United States Patent [19]

Ferguson

[11] **3,887,790**

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[54] **WRAP-AROUND ELECTRIC RESISTANCE HEATER**

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[52] **U.S. Cl.**..... **219/535;** 174/138 J; 219/550; 219/532; 219/537; 338/213; 338/317

[51] **Int. Cl.** **H05b 3/58**

[58] **Field of Search** ..... 219/532, 535, 536, 537, 219/549, 550, 552; 338/213, 317, 318, 319; 174/138 J

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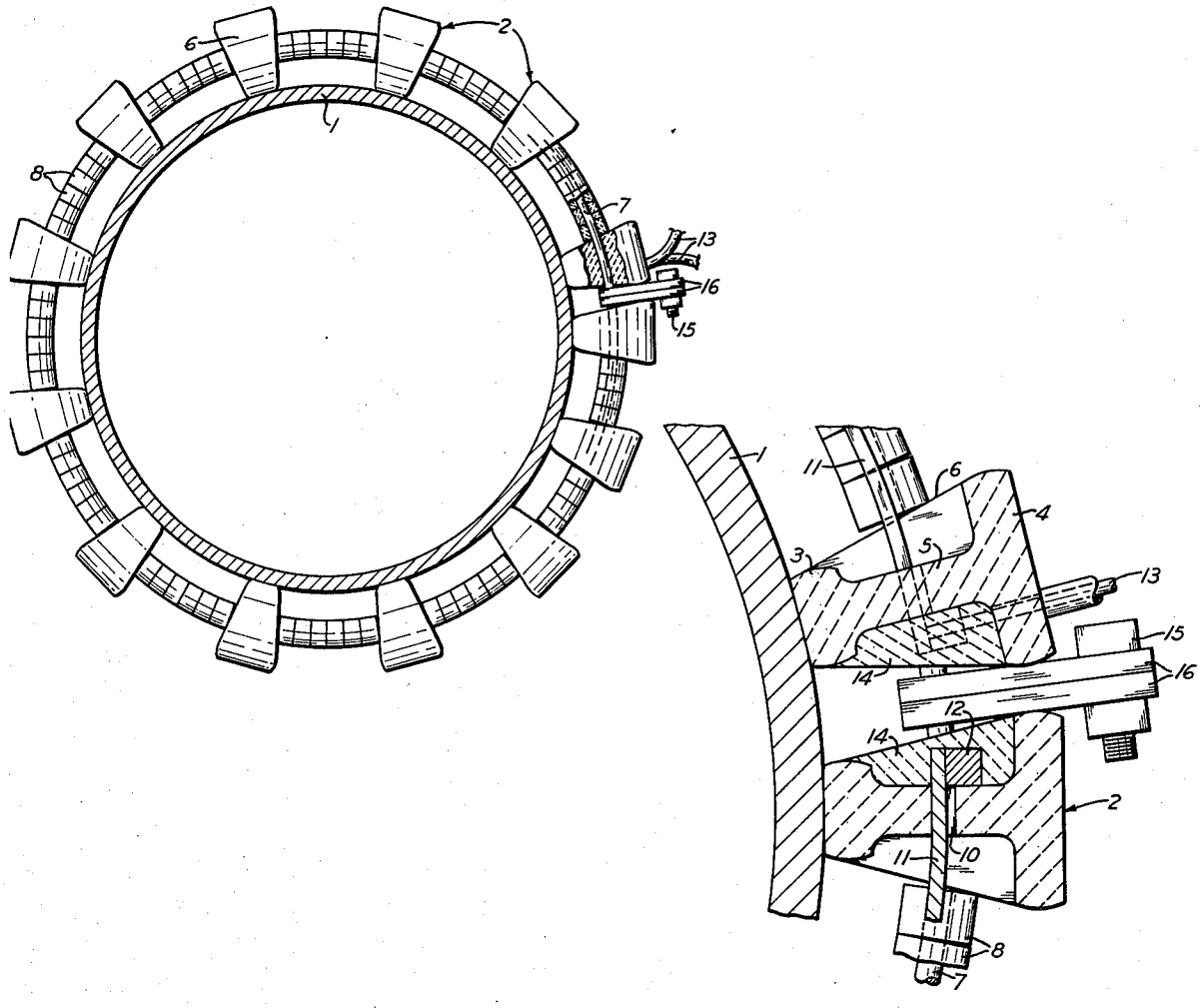
[57] **ABSTRACT**

Each of a plurality of spaced parallel insulating bars has a row of laterally spaced slots extending transversely through it and disposed edge to edge. Each end of each bar has a transverse passage therethrough, and a tie wire extends through all of the passages at each end of the bars and is provided with means spacing the bars apart. Laterally spaced parallel flexible electric resistance ribbons extend through the slots in the bars, with jumper means electrically connecting one end of each ribbon to the adjacent end of the next succeeding ribbon to form a zig zag electrical resistance element having electrical connections at its opposite ends. Fastening means attached to the opposite ends of each binding wire secure those ends together after the heater has been wrapped around an object, whereby to hold the heater in place.

11 Claims, 6 Drawing Figures



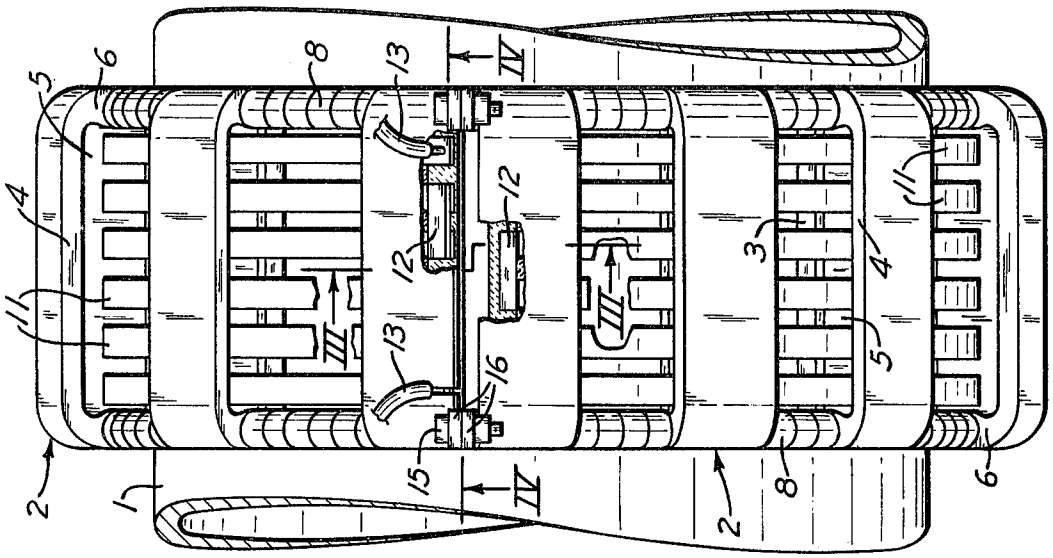


Fig. 2

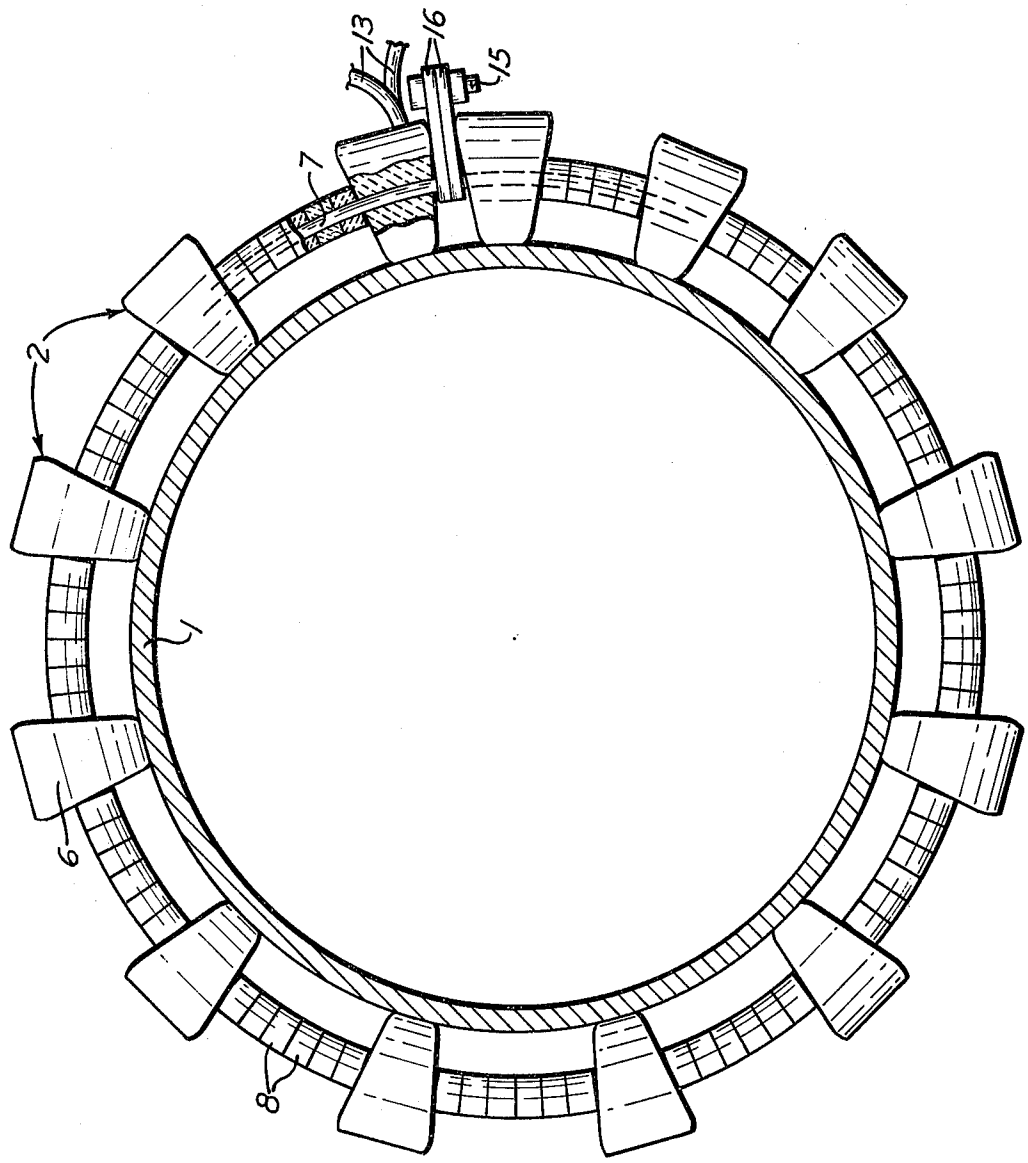


Fig. 1

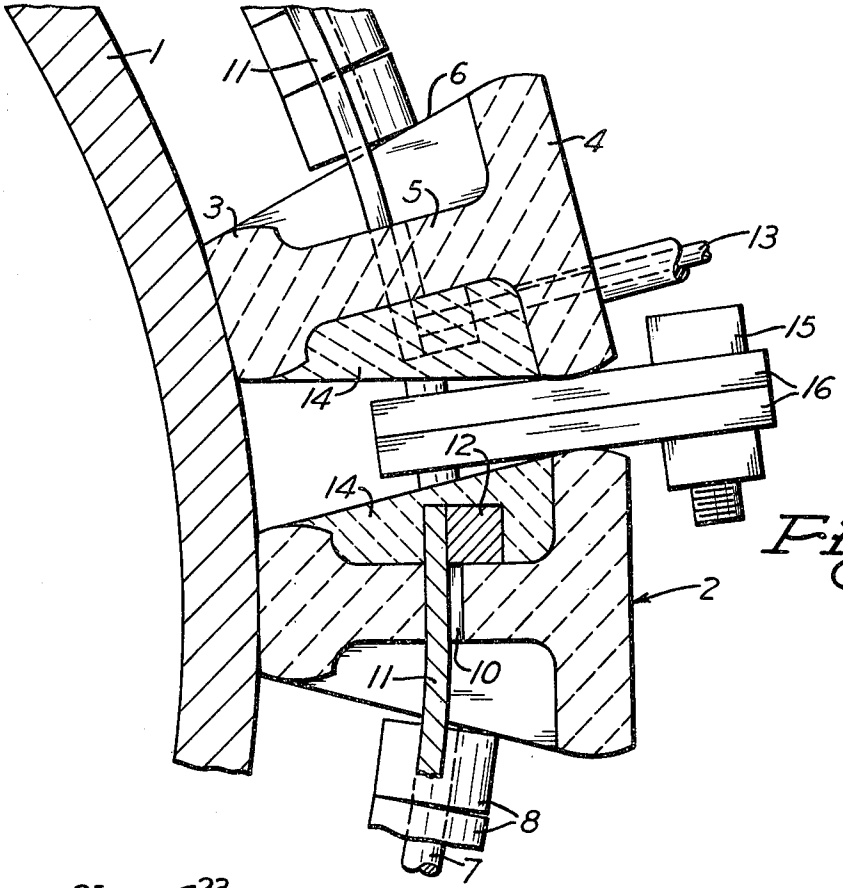


Fig. 3

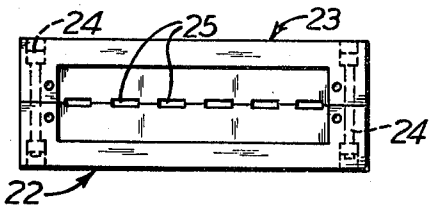


Fig. 6

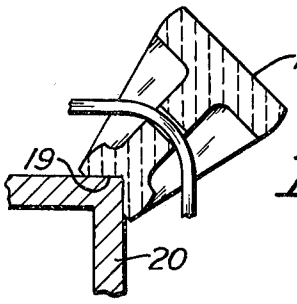


Fig. 5

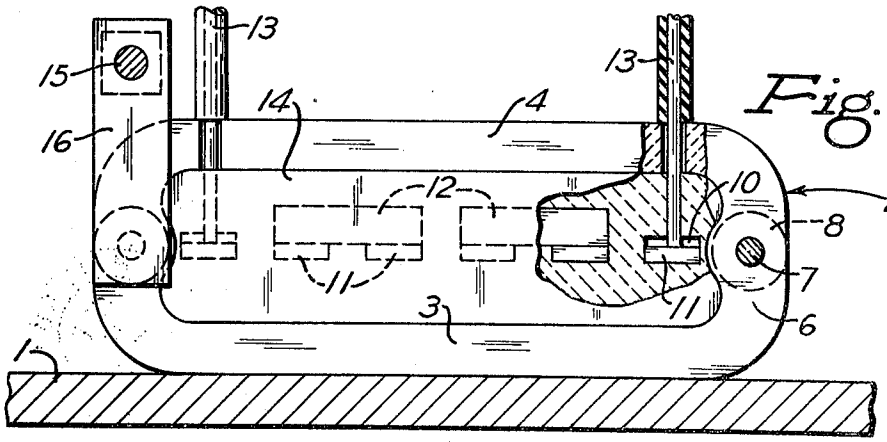


Fig. 4

WRAP-AROUND ELECTRIC RESISTANCE HEATER

It is among the objects of this invention to provide an electric resistance heater which can be wrapped around the object that is to be heated, which is of simple construction, which makes maximum use of the heating element, which is highly efficient, and which can be joined end to end with like heaters to increase its length.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which

FIG. 1 is an end view of the heater encircling a pipe that it is heating;

FIG. 2 is a side view of the heater;

FIGS. 3 and 4 are enlarged fragmentary sections taken on the lines III—III and IV—IV, respectively, of FIG. 2;

FIG. 5 is a cross section of an insulating bar of a heater wrapped around a rectangular object; and

FIG. 6 is a reduced side view of another embodiment of an insulating bar.

Referring to FIGS. 1 to 4 of the drawings, a circular object, such as a pipe 1, is encircled by an electric resistance heater to heat the pipe for any desired purpose. The heater is a wrap-around heater, which means that it is flexible and when not in use it can be laid out more or less flat, but when in use it is wrapped around the object that is to be heated and fastened in that position with the heated object supporting it. Of course, this heater can be used to heat plates and the like by laying it out flat on them.

The particular heater disclosed herein includes a plurality of parallel insulating bars 2 disposed in laterally spaced relation, which is also circumferentially spaced relation when the heater is in place as shown. Preferably, each bar is a ceramic member that has inner and outer longitudinal flanges 3 and 4 connected by a central web 5, as shown in FIGS. 3 and 4. At the opposite ends of the bar the inner and outer longitudinal flanges are integrally connected by end flanges 6. Each end flange has a transverse passage through it, and a tie wire 7 extends through all of the passages at each end of the bars. These two wires are provided with means holding the bars spaced apart from one another the desired distances. Such means may be crimps in the wire, metal pieces secured to the wires, or spacing members strung on the wires. Such spacing members may be, for example, beads or short ceramic cylinders 8.

A row of laterally spaced slots 10 (FIG. 3) extends transversely through the web of each insulating bar, with the slots in each row disposed edge to edge. That is, their wide side walls are parallel to inner and outer flanges 3 and 4. Extending through these slots in parallel relation are laterally spaced electric resistance bands or ribbons 11 made from thin flexible strips of an alloy suitable for an electrical resistance element. It follows that these ribbons also are disposed edge to edge, with their inner wide sides facing the pipe in order to radiate as much heat as possible directly to the pipe. The ends of the ribbons are electrically connected in such a manner as to form a continuous zig zag electrical resistance element extending from near one end of the insulating bars to near their opposite end. For this purpose, a short metal jumper strip 12 can be welded across the ends of each pair of ribbons, which means that one end of each ribbon is connected by a jumper strip to the adjacent end of the next succeeding ribbon,

so that one end of a ribbon will be electrically connected to the ribbon at its left-hand side and the other end of the ribbon will be connected to the ribbon at its right-hand side. Electrical connections are made to the opposite ends of the zig zag resistance element, such as by attaching terminals to those ends or by securing conducting wires 13 directly to them.

The jumper strips and the adjoining ends of the ribbons are anchored in the insulating bars at the opposite ends of the heater by insulating material 14, such as insulating cement filling the surrounding cavities formed by the flanges of the bars. Since it is highly desirable that the cement completely cover the jumpers and ribbon ends, the jumpers are quite narrow, but they are much thicker than the ribbons to give them a considerably greater cross sectional area so that they will not overheat and burn out, due to being enclosed in cement or the like. This resistance element has a low mass-to-radiating-surface ratio, which is highly desirable, and a large emissive area facing the pipe. A round resistance wire lacks both of these qualities, and is even worse when wound into a coil as a coil is very weak structurally.

This flexible electric heater is applied to a pipe 1 by wrapping the heater around it with the inner flanges of the insulating bars engaging the pipe, by which the heater is supported. This brings the opposite ends of each tie wire 7 close together so that they can be connected by a bolt 15 that extends through tabs 16 fastened to the ends of the wire. By tightening the bolts the heater is clamped onto the pipe.

Since it is highly desirable to expose as much as possible of the area of the inner surfaces of the ribbons directly to the pipe, the inner flanges 3 of the insulating bars are considerably narrower than the outer flanges. The end flanges of the bars are, therefore, tapered inwardly toward the pipe. As the webs of the insulating bars are relatively thin, very little temperature difference exists between the short lengths of ribbons in the web slots and the temperature of the ribbons between the bars. When the heater is wrapped around an object, the two end bars can be brought quite close together to minimize the width of the space between those two bars that does not produce heat.

Only enough bars are used to space the ribbons a uniform distance from the pipe. This means that enough bars must be used for the ribbons above the pipe to arch and not sag down toward the pipe. If more bars were used, the ribbons could become overheated due to too great an area being surrounded by the bars. Also, the efficiency of the heater would be reduced because the bars would interfere too much with radiation from the ribbons to the pipe. The bars themselves are relatively poor conductors of heat. If not enough bars are used, the ribbons will tend to extend in straight lines from bar to bar, or even sag toward or away from the pipe, and, therefore, would be closer to the pipe in some areas than in others. If desired, the outer surfaces of the ribbons can be coated with a suitable material, such as silicon or a film of glass, to reduce radiation outwardly from the heater.

If it is intended to use the heater to heat rectangular objects, the inner faces of the insulating bars, at least the corner bars 18 as shown in FIG. 5, can be provided notches 19 extending lengthwise of the bars for receiving and fitting the corners of a rectangular object 20.

In the further modified insulating bar shown in FIG. 6, the bar is divided lengthwise into identical inner and outer sections 22 and 23 that are normally connected together rigidly by countersunk bolts 24 in the end flanges of the bar. The meeting edges of the two sections are provided with registering recesses that form the slots 25 for the heater ribbons. The advantage of such a bar is that it permits a broken bar to be replaced easily in the field without having to remove other bars from the ribbons. By making the bar sections identical, only one die is required for both.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A wrap-around electric resistance heater for heating an object surrounded by it, comprising a plurality of spaced parallel insulating rigid bars, each bar having a row of laterally spaced slots extending transversely therethrough, the slots in each row being disposed edge to edge, each end of each bar having a transverse passage therethrough, a tie wire extending through all of the passages at each end of the bars and provided with spacing means holding the bars spaced apart, laterally spaced flexible electric resistance ribbons extending through said slots in parallel relation, low resistance metal jumper means electrically connecting one end of each ribbon to the adjacent end of the next succeeding ribbon to form a zig zag electrical resistance element, electrical connections at the opposite ends of said element, and fastening means secured to the opposite ends of each tie wire for fastening those ends together after the heater has been wrapped around an object, whereby to hold the heater in place with said bars engaging said object.

2. A wrap-around electric heater according to claim 1, in which said spacing means are a plurality of spacing members strung on each binding wire between each pair of adjacent insulating bars.

3. A wrap-around electric heater according to claim 1, in which said tie wire fastening means includes tabs attached to the ends of each wire and provided with registering holes, and a bolt extending through said holes and pulling the tabs toward each other.

4. A wrap-around electric heater according to claim 1, in which each insulating bar has inner and outer longitudinal flanges connected by a web provided with said slots.

5. A wrap-around electric heater according to claim 4, including end flanges integrally connecting said inner and outer flanges and provided with said tie wire passages.

6. A wrap-around electric heater according to claim 1, in which each insulating bar has inner and outer longitudinal flanges connected by a web provided with said slots, and end flanges integrally connecting said inner and outer flanges and provided with said tie wire passages, the inner flange of each bar being narrower than its outer flange, and the end flanges tapering in width from the outer flange to the inner flange.

7. A wrap-around electric heater according to claim 1, including a radiation-reducing coating on the outer surfaces of said ribbons.

8. A wrap-around electric heater according to claim 4, including insulating material filling the spaces between said flanges at the outer sides of the insulating bars at the opposite ends of the heater, with said jumper means and the adjoining ends of the ribbons embedded in said insulating material.

9. A wrap-around electric heater according to claim 8, in which said jumper means are metal bars of greater cross sectional area than said ribbons to prevent overheating.

10. A wrap-around electric heater according to claim 1, in which each of said insulating bars is divided lengthwise into inner and outer sections connected at their ends by countersunk bolts, and the meeting edges of said sections are provided with recesses forming said slots.

11. A wrap-around electric heater according to claim 1, in which at least some of said insulating bars are provided with patches extending lengthwise of the bars for receiving corners of a rectangular object surrounded by the heater.

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