Dec. 12, 1950 R. S. TICE 2,533,409

ELECTRICAL HEATING SYSTEM

Filed Jan. 28, 1947

Fig. 1.

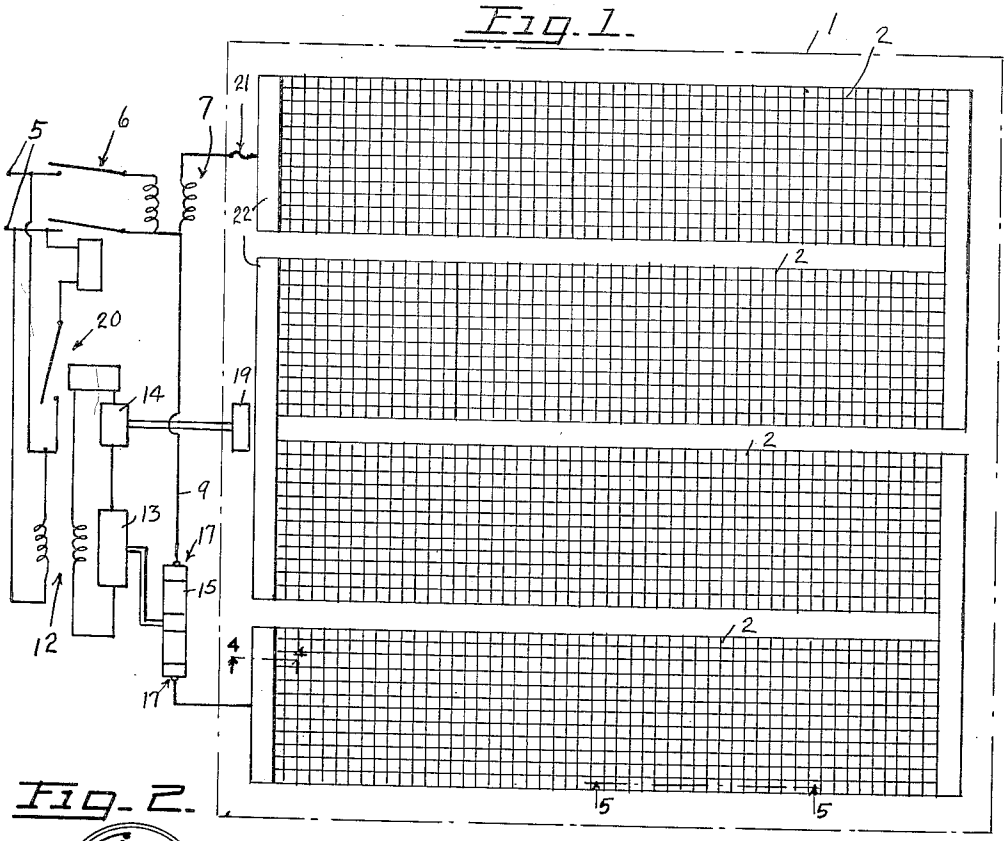


Fig. 2.

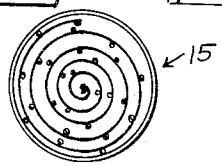


Fig. 4.

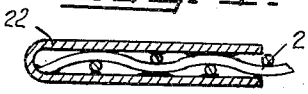


Fig. 3.

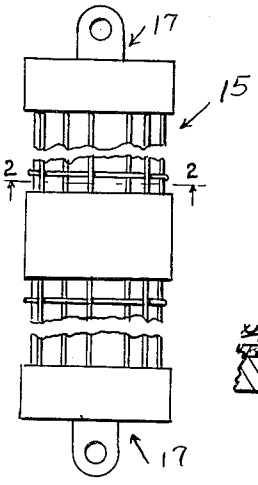


Fig. 5.

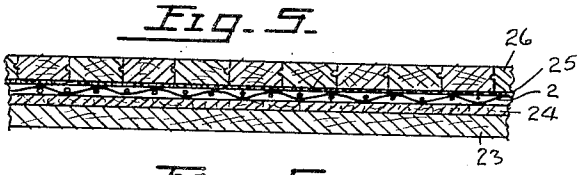


Fig. 6.

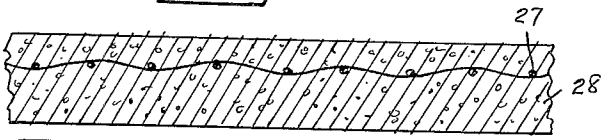
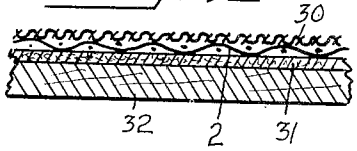


Fig. 7.



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ELECTRICAL HEATING SYSTEM

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Application January 28, 1947, Serial No. 724,825

5 Claims. (Cl. 219—19)

1

This invention relates to an electrical heating system, and to means for electrically heating rooms and their floors.

One of the main objects of the invention is the provision of a relatively inexpensive, safe, efficient, and quiet electrical heating system that does not require specially constructed expensive heating elements and that is practically indestructible from use.

Heretofore, suggestions have been made for forming special plates or wires of expensive alloys that are electrically insulated for panel heating and the like. Also, many of the installations heretofore suggested require the use of refractory material for heat insulation and some suspend the heating means in air spaces.

With the present invention, ordinary galvanized hardware cloth is suitable for providing an economical, indestructible heating means, and for providing a safe and uniformly heated floor, panel, or the like.

Also, this invention provides means for isolating the heating elements from the source of electrical power against the generation of dangerous and detrimental stray currents where the elements might be in moist areas that would be conducive to the generation of such currents.

In the drawings:

Fig. 1 is a diagrammatic plan view illustrative of an arrangement of the heating elements, or hardware cloth, and also, said view diagrammatically includes the control circuit.

Fig. 2 is an enlarged sectional view taken through the thermal unit that is one of the features of the invention, said view being taken along line 2—2 of Fig. 3.

Fig. 3 is a side elevational view of the thermal unit of Fig. 2.

Fig. 4 is an enlarged sectional view taken along line 4—4 of Fig. 1 through one of the end terminals of the heating system.

Fig. 5 is a sectional view through a finished floor as might be taken along line 5—5 of Fig. 1 when the floor covered the elements shown in Fig. 1.

Fig. 6 is a fragmentary sectional view taken through a concrete floor showing a section of large mesh hardware cloth therein.

Fig. 7 is a fragmentary sectional view of a modified form of the invention.

The dot-dash lines 1 shown in Fig. 1 are used to indicate the outlines of the floor of a room, and in which floor are strips 2 of standard hardware cloth arranged in a row in spaced parallel, coplanar, side by side relationship. This hardware cloth may be of from one-fourth to one inch mesh, any of which is standard. The size used, amount of heating and the currents applied are all related, as will later be explained more in detail.

2

While the voltages up to 50 volts may quite easily be used with the hardware cloth, the preferred voltage is between 30 and 35 volts. Using this, an example may be given showing the values required for heating a certain room volume.

Assuming it requires the expenditure of 3600 watts electrical energy to heat a given room volume and that 30 volts current is to be applied to the strips, it is necessary to know the length of the strips required. If I equals current in amperes, W equals power in watts and E equals voltage, the current required is found by the formula:

$$I=\frac{W}{E}=\frac{3600}{30}=120 \text{ amperes}$$

The total resistance of R in ohms of the conductor may be formed by the formula:

$$R=\frac{E}{I}=\frac{30}{120}=.250 \text{ ohm}$$

Since standard galvanized hardware cloth of No. 18 will be one-half mesh size and eighteen inches wide, it has a resistance R of approximately .0005 ohm per foot, and the length L in feet can be found by the formula:

$$L=\frac{R}{V}=\frac{.250}{.0005}=500 \text{ feet}$$

From the foregoing it is seen that for the above specifications the application of 120 amperes at 30 volts to 500 feet of such hardware cloth will supply heating of approximately 3600 watts.

The current and length of the conductor are inversely proportional to one another and either may be reduced by increasing the other. This example is for illustration only and other values may be adapted to suit the particular needs, but it is found that the size of hardware cloth specified and the values given therefor give adequate heating for the normal home where the strips are spaced several inches apart without raising the temperature to where it is dangerous.

In the circuit illustrated line voltage is supplied at terminals 5, which in the usual instance is 220 volts, 60 cycles, and is applied to the double pole relay switch 6 for applying the wire voltage to the primary of a step-down transformer 7, the secondary of which transformer is connect-

ed to the terminals 8 of the end strips 2. When switch 6 is closed, current at about 30 to 35 volts, as reduced by the transformer 7, is supplied to strips 2.

By the above it will be seen that the transformer 7 acts as an isolating transformer so that stray currents cannot be generated that would be detrimental to the power system servicing the particular job to be heated, nor could there be any danger to the occupants of the room due to such currents. This is a very important feature in the system

The line voltage is also applied to the primary of a transformer 12 whose secondary is connected in a 24 volt control circuit 9.

In series with the secondary winding of transformer 12 are two conventional thermostats 13, 14. The thermostat 13 is connected with a thermal unit 15 that is in series in the strip circuit as will later be explained, while the thermostat 14 is a room thermostat. Each thermostat includes the usual switch in the 24 volt circuit 9 for opening and closing said circuit according to the temperature of either the room air or of the thermal unit.

The thermal unit 15 is merely a section of the same kind of hardware cloth as the strips 2, which section is rolled up so that the longitudinally extending wires of the section and strip extend axially of the roll. Thus, the same number of conductor wires extend from end to end of the roll as extend longitudinally of each strip, and upon the same current passing through said wires the latter will have the same temperature as corresponding wires in the said strips.

Terminals 17 are electrically connected to the ends of the axially extending wires in said thermal unit in any suitable manner for connection of the thermal unit in series in the strip circuit. Said thermal unit may be entirely outside the room that is being heated, but the thermostat 13 is connected therewith for responding to the temperature of said unit for closing or opening the circuit 9.

The temperature sensitive element 19 of the room thermostat 14 is positioned within the room to be heated. Both thermostats are connected in series in circuit 9, and are so arranged that if and when the temperature in the room or of the cable should rise above a predetermined degree respectively, the control circuit is broken. The thermostat 13 may be permanently set at approximately 110° F. which is considerably below a temperature that would be dangerous to the floor. The room thermostat may be variably adjusted for breaking the circuit when the room temperature rises to say, 65° F. to whatever degree the occupants desire.

A relay switch 20 in circuit 9 is in series in said circuit and is arranged so that the switch of the relay will be opened whenever the control circuit 9 is broken by operation of either of the thermostats 13, 14. The switch of relay 20 is connected in series with the coil of relay switch 6, which coil is included in the circuit fed from terminals 5. This latter circuit is so arranged that as long as relay 20 is closed the relay 6 will be closed to permit line voltage to be applied to transformer 7, but when circuit 9 is broken the switch 6 will also be opened and no current will flow in strips 2.

The operation is clear that both of the thermostats 13, 14 must be closed in order that relays 6, 20 will be closed. Opening of either of the thermostatic switches caused by an excessive use in the temperature of the air in the room or by an excessive heating of the strips will open relay switches 6, 20.

A conventional fuse 21 of fusible material is preferably introduced into the strip circuit as an added safety precaution, which fuse will melt and break the circuit at a predetermined rise in the temperature of the strips.

The terminals 22 at the ends of strips 2 are preferably U-shaped strips (Fig. 4) of copper or any other suitable material adapted to receive the end marginal portions of the strips, and the longitudinal wires of strips 2 may be soldered, welded, or brazed to the strips 22 to insure a positive electrical connection between the corresponding ends of all of said wires.

As seen in Fig. 1, some of the said strips 22 are sufficiently long to form conductors between the corresponding ends of adjacent pairs of strips 2 for connecting said strips 2 in series.

A typical installation of the hardware cloth in a floor is seen in Fig. 5 in which there is a subfloor 23 of wood on which is a layer of fibrous, heat insulation material 24 such as the one commonly known under the trade-name of "Celotex." The hardware cloth strips 2 may be laid directly onto this layer of "Celotex" and a sheet or ordinary felt building paper 25 may be laid over the hardware cloth. On top of this felt 25 is the main floor 26. The strips of hardware cloth are preferably only a few inches apart.

With an installation as above described, a very uniform temperature may be maintained in the room at all times and there is no danger of noise.

Where layer mesh hardware cloth, such as the four inch mesh size is employed, it may be imbedded directly in concrete as seen in Fig. 6, wherein the cloth 27 is seen in the concrete 28, preferably near the upper or working surface of the concrete.

An additional use of the invention is shown in Fig. 7 wherein the hardware cloth 2 is shown in conjunction with a rug or carpet 30. In this installation a layer of some fibrous building material 31, such as those materials sold under the names "Koroseal" or "Celotex," is laid on standard flooring 32 and the grid of hardware cloth 33 is laid on top of the fibrous material. The carpet 30, with or without a pad, is then laid over the hardware cloth. The fibrous material 31 serves as a heat insulator as described above in conjunction with layer 24 of Fig. 5.

I claim:

1. A floor heating system comprising a wood subfloor and a wooden floor thereover, parallel electrical conductors having a total resistance of substantially .0005 ohm per foot arranged substantially coplanar between said floor and said subfloor and parallel therewith, a terminal at the ends of said conductors electrically connecting the corresponding ends thereof, a source of relatively high voltage electricity and a step-down transformer between said terminals and said source for supplying a relatively low voltage total current of substantially 10 watts per square foot of floor to said conductors, a sound insulation between said conductors and said floor and a heat insulation between said subfloor and said conductors, said sound insulation and said heat insulation being in direct engagement with the conductors therebetween and said subfloor and the floor above said conductors being in direct engagement with said heat insulation and said sound insulation respectively.

2. A floor heating system comprising a wooden subfloor and a floor thereover, a row of parallel strips of hardware cloth in spaced, coplanar, side by side relationship between said floor and said subfloor, terminals at the opposite ends of said strips respectively electrically connecting the longitudinal wire strands of said strips at each of the opposite ends of the latter, said strips being connected at their ends in series, a relatively high voltage source of electrical current, a step-down transformer connecting the opposite end terminals of said series of strips with said source for applying a relatively low voltage current to the longitudinally extending wires of said strips, a thermal unit and a power thermostat connected therewith in a secondary electrical circuit, said thermal unit comprising a section, the material of said strips formed into a roll with the longitudinally extending wires of said strip extending axially of said roll, terminals at the ends of said roll connected in series with said strips and a relay switch controlled by said thermostat for connecting said source with said transformer when the temperature of said thermal unit is below a predetermined temperature and for disconnecting said source from said transformer when the temperature of said unit is above said predetermined temperature.

3. A floor heating system comprising a wooden subfloor and a floor thereover, a row of parallel strips of hardware cloth in spaced, coplanar, side by side relationship between said floor and said subfloor, terminals at the opposite ends of said strips respectively electrically connecting the longitudinal wire strands of said strips at each of the opposite ends of the latter, said strips being connected at their ends in series, a relatively high voltage source of electrical current, a step-down transformer connecting the opposite end terminals of said series of strips with said source for applying a relatively low voltage current to the longitudinally extending wires of said strips, a thermal unit and a power thermostat connected therewith in a secondary electrical circuit, said thermal unit comprising a section, the material of said strips formed into a roll with the longitudinally extending wires of said strip extending axially of said roll, terminals at the ends of said roll connected in series with said strips and a relay switch controlled by said thermostat for connecting said source with said transformer when the temperature of said thermal unit is below a predetermined temperature and for disconnecting said source from said transformer when the temperature of said unit is above said predetermined temperature, said thermal unit being outside the room having said floor.

4. A floor heating system comprising a wooden subfloor and a floor thereover, a row of parallel strips of hardware cloth in spaced, coplanar, side by side relationship between said floor and said subfloor, terminals at the opposite ends of said strips respectively electrically connecting the longitudinal wire strands of said strips at each of the opposite ends of the latter, said strips being connected at their ends in series, a relatively high voltage source of electrical current, a step-down transformer connecting the opposite end terminals of said series of strips with said source for applying a relatively low voltage current to the longitudinally extending wires of said strips, a layer of felt building paper between said floor and said strips and a layer of fibrous heat insulating material between said subfloor and said strips, said heat insulating material being directly on said sub-floor and supporting said strips directly thereon, and a layer of building paper in relatively close engagement between said strips and the floor thereover.

5. In a floor heating system; a floor, a row of parallel conductors coplanar within said floor, said conductors being connected at their ends in series, end terminals connected with the end conductors of said row, a relatively high voltage source of electrical current, a step-down transformer connecting the end terminals of said series of conductors with said source for applying a relatively low voltage current to said conductors, a thermal unit and a power thermostat connected therewith in a secondary electrical circuit, said thermal unit comprising a conductor section having the same linear, cross sectional and resistance characteristics per unit of length as the respective conductors of said row, terminals at the ends of said section connected in series with the conductors of said row and a relay switch controlled by said thermostat for connecting said source with said transformer when the temperature of said section is below a predetermined temperature and for disconnecting said source from said transformer when the temperature of said unit is above said predetermined temperature.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,781,244	Oswald	Nov. 11, 1930
1,900,831	Marter	Mar. 7, 1933
2,165,970	Jaspers	July 11, 1939

FOREIGN PATENTS

Number	Country	Date
113,192	Australia	June 12, 1941
419,843	Great Britain	Nov. 20, 1934
493,533	Great Britain	Jan. 4, 1937
398,725	Germany	Apr. 5, 1923

OTHER REFERENCES

Ser. No. 317,610, Mossin (A. P. C.), published May 23, 1943.