

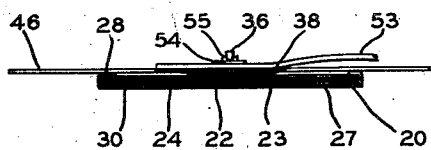
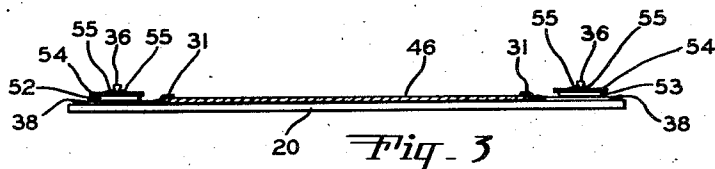
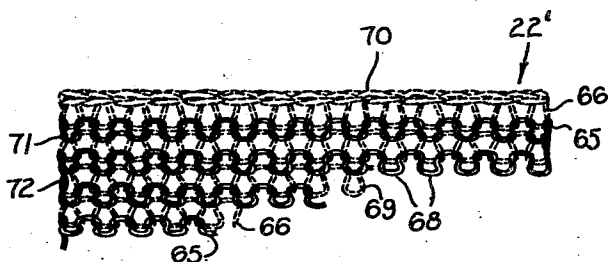
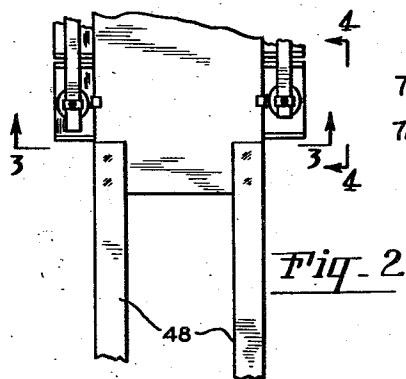
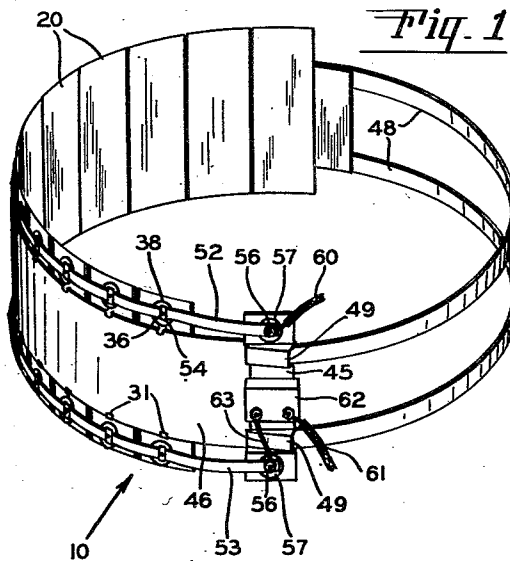
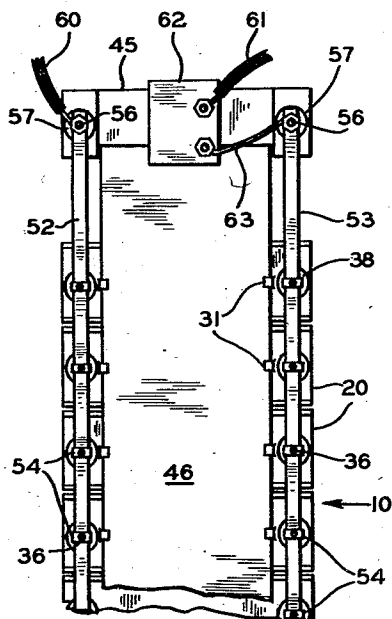
June 25, 1957

P. L. FOWLER ET AL
ELECTRIC HEATER

2,797,296

Filed July 25, 1955

2 Sheets-Sheet 1



INVENTORS
PAUL L. FOWLER
CHESTER A. ARTHUR
BY

Cook and Schermerhorn
ATTORNEYS

June 25, 1957

P. L. FOWLER ET AL
ELECTRIC HEATER

2,797,296

Filed July 25, 1955

2 Sheets-Sheet 2

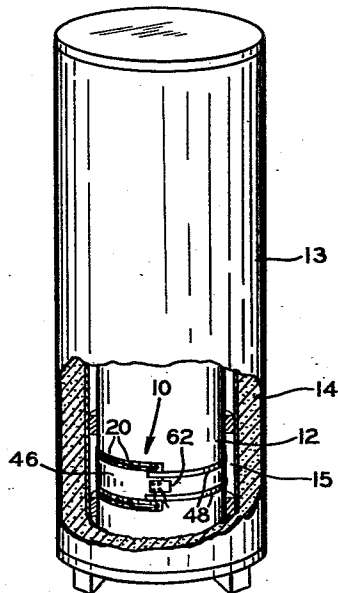


Fig. 5

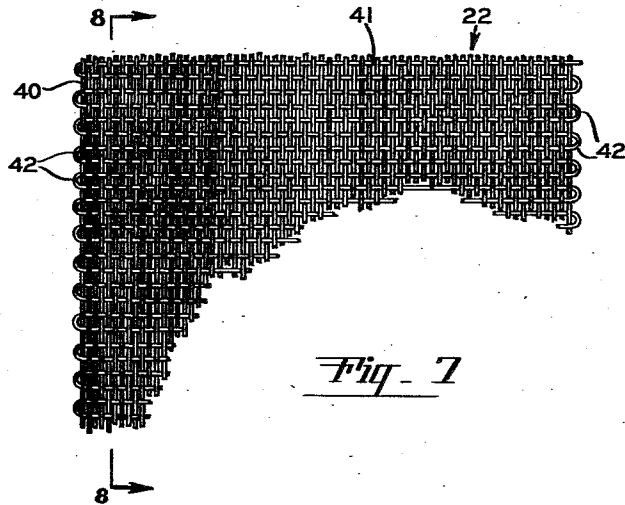


Fig. 7



Fig. 8

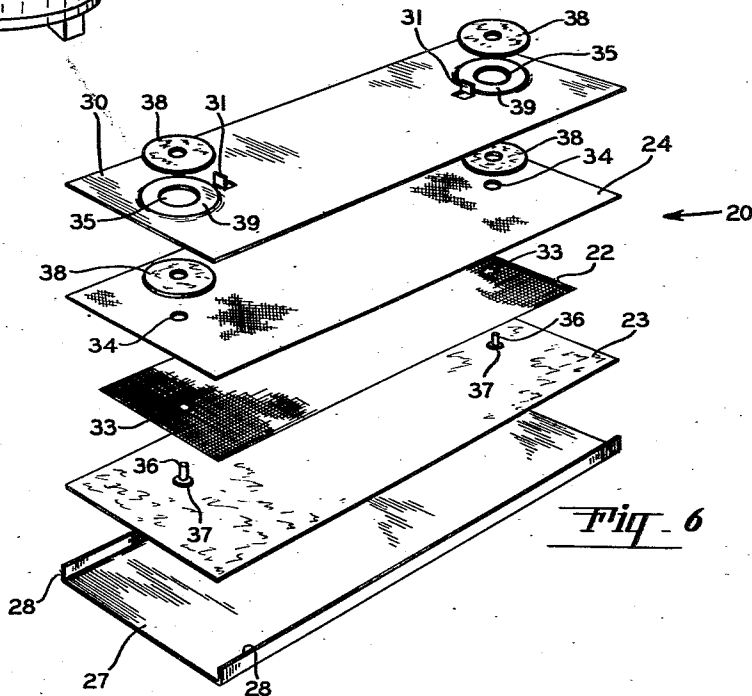


Fig. 6

INVENTORS
PAUL L. FOWLER
CHESTER A. ARTHUR

BY

Cook and Schermerhorn
ATTORNEYS

1

2,797,296

ELECTRIC HEATER

Paul L. Fowler, Portland, and Chester A. Arthur,
Jennings Lodge, Oreg.

Application July 25, 1955, Serial No. 524,020

10 Claims. (Cl. 219—38)

This invention relates to improvements in electric heaters, and has particular reference to improvements in band-type heaters for water tanks and the like.

An object of the invention is to provide an improved electric heating element of general application which may be economically manufactured for different voltage and current ratings.

Another important object of the invention is to provide a band-type electric heater for water tanks which has an improved arrangement of heating units for applying thermal energy to the outside of a tank or other surface to be heated.

A further object is to provide a band-type electric heater having a plurality of heating units which are conveniently and quickly assembled into a unitary heater structure conformable to a curved surface.

A further object is to provide a band-type electric heater which is readily applicable as a replacement or addition to most types of existing hot water tanks.

A further object is to provide a heater having a plurality of heating units which may be assembled in variable number according to the heating effect desired and wherein the failure of one unit will not seriously impair the operation of the heater.

A further object is to provide a heater having a plurality of units which are readily individually replaceable when defective.

A still further object is to provide an improved heating element which comprises a flexible web utilizing glass fiber threads and a resistor wire.

An additional object is to provide an improved heating element structure which is initially formed into a narrow continuous web composed of dielectric threads and a resistor wire and which may be severed in short lengths to form individual heating elements.

Still another object is to provide a heating element of the type described which may be fabricated on a conventional weaving or knitting machine, or the like, in strip form and then cut to lengths appropriate for the voltage to be applied and the temperature to be developed.

The improvements set forth in the above objects are accomplished by a heater structure utilizing certain novel component parts assembled in novel arrangement. The heater is of the band type which is arranged to encircle a metallic water tank and heat the water therein by conduction of thermal energy through the tank. The heater employs a plurality of novel heating units adapted to be held in contact with the outer tank surface in efficient heat transfer relation. The improvements obtained are accomplished by the heating unit structure providing as one feature the use of a novel heating element comprising a web of glass fiber threads and resistor wire which is initially formed in a continuous, narrow strip and subsequently severed into lengths desired.

The invention will be better understood and additional objects and advantages will become apparent from the following description taken in connection with

2

the accompanying drawings which illustrate a preferred form of the invention. It is to be understood, however, that the invention may take other forms, and that all such modifications and variations within the scope of the appended claims which will occur to persons skilled in the art are included in the invention.

In the drawings:

Figure 1 is a perspective view of the heater of the present invention shown in band form and having a plurality of individual heating units thereon;

Figure 2 is a plan view of the heater laid out in flat condition and prior to mounting on a water tank;

Figure 3 is a sectional view taken on the line 3—3 of Figure 2;

Figure 4 is a fragmentary side elevational view taken on the line 4—4 of Figure 2;

Figure 5 is a perspective view of a water tank with parts broken away showing the present heater applied thereto;

Figure 6 is an enlarged exploded view of one of the individual heating units;

Figure 7 is an enlarged fragmentary plan view of one form of heating element comprising a woven web;

Figure 8 is a sectional view taken on the line 8—8 of Figure 7; and

Figure 9 is an enlarged fragmentary plan view of another form of heating element comprising a knitted web.

Referring specifically to the drawings, the numeral 10 designates, generally, the heater of the present invention. This heater is a band-type heater and, although it may be used for applying thermal energy to various surface areas, it is described herein as being applied to a metallic water tank 12, Figure 5, which is in ordinary domestic use. In conventional constructions, an outer casing 13 is provided around the tank 12, and disposed between the tank and casing is an insulation blanket 14 and a dead air space 15.

The heater 10 utilizes a plurality of heating units, designated generally by the numeral 20 and shown in detail in Figure 6. Each of the heating units 20 comprises a heating element 22 which, in assembled relation, is disposed between sheets of insulation material 23 and 24. The sheet 23 is preferably mica, and the sheet 24 is preferably formed of an asbestos material. The casing for the heating unit 20 comprises a body member 27 having side flanges 28 and a cover portion 30 provided with a pair of tabs 31 struck out of the metal. The casing parts 27 and 30 are formed from a soft metal, preferably aluminum, and the parts of the unit are held in tightly layered position by bending the flanges 28 over into firm engagement with the cover 30, as shown in Figure 4.

The unit parts 22, 24 and 30 are provided with apertures 33, 34 and 35, respectively, adjacent the ends thereof for receiving a smooth, upstanding shank 36 of a headed pin 37 which, as will be described, forms a terminal post for the heating unit, the pin 37 preferably being formed of a soft metal such as aluminum. Apertures 35 in the cover portion 30 are enlarged relative to the diameter of the pin shank 36 so that clearance is provided around said pins to prevent electrical contact between the pins and the cover 30. A pair of washers 38, formed of a dielectric material, are disposed on opposite faces of the cover 30 at each end thereof. The cover is embossed at 39 forming an annular inset to center one of the washers 38 on each terminal post aperture 35.

The heating element 22 comprises a web of material, best shown in Figures 7 and 8, having interwoven glass threads 40 and a resistor wire 41. The heating element

3

22 is woven in a well known manner with the glass threads 40 forming the warp of the material and the resistor wire 41 forming the filler of woof of the material. The resistor wire 41 is interlaced back and forth with connecting loops 42 on the ends between adjoining strands, and the web material is preferably formed in long strips by conventional weaving machines and then merely cut to the desired length for use in the heating unit. Each of the interlaced strands of the resistor wire is held in spaced relation from the adjoining strands by the warp material 40.

Referring to Figures 1-4, the supporting structure of the heater 10 comprises an end bracket 45 and an intergal flexible band member 46, to which the individual heating units 20 are attached by means of the tabs 31 which are bent over to engage said band. A pair of strap members 48 are secured to the band 46, and the ends of these straps are engageable in a pair of clamps 49 on the bracket 45, whereby the heater can be looped around a water tank and held snugly thereon by engagement of the straps 48 in the clamp members 49.

Disposed adjacent the sides of the band 46 is a pair of bus bars 52 and 53 having apertures suitably spaced for receiving the projecting shank portions 36 of the pins 37 and for electrically connecting a plurality of the heating units 20 in parallel. The bus bars 52 and 53 are held in positive engagement with the shanks 36 by means of hardened spring nuts 54 having opposed spring tongues 55 provided with teeth edges for gripping positively into the soft metallic shank without requiring threads on the shank. These spring nuts are movable in only one direction on the shanks 36 by reason of pawl action of the teeth edges, and, therefore, when pressed down tightly on the shanks, the parts 22, 24 and 30 of the heating units are compressed firmly together and a good electrical connection is established between the heads of the pins 37 and underlying strands of the resistor wire 41. Apertures 33 in the heating element are not made in a manner to sever the resistor wire 41 but preferably by merely forcing the shanks 36 between the strands of glass and wire whereby the head of the pin will bear against several reaches of the wire at the point of electrical connection.

The bus bars 52 and 53 are secured to the bracket 45 by screws 56 which form terminals, and said bus bars and screws are insulated from the bracket by suitable dielectric washers 57. The heater is energized by a pair of lead wires 60 and 61. Lead wire 60 is electrically connected to one of the terminals 56, and the lead wire 61 is connected to an adjustable automatic thermostat 62 mounted on the bracket 45. Thermostat 62 is electrically connected in series between the lead wire 61 and the bus bar 53 by means of a wire 63 connected to the other terminal 56.

An important feature of the present heater structure is that it is easily and quickly assembled by workmen. The units 20 are readily assembled by laying the heating element 22, insulation sheets 23 and 24, and cover 30 in the body portion 27 and then bending flanges 28 into clamping engagement with the cover. The flanges 28 hold the parts in compact relationship, and, as described hereinbefore, a good electrical connection between the pin 37 and the element 22 is accomplished by the spring nuts 54 which are adapted effectively to compress the three top layers together as well as to draw the heads of the pins 37 into firm engagement with the resistor wire of the heating element. The individual heating units 20 are readily mounted on the band 46 by means of the tabs 31 and are more positively held in fixed position against sliding on the band 46 by the bus bars 52 and 53.

As the web for the element 22 is woven in a long strip and the resistor wire is disposed in transverse strands, lengths may be cut from said strip to provide elements having any desired wattage at a given voltage. The glass thread being refractory, the heating element may be operated at a red heat if desired. The element is thus suit-

4

able for toasters and other radiant heaters without being enclosed, as shown in Figure 6. When operated at lower temperatures the flexibility of the element 22 makes it suitable for heating pads, garments and other shape-forming applications.

Another advantage of the present form of construction is that the number of individual units 20 may be varied on the heater structure to increase or decrease the thermal capacity thereof, as desired. When the heater is cinched up tightly on a round tank, the individual units 20 are sufficiently yieldable to become curved to conform to the shape of the tank and provide good heat transfer by conduction. The insulation sheet 23 electrically insulates the element 22 from the body portion 27 but permits thermal energy to be transmitted readily from the element to the body portion. The other insulation sheet provides thermal as well as electrical insulation on the back of the unit.

The present invention, therefore, provides an improved heater for application to surface areas which has inexpensive component parts readily and quickly assembled by workmen. The invention resides in the component parts of the heater structure as well as the combination itself. Therefore, it is evident that the individual heating units 20 could be used in other types of structure than that shown and the heating element 22, similarly, may be used for other purposes not connected with the unit parts 20.

Figure 9 shows another form of heating element comprising a web of material 22' formed by conventional knitting processes. As seen, the knitted web is formed from two strands 65 and 66, the strand 65 shown in full lines comprising the resistor wire and the strand 66 shown in dotted lines, comprising a dielectric refractory strand such as glass thread. Most forms of knitting may be used to make the web 22', as long as the glass thread 66 separates transverse courses of the resistor wire. The particular type of web shown in Figure 9 is made by the jersey stitch, and may be made on conventional knitting machines.

In the jersey stitch, the transverse courses of resistor wire 65 comprise a plurality of loops 68, and the various courses of said resistor wire are held in spaced relation by the glass thread 66, comprising interconnecting loops 69. The web 22' is initially formed with an end interlocking portion 70 of glass thread, and is knitted in strip form having a predetermined width for assembly in desired sizes of heating units. The resistor wire 65 is a single continuous wire and the adjoining courses are connected by size portions 71 interlaced with side portions 72 of the glass thread 66 in the usual manner of knitting a rectangular web or tape.

The heating element strip 22' may be severed transversely into desired lengths for providing heating units 20 of desired wattage at a given voltage. When installed in a heating unit 20, the headed pins 36 are forced through the web and each pin engages at least one of the transverse courses of resistor wire to form an electrical connection therewith. The heating element is clamped firmly between the insulating sheets of the heating unit and can in no way unravel from its knitted form.

Having now described our invention and in what manner the same may be used, what we claim as new and desire to protect by Letters Patent is:

1. A band-type electric heater comprising an elongated flat band of flexible material, a transverse bracket on one end of said band projecting beyond the width of the band, bus bars mechanically connected with the ends of said bracket and extending parallel with said band in spaced relation beyond the opposite side edges thereof, heating units in individual flexible metal casings disposed side by side along said band with end portions projecting over the side edges of said band and connected with said bus bars, bendable tabs on said heating units engaging the edges of said band, straps on the other end of said band, and clamps for said straps on said bracket.

5

2. A band-type heater structure for a water tank and the like, comprising a plurality of flat heating units disposed in parallel relation, support means for holding said heating units in surface engagement with said tank, a heating element in each of said heating units comprising an interwoven web of resistor wire and dielectric threads, a pair of spaced terminal posts on each of said heating units, said terminal posts being electrically connected to said heating element and having an outwardly projecting portion, a pair of electrical conductors engageable with the projecting portions of said terminal posts for supplying electric energy to said heating elements, and fastening means engageable on said terminal posts arranged firmly to hold said electric conductors thereon and to urge said terminal posts into positive engagement with said heating element.

3. An electric heater comprising an elongated supporting band, bus bars extending along said band in spaced relation beyond opposite side edges thereof, a plurality of heating units having end portions projecting beyond said opposite side edges of said band, bendable tabs on said heating units engaging said band, heating elements in said units, headed terminal pins piercing said elements and projecting from said end portions of said units, and spring nuts on said pins securing said pins to said bus bars and clamping the heads of said pins against said heating elements.

4. In an electric heater, a heating element, headed terminal pins having smooth, soft metal shanks piercing said element, bus bars for energizing said heating elements, and hard metal spring nuts having biting jaws engaging said shanks to secure said pins to said bus bars and clamp the heads of the pins against said heating elements.

5. In a heater structure, a heating unit comprising a heating element, said heating element being composed of a flat interwoven web of glass threads and a resistor wire, a casing for said heating element, and electrical connecting means comprising headed metal pins forced through the mesh of said web frictionally engaging said element and extending outwardly through said casing.

6

6. A heating unit comprising a casing, said casing being composed of a body portion having cover means and foldable tabs arranged to fold into engagement with said cover means for quick assembly and disassembly of said casing, a heating element insulatedly mounted in said body portion, said heating element comprising a flat fabricated web of glass thread and a resistor wire, and electrical connecting means comprising headed terminal pins forced through the mesh of said web frictionally engaging said resistor wire.

7. A heating element comprising a web of straight, parallel glass fiber threads and a bare, uniform resistor wire interlaced in a plain weave.

8. A heating element in the form of an interwoven web comprising as the warp straight, parallel dielectric refractory threads and comprising as the filler a bare, uniform resistor wire.

9. A flexible heating element comprising a bare resistor wire and a glass fiber thread knitted together in interlacing loops in the form of a fabric wherein the wire loops and thread loops are of the same size and configuration.

10. A flexible heating element comprising a web having a warp of glass fiber threads disposed in parallel side-by-side relation without any appreciable openings therebetween, and a resistance wire filler interlaced with said warp threads in a plain substantially tight weave.

References Cited in the file of this patent

UNITED STATES PATENTS

1,321,462	Line	Nov. 11, 1919
1,642,197	Fowler	Sept. 13, 1927
1,704,413	Wait	Mar. 5, 1929
1,992,593	Whitney	Feb. 26, 1935
2,022,662	Geyser	Dec. 3, 1935
2,157,606	Harris	May 9, 1939
2,284,653	Hackethal	June 2, 1942
2,375,997	Larson	May 15, 1945
2,572,695	Briscoe et al.	Oct. 23, 1951