March 11, 1941. D. TENNEY 2,234,289

ELECTRICAL HEATER AND RESISTANCE

Filed May 4, 1939

Fig. 1.

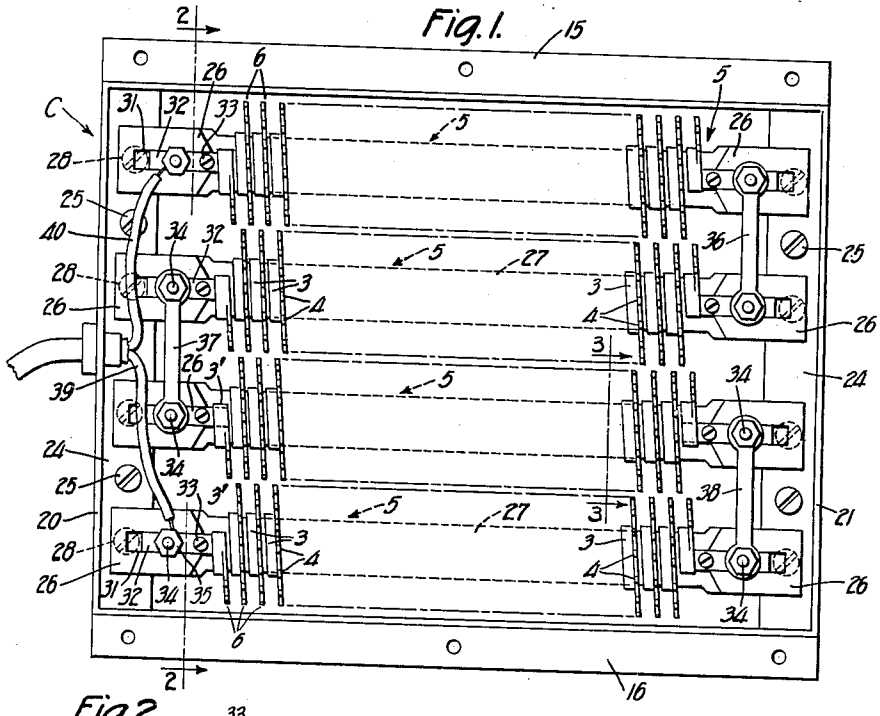


Fig. 2.

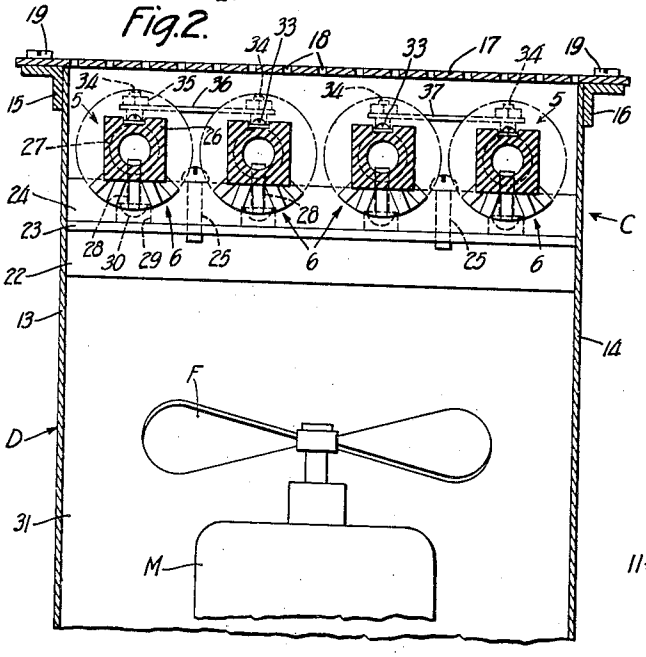


Fig. 3.

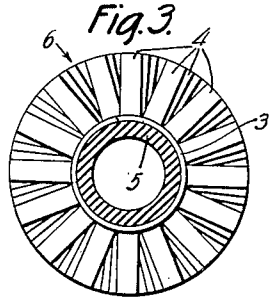


Fig. 4.

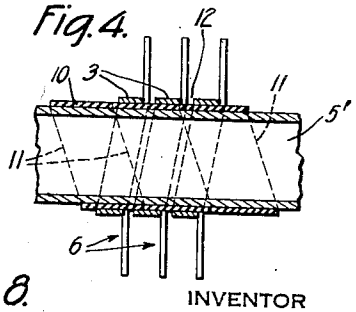


Fig. 5.

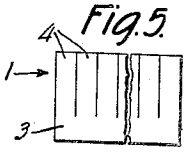


Fig. 6.

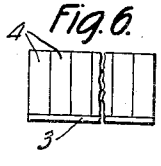
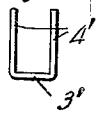


Fig. 7.



Fig. 8.



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UNITED STATES PATENT OFFICE

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ELECTRICAL HEATER AND RESISTANCE

Dwight Tenney, Verona, N. J.

Application May 4, 1939, Serial No. 271,725

8 Claims. (Cl. 201—74)

This invention relates to an improved type of electric resistor element which is rugged and inexpensive to manufacture.

A further object of the invention is to provide an electrical heating unit composed of one element primarily for carrying the current and another element primarily for dissipating the heat generated by the first element, with the temperature gradient between the two elements at a minimum.

Such a low temperature gradient is desirable because it makes it possible to provide a relatively low temperature in the current carrying element and thus prevents rapid deterioration of such element. Moreover, for a given temperature of the current carrying element, the temperature of the heat dissipating element is higher because of such low gradient, thus requiring less area of such element to dissipate a given amount of heat.

A further object of the invention is to provide an electrical heating unit as above described in which the said one element is in the form of a ribbon of electrical resistor material and the second element is in the form of metallic fins extending at an angle from the plane of the ribbon and in direct metallic connection with the said ribbon.

A still further object is to provide an electrical resistor so arranged that the current density varies in different, integral, consecutive sections of the current carrying member.

Another object is to provide an electrical heating device which can dissipate a large amount of electrical energy as heat to its ambient environment, and which also reaches its normal operating temperature within a short time after a potential is applied thereto.

A still further object is to provide an electric heating unit which is so arranged as to set up a turbulence in a stream of air, gas or other fluid passing over it thereby providing a high factor of heat transfer between the unit and the said stream.

Other objects of the invention will become apparent to those skilled in the art as the description thereof proceeds. For a better understanding of the invention, however, reference is made to the accompanying drawing in which:

Fig. 1 is a top plan view of an electric heater arrangement embodying the invention with the grille cover of the enclosing casing removed;

Fig. 2 is a fragmentary sectional view, of the arrangement shown in Fig. 1 with the casing cover in position, taken on the line 2—2;

Fig. 3 is transverse section view of one of the resistor units of Fig. 1 taken on the line 3—3;

Fig. 4 is a fragmentary longitudinal sectional view showing a modified form of resistor mounting;

Fig. 5 is a view in front elevation showing a resistor embodying the invention partly formed;

Fig. 6 is a view in front elevation showing the resistor of Fig. 5 in a later stage of formation;

Fig. 7 is an end view of the resistor of Fig. 6; and

Fig. 8 is an end view of a resistor similar to that of Figs. 6 and 7 in which fins are provided on both edges of the resistor strip.

Referring first to Figs. 5, 6 and 7, the preferred form of my invention is shown as comprising a long, flat bar or ribbon 1 in which a plurality of slits 2 are cut partly across leaving a relatively narrow continuous band 3 along one edge and forming a plurality of closely adjacent fingers or fins 4. The slits 2 may be formed by a shearing tool, in which case none of the resistor material is removed and the edges of the adjacent fins will remain in contact, or they may be formed by a cutting tool which removes some of the material such as a saw, in which case the edges of adjacent fins are slightly separated. The bar is now bent at the region where the fins 4 join the band 3 so that the fins 4 extend substantially at right angles to band 3, as shown in Figs. 6 and 7. To complete the resistor element, the ribbon 1 is now wound spirally around a preferably hollow rod 5 formed of any known insulating material such as porcelain, soapstone, etc., to form a plurality of spaced apart convolutions 6 as shown in Figs. 1 and 3. The flexing of the band portions 3 causes the fins 4 to separate from each other so that their adjacent edges are no longer in contact, as clearly shown in Fig. 3. The core 5 need not be rigid, but may also be made of flexible material. I have found that when a voltage is impressed across the ends of a resistor element made as above described, the major portion of the current passes through the continuous band portion 3, only a small fraction passing through the fins 4. The resistance of the resistor and hence the amount of heat generated therein and its surface temperature may be varied by making the slits 2 longer or shorter as desired.

In cases where a resistor of low value is desired, the ribbon 1 may be formed of any known flexible material having a relatively low specific electrical resistance. The heat generated by the current in passing through the band portion 3 is

readily conducted to the integrally formed fins 4 from whose surfaces it is transferred to the surrounding medium, such as air or gas, by radiation and convection. This rapid transfer of the heat from band portion 3 serves to maintain the resistor at a desired low temperature. In cases where a resistor having a higher value is desired for the purpose of generating a large amount of heat, the ribbon 1 may be formed of any known flexible material having a high specific resistance. High resistance metallic alloys of the nickel-chromium and nickel-steel types are suitable for this purpose, an alloy having the trade name "Cupron" having served satisfactorily. While the fins 4 are shown in Figs. 5 to 7 as being formed along only one side of the band portion 3, similar fins may be provided along its opposite side and bent up to extend parallel to the fins 4 thereby providing a larger area for radiating and convection of the heat generated. It is to be be noted that the length of the fins 4 and hence the area of the surface effective for heat transfer is entirely independent of the cross-sectional area of the current conducting band 3 though these parts are integrally formed. It is to be noted, also, that the current carrying portion 3 is not only integral but also continuous with the fins, over the greater part of the length of the said portion. In fact, it is continuous with the fins over all its length except for the relatively small amount of material that may be removed in forming the slits 2.

Fig. 4 shows a modified form of construction in which a layer 10 of insulating material is formed of a plurality of turns 11 wound spirally about the exterior surface of a hollow, cylindrical metal tube 5'. The ribbon 1 is wound spirally over the layer 10 with the flat band 3 in contact with the outside of the layer and in a direction opposite to the direction of winding of the turns 11. In the resistor units shown in Figs. 1 and 4 consecutive turns of the band 3 are separated merely by the intervening air space indicated at 12 but it will be understood that the consecutive turns may be separated by filling the space therebetween with any known insulation material (not shown).

For the purpose of generating a large amount of heat in an electric stove or heater, a plurality of the resistor units may be assembled together as shown in Figs. 1 and 2. In the structure shown the opposite side walls 13, 14 of a metallic casing C have secured to their upper ends the angle irons 15, 16 to which a grille cover 17, perforated as indicated at 18, may be secured by the screws 19. To the end walls 20 and 21 of casing C are secured the angle irons 22, having horizontal flanges 23 (only one being shown). Mounted on each flange 23 and extending across the width of casing C is a bar 24 of insulation material, the bars being secured to flanges 23 by the screws 25. Each hollow rod 5 is shown as having square end portions 26 and a reduced cylindrical central portion 27 on which the band 3 of the resistor unit is wound. The ends 26 of the rods 5 are secured in position on the bar 24 by securing screws 28, as shown, suitable counterbores 29 being provided in bar 24 to receive the heads 30 of the screws 28.

To provide terminals for the resistor units, each end 26 of the bars 5 is provided with an elongated shallow slot 31 in which is snugly seated a rectangular copper terminal strip 32, secured in position as by a screw 33. Extending upwardly from the outer end portion of each terminal strip 32 is a terminal screw 34 provided with a threaded nut 35. For the purpose of connecting the end of each resistor to a terminal strip 32, the end 3' of narrow band portion 3 is wrapped around and under the end of strip 32, these parts being thus firmly and electrically connected. As shown in Fig. 1, the four resistor units are connected in series by connecting busses 36, 37, 38 which extend between and connect the terminal screws 34 of adjacent units, as shown. The end terminal screws 34 of the heater arrangement are shown connected to the current supply mains, 39, 40 which lead to a source (not shown) of either direct or alternating current of suitable voltage. The heating units of the arrangement shown achieve a high heat dissipating property very rapidly after the application of a suitable operating voltage by reason of the fins being integrally connected with their current carrying portions and for the further reason that they are not enclosed in enamel or other solid material which would conduct away the heat as it is generated. For similar reasons the units cool off very rapidly upon disconnecting them from the source of potential, the heat stored in them being rapidly transferred to the air around the fins largely by convection but also somewhat by radiation.

I have found that the heater arrangement described is remarkably effective in transferring a large quantity of heat to the surrounding air, the heat being conducted away from the narrow band portion 3 by the fins 4 so rapidly that the elevation of temperature was insufficient to cause these parts to become overheated even when a large current was passing through it. In case it is desired to heat a current of air or other fluid medium, the casing C may constitute the end of a duct D through which the air is moved upwardly by a fan F driven by an electric motor M, this arrangement being effective to efficiently heat a large volume of air to a high temperature without undue increase in temperature of the resistor units.

I have described what I believe to be the best embodiments of my invention. I do not wish, however, to be confined to the embodiments shown, but what I desire to cover by Letters Patent is set forth in the appended claims.

I claim:

1. The method of forming an electrical resistor which comprises the steps of slitting transversely a bar of flexible conducting material at a plurality of spaced apart points along the length of the bar across a portion of it width, bending the bar to dispose the slitted and continuous portions substantially at right angles to each other and bending the continuous portion with the slitted portion extending outwardly.

2. An electrical resistor comprising a helical winding formed of metal having a high specific electrical resistance, said winding having a continuous current carrying portion and a plurality of fins arranged substantially normal to the edge part of the current carrying portion, the base lines of adjacent fins meeting each other.

3. An electrical resistor composed of metal having a high specific electrical resistance and comprising a continuous current carrying portion and a plurality of fins extending from one edge of the current carrying curved portion for a distance greater than the width of said portion, the fins being arranged at an angle to the immediately adjacent part of the current carrying

portion, the base lines of adjacent fins meeting each other.

4. An electrical resistor unit comprising, in combination, a core of insulating material, a ribbon wound helically about said core and composed of material having a high specific electrical resistance and means for dissipating the heat generated in said ribbon by the passage of an electrical current therethrough and comprising a plurality of fins projecting at an angle from an edge of the ribbon and formed intergral therewith, the base lines of adjacent fins meeting each other.

5. An electrical resistor unit comprising the combination of a hollow metallic tube, a layer of insulation material mounted on said tube, and a metallic conductor wound spirally about said layer; said conductor comprising a thin, current carrying portion in contact with the insulation layer and a plurality of fins extending at an angle from one edge of the current carrying portion and formed integrally therewith, the base lines of adjacent fins meeting each other.

6. An electrical heater comprising in combination, a casing, supporting bars extending across the opposite sides of said casing, a plurality of supporting rods having their ends mounted on said supporting bars and secured thereto, a metallic conductor wound helically around each of said supporting rods and comprising a thin, current carrying portion in contact with the rod and a plurality of fins extending from an edge of the current carrying portion and formed integral therewith, each of said fins being arranged substantially at right angles to its adjacent current carrying portion, and means for connecting said conductors in series including metallic terminal strips, means securing the strips to the ends of the said rods and to the ends of the metallic conductors, the current carrying portion of the conductors being enfolded about the ends of the terminal strips.

7. An electrical heating unit comprising a current conducting member in the form of a curved ribbon composed of resistor material and a heat dissipating member comprising a plurality of metallic fins extending at an angle to the plane of the ribbon and in direct metallic connection therewith, the base lines of adjacent fins meeting each other.

8. An electrical resistor unit comprising, in combination, a core at least the surface of which is composed of insulating material, a ribbon wound spirally about said core and composed of material having a high specific electrical resistance, and means for dissipating the heat generated in said ribbon by the passage of an electrical current therethrough, said means comprising a plurality of fins projecting generally normally to an edge of the ribbon the base lines of adjacent fins meeting each other.

DWIGHT TENNEY.

CERTIFICATE OF CORRECTION.

Patent No. 2,234,289. March 11, 1941.

DWIGHT TENNEY.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 72, claim 3, strike out the word "curved" and insert the same after "carrying" in line 70, same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of April, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)

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