidity to retain their shape and to perform their anchoring function after being bent to loop form and without requiring mechanical interlocking of the ends of the loop-forming portions. Other securing means, such as cord ties and strips of adhesive tape, may be used to anchor the heating element to the screen if desired.

We prefer to arrange the insulated heating wire in a plurality of straight runs 28 spaced apart substantially uniformly and interconnected at bent portions 30 adjacent opposite edges of the screen. Each longitudinal run 28 will be secured by the securing members 26 at a plurality of spaced points along its length and will preferably be anchored at twisted portions 20 of the wire screen at which the screening is reinforced or strengthened, as described above. It will be understood, however, that the pattern in which the heating wire is arranged, and the points at which it is secured to the screen, may differ from that described as long as the spacing of the heating wire runs imparts the desired heating characteristics to our unit and so long as a secure anchorage of the heating wire to the screen is obtained.

The opposite ends of the heating wire are connected to cold lead wires 32, each preferably being of flexible character, though not necessarily so, and provided with an insulating sheath 34 which may be of thermoplastic material such as a vinyl resin, or of any other suitable type. The terminal portions of the wires 22 and 32 are connected by a suitable fastener or connector element 36 to effect electrical connection therebetween. The bared portions of the wire are protected by a flexible tube or sleeve 38 of insulating material encasing the same and the connector 36 and also encasing portions of the insulations 24 and 34 of the respective connected wires. The sleeve 38 is preferably formed of thermoplastic material similar to that used in the insulation or sheathing 24 and 34 of the wires, such as a vinyl resin which is capable of being bonded by heat or by cement to insulating sheathings 24 and 34 to effect a liquid-tight seal or protection for the junction between the electric heating wire and each lead wire 32.

The electrical leads 32 may be connected to any suitable source of power 40 to complete a circuit under the control of a switch 42.

In the use of the unit, as in a driveway, concrete 44 is first poured in the usual forms (not shown) to a depth of at least several inches and preferably to a depth of one and one-half inches to two inches less than the desired depth or thickness of the pavement or slab, and is leveled throughout in the conventional manner. Our unit of the desired length is then laid upon the concrete. In the case of a driveway, the units will be positioned in the concrete at the part or parts thereof which normally will be traversed by the wheels of a vehicle, and will be laid the length of the driveway with the lead wires 32 of each unit projecting laterally to the exterior of the form. In long driveways a number of units may be required, the units being laid end to end in alignment throughout. The strip units will be laid substantially flat so as to be substantially parallel with the plane of the finished surface of the pavement. Thereupon additional concrete is poured into the form to cover the strip units and to complete the slab or pavement.

The lead wires 32 of adjacent strip units or sections can then be connected to a source of power 40 in a circuit under control of switch 42. If desired, adjacent strip units or sections may constitute independent circuits or they may be connected in series or in parallel relation.

The combination of the wire mesh 10 and the multi-

ple runs of insulated heating element 22, 24 will not sink in the fresh or fluid concrete of its own weight, and will not readily become displaced when the layer of concrete is poured thereon. Thus the strip units remain in the desired plane at a selected spacing below the top surface of the pavement 44 and substantially uniformly spaced therefrom throughout its length.

The wires or heating elements 22, 24 are maintained evenly or substantially uniformly spaced, or spaced in any other pattern having substantially uniform heating effect upon the pavement 44 in which they are embedded. The anchoring of the heating element to the wire screening places the insulation sheath 24 of the heating elements in contact with the wire screening at twisted or reinforcing portions 20 of the wire so as to transfer heat to the wires which make up the screen. These screen wires, being formed of metal, constitute good conductors of heat and serve to distribute evenly the heat generated by the heating elements 22, 24 throughout all portions of the wire screen 10 and substantially uniformly throughout the area of the pavement 44 in which the wire screen is embedded.

The strip unit is preferably placed with the heating elements 22, 24 positioned below the plane of the wire mesh or screen 10. In this manner the wire screen 10 serves to protect the heater wire 22, 24 from injury incident to manipulation of the concrete as the top layer of the concrete is leveled by tools in forming the pavement 44. Thus the wire screen protects the heating element 22, 24 from damage and at the same time serves to retain the heating element in proper position in the fluid concrete.

In addition to protection of the heating wire, the wire screen 10 serves to reinforce the concrete and to minimize cracking of the concrete. Avoidance of cracking of the concrete tends to protect the heating element 22, 24 embedded therein against breakage.

In the modified form of the heating structure shown in FIGURES 4, 5 and 6, an electrical resistance wire 52 is looped back and forth forming a series of parallel straight sections 54 and connecting curved sections 55. The spacing between the straight sections may be varied in any particular heating structure or from one heating structure to another to obtain the desired heat distribution in the pavement or other material in which the present structure is placed. Wire 52, which is constructed of the same material as the resistance wire employed in the previous embodiment, is mounted on and firmly secured to a plurality of parallel wood carrier members 56, 58 and 60, preferably extending the full length of the unit. Two, or more than the three carrier members shown, may be used if the size of the unit requires the modification, and these members in addition to wood may be of metal, treated paper board or plastic material. Staples 62 or other types of fixtures are used to secure the resistance wire to the members in the manner clearly shown in FIGURES 5 and 6. Opposite ends of wire 52 are connected by cold wires 64 and 66 which terminate in close proximity to facilitate connection into an electrical circuit at the time the heating unit is installed. Wire 66' connecting lead 66 with hot wire 52 may be either a hot or cold wire and is secured to the side of carrier member 56 by staples 68 or the like. When the heating structure shown in FIGURES 4, 5 and 6 has been assembled in the manner described, usually in a fabricating plant a substantial distance from the place where it will be installed, it is rolled crosswise into a compact unit by rolling or folding one of the side carrier members toward the opposite side. When the heating structure is to be installed, it is unrolled or unfolded into the shape shown in FIGURE 4 at the place of installation.

FIGURES 7 and 8 show fragmentary views of a structure similar to that shown in FIGURES 4, 5 and 6; however, in the former, carrier members 70 consisting of channel iron or open sided metal tubing are substituted for the wood members 56, 58 and 60, the fixtures 72 for securing the resistance wire 74 to the members being

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formed integrally with the members and being pressed inwardly toward the members to hold the wire. The structure incorporating members 70 is rolled or folded in the same manner as that described for the structure of FIGURE 4.

The heating structure disclosed in FIGURES 9, 10 and 11 is similar to the one disclosed in FIGURES 1 through 3 except that the carrier member for the resistance wire consists of welded parallel equally spaced wires 80 and 82 longitudinally and transversely arranged to form rectangular spaces therebetween. The resistance wire 84 is preferably placed in direct contact with either the longitudinal or transverse wires throughout most of their length and secured thereto by clips or fixtures 86. This heating structure can be rolled for storage and transportation and unrolled for installation, and when it has been intalled in a driveway, sidewalk or the like and energized, the heat from the resistance wire is distributed throughout the longitudinal and transverse wires 80 and 82 and thence substantially uniformly to the surface of the driveway or sidewalk.

Uniformity of the depth of the heating element and carrier in the concrete insures a uniform heating of the full length of the portion of the concrete 44 in which the strip unit is embedded. Consequently, when snow or ice collects upon a pavement, the energization of the heating elements will substantially uniformly melt snow and ice on the portions of the pavement having the embedded heating element and thereby will minimize the amount of electric current which is required to be consumed for the purpose of clearing the pavement of snow and ice. In this connection, only the amount of electrical current required to effect clearing of the pavement of snow and ice will be used.

In the installation of all of the embodiments of the present invention disclosed herein, the heating structure is laid in place as an integral unit during the construction of a driveway or other pavement and is held firmly therein while the construction operation is completed. The installation of the structure is completed without delaying construction of the pavement for any appreciable time and without the need for any skilled workmen, special tools or equipment. This is a distinct advantage over the conventional procedure which causes long interruption in the construction work while a single strand of wire is being laid back and forth on a partially completed slab of pavement and secured in place before the final layer of the pavement is poured.

Although the present description has been directed primarily to a heating structure for installation in driveways, sidewalks, ramps and the like, the structure can be effectively used without modification to warm or heat lawns and garden areas, hot beds and other farm applications, and walks and driveways constructed of loose material such as gravel, crushed stone and the like. In installing the present heating structure for these uses it is placed at a depth of between two and six inches, i.e. a sufficient depth below the surface to hold the structure in place and to protect it from surface travel. The term "pavement" will be used in the claims to refer to and include all the uses and purposes of the present heating structure mentioned herein.

Only the preferred embodiments of the invention have been illustrated and described in detail herein; however, it will be understood that changes in the construction may be made without departing from the scope of the invention.

We claim:

1. A combination heating and reinforcing structure for installation in pavement, comprising a strip of flexible wire mesh of longitudinally arranged intermittent sections, said sections being connected to adjacent sections by diagonally extending sections, an insulated electric resistance heating wire contacting said intermittent sections and lying parallel thereto and arranged in a predetermined pattern having uniformly spaced parallel sections and

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curved sections connecting adjacent parallel sections, a plurality of means spaced along said wire securing said heating wire to said intermittent sections, and flexible insulated electrical leads connected to each end of said resistance wire and projecting beyond the edge of said carrier strip.

2. A combination heating and reinforcing structure for installation in pavement, comprising a strip of flexible wire mesh of longitudinally arranged intermittent sections, said sections being connected to adjacent sections by diagonally extending sections, an insulated electric resistance heating wire contacting said intermittent sections and lying parallel thereto and arranged in a predetermined pattern having spaced parallel sections and curved sections connecting adjacent parallel sections, a plurality of means spaced along said wire connecting said heating wire to said intermittent sections, and insulated electrical leads connected to each end of said resistance wire and projecting beyond the edge of said carrier strip.

3. A combination heating and reinforcing structure for installation in pavement, comprising a strip of flexible wire mesh of longitudinally and transversely arranged wires, an insulated electric resistance heating wire secured to said first mentioned wires and lying parallel thereto and arranged in a predetermined pattern having spaced parallel sections and curved sections connecting adjacent parallel sections, a plurality of means spaced along said wire attaching said heating wire to said first mentioned wires, said heating wire and insulation being flexible and in the form of strands and so joined to said mesh by said means as to flex readily and fully therewith, and insulated electrical wires connected to each end of said heating wire.

4. An electric heating structure, comprising a strip of flexible mesh having longitudinally arranged spaced members, an insulated electric resistance heating wire connected to said members and lying parallel thereto and arranged in a predetermined pattern, a plurality of means spaced along said wire connecting said heating wire to said members, said heating wire and insulation being flexible and in the form of strands and so joined to said mesh by said means as to flex readily and fully therewith, and insulated electrical leads connected to each end of said heating wire.

5. An electric heating structure, comprising a flexible carrier of longitudinally arranged spaced members, an insulated electric resistance heating wire of flexible construction mounted on said members and arranged in a predetermined pattern having spaced parallel sections and curved sections connected adjacent parallel sections, a plurality of means spaced along said wire securing said heating wire to said members, said heating wire and insulation being in the form of strands and so joined to said members by said means as to form a structure which can be rolled and folded upon itself, and insulated electrical wires connected to each end of said resistance wire.

6. An electric heating structure, comprising a plurality of substantially flexible members arranged parallel and coextensive with each other, an insulated electric resistance heating wire of flexible construction mounted on and connected to said members and extending transverse thereto having spaced parallel sections and curved sections connecting adjacent parallel sections, a plurality of means spaced along said wire securing said heating wire to said members, said heating wire and insulation being in the form of strands and so joined to said members by said means as to form a structure which can be rolled and folded upon itself, and insulated electrical wires connected to each end of said resistance wire.

7. An electric heating structure, comprising a strip of flexible wire mesh having longitudinally arranged spaced members, an insulated electric resistance heating wire mounted on said members and lying parallel thereto, a plurality of means spaced along said wire connecting said heating wire to said members, said heating wire

and insulation being flexible and in the form of strands and so joined to said mesh by said means as to form a structure which can be rolled and folded upon itself, and insulated electrical wires connected to each end of said resistance wire.

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### Disclaimer

2,997,568.—*Herbert O. Leipold*, South Bend, and *Emil C. Evancich*, New Carlisle, Ind. HEATING STRUCTURE. Patent dated Aug. 22, 1961. Disclaimer filed Dec. 14, 1964, by the assignee, *The Singer Company*.

Hereby enters this disclaimer to claims 1, 2, 3, 4, 5 and 7 of said patent.  
[*Official Gazette March 23, 1965.*]

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