

April 29, 1947.

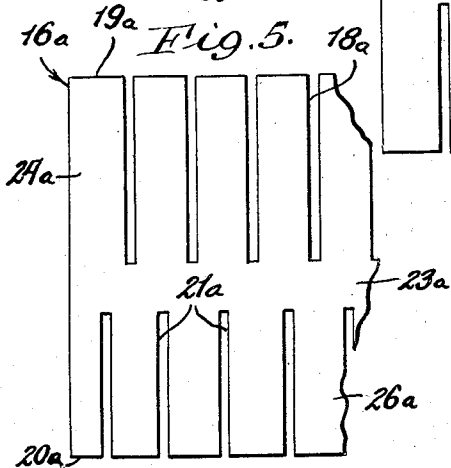
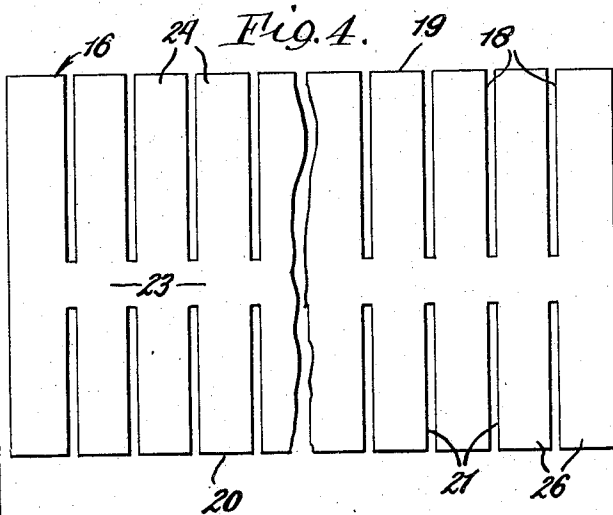
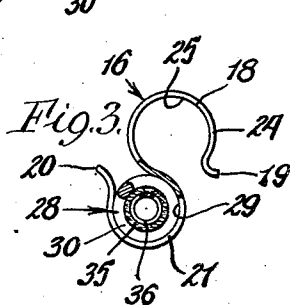
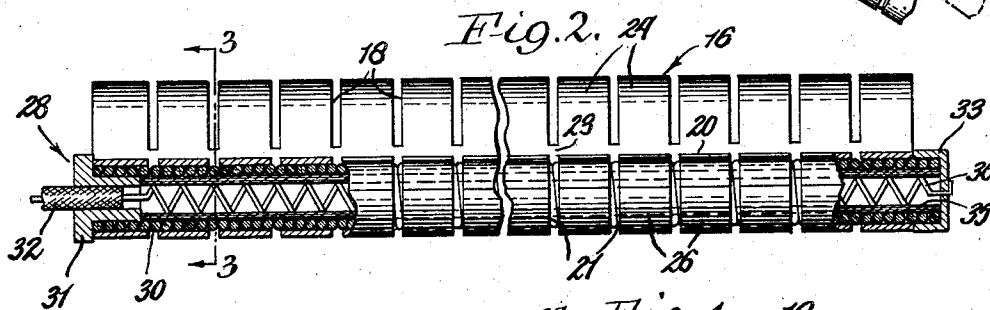
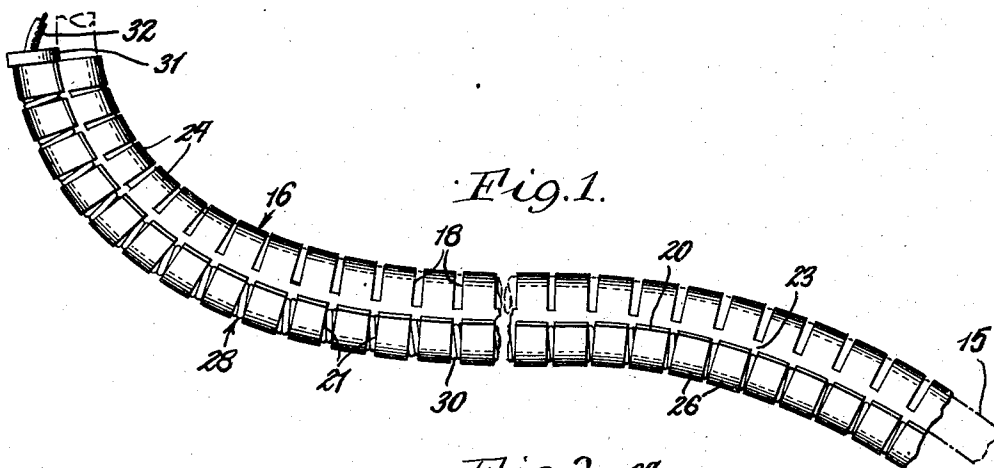
A. A. REISER

2,419,655

ELECTRIC HEATER

Filed Aug. 9, 1944

2 Sheets-Sheet 1



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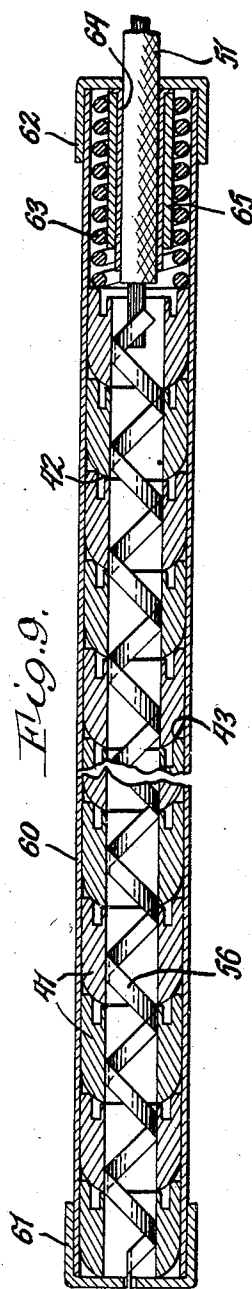
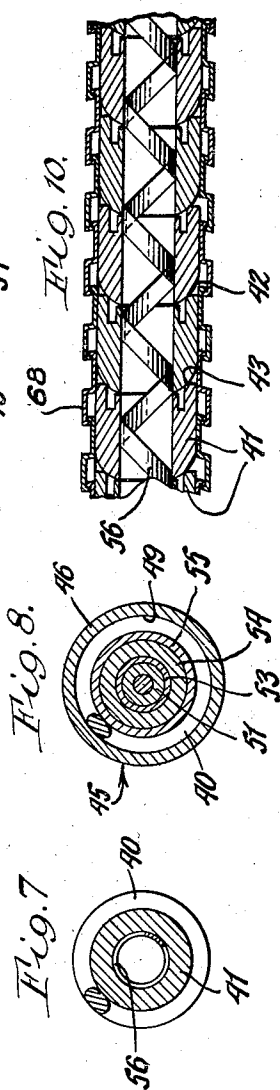
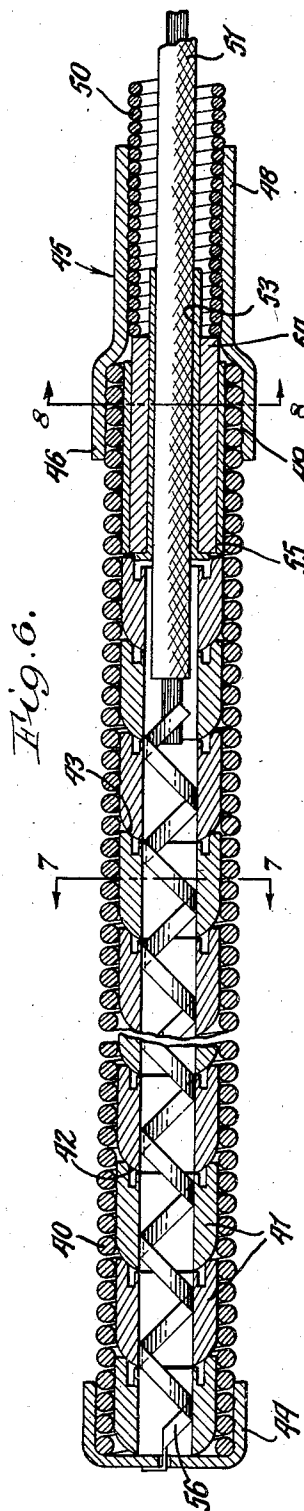
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ELECTRIC HEATER

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2 Sheets-Sheet 2



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2,419,655

ELECTRIC HEATER

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5 Claims. (Cl. 219-46)

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This invention relates to an electric heater and more particularly to a resistance heater unit of elongated flexible form capable of being curved or bent so that it can be applied to a curved pipe or the like or wrapped around the part to be heated and at the same time has the resistance element adequately sheathed against injury or deterioration.

One of the principal objects of the invention is to provide an elongated highly flexible heater unit capable of being bent into any serpentine form to conform to the part to be heated and at the same time is adequately sheathed against mechanical injury and deterioration.

A further object is to provide such a resistance heater in which the heating element is adequately insulated and supported.

A further object is to provide such an elongated flexible contact heater having a high degree of thermal conductivity through its sheath to the part to be heated.

A further object is to provide a form of such a contact heater, particularly applicable to low voltages, in which the lead in wire is arranged at one end of the same and is adequately protected, the other terminal of the resistance element being normally grounded on its metal sheath.

Another object is to provide such an elongated flexible heater unit in which the sheath can be in the form of a simple and inexpensive flexible metal tube or helical spring and which can be assembled at low cost.

A further aim is to so form the sheath that one part forms the duct for receiving the serpentine heater unit and another part clips over the pipe or the like to be heated and which serves as a highly efficient thermal conductor in maintaining the desired temperature of the pipe.

Other objects are to provide such a heater which is light in weight, simple and inexpensive in construction; which can be designed to handle any reasonable load and which will stand up under conditions of severe and constant use without getting out of order or requiring repairs.

In the accompanying drawings:

Fig. 1 is a side view of one form of flexible contact heater embodying the present invention and showing the same applied to a curved pipe.

Fig. 2 is an enlarged view similar to Fig. 1 and showing the ends in section.

Fig. 3 is a transverse section taken on line 3-3, Fig. 2.

Fig. 4 is a plan view of the blank used in mak-

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ing the sheath for the heater shown in Figs. 1-3.

Fig. 5 is a view similar to Fig. 4 showing a slightly modified form of blank whereby a greater degree of flexibility of the sheath is obtained.

Fig. 6 is a longitudinal section through a modified form of flexible heater embodying the present invention.

Figs. 7 and 8 are transverse sections taken on the correspondingly numbered lines of Fig. 6.

Fig. 9 is a view similar to Fig. 6 and showing a further modified form of the invention.

Fig. 10 is a view similar to Figs. 6 and 9 and showing a still further modified form of the invention.

Referring to the form of the invention shown in Figs. 1-4, the numeral 15 represents a curved tube or pipe which is to be heated. Such a tube or pipe could be a fuel or oil line in an airplane which is to be prevented from freezing or any conduit which it is desirable to heat or prevent from falling below a predetermined temperature. The heater is enclosed by a flexible sheath, indicated generally at 16, and made from a strip of sheet metal, the blank of which is shown in Fig. 4. As there shown the strip of metal is transversely slitted, as indicated at 18, at regular intervals from one edge 19 to a line extending approximately along the center of the strip. From its opposite edge 20 the strip of metal is transversely slitted, as indicated at 21, to a point short of the centerline of the strip, the slits 21 being thereby shorter than the slits 18 and leaving a continuous narrow strip 23 extending through the center of the blank.

The blank shown in Fig. 4 is then bent so as to be S-shaped in cross section, as indicated in Fig. 3, the fingers 24 formed by the slits 18 being each bent to provide a loop or C-shaped clip and the extremities 19 thereof being preferably reversely formed and spaced from the central longitudinal strip 23 of the sheath, so as to permit these fingers to be clipped to the pipe or tube 15, this tube or pipe being thereby arranged in the duct or passage 25 formed by the fingers 24 and being firmly gripped by each finger to insure good thermal contact therebetween. Similarly, each of the fingers 26 formed by the slits 21 is bent to provide a loop or C-shaped clip and the extremities 20 thereof are preferably reversely formed and spaced from the central longitudinal strip 23 of the sheath so as to permit these fingers to be clipped to a flexible elongated resistance heating structure, indicated generally at 28, this heating structure being thereby arranged in

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the duct or passage 29 formed by the fingers 26 and being firmly gripped by each finger to insure good thermal contact therebetween.

The resistance heating structure 28 is shown as comprising a helical metal spring 30 in one end of which a plug 31 is inserted, this plug having a bore receiving the hot or lead in wire 32 supplying current to the resistance heating element. The other end of the spring 30 is capped, as indicated at 33, this cap, when the heater is designed for low voltage, being in electrical contact with the sheath 16 so as to be grounded thereon. It will be understood that when the heater is to be used with high voltages two insulated leads would be provided instead of grounding one side of the heater on the sheathing thereof. Between the plug 31 and the cap 33 the spring 30 is preferably lined with a flexible tube 35 of insulating material, such as glass fiber. Within this lining is arranged a helical resistance heating element 36, one end of this element being connected with the lead 32 and the other end being grounded on the cap 33. It will be noted that the flexible tube 35 solidly fills the entire space between the heating element 36 and the spring 30 and is in full thermal contact with the periphery of the former and the bore of the latter.

In assembling the heater, the blank shown in Fig. 4 is bent into S-form in cross section, as shown in Fig. 3, and the heater assembly 28 is then inserted through the opening between the ends 20 of the fingers 26 into the conduit or channel 29 formed by these fingers. The C-shaped fingers 24 are then slipped over the pipe 15 to be heated, these fingers firmly embracing the pipe 19. The line 32 is then connected with a source of current and the heat generated by the resistance element 36 is conducted through the glass fiber lining 35 and spring 30 to the sheet metal sheath 16 and thence through the sheet metal sheath 16 to the pipe 15. The heat transfer efficiency is remarkably high and the form of the heater permits its ready application to curved pipes 15 as shown, this being a particularly desirable feature in preventing freezing of pipes where water tends to collect in a dip in the pipe and freeze.

The bank shown in Fig. 5 is the same as that shown in Fig. 4 except that the slits 18a are in staggered relation to the slits 20a. Since in other respects the two forms are identical, the same reference numerals have been applied and distinguished by the suffix a. It has been found that a sheath made from a blank as shown in Fig. 5 is somewhat more flexible than the sheath shown in Figs. 1-4.

The form of the invention shown in Figs. 6-8 comprises a heater which is adapted to be wrapped around the object to be heated in any form as conditions may require and is unprovided with the sheet metal sheath 16 as in the forms of the invention shown in Figs. 1-5. In this modified form of the invention the heater comprises a helical metal spring 40 which encloses a string of ceramic beads 41. These beads are of cylindrical tubular form and each has one rounding convex end 42 fitting in a rounding concave end 43 of a contiguous bead so that the string of beads flexes freely with the spring sheath 40. One end of the assembly is capped by a cap 44 and to the other end is secured a tubular extension 45 having an enlarged end 46 fitting over the end of the spring 40 and a reduced axially extending end 48. The walls of the enlargement

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46 are preferably spun inwardly upon the end convolutions of the spring to provide a firm interlock therewith, as indicated at 49, and in the extension 48 is suitably secured a helical spring 50 which projects outwardly from the end of the tubular extension 45 and forms a yielding support for the lead in wire 51 which enters the assembly through this tubular extension 45. This lead in wire 51 extends through a metal tube 53 fitted in the bore of a sleeve 54 of insulating material, this sleeve being in turn fitted in a metal sleeve 55 within the end convolutions of the spring 40 which have been displaced inwardly in spinning the enlargement 46 thereon and hence have a firm grip upon the sleeve 55. When the heater is to be used with low voltages, the heating element 56 is secured at one end to the lead in wire 51 and extends through the beads 56 and is grounded at its opposite end on the cap 44. The tension of the spring sheath 40 holds the beads 41 in compressive relation with one another.

It will be seen that the heater shown in Figs. 6-8 is readily wrapped around the object to be heated and that the heat is transferred from the heating element through the ceramic beads 41 and spring or sheath 40 to the object to be heated. Again it will be noted that the ceramic beads 41 fill the entire space between the heating element 56 and the spring sheath 40 and is in full thermal contact with the periphery of the heating element and the bore or inside surface of the spring sheath, thereby to insure a high rate of heat transfer.

Instead of a sheath in the form of a helical spring 40, it is apparent that this sheath could be in the form of a soft metal tube which is capable of being bent around the object to be heated, this form of the invention being shown in Fig. 9. As there shown the heating element 56, having substantially full contact with the inner surfaces of ceramic beads 41, are encased in a tube 60 of soft pliable metal with the beads in substantially full contact with the inside surface thereof. A cap 61 is secured to one end of the tube 60 and the corresponding end of the heating element is grounded on this cap when the heater is to be used with low voltages. To the other end of the tube 60 is secured a cap 62 through which the lead in wire 51 extends to be secured to the other end of the heating element 56. A helical compression spring 63 is interposed between the cap 62 and the adjacent endmost bead 41 to hold the beads in engagement with one another and within this spring 63 the lead in wire is surrounded by a sleeve 64 separated from the spring 63 by a ceramic sleeve 65.

It is also apparent that instead of the sheath being in the form of a continuous tube of soft metal it could be in the form of a flexible sheet metal conduit 68. Such form of the invention is shown in Fig. 10, the edges of the several convolutions of the conduit being interlocked so as to provide limited flexibility therein in the usual and well known manner.

While the invention has been more particularly described as a contact heater, it will be understood that features of the invention can be applied to air heaters and the like and the invention is therefore not to be construed as applying to any particular type of heater except as set forth in the accompanying claims.

From the foregoing it will be seen that the present invention provides a simple and inexpensive heater, particularly characterized by its flexibility and ready application under unusual cir-

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cumstances and at the same time is adequately sheathed against injury or deterioration.

I claim as my invention:

1. An electrical resistance heat unit of the character described, comprising a wire sheath formed of a helical metal spring having spaced convolutions which are round in cross section and helically wound to provide a laterally flexible tube, a liner for said sheath composed of a flexible dielectric material and providing a passage extending axially therethrough, and a laterally flexible resistance heating element extending longitudinally through said passage and bending in conformity with said sheath when said sheath is flexed.

2. An electrical heater for tubes and the like, comprising an elongated strip of metal formed to provide two conduits each extending longitudinally therethrough and the wall of each of said conduits being C-shaped and having a longitudinal opening therethrough whereby the walls of one of said conduits can be spread to embrace said tube, and a flexible electrical resistance heat unit arranged in the other of said conduits, the walls of each of said conduits being transversely slitted at intervals to render the heater transversely flexible.

3. An electrical heater for tubes and the like, comprising a relatively long strip of metal formed to provide two conduits each extending longitudinally therethrough and the wall of each of said conduits being C-shaped and having a longitudinal opening therethrough whereby the walls of one of said conduits can be spread to embrace said tube, and a flexible electrical resistance heat unit arranged in the other of said conduits, the walls of each of said conduits being transversely slitted at intervals to render the heater transversely flexible and the slits of one of said conduits being in offset relation to the slits of the other conduit.

4. An electrical resistance heat unit of the character described, comprising an elongated laterally flexible metal sheath having a duct extending longitudinally therethrough, a string of

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beads of insulating material arranged in said sheath and jointly providing an insulated passage extending axially through said sheath, a laterally flexible electrical resistance heating element extending longitudinally through said passage and bending in conformity with said sheath when said sheath is flexed, and means exerting yielding axial pressure against said beads to hold them in contact with one another.

5. An electrical resistance heat unit of the character described, comprising a metal sheath formed of a series of closely spaced convolutions to provide a laterally flexible tube, a string of beads of insulating material arranged in said sheath and jointly providing an insulated passage extending axially through said sheath, a laterally flexible electrical resistance heating element extending longitudinally through said passage and bending in conformity with said sheath when said sheath is flexed, and an abutment member provided at one end of said sheath and a spring member provided at the other end of said sheath, said members engaging the endmost beads to hold said string of beads in compressive relation with one another.

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