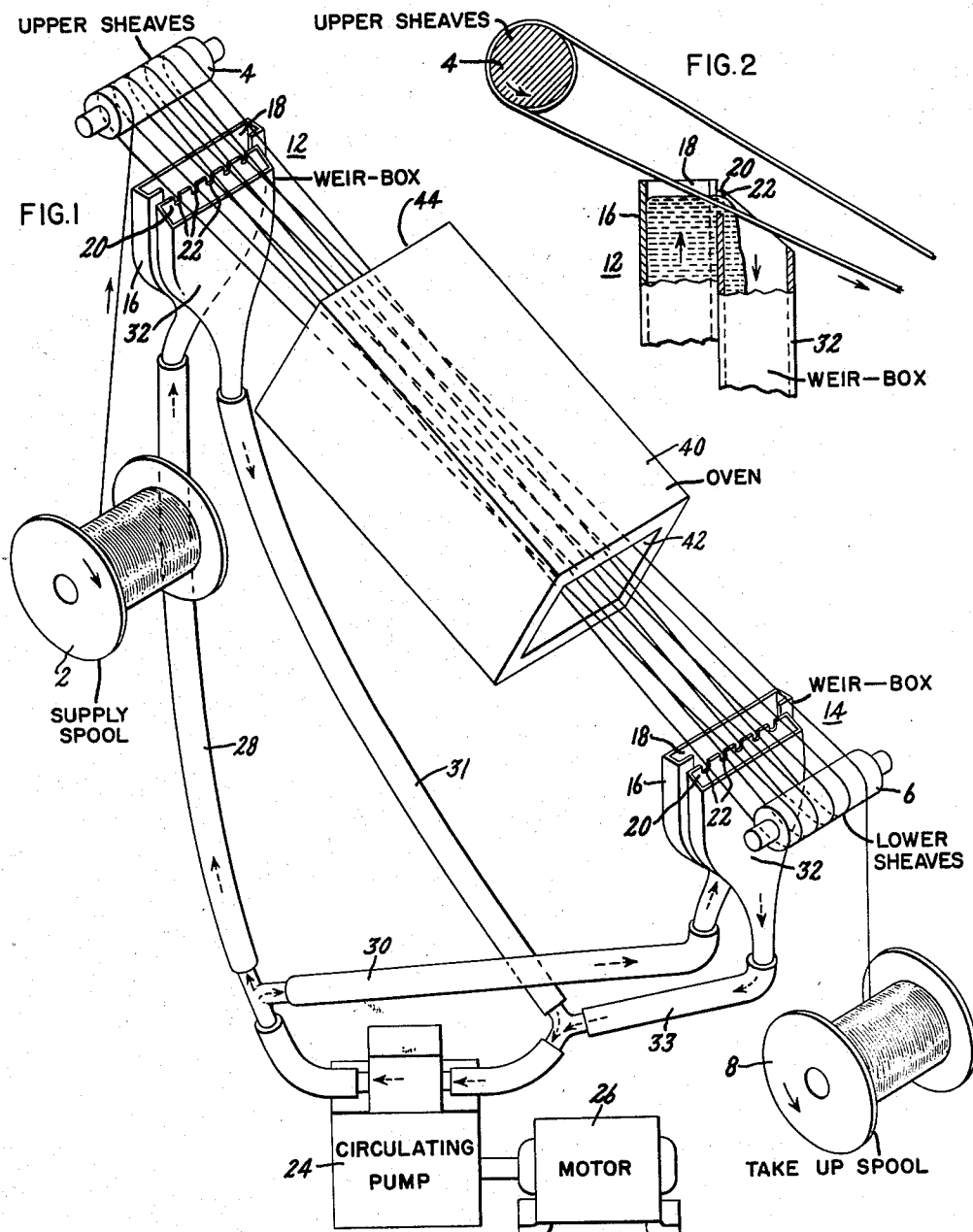


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W. H. NEWTON
WIRE COATING APPARATUS

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WIRE COATING APPARATUS

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This invention relates to apparatus for coating filamentary material. The invention has particular utility in the application of coatings of electrical insulating material to wire for heaters in thermal emissive electron tubes.

One known method of applying an insulating coating to wire involves passing the wire one or more times around a rotating roller grooved to accommodate the wire and immersed in a container filled with a solution of the insulating coating. This method has certain disadvantages, among which is the fact that the coating solution often consists of particles of insulating material in suspension and the abrasive qualities of the particles are such that the bearings supporting the coating roller and other moving parts in the immediate vicinity are subject to considerable wear. Also the quality and uniformity of thickness of the coating is adversely affected by the fact that the rotation of the coating roller in the bath of coating solution tends to draw air into the bath, and by the fact that the nesting of the wire in a groove of the coating roller as it passes through the bath interferes with uniform coating of the wires on all sides, i.e. throughout its circumference.

A principal object of the present invention, therefore, is to provide an improved coating apparatus which overcomes the foregoing difficulties and insures a coating of improved evenness, uniformity of thickness, and uniformly high quality.

Another object is to provide apparatus for coating filamentary material which is economical in use of coating material and in which the problem of abrasion or fouling of moving parts of the apparatus with coating material is eliminated.

Still another object is to provide apparatus for coating filamentary material which is compact, yet capable of applying any desired number of successive layers of coating material in one continuous process.

These and other objects of the invention will be apparent from the following description, and the scope of the invention will be defined in the appended claims.

Briefly, the foregoing objects are attained in accordance with a preferred form of the present invention by circulating the coating solution through a pair of weir-box assemblies in each of which the solution is arranged to overflow from a supply container to a recovery container across an overflow lip provided with a plurality of downwardly cut flow notches. The wire or other filamentary material to be coated is reeved back and forth between two sets of sheaves which serve as rotatable guides. The sheaves are so positioned that, in each passage from one sheave to the next, the running portion of the wire first passes through and is immersed in coating solution overflowing through a notch of one of the weir boxes, and then before coming in contact with the next sheave the wire passes through a drying oven in which the coating just applied is dried firmly in place. The overflow notches are so dimensioned as to preclude contact between the material being coated and the sides of the notches, and the running section of freshly coated material is led

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directly to the drying oven while still freely suspended in space, thereby precluding any deformation or damage to the coating before it is fully dry and set in place.

For a more complete description of the invention reference is made to the accompanying drawing wherein:

Figure 1 is a diagrammatic perspective view of a coating apparatus constructed in accordance with the invention, and

Figure 2 is a fragmentary enlarged sectional view of a portion of the apparatus of Figure 1.

Referring to Figure 1 of the drawing, a coating apparatus constructed in accordance with the present invention and particularly suitable for the coating of wire includes a supply spool 2 from which the material to be coated is led to one of an upper set of sheaves 4. The filamentary material to be coated may be of any desired cross-sectional shape, for example, a ribbon, and will be hereinafter referred to merely for convenience as wire. From the upper sheave the wire passes tautly to the corresponding one of a lower set of sheaves 6 spaced both horizontally and vertically downward from the upper sheaves, and after being reeved back and forth between successive sheaves of both sets the wire is led to a take-up spool 8.

The wire is so reeved about the several sheaves that, in passing between any two sheaves, it leaves the lower side of the one and arrives at the upper side of the next. In other words, as viewed from the side the several wire sections passing between the sheaves lie in two planes which intersect intermediate the two sets of sheaves. Thus each section of wire extending between a pair of sheaves is held straight, taut and well spaced from its neighbors. Suitable traversing mechanism (not shown) may be provided, if necessary, to insure smooth pay-out of wire from the supply spool 2 and even distribution of wire on the take-up spool 8.

Disposed along the path of the wire sections extending between the sets of sheaves is a pair of identical weir-box assemblies 12, 14. Each weir-box assembly consists of a supply container 16 having a generally rectangular upwardly facing open mouth 18. One edge of the mouth is spaced slightly below its other edges and forms an overflow lip 20 provided with a plurality of spaced downwardly cut notches 22. A circulating pump 24 driven by a motor 26 is arranged to supply a solution of coating material through supply hoses or pipes 28, 30 to each of the containers 16 in sufficient quantity to maintain a constant overflow of the coating solution through all of the respective notches 22. Each weir-box assembly further includes a receiver or return trough 32 arranged beneath the adjacent overflow lip 20 so as to recover the overflow of coating solution therefrom and return it to the circulating pump through pipes 31, 33.

The upper weir-box assembly 12 is arranged relative to the paths of wire sections moving from the upper set of sheaves 4 to the lower set of sheaves 6 so that each such wire section passes through one of the notches 22 in weir-box 12 and extends beneath the surface of the coating solution flowing through the notch so as to completely immerse the wire and uniformly expose it to coating solution throughout its circumference. Likewise the lower weir-box assembly 14 is so positioned adjacent the paths of wire sections moving from the lower set of sheaves 6 to the upper set of sheaves 4 that each of these wire sections passes through a respective notch in the overflow lip of weir-box 14 and is thereby completely immersed and uniformly exposed throughout its circumference to the coating solution flowing through the notch. All of the notches 22 are made large enough, in relation to the size of the wire and thickness of the layer of coating applied in each immersion of the wire, so that the coated wire passes freely through the notches without any contact be-

tween the edges of the notch and the coating applied to the wire.

Between the two weir-box assemblies 12, 14 is a drying oven 40 positioned so as to surround the paths of the running sections of wire but open at its ends 42, 44 to permit a clear passage of the wire therethrough. The drying oven 40 is made of sufficient length, in relation to the speed of movement of the wire, to thoroughly dry each coating applied to a segment of wire during its single passage through the oven and before it arrives at the next sheave.

In the operation of the apparatus the pump 24 continuously circulates the coating solution through the weir-box assemblies 12, 14 at a rate such as to maintain a constant level of overflow through the several notches 22. The wire is drawn continuously from the supply spool 2 around the first sheave of the upper set of sheaves 4, thence through the corresponding notch 22 in the upper weir-box assembly 12, through the oven 40, around the first sheave in the lower set of sheaves 6, then back through the coating solution in the corresponding notch of the lower weir-box assembly 14, again through the oven 40, around the next sheave in the upper set of sheaves, and on until the fully coated wire is finally wound on the take-up spool 8. Particularly when the coating material is carried in the coating solution in the form of a suspension, the rate of circulation of fluid through the weir-boxes should be sufficient to insure that the coating material will be adequately maintained in suspension. The speed of wire movement during the coating operation may vary over a wide range, the speed being dictated principally by the amount and density of coating material desired to be applied to the wire.

Coating apparatus constructed in accordance with the present invention has several advantages. First of all the passage of the wire through the overflow streams of the several notches 22 as described, and the arrangement of the weir-boxes beneath the wires together with the reeving of the wire so that it departs from the underside of one sheave and arrives at the upper side of the next, results in each section of wire being freely suspended in space and out of contact with any structure during the entire time during which a coating is being applied thereto and dried thereon, while enabling two separate weir-box assemblies to be grouped about a single oven. Thus any possibility that the coating might be partially stripped off the wire or otherwise damaged by contact with or adherence to a sheave or other object before being dried and firmly set in place, is completely precluded. Also with this arrangement both sets of sheaves run dry, i.e. completely free of contact with coating solution, and thus the possibility of building up an undesired deposit of coating solution or dried coating material on the sheaves, or fouling the bearings of the sheaves or other moving parts, is completely eliminated. Moreover, since nothing is immersed in the coating solution except the material to be coated, there is no problem of drawing air into the coating solution and thereby reducing the quality of the coating.

The coating apparatus described has the additional advantages that the weir-box assemblies need not accommodate any rotating drums or the like, and thus the weir-boxes may be made as small as desired consistent with the number of wire sections passing between the sheaves and the size of the wire to be coated, and the total amount of coating solution required is correspondingly minimized. Thus, though capable of applying any desired number of coatings in the one continuous process the entire apparatus is compact and can be of modest size. Additionally, since at the coating point the wire is completely immersed in coating solution and entirely free of contact with any structure it will be evident that an even and uniform coating of the wire with most economical use of coating material is assured, and any possibility of abrasion of the filamentary core material by the coating solution is minimized. Finally, the constant flow of the coating

solution through the overflow notches 22 automatically provides sufficient agitation to insure thorough and even distribution of the coating material in solution, and further contributes to the uniformity and quality of the applied coating.

Although it will be apparent that the foregoing apparatus may be used to apply any desired coating of the necessary adhesive properties to any desired material of filamentary form, the above described apparatus has particular utility in the application of a suitable coating of insulating material to wire for heaters which supply heat for the thermionic emitters of electron tubes. Such wire may consist, for example, of molybdenum or tungsten metal on which it is desired to provide an aluminum oxide insulating coating. For this purpose a suitable coating solution may be provided consisting of, for example, aluminum oxide, aluminum nitrate, ammonium hydroxide and distilled water. The speed of wire movement may vary from as low as, for example, five feet per minute to as high as one hundred feet per minute, and the coated wire may be suitably dried after each immersion with an oven temperature of, for example, 750° C.

Thus there has been shown and described an improved coating apparatus which is compact and economical in use of coating material, which provides a coating of improved quality, homogeneity, and uniformity of thickness, which minimizes abrasion of the material to be coated, and minimizes wear or fouling of the moving parts of the apparatus.

It will be appreciated by those skilled in the art that the invention may be carried out in various ways and may take various forms and embodiments other than the illustrative embodiments heretofore described. It is to be understood therefore that the scope of the invention is not limited by the details of the foregoing description but will be defined in the following claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In apparatus for coating filamentary material including upper and lower guides between which the material to be coated is adapted to be drawn in a straight line and a container between the guides adapted to hold a coating solution, the combination of an upstanding sidewall on the container, the top edge of said sidewall having a downwardly extending notch through which coating solution in the container is adapted to flow continuously therefrom, said notch forming a stream extending freely outwardly and downwardly therefrom whereby said coating solution flowing through said notch is continuously agitated thereby, said notch being positioned relative to said guides such that filamentary material passing in a straight line between the guides is drawn through said notch in spaced relation with the sides of said notch and is completely immersed in only the portion of the coating solution flowing through said notch, said notch being dimensioned to have a flow cross-section larger than that of filamentary material passing there-through so that the immersed portion of filamentary material passes freely therethrough without contacting the edges of said notch, the thickness of the container sidewall forming the sides of said notch being substantially less than the length of the portion of the path of filamentary material immersed in said coating solution whereby contact between the filamentary material and sides of said notch is minimized, and only drying means positioned between the notch and the guide toward which the coated filamentary material is drawn for drying an applied coating on the filamentary material before it contacts said latter guide.

2. In apparatus for coating filamentary material including two rotatable guide rolls around which the material to be coated is adapted to be reeved and a pair of containers between the guide rolls and each adapted to hold a coating solution, the improvement comprising a thin vertical wall in each container forming at its upper edge

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an overflow lip, said overflow lip being provided with a plurality of spaced downwardly extending notches through which coating solution in the container is adapted to flow continuously therefrom, each of said notches forming a stream extending freely outwardly and downwardly therefrom whereby said coating solution flowing through each said notch is continuously agitated thereby, one of said containers being positioned relative to the paths of the sections of filamentary material running from the first guide roll to the second guide roll so that each such running section is drawn through and completely immersed in only the portion of the coating solution flowing through a respective notch in said one container, the other of said containers being positioned relative to the paths of the sections of filamentary material running from the second guide roll to the first guide roll so that each such running section is drawn through and completely immersed in coating solution flowing through a respective notch in said other container, the thickness of the container sidewall forming the sides of said notch being substantially less than the length of the portion of the path of filamentary material immersed in said coat-

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ing solution whereby contact between the filamentary material and sides of said notch is minimized, and common drying means disposed between said containers and adjacent the paths of running sections of filamentary material for drying a coating applied to each of said running sections before it contacts the guide roll toward which it is drawn.

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