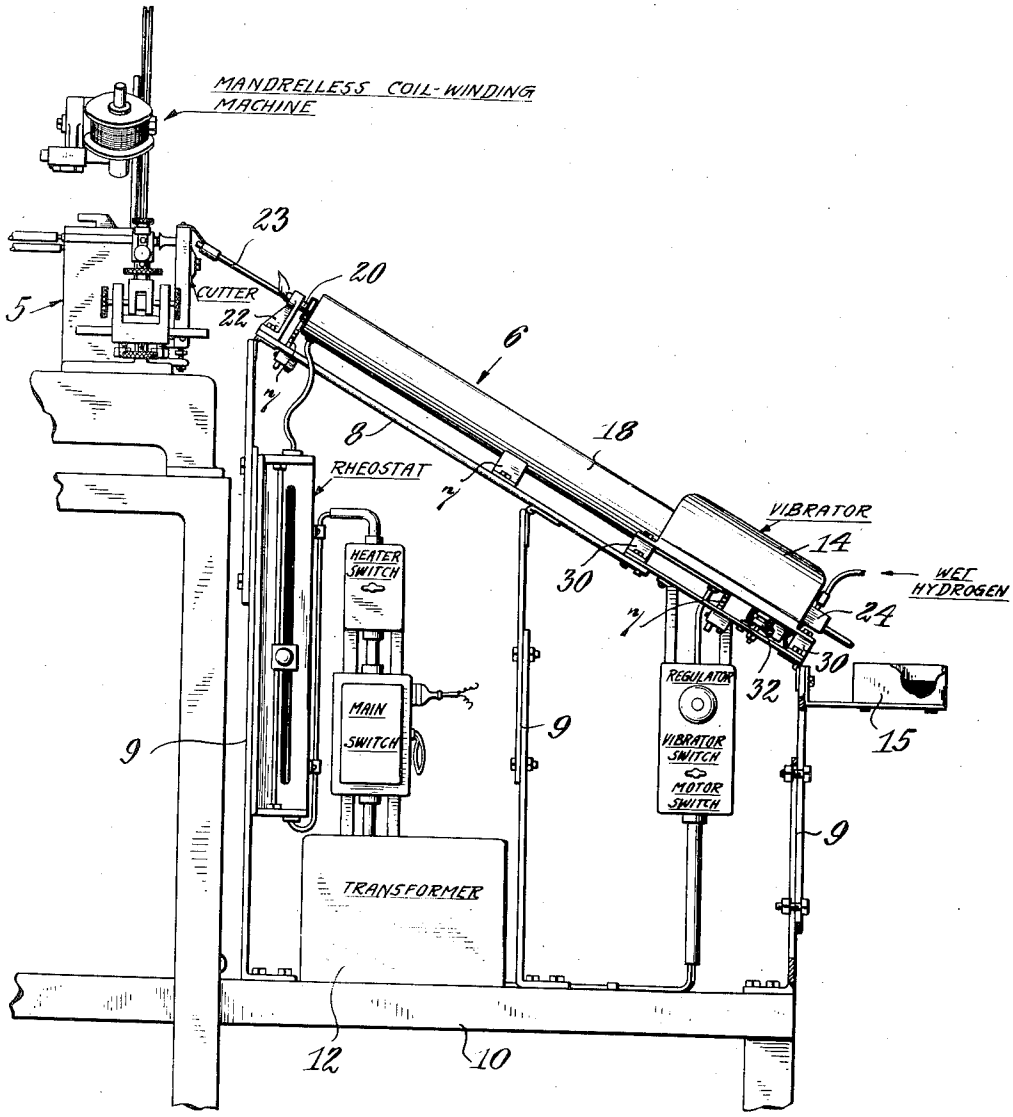
April 16, 1940. F. E. SUTTER 2,197,533

PROCESS FOR ANNEALING MANDRELLESS COILS

Filed Sept. 30, 1937 2 Sheets-Sheet 1

Fig. 1.



INVENTOR
F. E. SUTTER
BY
ATTORNEY

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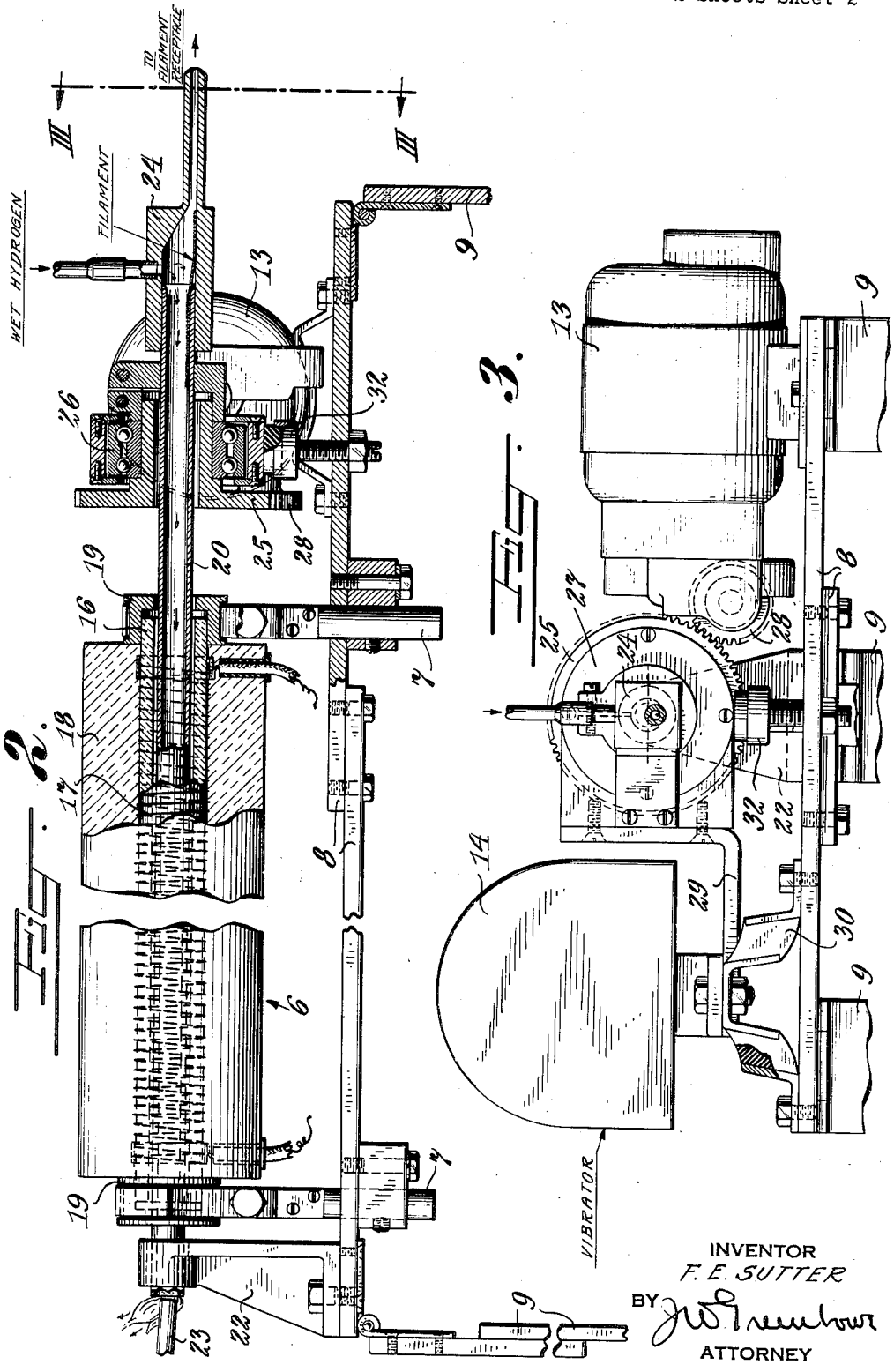

Fig. 2.

Fig. 3.

INVENTOR
F. E. SUTTER
BY
ATTORNEY

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PROCESS FOR ANNEALING MANDRELLESS COILS

Frederic E. Sutter, West Caldwell, N. J., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

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7 Claims. (Cl. 176—4)

The present invention relates to the method of and apparatus for treating metals and has particular reference to annealing mandrelless wound tungsten filaments for incandescent electric lamps.

At the present time it is well known in the art to employ tungsten filaments for incandescent lamps which are of the mandrelless coiled type and are formed by automatic machines without the necessity of utilizing a mandrel. However, inasmuch as the filaments are of a refractory metal, such as tungsten or the like, further manufacturing steps have heretofore been required. For example, it is necessary in order to insure uniformity in the wattage of the finished lamp that the filaments be of a preselected length and turns per inch.

To facilitate manufacture, the filaments must be slightly annealed so that they can be handled with ease without distortion as would otherwise result because of the brittleness of the refractory metal. Heretofore, processing of the filament has required various steps necessitating separate handling for each operation which naturally increased manufacturing losses known as "shrinkage" due to distorted filaments.

It is accordingly an object of the present invention to provide a method wherein the filament is completely treated immediately upon its initial formation without the necessity of handling the filament except to secure the same to the leading-in wires constituting a part of the mount for incandescent lamps.

Another object of the present invention is the provision of a method for annealing mandrelless wound filaments for incandescent lamps which enables standardizing of the filaments from the standpoint of length and turns per inch and at the same time conditions the filament for incorporation in an incandescent lamp immediately following its initial formation.

Another object of the present invention is the provision of a heat treating furnace which constitutes substantially an integral part of an automatic coil winding machine for the purpose of treating mandrelless wound filaments for incandescent lamps immediately following their initial formation.

Another object of the present invention is the provision of a heat treating furnace constituting substantially an integral part of a coil winding machine which individually treats each filament as it is discharged from the machine.

Another object of the present invention is the provision of a heat treating furnace for incandescent lamp filaments forming substantially an integral part of a coil winding machine wherein the incandescent lamp filaments are individually raised to an annealing temperature which sets and cleans the filaments as they are discharged from the machine.

Still further objects of the present invention will become obvious to those skilled in the art by reference to the accompanying drawings wherein:

Fig. 1 is an elevational side view of the furnace for treating incandescent lamp filaments attached to and forming substantially an integral part of a mandrelless coil winding machine.

Fig. 2 is a side view partly in cross section and on an enlarged scale of the furnace as shown in Fig. 1, and

Fig. 3 is an end view partly in cross section taken on the line III—III of Fig. 2 and looking in the direction indicated by the arrows.

Referring now to the drawings in detail a coil winding machine of any suitable type is partially shown generally at 5. Since the coil winding machine itself forms no part of the present invention, except insofar as the present invention is applicable in combination therewith, so as to form substantially an integral part thereof, further description of the coil winding portion of the machine is deemed unnecessary. Suffice it to say that such machine may be of any particular type which winds coiled filamentary sections without the necessity of employing a mandrel, such for example, as the machine shown and described in United States Patent No. 1,670,499, issued May 22, 1928, to J. W. Ekstedt, and assigned to the same assignee as the present invention.

As shown and described in this patent the coiled filamentary sections are discharged from the machine after being cut into predetermined lengths depending upon the particular wattage desired for the finished incandescent electric lamp. The present invention pertains more particularly to an electric furnace, shown generally at 6, and disposed adjacent the point of discharge of the mandrelless coiled filamentary sections and thus constituting substantially an integral part of the entire apparatus.

This furnace is supported by a plurality of adjustable brackets 7 which are secured to an inclined plate 8, the latter of which is in turn supported by uprights 9, extending from a channel member 10 and constituting a base portion of the coil winding machine 5. A transformer 12 is supported by the base portion 10 which supplies electrical energy to the furnace 6 through suitable switches and a controlling resistance or rheostat, as designated in Fig. 1.

In addition electrical energy may also be supplied by the transformer 12 to an electric motor 13 and a vibrator 14 which are utilized for a purpose to be hereinafter described more in detail. A receptacle 15 is shown secured to one of the furnace supports or uprights 9 for receiving the annealed coiled filamentary sections following their discharge from the coil winding ma-

chine and treatment during passage through the furnace 6.

As shown more in detail in Fig. 2, the furnace 6 may be of cylindrical form and comprises a tube of suitable material 16, such as isolantite or the like, which acts as an insulator for an electrical heating element 17 and at the same time possesses comparatively good thermal conductivity. In order to heat insulate the exterior of the furnace, the heating element 17 surrounding the isolantite tube 16, may be coated with a suitable material, such as magnesium oxide 18. A pair of bushings 19 are interposed between the isolantite tube 16 and the adjustable brackets 7 to retard heat transfer to the inclined plate 8 inasmuch as the isolantite tube is at a high temperature during operation of the furnace.

The heating chamber of the furnace may consist of a metallic tube 20, such as nichrome or the like which is disposed concentrically with respect to the isolantite tube 16 and passes loosely through the bushings 19. One end of this nichrome tube 20 is suitably journalled in a bracket bearing 22 secured to the inclined plate 8 so as to dispose the open end of the nichrome tube in juxtaposition with the discharge tube 23 (Fig. 1) of the coil winding machine. Similarly the opposite end of the nichrome tube is journalled in a block 24 constituting substantially a T-fitting, one opening of which discharges into the receptacle 15 (Fig. 1) and the opening normal to the intake and discharge openings communicating with a source of wet hydrogen gas.

For the purpose of rotating the furnace, inasmuch as the nichrome tube constitutes the heating chamber thereof, the nichrome tube 20 has a gear 25 secured thereto which is journalled in a suitable roller bearing 26, the latter being supported by a bracket 27, and this gear 25 meshes with a gear 28 constituting one of a set of reduction gearing connected to the shaft of the electric motor 13. The roller bearing 26 together with the bracket 27 are supported by an L-shaped bracket 29, which in turn is connected to a resilient support 30 secured to the inclined plate 8, and supporting the vibrator 14. In order to limit the vibration of the furnace a buffer 32 of rubber or the like is secured to the inclined plate 8 in alignment with the bearing 26 and bracket 27.

The operation of the device is as follows: the main line switch shown in Fig. 1 is first closed, followed by closure of the heating switch and adjustment of the rheostat and the furnace brought up to the desired temperature of approximately 1100° C. After the furnace has reached the desired temperature the source of wet hydrogen gas is allowed to flow through the fitting 24 and furnace tube 20, exhausting at the opposite end of the furnace in the form of a flame. The coil winding machine is next started which thus forms the coiled filamentary sections and discharges the same at a predetermined rate and of preselected length, as more fully shown and described in the aforenoted patent.

The vibrator and motor switches having been closed at the time of starting of the coil winding machine, the coiled filamentary sections discharge from the machine through the tube 23 and gravitate into the furnace 6 by passing into the nichrome tube 20. Since the furnace is inclined by virtue of being supported by the inclined plate 8, the coiled filamentary sections slowly gravitate the entire length of the furnace at a speed determinable by the angle of the furnace, which is adjustable for this purpose, and are finally discharged into the receptacle 15.

However, in order to assist gravitation of the coiled filamentary sections, as well as uniformly heat the sections, the nichrome tube 20 is slowly rotated by the motor 13 and gears 25 and 28 in the bearings formed in the bracket 22 and the T-fitting 24. At the same time the tube 20 is slightly vibrated by the vibrator 14, due to the resilient soft rubber support 30 which supports the vibrator as well as the bracket 29 together with the bracket or support 27 and roller bearing 26. Moreover, the nichrome tube 20 passes loosely through the bushings 19 and the gear assembly is loosely supported by the buffer 32 which permits slight vibration of the furnace. It should perhaps also be noted that while the fitting 14 is rigid and one end of the tube 20 is journalled therein, the tube is of sufficient length to allow for a slight vibration which is enough to assist gravitation to prevent piling up of the coiled filamentary sections.

Accordingly the mandrelless coiled filamentary sections, immediately following their initial formation, are discharged into the furnace 6. During their gradual gravitation they are subjected to a temperature of approximately 1100° C. in an atmosphere of wet hydrogen which thus raises each individual section to the temperature of the furnace before they are discharged into the receptacle 15. Since the nichrome tube 20, forming an integral part of the furnace, rotates this permits free access of the wet hydrogen gas to all parts of the coil giving a uniformity of heat and cleaning treatment.

By subjecting the coils to a temperature of approximately 1100° C. simultaneously with an atmosphere of wet hydrogen gas each individual coiled section is annealed and set which permits of its immediate incorporation on a mount for incandescent lamps without further handling. Moreover, the coiled sections are thoroughly cleaned of the aquedag coating and other impurities accumulated thereon during previous formation.

Also by having the annealing furnace substantially as an integral part of the coil winding machine the operator can readily check the machine to ascertain if the sections are being cut to the proper length and turns per inch as well as their contraction after heat treating thereof which determines their resiliency.

It thus becomes obvious to those skilled in the art that the present method and apparatus enables the complete formation of mandrelless coiled filaments for incandescent lamps by annealing the same immediately following their initial formation. Furthermore the sections are individually cleaned and annealed immediately following their formation which eliminates the necessity for further handling thereby decreasing possibility of manufacturing losses due to breakage. Moreover, a uniformity of cleaning and heating is obtained inasmuch as the individual coiled filaments do not shrink or contract as in prior treatments.

Although one embodiment of the present invention has been shown and described, it is to be understood that various other modifications of the same may be made without departing from the spirit and scope of the appended claims.

I claim:

1. An apparatus for forming and treating filaments for incandescent electric lamps comprising means for winding coiled filaments into sections of predetermined length in the absence

of a mandrel, means for discharging said formed filamentary sections from said last mentioned means, means connected to said discharge means for annealing and cleaning said sections comprising a furnace, means for gravitating said coiled sections through said furnace immediately following their formation, means for heating said sections during their passage through said furnace to definitely set said individual sections, and means for passing a gaseous atmosphere through said furnace and into contact with all portions of each individual coiled filamentary section to thoroughly clean the same.

2. An apparatus for forming and treating filaments for incandescent electric lamps comprising means for winding coiled filaments into sections of predetermined length in the absence of a mandrel, means for discharging said formed filamentary sections from said last mentioned means, means connected to said discharge means for annealing and cleaning said sections comprising a furnace provided with a tubular heating chamber, means for rotating said tubular chamber to uniformly heat all portions of said coiled filamentary sections as they gravitate through said heating chamber immediately following their initial formation, means surrounding said heating chamber for heating said coiled sections to definitely set said individual sections, and means for passing a gaseous atmosphere through said heating chamber and into contact with all portions of each individual coiled section to thoroughly clean the same preparatory to their incorporation in incandescent electric lamps.

3. An apparatus for forming and treating filaments for incandescent electric lamps comprising means for winding coiled filaments into sections of predetermined length in the absence of a mandrel, means for discharging said formed filamentary sections from said last mentioned means, means connected to said discharge means for annealing and cleaning said sections comprising an inclined furnace provided with a tubular heating chamber, means for gravitating said coiled filamentary sections through said furnace immediately following their initial formation, means surrounding said heating chamber for uniformly heating said coiled filamentary sections as they pass through said heating chamber to definitely anneal and set said sections, and means for passing a gaseous atmosphere through said heating chamber for contacting all portions of each coiled filamentary section to thoroughly clean the same preparatory to their incorporation in incandescent electric lamps.

4. An apparatus for forming and treating filaments for incandescent electric lamps comprising means for winding coiled filaments into sections of predetermined length in the absence of a mandrel, means for discharging said formed filamentary sections from said last mentioned means, means connected to said discharge means for annealing and cleaning said sections comprising an inclined furnace provided with a tubular heating chamber, heating means surrounding said tubular chamber for supplying heat thereto, means connected to said tubular chamber for causing rotation thereof to enable said coiled filamentary sections to be uniformly heated as they gravitate through said heating chamber to anneal and definitely set said sections, and means for passing a gaseous atmosphere of wet hydrogen through said tubular chamber and into contact with all portions of each individual section to thoroughly clean the same preparatory to their incorporation in an incandescent electric lamp.

5. An apparatus for forming and treating filaments for incandescent electric lamps comprising means for winding coiled filaments into sections of predetermined length in the absence of a mandrel, means for discharging said formed filamentary sections from said last mentioned means, means connected to said discharge means for annealing and cleaning said sections comprising an inclined furnace provided with a tubular heating chamber, heating means surrounding said tubular chamber for supplying heat thereto, means connected to said tubular chamber for causing rotation thereof to enable said coiled filamentary sections to be uniformly heated as they gravitate through said heating chamber to anneal and definitely set said sections, means for passing a gaseous atmosphere of wet hydrogen through said tubular chamber and into contact with all portions of each individual section to thoroughly clean the same preparatory to their incorporation in incandescent electric lamps, and vibratory means connected to said tubular heating chamber for causing a slight vibration thereof to assist gravitation of each individual section through said furnace.

6. An apparatus for forming and treating filaments for incandescent electric lamps comprising means for winding coiled filaments into sections of predetermined length in the absence of a mandrel, means for discharging said formed filamentary sections from said last mentioned means, means connected to said discharge means for annealing and cleaning said sections comprising a furnace, means for gravitating said coiled filamentary sections through said furnace immediately following their formation, means for heating said sections during their passage through said furnace to definitely set said sections, means for passing a gaseous atmosphere through said furnace and into contact with all portions of each coiled filamentary section to thoroughly clean the same, and means connected to said furnace and operable to assist the movement of said sections through said furnace.

7. An apparatus for forming and treating filaments for incandescent electric lamps comprising means for winding coiled filaments into sections of predetermined length in the absence of a mandrel, means for discharging said formed filamentary sections from said last mentioned means, means connected to said discharge means for annealing and cleaning said sections comprising a furnace provided with a tubular heating chamber, means for rotating said tubular chamber to uniformly heat all portions of said coiled filamentary sections as they gravitate through said heating chamber immediately following their initial formation, means surrounding said heating chamber for heating said coiled sections to definitely set said sections, means for passing a gaseous atmosphere through said heating chamber and into contact with all portions of each coiled section to thoroughly clean the same preparatory to their incorporation in incandescent electric lamps, and means connected to said heating chamber and operable to cause a slight vibration thereof for the purpose of assisting gravitation of said coiled filamentary sections through said heating chamber.

FREDERIC E. SUTTER.