July 6, 1937. H. A. SOVERHILL 2,085,772

ELECTRIC HEATER

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Fig. 1

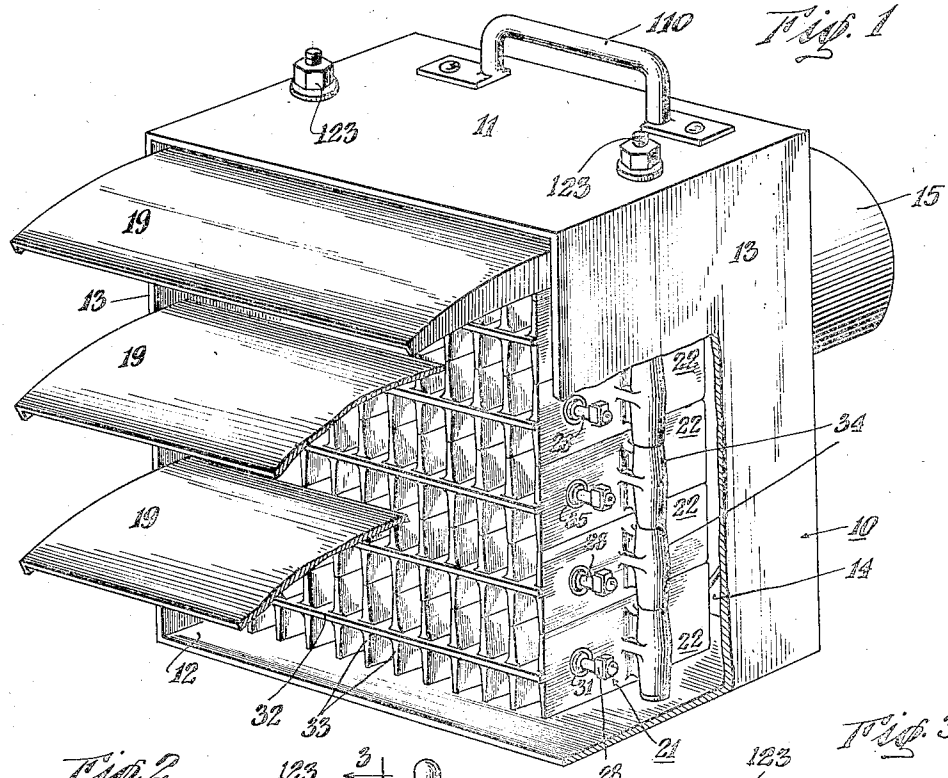

Fig. 2

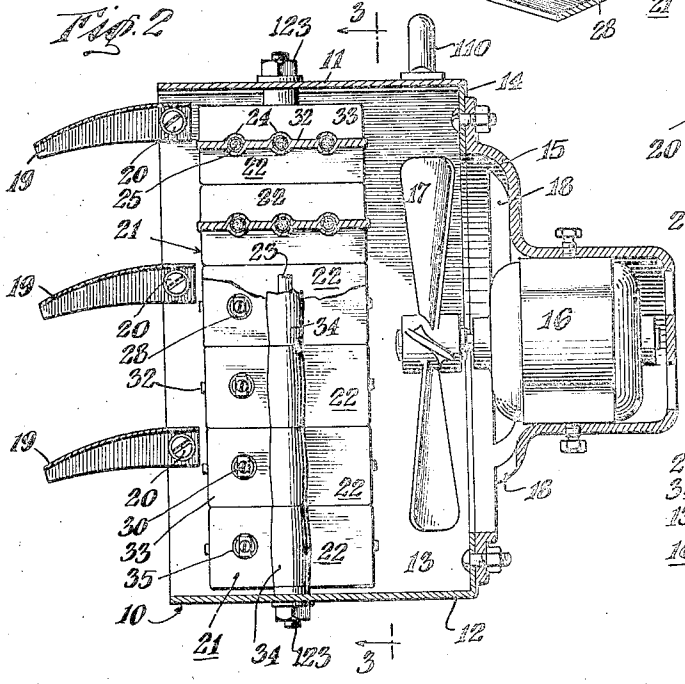

Fig. 3

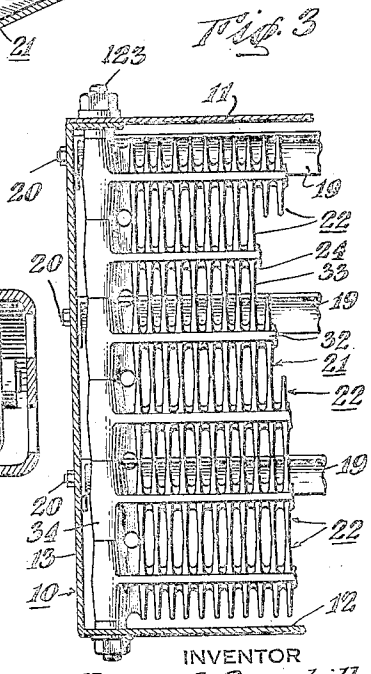

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Fig. 4

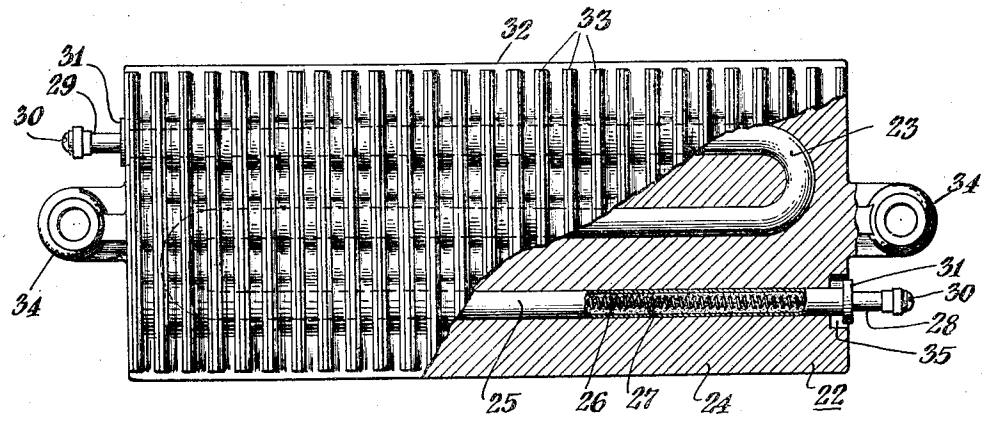


Fig. 5

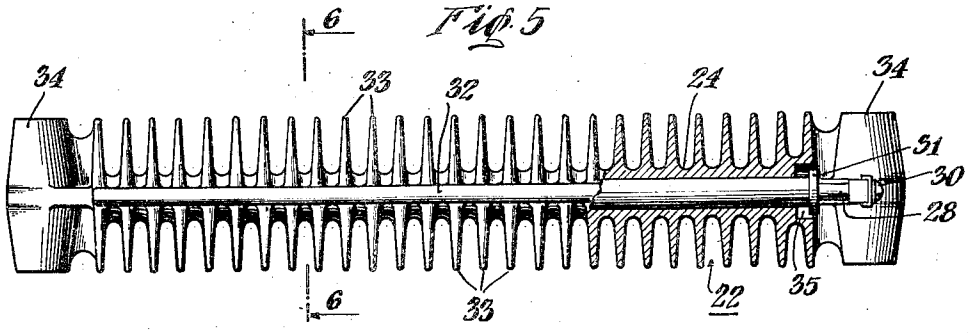


Fig. 8

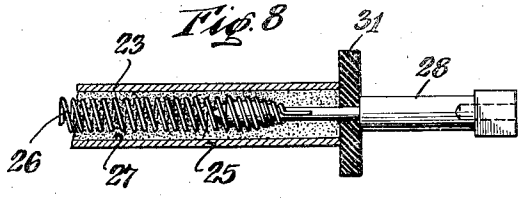


Fig. 6

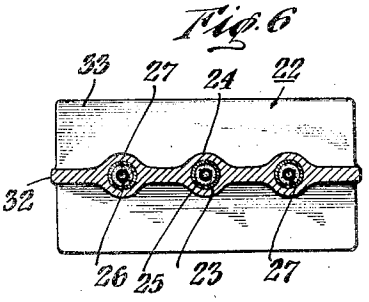
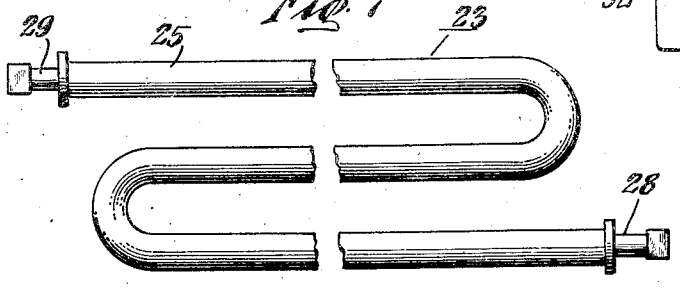


Fig. 7



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Patented July 6, 1937 2,085,772

UNITED STATES PATENT OFFICE

2,085,772

ELECTRIC HEATER

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Application February 18, 1933, Serial No. 657,320

9 Claims. (Cl. 219—39)

The invention relates to heating, and more particularly to electric air heaters.

The invention further relates to a portable electric air heater having electric heating elements and a fan for maintaining a blast of air across the heating elements.

According to a preferred form of the invention, a sheath-wire strip, heating element, made up of a metal sheath having resistance wire disposed therein and powdered electric insulating, heat conducting material between the resistance wire and the sheath, has cast thereon a metal jacket having a greatly extended heat dissipating surface. The sheath-wire heating element may be doubled up or S-shaped and the jacket may have a large flat body in which the heating element is embedded. By using a metal of good heat conductivity and by casting the jacket directly on the sheath of the heating element and by providing a large number of heat dissipating fins, the heat dissipating capacity of the sheath-wire heating element can be increased very many fold.

The invention also consists in certain new and original features of construction and combination of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which

Fig. 1 illustrates a perspective of a portable electric heater according to the invention;

Fig. 2 is a section taken through Fig. 1;

Fig. 3 is a detail taken on the line 3—3 of Fig. 2;

Fig. 4 is a plan view of one of the heater elements or sections, partly in cross section;

Fig. 5 is a side elevation of the heater unit shown in Fig. 4;

Fig. 6 is a section on the line 6—6 of Fig. 5;

Fig. 7 is a separate view of the S-shaped strip sheath-wire heating element; and

Fig. 8 is a section through one end of the heating element illustrating the connection of the binding post thereon.

In the following description and in the claims, various details will be identified by specific names for convenience, but they are intended to be as generic in their application as the art will permit.

Like reference characters denote like parts in the several figures of the drawings.

In the drawings accompanying and forming part of this specification, certain specific disclosure of the invention is made for purposes of explanation, but it will be understood that the details may be modified in various respects without departure from the broad aspect of the invention.

Referring now to the drawings, and more particularly to Figs. 1–3, the portable heater comprises a sheet metal casing 10 having a top wall 11, bottom wall 12 and side walls 13. A handle 110 is connected to the top wall 11 in the case of a portable heater. It will be understood, however, that the heater may be mounted permanently in fixed position, if desired.

The casing 10 has a generally open front and an open back, the back being provided with a wall or flange 14 to which is secured a spider casing 15 having openings 18. An electric motor 16 is mounted within the casing 15, the motor driving a fan 17 which forces air in through the openings 18, through the honeycombed radiator 21 and out the front of the casing 10. The front of the casing is provided with a plurality of louvers or deflectors 19 pivoted to the casing at 20, which may be adjusted to deflect the air blast to the desired point.

The source of heat comprises a honeycomb radiator or heater 21 made up of a stack of heating units 22 bolted together and to the casing by bolts 123 which may pass through the top and bottom walls of the casing.

Referring now to Figs. 4–8, each heating unit 22 is made up of an S-shaped, doubled up sheath-wire strip heating element 23 (Fig. 7) having cast thereon a jacket 24 of metal having high heat conductivity. The jacket 24 comprises a flat body 32 having heat dissipating fins 33.

The sheath-wire strip heating element 23 is made up of a flexible tubular sheath 25 which may be steel, a coiled resistance wire 26 and powdered electric insulating, heat conducting material 27 packed in between.

At opposite ends of the sheath-wire heating element 23 are binding posts 28 and 29, these binding posts being connected to the resistance wire 26, but insulated from the sheath 25 by insulating washer 31, as is well known in the art. This construction is illustrated in Fig. 8. Each binding post 28 and 29 has a threaded opening in which is disposed a set screw 30 for clamping a conductor for the purpose of supplying the heater with electricity, as will be understood by those skilled in the art. This heating element 23 is available on the market and, by itself, forms no part of the present invention.

The sheath-wire heater 23 is doubled up and made S-shaped in the form shown and then a jacket 24, preferably of aluminum, is cast and shrunk thereon. Although the heating element 23 is illustrated as S-shaped, it will be appreciated that it may be doubled up any number of times and the binding posts 28 and 29 may be at the opposite ends of the heating unit 22, as shown, or at the same end.

Furthermore, the sheath-wire heater instead of running lengthwise of the heating unit **22**, may be doubled up so that the parts between bends run crosswise of the heating unit **22**.

In the form shown, the heating element **23** is cast within the flat body **32** of the jacket **24**, which forms a close bond with the sheath **25** so as to afford little resistance to the dissipation of heat generated by the resistance wire **26**. A plurality of fins **33** are cast integral on both the top and bottom surfaces of the flat body **32** to greatly extend the heat dissipating area of the jacket **24**. The jacket is also provided with lugs **34** through which the fastening bolts **123** pass. It will be noted, especially from Figs. 1–2, that the fastening bolts **123** hold the lugs **34** in line and the fins **33** of the several heating units in line to provide a radiator **21** of general honeycomb formation. It will be noted that pockets **35** are cast in the jacket **24** to provide clearance for the binding posts **28** and **29** and to prevent electrical contact between these binding posts and the metal jacket.

The honeycomb construction is such that every part of the heating element is directly exposed to the blast of air caused by the fan **17**, which travels in a direction parallel to the planes of both body **32** and fins **33** of the units **21**. A sufficient volume of air is passed through the heater to keep the surface of the heater at a comparatively low temperature of approximately 230° F. The air leaving the heater is, therefore, not sufficiently hot to scorch anything with which it comes into contact. The term "a comparatively low temperature" is not intended to be limited to any specific temperature but to embrace the range of substantially non-scorching temperatures. It will be seen that the resistance to heat flow between resistance wire **26** and the surface of the fins **33** is very small. Because of this and by maintaining a low surface temperature on the jacket, it will be appreciated that greatly increased amounts of power may be dissipated without exceeding the maximum safe operating temperature of the resistance wire **26**. The casting and shrinking of the jacket on the sheath-wire heater makes a most intimate contact between these parts and assists materially in providing an excellent heat transfer path between resistance wire and jacket.

By the use of an electric heater according to the present invention, the heat dissipating capacity of sheath-wire heating elements may be increased very many fold. For instance, the allowable capacity of a plain sheath-wire heater, such as disclosed in Fig. 7, is about 10 watts per square inch of sheath surface when used with a blast of air. By casting the finned jacket on such a heater and by the use of the fan, the capacity of the sheath-wire heater has been increased to about 80 watts per square inch of sheath surface in heaters according to the invention now in commercial use.

It will be understood that the binding posts **28** and **29** of the several heating units will have wires or bus-bars connected thereto to connect the heating units in series or parallel or in series-parallel according to the voltage and other operating conditions. From the above it will be seen that the surface of the sheath of the resistance element is considerably extended. The surface may be extended by the plurality of thin fins up to, for example, the ratio of 18 to 1. By this greatly extended surface and by a sufficiently large volume of air, which may have a velocity, for example, as high as 800 ft. per minute in ordinary requirements and to 1500 ft. per minute for special purposes, great amounts of energy may be dissipated with heaters of comparatively small physical dimension. Furthermore, the heaters may be used at their greatly increased capacity for long periods of time without burning out. Furthermore, there is no chance for short circuits as are liable to occur in electric heaters of the bare wire type.

The direct casting of the jacket on the sheath-wire heater eliminates all air pockets and other non-heat-conducting mediums which would prevent the obtaining of a low resistance heat flow path.

Furthermore, the use of a single conductor sheath-wire heating element **23** and the spacing of the loops thereof sufficiently far apart in the flat body **32** of the jacket, places all parts of the resistance wire **26** in close and direct heat-transfer relation to the jacket.

Due to the high concentration of heat dissipation, it is absolutely essential that all points on the resistance wire **26** be in close heat transfer relation to the heat dissipating jacket. For this reason, the binding posts **28** and **29** extend within the jacket **24** so that the points of connection between the resistance wire **26** and the binding posts are well within the protective sphere of the finned jacket.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. In an air heater, a sheath-wire, strip, heating unit comprising a metal sheath, a single resistance wire disposed within said sheath, electric insulating, heat conducting material within said sheath around said wire, said sheath-wire heating unit being doubled back on itself to form a plurality of loops, a thin metal jacket of high heat conductivity cast around and shrunk onto said sheath, said jacket having cast integral therewith a large number of thin ribs to greatly extend the heat dissipating surface of the jacket, means for passing over said jacket a sufficiently large volume of air to maintain the extended surface of the jacket at a comparatively low temperature, all parts of said resistance wire having close and direct thermal relation to said jacket, whereby with the low resistance heat transfer path between resistance wire and jacket surface, large amounts of electrical energy may be dissipated at low temperatures.

2. In an air heater, a sheath-wire, strip, heating unit comprising a metal sheath, a single resistance wire disposed within said sheath, electric insulating, heat conducting material within said sheath around said wire, said sheath-wire heating unit being doubled back on itself to form a plurality of loops, all in the same plane, a thin, metal heat conducting jacket having a thin flat body cast directly around said doubled back unit and shrunk onto the sheath thereof, said body being continuous in both directions throughout the extent of the doubled back part of the sheath-wire unit, said jacket having cast integral therewith a large number of thin ribs to greatly extend the heat dissipating surface of the jacket, means for passing over said jacket a sufficiently large volume of air to maintain the extended surface of the jacket at a comparatively low tem-

perature, whereby, with the low resistance heat transfer path between resistance wire and jacket surface, large amounts of electrical energy may be dissipated at low temperatures.

3. In an air heater, a single sheath-wire, strip, heating unit comprising a metal sheath, a single resistance wire disposed within said sheath, electric insulating, heat conducting material within said sheath around said wire, said sheath-wire heating unit being doubled back on itself to form a plurality of loops, all in the same medial surface, a thin, metal heat conducting jacket having a thin flat body cast directly around said doubled back unit and shrunk onto the sheath thereof, said body being continuous in both directions throughout the extent of the doubled back part of the sheath-wire unit, the ends of said sheath-wire heating unit having binding posts, said binding posts being disposed at opposite ends of said jacket, said jacket having cast integral therewith a large number of thin ribs on opposite sides of the flat body to greatly extend the heat dissipating surface of the jacket, means for passing over said jacket a sufficiently large volume of air in a direction parallel to the planes of said jacket body and of said ribs to maintain the extended surface of the jacket at a comparatively low temperature, whereby, with the low resistance heat transfer path between resistance wire and jacket surface, large amounts of electrical energy may be dissipated at low temperatures.

4. In an air heater, a metal jacket comprising a plate-like body having its thickness comparatively small as compared with its length and width, a single, electric, sheath-wire, strip, heating unit comprising a single helical resistance wire enclosed within a metal sheath with electric insulating, heat conducting material packed tightly therebetween, said body being cast directly around said unit and shrunk onto the sheath thereof, said unit being doubled back on itself to form a plurality of bends connected by connecting portions, said connecting portions being comparatively widely spaced by portions of said jacket, and said connecting portions and loops lying in the same medial surface and forming but a single layer of heating unit to permit each part of the heating unit effectively to dissipate its heat, a plurality of heat dissipating fins cast to said body to greatly extend the heat dissipating surface thereof, means for establishing a blast of air, said body being disposed edgewise in said blast and the planes of said fins being parallel to the direction of said blast, whereby maximum surface is exposed to said blast with minimum impedance thereto and whereby a low resistance heat transfer path between said resistance wire and jacket surface is established so that large electrical energy may be dissipated at low temperatures.

5. In an air heater, a metal jacket comprising a plate-like body having its thickness comparatively small as compared with its length and width, a single, electric, sheath-wire, strip, heating unit comprising a single helical resistance wire enclosed within a metal sheath with electric insulating, heat conducting material packed tightly therebetween, said body being cast directly around said unit and shrunk onto the sheath thereof, said unit being doubled back on itself and having all parts lying in the same single medial surface, all adjacent parts of said unit being comparatively widely separated from each other by portions of said body to permit each part of said heating unit effectively to dissipate its heat, a plurality of heat dissipating fins cast to said body to greatly extend the heat dissipating surface thereof, means for establishing a blast of air, said body being disposed edgewise in said blast and the planes of said fins being parallel to the direction of said blast.

6. In an air heater, a single sheath-wire electric heating unit having a single resistance wire, a tubular metal sheath closely surrounding the resistance wire with heat-conducting, electric insulating material packed between the resistance wire and the sheath, a metal jacket having a generally flat body cast and shrunk around all points of said unit at which heat is generated, said unit being bent to extend to all parts of said generally flat body, all parts of said bent unit lying in the same medial surface, said jacket having a plurality of flanges to greatly extend the heat dissipating surface thereof, and means for passing a sufficiently large volume of air across said jacket to maintain the extended surface of the jacket at a comparatively low temperature, said generally flat body and said flanges being disposed edgewise in said blast.

7. In an air heater, a sheath-wire electric heating unit having a single resistance wire, a tubular metal sheath closely surrounding the resistance wire with heat-conducting, electric insulating material packed between the resistance wire and the sheath, a metal jacket cast and shrunk onto said sheath at all points of said unit at which heat is generated, said jacket having a greatly extended heat dissipating surface, and means for passing a sufficiently large volume of air across said jacket to maintain the extended surface of said jacket at a comparatively low temperature.

8. In an air heater, a sheath-wire electric heating unit having a single resistance wire, a tubular metal sheath closely surrounding the resistance wire with heat-conducting, electric insulating material packed between the resistance wire and the sheath, a metal jacket of high heat conductivity cast and shrunk around said unit and having a greatly extended heat dissipating surface, said heating unit having a plurality of portions extending in the same general direction, said portions being spaced apart sufficiently by the portion of said jacket therebetween to permit all parts of said unit effectively to dissipate their heat, and means for establishing a sufficiently large volume of air across said jacket to maintain the extended surface of said jacket at a comparatively low temperature.

9. In an air heater, a sheath-wire electric heating unit having a single resistance wire, a tubular metal sheath closely surrounding the resistance wire with heat-conducting, electric insulating material packed between the resistance wire and the sheath, binding posts of good electrical conducting material extending within the opposite ends of the sheath-wire heating unit and making contact with the resistance wire a substantial distance from the ends of the sheath, a metal jacket cast around and shrunk onto said sheath at all points of said unit at which heat is generated, said metal jacket being also cast around and shrunk onto said sheath at the inner ends of said binding posts, said jacket having a greatly extended heat dissipating surface, and means for maintaining a forced blast of air across said jacket.

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