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J. N. SELVIG

2,318,533

APPARATUS FOR HEATING MATERIAL

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FIG. 1

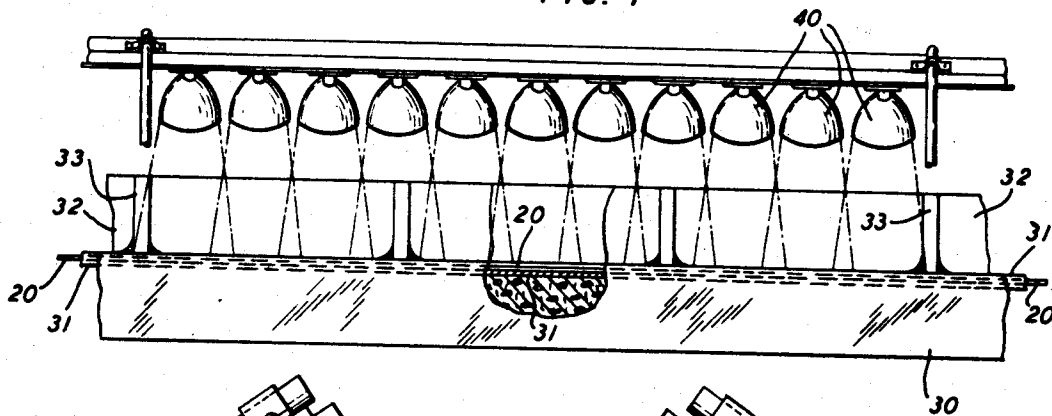


FIG. 6

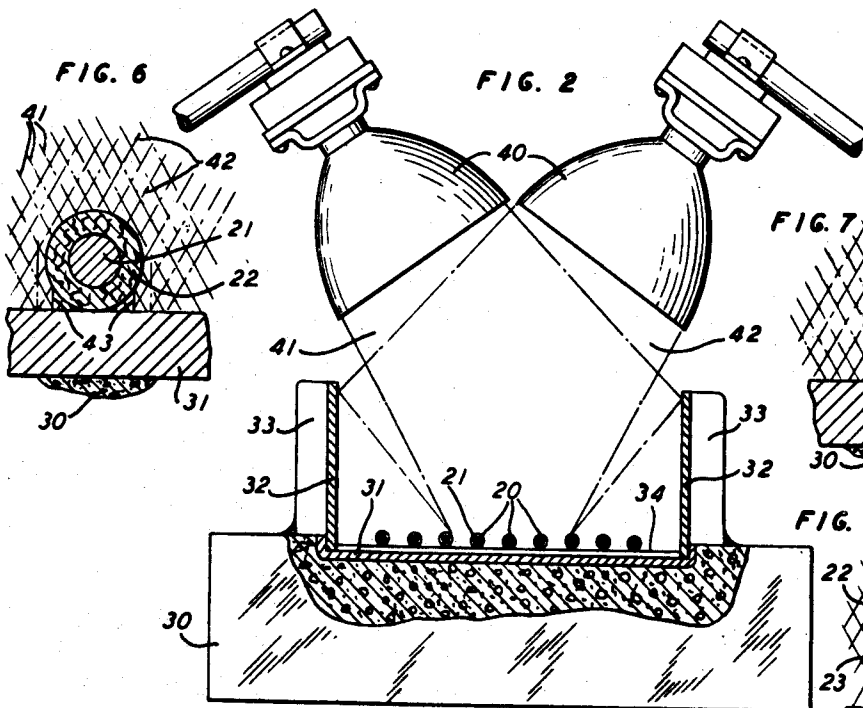


FIG. 2

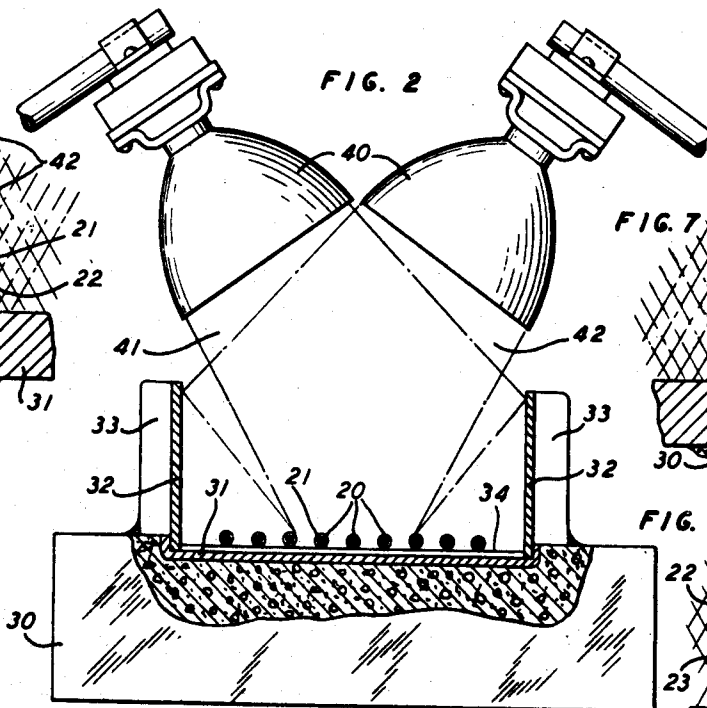


FIG. 7

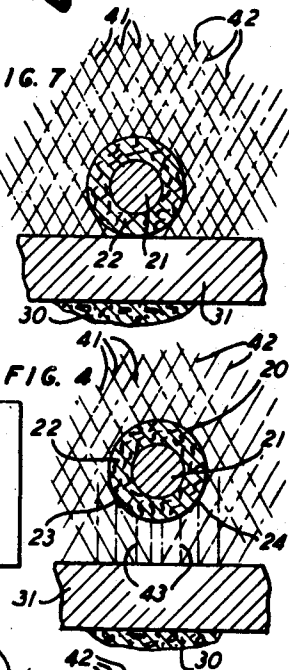


FIG. 4

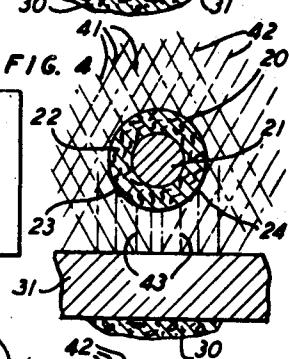


FIG. 3

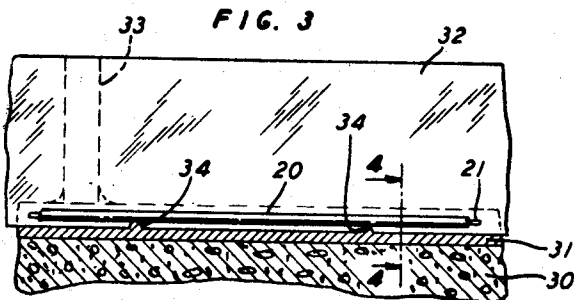
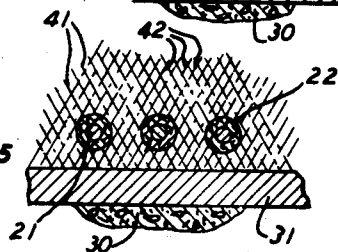


FIG. 5



INVENTOR
J. N. SELVIG

BY

E.R. Nowlan
ATTORNEY

UNITED STATES PATENT OFFICE

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APPARATUS FOR HEATING MATERIAL

John N. Selvig, Westfield, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

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1 Claim. (Cl. 219—34)

This invention relates to apparatus for heating material, and more particularly for drying strand material such as wire sheathed in paper pulp.

The heating of material in strand form such as wire coated with one or another form of electrically insulating or otherwise protecting material has long been practised by methods and apparatus involving exposures to radiant heat from oven surfaces, electrically heated resistance elements, and the like. There are three fundamental ends to be aimed at in all such methods and apparatus, namely, to apply heat to the strand equally from all sides at each point of the exposed portion, to apply the heat along the strand without excessive temperatures at any part of the portion exposed to the heat, and to minimize tensional stresses in the heated portion. This last point is one whose importance is not always appreciated, especially in the case of electrical conductor wires of copper or of aluminum or of other metals or metallic alloys of high conductivity but sometimes also of high malleability and relatively low tensile strength especially when heated. In a particular case, wires of high conductivity copper have recently been provided with an insulating sheath of felted cellulosic or textile fibres formed directly on the wire as a seamless envelope of wet pulp and then dried. In another instance, such wires are covered with textile threads served, braided or knitted into a seamless envelope and subsequently coated with a solid material, e. g. cellulose acetate, in a liquid solvent or vehicle, e. g. acetone, and are then heated to dry out the solvent or vehicle. In such cases the sheathed wires have been passed through long vertical chambers or through long horizontal chambers while being subjected to radiant heat from oven walls, electrical resistance elements or the like. When passed through vertical drying chambers, there is no difficulty in applying the heat uniformly to all sides of the wet sheathed wire, since the wire may hang free in its passage from one guide sheave to another; but the weight of the free hanging length of the wire is superimposed on the tension in the wire caused by whatever means is employed to pull the wire through the apparatus, and this weight may be great enough to cause stretching of the heated wire with consequent damage both to the wire and to the sheath thereon. A similar difficulty arises in the case where the wire travels in a free hung catenary through a horizontal chamber from one sheave to another. The tension required to keep the catenary practicably shallow may well exceed the

tension due to the weight of the wire in a vertical chamber. Attempts have been made to utilize a horizontal chamber in which such superadded tensions are avoided by supporting the wire during its passage through the heated zone. This, of course, avoids the weight tensions; but obviously introduces problems of applying heat equally to all sides of the wire because of obstruction by the supporting means employed.

An object of the present invention is to provide apparatus for heating strand material uniformly without any necessity for weight tension on the strand while being heated.

With the above and other objects in view, the invention may be embodied in an apparatus wherein strands to be heated are advanced horizontally over while being supported on a flat horizontal secondarily radiant surface, and while primary radiant heat is supplied from above to substantially evenly envelope each strand in combined primary and secondary radiant heat.

Other objects and features of the invention will appear from the following detailed description of one embodiment of the invention in an apparatus constructed in accordance with the invention, taken in connection with the accompanying drawing in which the same reference numerals are applied to identical parts in the several figures and in which

Fig. 1 is a generally diagrammatic view of a part of the apparatus in side elevation and partly in section;

Fig. 2 is an enlarged view thereof in end elevation and partly in section;

Fig. 3 is a partial view of the showing of Fig. 2 in longitudinal vertical section;

Fig. 4 is an enlarged fragmentary section on the line 4—4 of Fig. 3;

Fig. 5 is a further enlarged view similar to Fig. 4 of a modified form;

Fig. 6 is a corresponding view of another modified form; and

Fig. 7 is a corresponding view of still another modified form.

As herein disclosed, strands 20 comprise a core 21 and a covering, coating or sheath 22 and are to be uniformly heated while passing through the apparatus shown, being advanced by means not shown.

The apparatus comprises a bed or base 30 having the general form of a long block or slab of some suitable material, preferably a relatively good heat insulating substance such as cement, concrete, ceramic blocks or bricks, or the like. Preferably inset into the flat horizontal top sur-

face of the base is a wide, shallow trough 31 of sheet metal having a generally flat bottom and vertically upturned side flanges. Vertical side wall members 32 of sheet metal are backed along their lower edges against these upturned flanges and are supported by suitable posts 33 positioned at intervals against their outside faces and on the bed 30.

Suitable sources of primary radiant heat such as infra red lamps 40 are supported over the channel formed by the trough 31 and walls 32 to direct substantially parallel bundles of rays of primary radiant heat down into the channel. These lamps are preferably arranged in pairs transversely opposite each other so that one lamp of each pair directs its rays 41 slantingly down against the right hand wall 32 (Fig. 2) and not less than half the width of the floor of the channel, while the other lamp of the pair similarly directs its rays 42 slantingly down against the left hand wall 32 and not less than half the width of the floor. Radiation thus directed against the floor of the channel either directly from the lamps or by reflection from the walls 32 will be termed primary radiation; while radiation coming up from the floor member whether by reflection or otherwise will be termed secondary radiation.

The inner faces of the walls 32 are highly polished and are preferably coated with polished gold to provide as durable and as perfectly reflecting a surface as possible.

The upper surface of the floor member 31 may be treated in either of two ways, by which the same end result is achieved but in somewhat differing fashions. This surface may also be a reflector, e. g. gold plated and polished, which will reflect a maximum and absorb a minimum of radiant energy falling upon it. Or it may be a black body surface treated to reflect a minimum and absorb a maximum of radiant energy. If the member 31 be made of iron or steel and its top surface phosphatized to produce the familiar minutely rough, matt, substantially black surface characteristic of surfaces rust proofed by phosphatizing, a substantially black body surface is created, suitable for the present use.

In the preferred embodiment, shown in Figs. 1 through 4, the floor is treated to have a black body surface and is also provided with a number of spaced, transverse, narrow upstanding ridges whose height is about the same as the thickness of the strands 20 to be treated. These ridges 34 are of practically negligible width along the strands, and are spaced at such distances apart as to support the strands at points close enough together to obviate any material sagging of the strands between ridges as the strands are drawn along over them.

The lamps 40 are so placed as to the directions of their rays that the condition disclosed in Fig. 4 is substantially achieved, namely, that no part of the floor 31 is wholly shaded by a strand 20 from both lamps. The shadow in the bundle of rays 41 is wholly irradiated by the bundle 42; and the shadow in 42 is wholly irradiated by 41. Thus the upper surface of the strand 20 down to the points 23 and 24 is irradiated by primary radiation either directly from the lamps or reflected from the side walls.

The top surface of the bottom member 31 being a black body surface, absorbs the radiant energy falling upon it practically entirely and reflects practically none. This absorbed radiant energy is converted in the body of the member

31 into kinetic heat energy and raises the temperature of its substance to a point where there is equilibrium between energy falling upon it and energy re-radiated from the black body surface. This re-radiated energy is radiated vertically up from the horizontal top surface of the member 31 as indicated at 43 in Fig. 4 and thus irradiates the under surface of the wire 20. Thus the wire is subjected to substantially uniform radiant energy on all sides due to the combined primary and secondary radiation thus provided.

A number of strands may be simultaneously treated in this manner, as indicated in Fig. 2, by running them over the member 31 parallel to each other, and spaced from each other a distance apart preferably not less than their own diameters.

In the modification shown in Fig. 5, the member 31 has the same transverse ridges 34 as before, but its top surface is made as nearly totally reflecting as possible. The secondary radiation from below in such case, is reflected and comes up from the reflecting surface slanting the same amount from the perpendicular as the primary radiation, instead of vertically as in Fig. 4. Each wire 20, however, is again irradiated substantially equally on all sides.

As modified in Fig. 6, the ridges 34 are omitted and the top surface of the member 31 is treated to be a black body surface. In this case the strands are supported at every point of their length along the member 31. Since each strand 20 thus lies directly tangent to the surface of the member 31, a portion of the surface directly under the strand will be shadowed by the strand from the primary radiation. However, there are portions of this surface between the strands and wider than the distance between the strands which will be irradiated with primary radiation and will absorb energy. Since the member 31 is of metal this energy will be distributed substantially evenly throughout its substance and will be re-radiated as secondary radiation directly up under each strand from the portion of surface under the same. Thus a satisfactory result is achieved in this case also.

Fig. 7 shows the case where the ridges 34 are omitted and the top surface of the member 31 is made reflecting. Here there should in theory be an unsatisfactory irradiation of a small portion of the surface of the strand on each side of its line of tangency with the surface of the member 31. However, in practice no metallic surface is truly totally reflecting, and there will be sufficient black body radiation directly under the strand to supplement the reflected radiation satisfactorily. The same mixed effect will, of course, also characterize the arrangement of Fig. 5.

Only so much of the apparatus is herein disclosed as is needed to describe and delimit the invention. In practice there may be required means to remove and carry away water vapors, solvent fumes and the like liberated from the strand by the heat applied in the manner described. Also means are required to propel the strands, preferably at a uniform rate, longitudinally through the apparatus. Such means are no part of the invention and so are not shown. The specific structure and mode of operation of the heat radiating means 40 are also no part of the invention, it being merely required for the purposes of the invention that these means or lamps project radiant heat in bundles of substantially parallel rays. Details of a suitable radiant heat projector for the present purposes

may be found, if desired, however, in U. S. Patent 2,057,776 of October 20, 1936 to F. J. Groven.

The embodiments of the invention herein disclosed are illustrative and may be variously modified and departed from without departing from the spirit and scope of the invention as pointed out in the appended claim.

What is claimed is:

An apparatus for heating material in strand form and comprising members to form an open topped channel with vertical side walls and with a horizontal floor to support a strand passing over the floor and between the walls, the inner faces of the side walls being polished to reflect radiant heat and the floor surface being

blackened to radiate secondary radiant heat by black body radiation when irradiated with primary radiant heat, in combination with a plurality of sources of primary radiant heat positioned to irradiate the inner faces of the side walls and the floor surface with primary radiant heat from two angularly diverging directions simultaneously and thereby to irradiate a strand passing through the channel upon its upper portion with primary radiant heat and upon its lower portion with secondary radiant heat radiated by black body radiation from the floor surface.

JOHN N. SELVIG.