Feb. 12, 1952 D. B. COX 2,585,443

ELECTRIC HEATING UNIT

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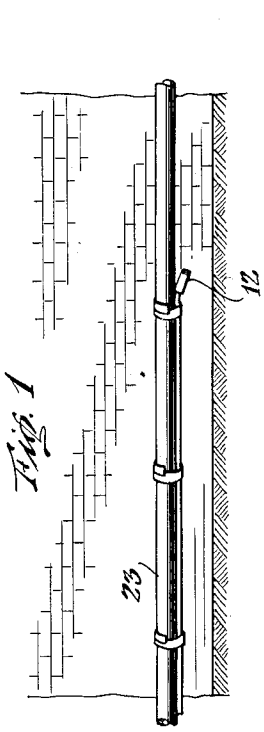
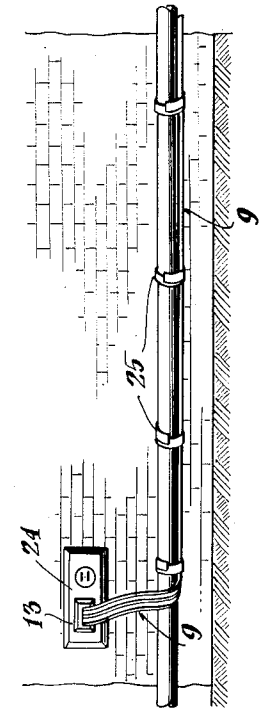


Fig. 1



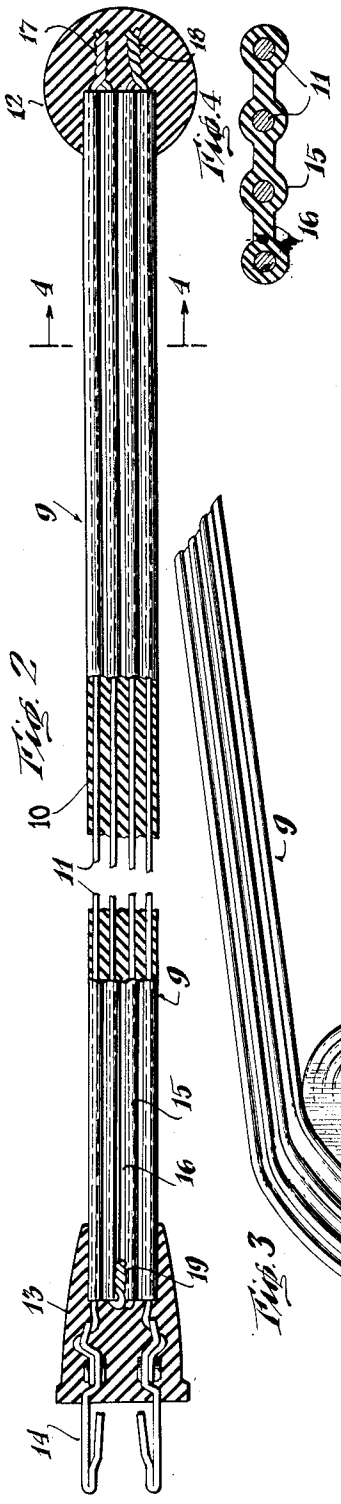


Fig. 2

Fig. 4

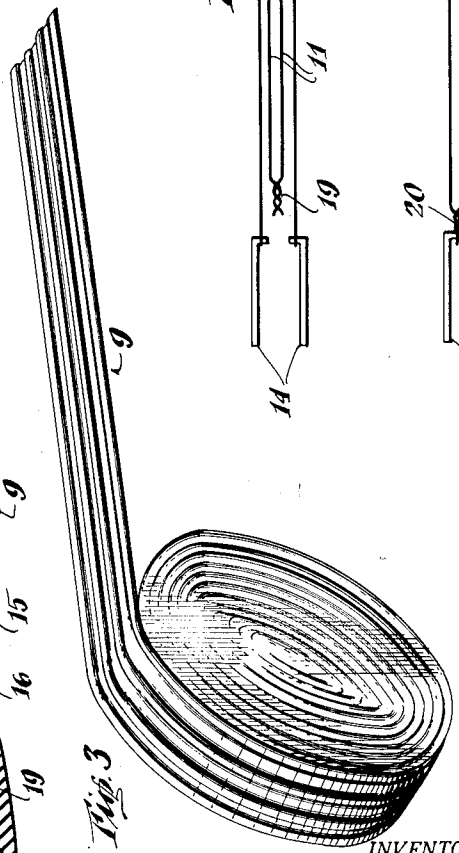


Fig. 3



Fig. 5



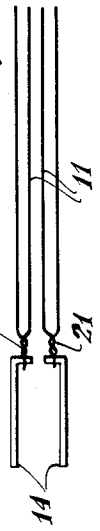


Fig. 6

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ELECTRIC HEATING UNIT

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1 Claim. (Cl. 219—46)

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This invention relates to an improved electric heater in elongated strip or ribbon form.

It is an object of this invention to provide an improved heater of the above character which is simple and inexpensive to manufacture, which is safe and efficient in operation and which is relatively rugged so as to withstand reasonable wear and tear.

A further object is the provision of an electric heater in the form of a pre-formed continuous ribbon having a plurality of separate conductors therein and which can be cut to any desired length and the conductors thereafter joined together to form the desired circuits.

My heater has many different purposes and uses. However, it is particularly useful in association with water pipes to prevent the freezing thereof. Heretofore, it has been proposed to insulate such pipes to prevent their freezing. However, this is not very satisfactory since the insulation does not prevent the water from freezing when it is stationary or static within the pipe for any protracted period of time. It has also been proposed to use an electric heater consisting of a single strand of Nichrome wire wrapped in a layer of asbestos and covered with several layers of varnished cambric plus a coating of lead. The two ends of a suitable length, say 60 feet, are connected to the blades of a conventional attachment plug for connection to a current source. Such heaters, however, are relatively expensive and difficult to install because of the stiffness and weight of the cable. They are relatively inefficient because of the small area of contact between the round cable and the pipe. In some instances it has also been proposed to use a strand of resistance wire coated with a plastic material. In devices of this type the two ends of a suitable length are also connected to an attachment plug. This type of heater has also been inefficient because of the small area of contact with the pipe and has been unsatisfactory because the excessive temperature of the device in the air when out of contact with the pipe has caused deterioration of the plastic material.

It is a particular object of the invention to overcome the difficulties heretofore encountered and to provide an improved electric heating unit useful in association with water pipes to prevent the freezing thereof, which will be inexpensive to manufacture and efficient and safe in operation, which will provide maximum heat transfer from the unit to the pipe to which it is applied, which is so designed and constructed as to provide maximum heat dissipation in the air to prevent undue elevation of the temperature thereof, which is constructed so as to be flexible in design so that the electrical circuits may be readily arranged to meet particular operating conditions and which is sufficiently rugged to be able to withstand the reasonable use and abuse to which a heater of this type is subjected.

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In the accompanying drawing—

Fig. 1 is a side elevation of a water pipe with one of my heaters in association therewith;

Fig. 2 is a fragmentary partially sectional view of one of the heater units;

Fig. 3 is a fragmentary view of the ribbon material from which the heater is made;

Fig. 4 is a transverse sectional view on the lines 4—4 of Fig. 2;

Fig. 5 is a schematic view showing the circuit involved in a heater of the type illustrated in Fig. 2; and

Fig. 6 is a schematic view of a slightly modified form of circuit.

My improved heater consists generally of an elongated ribbon or strip 9 formed of a plurality of conductors 11 embedded in a plastic body 10 and having a cap 12 encasing the return connections of the conductors at one end and a plug 13 at the opposite end.

The plug 13 is of conventional construction being formed of a body of insulating material with the conducting prongs 14 made of suitable metal projecting therefrom. The cap 12 is made of suitable insulating material and encases and is attached to cement, heat or other suitable means to the opposite end of the ribbon 9. The body portion 10 is made of a flexible thermoplastic material which can withstand reasonably high temperatures and having high dielectric characteristics and for this purpose I prefer to use a vinyl resin particularly a plasticized polyvinyl chloride. As shown the conductors are embedded in the plastic medium of the body which serves not only as an insulator but also as a structural member to properly position and support the conductors relative to each other.

As shown most clearly in Fig. 4 the body of the ribbon is of corrugated or ribbed construction with the corrugations or ribs running longitudinally. The corrugations are in the form of tubular or cylindrical portions 15 surrounding the conductors and connected together by flat web-like portions 16. The corrugated construction serves to augment heat radiation or dissipation so as to prevent undue increase in the temperature of the unit or of portions of the unit not in contact with a water pipe or other article. At the same

time the corrugations do not detract from the heat transfer efficiency of the device when it is applied to a water pipe.

The conductors 11 are made of a high resistance alloy such as Nichrome or stainless steel. A plurality of separate conductors of this type are embedded in the plastic medium of the ribbon in spaced relationship as shown and for the purposes indicated herein I have found that optimum results are obtained by employing four such conductors. Thus, where it is desired to use my heater in association with water pipes to prevent freezing it is desirable to have a heat dissipation in the order of 7 or 8 watts per foot. An even number of wires must be used to complete the circuit at the same end of the ribbon. In order to obtain the desired heat dissipation with the voltage of 110–120 volts generally available in household electric circuits in a ribbon of reasonable length I have found that four conductors should be employed. If two wires are employed each wire would have to dissipate 3½ to 4 watts per foot. My tests show that this results in too high a temperature for the plastic insulation to give good service over a period of years. Also, the ribbon would be of excessive length or the wires would have to be so fine that they would have insufficient tensile strength. If, on the other hand, 6 or 8 wires are employed the cost is increased without any worthwhile advantage.

The members 11 in addition to being the electric conductors are the tensile members supplying the principal tensile strength. Although the plastic has considerable tensile strength in itself, my tests have shown that it has such a low modulus of elasticity as compared to that of any metal which might be used for the conductor, that before it had been stretched sufficiently to carry an appreciable part of any applied stress, the conductor will be permanently stretched, if not broken. Hence, I have found that the design must provide for a conductor sufficiently large in diameter to carry any applied stress by itself, without appreciably stressing the plastic. Where a chrome nickel steel of the type indicated is used in the conductors, I have found that satisfactory results are obtained by using annealed wire with a diameter of approximately .020". This provides a tensile strength of approximately 30-pounds for each conductor. If hard wire is used greater strength would be obtained but the finished tape is springy and more difficult to install because it tends to spring away from the pipe at bends instead of readily conforming. If the ribbon does not have the desired tensile strength it might be subject to stretching at localized areas with the result that the conductors in those areas will be drawn more finely and the resistance increased. This, of course, results in a proportionate local increase in heat dissipation and is extremely objectionable, because of the reduced life for the plastic which would result. In order to avoid this possibility of stretching I have found that a wire size smaller than .0159" cannot successfully be used. Stainless steel wire of .0159" has a tensile strength of approximately 19 pounds which is satisfactory in the complete ribbon.

The spacing between the conductors 11 should be such as to permit adequate heat dissipation and so as not to create any localized areas having excessive temperatures which will cause the plastic material to deteriorate. Thus, for conductors of the type referred to above, used in connection with ordinary household current I have found that best results are obtained by spacing the conductors between 1/16" and 3/8" apart with an optimum spacing of .120" from the standpoint of both cost and efficiency. Wider spacings increase the cost without making a worthwhile decrease in the maximum temperature, and smaller spacing do not offer sufficient cost saving to offset the disadvantage of increased temperature between the wires.

In using my device I have found that it is desirable that it be so constructed that it can be readily bent to conform in shape with the pipe or other article to which it is applied. The plastic body portion is flexible and permits the ribbon to be bent. I prefer to form the conductors 11 from annealed wire which not only can be readily bent but also will remain in the new shape or position after it has been so bent.

Economy in production and flexibility of design are obtained by making the ribbon 9 in long continuous lengths as shown in Fig. 3. The ribbon can then be cut to the desired lengths, the circuit between the conductors completed in the desired manner, and the insulating cap 12 applied to one end and the plug 13 to the other end of the cut section of the ribbon.

In Figs. 2 and 5 I have illustrated the circuit connection for a ribbon of shorter length. Thus, it will be seen that the two adjacent conductors on both sides of the ribbon are twisted together and soldered at the capped end as shown at 17 and 18 and the two central conductors are connected together and soldered at the plug end of the ribbon as shown at 19. This provides a continuous circuit from one of the prongs 14 of the plug lengthwise of the ribbon four times and terminating at the other prong 14 of the plug. I have found that when connected in the circuit illustrated in Figs. 2 and 5 and used with ordinary household current a ribbon heater of the type illustrated and described above and approximately 20" in length will provide heat dissipation of approximately 7 or 8 watts per foot.

In Fig. 6 I have illustrated the circuit to give the same heat dissipation for a ribbon of double the length made from the same ribbon. According to this circuit the two adjacent conductors 11 on both sides of the ribbon are connected in parallel to the respective prongs 14 of the plug 13 as shown at 20 and 21. At the opposite or capped end of the ribbon all of the conductors are connected together as shown at 22. The circuit of Fig. 6 provides one pass in each direction for the length of the ribbon, each pass extending through a pair of parallel conductors. When a device of this type illustrated in Fig. 6 is connected to ordinary household current, a heat dissipation of approximately 7 or 8 watts per foot is obtained where the ribbon is approximately 40 ft. in length.

In Fig. 1, I have illustrated my device as employed in association with a water pipe to prevent the freezing thereof. Thus, the ribbon 9 has been secured with one of its broad surfaces in contact with a water pipe 23 and the plug 13 has been engaged in a receptacle or outlet 24. The ribbon may be secured in place in any desired manner as by being taped or tied at spaced intervals as indicated at 25. When used in the manner illustrated my device will operate in an efficient manner to transfer heat to the pipe and its contents and prevent freezing thereof. Due to the construction of my device it will readily conform to any configurations of the pipe such as elbows, traps, return bends or the like.

It will thus be seen that I have provided an

improved electric heater in ribbon or strip form which is simple and inexpensive in construction, which is easy to use and operate, which is efficient in operation and will provide for uniform heat transfer throughout its length and which is sufficiently rugged in construction to withstand reasonable use and abuse. Modifications may be made in the illustrated embodiment of the invention without departing from the invention as set forth in the accompanying claim.

I claim:

An electrical heater unit comprising: an elongated ribbon of vinyl chloride formed with longitudinal corrugations presenting four ribs and three grooves in alternate relationship, said ribbon being of substantially greater width than thickness; four elongated attenuated conductors made of resistance wire at least .0159" in diameter in annealed form embedded in said ribbon in spaced parallel relationship with the conductors in alignment with the ribs of the ribbon, the width of the grooves in the ribbon and of the space between the conductors being betwen $\frac{1}{16}$" and $\frac{3}{8}$"; and a plug for providing electric connection to a receptacle at one end of said ribbon said conductors being connected together and to said plug so as to provide a complete electric circuit.

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