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ELECTRICAL HEATING SYSTEM FOR DAMP PLACES

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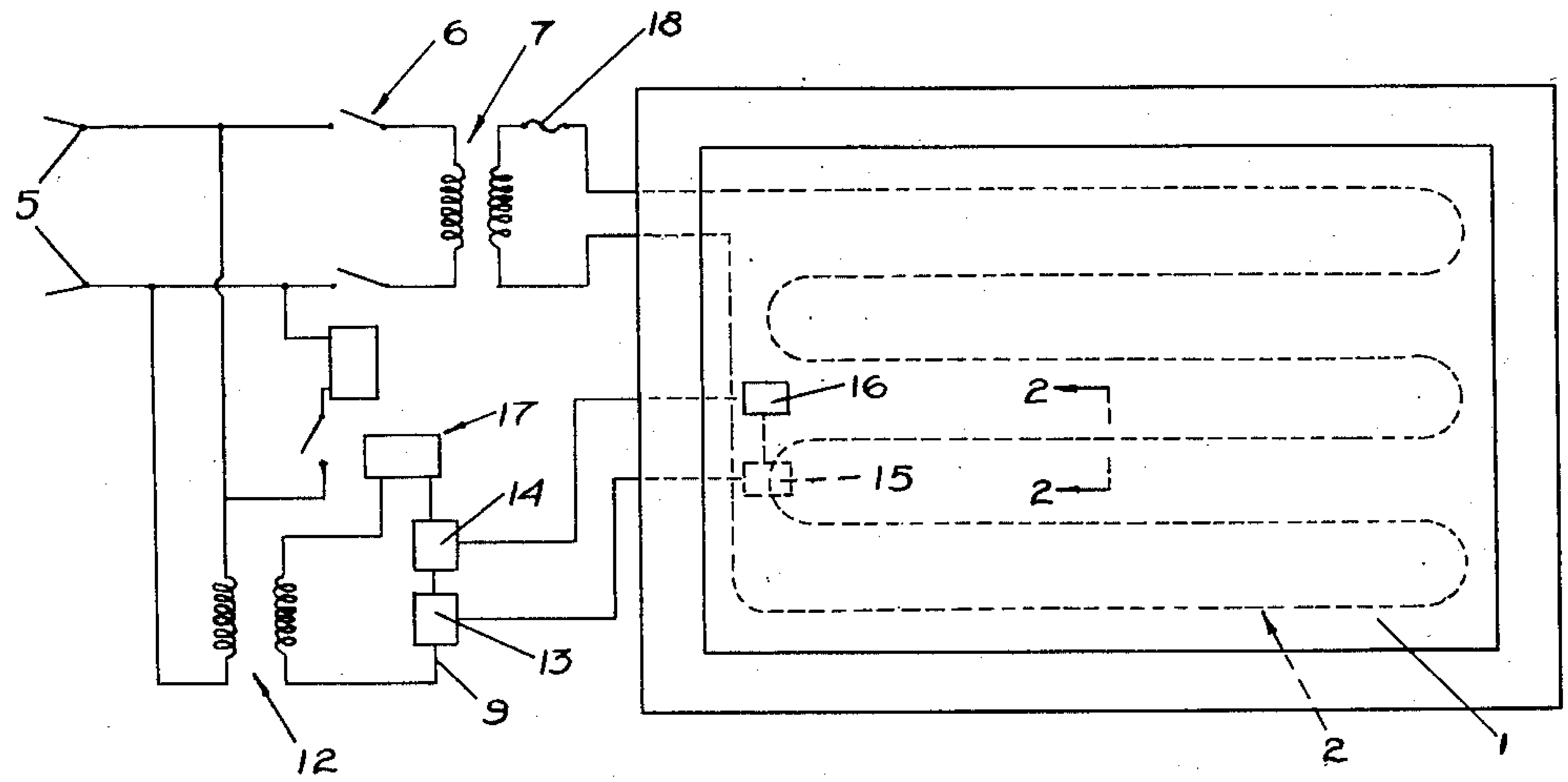

Fig_1

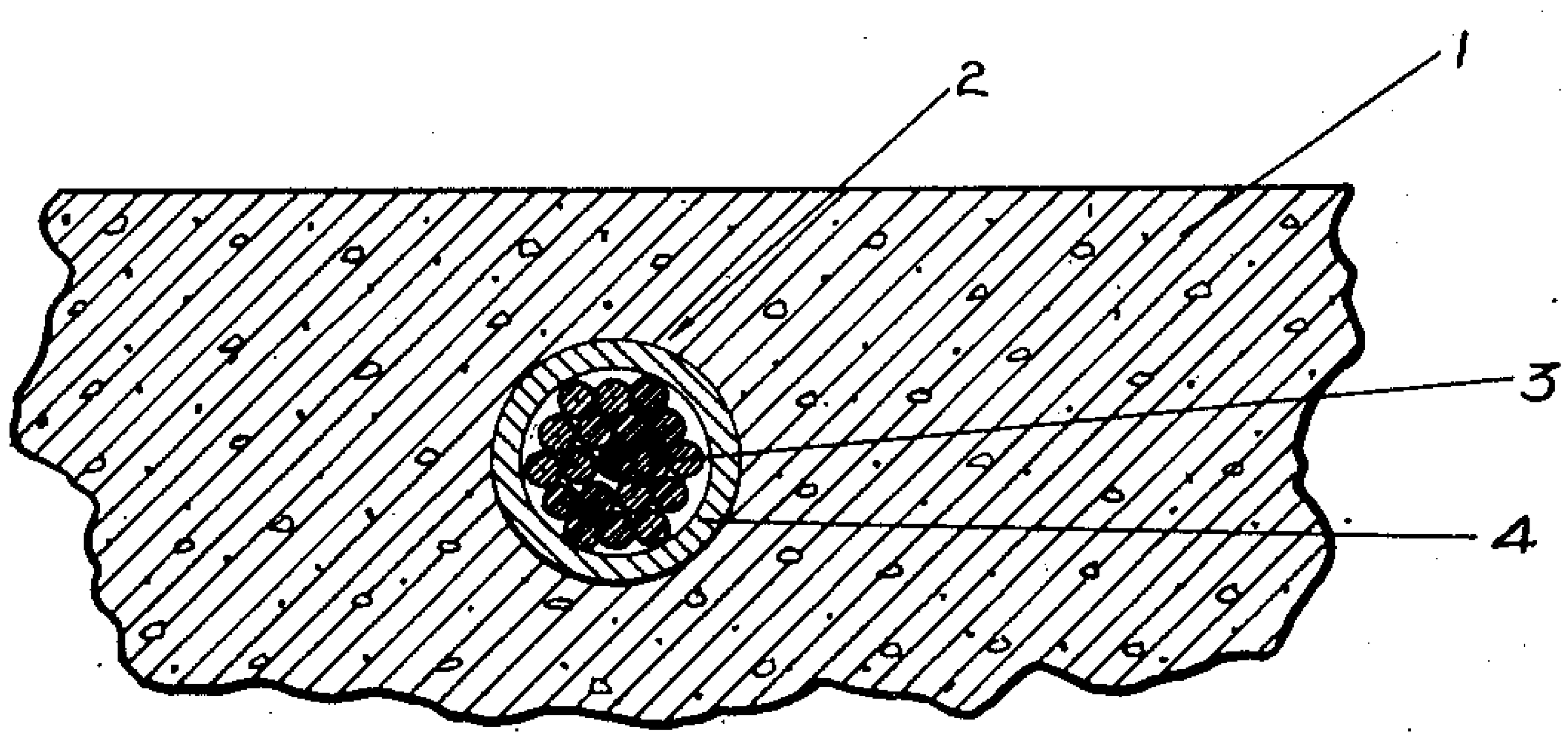

Fig_2

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ELECTRICAL HEATING SYSTEM FOR DAMP PLACES

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4 Claims. (Cl. 219—19)

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This invention relates to an electrical heating system for damp places, such as for swimming pools, concrete floors that may be wet or damp, or in damp soil, etc.

One of the objects of the invention is the provision of means for heating damp places of this above type more efficiently and economically than heretofore, and with safety.

Heretofore, heating by electrical energy has, for the most part, been effected through relatively high resistance heating elements utilizing relatively high voltages of from 110 volts upward. Where relatively large areas are heated a 220 volt circuit is employed. In such installations mechanical failure is relatively frequent, and there is considerable opportunity for short circuits and leakage with consequent danger to human beings and animals. Where there is mechanical failure, etc., the cost of repairs is very high, particularly in such installations as in floors, swimming pools, soil, and the like.

With the present system, no mechanical failure can occur short of a catastrophe apart from that associated with the use of the system. In other words, there is no detrimental wear, as in the case of high resistance elements, and no opportunity for leakages or shorts in the main heating system itself, even where the conductors are damp or wet concrete, or soil.

Furthermore, by the present structure the system is self-grounded and the heating efficiency is increased through the induction of currents in the metallic, non-magnetic, electrical and water insulation material surrounding the magnetic conductor, which material in the present instance, is preferably lead or the like.

In the drawings,

Fig. 1 is a diagrammatic plan view of a swimming pool showing the system.

Fig. 2 is a cross-sectional view taken along line 2—2 of Fig. 1, showing the structure of the conductor and substantially its position within the bottom of the pool.

In detail, the bottom 1 of the pool, or of the concrete floor of a building, or any floor, wall, or ground where there is moisture, or the likelihood of moisture being present, has the electrical conductor 2 imbedded therein.

Conductor 2 is in the form of a cable 3 of magnetic material, such as iron or steel. A relatively soft iron is preferable from the standpoint of economy and to facilitate bending, provided the electrical resistance is substantially uniform throughout the length of the same.

Cable 3 has a covering 4 of lead of sufficient

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thickness, say about $\frac{1}{16}$ of an inch, to provide adequate electrical insulation, and the cable itself is preferably about ½ inch in diameter. When imbedded in a concrete floor the rope or cable may be from about one to two inches below the surface. Of course, where the cable is in a swimming pool it may be exposed to the water, or imbedded in the bottom or walls, or both, as desired. In soil, the conductor may be below the plants or seeds.

While voltages from 50 volts up may be used, in actual installations the voltage is usually between about 20 volts and 100 volts. The preferred voltage in most instances, is about 70 volts, particularly in cement floors in buildings, and in such instances the basic equation may be from about 10 to 50 watts per square foot of total surface to be heated, which may be secured with higher or lower voltages or current or amperes.

Using 30 volts, an example may readily be given showing the values required for heating a certain room volume. Assuming it requires the expenditures of 3900 watts electrical energy to heat a given room volume, and that 30 volts current is to be applied to the cable, it is necessary to know the length of the cable required. If I equals current in amperes, W equals power in watts, and E equals voltage in volts, the current required is found by the formula:

$$I=\frac{W}{E}=\frac{3900}{30}=130 \text{ amperes}$$

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

$$R=\frac{E}{I}=\frac{30}{130}=.232 \text{ ohm}$$

Since it is known that the special ½ inch cable here employed has a resistance R of approximately .00077 ohm per foot, the length can be found by the following formula, where L equals the total length in feet:

$$L=\frac{R}{V}=\frac{.232}{.00077}=300 \text{ feet}$$

Thus, it is seen for the specification adapted, the application of 83.3 amperes at 30 volts to 373 feet of ½ inch 6 x 37 cable or rope will supply heating of approximately 3900 watts. The current and length of the conductor are inversely proportional to one another and either may be reduced by increasing the other.

The example given is for a bare cable and is for illustration, and other values may be adapted to such particular needs.

In the present instance, the magnetic conductor, which is the iron or steel cable, is covered with lead, with the result that current flowing through the wire will cause a flow of induced currents in the lead covering, with the result that the lead is heated by reason of said induced currents, as well as by heat conducted thereto from the cable.

The lead covering of the conductor will also ground the conductor.

In actual practice, the temperature of the lead covered cable for floor heating will usually not exceed about 140° F., although this may be greater where the heating system is used to heat the water in swimming pools, and in pools it is not absolutely essential that the cable be imbedded in the concrete, since it may be supported on the bottom or against the sides adjacent the bottom and may be covered by any suitable sheets or the like, to present a smooth surface to swimmers.

The heating system is also very satisfactory for soil heating, as in the case of seed and plant beds.

In the circuit illustrated, line voltage is supplied at terminals **5**, which voltage is usually 220 volts, 60 cycles, and is applied to the double pole relay switch **6**, preferably of the silent mercury displacement type, for applying the line voltage to the primary winding of a transformer **7**. The secondary winding of transformer **7** is connected with the terminals of the cable **3**. When switch **6** is closed a current of, say 34 volts, is applied to the cable **3**.

By the above arrangement, 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 job, nor could there by any injury to the occupants of the building being heated due to stray currents that might be generated in the absence of the transformer.

The line voltage is also applied to the primary of a transformer **12** whose secondary is in a low voltage control circuit **9**. In series with the secondary winding of transformer **12** are two conventional thermostats, one being a cable thermostat **13**, and the other being a room or water thermostat **14**, according to whether the same is to be used in a room or pool. These thermostats include the conventional switching elements for opening and closing the electrical circuit **9** at predetermined temperature limits of the water, air, or soil, and of the cable.

The temperature sensitive element **15** of the thermostat **13** is connected directly to the conductor **2**, and the temperature sensitive element **16** of the room or pool thermostat is positioned within the space to be heated. Both thermostats are in series in circuit **9** and are so arranged that the switches actuated by said thermostats must both be closed before the circuit **9** is energized.

The conductor thermostat may be permanently set at whatever degree is desirable and which is usually between, say 85° F. and 140° F. where the air of a room is to be heated, or it may be considerably higher for pool heating. The room or pool thermostat is preferably adjustable for actuation of the switch in circuit **9** to open the circuit when the temperature of the room or water rises to a predetermined maximum, which is usually substantially below that at which the conductor thermostat is actuated to open the circuit.

A relay switch **17** 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 is broken by operation of either of the thermostats. The switch of relay **17** 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 **17** is closed, the relay **6** will be closed to permit voltage to be applied to transformer **7**, but when the circuit **9** is broken, the switch **6** will be opened and no current will flow in cable **2**.

Line voltage thermostats could be used, but the present control system is safer and is generally preferred.

A conventional fuse **18** of fusible metal is also introduced into the cable circuit as an added safety precaution, which fuse will melt and will break the cable circuit at a predetermined temperature below that at which danger may follow an excessive rise in temperature.

The lead covered cable **2** may be laid with parallel runs connected by return bends to form a grid, as indicated in Fig. 1, with the adjacent runs spaced apart about a foot where the grid is in a floor.

The present system, apart from the particular conductor shown herein and the installation in water or moist places, is shown in my co-pending application Serial No. 724,824, filed January 24, 1947, now Patent No. 2,540,465, issued February 6, 1950. In that instance, there is no insulation on the cable, which would obviously render the cable unsuitable for the present use.

In the present instance, absolute safety is insured with increased efficiency where the conductor is in wet or damp places, due to the magnetic conductor and the non-magnetic insulation in which currents are induced to flow upon energizing the conductor.

I claim:

1. In an electrical heating system including an electrical alternating current circuit of relatively high amperage and relatively low voltage having a conductor of magnetic material therein providing the heating element, a metallic, waterproof, non-magnetic material enclosing said conductor providing a medium around said cable for establishment of induced currents and consequent heating thereby.

2. In an electrical heating system including an electrical circuit of relatively high amperage and relatively low voltage a lead covered iron cable therein providing the heating element in said system.

3. In an electrical heating system including an electrical circuit of relatively high amperage and relatively low voltage a lead covered iron cable therein providing the heating element in said system, said cable being substantially one-half inch in diameter and the lead covering being substantially one-sixteenth of an inch in thickness.

4. An electrical heating system comprising, a source of electrical energy of relatively high voltage, a heating circuit comprising an iron cable formed to provide a grid, a step-down transformer connecting said source and said cable for establishing a heating current of relatively low voltage and high amperage in said cable, and a lead covering on said cable in intimate contact with the latter providing a waterproof electrical insulation for said cable that is adapted to

ground said cable and to provide for the production of heating induction currents therein when said cable is energized.

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