United States Patent

[11] **3,578,952**

[72] Inventor **Robert C. Boose**
Mayes, Okla.

[21] Appl. No. **838,722**
[22] Filed **June 5, 1969**
[45] Patented **May 18, 1971**
[73] Assignee **Escoa Fintube Corporation**
Pryor, Okla.

[54] **TUBULAR ELECTRICAL HEATING ELEMENT WITH A SEGMENTED HELICAL FIN**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **219/540,** 165/184, 219/530
[51] **Int. Cl.** **H05b 3/50**
[50] **Field of Search** ..... 219/530, 540, 535-6-7, 430-9; 165/184; 338/238—42

[56] **References Cited**

UNITED STATES PATENTS

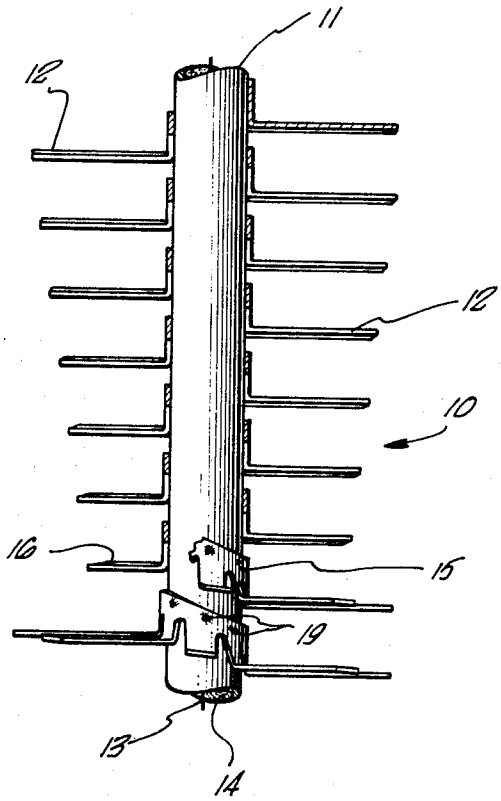
1,932,610	10/1933	Tilley	165/184
1,997,844	4/1935	Wiegand	219/540X
2,646,972	7/1953	Schmid	165/184
2,767,288	10/1956	Lennox	338/238
3,089,016	5/1963	Kelly	219/540
3,362,058	1/1968	Morris et al.	165/184X

FOREIGN PATENTS

893,064	1/1944	France	165/184

Primary Examiner—Volodymyr Y. Mayewsky
Attorney—Jackson & Jones

ABSTRACT: The disclosure describes a tubular electrical heating element comprising a cylindrical sheath having a helical fin attached thereto. The cylindrical sheath includes a heating coil disposed within the interior of the sheath and a quantity of insulating material compacted between the coil and the sheath. The fin includes a plurality of segmented L-shaped blades having a continuous base that is helically wound around the cylindrical surface of the sheath and is bonded thereto by a plurality of spot welds extending along the length of the base.



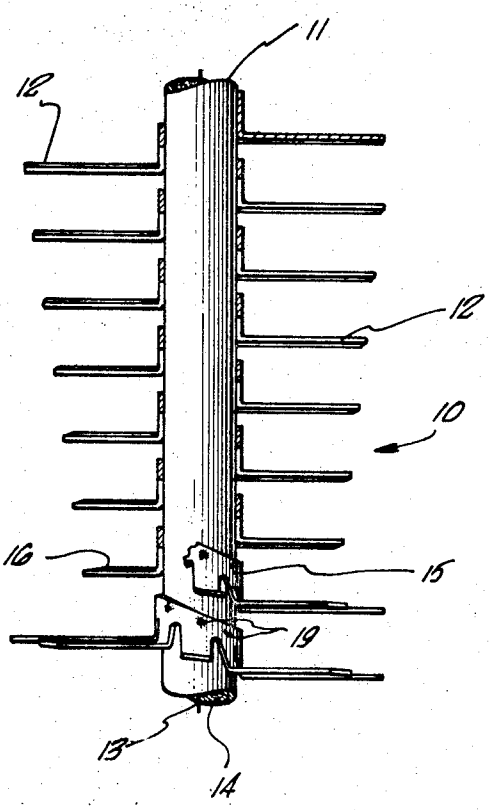


FIG. 1

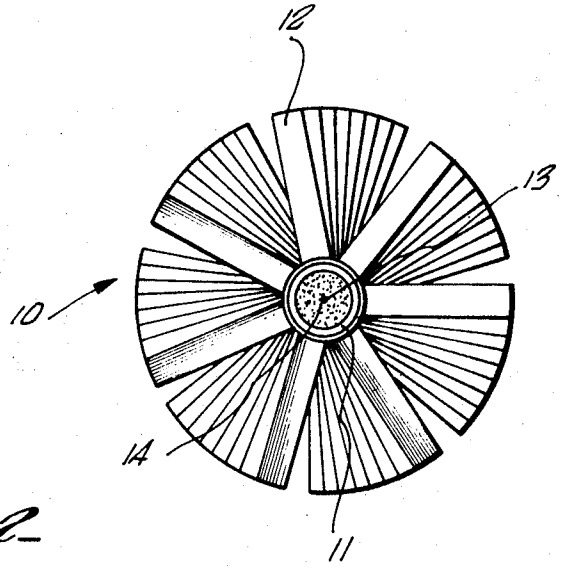


FIG. 2

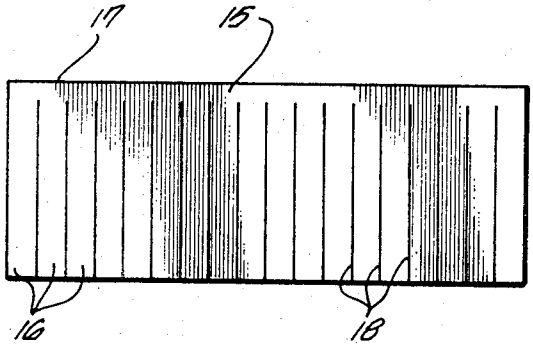


FIG. 3

INVENTOR.
ROBERT C. BOOSE
BY
Jackson & Jones
ATTORNEYS.

TUBULAR ELECTRICAL HEATING ELEMENT WITH A SEGMENTED HELICAL FIN

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to heat exchangers and more particularly to finned tubular electrical heaters.

2. Description of the Prior Art

Finned tubular electrical heaters are designed primarily for air heating applications in (1) natural convection space heaters, (2) forced draft space heaters, including unit ventilators, duct heaters and air handling units, and (3) industrial process air heating.

Other uses for finned electrical heaters include use in resistor load banks, in process dyeing, baking and in recirculating ovens.

Finned electrical heaters have much better heat transfer characteristics than straight walled heaters because the surface area exposed to the air or other gases for heat purposes is greatly increased by the fins. Prior finned tubular electrical heaters usually include cylindrical metal sheath, e.g. copper plated steel, having a fin wound around the metal sheath in a continuous helix. The sheath and the fin are generally bonded together by copper brazing.

Although these prior finned heaters are used extensively, various difficulties are encountered in their manufacture and use.

The most serious shortcoming lies in the brazing process utilized in bonding the fin to the sheath. Because the solder can not withstand high temperatures, the heating element is, of course, limited to low temperature ranges. Moreover, because of the low bonding strength of brazing, relatively thin gauge material must be utilized in making the fin. This also limits the fin to low temperature ranges, with the added disadvantage that the thin fin has relatively poorer heat transfer characteristics.

Another important disadvantage is the high cost involved in manufacturing these heating elements. In attaching the fin to the sheath, two steps are necessary, i.e. (1) the fin must be formed into a helix and wound around the sheath, and (2) the solder must then be applied at the base of the fin and the entire element placed in an oven for heating. Such a process not only is costly but is time consuming as well. Moreover, the range of materials that can be bonded by the brazing process is limited. As a result, finned tubular heaters are severely limited. As a result, finned tubular heaters are severely limited as to their practical range of utilization.

SUMMARY OF THE INVENTION

This invention obviates the above-mentioned shortcomings by providing a tubular electrical heating element having a segmented fin helically wound around a cylindrical sheath and bonded thereto by a plurality of spot welds extending along the length of the base. The fin is fabricated from a strip of sheet metal comprising a base formed along a longitudinal edge of the strip. A plurality of blades are formed by cutting a plurality of lateral slits longitudinally spaced along the strip. The base of the fin extends around the cylindrical surface of the sheath in a continuous helix with the blades extending radially outward from the sheath. The cylindrical sheath includes a heating coil disposed within the interior of the sheath and a quantity of insulating material such as magnesium oxide compacted between the coil and the sheath to insure rapid heat dissipation from the soil to the sheath.

The main advantage of such a device is that the welding process utilized in bonding the fin to the sheath enables the element to withstand higher temperatures heretofore impossible in prior heating elements. Moreover, because of the high bonding strength of the welds, relatively thicker gauge material can be used in forming the fin, thereby enhancing its heat transfer characteristics.

Although thicker material is utilized, the base of the fin can still be tightly wound around the sheath without crimping because the fin is segmented to permit the individual blade to separate as the base is wound around the sheath. Not only does this permit more efficient heat transfer, but the continuous engagement of the base with the sheath prevents any burn-through of the base during the welding process.

Moreover, these segmented finned heaters create more turbulence than continuous finned tubulars, thereby achieving a much higher performance, i.e. higher heat transfer coefficients.

Another important advantage of using the welding process is that the fin forming and the welding process can be carried out in a single step, thereby making the manufacturing process simpler and less expensive. Furthermore, since the welding process can be utilized on a broader range of materials than the brazing process, a larger selection of materials is available in forming the fin.

Thus, the device fulfills a primary object of the invention, i.e. to provide a finned tubular electrical heating element that is easier and more practical to produce and is capable of operating more efficiently in temperature ranges heretofore impossible.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a segmented finned tubular with a portion of the fin broken away and shown in section;

FIG. 2 is a top elevational view of the segmented finned tubular with the sheath shown in cross section; and

FIG. 3 is a plan view of a strip of the segmented pin prior to the formation and assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, FIGS. 1 and 2 show a tubular electrical heating element, generally indicated by arrow **10**, having a cylindrical metal sheath **11** and a segmented fin **12** helically attached thereto. The metal sheath **11** is usually copper plated steel and includes a length of high grade resistance wire **13** precisely centered therein. The length of wire can be of any configuration although a coil or a helical configuration is preferred. The length of wire **13** is electrically insulated from the metal sheath **11** by a quantity of magnesium oxide **14** compacted within the sheath **11**. Such an oxide **14** also insures rapid heat dissipation from the wire **13** to the sheath **11**. The ends of the sheath (not shown) terminate into a pair of terminals having means forming conventional electrical connections for the heating wire. The fin **12** is usually made of copper plated steel and includes a continuous base **15** which is helically wound around the cylindrical surface of the sheath. A plurality of blades **16** are formed at the base thereof and extend radially outward therefrom.

As shown in FIG. 3 the fin **12** is made from an elongated strip of metal. The base **15** of the fin is formed along an edge **17** of the strip with the blades **16** formed by cutting a plurality of lateral slits **18** longitudinally spaced along the entire length thereof. The cuts or slits **18** extend to the base **15** of the fin **12** with the blades **16** being defined therebetween. It is preferable that the width of the blades **16** be cut to a narrow width of approximately five sixty-fourths of an inch, the advantage of which will be discussed in greater detail hereinafter. In assembling the fin **12**, the blades **16** are rolled or bent at their roots approximately 90° to the base **15** to form an L-shaped segmented fin.

Referring back to FIGS. 1 and 2, the base **15** of the fin **12** is then helically wound around the cylindrical surface of the

sheath **11** with the blades **16** extending radially outward therefrom. Since the blades **16** are segmented and can separate freely without crimping as the base **15** is wound around the sheath **11**, the base **15** can lie flush with the cylindrical surface of the sheath **11** without having any gaps formed therebetween caused by blade crimping. Furthermore, the widths of the blades **16** are relatively smaller than the diameter of the sheath **11**, which also permits the base **15** to be wrapped tightly around the sheath **11** without blade crimping.

Upon winding the base **15** around the sheath **11**, the base **15** is then welded to the cylindrical surface of the sheath **11**. Although a continuous weld could be utilized, the preferred embodiment shows a plurality of spot welds **19** extending intermittently along the length of the base **15**. Although not shown, the forming of the base **15** and the welding thereof to the sheath is carried out by a single-step process utilizing a welding wheel. It should be noted since the bonding strength of the welds **19** is great, a relatively thicker gauge of material can be utilized in making the fin **12**. However, even though a thicker fin is utilized, the base **15** can still be tightly drawn around the sheath **11** because of the separation of the segmented blades **16** as the base **15** is wound thereupon.

An important advantage of having the base **15** lying flush against the cylindrical surface of the sheath **11** is that the heat generated by the welds **19** on the base **15** is carried off by the sheath, thereby eliminating the possibility of the welds **19** burning through the base **15**.

The primary advantage of utilizing a welding process in bonding the fin to the sheath is that the heating element is capable of operating in higher temperature ranges than elements bonded by a brazing process.

Moreover, the selection of materials for forming the fin is larger since the welding process can bond a greater variety of different materials.

As can be seen, finned tube heaters, in accordance with the present invention, can be manufactured quite easily and inexpensively, and can operate efficiently in temperature ranges

heretofore impossible with prior heating elements.

I claim:

1. A tubular electrical heating element comprising:

a cylindrical sheath having a heating wire disposed within the interior of said sheath and a quantity of insulating material compacted between said wire and said sheath;

a fin fabricated from a strip of sheet metal comprising a base formed along a longitudinal edge of the strip, and a plurality of blades formed by cutting a plurality of lateral slits longitudinally spaced along the strip, said blades subtending an included angle with respect to said base, the base of the fin extending around the cylindrical surface of the sheath in a continuous helix with the blades extending radially outward from said sheath, the width of each blade is narrower than the diameter of said sheath to permit the base to lie flush with the cylindrical surface of the sheath without having the blade crimp, said blades subtend an included angle of approximately 90° from said base; and

weld means extending along the length of the base for bonding said base to the cylindrical surface of said sheath.

2. The invention in accordance with claim **1** wherein said weld means includes a plurality of spot welds extending along the length of the base.

3. The invention in accordance with claim **1** wherein said weld means includes a continuous weld extending along the length of the base.

4. The invention in accordance with claim **1** wherein the width of the blade is approximately five sixty-fourths of an inch.

5. The invention in accordance with claim **1** wherein the sheath is made of copper plated steel.

6. The invention in accordance with claim **1** wherein said fin is made of copper plated steel.

7. The invention in accordance with claim **1** wherein said quantity of insulating material is magnesium oxide.