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PIPE HEATING ARRANGEMENT

Original Filed July 26, 1963

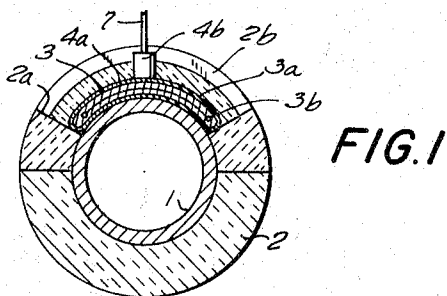


FIG. 1

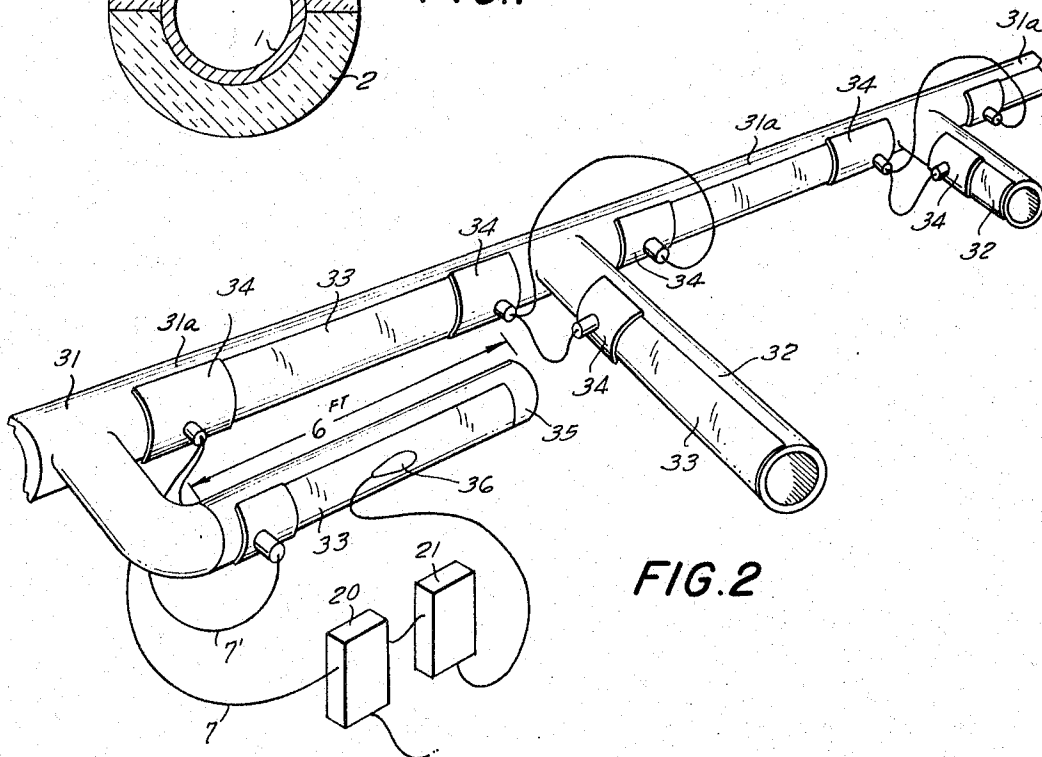


FIG. 2

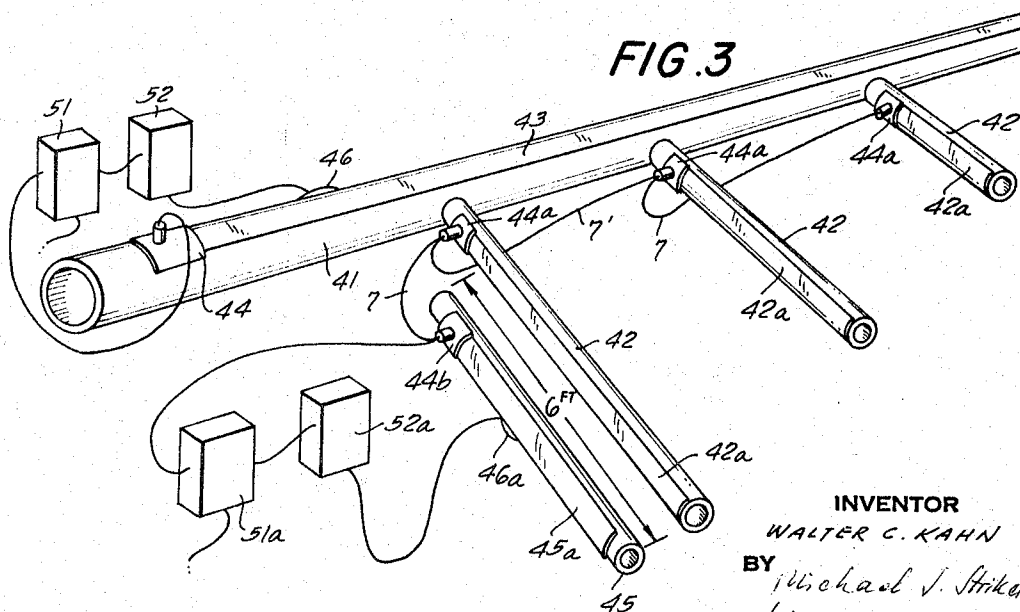


FIG. 3

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1

3,364,337

PIPE HEATING ARRANGEMENT

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8 Claims. (Cl. 219—301)

ABSTRACT OF THE DISCLOSURE

A pipe heating arrangement, comprising, in combination, current-conductive pipe means adapted to contain a fluid and including a first pipe and a plurality of branch pipes at least one of which is adapted to contain the fluid in non-flowing condition; a plurality of thin flat elongated heating strips each including a thin resistance element, a pair of elongated electrodes electrically connected with the resistance element so that current flows transversely through the resistance element across the length of the same, electrical insulating means surrounding and substantially coextensive with the resistance element and electrodes, and connector means at one end of the strip and having terminals connected with the electrodes, respectively, the strips being disposed on the outer surfaces of the first pipe and branch pipes, respectively, extending along the length of the same; and the electrical insulating means insulating the heating strip from the pipe means, and the connector means being respectively located at one end of each of the first and branch pipes; first and second switching means respectively connected to the connector means of the first pipe and to the connector means of the branch pipes, the first and second switching means being adapted to be connected to a voltage source; thermal insulating means surrounding the pipe means and the heating strips for minimizing heat radiation to the ambient atmosphere; and first temperature responsive means disposed on the first pipe, and second temperature responsive means located in the region of the one branch pipe to respond to the temperature of the non-flowing fluid therein the first and second thermostat means being located inwardly of the thermal insulating means so as to remain free from influence by the temperature of the ambient atmosphere and respectively connected with the first and second switching means for controlling the same independently of each other so as to effect heating of the first pipe and of the branch pipes at a constant temperature along the entire length of the same irrespective of the temperature of a fluid entering a branch pipe.

Cross reference to related applications

This application is a division of my copending application, entitled, "Pipe Heating Arrangement," Ser. No. 297,875, filed on July 26, 1963.

Background of the invention

The present invention relates to a pipe heating arrangement, and more particularly to an arrangement for heating pipes through which a fluid or liquid flows so that the fluid is maintained at a desired temperature, or freezing of a liquid in a pipe is prevented.

It is known to provide electric heating elements on pipes, and more particularly on pipes enveloped in a thermal insulating material. However, the arrangements of the prior art have the disadvantage that narrow heating elements disposed between the pipe and the insulating material, create longitudinal air gaps between the pipe and the insulating material. Furthermore, it is necessary to connect a heating element which has terminals at the ends

2

thereof at both ends of the pipe to a source of voltage, so that access to both pipe ends, and to both ends of the heating element is necessary.

These disadvantages have been overcome with the arrangement disclosed in my above-mentioned copending application. However, other problems still exist in connection with such pipe heating arrangements. Specifically, it is not possible in the arrangements known heretofore to provide a system of two or more pipes, and to control the temperature possible in any pipe of such a system, irrespective of the temperature of fluid which enters the system.

Summary of the invention

More particularly, the invention provides a heating arrangement in which the temperature of a fluid flowing in a pipe system is controlled in accordance with the lowest temperature possible in any pipe of the system, irrespective of the temperature of a fluid entering the pipe system.

The present invention also makes it possible to so control the heating of larger and smaller pipes of a system that the temperature of the fluid in the pipe sections is maintained at the same constant level irrespective of the diameter of the pipe sections, and the amount of fluid flowing therethrough.

Briefly stated, one feature of my invention resides in the provision of a pipe heating arrangement in which a thin flat heating strip is used for heating pipe means containing a fluid. This heating strip, including a thin resistance element, a pair of elongated electrodes electrically connected with said heating element, and connector means at one end of the strip and having terminals connected with the electrodes, is placed on the outer surface of pipe means, and attached to the same to extend along the entire length of the pipe means.

The connector means may be located at the end of the pipe means, or at the particularly accessible point of the pipe means, so that the source of voltage has to be connected only to one point of the pipe means to which access is easily possible. Since the heating strip extends along the pipe for any desired length, the entire pipe is heated, although for the purpose of making electrical connections, or repairs, only a small portion of the pipe has to be arranged to be accessible to an operator. This is particularly advantageous if the heated pipe is buried in the ground below the surface.

The switching means of the heating element is preferably controlled by a thermal sensor, such as a thermostat which may be controlled by a thermostat bulb placed on the outer surface of a pipe and within the thermal insulating material. However, while reference will hereafter be had to "thermostat" in describing this sensor, for the sake of convenience, it is to be understood that other sensors, such as thermocouples and the like, are also included in this description.

According to the invention, the pipe means includes the fluid-conducting pipe and a "dummy" pipe section, and the thermostat bulb is not placed on the pipe through which the fluid flows, but on the "dummy" pipe section which is closed and filled with stationary fluid. In branched piping in which fluid may flow in some branch lines, and not in others, the temperature of the entire pipe system is controlled in accordance with the low temperature of the non-moving fluid in the closed pipe or pipe section whereas, if the thermostat bulb would be mounted on one of the branches in which fluid is flowing, the thermostat might switch off the heating means when fluid having a high temperature enters the respective pipe, causing the fluid in another pipe to freeze.

The novel features which are considered as characteristic for the invention are set forth in particular in the

appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

Brief description of the drawing

FIG. 1 is a cross sectional view illustrating the principle of heating an insulated pipe by means of a heating strip.

FIG. 2 is a perspective view illustrating an embodiment in accordance with the present invention; and

FIG. 3 is a perspective view illustrating a further embodiment of the invention.

Description of the preferred embodiments

Referring now to the drawing, and more particularly to FIG. 1, a pipe 1 is enveloped by a thermal insulating material 2 provided with a cutout which may be located at the end of the insulated pipe.

A thin flat elongated heating strip 3 is disposed on the outer surface of pipe 1 within the insulating material 2.

Heating strip 3 has two outer layers of an insulating material, for example of the trademarked materials Teflon or Aclar, heat bonded to each other and to a glass-asbestos layer which is sandwiched between the outer layers and protected by the same from heat and moisture. A conductive resistance layer 3a is embedded in the glass-asbestos fiber layer. Parallel to the lateral longitudinal edges of the strip, two band-shaped copper electrodes 3b are disposed in conductive contact with the lateral portions of the resistance element 3a and covered by the glass-asbestos layer. A voltage applied to electrodes 3b causes a current to flow transversely to the direction of the strip across the resistance element 3a. Consequently, the same heat per unit of area regardless of the length of the strip is produced when current flows through the resistance element 3a. Heating strips of this type but without the Teflon or Aclar cover are known, and are not an object of the present invention. U.S. Patents 2,952,761; 2,803,566; and 3,002,862 disclose related subject matter.

A connector means 4 is provided at the end of strip 3 and includes a flexible bag-shaped insulating end piece 4a to which a threaded connector piece 4b is attached into which wires 7, 7' are inserted. A pair of wires 7a is connected to the ends of a wire 7, and a pair of wires 7a' is connected to the wire 7'. Wires 7a, 7a' are connected to the respective electrode 3b. When a voltage source is connected to wire 7, current flows through the electrodes 3b, and across the heating element 3a.

Annular straps 5 embrace pipe 1 and heating strip 3 to hold the same in place. The width of heating strip 3 is, for example, 3" which is less than the circumference of pipe 1, so that the insulating material 2 is in direct contact with the greater part of the outer surface of pipe 1, particularly since the heating strip is very thin, for example less than $\frac{1}{32}$ ".

Therefore, the usual oversize insulation is not required, and there are no inefficient air spaces between the insulating material 2 and the pipe 1. Tracer pipes or heating cables, and the cost of labor and material for bonding the tracers to the pipe are eliminated.

Since the heat output is spread evenly over a three inch wide surface, the heat density is low, for example 1 watt per square inch, eliminating coking or spoilage due to overheating or particularly hot spots. After a shutdown, the heat is gradually increased so that the temperature of a fluid in the pipe is restored without harm to even the most sensitive fluids.

The Teflon or Aclar insulation of the strip has the advantage that it is completely unaffected by weather, corrosive atmosphere, condensate, oils and industrial acids and caustics, and that the material absorbs no water.

Due to these properties of the insulating layers of the heating strip, the same is practically unaffected by time.

Due to the fact that the source of voltage need be connected only to one end of the strip, any length of pipe can be heated by a correspondingly long strip attached thereto, while only the portion of the pipe where the connector 4 is located, must be disposed to be accessible for service and repair. Access is facilitated by the cutout 2a in the insulating material 2, and as shown in FIG. 1, a thinner layer of insulating material 2b is placed in cutout 3a and has such a thickness that the connector part 4b projects above insulating layer 2b. Since the electrical connections in the region of connector 4 produce additional heat, a thinner thermo-insulating layer 2b is sufficient.

The construction illustrated and described thus far is known from my copending application, Ser. No. 297,875, of which the present application is a division. It has been included here to facilitate understanding of the invention.

FIG. 2 illustrates an embodiment in accordance with the present invention in a simplified manner, omitting the insulating material 2 for the sake of clarity.

As mentioned before, if the layout of the pipe system includes branch pipes, a fluid or liquid may enter one branch pipe at a high temperature which may be sensed by a thermostat bulb on the respective branch pipe, causing disconnection of all heating strips although in other pipe sections the fluid or liquid is cooler. Under such circumstances, the fluid or liquid in the other pipe sections may freeze, whereas the thermostat would respond to the higher temperature of fluid entering the system through one sensed branch pipe.

This disadvantage is overcome by the arrangement illustrated in FIGS. 2 and 3. As illustrated in FIG. 2, branch pipes 32 are connected to a pipe 31 between pipe sections 31a. Heating strips 33 are provided on each pipe section and have connector means 34 connected to other connector means by jumper wire means 7, 7'. A length of pipe 35 is connected to pipe 31 at one end, and closed at the other end. Since pipe 35 communicates with pipe 31 it is filled with the liquid flowing through the same, however, the liquid does not move in pipe 35. Pipe 35 has a heating strip 33 connected by jumper wire means 7' to the first connector means 34 on pipe 31, and this connector means is also connected to the switch means 20 through which current is supplied from a voltage source under the control of the thermostat means 21 whose thermostat bulb 36 is disposed on heating strip 33 of pipe 35. It is also possible to immerse the thermostat bulb 36 in the fluid contained in pipe section 35.

In the arrangements shown in FIGS. 2 and 3, the electrodes of each heating strip 33 are connected to two pairs of wires 7a, 7a', as explained with reference to FIG. 1. A wire means 7 supplies current to the connector on section 31a, and the current flows from there through wire means 7' to the connector on section 35.

The temperature maintained by the thermostat means 21, 36 and the switching means 20 in all pipes will correspond to the temperature of the non-moving fluid in pipe section 35, and cannot be influenced by fluid flowing through a branch pipe into the pipe system at a high temperature.

Referring now to the embodiment of FIG. 3, a plurality of branch pipes 42 are connected to a main pipe 41. A heating strip 43 extends along the length of main pipe 41 and has at one end a connector means 44 connected by a wire means to a switching means 51 controlled by a thermostat means 52 whose thermostat bulb 46 is located on the heating strip 43. Consequently, the heating strip 43 will be switched on and off in accordance with the temperature sensed by thermostat 46.

Connectors 44a of the heating strips 42a of branch pipes 42 are connected to each other by jumper wire means 7, 7' and one connector 44a is connected by a

jumper wire means 7 to the connector 44b at one end of a heating strip 45a which is disposed on a short length of pipe 45 closed at both ends and containing the same fluid which flows through pipes 41 and 42. Connector 44b is electrically connected to switching means 51a controlled by a thermostat means 52a having a thermostat bulb 46a disposed on heating strip 45a.

Due to the fact that the branch pipes 42 are of a lesser diameter than the main pipe 41, the fluid in the branch pipes will have a different temperature than the fluid flowing in main pipe 41. Therefore, independent switching and thermostat means are provided for the main pipe 41 and for the branch pipes 42. It would be possible to provide a thermostat bulb on one of the branch pipes, but since fluid entering the respective sensed branch pipe may have a higher temperature than the fluid in other branch pipes, the switching means may be improperly operated, and consequently it is preferred to provide the closed pipe section 45 whose non-moving fluid will have the lowest temperature of all pipes. Therefore, the thermostat means 52a and the switching means 51a will reliably maintain the temperature at such a height that freezing of the fluid in any branch pipe is prevented.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of pipe heating arrangements differing from the types described above.

While the invention has been illustrated and described as embodied in a sensor-controlled pipe heating arrangement, it is not intended to be limited to the details shown since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the stand-point of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is new and desired to be secured by Letters Patent is set forth in the following:

1. A pipe heating arrangement, comprising, in combination, current-conductive pipe means adapted to contain a fluid and including a first pipe section and a plurality of second pipe sections at least one of which is adapted to contain the fluid in non-flowing condition; a plurality of thin flat elongated heating strips each including a thin resistance element, a pair of elongated electrodes electrically connected with said resistance element so that current flows transversely through said resistance element across the length of the same, electrical insulating means surrounding and substantially coextensive with said resistance element and electrodes, and connector means at one end of each strip and having terminals connected with said electrodes thereof, respectively, said strips being disposed on the outer surfaces of said first pipe section and

said second pipe sections, respectively, extending along the length of the same, and said electrical insulating means insulating said heating strip from said pipe means, and said connector means being respectively located at one end of each of said first and second pipe sections; switching means connected to said connector means of at least said first pipe section and being adapted to be connected to a voltage source; thermal insulating means surrounding said pipe means and said heating strips for minimizing heat radiation to the ambient atmosphere; and temperature responsive means located at least in the region of said one second pipe section to respond to the temperature of the non-flowing fluid therein, said temperature responsive means being located inwardly of said thermal insulating means so as to remain free from influence by the temperature of the ambient atmosphere and being connected with said switching means for controlling the same so as to effect heating of said first pipe section and of said second pipe sections at a constant temperature along the entire length of the same irrespective of the temperature of a fluid entering a second pipe section.

2. A pipe heating arrangement as defined in claim 1, wherein said one second pipe section has two ends, one of said ends being open and communicating with said first pipe section and the other of said ends being closed and being spaced from said first pipe section.

3. A pipe heating arrangement as defined in claim 1, wherein said one second pipe section is a closed length of pipe located adjacent to said first pipe section and the remaining second pipe sections.

4. A pipe heating arrangement as defined in claim 1, wherein said temperature responsive means comprises thermostat means.

5. A pipe heating arrangement as defined in claim 1, wherein said first pipe section has a diameter different from the diameter of said one second pipe section.

6. A pipe heating arrangement as defined in claim 5, wherein the diameter of said first pipe section exceeds the diameter of said second pipe sections.

7. A pipe heating arrangement as defined in claim 1, wherein said pipe means is metallic.

8. A pipe heating arrangement as defined in claim 1, wherein said switching means comprises first switching means connected to said connector means of said first pipe section, and second switching means connected to said connector means of said second pipe sections, and wherein said temperature responsive means comprises first temperature responsive means disposed on said first pipe section and second temperature responsive means located in the region of said one second pipe section, said first and second temperature responsive means being respectively connected with said first and second switching means for controlling the same independently of each other.

No references cited.

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