

United States Patent

Costello

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[54] HEATING & FUSING DEVICE

[72] Inventor: **Bernard J. Costello**, Ringoes, N.J.

[73] Assignee: **Argus Engineering Company, Inc.**, Hopewell, N.J.

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[51] Int. Cl. **B23k 1/02**

[58] Field of Search 219/85, 347, 349, 354; 29/498, 29/471.1; 350/293, 295, 299

[56] References Cited

UNITED STATES PATENTS

2,221,318	11/1940	Worthing et al.	219/347
3,509,317	4/1970	Valsamakis et al.	219/347 X
2,967,603	6/1961	Thomson	219/347
3,283,124	11/1966	Kawecki	219/85 X

2,298,175	10/1942	Schenk	219/34.7
3,374,531	3/1968	Bruce	219/85 X

Primary Examiner—J. V. Truhe
Assistant Examiner—L. A. Schutzman
Attorney—Ostrolenk, Faber, Gerb & Soffen

[57] ABSTRACT

A heating device comprised of an elongated source of radiant energy and a reflector having a concave reflective surface whose cross-sectional configuration is substantially elliptical. The elongated energy source is positioned substantially coincident with the primary focus of the elliptical cylindrical reflector so as to cause radiant energy striking the reflective concave surface to be focused at the image focus of the elliptical surface.

The reflector is a cylindrical member having planar highly reflective end portions which act to compensate for end losses and provide substantially uniform intensity of radiation along the entire line image.

8 Claims, 2 Drawing Figures

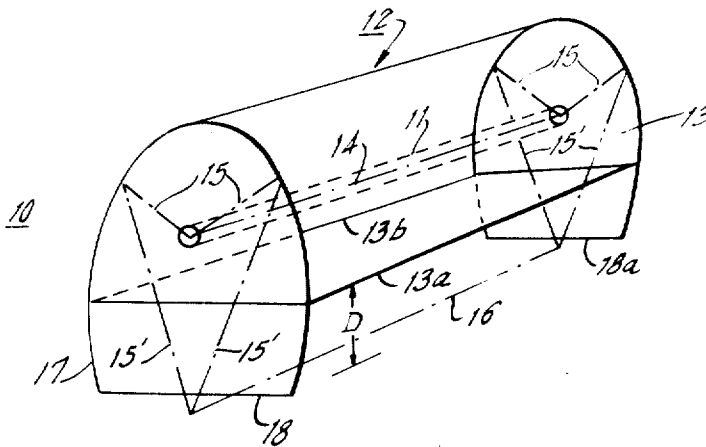


FIG. 1.

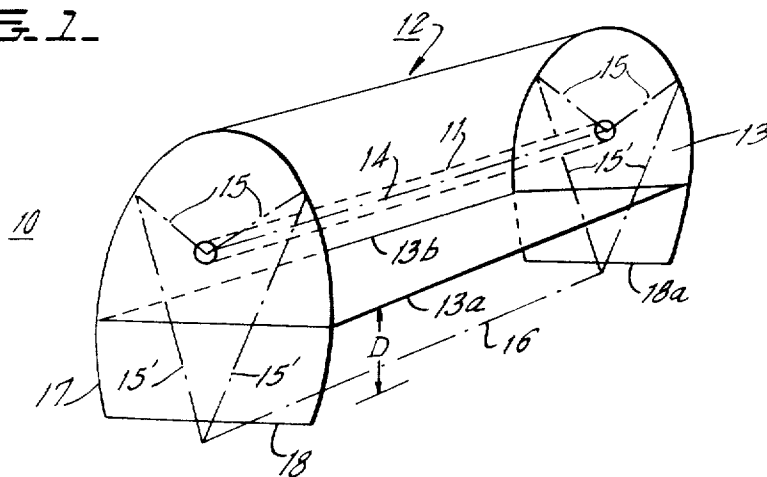
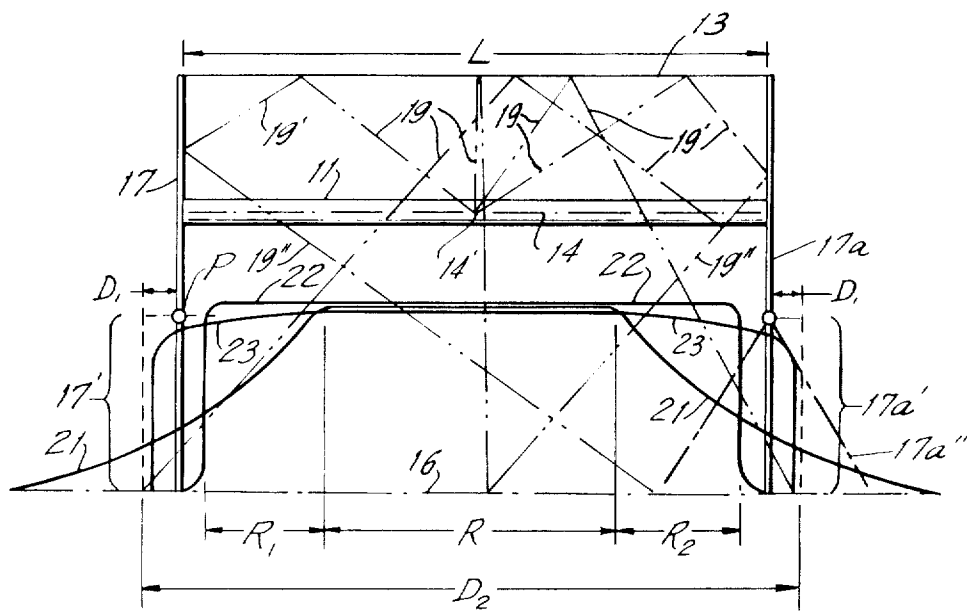


FIG. 2.



INVENTOR.
BERNARD J. COSTELLO

BY
Ostrolenk, Faber, Gerb & Sofka
ATTORNEYS

HEATING & FUSING DEVICE

The present invention relates to heating and fusing apparatus and more particularly to a novel line heater for irradiating and heating a narrow elongated surface area, which apparatus includes reflective end portions for extending the useful length of the "line image" while preserving accessibility along the length of the line heater to facilitate access to the region of the line image.

The use and application of radiant heating devices has become rather widespread in the past few years. A typical structure of such devices incorporates a reflector member having a reflective concave surface and a radiant heating source positioned at a primary focal point for generating radiant energy. The radiant energy reflected from the reflector member is focused at a secondary focal point for irradiating and heating a variety of devices, such as printed wiring boards, the terminals of circuit components and devices such as reed relay which require airtight glass-to-metal seals, by placing such components in the region of influence of the line image. Heating devices of this type may assume a variety of configurations. In applications wherein it is desired to provide radiant energy to heat a long narrow region, the radiant energy source is normally comprised of an elongated reflector member having a curved cross-sectional configuration wherein the concave surface thereof is made highly reflective for reflecting and focusing radiant energy from an elongated "line source" to form a "line image" which is substantially displaced from the reflector and lying in a predetermined focal zone.

It has been found that the intensity of radiation along the "line image" drops considerably near the ends thereof whereby the length of the "line image" which is of sufficient intensity to perform the heating operation is substantially shorter than the length of the elongated energy source.

The present invention is characterized by providing a line heater apparatus which incorporates highly reflective end portions hereinafter referred to as "blinders" for increasing the radiation intensity at the ends of said line image without impeding accessibility to the region of the "line image."

The present invention is comprised of an elongated energy source such as, for example, a high temperature filament enclosed within a hermetically sealed transparent envelope. An elongated reflector member having a substantially ellipsoidal cross-sectional configuration and a highly reflective concave surface adapted to focus reflected radiation along an image focus lying in a focal zone substantially removed from said reflector. The ends of said reflector being comprised of plane reflective members positioned substantially perpendicular to said filament and extending to the open face of said reflector.

The ends of the heater assembly are further provided with highly reflective "blinders" which act to extend the length of the line image, as well as increasing the intensity of the line image near its ends. The height of the blinder members may be selected so as to enable the line heater to be supported upon a surface which may further support the items to be irradiated so as to accurately align the line image with the items being heated.

It is, therefore, one object of the present invention to provide a novel line heater assembly for use in developing a "line image" for irradiating items to be heated comprising a reflective member having a concave surface for focusing radiant energy, emitted from an energy source positioned along the primary focus, along an image focus wherein the ends of the line heater are provided with highly reflective "blinders" for elongating the useful length of the line image and increasing the intensity of the line image near the ends thereof to produce a substantially uniform energy distribution along said line.

This as well as other objects of the present invention will become apparent when reading the accompanying description and drawings in which:

FIG. 1 is a perspective view showing a line heater designed in accordance with the principles of the present invention.

FIG. 2 is an elevational view of the line heater of FIG. 1 which includes a plurality of radiation intensity curves useful in explaining the advantages of the present invention.

The line heater 10 of the present invention is comprised of an elongated energy source 11 (shown in dotted fashion) which may, for example, be a high wattage filament encased within a radiation transmissive envelope. The reflector assembly 12 is comprised of an elongated reflector member 13 having a truncated elliptical cross-sectional configuration. The elongated radiant energy source 11 has its central axis substantially coincident with the primary focus 14 (indicated as a phantom line). Radiant energy emitted from the line source 11 is focused by the concave reflective surface of reflector 13 along an image focus line 16 (shown in phantom line fashion). Typical energy rays 15 are shown as being emitted from line source 11 and reflected as rays 15' so as to be focused to form the line image 16.

The ends of reflector 13 are enclosed by reflective planar surfaces 17 and 17a extending to the edges 13a and 13b of reflector 13. An extension of surfaces 17 and 17a, designated 17' and 17a', extends beyond edges 13a and 13b to the region of the line image and substantially in the same plane as 17 and 17a. The lower edges 18 and 18a of blinders 17 and 17a are substantially coplanar with the line image 16, which is of a length and dimension substantially equal to the line source 11.

FIG. 2 shows a sectional elevational view of the line heater of FIG. 1 to further indicate that radiant energy emitted from line source 11 is substantially omnidirectional and as described by Lambert's Law: $I = I_n \cos \theta$ where I_n is the intensity of energy normal to the emitting surface and I is the intensity at any angle θ . The emitted rays being omnidirectional therefore may strike the elliptical surface 13 or the end surfaces 17, 17a or both. This is depicted by the rays of energy 19 which are dispersed from any given point (for example, point 14') along the true focus 14 in an omnidirectional manner. The upwardly directed rays are reflected by both the ellipsoidal shaped reflector 13 (as rays 19') as well as being further reflected (in selected cases) as depicted by the rays 19''.

All of the radiant energy impinging upon the ellipsoidal shaped reflector 13 and the end planes 17 and 17a are focused along the image focus line 16. The intensity of radiation along the line image is depicted by the curves 21-23.

Curve 21 is the curve of radiant energy intensity along the line image for the case where the ellipsoidal reflector 13 has no reflective "blinders" 17a, 17a'. The radiant energy in the central region of the line heater is substantially uniform in the region R. However, the intensity at the end portions of the "line image" beyond region R diminish significantly and trail beyond the end planes 17 and 17a.

The addition of the highly reflective "blinders" 17' and 17a' yields a resultant radiant energy intensity curve 22 which is substantially of uniform intensity throughout the entire length of the line image 16 and is equal in intensity in both its end portions beyond R and its central portion R to the level of radiation intensity developed by a reflector 13 in the absence of "blinders."

FIG. 2 shows an alternative arrangement for the blinders 17' and 17a' extended outwardly by a distance D_1 so as to be separated by a distance D_2 which is greater than the length L of the ellipsoidal reflector 13. Blinders of this configuration yield a radiation intensity curve 23 which extends the length of the line image 16 to an amount beyond the normal length L with a slight decrease in intensity in the extreme portions of the end regions R₁ and R₂.

In one specific embodiment, it has been found that an ellipsoidal reflector having a length of 7 inches generates a line image having a length of 5 inches in the intermediate region R which is of the desired intensity with the remaining end portions of the line image decreasing rather rapidly in intensity and likewise, in effectiveness. The use of an elliptical cylindrical shaped reflector of the dimensions set forth hereinabove in conjunction with the blinders 17 and 17a yields a line image having a length of 7 inches in the inter-

mediate region R which provides the requisite intensity and heat level. The modification of the "blinders" by extending the lower portions 17' and 17a' thereof so that they are separated by a distance of 8¼ inches yields a line image having a length of 8 inches wherein the extreme end portions of the resulting line image are not quite as uniform as the 7 inch line image developed by the ellipsoidal reflector with planar blinders. However, the slight drop in intensity in the extreme end portions is relatively insignificant so as to yield the requisite intensity and temperature level substantially over the entire 8-inch length of the "line image."

Another significant characteristics of the line heater is the fact that the lower edges 13a and 13b of the sides of ellipsoidal shaped reflector 13 lie a spaced distance D above the lower edges 18 and 18a of blinders 17 and 17a, respectively. This arrangement provides easy accessibility to the immediate region of the line image from either side of the line heater to greatly facilitate positioning and/or removal of objects to be heated.

The line heater of the Figures may further be modified in a unique manner to provide for adjustment of the intensity of the line image to satisfy any of a variety of heating requirements. By pivoting either or both of the blinders about points P (see FIG. 2) to alter the dihedral angle formed between the plane of the blinders and the associated ends of reflector 13 both the intensity and useful length of the line image may be altered. FIG. 2 shows blinders 17a'' and 17a''' extending respectively to the right and to the left of the vertical line represented by blinder 17. Obviously the pivotally mounted blinders may be selectively positioned at any other desired angle and the blinders need not be aligned at equal angles.

It can be seen from the foregoing description that the present invention provides a novel line heater capable of generating a line image of radiant energy which is substantially of uniform intensity along its entire length and which provides easy accessibility to the region of the line image for placement or removal of elements to be heated. As an obvious alternative to the preferred embodiment described hereinabove, one of the sides of reflector 13 may extend downwardly so that its lower edge (13a or 13b) is coplanar with the lower edges 18 and 18a or may be positioned closer to the lower edges 18 and 18a so long as one side of reflector 13 provides the accessible opening.

Although there has been described a preferred embodiment of this novel invention, many variations and modifications will now be apparent to those skilled in the art. Therefore, this invention is to be limited, not by the specific disclosure herein, but only by the appending claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. Heating apparatus comprising:
an elongated source of radiant energy;

an elongated cylindroidal reflector having a truncated cross-sectional configuration, the concave surface of said reflector being highly reflective to the radiant energy emitted from said source; the ends of said reflector being polished plane surfaces arranged substantially normal to said source and extending to the plane of truncation of said reflector;

the longitudinal axis of said source being substantially coincident with the primary focus of said reflector whereby said reflector is adapted to focus the radiant energy emitted from said source and impinging upon said reflective surface along the image focus of said reflector to form an image of focused radiation;

polished plane surfaces being highly reflective to the radiant energy emitted from said source and herein referred to as "blinders," lying substantially in the plane of said ends extending toward or beyond the image focus of said reflector, to obtain a substantially uniform intensity distribution of radiant energy between said end extensions and along said image said "blinders" being adapted to support said apparatus upon a supporting surface and thereby the plane of truncation of said reflector lies a substantial distance above said supporting surface to facilitate insertion and removal of items to be heated by said apparatus.

2. The apparatus of claim 1 wherein the cross-section of said reflector is elliptical.

3. The apparatus of claim 1 wherein said image is a line of substantially the same dimension as said source.

4. The heating apparatus of claim 1 wherein the lower edges of said blinders are substantially coplanar with an imaginary plane containing said line image.

5. The heating apparatus of claim 1 wherein said blinders are spaced a greater distance apart than the spacing between said reflector ends to increase the effective length of the line image beyond said reflector ends without undue loss of intensity uniformity along said line image.

6. The apparatus of claim 3 wherein said increase in distance between said blinders is a maximum of 1 inch or 15 percent of the distance between said reflector ends, whichever is greater.

7. The apparatus of claim 1 wherein said blinders are aligned transversely to an imaginary plane coincident with the ends of said reflector adjacent said blinders to form a predetermined angle commensurate with the desired intensity and length of said line image.

8. The apparatus of claim 1 wherein said blinders are pivotally mounted to said reflector to enable said blinders to be aligned transversely to an imaginary plane coincident with the ends of said reflector adjacent said blinders to adjust the intensity and length of said line image.

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