

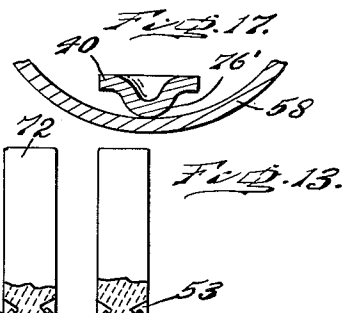
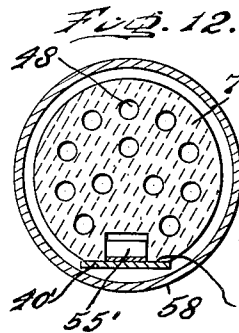
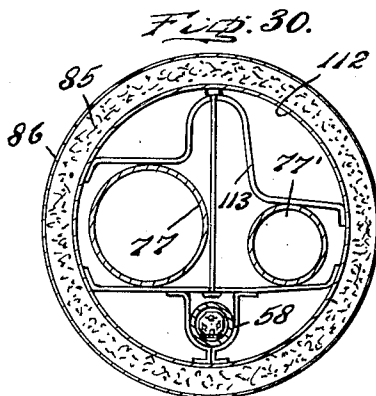
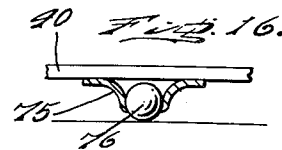
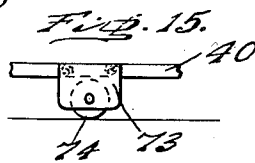
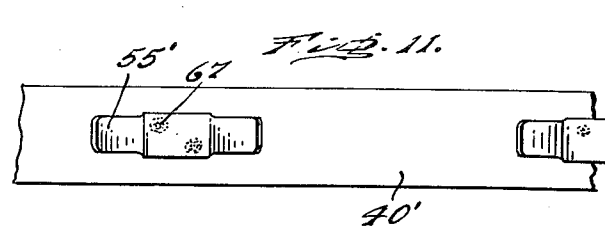
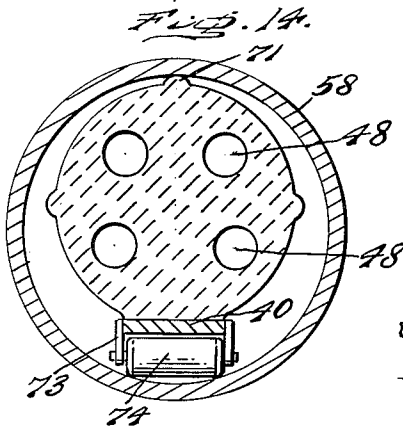
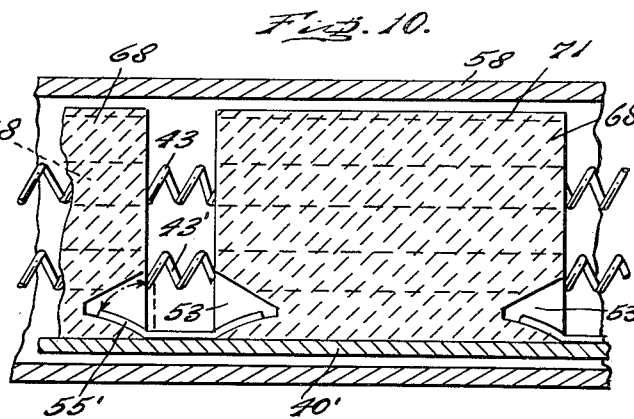
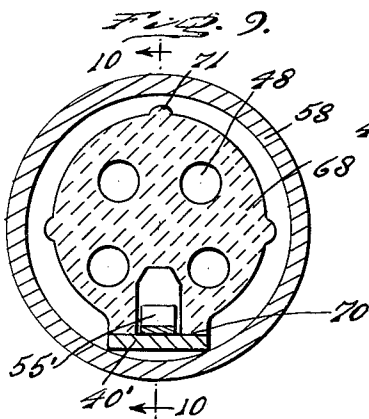
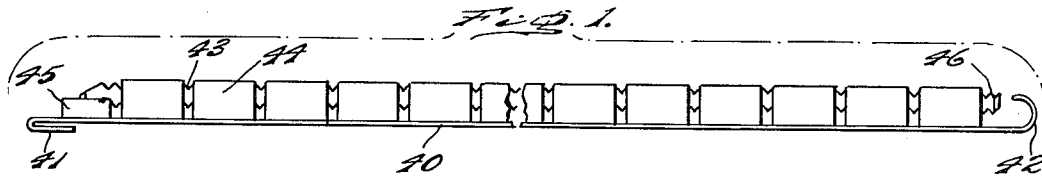
June 12, 1956

L. P. HYNES
ELECTRIC HEATER

2,750,487

Filed Aug. 12, 1952

4 Sheets-Sheet 1



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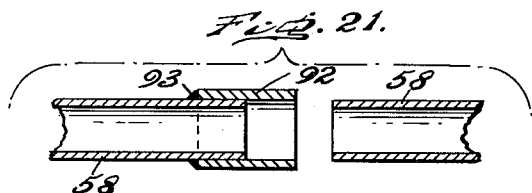
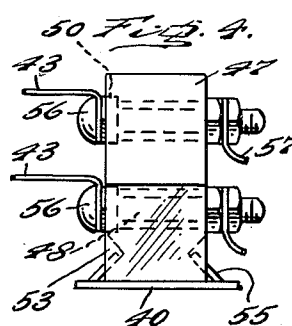
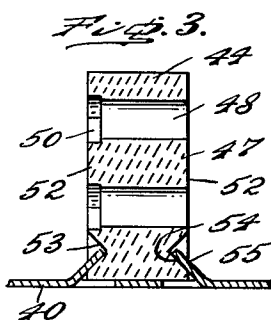
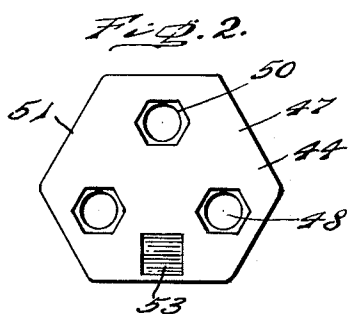
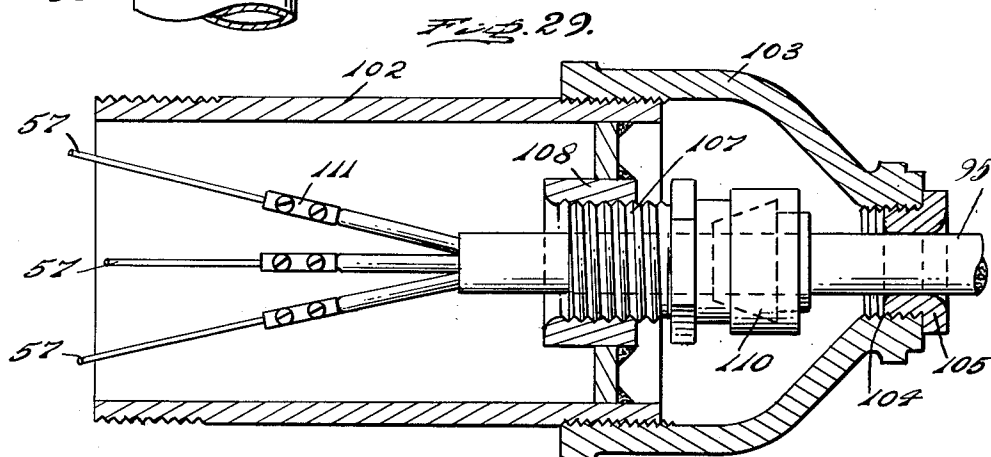
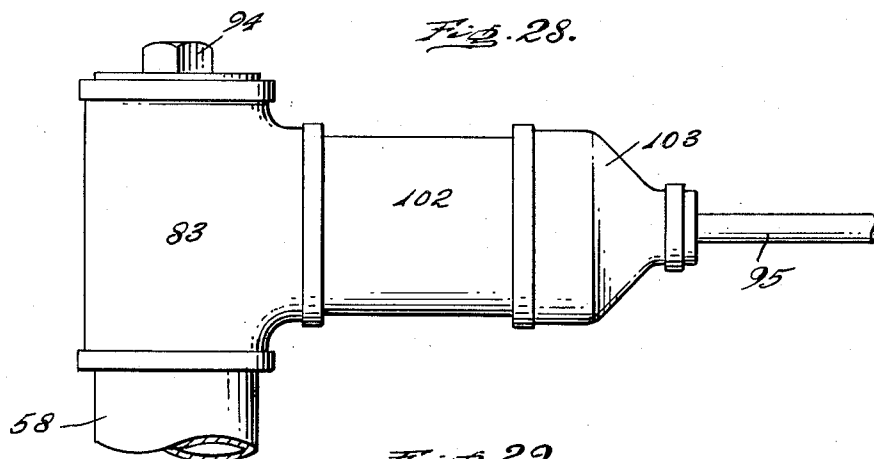
June 12, 1956

L. P. HYNES
ELECTRIC HEATER

2,750,487

Filed Aug. 12, 1952

4 Sheets-Sheet 2



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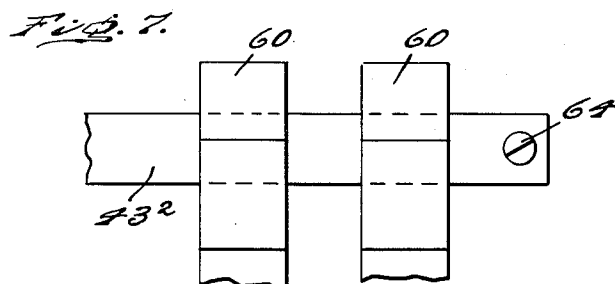
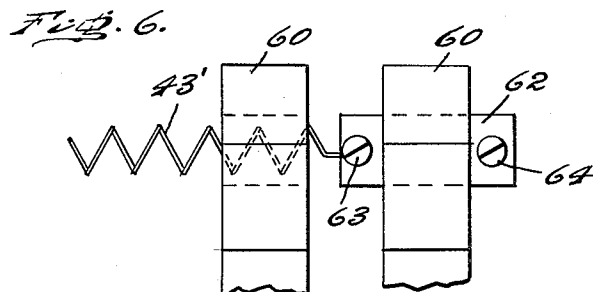
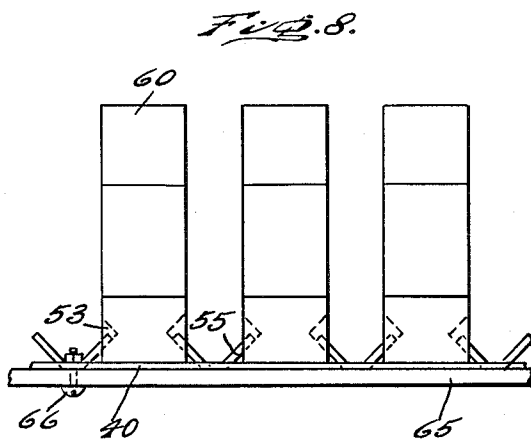
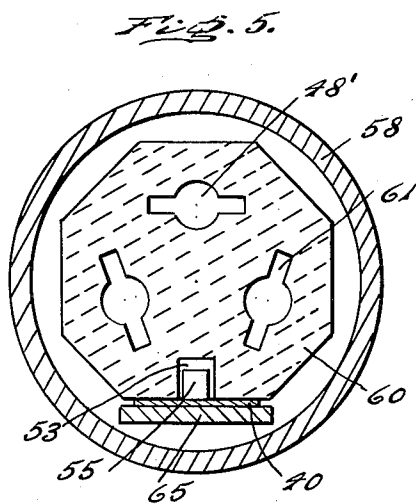
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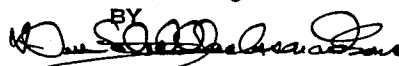
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Filed Aug. 12, 1952

4 Sheets-Sheet 3



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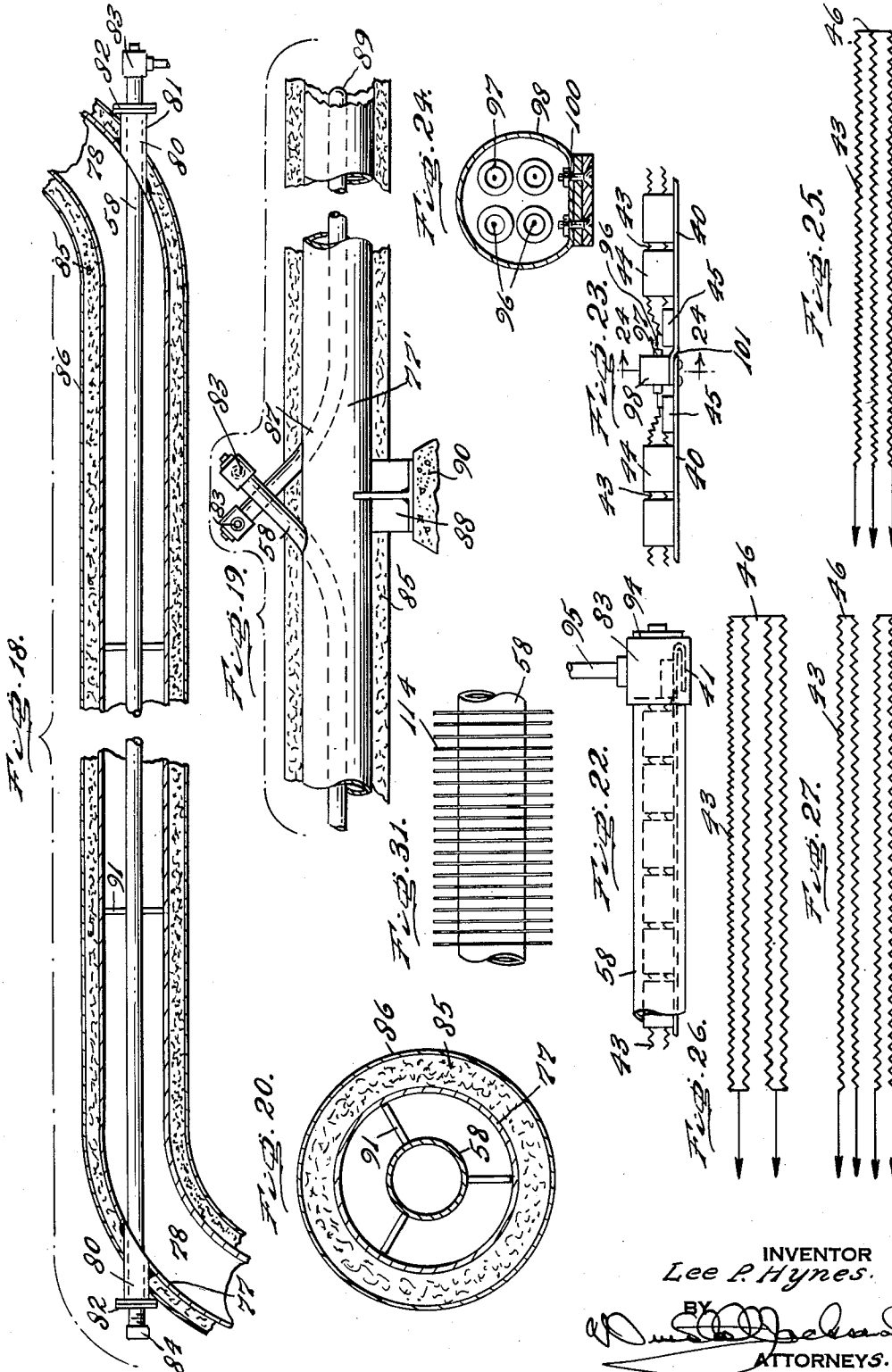
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ELECTRIC HEATER

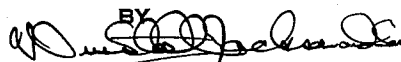
2,750,487

Filed Aug. 12, 1952

4 Sheets-Sheet 4



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2,750,487

ELECTRIC HEATER

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Application August 12, 1952, Serial No. 303,949

12 Claims. (Cl. 219—19)

The present invention relates to electric heaters, particularly of the type which are used to heat conduits and the like.

A purpose of the invention is to reduce the overall size of electric heaters for conduits and the like and simplify the construction.

A further purpose is to reduce the cost and increase the reliability of attachment for interconnection between a metallic heater strap and a heater insulator along the strap.

A further purpose is to reduce the rejections on insulators for electric heaters by making them moldable by flow entirely in one direction, avoiding the necessity for lateral flow under molding.

A further purpose is to make electric heaters for conduits more accessible.

A further purpose is to enable the supplier to ship the heater pipe to the field and assemble the electric heater in the field.

A further purpose is to provide more effectively for expansion and contraction of electric heater pipes and of electric heaters.

A further purpose is to make electric heater construction explosion-proof.

A further purpose is to provide clips at intervals along a metallic strap of an electric heater and to engage the clips into clip sockets at opposite ends of the insulators near the side of the insulators adjoining the strap so as to secure the insulators to the strap.

A further purpose is to lance the clips from the strap.

A further purpose is to mount both electric resistors and terminals in aligned longitudinal holes through the insulators.

A further purpose is to make provision in the insulators alternatively to receive circular resistors and strip resistors.

A further purpose is to secure the metallic straps at intervals to heater bars and to lance clips from the straps to engage in clip sockets at opposite ends of the resistors.

A further purpose is to provide anti-friction bearings suitably in the form of rollers, balls or ball circumference portions on the straps to engage the inside of the heater pipe during longitudinal motion of the strap or heater pipe.

A further purpose is to extend both ends of the heater pipe through the wall of the conduit and desirably provide stuffing boxes to engage and seal the pipe as it passes through the conduit, thus permitting access to both ends of the heater outside the conduit.

A further purpose is to extend the heater pipe in a gradual curve and carry it out through the wall of the conduit at at least one end so that access to the heater can be obtained beyond the conduit.

A further purpose is to provide radially extending sliding elements on the heater pipe to space the heater pipe from the conduit and slide along the conduit.

A further purpose is to provide a frame inside an insulated casing to support outgoing and incoming conduits

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and also to support the heater pipe in expansible and contractable relation.

Further purposes appear in the specification and in the claims.

5 In the drawings I have chosen to illustrate a few only of the numerous embodiments in which my invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation, and clear demonstration of the principles involved.

10 Figure 1 is a side elevation partly broken of a heater minus the heater pipe as used in the invention.

Figure 2 is a front elevation of a desirable embodiment of insulator.

15 Figure 3 is a central longitudinal section of the insulator of Figure 2, showing the interconnection between the metallic strap and the insulator.

Figure 4 is a fragmentary side elevation of the strap and insulator at the terminals.

20 Figure 5 is a transverse section of a variant embodiment of the heater of the invention, omitting the resistors.

Figure 6 is a fragmentary side elevation of the embodiment of Figure 5 showing one terminal and resistor arrangement.

25 Figure 7 is a variant of Figure 6 showing another terminal arrangement.

Figure 8 is a fragmentary side elevation of the electric heater of Figure 5 omitting the heater pipe and omitting the resistor elements.

30 Figure 9 is a transverse section similar to Figure 5 showing a variant in the electric heater of the invention, omitting the resistors.

Figure 10 is a fragmentary longitudinal section of the heater of Figure 9, on the line 10—10, including the resistors.

35 Figure 11 is a fragmentary top plan view of the strap and clips used in Figures 9 and 10, omitting other structure.

Figure 12 is a reduced scale transverse section of a variant form of heater of the invention omitting the resistors.

40 Figure 13 is a side elevation of the form of Figure 12 partly in central longitudinal section and omitting the pipe and resistors.

Figure 14 is a transverse section of a variant heater in accordance with the invention omitting the resistors.

45 Figures 15 and 16 are fragmentary detail side elevations, partly in central longitudinal section in Figure 16, showing variant bearings applied to the metallic strap.

Figure 17 is a fragmentary transverse section of the heater pipe and strap showing a still further variant of the bearing.

Figure 18 is a fragmentary longitudinal section of a conduit and heater in accordance with the invention showing the installation of the heater in the conduit.

55 Figure 19 is a fragmentary longitudinal section of a conduit and heaters of variant construction.

Figure 20 is an enlarged transverse section through a conduit and heater of Figures 18 and 19 omitting the interior construction of the heater.

60 Figure 21 is a fragmentary central longitudinal exploded section showing the endwise joining of heater pipes inside the conduit.

Figure 22 is a fragmentary side elevation of a heater of the invention, showing the terminal construction.

65 Figure 23 is a fragmentary side elevation showing the joining endwise of two heater assemblies inside the heater pipe.

Figure 24 is an enlarged section of Figure 23 on the line 24—24.

70 Figures 25, 26 and 27 are circuit diagrams showing variant forms of heater connections in accordance with the invention.

Figure 28 is a fragmentary enlarged side elevation of the terminal construction in accordance with the invention.

Figure 29 is an axial section further enlarged showing the connection of a cable to the structure of Figure 28.

Figure 30 is a transverse section through a conduit and heater tube showing a variant form of the invention.

Figure 31 is a fragmentary side elevation of a modified form of heater pipe in accordance with the invention. In the drawings like numerals refer to like parts throughout.

Describing in illustration but not in limitation and referring to the drawings:

Electric heaters for conduits and the like as shown in my U. S. Patent No. 1,997,146, granted April 9, 1935, for Electric Heater have been extensively used for thawing ice around gates of power plants and the like, and for preventing freezing and maintaining proper viscosity in lines through which water, oil, tar, chemicals and the like are caused to flow. In the construction of my prior patent, it was necessary to employ a complicated and expensive insulator, which underwent flow in two different directions during molding, and was correspondingly subject to a high cost and high rejection rate. The attachment of the insulator to the strap was accomplished by cotter pins, and necessitated that holes for this purpose run clear through the insulator in a direction transverse to the length of the insulator.

Because of the complexity of the construction, it was usually necessary in the prior art to install the complete heater prior to shipment, and the construction did not lend itself as well as the present construction to field assembly.

It was often difficult in the prior constructions used to obtain access to the heater and rarely in the prior constructions were both ends of the heater accessible. The tendency more recently has been to increase the size of installations, often running heated conduits for several hundred feet between terminal points.

In accordance with the present invention, the construction of the insulator has been greatly simplified, the cost of production has been reduced, and the manner of the attachment of the insulator to the metallic strap has been improved. Field installation is now very readily accomplished. Improved arrangements are made for access to one or both ends of the heater even though the conduit may be in a duct or actually buried beneath the ground.

The improved construction lends itself very well to terminal arrangements, and the same insulators can be used to support the terminals as those employed to support the resistor. The insulators may also interchangeably support round or strip resistors.

Improved provision has also been made for longitudinal motion of the electric heater inside the heater pipe, whether due to expansion and contraction or otherwise, and also for longitudinal expansion and contraction of the heater pipe itself.

The improved construction lends itself well to use around inflammable fluids, and where desired may be made explosion-proof.

Figure 1 shows an electric heater having an elongated metallic strap 40 reversely bent at one end 41 so as to engage an anchor and suitably curved at the other end 42 to protect the endmost insulator and cross connection against the end of the surrounding pipe. As in all of the forms of the invention, resistors 43 run longitudinally through openings in a line of insulators 44 which are secured to the strap 40 in a manner which will be described. The resistors are connected at one end to a terminal block 45 and at the other end are suitably cross connected at 46. The form of Figure 1 will serve as a generic showing of the general construction, in order to simplify the showing of the remaining forms and avoid

the necessity of repeating the resistors and other features common to all of the forms.

The preferred embodiment of the insulator is shown in Figures 2, 3 and 4, consisting of an insulator block 47 of suitable refractory such as porcelain having a plurality of longitudinally extending openings 48 which are in line throughout the group of insulators and receive the resistors 43 already described. In the form shown the openings 48 are round, but have suitably hexagonal bolt head sockets 50 at one end for use on terminals.

The particular insulator block shown has a pentagonal outer rim 51, but it will be understood that any desired form whether circular or polygonal may be used. The insulator has opposite ends 52 which are provided, adjoining one side which is to engage the metallic strip 40, with opposed clip sockets 53. The preferred form as shown has oppositely diagonal engaging surfaces 54 of the clip sockets to receive the clips. In this form the metallic strap 40 has clips 55 lanced from the strips in pairs and deformed by bending into the clip sockets so as to engage the insulator and hold it effectively in place against the strap 40.

At the terminal the resistors 43 are engaged by terminal bolts 56 which extend through the openings 48 and carry the usual nuts to engage terminal wires 57 which extend to connecting wiring.

The insulators and strap of Figures 2 to 4 along with the resistors extending through the openings of the insulators are surrounded by a heater pipe not shown in Figures 1 to 4, but illustrated at 58 in Figure 5. In the form as shown in Figures 5 to 8 inclusive, the insulator block 60 is of octagonal form and has opposed clip sockets 53 as already described. The openings 48' which extend longitudinally through the insulators and are in line throughout the group of insulators are in this case of key-hole form, with a round portion in the center adapted to receive a helical resistor 43' as shown in Figure 6 and with slots 61 at opposite positions on the round portion extending longitudinally throughout the insulator and adapted to receive a strip resistor 43² as shown in Figure 7. Where the helical or other round resistor is used, I may nevertheless employ a strip metallic terminal 62 engaged in the slots 61 of the endmost insulator and having terminal screws 63 and 64, one engaging the resistor and the other engaging the lead. Where there is a strip or ribbon type of resistor the resistor may extend clear to the end and be provided with a terminal screw 64 as shown in Figure 7 to engage the lead.

The means of attachment of the insulators is somewhat different in the form of Figures 5 to 8. In this case a comparatively light strap 40 having the clips 55 lanced from it as in the form of Figures 2 to 4 is mounted on a relatively heavier heater bar 65 by bolts 66 at intervals and conveniently located for accessibility at points at which the clips of a pair diverge.

In the form of Figures 9 to 11 the strap and clip construction varies slightly in that the clips 55' are suitably of separate metallic stock spot welded to the metallic strap 40' as at 67 (Figure 11). The clip sockets 53 in the insulators are effectively the same but in this case the insulators 68 are generally cylindrical with flats 70 to engage the straps. Spacer ribs 71 are placed around the circumference of the insulators to protect the insulators against the pipe and permit a low frictional engagement between the insulators and the heater pipe.

In Figures 12 and 13 a different insulator block 72 is shown which is more truly cylindrical with a flat 70' where it engages the strap.

The form of Figures 12 and 13 has a large number of holes 48 which are in line throughout the different insulators and will receive a large number of resistors. In normal operation of the heater there is a considerable amount of expansion and contraction as the heater heats and cools and as the medium changes its temperature around the heater pipe. It is therefore very desirable to

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facilitate longitudinal movement of the metallic strap with respect to the heater pipe not only from the standpoint of expansion and contraction but also to permit insertion and removal of long lengths of heater elements inside the heater pipe.

In Figure 14 the strip 40 is provided with journals 73 united to the sides as by welding and providing bearings for roller bearings 74 (see also Figure 15).

Another form of bearing construction uses a ball at intervals under the strap 40 as shown in Figure 16, where a ball socket 75 is united to the bottom of the strap as by spot welding and retains a freely moving ball bearing 76 which rides the inside of the heater pipe.

In some cases it is sufficient to have a surface engaging the pipe which is a portion of a sphere, and in Figure 17 a hemispherical bearing slider 76' has been formed from the strip 40 at intervals to engage the pipe.

It is very desirable not only to provide for expansion of the heater element within the heater pipe, but also to provide for expansion of the heater pipe itself. This can often be done (Figure 18) by bending a conduit 77 containing a medium to be heated at intervals along its length as shown at 78 and extending a heater pipe 58 out through the wall of the conduit at opposite ends as shown at 80. This has been accomplished by placing enlarged sleeves 81 welded into the conduit and surrounding the heater pipe as it is carried out of the conduit, and fitting packing glands and packing 82 on the sleeves to engage the heater pipe, thus permitting relative sliding of the heater pipe. Thus the heater pipe is accessible at one end by a terminal fitting 83 and at the other end suitably by a cap 84 so that access can be obtained to either end of the heater. The conduit 77 is desirably insulated by an insulating layer 85 inside a metallic casing 86.

In some cases the conduit passes underground or in ducts for a considerable distance without bends, and access to the heater inside the heater pipe may be more difficult. In this case with a relatively straight conduit 77' I bend the heater pipe along gradual bends 87 and pass it through an opening in the conduit and weld it to the conduit, gaining access to the terminals at the ends outside the conduit (Figure 19). Ends of adjoining heaters having terminals 83 are desirably brought up together, either above the ground, or in a box or manhole. An insulating layer 85 desirably surrounds the conduit and the conduit may be supported on seats 88 from piers 90. The remote end of the heater pipe in this form is closed as by welding at 89.

When the heater pipe is carried for a considerable distance through the interior of the conduit it is desirable to provide radial sliding and supporting elements 91, suitably welded to the heater pipe, extending out from the pipe and engaging the interior of the conduit as shown in Figure 20.

In some cases the heater pipe extends for such a length inside the conduit that a longitudinal joint must be made. In Figure 21 I show a sleeve joint in which two sections of heater pipe are abutted within a sleeve 92 which has previously been welded to one section at 93 and after the joint is made is similarly welded to the other section.

Figure 22 shows a terminal construction which may be conveniently used. The end having the reverse bend on the metallic strap at 41 leads into the terminal 83 which may conveniently be contained within a T having an end plug 94 and a side connection to electrical cable 95.

When two electric heater elements must be joined end to end inside the heater pipe it is desirable to use the construction of Figures 23 and 24. Terminal blocks 45 are provided and from these terminal blocks leads 96 extend through insulating tubes 97 which are surrounded and protected by a suitably metallic band 98 secured by bolts 100 at a point of overlapping of the metallic straps 40, one strap being deformed slightly at 101. The bolts 100 serve also to unite the straps.

Any well recognized form of electrical connection may

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be used. For example Figure 25 shows resistors 43 cross connected for a three phase star arrangement. Figure 26 shows resistors 43 connected in parallel to a single phase power source. Figure 27 shows one set of connections for a two phase circuit or two single phase circuits.

One desirable form of terminal arrangement is shown in Figures 28 and 29. In this form a cable grip is mounted in the terminal T by inserting nipple 102 in the side of the T, and threading cap 103 on the nipple at the end remote from the T. The cap has a reduced threaded opening 104 which may make threaded engagement with electrical conduit, but in the form shown receives a threaded grommet 105 and passes electrical cable 95 which extends through a cable grip 107 which is threaded into a grip socket 108 secured on the inside of the nipple in spaced relation to the nipple wall. The grip 107 has a locking collar 110 to secure the cable as well known, forming a watertight joint. The conductors in the cable are interconnected with leads 57 to the resistors by connectors 111 which are suitably insulated in a manner not shown. This construction is moisture proof and explosion proof.

In some cases it is desirable to carry several conduits 77 and 77' through a duct 112 having insulation 85 and an insulating housing 86 around the duct. The heater pipe and heater therein in this case is carried through the duct 112 but outside of the conduit. Suitable spaced relations between the outgoing conduit 77, the return conduit 77' and the heater pipe are maintained by frames 113 located at intervals along the length of the duct and having elements which engage and support the heater pipe 58 and the conduits 77 and 77' and which engage the inside of the duct 112 and support the interior structure away from the conduit wall.

In some cases it is desirable to improve the heat transfer from the heater pipes to the surrounding medium especially when air and other gases are flowing through the conduit around the heater. In Figure 31 I provide fins 114 on the heater pipe for improvement of heat transfer in the surrounding medium.

It will be evident that while the invention finds wide application in the melting of ice and the heating of oil, tar and other chemicals, it may be employed wherever elongated heaters are to be used, especially for pipes and structural members of considerable length.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I therefore claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an electric heater, an elongated metallic strap, clips at intervals along the strap in pairs extending diagonally oppositely from the strap at the same side at various points along the strap, insulators arranged in line against that side of the strap and having in the opposite end surfaces of the insulators opposed recesses adjoining the strap which have opposite diagonally disposed surfaces engaged by the clips, there being at least one longitudinal opening through each insulator, the openings being in line throughout the group of insulators, and electric resistor means extending through the openings of a plurality of the insulators.

2. An electric heater according to claim 1, in combination with a protective pipe surrounding the strap, the insulators and the electric resistor means, and bearing means on the strap engaging the interior of the pipe and guiding the strap along the pipe.

3. An electric heater according to claim 1, in which the clips are integral with and lanced from the strap.

4. An electric heater according to claim 1, in combination with electric terminals extending through and respec-

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tively mounted in an opening in at least one of the insulators and connected to the electric resistor means.

5. An electric heater according to claim 1, in combination with a metallic heater bar extending longitudinally, and means securing the strap at intervals along one side of the heater bar, the clips extending out on the side of the strap remote from the heater bar.

6. An electric heater according to claim 1, in which each of the openings through the insulators includes a round opening and opposed slots on the opposed edges of the round opening, the round openings being adapted to receive circular electric resistor means and the slots and the round openings being adapted to receive rectangular electric resistor means.

7. An electric heater according to claim 1, in combination with a conduit for fluids, a pipe extending through the conduit and extending beyond the conduit at both ends, the pipe surrounding the strap, insulators and electric resistor means, packing gland means in the conduit sealing to the pipe as it leaves the conduit at each end and removable closures for the ends of the pipe beyond the conduit.

8. An electric heater according to claim 1, in combination with a conduit for fluids, a pipe extending through the conduit, bent in a curve beyond the conduit wall, the strap, insulators and electric resistor means extending through the interior of the pipe and a removable closure for the end of the pipe beyond the conduit.

9. An electric heater according to claim 8, in combination with radial spacers extending from the pipe and engaging the interior of the conduit in slidable relation.

10. An electric heater according to claim 1, in combination with an insulated duct having a hollow interior, outgoing and return pipes for fluid in the duct, an electric heater pipe in the duct at one end extending through the duct wall, sealed in the duct wall and surrounding the strap, insulators and electric heater means, and a frame engaging the inside of the duct and engaging the outgoing and return pipes and the heater pipe at intervals and holding the same in spaced relation within the duct.

11. An electric insulator comprising a ceramic block having generally circumferential side walls adapted to conform to the interior of a pipe, there being a flat surface at one position on the side walls, having generally flat parallel end walls, there being a plurality of parallel openings extending from one end wall to the other transverse to the

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end walls and displaced from one another both laterally and transversely so as to hold a group of resistors in insulated relation, there being in the two opposite end walls adjoining the flat surface of the side wall and symmetrically placed with respect to the longitudinal opening opposed retaining clip receiving recesses, each of the recesses having a wall which is nearest to the flat surface and which extends diagonal to the longitudinal axis of the insulator.

12. In an electric heater terminal, a T fitting having internal threads, a nipple having male threads at the opposite ends and threaded into the transverse position on the T fitting, a spacer welded in the end of the nipple remote from the T fitting, an internally threaded cable grip socket secured to the spacer inside the nipple, a cap having a female thread at one end interthreaded with the nipple and having a reduced internally threaded opening at the end remote from the nipple, a cable extending through the reduced opening and through the cable grip socket, a cable grip threaded into the cable grip socket and gripping the cable inside the cap, a bushing threaded into the reduced opening and surrounding the cable, and a distribution connector interconnected with the cable inside the nipple.

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