

April 24, 1951

L. E. STEINER

2,549,944

ELECTRICAL HEATING DEVICE

Filed June 19, 1948

2 Sheets-Sheet 1

Fig 1

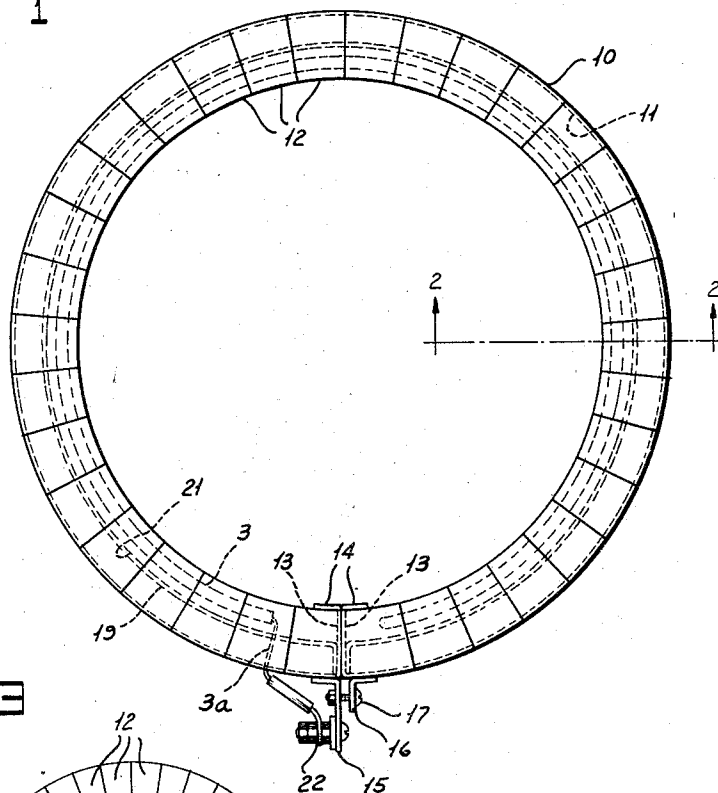


Fig 3

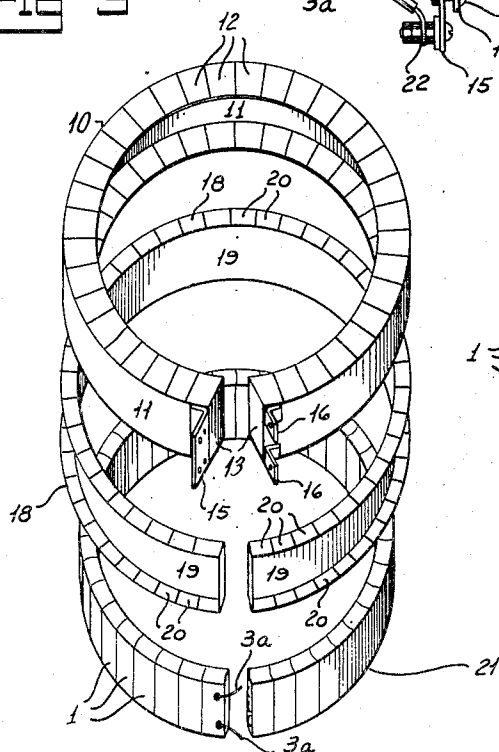
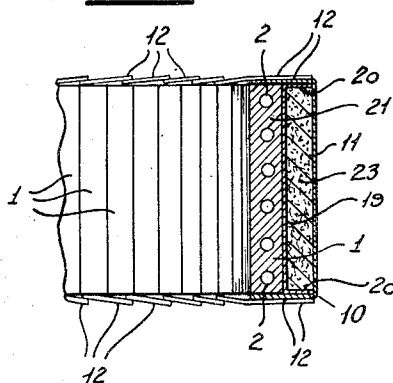


Fig 2



INVENTOR
LEONARD E. STEINER
BY *Cornelius Zaluski*
ATTORNEY

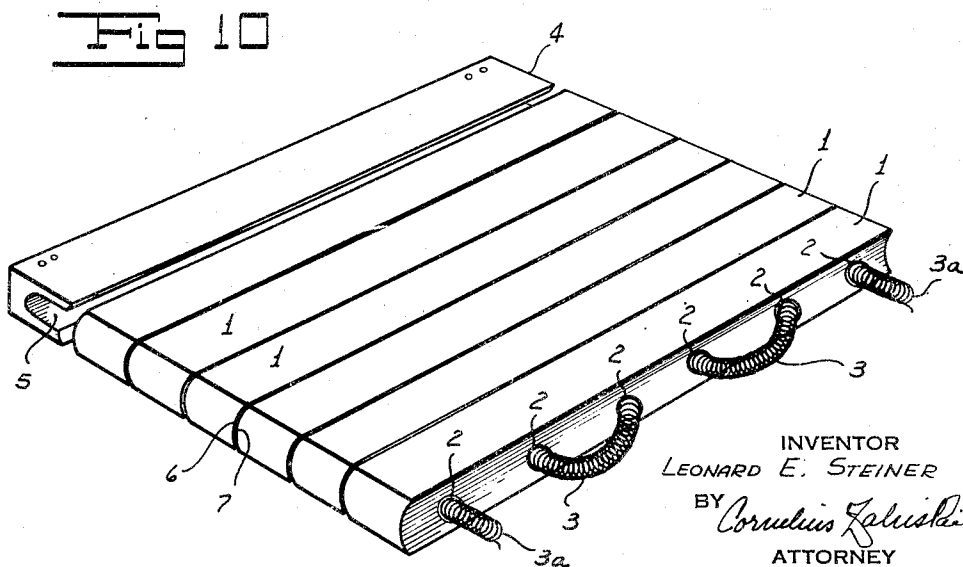
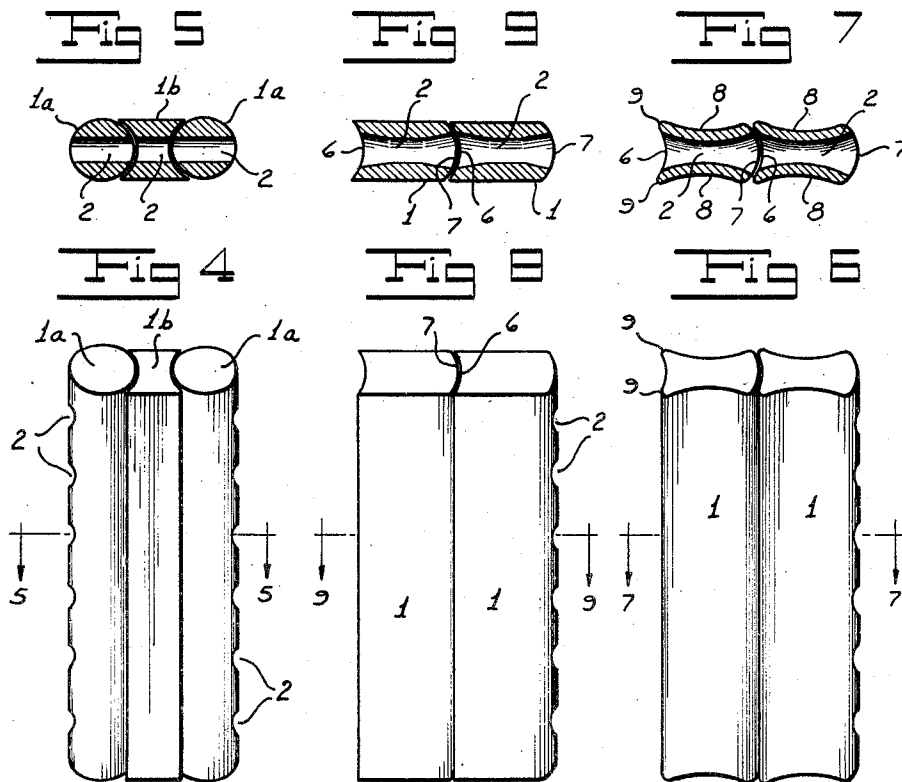
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INVENTOR
LEONARD E. STEINER
BY *Cornelius Zaluski*
ATTORNEY

UNITED STATES PATENT OFFICE

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ELECTRICAL HEATING DEVICE

Leonard E. Steiner, Westfield, N. J.

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2 Claims. (Cl. 219-46)

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This invention is an electrical heating device adapted for various uses, primarily in industrial fields, but particularly adapted for the electrical heating of cylinders associated with the extrusion, injection or molding of plastics. These are usually circular in form and, in order to function properly, must be heated to relatively high temperatures. This heating has generally been accomplished electrically, but considerable difficulty is being encountered in obtaining the high temperatures required under present day practice.

The object of the present invention is to provide a heating device which will satisfactorily fulfill all requirements in the heating of circular and polygonal bodies, one which can be readily mounted on and removed from such bodies and so constructed that it will efficiently support the electrical resistance coils on such body without placing undesirable strains thereon.

A further object of the invention is to provide novel means for introducing into a heating device of a given area the maximum mass of resistance material and thus minimize the amount of B. t. u. output per unit of mass.

These and other objects are accomplished according to this invention through the provision of a novel heating element embodying resistance coils and built up of rigid di-electric sections enclosed within a casing of novel construction. The heating element is flexible so that it may be used flat or bent into conformity with the object to be heated and the casing is so constituted as to properly coact with the heating element under all conditions.

Speaking generally, the heating device of the present invention utilizes a heating element in the form of a mat made up of a succession of rigid di-electric sections arranged edge to edge and having contiguous surfaces shaped to articulate with respect to one another. Each of these sections is provided with passages which extend through the sections from one articulating edge to the other. These passages are spaced apart from one another longitudinally of the section, the spacing being such that, when the several sections are in edge to edge relation, straight through passages will be provided through the mat and through these passages one or more coils of resistance wire are passed back and forth. The successive reaches of the coil are thus insulated from one another and the coil itself serves to maintain the several sections in assembled relation, with their contiguous edges in contacting articulating relation. Such a mat assembly may be used flat or may be wrapped about a cylindrical or polygonal body to very closely conform and contact with the major portion of the circumference or periphery of such body, so that, when electrical current is passed through

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the coil, maximum heat transfer between the coil and the body to be heated is obtained.

The heating element of this invention may be secured in place about the body to be heated in any suitable manner, but, in the preferred form of the invention, it is enclosed within a shield of novel construction hereinafter more fully described. This shield is so constructed that it will not only house the heating element, but will conform to the heating element and to the body on which the heating element is mounted to provide an efficient closure for the element and conserve the heat generated therein.

Features of the invention, other than those adverted to, will be apparent from the hereinafter detailed description and appended claims, when read in conjunction with the accompanying drawings.

The accompanying drawings illustrate different practical embodiments of the invention, but the constructions therein shown are to be understood as illustrative, only, and not as defining the limits of the invention.

Figure 1 is an edge view of a heating device embodying the present invention.

Figure 2 is a section on the line 2-2 of Figure 1.

Figure 3 shows the structure of Figure 1 dismantled and the parts separated from one another, so as to illustrate, generally, their individual structures.

Figure 4 is a perspective view showing one form of ceramic sections embodying the present invention.

Figure 5 is a section on the line 5-5 of Figure 4.

Figure 6 shows another form of ceramic sections.

Figure 7 is a section on the line 7-7 of Figure 6.

Figure 8 shows still another form of ceramic sections embodying the present invention.

Figure 9 is a section on the line 9-9 of Figure 8.

Figure 10 is a perspective view showing a heating element built up of ceramic sections, such as shown in Figures 8 and 9 and serving to support a coil of resistance wire.

One form of heating element or mat of the present invention is shown generally in Figure 10. Here a number of sections 1 of di-electric material, such as a ceramic or silica carbide, or the like, are positioned edge to edge and are provided with transverse, longitudinally spaced apart passages 2, through which a coil 3 of resistance wire is threaded back and forth throughout the length of the element to maintain the contiguous edges of the several sections in contacting relation. This coil 3 may be continuous or it may be composed of a plurality of coils connected in

series or multiple at either or both ends of the element. A single or continuous wire coil is shown in Figure 10 for the purpose of illustration.

In practice there may be provided at one end of the heating element a section 4 having therein a channel 5 to house those portions of the coil which pass exteriorly of the contiguous edge of the next section 1, so as to enclose the coil at this point. A similar section may be provided at the other end of the element with holes through which the free ends 3a of the coil may be passed to appropriate terminals. The sections 1 and 4 may be of any appropriate length and width according to practical requirements.

This invention is directed, among other things, to the shaping of the abutting edges of the several sections 1 and 4, so that they are adapted for articulation. The elements shown in Figure 10 show the type of section 1 illustrated specifically in Figures 8 and 9. The abutting edges of this type of section are complementary concavo-convex. That is to say, one mating edge 6 of each pair of adjacent sections is concave, while the abutting mating edge 7 of the next section is convex. The edges 6 and 7 are complementary to one another, so as to permit the adjacent sections to be moved from substantially the aligned relation shown in Figure 9 into an angular relation. In other words, each pair of adjacent elements are adapted to articulate at their interposed joint 6-7 to permit the mat to be used flat, as shown in Figure 10, or wrapped about a cylindrical or polygonal body, such as a casting or extrusion mold. The passages 2 through which the coil 3 is passed are shown in Figure 9 as countersunk at their opposite ends, to allow of the aforesaid articulation without crimping the coil, although, if desired, the passages may be straight, as shown in Figure 5, or flared toward their opposite ends, as shown in Figure 7.

In the showing of Figures 8 and 9, the opposite faces of the several sections 1 are illustrated as flat, but if desired, they may be made concave as indicated at 8 in Figures 6 and 7. I prefer the concave structure with the longitudinal edges of the several sections slightly rounded or chamfered, as shown at 9. The concave surfaces 8 insure a more intimate and greater area of contact between the mat and the cylindrical body about which it may be wrapped, while the chamfering of the edges at 9 make chipping or checking of these edges less likely than is the case when they are made sharp and angular, as shown in Figures 8 and 9.

In the showing of Figures 6-10 all of the elements 1 are of the same shape. It is within the purview of this invention, however, to make them alternately of different shape, as shown, for example, in Figures 4 and 5. Here the alternate sections 1a are cylindrical or substantially so, while the interposed sections 1b have flat faces and concave edges, which latter are adapted to articulate with the cylindrical surfaces of the sections 1a. The passages 2 formed in the sections 1a and 1b are shown as cylindrical though it is to be understood that the particular shaping of these passages is optional not only with respect to the construction of these particular figures, but also to the structures of the other figures shown in the drawings.

The heating element or mat, fabricated from sections, as hereinbefore described, is adapted to be wrapped about the body to be heated and secured in place in any suitable way and it may

be used either with or without the end guard sections 4. In practice, I prefer to mount the heating element in a novel form of housing after the manner shown in Figures 1, 2 and 3. In its preferred form, this housing comprises a sheath 10 in the form of a sheet metal strap 11 provided along its longitudinal edges with inturned flanges comprising a circumferential succession of overlapping tongues 12, while the opposite ends of said strap are bent inwardly and terminate at 13 in oppositely extending flanges 14, as seen in Figure 1.

The sheath 10 may be conventionally made from a flat blank of sheet metal, the intermediate portion of the width of which constitutes the strap 11, while the margins of the strip are slit and upset into right angular relation with the flat strap. The strap thus produced is flexible and may be bent about a cylindrical or polygonal body, the tongues 12 overlapping one another, as shown in Figure 2, to form, in effect, a continuous flange at each circumferential edge of the strap. The tongues which would be formed at the opposite ends of the strap are cut away and the ends inturned at 13 and 14 as described. Mounted on the ends of the strap and on the outer surface thereof are clamping plates 15 and 16 perforated for the passage of bolts 17 by which the sheath may be secured in place about the body to be heated. In lieu of the plates and bolts I may employ any other convenient means for securing the device in wrapped condition about the object to be heated.

In the preferred form of the invention shown in Figures 1-3, there is within the sheath a spacer 18 in the form of a strap 19 provided along its lateral edges with outwardly extending tongues 20 forming substantially continuous external flanges of somewhat less depth than the internal flanges of the sleeve. This spacer is adapted to be positioned within the sheath with the outer circumference of the flange tongues 20 bearing against the inner face of the strap 11 and the outer faces of these flanges in contact with the inner faces of the tongues 12, as shown best in Figure 2. The strap 19 is thus spaced from the strap 11 and the space between the straps 11 and 19 is adapted to be filled with a flexible refractory insulating material 23, e. g., asbestos or a heat insulating cement of any appropriate kind. This insulating material serves to minimize undue heat losses through the strap 11 of the sheath.

The heating mat made as hereinbefore described and indicated by the reference character 21 in Figures 1-3 is adapted to be placed within the sheath 10 with the outer surface of the mat seated against the inner circumference of the spacer strap 19. The tongues 12 of the sheath are of such radial depth as to overlie the lateral edges of the heating element and extend to substantially the inner circumference of the latter, while the opposite ends of the heating element about the opposite faces of the turned in portions 13 of the strap 11 with the flanges 14 of the strap overlying the inner faces of the terminal sections of the heating element. The wire ends 3a of the heating coils extend out through perforations in the straps 19 and 11 and are connected to binding posts 22 as shown in Figure 1. The perforations through which these wires are passed are preferably bushed with insulating material to preclude short circuiting.

A heating mat made as described, when wrapped about a cylindrical body, will intimately

conform to the surface of the latter. The fact that the flanges of the sheath and filler are slit into successive tongues permits the straps 11 and 19 to be flexed in wrapping or unwrapping the sleeve about such a body. The heating mat itself is also flexible because its articulating sections do not interfere with this procedure and the heat insulating material 23 is also of a flexible character. The device thus may be manipulated after the manner of a flexible split ring which can be opened or closed and locked in closed position by the bolts 17 in intimate contacting relation about the body to be heated.

In the preferred form of the invention shown in Figures 1-3, I utilize the spacer 18, but, if desired, this spacer may be omitted. In this case the tongues 12 which form the flanges of the sheath should be made of much less radial depth so as not to interfere with a contact between the heating element and the body with which it is associated. It is desirable, however, that at least a sheet of asbestos or some other insulating material be interposed between the outer circumference of the sheath and the heating element in order to preclude excessive heating of the sheath or heat losses therethrough.

The device of this invention is adapted for a wide variety of uses in the industrial fields. It has been used to heat cylindrical apparatus of various kinds. When used for the heating of extrusion and casting molds, it has been found highly efficient in quickly raising the temperatures of these molds to the desired degree and maintaining them so.

An important advantage of this invention is that the current carrying coils are thoroughly insulated and may be flexed to bring about proper conformity of the device to the article to be heated without placing undue strains upon such current carrying elements and without crimping them. The structure further permits the use of relatively large heating coils in a heating device of minimum overall size.

In practice, I preferably make each of the straps 19 and 11 continuous from end to end. If desired, however, these straps may each be made in two sections hinged together, so that each section is substantially semi-circular, without departing from this invention. In such event, continuous heating coils may extend through both sections of the sleeve collectively or each section may be equipped with its own individual heating coils without departing from this invention, although I prefer and I find it thoroughly practical in all instances in which I have thus far encountered, to make each of these straps in one piece as illustrated because the flexibility of the entire construction is such as to permit of satisfactory use of the device when thus constituted.

The foregoing detailed description sets forth the invention in its preferred practical form, but the invention is to be understood as fully commensurate with the appended claims.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. In an electrical heating device, the combination comprising an articulated electric heating multiple-bar mat adapted to be wrapped about a body to closely conform and contact with the major portion of the periphery of such body; each of the several bars of said multiple-bar mat

comprising a rigid elongated dielectric refractory bar of much greater length than its width and thickness, said bar having substantially smooth side surfaces and having arcuate cylindrical longitudinal lateral edges defining arcuate cylindrical surfaces extending throughout substantially the entire area of said edges, said bar having a plurality of holes spaced apart longitudinally of the bar and extending entirely through said bar substantially centrally between the sides thereof from one of said arcuate cylindrical surfaces to the other with each of said holes being counter-sunk to flare outwardly to such arcuate cylindrical surfaces; said bars being placed in edge to edge contact with one another with said holes of the several bars in axial alignment, and an electrical resistance wire threaded back and forth through the aligned holes in the several bars holding the contiguous edges of the several bars in contacting relation.

2. In an electrical heating device, the combination comprising an articulated electric heating multiple-bar mat adapted to be wrapped about a body to closely conform and contact with the major portion of the periphery of such body; each of the several bars of said multiple-bar mat comprising a rigid elongated dielectric refractory bar of much greater length than its width and thickness, said bar having substantially smooth side surfaces and having arcuate cylindrical longitudinal lateral edges defining arcuate cylindrical surfaces extending throughout substantially the entire area of said edges, said bar having a plurality of holes spaced apart longitudinally of the bar and extending entirely through said bar substantially centrally between the sides thereof from one of said arcuate cylindrical surfaces to the other with each of said holes being counter-sunk to flare outwardly to such arcuate cylindrical surfaces, and at least one of the sides of said bar being transversely concave; said bars being placed in edge to edge contact with one another with said holes of the several bars in axial alignment, and an electrical resistance wire threaded back and forth through the aligned holes in the several bars holding the contiguous edges of the several bars in contacting relation.

LEONARD E. STEINER.

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